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"Audible dick" in the section about the Temporomandibular joint.Useful otherwise. ...more Emily rated it really liked it Mar 21, 2020 Sung1915 rated it it was ok Jun 20, 2014 Jessica Severt rated it really liked it Aug 20, 2015 Jennifer rated it it was amazing Sep 01, 2020 Cheyanna rated it it was amazing Apr 17, 2020 Mohamad rated it really liked it Dec 12, 2015 Jennie rated it really liked it Dec 21, 2021 Jill rated it it was ok Mar 16, 2015 Jerin Johny rated it it was amazing Jan 11, 2015 Mohamad rated it really liked it Dec 12, 2015 Joan Henlon rated it it was amazing Apr 20, 2014 BookDB marked it as to-read Sep 16, 2016 Sharmarie marked it as to-read Mar 10, 2010 Rosie Bak marked it as to-read Jan 08, 2013 Luna Moon marked it as to-read Oct 11, 2014 Emily Ho marked it as to-read Nov 21, 2015 Debbi Ann marked it as to-read Oct 28, 2014 Janna marked it as to-read Dec 03, 2014 Jatova marked it as to-read Jan 09, 2015 Angie Lam marked it as to-read Jan 12, 2015 Ann Vivant marked it as to-read Dec 12, 2015 Vanesa O is currently reading it May 01, 2015 How This Book Is Organized The following colour bars are used consistently for each section within a chapter to help locate specific information: STRUCT U R E A N D F U N C T I O N Anatomy and physiology of the body system SUB J E C T I V E DATA Health history through questions (Examiner Asks) and explanation (Rationale) OB J E C T I V E DATA Core of the examination part of each body system chapter with skills, expected findings, and common variations for healthy people, as well as selected abnormal findings, health promotion, and a summary examination checklist D O CUMENTATION A N D C R I T I C A L T H I N K I N G Clinical case studies with sample documentation for subjective, objective, and assessment data ABNO R M A L F I N D I N G S Tables describing pathological disorders and conditions, with illustrations and photographs of abnormal findings S PECIAL CONSIDERAT I O N S F O R A DVAN C E D P RACT I C E Tables of illustrations and photographs of abnormal findings for special circumstances, where appropriate Contents UNIT 1 ASSESSMENT OF THE WHOLE PERSON 16 Ears, 341 1 Critical Thinking and Evidence-Informed Assessment, 1 17 Nose, Mouth, and Throat, 368 2 Health Promotion in the Context of Health Assessment, 18 3 Cultural and Social Considerations in Health Assessment, 27 4 The Interview, 45 5 The Complete Health History, 66 6 Mental Health Assessment, 82 7 Substance Use in the Context of Health Assessment, 107 8 Interpersonal Violence Assessment, 120 18 Breasts and Regional Lymphatics, 404 19 Thorax and Lungs, 432 20 Heart and Neck Vessels, 475 21 Peripheral Vascular System and Lymphatic System, 519 22 The Abdomen, 546 23 Anus, Rectum, and Prostate, 583 24 Musculoskeletal System, 599 25 Neurological System, 656 26 Male Genitourinary System, 715 27 Female Genitourinary System, 744 UNIT 2 APPROACH TO THE CLINICAL SETTING 9 Assessment Techniques and the Clinical Setting, 138 UNIT 4 INTEGRATION OF THE HEALTH ASSESSMENT 10 General Survey, Measurement, and Vital Signs, 151 28 The Complete Health Assessment: Putting It All Together, 782 11 Pain Assessment, 182 12 Nutritional Assessment and Nursing Practice, 197 UNIT 3 PHYSICAL EXAMINATION 13 Skin, Hair, and Nails, 219 14 Head, Face, and Neck, Including Regional Lymphatics, 269 15 Eyes, 295 29 Bedside Assessment of the Hospitalized Adult, 804 30 Pregnancy, 811 31 Functional Assessment of the Older Adult, 849 CREDITS, 867 INDEX, 874 YOU'VE JUST PURCHASED MORE THAN A TEXTBOOK ACTIVATE THE COMPLETE LEARNING EXPERIENCE THAT COMES WITH YOUR BOOK BY REGISTERING AT Once you register, you will have access to your FREE STUDY TOOLS: • Abdomen, Heart, and Lung Sounds • Complete Physical Examination Form • Animations • Examination Review Questions • Appendices • Health Promotion Guides • Assessment Videos • Key Points • Bedside Assessment Summary Checklists • Physical Examination Summary Checklists • Case Studies • Quick Assessments for Common Conditions REGISTER TODAY! J A R V I S Physical Examination & Health Assessment Second Canadian Edition This page intentionally left blank J A R V I S Physical Examination & Health Assessment SECOND CANADIAN EDITION Carolyn Jarvis, PhD, APN, CNP Professor of Nursing School of Nursing Illinois Wesleyan University Bloomington, Illinois Family Nurse Practitioner Bloomington, Illinois Original Illustrations by Pat Thomas, CMI, FAMI Oak Park, Illinois Assessment Photographs by Kevin Strandberg Professor of Art Illinois Wesleyan University Bloomington, Illinois Canadian Editors Annette J. Browne, PhD, RN Professor School of Nursing University of British Columbia Vancouver, British Columbia June MacDonald-Jenkins, RN, BScN, MSc Professor, School of Health and Community Studies Durham College Assistant Professor Faculty of Health Science University of Ontario Institute of Technology Oshawa, Ontario Marian Luctkar-Flude, RN, MScN, PhD(c) Lecturer School of Nursing Queen's University Kingston, Ontario Library and Archives Canada Cataloguing in Publication Jarvis, Carolyn Physical examination & health assessment / Carolyn Jarvis; Canadian editors, Annette J. Browne, June MacDonald-Jenkins, Marian Luctkar-Flude; original illustrations by Pat Thomas; assessment photographs by Kevin Strandberg.—2nd Canadian ed. Includes bibliographical references. ISBN 978-1-926648-72-9 1. Physical diagnosis. 2. Nursing assessment. I. Browne, Annette J. II. MacDonald-Jenkins, June, 1965- III. Luctkar-Flude, Marian, 1961- IV. Title. V. Title: Physical examination and health assessment. RC76.J37 2013 616.07'5 C2013-901415-2 ISBN: 978-1-926648-72-9 Ebook ISBN: 978-1-926648-79-8 Vice President, Publishing: Ann Millar Managing Developmental Editor: Martina van de Velde Publishing Services Manager: Deborah L. Vogel Project Manager: John W. Gabbert Copy Editor: Anne Ostroff Design Direction: Teresa McBryan Typesetting and Assembly: Toppan Best-set Premedia Limited Printing and Binding: Transcontinental Elsevier Canada 905 King Street West, 4th Floor Toronto, ON, Canada M6K 3G9 Phone: 1-866-896-3331 Fax: 1-866-359-9534 Printed in Canada 1 2 3 4 5 18 17 16 15 14 To my mother, Frances, With gratitude –Carolyn Jarvis This book is dedicated to Rachel (Ray) Browne, whom I dearly love. –Annette J. Browne I would like to dedicate my work in this edition in memory of my sister Sandra, my very best friend and cheerleader. –June MacDonald-Jenkins My work on this book is dedicated to the memory of my mother, Annemarie, who first encouraged me to pursue a career in nursing, and to my nursing students, past and future, who keep me going. –Marian Luctkar-Flude ABOUT THE AUTHOR Carolyn Jarvis received her BSN cum laude from the University of Iowa, her MSN from Loyola University (Chicago), and her PhD from the University of Illinois at Chicago, with a research interest in the physiological effect of alcohol on the cardiovascular system. She has taught physical assessment and critical care nursing at Rush University (Chicago), the University of Missouri (Columbia), and the University of Illinois (Urbana), and has also taught pharmacology, pathophysiology, and nursing research at Illinois Wesleyan University (Bloomington). Dr. Jarvis is a recipient of the University of Missouri's Superior Teaching Award; has taught physical assessment to thousands of baccalaureate and graduate students, and nursing professionals; has held 150 continuing education seminars; and is the author of numerous articles and textbook contributions. Dr. Jarvis has maintained a clinical practice in advanced practice roles—first as a cardiovascular clinical specialist in various critical care settings and as a certified family nurse practitioner in primary care. She is currently a professor at Illinois Wesleyan University; a nurse practitioner in Bloomington, Illinois; and licensed as an advanced practice nurse in the state of Illinois. During the past 6 years, her enthusiasm has focused on speaking Spanish to provide health care in rural Guatemala and in a local Bloomington clinic. ABOUT THE CANADIAN EDITORS Annette J. Browne's career began as an outpost nurse, living and working in northern First Nations and Inuit communities in Canada. She holds a master's degree as a family nurse practitioner from the University of Rhode Island and a PhD in nursing from the University of British Columbia (UBC). Dr. Browne is a professor at the UBC School of Nursing and has taught advanced health assessment to nurse practitioners and post-RNs for many years. Dr. Browne is an active researcher who focuses on health and health care inequities, with a particular focus on fostering health equity with Indigenous peoples. She conducts research on access to health care, women's health, cultural safety, and primary health care interventions to improve health outcomes. Her work is aimed at promoting health equity through improvements in nursing practice, health care delivery, and health policy. June MacDonald-Jenkins is a recognized expert in hybrid course delivery e-learning, having worked in this field for vi many years. As a nursing professor in the Durham College/ University of Ontario Institute of Technology (UOIT) BScN program, Ms. MacDonald-Jenkins brings strong education experience to the team. She has taught health assessment to thousands of students, from those enrolled in diploma to advanced practice programs. She is also an accomplished practitioner and researcher on the subject of technology and hybrid course delivery use in nursing education. She has recently been seconded as Dean of Police Education and Innovation for a two-year period to enhance policing education through customization of the learning environment. Ms. MacDonald-Jenkins's research interests are primarily in the areas of assessing core competencies across curriculum, simulation, and e-learning course delivery. She is the recipient of the 2007 Elsevier Canada Resource Award, which recognizes exemplary use of technology resources in the academic environment. Ms. MacDonald-Jenkins has presented across the country to numerous nursing faculties and internationally on the concept of creating engaging hybrid learning environments. She is a faculty member with SIM_One–Ontario Simulation Network focusing on the enhancement of e-Learning strategies. Marian Luctkar-Flude received her BScN and MScN from the University of Ottawa, her critical care nursing diploma from St. Lawrence College (Kingston), and is currently working on her PhD in Rehabilitation Sciences at Queen's University. She has more than 20 years' medical–surgical nursing experience in various clinical settings and, in particular, in general surgery and urology nursing. She has taught clinically in the St. Lawrence College and Queen's University (Kingston) nursing programs and is now a faculty member of the Queen's University School of Nursing where she has provided a leadership role in the integration of patient simulation throughout the undergraduate program, including the Nursing Health Assessment course. She currently teaches the Nursing Research, and the Common Health Challenges and Implications for Care courses and is actively involved in interprofessional education and curriculum development. Her research interests include older persons with cancer, cancer fatigue and physical activity, breast cancer survivorship care, knowledge translation interventions for primary care providers, and the use of patient simulation in undergraduate nursing, with a focus on interprofessional education. She has presented at local, national, and international nursing conferences and has acted as a peer reviewer for several nursing and medical journals. 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She is involved with studies of older patients in orthopedics, oncology, cardiology, and psychiatry. She received her undergraduate and master's degrees from Queen's University and her PhD from the University of Toronto. Chapter 31: Functional Assessment of the Older Adult Martha Driessnack, PhD, PNP-BC, RN Martha Driessnack is a Pediatric Nurse Practitioner with more than 25 years of experience in teaching, practice, and research. She received her PhD from Oregon Health & Science University, completed a post-doctoral research fellowship in Clinical Genetics from the University of Iowa, and is an Assistant Professor in the College of Nursing at the University of Iowa. Promoting Health feature boxes from the U.S. 6th edition Dana S. Edge, PhD, RN Dana Edge received her BSN from the University of Iowa, her MSN from the University of North Carolina at Chapel Hill, and her doctorate in epidemiology from the University of Toronto. 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Having worked in both clinical and instructional settings, she is an experienced and well-known practitioner, teacher, researcher, and author in the area of clinical nutrition. Chapter 12: Nutritional Assessment and Nursing Practice Melissa A. Lee, MS, RN, CNS-BC Melissa Lee is a clinical nurse specialist at the University of California San Francisco Medical Center. She has experience in medical–surgical and telemetry nursing and education. She is certified in geriatrics by the American Nurses Credentialing Center. Chapter 31: Functional Assessment of the Older Adult vii viii Contributors Freda O'Bannon Lemmi, RN, MS, ANP-C, FNP Deborah E. Swenson, MSN, ARNP, C-WHCNP Images of normal and abnormal conditions are original photographs from patients in her clinical practice, students, relatives, and friends. She has been teaching physical assessment and curriculum of nurse practitioner programs as Professor of Nursing at California State University and at UCLA. She taught physical assessment classes in England to help prepare faculty to teach advanced nursing practice roles at the Royal Brompton Hospital in London in 1995 and at Oxford University in 1996. Carlos A.E. Lemmi, PhD, has taught microscopic anatomy to medical, dental, and graduate students at the UCLA school of medicine for over 15 years. His medical background and knowledge of computer graphics helped prepare the images for this book. Deborah Swenson is a certified women's health care nurse practitioner with Swedish Medical Center's Perinatal Medicine Clinic and OBSTETRIX Medical Group of Washington, Inc., PS, in Seattle, Washington. She holds certification from the NCC as a women's health care nurse practitioner. She is the author of Telephone Triage for the Obstetric Patient: A Nursing Guide. Chapter 30: Pregnancy Laraine Michalson, MSN, RN Laraine Michalson has worked for 15 years as a Public Health Nurse at the Sheway Program in Vancouver, British Columbia. 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Chapter 12: Nutritional Assessment and Nursing Practice Shawna S. Mudd, MSN, CRNP Shawna Mudd is a pediatric nurse practitioner in the Pediatric Emergency Department at the Johns Hopkins Hospital. She is also a member of the hospital's child protection team, which provides inpatient and outpatient consultation for cases of suspected child abuse and neglect. She is also faculty at the Johns Hopkins University School of Nursing. Chapter 7: Domestic Violence Assessment (U.S. Sixth Edition) Daniel Sheridan, PhD, RN, FAAN Daniel Sheridan is an associate professor in the Johns Hopkins University School of Nursing, where he coordinates a forensic clinical nurse specialist graduate degree programs at the Masters, DNP, and PhD levels. Dr. Sheridan has 25 years of experience working with survivors of family abuse and sexual assault, and he lectures and consults nationally and internationally on these topics. Chapter 7: Domestic Violence Assessment (U.S. Sixth Edition) Denise Tarlier, PhD, MSN, NP(F), NCMP Denise Tarlier is a family nurse practitioner in British Columbia and has also held national U.S. NP certification since 1998. She is a certified menopause practitioner with the North American Menopause Society. Her clinical practice over many years has been primarily in remote and northern Aboriginal communities across Canada. Denise is currently practicing as a family nurse practitioner in Kamloops, British Columbia. She is also a member of the Nurse Practitioner Leadership Team in the Family Nurse Practitioner program at the University of Northern British Columbia in Prince George. Her scholarship and teaching are guided by a strong clinical practice orientation to primary health care, rural and remote health care services, Aboriginal health issues, and primary care and nurse practitioner nursing roles. 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She recently co-led a longitudinal study of the health and economic effects of violence against women after women have left abusive partners. She is currently leading a study of a health care intervention for Aboriginal women who have experienced violence and co-leading an intervention study to promote equity in primary health care. She has more than 90 peer-reviewed publications and is writing a textbook on nursing as relational inquiry, with co-author Gweneth Hartrick Doane. Chapter 3: Cultural and Social Considerations in Health Assessment; Chapter 7: Substance Use in the Context of Health Assessment; and Chapter 8: Interpersonal Violence Assessment Contributors ix Ellen Vogel, PhD, RD, FDC Kathryn Weaver, PhD, RN Ellen Vogel is dean and associate professor in the Faculty of Health Sciences at the University of Ontario Institute of Technology, located in Oshawa, Ontario. Dr. Vogel completed a PhD in nutrition and metabolism at the University of Alberta (2001). 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Her teaching and research interests include qualitative and mixed methods research, psychiatric-mental health nursing, community development, ethical sensitivity in professional practice, and eating disorders. She is principal investigator of the video documentary Through True Eyes: Recovery from Eating Disorders produced by Atlantic Mediaworks, Fredericton, New Brunswick (2009). Chapter 6: Mental Health Assessment Nancy Watts, RN, MN Barbara Wilson-Keates, RN, PhD Nancy Watts has worked in various nursing settings with a primary focus in obstetrical nursing. Her education includes a master's degree in Nursing and certification in Perinatal Nursing. Nancy has pursued learning in family-centred care, adult learning, and complex care planning. She is currently the President of the Canadian Association of Perinatal and Women's Health Nurses (CAPWHN). She has been the author of various publications including chapters on Pregnancy and High Risk Labour/Birth in recent textbooks. 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Bloomberg Faculty of Nursing University of Toronto Toronto, Ontario x Maureen MacInnis-Wheatley, RN, MN Learning Resource Coordinator & Instructor; Sessional Lecturer School of Nursing University of Prince Edward Island Charlottetown, Prince Edward Island Faith Richardson, DNP, MSN-FNP Assistant Professor School of Nursing Trinity Western University Langley, British Columbia Lori Schindel-Martin, RN, PhD Associate Professor, Daphne Cockwell School of Nursing Associate Director—Scholarship, Research & Creative Activities, Faculty of Community Services Ryerson University Toronto, Ontario Karen Silvester, RN, BSN, MN(c) Nursing Faculty Baccalaureate Nursing Program North Island College Courtenay, British Columbia Lisa Sworts, RN, BSN Lab Resource Nurse Vancouver Island University Nanaimo, British Columbia Margaret Verkuyl, NP-PHC, MN, AGD : ANP Nursing Professor Centennial College Toronto, Ontario Preface It is important that students develop, practise, and then learn to trust their health history and physical examination skills. In this book we give you the tools to do that. Learn to listen to the patient—most often he or she will tell you what is wrong (and right) and what you can do to meet his or her health care needs. Then learn to inspect, examine, and listen to the person's body. The data are all there and are accessible to you by using just a few extra tools. High-technological machinery is a smart and sophisticated adjunct, but it cannot replace your own bedside assessment of your patient. Whether you are a beginning examiner or an advancedpractice student, this book holds the content you need to develop and refine your clinical skills. The Second Canadian Edition of Physical Examination & Health Assessment is a comprehensive textbook of health history-taking methods, physical examination skills, health promotion techniques, and clinical assessment tools. Thank you for your enthusiastic anticipation of this second Canadian edition. We are excited to be able to bring you an established, successful text with a focus on Canadian issues and content to further meet the needs of both novice and advanced practitioners in Canada. DUAL FOCUS AS TEXT AND REFERENCE Physical Examination & Health Assessment is both a text for beginning students of physical examination and also a text and reference for advanced practitioners such as nurse practitioners and clinical nurse specialists. The chapter progression and format permit this scope without sacrificing one use for the other. Chapters 1 through 8 focus on health assessment of individuals and families, including developmental tasks and health promotion for all age groups; the importance of relational practice in health assessment; cultural and social considerations in assessment; interviewing and complete health history gathering; and the social context of mental health assessment, substance use assessment, and interpersonal violence assessment. Chapters 9 through 12 begin the approach to the clinical care setting, describing physical data-gathering techniques, how to set up the examination site, body measurement and vital signs, pain assessment, and nutritional assessment. Chapters 13 through 27 focus on the physical examination and related health history in a body-systems approach. This is the most efficient method of performing the examination and is the most systematic and logical method for student learning and retrieval of data. Each chapter has five major sections: Structure and Function, Subjective Data (history), Objective Data (examination skills and findings), Documentation and Critical Thinking, and Abnormal Findings. The novice practitioner can review anatomy and physiology and learn the skills, expected findings, and common variations for generally healthy people and selected abnormal findings in the Objective Data sections. New to this edition is a sixth section, Special Considerations for Advanced Practice, in selected relevant chapters. The sections on Special Considerations for Advanced Practice were created to address assessment approaches that are particularly relevant for advanced practice nurses. These sections also help to delineate the boundaries between basic assessments and more advanced assessments that may be conducted by advanced practice nurses. Chapters 28 through 31 integrate the complete health assessment. Chapters 28 and 29 present the choreography of the head-to-toe examination for a complete screening examination in various age groups and for the focused examination of a hospitalized adult. Special populations are addressed in Chapters 30 and 31—the health assessment of the pregnant woman and the functional assessment of the older adult. Students continue to use this text in subsequent courses throughout their education, and experienced clinicians will use this text as part of their advanced nursing practice. Given that each course demands more advanced skills and techniques, students can review the detailed presentation and the additional techniques in the Objective Data sections as well as variations for different age levels. Students can also study the extensive pathology illustrations and detailed text in the Abnormal Findings sections. This text is valuable to both advanced practice students and experienced clinicians because of its comprehensive approach. Physical Examination & Health Assessment can help clinicians learn the skills for advanced practice, refresh their memory, review a specific examination technique when confronted with an unfamiliar clinical situation, and compare and label a diagnostic finding. NEW TO THE SECOND CANADIAN EDITION All chapters are revised and updated to include Canadian concepts, terminology, statistics, standards and guidelines, and assessment tools commonly used in Canadian health care settings. Four newly written chapters and several new features that span various chapters are presented in this Second xi xii Preface Canadian Edition. Three new and 15 revised Promoting Health boxes are presented, at least one in each of the physical examination chapters. These boxes describe an important health promotion topic related to the system discussed in each chapter—a topic you can use to enhance patient education initiatives. New Special Considerations for Advanced Practice sections provided in selected chapters identify assessment approaches that are particularly relevant for advanced practice nurses. New Critical Findings textboxes are placed strategically throughout the chapters to alert practitioners to assessment findings that require immediate attention, action, and decision-making. The Cultural and Social Considerations sections have been newly written in each chapter to reflect content relevant to Canada. The cultural and social factors that influence health, illness, and access to health care are discussed, and implications requiring consideration in the context of health assessment are identified. Highlights of Canadian content in each chapter are outlined below. Chapter 1, Critical Thinking and Evidence-Informed Assessment, includes new perspectives on critical thinking and diagnostic reasoning as integral to health assessment. The relevance of conducting assessments based on evidenceinformed decisions is emphasized. Relational approaches to nursing practice are discussed to foster nurses' capacities to convey respect, and as a means to avoid objectifying people in the process of health assessment. Chapter 2, Health Promotion in the Context of Health Assessment, is newly written and integrates the latest Canadian guidelines for health promotion, illness prevention, screening, immunizations, developmental assessment, and health education and patient counseling across the lifespan. Emphasis is placed on health promotion opportunities and actions that can be taken in the process of conducting health assessments. Chapter 3, Cultural and Social Considerations in Health Assessment, is newly written to reflect the ethnocultural and social diversity within the Canadian population. Examples of current trends in health, social, and gender inequities are reviewed and discussed in terms of the implications for health assessment. Guidelines are provided for assessing culturally based understandings and the social and economic contexts shaping people's lives. Chapter 6, Mental Health Assessment, is newly written to provide content reflecting Canadian perspectives on the personal and social factors that shape people's mental health. The chapter provides strategies for conducting mental health assessments, including mental status examinations and risk assessments for suicide. The developmental adaptations that are required to conduct respectful assessments across the lifespan are also discussed. Chapter 7, Substance Use in the Context of Health Assessment, is a cutting-edge, new chapter—one of the first of its kind in a nursing health assessment textbook. It provides clinicians with the knowledge and skills to integrate assessments regarding substance use across a range of practice settings and with patients of all ages. Factors influencing the use of substances and the health effects of substance use are discussed. Emphasis is placed on nonjudgemental, respectful approaches and techniques for assessing substance use. Chapter 8, Interpersonal Violence Assessment, has also been heavily revised to include guidelines for assessing intimate partner violence, sexual assault, child abuse, and elder abuse as important problems for health care professionals to recognize and respond to. The chapter discusses the longterm effects of violence on health and the implications in the context of health assessment. Mandatory reporting requirements are also discussed, and strategies for assessing violence in a nonjudgemental and accepting manner are emphasized. Chapter 9, Assessment Techniques and the Clinical Setting, focuses on assessment techniques and includes the Canadian Hypertensive Education Program guidelines for diagnosis. The chapter will help both novice and advanced practitioners make clinical decisions based on accurate assessment techniques. Chapter 11, Pain Assessment, has been updated to include assessment tools for both conscious and unconscious patients. These additions reflect a growing trend toward caring for palliative patients in the community setting and the increased complexity of caring for the patient found outside the intensive care environment. Chapter 12, Nutritional Assessment and Nursing Practice, has been updated to reflect developmental considerations with regard to nutrition, address determinants of health, and reinforce the latest information concerning dietary reference intakes and nutrition labeling in Canada. Chapter 30, Pregnancy, incorporates Canadian screening and diagnostic tests for the pregnant woman and guidelines for health promotion. Chapter 31, Functional Assessment of the Older Adult, includes Canadian statistics on aging; guidelines for screening for elder abuse and prevention of falls; and content related to caregiver, environmental, and spiritual assessments. Tools for assessment of activities of daily living, instrumental activities of daily living, and advanced activities of daily living are discussed. APPROACHES USED IN THIS EDITION The Second Canadian Edition of Physical Examination & Health Assessment builds on the strengths of the U.S. Sixth Edition and is designed to engage students and enhance learning: 1. Method of examination (Objective Data section) is clear, orderly, and easy to follow. Hundreds of original examination illustrations are placed directly with the text to demonstrate the physical examination in a step-by-step format. 2. Two-column format begins in the Subjective Data section, where the running column highlights the rationales for asking various history questions. In the Objective Data section, the running column highlights selected abnormal findings to show a clear relationship between normal and abnormal findings. 3. Abnormal Findings tables organize and expand on material in the examination section. These have been Preface revised and updated with many new clinical photos. The atlas format of these extensive collections of pathology and original illustrations helps students recognize, sort, and describe abnormal findings. When applicable, the text under a table entry is presented in a Subjective Data– Objective Data format. 4. Developmental approach in each chapter presents prototypical content on the adult, then age-specific content for the infant, child, adolescent, pregnant woman, and older adult so that students can learn common variations for all age groups. 5. Cultural and social considerations are discussed throughout as factors that shape health, illness, and access to health care. In addition to Chapter 3, where these issues are discussed in depth, cultural and social considerations are included throughout the chapters to orient readers to relevant issues in the Canadian context. Readers will note that literature citations based on U.S. or British research continue to use the terms "Black" (to refer to people of African American descent) and "White" (for people of European descent). In Canada, there has been a shift away from identifying people on the basis of "race," and these issues are discussed in more depth in Chapter 3. When U.S. or British literature is cited, however, the terms "Black" and "White" are retained in keeping with the original reference sources. 6. Stunning full-colour art shows detailed human anatomy, physiology, examination techniques, and abnormal findings. 7. Health history (Subjective Data) appears in two places: Chapter 4, The Interview, has the most complete discussion available on the process of communication and on interviewing skills, techniques, and potential traps to avoid. This chapter includes guidelines for communicating with people whose primary language differs from yours and for working with interpreters to conduct sensitive and accurate health assessments. In Chapter 5, The Complete Health History, and in pertinent history questions that are repeated and expanded in each chapter, history questions are included that highlight health promotion opportunities and activities. This approach to emphasizing history questions helps students to understand the relationship between subjective and objective data. Because the history and examination data are considered together, as they would be in the clinical setting, each chapter can stand on its own if a person has a specific problem related to that body system. 8. Summary checklists toward the end of each chapter provide a quick review of examination steps to help you develop a mental checklist. 9. Sample recordings of normal findings show the written language you should use to ensure that charting is complete yet succinct. 10. Focused assessment and clinical case studies of frequently encountered situations demonstrate the application of assessment techniques to patients of different ages in differing clinical situations. These case histories, in subjective-objective-assessment-plan (SOAP) format, xiii ending in diagnosis, are presented in the language actually used during recording. 11. Integration of the complete health assessment for the adult, infant, and child is presented as an illustrated essay in Chapter 28. This approach integrates all the steps into a choreographed whole. Included is a complete write-up of a health history and physical examination. 12. User-friendly design makes the book easy to use. Frequent subheadings and instructional headings help readers to easily retrieve content. 13. Bedside Assessment of the Hospitalized Adult, in Chapter 29, provides a unique photo sequence that illustrates a head-to-toe assessment suitable for each daily shift of care. It would be neither possible nor pertinent to perform a complete head-to-toe examination on every patient during every 24-hour stay in the hospital; therefore, this sequence shows a consistent specialized examination for each 8-hour shift that focuses on certain parameters pertinent to areas of medical, surgical, and cardiac step-down care. The Canadian content that appears in the book—particularly the content about dealing with hospitalized patients, older adults, and pain assessment; relating to substance use and interpersonal violence; and cultural and social considerations—form part of the standard repertoire of knowledge from which Canadian examiners can draw. CONCEPTUAL APPROACH The Second Canadian Edition of Physical Examination & Health Assessment reflects a commitment to the following approaches: • Relational practice in clinical practice recognizes that health, illness, and the meanings they hold for people are shaped by one's gender, age, ability, and social, cultural, familial, historical, and geographical contexts. These contexts influence how nurses and other health care professionals view, relate, and work with patients and families. By practising relationally, health care professionals will be optimally prepared to conduct accurate health assessments and to respond meaningfully to the patient's health, illness, and health promotion needs. • Health promotion is discussed in depth in Chapter 2, with an emphasis on how to integrate health promotion into the process of health assessment. Health promotion textboxes are also provided in most chapters outlining the latest health promoting practices. • Engaging with the patient as an active participant in health care involves encouraging discussion of what the person is currently doing to promote his or her health and supporting people to participate in health promoting practices given the social contexts of their lives. • Cultural and social considerations take into account our global society and the wide range of ethnocultural and social diversity within Canada. • Assessing individuals across the lifespan reflects the understanding that a person's state of health must be considered in light of his or her developmental stage. xiv Preface Developmental anatomy; modifications of examination techniques; and expected findings for infants and children, adolescents, pregnant women, and older adults are provided. Developmental Considerations are provided in each relevant chapter, along with strategies for adapting health assessment approaches and techniques across the lifespan. ANCILLARIES • The Pocket Companion for Physical Examination & Health Assessment continues to be a handy and current clinical reference that provides pertinent material in full colour, with over 150 illustrations from the textbook. • The Student Laboratory Manual with physical examination forms is a workbook that includes a student study guide, glossary of key terms, clinical objectives, regional write-up forms, and review questions for each chapter. The pages are perforated so that students can use the regional write-up forms in the skills laboratory or in the clinical setting and turn them in to the instructor. • The new revised Health Assessment Online resource is an innovative and dynamic teaching and learning tool with more than 8000 electronic assets, including video clips, anatomic overlays, animations, audio clips, interactive exercises, laboratory/diagnostic tests, review questions, and new electronic charting activities. Comprehensive Self-Paced Learning Modules offer increased flexibility to faculty who wish to provide students with tutorial learning modules and in-depth capstone cases for each body system chapter in the text. The Capstone Case Studies now include Quality and Safety Challenge activities. Additional Advance Practice Case Studies put the student in the exam room and test history taking and documentation skills. The comprehensive video clip library shows exam procedures across the life span and is expanded to now include clips on the pregnant woman. Animations, sounds, images, interactive activities, and video clips are embedded in the learning modules and cases to provide a dynamic, multimodal learning environment for today's learners. • Physical Examination & Health Assessment Video Series is an 18-video package developed in conjunction with this text. There are 12 body system videos and 6 head-to-toe videos, with the latter containing complete examinations of the neonate, child, adult, older adult, and pregnant woman, and the bedside examination of the hospitalized adult. This series is available in DVD or streaming online formats. There are over 5 hours of video footage with highlighted Cross-Cultural Care Considerations, Developmental Considerations, and Health Promotion Tips, as well as Instructor Booklets with video overviews, outlines, learning objectives, discussion topics, and questions with answers. • The companion EVOLVE Web site (. com/Canada/Jarvis/examination/) contains learning objectives: more than 150 multiple-choice review questions; new system-by-system examination summaries and bedside examination summaries that are downloadable into audio CD or MP3 player files; a comprehensive physical examination form for the adult; and numerous reference appendices from previous editions that have been updated and moved online, including immunization schedules, standard precautions, growth charts, and blood pressure levels. Case studies—including a variety of developmental and cultural variables—help students apply health assessment skills and knowledge. These include 25 in-depth case studies with critical thinking questions and answer guidelines, as well as printable health promotion handouts. Also included is a complete Head-to-Toe Video examination of the adult that can be viewed in its entirety or by systems, as well as a new printable section on Quick Assessments for Common Conditions. • Simulation Learning System. The new Simulation Learning System (SLS) is an online toolkit that incorporates medium- to high-fidelity simulation with scenarios that enhance the clinical decision-making skills of students. The SLS offers a comprehensive package of resources, including leveled patient scenarios, detailed instructions for preparation and implementation of the simulation experience, debriefing questions that encourage critical thinking, and learning resources to reinforce student comprehension. • For instructors, the Evolve website presents an Instructor's Manual and PowerPoint slides, a comprehensive Image Collection, and a Test Bank. The Instructor's Manual provides annotated learning objectives; key terms; and teaching strategies for the classroom in a revised section with strategies for both clinical and simulation lab use, critical thinking exercises, websites, and performance checklists. The PowerPoint slides include 2000 slides with integrated images. A separate 1200-illustration Image Collection is featured. Finally, the ExamView Test Bank has more than 850 multiple choice questions with coded answers and rationales. Instructors also have access to the accompanying online course, Health Assessment Online. IN CONCLUSION Throughout all stages of manuscript preparation and production, every effort has been made to develop a book that is readable, informative, instructive, and vital. Your comments and suggestions have been important to this task and continue to be welcome for this new Canadian edition. Carolyn Jarvis Annette J. Browne June MacDonald-Jenkins Marian Luctkar-Flude c/o Elsevier Canada 905 King Street West, 4th Floor Toronto, ON M6K 3G9 Acknowledgements for the U.S. Sixth Edition It is my pleasure to recognize the many wonderful friends and colleagues who helped make the revision of this textbook possible. For their help and support I send my gratitude: To my artistic colleagues, who made this book the vibrant visual display it is. Pat Thomas, medical illustrator, is a gifted artist with an eye for detail and clarity. Kevin Strandberg is a clever and careful photographer who has endless patience for capturing the images of children and adults in just the right moment of the examination. It is wonderful to collaborate with these two professionals. Our team has worked together for six editions, providing an artistic unity and clarity to this latest textbook. We are joined in this edition by Ronnie Lemmi, who contributed many photos of abnormal conditions, gathered through her clinical practice. To my research assistants, whose tireless help enabled me to survive and proceed through manuscript preparation and revision. Erin Kugler and Abby Koestra searched for and retrieved countless articles. Abby read and reread endless copies of galley and page proofs, making astute suggestions and finding errors. To the faculty and students who took the time to write letters of encouragement and suggestions—your comments are gratefully received and are very helpful. To the reviewers who spent considerable time reading the chapter manuscript and filling out response questionnaires—your suggestions and ideas are very important for this sixth edition. Thank you to the remarkable professional team at Elsevier. I am grateful to Sally Schrefer, Managing Director, Nursing and Health Professions, for her guidance and support for the book and its ancillaries. Sally knows the text well and has been personally involved in its advancement and promotion. Robin Carter, Executive Editor, has been a beacon of support for me and for the book. Robin always has sound suggestions for new ideas for the book and is everlastingly prompt and positive. Many people worked very hard to guide this book through production. I am grateful to Debbie Vogel, Publishing Services Manager, for supervising the schedule for book production and making all the contacts to keep everyone on schedule. 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Deanna has worked tirelessly to guide the instructor ancillaries, the Pocket Companion, and the Student Laboratory Manual. I am very grateful to Laurie and Deanna. Most important are the members of my wonderful family for their help, love, and complete support. Their constant belief in me and their encouragement have kept me going throughout this process. Carolyn Jarvis ACKNOWLEDGEMENTS FOR THE SECOND CANADIAN EDITION Carolyn Jarvis's text has been a constant companion throughout my clinical and teaching career. The opportunity to adapt this classic textbook to reflect Canadian perspectives, content, and guidelines is a major honour. I have thoroughly enjoyed thinking critically about the range of content to include, especially given the diverse range of students, clinicians, and faculty who may use this text. I want to thank Dr. Sally Thorne, a professor at the University of British Columbia School of Nursing, for encouraging me to take on this project, and Ann Millar at Elsevier for her expert guidance throughout this process. I am also grateful to June MacDonaldJenkins and Marian Luctkar-Flude for adapting this text in significant ways to reflect the unique context of nursing practice in Canada. I am fortunate to be able to draw on the expertise of Dr. Colleen Varcoe, Dr. Dana Edge, Dr. Denise Tarlier, and Dr. Kate Weaver as chapter authors and contributors, and I thank them for providing highly pertinent and cutting-edge content. To John, whose loving support makes this work possible. Annette J. Browne What a pleasure to have been given the opportunity to potentially influence the learning of students across the country. My thanks to every student who risked taking a stance of inquiry, looked for more, and sought the answers; you are the xv xvi Acknowledgements for the U.S. Sixth Edition reason that editing this text was such a pleasure. I, too, would like to thank the editorial team at Elsevier Canada; they have been gracious and supportive while ensuring that we met timelines for publication of the Second Canadian Edition. I would like to thank my colleagues Dr. Ellen Vogel, Christina Vaillancourt, and Andrea Miller for contributing to Chapter 12, Nutritional Assessment and Nursing Practice, and to Lynn Haslam for her work on Chapter 11, Pain. I extend my thanks to these four professionals for hours of collaboration and consultation to ensure the inclusion of a truly national perspective. Many thanks, as well, to my co-editors Annette and Marian; your knowledge and insight have truly shaped the perspective of this text. I would like to thank my family for their endless support and indulgence of my "adventures:" my husband, Dean, and my three daughters, Sarah, Emily, and Mackenzie. June MacDonald-Jenkins I am truly grateful for having had the opportunity to participate in the development of the Second Canadian Edition of Jarvis's Physical Examination & Health Assessment. The support of the Elsevier Canada staff throughout this challenging process has been invaluable. In particular, I would like to thank the publisher, Ann Millar, the managing developmental editor, Martina van de Velde, and the project manager, John Gabbert, for their guidance. I would also like to thank my colleagues Barbara Wilson-Keates and Dianne Groll for their contributions to the Nose, Mouth, and Throat, and Functional Assessment of the Older Adult chapters; and Nancy Watts for contributing to the Pregnancy chapter, as these are not my areas of expertise. I would like to thank my Canadian coeditors, Annette J. Browne and June MacDonaldJenkins, for their long-distance collaboration, for sharing their knowledge, contacts, and resources, and for providing helpful feedback on my revisions. It has been a pleasure and a great learning experience to work with each of you. And, finally, I would like to acknowledge the support of those dearest to me: Richard, Curtis and Sarena, Cameron and Katurah, Corey, and Brianna. Marian Luctkar-Flude J A R V I S Physical Examination & Health Assessment Second Canadian Edition This page intentionally left blank CHAPTER 1 Critical Thinking and Evidence-Informed Assessment Written by Carolyn Jarvis, PhD, APN, CNP Adapted by Annette J. Browne, PhD, RN • Appendices • Examination Review Questions • Key Points OUTLINE Assessment: Point of Entry in an Ongoing Process Evidence-Informed Assessment Expanding the Concept of Health The ability to conduct a high-quality health assessment and physical examination is foundational to nursing practice. Similarly, in order to provide relevant, timely, and appropriate nursing and health care, nurses must be able to accurately describe assessment findings to patients, families, and other members of the interprofessional team. Assessments must be conducted in ways that convey respect for the whole person, to avoid objectifying people. Learning to conduct systematic assessments is integral to developing confidence in clinical abilities and capacity to respond effectively to patients' needs. You work in a primary health care clinic in a Canadian city. Ellen K. is a 23-year-old woman whom you have seen several times over the past 2 months (Figure 1-1). She has been admitted for observation at the Emergency Department because of sudden onset of shortness of breath. The health care provider in the Emergency Department documented a health history and performed a complete physical examination. Examples of the preliminary list of significant findings recorded in her health record are as follows: • Appearance: Sitting quietly alone in the examination room. Facial expression appears sad. Eyes fill with tears when she discusses her boyfriend. • Elevated BP [blood pressure]; 142/100 at end of examination today • Diminished breath sounds, with moderate expiratory wheeze and scattered rhonchi at both bases Collecting Four Types of Data Frequency of Assessment Assessment Throughout the Life Cycle • Grade II/VI systolic heart murmur, left lower sternal border • Resolving hematoma, 2 to 3 cm, R [right] infraorbital ridge • Missing R lower first molar, gums receding on lower incisors, multiple dark spots on front upper teeth • Well-healed scar, 28 cm long × 2 cm wide, R lower leg, with R leg 3 cm shorter than L [left], sequelae of auto accident at age 12 • Altered nutrition: omits breakfast; daily intake has no fruits, no vegetables; meals at fast food restaurants most days • Oral contraceptives for birth control × 3 years, last pelvic examination 1 year ago • Smokes a half PPD [pack of cigarettes per day] × 2 years, prior use one PPD × 4 years. • Alcohol use started age 16. For past 2 years, has equivalent of 3–4 drinks per day × 4–5 days a week. Last intake of alcohol was yesterday. • Currently is unemployed × 6 months. Receives employment insurance (≈$680/month). Previous work as cashier in large department store. • History of emotional and physical abuse related to current relationship with boyfriend. Today has orbital hematoma as a result of being struck by boyfriend with the back of his hand. States, "We had a big fight—I probably deserved it" • Relationships: Over past 12 months, has not been in communication with her parents, who live in another city. Has 1 2 UNIT 1 Assessment of the Whole Person of objective data is "Resolving hematoma, 2 to 3 cm, R infraorbital ridge." From the database, you make a clinical judgement or diagnosis about the individual's health state or response to actual health problems or risk factors and life processes, as well as diagnoses about overall levels of wellness. Thus, the purpose of assessment is to make a judgement or diagnosis on the basis of data from various sources. An organized assessment is the starting point of diagnostic reasoning. Because all health care diagnoses, decisions, and treatments are based on the data you gather during assessment, it is paramount that your assessment be factual and complete. 1-1 one close woman friend who lives nearby. Significant relationship is with boyfriend of 2 years, with whom she resides in a rented small basement suite. The examiner analyzed and interpreted all the data; clustered the information, sorting out which data to refer and which to treat; and identified the diagnoses. Of interest is how many significant findings are derived from data the examiner collected. Not just physical data but also cognitive, psychosocial, and behavioural data are significant for an analysis of Ellen's health state. Also, the findings are interesting when considered from a life cycle perspective; that is, Ellen is a young adult who normally should be concerned with the developmental tasks of emancipation from parents, building an economically stable life, and developing caring relationships. A body of clinical evidence has validated the importance of using the assessment techniques in Ellen's case. For example, measuring blood pressure is a way to screen for hypertension, and early intervention can ward off heart attack and stroke. Listening to breath sounds is a way to screen (in Ellen's case) for asthma, which is compounded by her smoking. Listening to heart sounds reveals Ellen's heart murmur, which could be "innocent" or a sign of a structural abnormality in a heart valve; further examination will yield further data. The physical examination is not just a rote formality. Its parts are determined by the best clinical evidence available and documented in the professional literature. ASSESSMENT: POINT OF ENTRY IN AN ONGOING PROCESS Assessment is the collection of data about an individual's health state. Throughout this text, you will study the techniques of collecting and analyzing subjective data (i.e., what the person says about himself or herself during history taking) and objective data (i.e., what you as the health care provider observe by inspecting, percussing, palpating, and auscultating during the physical examination). Together with the patient's record and laboratory studies, these elements form the database. For example, in the case of Ellen, above, an example of subjective data is "History of emotional and physical abuse in current relationship with boyfriend." An example Diagnostic Reasoning The step from data collection to diagnosis can be a difficult one. Most beginning examiners perform well in gathering the data, with adequate practice, but then treat all the data as being equally important. This makes decision making slow and laboured. Diagnostic reasoning, the process of analyzing health data and drawing conclusions to identify diagnoses, is based on the scientific method. It has four major components: (a) attending to initially available cues; (b) formulating diagnostic hypotheses; (c) gathering data relative to the tentative hypotheses; and (d) evaluating each hypothesis with the new data collected, thus arriving at a final diagnosis. A cue is a piece of information, a sign or symptom, or a piece of laboratory data. A hypothesis is a tentative explanation for a cue or a set of cues that can be used as a basis for further investigation. For example, Ellen K., the patient described at the beginning of this chapter, presents with a number of initial cues, one of which is the resolving hematoma under her eye. (a) You can recognize this cue even before history documentation begins. Is it significant? (b) If Ellen were to say she ran into a door, mumbles as she speaks, and avoids eye contact, you formulate a hypothesis of trauma. (c) During the history documentation and physical examination, you gather data to support or reject the tentative hypothesis. (d) You synthesize the new data collected, which support the hypothesis of trauma but eliminate the accidental cause. The final diagnoses are "resolving right orbital contusion" and "risk for trauma." Diagnostic hypotheses are activated very early in the reasoning process. Consider a hunch that Ellen has suffered physical trauma. A hunch helps diagnosticians adapt to large amounts of information because it clusters cues into meaningful groups and directs subsequent data collection. Later, you can accept your hunch or rule it out. Once you complete data collection, develop a preliminary list of significant signs and symptoms and all patient health needs. This is less formal in structure than your final list of diagnoses will be and is in no particular order. (Such a list for Ellen is found on p. 1–2.) In some institutions, it is easier to generate such a list if you use a conceptual model. Examples of conceptual models are described later in this chapter. CHAPTER 1 Critical Thinking and Evidence-Informed Assessment 3 Cluster or group together the assessment data that appear to be causal or associated. For example, for a person in acute pain, associated data may include rapid heart rate and anxiety. Organizing the data into meaningful clusters is slow at first; experienced examiners cluster data more rapidly because they recall proven results of earlier patient situations (Benner, 2001). Use of a conceptual model helps to organize data. Validate the data you collect to make sure they are accurate. As you validate your information, look for gaps in data collection. Be sure to find the missing information because identifying missing information is an essential critical thinking skill. How you validate your data depends on experience. If you are unsure of the blood pressure, validate it by repeating the measurement yourself. Eliminate any extraneous variables that could influence blood pressure results, such as recent activity or anxiety over admission. If you have less experience analyzing breath sounds or heart murmurs, ask an expert to listen. Even for nurses with years of clinical experience, some signs always require validation (e.g., a breast lump). conclusions conflict with technologically driven data. For example, consider the expert nurse's actions in assessing a woman with a drug overdose who had an endotracheal tube and was receiving mechanical ventilation: Critical Thinking and the Diagnostic Process Functioning at the level of expert in clinical judgement includes using intuition: that is, knowledge received as a whole. Intuition is

characterized by immediate recognition of patterns; expert practitioners learn to attend to a pattern of assessment data and act without consciously labelling it. Whereas the beginning nurse operates more from a set of defined, structured rules, the expert practitioner uses intuitive links, has the ability to perceive salient issues in a patient situation, and knows instant therapeutic responses (Benner, 2001). The expert nurse has a storehouse of experience about which interventions have been successful in the past. For example, compare the actions of the nonexpert nurse and the expert nurse in the following situation of a young man with Pneumocystis jirovecii (P. carinii) pneumonia: The standards of practice in nursing, traditionally termed the nursing process, include six phases: assessment, diagnosis, outcome identification, planning, implementation, and evaluation (American Nurses Association, 2004; Canadian Nurses Association, 2010). In the 1970s and 1980s, the nursing process was considered a clear, stepwise, linear approach that started with assessment and ended with evaluation. Now it is considered a more dynamic, interactive process; in today's complex clinical setting, practitioners move back and forth within the steps (Figure 1-2). Although the nursing process is a problem-solving approach to clinical judgements, the way in which a nurse applies the process depends on level and time of experience. Novice nurses have no experience with a specified patient population and use rules to guide performance (Benner, 2001). It takes time, perhaps 2 to 3 years in similar clinical situations, to achieve competency, whereby nurses see actions in the context of arching goals or daily plans for patients. Proficient nurses, who have had more time and experience, understand a patient's situation as a whole rather than as a list of tasks. These nurses envision long-term goals for the patient and how today's nursing actions apply to achieving those goals (e.g., for example, 6 weeks. Finally, expert nurses appear to vault over the steps and arrive at a clinical judgement in one leap. Expert nurses have an intuitive grasp of a clinical situation and pinpoint the accurate solution (Benner, 2001). This is true particularly with expert nurses in critical care situations in which patient status changes rapidly and accurate decisions are paramount. The stakes are high, and nursing autonomy is strong. In these cases, expert nurses focus on patients' responses and prevent complications by vigilant monitoring (Dains, Ciofu Baumann, & Scheibel, 2012). Expert nurses have well-developed physical assessment skills and trust these physical findings, even if their The expert nurse examined the woman's posterior chest during morbid rounds. She said to the medical team, "Mrs. Potter has bronchial breath sounds and dullness to percussion here and here (pointing to an area the size of a nickel and to another area the size of a quarter over the right lower lobe). Do you think she aspirated?" The physicians said, "No, her chest x-ray is normal." Three physicians took turns auscultating and percussing Mrs. Potter's chest. None of them could hear the changes, even when the expert nurse "pointed" (now) circles around the areas. The medical conclusion was that Mrs. Potter had not aspirated. Undaunted, the expert nurse initiated a regimen of pulmonary interventions. On rounds the next day, the medical team ordered antibiotics and frequent pulmonary treatments based on the early morning chest x-ray findings of right lower lobe consolidation. (Hanneman, 1996, p. 332) He was banging the side rails, making gurgling sounds, and pointing to his endotracheal tube. He was diaphoretic, gasping, and frantic. The nurse put her hand on his arm and tried to ascertain whether he had a sore throat from the tube. While she was away from the bedside retrieving an analgesic, the expert nurse strolled by, hesitated, listened, went to the man's bedside, re-inflated the endotracheal cuff, and accepted the patient's look of gratitude because he was able to breathe again. The nonexpert nurse was distressed that she had misread the situation. The expert reviewed the signs of a leaky cuff with the nonexpert and pointed out that banging the side rails and panic help differentiate acute respiratory distress from pain. (Hanneman, 1996, p. 333) The method of moving from novice to becoming an expert practitioner is through the use of critical thinking. All nurses start as novices, when clear-cut rules are needed to guide actions. Critical thinking is the means by which nurses learn to assess and modify, if indicated, before acting. Critical thinking is required for sound diagnostic reasoning and clinical judgement. During your career, you will need to sort through vast amounts of data and information in 4 UNIT 1 Assessment of the Whole Person ASSESSMENT • Collect data: Review of the clinical record Health history Physical examination Functional assessment Risk assessment Review of the literature • Use evidence-based assessment techniques • Document relevant data DIAGNOSIS • Compare clinical findings with normal and abnormal variation and developmental events EVALUATION • Progress toward outcomes • Conduct systematic, ongoing, criterion-based evaluation • Interpret data Identify clusters of clues Make hypotheses Test hypotheses Derive diagnoses • Include patient and significant others • Use ongoing assessment to revise diagnoses, outcomes, plan • Disseminate results to patient and family • Validate diagnoses • Document diagnoses OUTCOME IDENTIFICATION • Identify expected outcomes • Individualize to the person • Culturally appropriate • Realistic and measurable • Include a timeline IMPLEMENTATION • Implement in a safe and timely manner • Use evidence-based interventions • Collaborate with colleagues • Use community resources • Coordinate care delivery • Provide health teaching and health promotion • Document implementation and any modification THE INDIVIDUAL PLANNING • Establish priorities • Develop outcomes • Set timelines for outcomes • Identify interventions • Integrate evidence-based trends and research • Document plan of care 1-2 order to make the sound judgements the nursing care plan. This data will be dynamic, unpredictable, and ever changing. No single protocol that you can memorize will apply to every situation. The following critical thinking skills are organized in a logical progression of the ways the skills might be used in the nursing process (Alfaro-LeFevre, 2009). Although each skill here is described separately, they are not used that way in the clinical area. Rather than a step-by-step linear process, critical thinking is a multidimensional thinking process. With experience, you will be able to apply these skills in a rapid, dynamic, and interactive way. You will also be able to conduct health assessments and physical examinations in ways that convey genuine positive regard and acceptance toward the person, in ways that show you are not viewing people with regard merely to their bodily parts. For now, follow Ellen's case study through the steps. 1. Identifying assumptions; that is, recognize that you could take information for granted or see it as fact when actually there is no evidence for it. Ask yourself what you may be taking for granted here. For example, in Ellen's situation, you might have assumptions of a "typical profile" of a person who uses alcohol or who experiences physical violence on the basis of your past experience or exposure to media coverage. However, the facts of Ellen's situation are unique. CHAPTER 1 Critical Thinking and Evidence-Informed Assessment 2. Identifying an organized and comprehensive approach to assessment. This approach depends on the patient's priority needs and your personal or institutional preference. Ellen has many physical and psychosocial issues, but at her time of admission, she is not acutely physically ill. Thus you may use any organized format for assessment that is feasible for you: a head-to-toe approach, a body systems approach (e.g., cardiovascular, gastrointestinal), a regional area approach (e.g., pelvic examination), or the use of a preprinted assessment form developed by the hospital or clinic. 3. Validation or checking the accuracy and reliability of data. For example, in addiction treatment, a clinician corroborates data with a family member or friend in order to verify the accuracy of Ellen's history. In Ellen's particular case, her significant others are absent or nonsupportive, and the counsellor will have to be with a social worker. 4. Distinguishing normal from abnormal when signs and symptoms are identified. This is the first step in problem identification, and your ease will grow with study, practice, and experience. Increased blood pressure, wheezing, and heart murmur are among the many abnormal findings in Ellen's case. 5. Making inferences or hypotheses. This involves interpreting the data and deriving a correct conclusion about the health status. This is a challenge for the beginning examiner because both a baseline amount of knowledge and experience are needed. Is Ellen's blood pressure increased as a result of the stress of admission or a result of chronic condition? Is the heart murmur "innocent" or a sign of heart valve disease? 6. Clustering related cues, which helps you see relationships among the data. For example, heavy alcohol use, social and interpersonal consequences of alcohol use, academic consequences, and occupational consequences are a clustering of cues that suggest a maladaptive pattern of alcohol use. 7. Distinguishing relevant from irrelevant. A complete history and physical examination yield a vast amount of data. Look at the clusters of data, and consider which data are important for a health problem or a health promotion need. This skill is also a challenge for beginning examiners and one area in which the expertise of a clinical mentor can be invaluable. 8. Recognizing inconsistencies. Ellen's explanation that she ran into a door (subjective data) is at odds with the location of the infraorbital hematoma (objective data). With this kind of conflicting information, you can investigate and further clarify the situation. 9. Identifying patterns. Awareness of patterns helps you fill in the whole picture and discover missing pieces of information. To decide whether the systolic murmur is a problem for Ellen, you need to know the usual function of the heart, characteristics of innocent murmurs, and risk factors for abnormal or pathological murmurs. 10. Identifying missing information, gaps in data, or need for more data to make a diagnosis. Ellen needs 5 more interviewing regarding any increasing tolerance to alcohol, any withdrawal signs or symptoms, and laboratory data regarding liver enzyme levels and blood cell count, in order to specify a diagnosis. 11. Promoting health by identifying priorities with the patients, caregivers, and considering a patient's social contexts. This applies to generally healthy people and concern disease prevention and health promotion. To accomplish this skill, you need to identify and work with each patient to manage known risk factors for the individual's age group and social context. Managing risk factors drives the health promotion goals and priorities. For example, safety planning is an important intervention for Ellen, inasmuch as she identified interpersonal violence as an immediate concern. Following Ellen's lead, you would convey acceptance of her and a willingness to listen, and you would tell Ellen that the abuse she experiences is not her fault (see Chapter 8). You would ask Ellen whether she is interested in developing a safety plan to ensure that she has a safe place to go to if her boyfriend becomes abusive, or whether she is interested in discussing other issues that she identifies as priorities. You might ask her whether she would like to talk to a social worker who could help her address her social, economic, or housing needs. Depending on her priorities, you might also refer Ellen to a dental clinic that provides low-cost or no-cost dental care. 12. Diagnosing actual and potential (risk) problems from the assessment data. All diagnoses (both medical and nursing) derived from Ellen K.'s health history and physical examination findings are listed in Chapter 28. As nursing diagnoses can be conceptualized as clinical judgements about a person's response to an actual or potential health state and identification of their health concerns, risks, and goals in response to the nurse's analysis of assessment data. The 2012–2014 North American Nursing Diagnosis Association (NANDA) list is provided in Appendix H on the Evolve Web site. The NANDA listing has become popular as a device to organize nursing care because it allows for efficient categorization of patients' problems or diagnoses into computer databases that can then help prepare standardized nursing care plans (Thorne, 2006). Despite its popularity with health care administrators in some jurisdictions, the NANDA list is not used uniformly and can create challenges for nurses who prefer to develop more individualized ways of identifying and responding to unique patient problems. Note that the list includes (a) actual diagnoses, which are existing problems that are amenable to independent nursing interventions; (b) risk diagnoses, which are potential problems that an individual does not currently have but is particularly vulnerable to developing; and (c) wellness diagnoses, which focus on strengths and reflect an individual's transition to a higher level of wellness. Throughout this book, appropriate diagnoses from this list are presented and developed as they pertain to related content in each chapter. In Chapter 28, as noted 6 UNIT 1 Assessment of the Whole Person previously, the findings for Ellen K. are analyzed and rewritten as diagnoses. Medical and nursing diagnoses should not be considered isolated from each other; interprofessional perspectives and assessment data are needed to fully understand a person's health status. Nurse practitioners, for example, have expanded scopes of practice. Nurse practitioners are registered nurses who typically have master's degrees and have advanced education in health assessment and therapeutic management of illnesses and injuries, including the ability to prescribe medications. Nurse practitioners provide a direct point of entry to the health care system for case management, diagnosis, treatment, prevention and promotion, and, in some cases, palliative care (Canadian Nurses Association, 2009). It makes sense that the medical diagnosis of asthma be reflected in the nursing diagnoses, in view of the nurse's knowledge of the signs of asthma. In this book, common nursing diagnoses are presented along with medical diagnoses to illustrate common abnormalities. It is important to observe how these two types of diagnoses are interrelated. With regard to Ellen's case, for example, the medical diagnosis is used to evaluate the cause of disease. The nursing diagnosis is used to evaluate the response of the whole person to actual or potential health problems. Note that the admitting nurse and later the physician auscultate Ellen's lung sounds and determine that they are diminished and that wheezing is present. This is both a medical problem and a nursing clinical problem. The physician or nurse practitioner listens to diagnose the cause of the abnormal sounds (in this case, asthma) and to order specific drug treatment. The nurse listens to detect abnormal sounds early, to monitor Ellen's response to treatment, and to initiate supportive measures and health education. 13. Setting priorities when a patient has more than one health or illness issue occurring concurrently (which is often the case). In the acute care hospital setting, the initial problems are usually related to the reason for admission. However, the acuity of illness, as well as the person's social and family context, often determines the order of priorities of the person's problems (Table 1-1). For example, first-level priority problems are those that are emergencies, life-threatening, and immediate, such as establishing an airway or supporting breathing. Second-level priority problems are those that are next in urgency: those necessitating your prompt intervention to forestall further deterioration, such as mental status change, acute pain, acute urinary elimination problems, untreated medical problems, abnormal laboratory values, risks of infection, or risk to safety or security. Ellen has abnormal physical signs that fit in the category of untreated medical problems. For example, Ellen's adventitious breath sounds are a cue to further assess respiratory status to determine the final diagnosis. Ellen's mildly elevated blood pressure also needs monitoring. TABLE 1-1 Identifying Immediate Priorities PRINCIPLES OF SETTING PRIORITIES 1. Make a complete list of current medications, medical problems, allergies, and reasons for seeking care. Refer to them frequently because they may affect how you set priorities. 2. Determine the relationships among the problems: If problem Y causes problem Z, problem Y takes priority over problem Z. Example: If pain is causing immobility, pain management is a high priority. Setting priorities is a dynamic, changing process; at times, the order of priority changes, depending on the seriousness and relationship of the problems. Example: If abnormal laboratory values are at life-threatening levels, they become a higher priority; if the patient is having trouble breathing because of acute rib pain, managing the pain may be a higher priority than dealing with a rapid pulse (first-level priority, listed in the following section of this table). STEPS TO SETTING PRIORITIES 1. Assign high priority to first-level priority problems (immediate priorities): Remember the "ABCs plus V's": • Airway problems • Breathing problems • Cardiac/circulation problems • Vital sign concerns (e.g., high fever) Exception: With cardiopulmonary resuscitation (CPR) for cardiac arrest, begin chest compressions immediately. Go online to ichc.iaiQ-iAWJHJ/b.630/195/k/9480CPRguidelines.htm for the most current CPR guidelines. 2. Next, attend to second-level priority problems: • Mental status change (e.g., confusion, decreased alertness) • Untreated medical problems that necessitate immediate attention (e.g., for a diabetic patient who has not had insulin) • Acute pain • Acute urinary elimination problems • Abnormal laboratory values • Risks of infection, to safety, or to security (for the patient or for others) 3. Address third-level priority problems (later priorities): • Health problems that do not fit into the previous categories (e.g., problems with lack of knowledge, activity, rest, family coping) Adapted from Alfaro-LeFevre, R. (2009). Critical thinking and clinical judgement: A practical approach (4th ed.). Philadelphia: W. B. Saunders. Third-level priority problems are those that are important to the patient's health but can be addressed after more urgent health problems are addressed. In Ellen's case, the data indicating diagnoses of knowledge deficit, social isolation, risk for other-directed violence, and risk for situational low self-esteem fit in this category. Interventions to treat these problems are important, and the nurse or designate is expected to take more time. Collaborative problems are certain physiological complications in which nurses have the primary responsibility to diagnose the onset and monitor the changes in status (Carpenito-Moyet, 2004). For example, the data CHAPTER 1 Critical Thinking and Evidence-Informed Assessment 14. 15. 16. 17. regarding the alcohol use, indicate potential collaborative problems. With this problem, the sudden withdrawal of alcohol has profound implications on the central nervous and cardiovascular systems. Ellen's response to the rebound effects of these systems is managed. Identifying patient-centred expected outcomes. What specific, measurable results that will show an improvement in the person's problem after treatment will you expect? The outcome statement should include a specific time frame. For example, before discharge from the emergency department, Ellen will identify a safety plan for dealing with interpersonal violence that fits with her life context. Determining specific interventions that will achieve positive outcomes. These interventions aim to prevent, manage, or resolve health problems. They constitute the health care plan. For specific interventions, state who should perform the intervention, when and how often, and the method used. Evaluating and revising your thinking. Observe the actual outcomes, and evaluate them in relation to the expected outcomes (do the stated outcomes match the individual's actual progress?). Then, analyze whether your interventions were successful or not. Continually think about what you could be doing differently or better. Determining a comprehensive plan or evaluating and updating the plan. Record the revised plan of care and keep it up to date. The use of electronic health records is widespread in Canada; nurses play an important role in influencing the flow, use, and management of information. Communicate the plan to the multidisciplinary team. Be aware that the plan of care is a legal document, and accurate recording is important for accountability purposes, billing purposes, evaluation, and research. EVIDENCE-INFORMED ASSESSMENT Does honey help burn wounds heal more quickly? Is St. John's wort effective in relieving the symptoms of major depression? Does male circumcision reduce the risk of transmitting human immunodeficiency virus (HIV) in heterosexual men? Can magnesium sulphate reduce risk for cerebral palsy in premature infants? Can infusing hearts with stem cells help heal tissue damage after a heart attack? Health care in Canada is increasingly shaped by corporatization, cost constraints, and cutbacks of community-based health and social services (Varcoe & Rodney, 2009). Lack of timely access to primary care services is linked to the increasingly acute conditions among hospitalized patients, many of whom are discharged earlier than traditionally and without adequate supports in their home or communities. Despite these realities, studies show that nurses and nursing continue to find ways of ensuring that patients are provided with high-quality clinical care (see, for example, Laschinger, Wong, Grau, Read, & Stam, 2011; Tourangeau et al., 2011; Tourangeau, Cranley, Laschinger, & Pachis, 2010). All patients deserve to be treated with the most current best-practice techniques. It is this conviction that led to the 7 development of evidence-based practice (EBP).* In 1972, a British epidemiologist and early proponent of EBP, Archie Cochrane, identified a pressing need for systematic reviews of randomized clinical trials. In a landmark case, Dr. Cochrane noted that multiple clinical trials published between 1972 and 1981 showed that the use of corticosteroids to treat women in premature labour reduced the incidence of infant mortality. A short course of corticosteroid stimulates fetal lung development, thus preventing respiratory distress syndrome, a serious and common complication of premature birth. However, these findings had not been implemented into daily practice, and thousands of premature infants of low birth weight were needlessly dying. After a systematic review of the evidence in 1989, obstetricians were finally aware that the corticosteroid treatment was effective. Corticosteroid treatment has since been shown to reduce the risk of infant mortality by 30% to 50% (Crowther, McKinlay, Middleton, & Harding, 2011). The term evidence-informed practice (EIP) is increasingly used in the literature to encompass a more inclusive view of what "counts" as evidence than is conventionally implied when using the term evidence-based practice (Rycroft-Malone, 2008). While the literature on evidence-based practice recognizes the appropriateness of the randomized controlled trial for evidence of effectiveness of nursing and medical interventions, other forms of evidence also inform clinical decision making and the delivery of nursing care—hence the relevance of the term evidence-informed practice (Rycroft-Malone, 2008). EIP is more than the use of best-practice techniques to treat patients; it is "a systematic approach to practice that emphasizes the use of best evidence in combination with the clinician's experience, as well as the patient preferences and values, to make decisions about care and treatment" (Leufer, 2009; Figure 1-3). This definition is comprehensive and inclusive of the various factors and contexts that shape the delivery of nursing care. Note how clinical decision making depends on all four factors: the best and most appropriate evidence from a critical review of research literature; the patient's own context and preferences; the clinician's expertise, including his or her skill in history taking, physical examination and assessment. Assessment skills must be practised with hands-on experience and refined to a high level. Although assessment skills are foundational to EIP, it is important to question tradition when no compelling research evidence exists to support it. Some time-honoured assessment techniques have been omitted from the examination repertoire because clinical evidence has shown them to be less than useful. For example, the traditional practice of auscultating bowel sounds was found not to be the best indicator of returning gastrointestinal motility in patients having abdominal surgery (Madsen, Sebolt, Cullen, Folkedahl, Mueller, Richardson, & Titler, 2005). Madsen and colleagues first reviewed earlier studies suggesting that early postoperative bowel sounds probably do not represent the return of normal gastrointestinal motility and that listening to the abdomen is therefore not useful in this situation. Research *In this chapter, evidence-informed practice is used interchangeably with evidence-based practice. 8 UNIT 1 Assessment of the Whole Person Evidence from research and evidence-informed theories Patient preferences and values Evidence-informed clinical decision making Physical examination and assessment of patient Clinician's experience skills and clinical Clinical resources 1-3 settings and contexts; they are learning to discern which interventions would best serve the wide range of patients encountered in practice. Facilitating support for EIP at the organizational level includes time to go to the library; teaching to conduct electronic searches; journal club meetings; establishing nursing research committees; linking staff with university researchers; and ensuring the availability of adequate research journals and preprocessed evidence resources in the library (DiCenso et al., 2005). "Evidence-informed practice is a problem-solving process in which practitioners are active stakeholders, not passive recipients" (Rycroft-Malone, 2008, p. 407). EXPANDING THE CONCEPT OF HEALTH Clinical expertise 1-3 did show the primary markers for returning gastrointestinal motility after abdominal surgery to be the return of flatus and the first postoperative bowel movement. Madsen and colleagues instituted a new practice protocol and monitored patient outcomes to check whether discontinuing the auscultation of bowel sounds was detrimental to patients who had undergone abdominal surgery. Detrimental outcomes did not occur; the new practice guideline was shown to be safe for patients' recovery and a better allocation of staff time. Despite the advantages for patients who receive care based on EIP, it often takes many years for research findings to be implemented into practice. This gap has led researchers to examine closely the factors that influence the uptake of evidence into practice, at the levels of both the individual practitioner and the organization (Baumbusch et al., 2008; DiCenso, Guyatt, & Ciliska, 2005; Estabrooks et al., 2011; Rycroft-Malone, 2008). Nurses working in hospital and community settings may not have the types of research partnerships that would enable them to develop their research knowledge and skills. More significant barriers are often located in the organizational characteristics of health care settings. The "structure of nurses' work often prevents them from having time to dedicate to accessing research articles, attending research presentations, or conducting studies in collaboration with university researchers. Organizational support for EIP is required in order for nurses to implement changes in patient care (DiCenso et al., 2005). Furthermore, Rycroft-Malone (2008) argued that "investing in the capability of key individuals at multiple levels of the organization as leaders of evidence-based practice activities may be one promising organizational strategy" (p. 404). Fostering a culture of EIP is also important; a first step in fostering a culture of EIP is to further the understanding at undergraduate and graduate levels is one way in which educators are attempting to make EIP the "gold standard" of practice. Students of nursing and medicine are now taught how to critically appraise the health Assessment is the collection of data about an individual's health state. A clear idea of an individual patient's health status is important because this determines which assessment data should be collected. In general, the list of data that must be collected has lengthened as the concept of health has broadened. According to the biomedical model of Western tradition, health is the absence of disease (Figure 1-4). Health and disease are opposites, extremes on a linear continuum. Disease is caused by specific agents or pathogens. Thus the biomedical focus is the diagnosis and treatment of those pathogens and the curing of disease. Assessment factors are a list of biophysical symptoms and signs. A person is certified as healthy when these symptoms and signs have been eliminated. When disease does exist, medical diagnosis is needed to identify and explain the cause of disease. Accurate diagnosis and treatment of illness are important parts of health care. However, the medical model has limiting boundaries. According to the behavioural model, health care extends beyond treating disease to include secondary and primary preventions, with emphasis on changing behaviours and lifestyles (e.g., quitting smoking or eating nutritiously; Doane & Varcoe, 2005). The socioenvironmental model incorporates sociological and environmental aspects in addition to the biomedical and behavioural ones. The socioenvironmental perspective parallels the definition provided by the World Health Organization (1986), which defines health as a resource for living and as the abilities to realize goals or aspirations, meet personal needs, and change or cope with everyday life. Building on these ideas, the Ottawa Charter for Health Promotion (World Health Organization, 1986) identified the prerequisites to health as peace, shelter, education, food, income, a stable ecosystem, sustainable resources, social justice, and equity. Although the Ottawa Charter was written in 1986, many people in Canada still lack these basic prerequisites, and their health is profoundly compromised as a result. Figure 1-5 By developing The Ottawa Charter for Health Promotion, Canada has taken a leading international role in emphasizing the importance of the social determinants of health. Social determinants are the social, economic, and political conditions that shape the health of individuals, families, and communities (Canadian Nurses Association, 2005; Raphael, CHAPTER 1 Critical Thinking and Evidence-Informed Assessment 1-4 2009). For example, some of the best predictors of adulthood diabetes, mental illness, heart attack, and stroke are low income, inability to afford nutritious foods, and crowded housing or lack of affordable housing. These are issues that also affect patients' and families' abilities to engage in healthpromoting practices. Canada has also been a major international leader in the area of health promotion. Health promotion can be defined as a comprehensive social and political process of enabling people to increase control over the determinants of health and thereby improve their health (Raphael, 2010). Health promotion activities focus on strengthening the skills and capabilities of individuals and families and are directed toward changing social, economic, and environmental conditions to improve health. The concept of "relational" is increasingly used to describe the complex, interrelated nature of health, people, society, and nursing practice (Doane & Varcoe, 2005). Relational is not the same as relationships: Although relationships between people are important, relational practice refers to more than interpersonal relationships. A relational approach in nursing practice accounts for the fact that health, illness, and the meanings they hold for a person are shaped by the person's social, cultural, family, historical, and geographical contexts, as well as the person's gender, age, ability, and and other individual contexts. Relational approaches focus nurses' attention on what is significant to people in the context of their everyday lives and how capacities and socioenvironmental limitations shape people's choices. One of the central skills of relational practice is reflexivity, a process of continually examining how you view and respond to patients on the basis of your own assumptions, cultural and social orientation, past experiences, and so on. Practising from a relational stance is therefore critical to "connecting across differences," which means differences in your own and your patients' values, beliefs, privileges, practices, concerns, and experiences. Approaching difference relationally promotes (a) understanding rather than defensiveness and (b) responsiveness rather than a sense of frustration or powerlessness. These concepts are discussed further in Chapters 3, 4, and 8. Nurses need to draw on a variety of perspectives. For example, if you were working with Ellen, the young woman 9 in the case study, you would use a medical perspective to assess and treat her underlying respiratory problems. From a behavioural perspective, you might focus on providing information and teaching Ellen about how to eat more nutritious foods. The socioenvironmental model would attune you to assessing Ellen's risks for violence and helping her develop a safety plan in case she needs to remove herself quickly from a violent situation at home. Considering the social determinants of health, you would focus attention on whether Ellen could afford fresh fruits or vegetables or pay for the prescription necessary to treat her respiratory infection. A relational stance would prompt you to consider what biases or assumptions might be influencing your judgements or ability to listen to Ellen and would involve your exploring with her the issues she thought were most important at this point in her life. For example, the health assessment process might indicate that the most important health-promoting intervention would be a referral to a women's social support agency in the community. COLLECTING FOUR TYPES OF DATA Every examiner needs to collect four different kinds of data depending on the clinical situation: complete, episodic or problem-centred, follow-up, and emergency. Complete (Total Health) Database The complete database includes a complete health history and results of a full physical examination. It describes the current and past health states and forms a baseline against which all future changes can be measured. It yields the first diagnoses. In primary care, the complete database is compiled in a primary care setting, such as a pediatric or family practice clinic, independent or group private practice, college health service, women's health care agency, visiting nurse agency, or community health care agency. When you work in these settings, you are the first health care provider to see the patient, and you have primary responsibility for monitoring the patient's health care. For the well person, this database must describe the person's health state, perception of health, strengths or assets such as the ability to engage in health maintenance or health-promoting practices, support systems, current developmental tasks, and any risk factors or social issues. For the ill person, the database also includes a description of the person's health problems, perception of illness, and response to the problems. For well and ill people, the complete database must help nurses screen for disease and determine the ways people respond to that disease or to any health problem. You must screen for disease because you are the first, and often the only, health care provider to see the patient. You need to discover in order to refer the patient to another professional, to help the patient make decisions, and to perform appropriate treatments. However, this database also notes the human responses to health problems. This factor is important because it provides additional information about the person that leads to nursing diagnoses. 10 UNIT 1 Assessment of the Whole Person In acute hospital care, the complete database is also compiled after the patient's admission to the hospital. In the hospital, data related specifically to disease may be collected by the admitting physician. You collect additional information about the patient's perception of illness, functional ability or patterns of living, activities of daily living, health maintenance behaviours, response to health problems, coping patterns, interaction patterns, and health goals. This information completes the database from which the nursing diagnoses can be made. Episodic or Problem-Centred Database The episodic database is for a limited or short-term problem. It is a "mini-database," smaller in scope and more focused than the complete database. It concerns mainly one problem, one cue complex, or one body system. It is used in all settings: hospital, primary care, or long-term care. For example, 2 days after surgery, a hospitalized person suddenly has a congested cough, shortness of breath, and fatigue. The history and examination focus primarily on the respiratory and cardiovascular systems. In another example, a person presents with a rash in an outpatient clinic. The history and examination follow the direction of this presenting concern, such as whether the rash had an acute or chronic onset, was associated with a fever, and was localized or generalized. Documentation of the history and examination must include a clear description of the rash. Follow-Up Database The status of any identified problems should be evaluated at regular and appropriate intervals. What change has occurred? Is the problem getting better or worse? What coping strategies are used? The follow-up database is used in all settings to monitor short-term or chronic health problems. Emergency Database The emergency database calls for a rapid collection of the data, often compiled while life-saving measures are occurring. Diagnosis must be swift and sure. For example, in a hospital emergency department, a person is brought in with suspected substance overdose. The first history questions are "What did you take?", "How much did you take?", and "When did you take it?" The person is questioned simultaneously while his or her airway, breathing, circulation, level of consciousness, and disability are being assessed. Clearly, the emergency database requires more rapid collection of data than does the episodic database. FREQUENCY OF ASSESSMENT The frequency of assessment varies with the person's age, gender, social context, and illness and wellness needs. Most people seek care because of pain or some abnormal signs and symptoms they have noticed. This prompts an assessment: gathering a complete, an episodic, or an emergency database. For the well person, however, opinions are changing about assessment intervals. The term annual checkup is vague. What does it constitute? Is it necessary or cost effective? Does it sometimes give an implicit promise of health and thus provide false security? What about the classic situation in which a person suffers a heart attack 2 weeks after a routine checkup that includes normal findings on an electrocardiogram? The timing of some formerly accepted recommendations also has now changed; for example, the Papanicolaou (Pap) test for cervical cancer in women is no longer required annually depending on past test results and the woman's health history (Canadian Task Force on Preventive Health Care, 2013b). Screening guidelines for breast self-exam, and clinical breast exam to screen for breast cancer have also recently changed, and recommendations vary significantly in different provinces (Canadian Task Force on Preventive Health Care, 2013c). The same annual routine physical examination cannot be recommended for all persons because health priorities vary among individuals, different age groups, and risk categories. In Canada, there are various guidelines for disease prevention and health promotion. For example, national guidelines are developed regularly for particular populations, as are national guidelines for adolescents (HPV Consensus Guidelines Committee, 2007). Many of these guidelines are outlined in Chapter 2. National standards for immunizations are contained in the Canadian Immunization Guide (Public Health Agency of Canada, 2012). Each province and territory adapts these standards slightly according to its population's needs. In addition, there are ongoing updates posted by the National Advisory Committee on Immunizations (2012). It is important to check the provincial or territorial guidelines where you practise. Periodic health examinations are designed to prevent morbidity and mortality by identifying modifiable risk factors and early signs of treatable conditions (Milone & Lopes Milone, 2006). In 1980, the Canadian Task Force on the Periodic Health Examination produced its first evidence-informed clinical practice guidelines. The task force was renamed the Canadian Task Force on Preventive Health Care in 1984, and many of the guidelines were updated in 2006 and again in 2013 (Canadian Task Force on Preventive Health Care, 2013a). Since 2006, the Public Health Agency of Canada (2011) has taken the lead in developing and distributing health promotion, disease prevention, and other guidelines for children, adults, pregnant women, and older adults. The Canadian Medical Association's (2012) Clinical Practice Guidelines are also updated regularly and include prevention, promotion, and treatment guidelines for use by nurses, nurse practitioners, and physicians. For infants and children, clinical practice guidelines developed at the provincial and territorial level are accessible; these guidelines include the following: • Developmental screening tests • Schedules for periodic well-child assessments • Health promotion, injury prevention, and disease prevention strategies for various age groups • Depression screening tools for adolescents • Strategies to promote healthy parenting • Strategies to support psychosocial and emotional development in children CHAPTER 1 Critical Thinking and Evidence-Informed Assessment For example, the Rourke Baby Record (Rourke, Leduc, & Rourke, 2011) is an evidence-informed health maintenance and prevention guide that can be used by community health nurses, nurse practitioners, and physicians caring for children during the first 5 years of life. The Canadian Paediatric Society (2012) and the World Health Organization (2012) also have evidence-informed developmental screening guidelines for age-specific periodic health visits and preventive services in the Guide to Clinical Preventive Services, Second Edition (U.S. Preventive Services Task Force, 2006). Aspects of these guidelines can be adapted for use with Canadian populations; for example: • Screening for major risk factors • Age-specific and gender-specific items for physical examination and laboratory procedures • Health promotion guidelines (however, nurses should follow the Canadian rather than the U.S. immunization schedule) • Health education and counselling topics Tables 1-2, 1-3, 1-4, and 1-5 contain examples of clinical preventive health care recommendations per age group, beginning with birth to 9 years of age. These recommendations are periodically updated, and they vary from one province or territory to another, as noted previously; however, these tables provide a good overview of preventive guidelines over the life span. Addressing health promotion in the context of health assessment is discussed in depth in Chapter 2. ASSESSMENT THROUGHOUT THE LIFE CYCLE It makes good sense to consider health assessment from a life cycle approach. First, you must be familiar with the usual and expected developmental tasks for each age group. This alerts you to which physical, psychosocial, cognitive, and behavioural tasks are currently important for each person. For example, an adult in Ellen K.'s age group has developmental tasks that include growing independent from the parents' home and care, establishing a vocation, forming an intimate bond with another person, making friends, and establishing a social group. Next, once assessment skills are learned, they are more meaningful when considered from a developmental perspective. Your knowledge of communication skills and health history content is enhanced as you consider how they apply TABLE 1-2 11 to individuals throughout the life cycle. The physical examination also is more relevant when you consider age-specific data about anatomy, the method of examination, normal findings, and abnormal findings. For example, an average normal blood pressure for a woman Ellen K.'s age is 116/70 mm Hg (see Figure 10-18 on p. 174). For each age group, the approach to health assessment arises from an orientation toward wellness, quality of life, and health maintenance. The nurse tries to capitalize on the patient's strengths. What is the patient already doing that promotes health? What other areas are amenable to health teaching so that the patient can further build his or her potential for health? CULTURAL AND SOCIAL CONSIDERATIONS Cultural and social considerations are critical in health and physical assessments. An introduction to key concepts is provided in Chapter 3. These concepts are threaded throughout the text as they specifically relate to other chapters. Of importance is that a relational stance in your clinical practice will help you to attend to the varying contexts that shape people's health and well-being. Canada's population, estimated at 35,002,447 in 2012, is very diverse (Statistics Canada, 2012). The Canadian population grew more rapidly between 2001 and 2006 than it did in the previous 5-year interval, and this acceleration was attributable primarily to an increase in international migration (Statistics Canada, 2007a, 2007b). During 2001 to 2006, it was estimated that just over 1 million people immigrated to Canada. Canada's Aboriginal population is also relatively large, accounting for almost 4% of the total population (Statistics Canada, 2008). Aboriginal people in Canada include the First Nations, Métis, and Inuit groups, which are recognized as three separate groups with unique histories, cultural backgrounds, and language spoken. A disturbing trend is the increasing divisions between people who are wealthy and those who are poor (Beiser & Stewart, 2005). At least 15% of Canadians live in impoverished circumstances, and these rates are dramatically higher for low-income families (51%; Raphael, 2007). Of concern is the fact that income and health status declines (Raphael, 2010). Nurses and other health care providers therefore require the skills and knowledge to effectively—and respectfully—explore these interrelated biological, social, cultural, and economic factors. Clinical Preventive Health Care Recommendations: Birth to Age 9 Years LEADING CAUSES OF DEATH (2004)1 Conditions originating in perinatal period Congenital anomalies Sudden infant death syndrome (SIDS) Unintentional injuries Cancer Source of immunization schedule: Public Health Agency of Canada (2012). 1 Data from Public Health Agency of Canada (2008). Leading causes of death and hospitalization in Canada. Retrieved from Continued 12 TABLE 1-2 UNIT 1 Assessment of the Whole Person Clinical Preventive Health Care Recommendations: Birth to Age 9 Years—cont'd INTERVENTIONS FOR THE PEDIATRIC POPULATION2 Screening Hip examination, serial (first year) Eye examination (infants) Hearing examination, serial (first year) Vision screen (age 3 or 4 yr) Serial height, weight, head circumference measurements (infants) Phenylalanine level (birth) Thyroid stimulating hormone (TSH) (at birth) Counselling Injury Prevention: Child safety car seats (≤40 mm Hg; diastolic, >90 mm Hg) and heart failure also increases, with age. In Canada the prevalence of death from CVD is sharply decreasing on an annual basis, and yet the incidence of CVD itself continues to increase. Better medications, early intervention, and public health awareness are some of the factors contributing to the reduction in death rates. According to Statistics Canada (2010), men and women in Canada have almost equal rates of death from CVD, a trend noted since 2000. Interestingly, as CVD death rates have declined (29.6%), those of mortality from cancer have increased (29.6%), and so cancer is the number one killer of Canadians in all provinces for the first time. Of interest, however, is that CVD remains the primary killer of Canadian women. The prevalence of heart disease and stroke is higher among adults of African descent than in any other ethnic group. These differences in prevalence show the crucial need to improve early detection, screening, and treatment. Socioeconomic factors also influence the incidence of CVD in Canadians. Concerns about food security continue to be in the forefront of arguments for action to diminish heart disease. Food security will continue to be a challenge in economic and physical access by all people to sufficient, safe, and nutritious food or hunger. These problems have reached epidemic proportions in Canada. Among Canadian men, the prevalence of obesity, at 24.3%, is only slightly higher than that among women, at 23.9%. Since 2000, the percentage of obesity rates has increased by 10% in Canada. Overweight and obesity among children are of national concern; 25% of girls and 29% of boys between the ages of 2 and 17 years weigh above the national average BMI. There is significant evidence that obesity is at least partly genetic. Certain ethnic groups are more vulnerable to obesity and obesity-related disorders. Genome-wide association studies show that some genes are associated with a higher BMI. However, genes are not the whole story: The significant change in obesity rates since the 1990s is evidence against genetic drift and in favour of strong environmental influences interacting with existing genes. Children are particularly vulnerable to weight gain associated with a sedentary lifestyle. Children's eating habits and physical activity patterns tend to be similar to those of their parents, which is one environmental reason why obesity and obesity-related disorders often run in families. There is growing evidence that the environment in the womb helps to "program" a child's metabolism. Exposure to gestational diabetes or maternal obesity, high birth weight, and intrauterine growth retardation with rapid catch-up growth are all associated with obesity later on. In contrast, breastfeeding in infancy may reduce the risk of obesity, as may other healthy practices, such as getting enough sleep, and eating only in response to appetite cues. Diabetes. More than 9 million Canadians live with diabetes or prediabetes. It is estimated that the prevalence will increase significantly by 2025. In part because the population is aging, obesity rates are rising, Canadian lifestyles are increasingly sedentary, and nearly 80% of all new Canadians belong to Hispanic, Asian, South Asian, and African populations, which are at increased risk of developing type 2 diabetes. The personal cost of diabetes may include a reduced quality of life and an increased likelihood of complications, such as heart disease, stroke, kidney disease, blindness, need for amputation, and erectile dysfunction. Approximately 80% of people with diabetes die as a result of heart disease or stroke. Medical costs for individuals with diabetes are two to three times higher than those for individuals without the disease. By 2020, it is estimated that diabetes will cost the Canadian health care system $16.9 billion (Canadian Diabetes Association, 2011). SUBJ E C T I V E DATA 1. Chest pain 2. Dyspnea 3. Orthopnea 4. Cough 5. Fatigue 6. Cyanosis or pallor 7. Edema 8. Nocturia 9. Past cardiac history 10. Family cardiac history 11. Personal habits (cardiac risk factors) Subjective Data necessary to meet both their dietary needs and their food preferences to lead an active, healthy life (this was discussed in Chapter 12). A lack of food security as a result of economic or geographic barriers, as in most northern communities, is a significant determinant of health and an important heart health issue for many Canadians (Heart and Stroke Foundation, 2009). Income and employment, access to resources, and extended health care plans also influence the ability to support a heart-healthy lifestyle. The major risk factors for heart disease and stroke are high blood pressure, smoking, high cholesterol levels, obesity, physical inactivity, and diabetes. In addition, for women, the use of oral contraceptives and the presence of postmenopausal hormones are risk factors. High Blood Pressure. In 2010, nearly 5 million Canadians (17.1%) aged 20 years and older had received a diagnosis of hypertension. These rates are lower than the self-reported numbers noted in 2010 by the Canadian Health Survey (19.4%). This discrepancy could reflect the number of Canadians self-managing their hypertension without pharmaceutical intervention. Rates of hypertension increase with age, with prevalence is more common among women after the age of 55. The Atlantic provinces have the highest prevalence of hypertension in the nation; the western and the northern provinces (Yukon, British Columbia, and Northwest Territories) have the lowest rates (Statistics Canada, 2011). Smoking. The Canadian Tobacco Use Monitoring Survey revealed an 8% decline in the overall prevalence of smoking in Canada from 1999 to 2010 (Health Canada, 2011). An estimated 4.7 million Canadians, or 17% of the population aged 15 and older, reported smoking daily or occasionally in 2010. The national smoking cessation strategy discussed in Chapter 19 highlights the country's desire to manage this contributing factor. Smoking cessation programs are available at all public health units. Serum Cholesterol. During childhood (ages 4 to 19), children and adolescents of African descent have higher levels of total cholesterol, low-density lipoprotein (LDL) cholesterol, and high-density lipoprotein cholesterol (the "good" cholesterol) than do children and adolescents of Euro-Canadian descent. These differences reverse during adulthood, so that individuals of African descent have lower serum cholesterol levels than do those of Euro-Canadian descent. Obesity. Overweight is defined by a body mass index (BMI) of 25 to 29.9 kg/m2 and obesity by a BMI of 30 kg/m2 487 Structure & Function CHAPTER 20 Heart and Neck Vessels 488 UNIT 3 Physical Examination HEALTH HISTORY QUESTIONS Examiner Asks Subjective Data 1. Chest pain. Any chest pain or tightness? • Onset: When did it start? How long have you had it this time? Have you had this type of pain before? How often? • Location: Where did the pain start? Does the pain radiate to any other spot? • Character: How would you describe it: crushing, stabbing, burning, viselike? (Allow the patient to offer adjectives before you suggest them. Note whether the patient uses a clenched fist to describe pain.) • Is the pain brought on by activity (what type), rest, emotional upset, eating, sexual intercourse, or cold weather? • Do you have any associated symptoms: sweating, ashen grey or pale skin, heart skipping a beat, shortness of breath, nausea or vomiting, heart racing? • Is the pain made worse by moving the arms or neck, by breathing, or by lying flat? • Is the pain relieved by rest or nitroglycerine? How many spray(s)? 2. Dyspnea. Do you ever have shortness of breath? • What type of activity, and how much, brings on shortness of breath? How much activity brought it on 6 months ago? • Onset: Does the shortness of breath come on unexpectedly? • Duration: constant or does it come and go? • Seems to be affected by position: lying down? • Awaken you from sleep at night? Rationale Angina, an important cardiac symptom, occurs when heart's vascular supply cannot keep up with metabolic demand. Chest pain also may be of pulmonary, musculoskeletal, or gastrointestinal origin; it is important to differentiate. A squeezing "clenched fist" sign is characteristic of angina, but the symptoms listed as follows may be anginal equivalents in the absence of chest pain. Diaphoresis, cold sweats, pallor, greyness Palpitations, dyspnea, nausea, tachycardia, fatigue Try to differentiate pain of cardiac versus noncardiac origin. Dyspnea on exertion (DOE): quantify exactly (e.g., DOE after walking two level blocks) Paroxysmal dyspnea Constant or intermittent dyspnea Recumbent dyspnea Paroxysmal nocturnal dyspnea occurs with heart failure. Lying down increases volume of intrathoracic blood, and the weakened heart cannot accommodate the increased load. Affected patients classically awaken after 2 hours of sleep with the perception of needing fresh air. • Does the shortness of breath interfere with activities of daily living? 3. Orthopnea. How many pillows do you use when sleeping or lying down? Orthopnea is the need to assume a more upright position to breathe. Note the exact number of pillows used. 4. Cough. Do you have a cough? • How long have you had it? Frequency: Is it related to time of day? Type: Is it dry, hacking, barky, hoarse, or productive? Do you cough up mucus? What colour is it? Any odour? Blood-tinged (hemoptysis)? • Is the cough associated with activity, position (lying down), anxiety, talking? • Does activity make it better or worse (sit, walk, exercise)? • Is it relieved by rest or medication? 5. Fatigue. Do you seem to tire easily? Are you able to keep up with your family and coworkers? • Onset: When did fatigue start? Was it sudden or gradual? Has any recent change occurred in energy level? • Is fatigue related to time of day: all day, morning, evening? Sputum production, mucoid or purulent Hemoptysis is often a pulmonary disorder but also occurs with mitral stenosis. Fatigue from decreased cardiac output is worse in the evening, whereas fatigue from anxiety or depression is present all day or is worse in the morning. CHAPTER 20 Heart and Neck Vessels Examiner Asks 6. Cyanosis or pallor. Ever noted your facial skin turn blue or ashen? 7. Edema. Any swelling of your feet and legs? Rationale Cyanosis or pallor occurs with myocardial infarction or low cardiac output states as a result of decreased tissue perfusion. Edema is dependent when caused by heart failure. Cardiac edema is worse at evening and better in morning after legs are elevated all night. Cardiac edema is bilateral; unilateral swelling has a local vein cause. Recumbent at night promotes fluid reabsorption and excretion; nocturia occurs with heart failure in patients who are ambulatory during the day. 9. Cardiac history. Do you have any history of hypertension, elevated cholesterol or triglyceride levels, heart murmur, congenital heart disease, rheumatic fever or unexplained joint pains in childhood or youth, recurrent tonsillitis, anemia, or diabetes? • Ever had heart disease? When was this? Was it treated by medication or heart surgery? • When was your last ECG, stress ECG, serum cholesterol measurement, or other heart tests? 10. Family cardiac history. Any family history of hypertension, obesity, diabetes, CAD, sudden death at a young age? 11. Personal habits (cardiac risk factors) • Nutrition: Please describe your usual daily diet. (Note whether this diet is representative of the basic food groups, and note the amount of calories, cholesterol, and any additives such as salt.) What is your usual weight? Any recent change? • Smoking: Do you smoke cigarettes or other tobacco? At what age did you start? How many packs per day? For how many years have you smoked this amount? Have you ever tried to quit? If so, how did this go? • Alcohol: How much alcohol do you usually drink each week or each day? When was your most recent drink? What was the number of drinks that episode? Have you ever been told you had a drinking problem? • Exercise: What is your usual amount of exercise each day or week? How many minutes per day do you exercise? What type of exercise (state type or sport)? If a sport, what is your usual amount (light, moderate, heavy)? • Drugs: Do you take any antihypertensives, β-blockers, calcium channel blockers, digoxin, diuretics, aspirin and anticoagulants, over-the-counter drugs, or street drugs? • Do you take any oral contraceptives? • Do you use any street drugs? Marijuana? • Stress: Tell me about stress in your life. How do you manage it? How does it affect you? Risk factors for CAD: Collect data regarding elevated cholesterol level, elevated blood pressure, blood sugar levels above 6.0, random plasma glucose level value in excess of 11.1 mmol/L or known diabetes mellitus, obesity, cigarette smoking, low activity level, and, for postmenopausal women, length of any hormone replacement therapy. Subjective Data • Onset: When did you first notice this? • Any recent change? • What time of day does the swelling occur? Do your shoes feel tight at the end of day? • How much swelling would you say there is? Are both legs equally swollen? • Does the swelling go away with rest, with elevation, or after a night's sleep? • Do you have any associated symptoms, such as shortness of breath? If so, does the shortness of breath occur before leg swelling or after? 8. Nocturia. Do you awaken at night with an urgent need to urinate? How long has this been occurring? Any recent change? 489 490 UNIT 3 Physical Examination PROMOTING HEALTH: WOMEN AND HEART ATTACK Subjective Data The Heart Truth: Women and Heart Attacks When someone complains of chest pain or pain radiating down the left arm, the person almost always thinks "heart attack." After all, these are the typical symptoms, correct? Well, yes and no. In the past it was believed that women experienced different warning signs than men. The Heart and Stroke Foundation (2009) notes that this may not actually be the case. Both women and men may experience typical or atypical symptoms, such as nausea; sweating; pain in the arm, throat, or jaw; or pain that is unusual. However, women may describe their pain differently than men. Nevertheless, the most common symptom in women is still chest pain. Many of the symptoms that women experience are easily attributable to something else, other than the heart, and are therefore often ignored. According to the Women's Heart Foundation (2013) almost one third of affected women experience little to no chest pain at all when having a heart attack. In fact, 71% reported flu-like symptoms, including extreme fatigue, for up to a month before the attack. Women are more likely to feel hot or cold burning sensations or a tenderness to touch on their back, shoulder, arms, or jaw—not sharp pain. Other symptoms include nausea, vomiting, indigestion, and shortness of breath, which are easily attributed to other conditions. Scientific evidence now shows that women tend to minimize the significance of the symptoms of cardiac disease. Moreover, the reason for this may be a lack of awareness. Heart disease is the leading cause of death in women older than 55 years. Women tend to be safeguarded from heart disease before menopause because of the naturally occurring estrogen, but not always. For example, in premenopausal women with diabetes, the risk is similar to that of men of the same age because diabetes cancels out the protective effect that estrogen provides to premenopausal women. Some factors directly influence a woman's risk of cardiovascular disease. During a woman's reproductive life cycle, from approximately ages 12 to 50, the naturally occurring estrogen provides a protective effect on women's cardiovascular health. However, estrogen's protective effect can change, depending on a variety of factors and conditions. Oral contraceptives are much safer now than the forms used in the past. In women younger than 35 who do not smoke, contraceptive use generally does not increase the risk of stroke. However, in a small proportion of women, oral contraceptives increase the risk of high blood pressure and blood clots. The risk increases if the woman smokes or already has high blood pressure or other risk factors for heart disease or stroke. During the menopausal transition, which occurs around age 51, a woman's risk for heart disease and stroke increases. During this period, the ovaries slowly decrease the production of the hormone estrogen, which, as previously mentioned, has a protective effect on the heart. A menopausal woman may experience an increase in LDL ("bad") cholesterol and triglyceride levels and a decrease in HDL ("good") cholesterol. She may also develop a tendency toward higher blood pressure. Reduced estrogen levels may also increase body fat above the waist, have harmful effects HDL, high-density lipoprotein; LDL, low-density lipoprotein. on the way blood clots, and affect the way the body metabolizes sugar, a precursor condition to diabetes. Until the 2000s, it was thought that hormone replacement therapy (HRT) could help reduce the risk of cardiac disease in menopausal women. However, studies have shown that taking certain types of hormones (estrogen with progestin) can actually increase the risk of heart attack, stroke, blood clots, and breast cancer for some women. As a result of these studies, HRT is no longer recommended for the prevention of heart disease, although it may be helpful for some women in treating other symptoms of menopause, such as hot flashes. Women should always consult their physician for recommendations regarding HRT. Naturally occurring estrogen also helps to keep cholesterol levels in a healthy range. However, 40% of Canadian women between the ages of 18 and 74 have cholesterol levels that are too high. After menopause, as estrogen levels drop, the incidence of high cholesterol increases. A health care provider should be consulted about how often cholesterol levels should be checked. Exercise and weight control are paramount for reducing the risk of heart disease. Thirty minutes of physical activity, four to six times a week, helps to keep the heart strong and prevent heart disease. Even losing a small amount of extra weight can also help reduce the risk. The Heart Truth is a national public health education campaign to raise awareness that heart disease and stroke is a national priority. The Heart and Stroke Foundation of Canada adopted this U.S.-based initiative in 2008 because of its overwhelming success. The Heart Truth campaign introduced the Red Dress as the national symbol for women and heart disease awareness. Since its introduction, many women have taken ownership of the symbol. Each year, the Red Dress is featured on runways as top Canadian fashion designers create original red dress creations, modelled by some of Canada's most celebrated women. For more information about women and heart disease, consult the following Web sites: • Women with Heart Disease: Living a Good Life. http://www.phac-aspc.gc.ca/cd-mc/cvd-mcv/women-femmes_living-eng.php • Heart and Stroke Foundation of Canada: heartandstroke.ca • Women's Heart Foundation. (2013). Women and Heart Disease Facts. Retrieved from Heart/Disease/heart_disease_facts.php CHAPTER 20 Heart and Neck Vessels Examiner Asks 491 Rationale Additional History for Infants 1. Maternal health. How was the mother's health during pregnancy: any unex- plained fever, rubella during first trimester, other infection, hypertension, drugs taken? 2. Feeding. Have you noted any cyanosis while the baby is nursing or crying? Is the baby able to eat, nurse, or finish bottle without tiring? How many ounces or how long does the baby eat? 3. Activity. Were the baby's motor milestones achieved as expected? Is the baby able to play without tiring? How many naps does the baby take each day? How long does a nap last? Additional History for Children 1. Growth. Has the child grown as expected by growth charts? 2. Activity. Is the child able to keep up with siblings or age mates? Is the child willing or reluctant to go out to play? Is the child able to climb stairs, ride a bike, walk a few blocks? Does the child squat to rest during play or to watch television, or assume a knee-chest position while sleeping? 3. Joint pain and fever. Has the child had any unexplained joint pains or unexplained fever? 4. Headache and nosebleed. Does the child have frequent headaches or nosebleeds? 5. Respiratory disease. Does the child have frequent respiratory infections? How many per year? How were they treated? Have any of these proved to be streptococcal infections? 6. Family history. Does the child have a sibling with heart defect? Is anyone in the child's family known to have chromosomal abnormalities, such as Down's syndrome? Poor weight gain. Fatigue: Record specific limitations. Cyanosis Additional History for Pregnant Women 1. Hypertension. Have you had any high blood pressure during this or earlier pregnancies? • What was your usual blood pressure level before pregnancy? How has your blood pressure been monitored during the pregnancy? • If you have had high blood pressure, what treatment have you had? • Any associated symptoms: weight gain; protein in urine; swelling in feet, legs, or face? 2. Hypotension. Have you had any faintness or dizziness with this pregnancy? Additional History for Older Adults 1. Cardiac. Do you have any known heart or lung disease: hypertension, CAD, chronic emphysema, or bronchitis? • What efforts to treat this have been started? • Have your usual symptoms changed recently? Does your illness interfere with activities of daily living? 2. Medication. Do you take any medications for your heart, such as water pills, blood pressure pills, or heart pills? Are you aware of side effects? Have you recently stopped taking your medication? Why? 3. Environment. Does your home have any stairs? How often do you need to climb them? Does this have any effect on activities of daily living? Noncompliance with a treatment regimen may be related to side effects or lack of finances. Subjective Data 3. Growth. Has the baby grown as expected by growth charts and height of the parents? Poor weight gain is common in an infant, note fatigue during feeding. Infants with heart failure take fewer ounces each feeding; become dyspneic with sucking; may be diaphoretic and then fall into exhausted sleep; and awaken after a short time hungry again. Poor weight gain 492 UNIT 3 Physical Examination OB J E C T I V E DATA Objective Data PREPARATION E Q U I P M E N T N E E D E D To evaluate the carotid arteries, the patient can be sitting up. To assess the jugular veins and the precordium, the patient should be supine with the head and chest slightly elevated. Stand on the patient's right side; this will facilitate your hand placement and auscultation of the precordium. The room must be warm; chilling makes the patient uncomfortable, and shivering interferes with heart sounds. Take scrupulous care to ensure quiet; heart sounds are very soft, and any ambient noise makes this task difficult. A woman's left breast overrides part of the area you need to examine. Gently displace the breast yourself, or ask the woman to hold it out of the way. Perform a regional cardiovascular assessment in this order: 1. Pulse and blood pressure (see Chapter 10) 2. Extremities (see Chapter 21) 3. Neck vessels 4. Precordium The logic of this order is that you will begin observations first peripherally and move in toward the heart. For choreography of these steps in the complete physical examination, see Chapter 28. Normal Range of Findings Marking pen Small centimetre ruler Stethoscope with diaphragm and bell end pieces Alcohol wipe (to clean end pieces) Abnormal Findings THE NECK VESSELS Auscultate the Carotid Artery For middle-aged or older patients or patients who show symptoms or signs of CVD, auscultate each carotid artery for the presence of a bruit (pronounced brü-ee; Figure 20-16). This is a blowing, swishing sound indicating blood flow turbulence; normal none is present. Keep the neck in a neutral position. Lightly apply the bell of the stethoscope over the carotid artery at three levels: (1) the angle of the jaw; (2) the midcervical area, and (3) the base of the neck (see Figure 20-16). Avoid compressing the artery because this could create an artificial bruit, and it could compromise circulation if the carotid artery is already narrowed by atherosclerosis. Ask the patient to take a breath, exhale, and hold still briefly without breathing while you listen so that tracheal breath sounds do not mask

or mimic a carotid artery bruit. (Holding the breath on inhalation will also tense the levator scapulae muscles, which makes it harder to hear the carotid arteries.) Sometimes you can hear normal heart sounds transmitted to the neck; do not confuse these with a bruit. 1 2 3 20-16 A bruit indicates turbulence with a local vascular cause, such as atherosclerotic narrowing. A carotid bruit is audible when the lumen is half to two-thirds occluded. Bruit loudness increases as the atherosclerosis worsens until the lumen is two-thirds occluded. After that, bruit loudness decreases. When the lumen is completely occluded, the bruit disappears. Thus absence of a bruit does not ensure absence of a carotid lesion. A murmur sounds much the same but is caused by a cardiac disorder. Some aortic valve murmurs (aortic stenosis) radiate to the neck and must be distinguished from a local bruit. CHAPTER 20 Heart and Neck Vessels Normal Range of Findings 493 Abnormal Findings Palpate the Carotid Artery Located central to the heart, the carotid artery yields important information about cardiac function. Palpate each carotid artery medial to the sternomastoid muscle in the neck (Figure 20-17). Avoid excessive pressure on the carotid sinus area higher in the neck; excessive vagal stimulation here could slow down the heart rate, especially in older adults. Take care to palpate gently. To avoid compromising arterial blood flow to the brain, palpate only one carotid artery at a time. Carotid sinus hypersensitivity is the condition in which pressure over the carotid sinus leads to a decrease in heart rate, a decrease in blood pressure, and cerebral ischemia with syncope. This may occur in older adults with hypertension or occlusion of the carotid artery Objective Data 20-17 Feel the contour and amplitude of the pulse. Normally the contour is smooth with a rapid upstroke and slower downstroke, and the normal strength is 2+ or moderate (see Chapter 21). The findings should be the same bilaterally. Diminished pulse feels small and weak (decreased stroke volume). Increased pulse feels full and strong (hyperkinetic states; see Table 21-2, p. 541). Estimate the Jugular Venous Pressure Think of the jugular veins as a central venous pressure (CVP) manometer attached directly to the right atrium. You can "read" the CVP at the highest level of pulsations (Figure 20-18). Use the angle of Louis (sternal angle) as an arbitrary reference point, and compare it with the highest level of venous pulsation. Hold a vertical ruler on the sternal angle. Align a straight edge on the ruler like a T-square, and adjust the level of the horizontal straight edge to the level of pulsation. Read the level of intersection on the vertical ruler; normal jugular venous pulsation is 2 cm or less above the sternal angle. Also state the patient's position; for example, "internal jugular vein pulsations 3 cm above sternal angle when elevated 30 degrees." 20-18 Elevated pressure is a level of pulsation that is more than 3 cm above the sternal angle while at 45 degrees. This occurs with heart failure. 494 UNIT 3 Physical Examination Normal Range of Findings If heart failure is suspected, the jugular veins will stay elevated as long as you push. Objective Data If you cannot find the internal jugular veins, use the external jugular veins and note the point where they look collapsed. Be aware that the technique of estimating venous pressure is difficult and is not always a reliable predictor of CVP. Consistency in grading among examiners is difficult to achieve. If venous pressure is elevated, or if you suspect heart failure, perform hepatojugular reflux (Figure 20-19). Position the patient comfortably supine and instruct him or her to breathe quietly through an open mouth. Hold your right hand on the right upper quadrant of the patient's abdomen just below the rib cage. Watch the level of jugular pulsation as you push in with your hand. Exert firm sustained pressure for 30 seconds. This empties venous blood out of the liver sinusoids and adds its volume to the venous system. If the heart is able to pump this additional volume (i.e., if CVP is not elevated), the jugular veins will rise for a few seconds and then recede back to the previous level. Hepatojugular Reflux Test Positive Hepatojugular reflux; the jugular veins will stay elevated for as long as you push. 20-19 Hepatojugular reflux. THE PRECORDIUM Inspect the Anterior Chest Arrange tangential lighting to accentuate any flicker of movement. Pulsations. You may or may not see the apical impulse, the pulsation created as the left ventricle rotates against the chest wall during systole. When visible, it appears at the level of the fourth or fifth intercostal space, at or inside the midclavicular line. It is easier to see in children and in patients with thin chest walls. Palpate the Apical Impulse (This used to be called the point of maximal impulse. Because some abnormal conditions may cause a maximal impulse to be felt elsewhere on the chest, use the term apical impulse specifically for the apex beat.) Localize the apical impulse precisely by using one finger pad (Figure 20-20, A). Asking the patient to "exhale and then hold it" aids the examiner in locating the pulsation. You may need to roll the patient midway to the left to find it; note that this also displaces the apical impulse farther to the left (see Figure 20-20, B). A heave or lift is a sustained forceful thrusting of the ventricle during systole. It occurs with ventricular hypertrophy as a result of increased workload. A right ventricular heave is seen at the sternal border; a left ventricular heave is seen at the apex (see Table 20-8, p. 512). CHAPTER 20 Heart and Neck Vessels Normal Range of Findings A 495 Abnormal Findings B 20-20 Note the location, size, amplitude, and duration. Location: The apical impulse should occupy only one interspace, the fourth or fifth, and be at or medial to the midclavicular line. Size: Normally 1 × 2 cm • Amplitude: Normally a short, gentle tap • Duration: Short, normally occupies only first half of systole Abnormal Findings Objective Data Percussion Percussion is used to outline the heart's borders, but chest radiography and echocardiography are much more accurate methods of detecting heart enlargement. When the right ventricle enlarges, it does so in the anteroposterior diameter, which is better seen on radiographs. Evidence from numerous comparison studies shows the cardiac border defined by percussion is correlated "only moderately" with the true cardiac border (McGee, 2007). Also, percussion is of limited usefulness with the female breast tissue, in an obese patient, and in a patient with a muscular chest wall. However, there are times when your percussing hands are the only tools you have with you, as in an outpatient setting, an extended-care facility, or a patient's home. When you need to search for cardiac enlargement, place your stationary finger over the patient's fifth intercostal space on the left side of the chest near the anterior axillary line. Slide your stationary hand toward yourself, percussing as you go, and note the change of sound from resonance (over the lung) to dull (over the heart). Normally, the left border of cardiac dullness is at the midclavicular line in the fifth interspace and slopes in toward the sternum as you progress upward, so that by the second interspace the border of dullness coincides with the left sternal border. The right border of dullness normally matches the sternal border. Cardiac enlargement is caused by increased ventricular volume or wall thickness; it occurs with hypertension, CAD, heart failure, and cardiomyopathy. Auscultation Identify the auscultatory areas where you will listen. These include the four traditional valve "areas" (Figure 20-22). The valve areas are not over the actual anatomical locations of the valves but are the sites on the chest wall where sounds produced by the valves are best heard. The sound radiates with the direction of blood flow. The valve areas are as follows: • Second right interspace: aortic valve area • Second left interspace: pulmonic valve area • Left lower sternal border: tricuspid valve area • Fifth interspace at left midclavicular line: mitral valve area 1 2 Aortic area Mitral area Traditional RV Revised AUSCULTATORY AREAS 3 4 RA 5 2 LA Erb's point 4 20-22 Auscultatory areas. PA Pulmonic area 3 Tricuspid area 1 AO LV 5 CHAPTER 20 Heart and Neck Vessels Normal Range of Findings Abnormal Findings Premature beat: An isolated beat is early, or a pattern occurs in which every third or fourth beat sounds early. Irregularly irregular: Sounds have no pattern; beats come rapidly and at random intervals. A pulse deficit signals a weak contraction of the ventricles; it occurs with atrial fibrillation, premature beats, and heart failure. Objective Data Do not limit your auscultation to only four locations. Sounds produced by the valves may be heard all over the precordium. (For this reason, many experts even discourage the naming of the valve areas.) Thus learn to inch your stethoscope in a rough Z pattern, from the base of the heart across and down, then over to the apex. Or start at the apex and work your way up. Include the sites shown in Figure 20-22. Recall the characteristics of a high-quality stethoscope (see Chapter 9). Clean the earpiece and endpiece with an alcohol wipe; you will use both. Although all heart sounds are low frequency, the diaphragm is for relatively higher pitched sounds, and the bell is for relatively lower pitched ones. Before you begin, alert the patient: "I always listen to the heart in a number of places on the chest. Just because I am listening a long time, it does not necessarily mean that something is wrong." After you place the stethoscope, try closing your eyes briefly to tune out any distractions. Concentrate, and listen selectively to one sound at a time. Consider that at least two, and perhaps three or four, sounds may be happening in less than 1 second. You cannot process everything at once. Begin with the diaphragm endpiece and use the following routine: (a) Note the rate and rhythm, (b) identify S1 and S2, (c) assess S1 and S2 separately, (d) listen for extra heart sounds, and (e) listen for murmurs. Note the Rate and Rhythm. The rate ranges normally from 60 to 100 beats per minute. (Review the full discussion of the pulse in Chapter 10 and the normal rates across age groups.) The rhythm should be regular, although sinus arrhythmia occurs normally in young adults and children. With sinus arrhythmia, the rhythm varies with the patient's breathing, increasing at the peak of inspiration and slowing with expiration. Note any other irregular rhythm. If one occurs, check whether it has any pattern or if it is totally irregular. When you notice any irregularity, check for a pulse deficit by auscultating the apical beat while simultaneously palpating the radial pulse. Count a serial measurement (one after the other) of apical beat and radial pulse. Normally, with every beat you hear at the apex, the pulse should perfuse to the periphery and be palpable. The two counts should be identical. When they are different, subtract the radial rate from the apical rate, and record the remainder as the pulse deficit. Identify S1 and S2. This is important because S1 is the start of systole and thus serves as the reference point for the timing of all other cardiac sounds. Usually, you can identify S1 instantly because you hear a pair of sounds close together ("lub-dup"), and S1 is the first of the pair. This guideline works except in the cases of the tachyarrhythmias (rates >100 per minute). In those cases, the diastolic filling time is shortened, and the beats are too close together to distinguish. Other guidelines to distinguish S1 from S2 are as follows: • S1 is louder than S2 at the apex; S2 is louder than S1 at the base. • S1 coincides with the carotid artery pulse. Feel the carotid pulse gently as you auscultate at the apex; the sound you hear as you feel each pulse is S1 (Figure 20-23). • If the patient is on an electrocardiographic monitor, the monitor will show S1 coinciding with the R wave (the upstroke of the QRS complex). Listen to S1 and S2 Separately. Note whether each heart sound is normal, accentuated, diminished, or split. Inch your diaphragm across the chest as you do this. 497 498 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings 20-23 Objective Data First Heart Sound (S1). Caused by closure of the AV valves, S1 signals the beginning of systole. You can hear it over the entire precordium, although it is loudest at the apex (Figure 20-24). Sometimes the two sounds are equally loud at the apex because S1 is lower pitched than S2. You can hear S1 with the diaphragm of the stethoscope when the patient is in any position and equally well during respiration and expiration. A split S1 is normal, but it is rare. A split S1 means you are hearing the mitral and tricuspid components separately. It is audible in the tricuspid valve area (the left lower sternal border). The split is very rapid, with the two components only 0.03 second apart. S1 Causes of accentuated or diminished S1 are listed in Table 20-3 (p. 508). Both heart sounds are diminished with conditions that place more tissue between the heart and your stethoscope (e.g., emphysema [hyperinflated lungs], obesity, pericardial fluid). S2 APEX LUB — dup 20-24 Second Heart Sound (S2). The S2 is associated with closure of the semilunar valves. You can hear it with the diaphragm over the entire precordium, although S2 is loudest at the base (Figure 20-25). S1 S2 BASE lub — DUP 20-25 Splitting of S2. A split S2 is a normal phenomenon that occurs toward the end of inspiration in some people. Recall that closure of the aortic and pulmonic valves is nearly synchronous. Because of the effects of respiration on the heart described earlier, inspiration separates the timing of closure of the two valves, and the aortic valve closes 0.06 seconds before the pulmonic valve. Instead of one "DUP," you hear a split sound: "T-DUP" (Figure 20-26). During expiration, synchrony returns, and the aortic and pulmonic components fuse together. A split S2 is heard only in the pulmonic valve area (the second left interspace). Accentuated or diminished S2 is described in Table 20-4 ("Variations in S2," on p. 508). CHAPTER 20 Heart and Neck Vessels Normal Range of Findings 499 Abnormal Findings SPLITTING OF THE SECOND HEART SOUND EXPIRATION S1 S2 INSPIRATION S1 S2 A2 P2 lub — DUP A2 P2 lub — T-DUP 20-26 Location. Describe the area of maximum intensity of the murmur (where it is best heard) by noting the valve area or intercostal spaces. Radiation. The murmur may be transmitted downstream in the direction of blood flow and may be heard in another place on the precordium, on the neck, on the back, or on the axilla. Posture. Some murmurs disappear or are enhanced by a change in position. Some murmurs are common in healthy children or adolescents and are termed innocent or functional. Innocent murmurs have no valvular or other pathological cause; functional murmurs are caused by increased blood flow in the heart (e.g., in anemia, fever, pregnancy, hyperthyroidism). The contractile force of the heart is greater in children. This increases blood flow velocity. Because of the increased velocity and a smaller chest measurement, a murmur is audible. Although it is important to distinguish innocent murmurs from pathological ones, it is best to suspect all murmurs as pathological until they are proved otherwise. Diagnostic tests such as electrocardiography, phonocardiography, and echocardiography are needed to establish an accurate diagnosis. Murmurs may be caused by congenital defects and acquired valvular defects. Study Tables 20-9 and 20-10, pp. 513 and 515, for a complete description. A systolic murmur may occur with a normal heart or with heart disease; a diastolic murmur always indicates heart disease. The murmur of mitral stenosis is rumbling, whereas that of aortic stenosis is harsh. Identify S1 and S2. The innocent murmur is generally soft (grade II), midsystolic, short, crescendo–decrescendo, and with a vibratory or musical quality ("like fiddle strings"). Also, the innocent murmur is heard at the second or third left intercostal space and disappears with sitting, and the young person has no associated signs of cardiac dysfunction. Objective Data Listen for Murmurs. A murmur is a blowing, swooshing sound that occurs with turbulent blood flow in the heart or great vessels. Except for the innocent murmurs described in the "Posture" section, murmurs are abnormal. If you hear a murmur, describe it by indicating the following characteristics. Timing. It is crucial to define the murmur by its occurrence in systole or diastole. You must be able to identify S1 and S2 accurately to do this. Try to further describe the murmur as being in early, middle, or late systole or diastole; throughout the cardiac event (termed pansystolic, holosystolic/pandiastolic, or holodiastolic); and whether it obscures or muffles the heart sounds. Loudness. Describe the intensity in terms of six "grades." For example, record a grade II murmur as "II/VI." Grade I: barely audible, heard only in a quiet room and then with difficulty Grade II: clearly audible, but faint Grade III: moderately loud, easy to hear Grade IV: loud, associated with a thrill palpable on the chest wall Grade V: very loud, heard with one corner of the stethoscope lifted off the chest wall Grade VI: loudest, still heard with entire stethoscope lifted just off the chest wall Pitch. Describe the pitch as high, medium, or low. The pitch depends on the pressure and the rate of blood flow producing the murmur. Pattern. The intensity may follow a pattern during the cardiac phase, growing louder (crescendo), tapering off (decrescendo), or increasing to a peak and then decreasing (crescendo–decrescendo, or diamond-shaped). Because the whole murmur is just milliseconds long, it takes practice to diagnose any pattern. Quality. Describe the quality as musical, blowing, harsh, or rumbling. 500 UNIT 3 Physical Examination Normal Range of Findings Objective Data Change Position. After auscultating in the supine position, roll the patient toward his or her left side. Listen with the bell at the apex for the presence of any diastolic filling sounds (i.e., the S3 or S4; Figure 20-27). Abnormal Findings S3 and S4, and the murmur of mitral stenosis are sometimes heard only when on the left side. 20-27 Ask the patient to sit up, lean forward slightly, and exhale. Listen with the diaphragm firmly pressed at the base, right, and left sides. Check for the soft, high-pitched, early diastolic murmur of aortic or pulmonic regurgitation (Figure 20-28). Murmur of aortic regurgitation sometimes may be heard only when the patient is leaning forward in the sitting position. 20-28 DEVELOPMENTAL CONSIDERATIONS Infants The transition from fetal to pulmonic circulation occurs in the immediate neonatal period. Fetal shunts normally close within 10 to 15 hours after birth but may take up to 48 hours. Thus you should assess the cardiovascular system during the first 24 hours and again in 2 to 3 days. Failure of shunts to close (e.g., patent ductus arteriosus, atrial septal defect); see Table 20-9, p. 513. CHAPTER 20 Heart and Neck Vessels Normal Range of Findings Note any extracardiac signs that may reflect heart status (particularly in the skin), liver size, and respiratory status. The skin colour should be pink to pinkish brown, depending on the infant's genetic heritage. If cyanosis is present, determine its first appearance: at or shortly after birth versus after the neonatal period. Normally, the liver is not enlarged, and the respirations are not laboured. Also note the expected parameters of weight gain throughout infancy. Palpate the apical impulse to determine the size and position of the heart. Because the infant's heart has a more horizontal placement, expect to palpate the apical impulse at the fourth intercostal space just lateral to the midclavicular line. It may or may not be visible. Abnormal Findings Cyanosis at or just after birth signals oxygen desaturation of congenital heart disease (Table 20-9, p. 514). The most important signs of heart failure in an infant are persistent tachycardia, tachypnea, and liver enlargement. Engorged veins, gallop rhythm, and pulsus alternans are additional signs. Respiratory crackles (rales) is an important sign in adults but not in infants. Failure to thrive occurs with cardiac disease. Objective Data The apex is displaced in certain conditions: • Cardiac enlargement: shifts to the left • Pneumothorax: shifts away from affected side • Diaphragmatic hernia: shifts usually to right because this hernia occurs more often on the left • Dextrocardia: a rare anomaly in which the heart is located on right side of chest Persistent tachycardia is a heart rate of more than 200 per minute in newborns and more than 150 per minute in older infants. Bradycardia is a heart rate of less than 90 per minute in newborns and less than 60 in older infants or children. This causes a serious drop in cardiac output because the small muscle mass of their hearts cannot increase stroke volume significantly. 20-29 Expect the heart rhythm to have sinus arrhythmia, the phasic speeding up or slowing down with the respiratory cycle. Investigate any sinus arrhythmia. irregularity except Objective Data The heart rate is best auscultated because radial pulses are hard to count accurately. Use the small (pediatric size) diaphragm and bell (Figure 20-29). The heart rate may range from 100 to 180 per minute immediately after birth and then stabilize to an average of 120 to 140 per minute. Infants normally have wide fluctuations with activity, from 170 per minute or more during crying or other activity to 70 to 90 per minute during sleep. Variations are greatest at birth and are even more so with premature babies. 501 502 UNIT 3 Physical Examination Normal Range of Findings Objective Data Heart sounds are louder in infants than in adults because of the infant's thinner chest wall. Also, S2 has a higher pitch and is sharper than S1. Splitting of S2 just after the height of inspiration is common, not at birth, but beginning a few hours after birth. Murmurs in the immediate neonatal period do not necessarily indicate congenital heart disease. Murmurs are relatively common in the first 2 to 3 days because of fetal shunt closure. These murmurs are usually grade I or II, are systolic, accompany no other signs of cardiac disease, and disappear in 2 to 3 days. The murmur of patent ductus arteriosus is a continuous machinery-like murmur, which disappears by 2 to 3 days. On the other hand, absence of a murmur in the immediate neonatal period does not ensure that the heart is perfect; congenital defects can be present but not signalled by an early murmur. It is best to listen frequently and note and describe any murmur according to the characteristics listed on p. 499. To help facilitate the assessment of an infant, you should listen to the heart sounds while the infant is quiet. This may mean that you need to alter the traditional sequence of assessment. Abnormal Findings Fixed split S2 indicates atrial septal defect (see Table 20-5, p. 509). Persistent murmur after 2 to 3 days, holosystolic murmurs or those that last into diastole, and those that are loud all warrant further evaluation. Children Note any extracardiac or cardiac signs that may indicate heart disease: poor weight gain, developmental delay, persistent tachycardia, tachypnea, DOE, cyanosis, and clubbing. Note that clubbing of fingers and toes usually does not appear until late in the first year, even with severe cyanotic defects. The apical impulse is sometimes visible in children with thin chest walls. Note any obvious bulge or any heave; these are not normal. Palpate the apical impulse: in the fourth intercostal space to the left of the midclavicular line until age 4 years; at the fourth interspace at the midclavicular line from ages 4 to 6 years; and in the fifth interspace to the right of the midclavicular line at age 7 years (Figure 20-30). The average heart rate slows as the child grows older, although it still varies with rest and activity (see Table 10-2, p. 159). 20-30 A precordial bulge to the left of the sternum with a hyperdynamic precordium signals cardiac enlargement. The bulge occurs because the cartilaginous rib cage is more compliant. A substernal heave occurs with right ventricular enlargement, and an apical heave occurs with left ventricular hypertrophy. The apical impulse moves laterally with cardiac enlargement. Thrill (palpable vibration) is abnormal. CHAPTER 20 Heart and Neck Vessels Normal Range of Findings Normal Range of Findings The heart rhythm remains characterized by sinus arrhythmia. Physiological S3 is common in children (see Table 20-7, p. 511). It occurs in early diastole, just after S2, and is a dull, soft sound that is best heard at the apex. A venous hum—which represents turbulence of blood flow in the jugular venous system—is common in healthy children and has no pathological significance. It is a continuous, low-pitched, soft hum that is heard throughout the cycle, although it is loudest in diastole. Listen with the bell over the supraclavicular fossa at the medial third of the clavicle, especially on the right or over the upper anterior thorax. The venous hum is usually not affected by respiration, may sound louder when the child stands, and is easily obliterated by occluding the jugular veins in the neck with your fingers. Abnormal Findings This latter manoeuvre helps differentiate the venous hum from other cardiac murmurs (e.g., that of patent ductus arteriosus). Distinguish innocent murmurs from pathological ones. This may involve referral to another examiner or the performance of diagnostic tests such as electrocardiography or ultrasonography. Objective Data Heart murmurs that are innocent (or functional) in origin are very common throughout childhood. Results of some studies indicate that they have a 30% occurrence, and others indicate that nearly all children may demonstrate a murmur at some time. Most innocent murmurs have these characteristics: soft, relatively short systolic ejection murmur; medium pitch; vibratory; and best heard at the left lower sternal or midsternal border, with no radiation to the apex, base, or back. For a child whose murmur has been shown to be innocent, it is very important that the parents understand this completely. They need to believe that this murmur is just a "noise" and has no pathological significance. Otherwise, the parents may become overprotective and limit activity for the child, which may cause the child to develop a negative self-concept. 503 Pregnant Women The vital signs usually reveal that the resting pulse rate is increased by 10 to 15 beats per minute and that blood pressure is lower than the normal prepregnancy level. The blood pressure decreases to its lowest point during the second trimester and then slowly rises during the third trimester. The blood pressure varies with position. It is usually lowest in left lateral recumbent position, a bit higher in the supine position, and highest in the sitting position (Cunningham et al., 2005). Inspection of the skin often reveals a mild hyperemia in light-skinned women because the increased cutaneous blood flow is an attempt to eliminate the excess heat generated by the increased metabolism. Palpation of the apical impulse is higher and lateral than when the heart is in the normal position, as the enlarging uterus elevates the diaphragm and displaces the heart up and to the left and rotates it on its long axis. Auscultation of the heart sounds reveals changes caused by the increased blood volume and workload: • Heart sounds Exaggerated splitting of S1 and increased loudness of S1 A loud, easily heard S3 • Heart murmurs A systolic murmur in 90%, which disappears soon after delivery A soft, diastolic murmur transiently in 19% A continuous murmur from breast vasculature in 10% (Cunningham et al., 2005) The last-mentioned murmur is termed a mammary souffle (pronounced soof' fl), which occurs near term or when the mother is lactating; it is caused by increased blood flow through the internal mammary artery. The murmur is heard in the second, third, or fourth intercostal space; it is continuous, although it is accented in systole. You can obliterate it by pressure with the stethoscope or one finger lateral to the murmur. Suspect pregnancy-induced hypertension with a sustained rise of 30 mm Hg systolic or 15 mm Hg diastolic under basal conditions. Murmurs of aortic valve disease cannot be obliterated. 504 UNIT 3 Physical Examination Normal Range of Findings Older Adults The ECG shows no changes except for a slight left axis deviation as a result of the change in the heart's position. Objective Data Older Adults A gradual rise in systolic blood pressure is common in older patients; the diastolic blood pressure stays fairly constant, with a resulting widened pulse pressure. Some older adults experience orthostatic hypotension, a sudden drop in blood pressure when rising to sit or stand. Use caution in palpating and auscultating the carotid artery. Avoid pressure in the carotid sinus area, which could cause a reflex slowing of the heart rate. Also, pressure on the carotid artery could compromise circulation if the artery is already narrowed by atherosclerosis. When measuring jugular venous pressure, view the right internal jugular vein. The aorta stiffens, dilates, and elongates with aging, which may compress the left neck veins and obscure pulsations on the left side (Fleg, 1990). The chest often increases in anteroposterior diameter in older patients. This makes it more difficult to palpate the apical impulse and to hear the splitting of S2. The S4 often occurs in older people with no known cardiac disease. Systolic murmurs are common, occurring in more than 50% of older people (Fleg, 1990). Occasional premature ectopic beats are common and do not necessarily indicate underlying heart disease. When in doubt, obtain an ECG. However, consider that the ECG is a recording of only 1 isolated minute in time and may need to be supplemented by a test of 24-hour ambulatory heart monitoring. The S3 is associated with heart failure and is always abnormal when present after 40 years of age (see Table 20-7, p. 511). SPECIAL CONSIDERATIONS FOR ADVANCED PRACTICE Normal Range of Findings Abnormal Findings Special Considerations for Advanced Practice INSPECT THE JUGULAR VENOUS PULSE From the jugular veins you can assess the CVP and thus judge the heart's efficiency as a pump. Although the external jugular vein is easier to see, the internal jugular vein is more directly attached to the superior vena cava and thus is more reliable for assessment. You cannot see the internal jugular vein itself, but you can see its pulsation. Position the patient supine at a 30- to a 45-degree angle, wherever you can best see the pulsations. In general, the higher the venous pressure is, the higher the position you need. Remove the pillow to avoid flexing the neck; the head should be in the same plane as the trunk. Turn the patient's head slightly away from the examined side, and direct a strong light tangentially onto the neck to highlight pulsations and shadows. Note the external jugular veins overlying the sternomastoid muscle. In some patients, the veins are not visible at all, whereas in others they are full in the supine position. As the patient is raised to a sitting position, these external jugular veins flatten and disappear, usually at 45 degrees. Now look for pulsations of the internal jugular veins in the area of the suprasternal notch or around the origin of the sternomastoid muscle around the clavicle. You must be able to distinguish pulsation of the internal jugular vein from that of the carotid artery. It is easy to confuse them because they lie close together. Use the guidelines shown in Table 20-1. This inspection is considered by many authorities to be an advanced skill for practitioners in the cardiopulmonary environments in particular. It is not considered part of the basic cardiac assessment when no other abnormal cardiac findings are evident. Unilateral distension of external jugular veins has a local cause (kinking or aneurysm). Full distended external jugular veins above 45 degrees signify increased CVP, as with heart failure. CHAPTER 20 Heart and Neck Vessels Normal Range of Findings TABLE 20-1 505 Abnormal Findings Characteristic of Jugular Versus Carotid Pulsations Characteristic Internal Jugular Pulse Carotid Pulse Location Lower, more lateral, under or behind the sternomastoid muscle Higher and medial to this muscle Quality Undulant and diffuse; two visible waves per cycle Brisk and localized; one wave per cycle Respiration Varies with respiration; its level descends during inspiration when intrathoracic pressure is decreased Does not vary Palpability Non Yes Pressure Light pressure at the base of the neck easily obliterates No change Position of patient Level of pulse drops and disappears as the patient is brought to a sitting position Unaffected Normal Range of Findings Objective Data ADVANCED PRACTICE SPLITTING OF S2 When you first hear the split S2, do not be tempted to ask the patient to hold his or her breath so that you can concentrate on the sounds. Breath-holding will only equalize ejection times in the right and left sides of the heart and cause the split to go away. Instead, concentrate on the split as you watch the patient's chest rise up and down with breathing. The split S2 occurs about every fourth heartbeat, fading in with inhalation and fading out with exhalation. A fixed split is unaffected by respiration; the split is always there. A paradoxical split is the opposite of what you would expect; the sounds fuse on inspiration and split on expiration (see Table 20-5, p. 509). Focus on Systole, Then on Diastole, and Listen for Any Extra Heart Sounds Listen with the diaphragm, and then switch to the bell, covering all auscultatory areas (Figure 20-31). Usually, there are silent periods. When you do detect an extra heart sound, listen carefully to note its timing and characteristics. During systole, the midsystolic click (which is associated with mitral valve prolapse) is the most common extra sound (see Table 20-6, p. 510). The third and fourth heart sounds occur in diastole; either may be normal or abnormal (see Table 20-7, pp. 511–512). A pathological S3 (ventricular gallop) occurs with heart failure and volume overload; a pathological S4 (atrial gallop) occurs with CAD (see Table 20-7, p. 510, for a full description). Special Considerations for Advanced Practice 20-31 506 UNIT 3 Physical Examination SUMMARY CHECKLIST ... [illegible] CLINICAL THINKING Sample Charting SUBJECTIVE No chest pain, dyspnoea, orthopnoea, cough, fatigue, or edema. No personal history of hypertension, abnormal blood tests, heart murmur, or rheumatic fever. Last ECG 2 yr PTA, result normal. No stress ECG or other heart tests. Family history: father with obesity, smoking, and hypertension, treated with diuretic medication. No other family history significant for CVD. Personal habits: diet balanced in 4 food groups, 2 to 3 regular coffee/day; no smoking; alcohol, 1 to 2 beers occasionally on weekend; exercise, runs 5 km, 3 to 4 ×/week; no prescription or OTC medications or street drugs. OBJECTIVE Neck: Carotids 2+ and = bilaterally. Internal jugular vein pulsations present when supine, and disappear when elevated to a 45-degree position. Precordium: Inspection. No visible pulsations, no heave or lift. Palpation: Apical impulse in fifth ICS (intercostal space) at left midclavicular line; no thrill. Auscultation: Rate 68 beats per minute, rhythm regular, S1–S2 are normal, not diminished or accentuated, no S3, no S4 or other extra sounds, no murmurs. ASSESSMENT Neck vessels healthy by inspection and auscultation Heart sounds normal Focused Assessment: Clinical Case Study Documentation & Critical Thinking Mr. V. V. is a 53-year-old Euro-Canadian male woodcutter admitted to the critical care unit at Toronto General Hospital (TGH) with chest pain. SUBJECTIVE • 1 year PTA: N. V. admitted to TGH with crushing substernal chest pain, radiating to L shoulder, accompanied by nausea, vomiting, diaphoresis. • Diagnosis, MI (myocardial infarction), hospitalized 7 days, discharged with nitroglycerine prn [as needed] for anginal pain. • Did not return to work. Activity included walking 2 km/day, hunting. Had occasional episodes of chest pain with exercise, relieved by rest. • 1 day PTA: had increasing frequency of chest pain, about every 2 hours, lasting few minutes, saw pain as warning to go to doctor. • Day of admission: severe substernal chest pain ("like someone sitting on my chest") unrelieved by rest. Saw personal doctor; while in office had episode of chest pain same as last year's, accompanied by diaphoresis, no N & V [nausea and vomiting] or shortness of breath, relieved by 1 nitroglycerine. Transferred to TGH by paramedics. No further pain since admission 2 hours ago. • Family hx: mother died of MI at age 57. • Personal habits: smokes 1½ pack cigarettes daily × 34 years, no alcohol, diet; trying to limit fat and fried food, still high in added salt. OBJECTIVE Extremities: Skin pink, no cyanosis. Upper extrem.: capillary refill sluggish, no clubbing. Lower extrem.: no edema, no hair growth 10 cm below knee bilaterally. Pulses: Carotid 2+ Brachial: 2+ Radial: 2+ Femoral: 2+ Popliteal: 0 PT: [posterior tibial]: 0 CHAPTER 20 Heart and Neck Vessels 507 D.P. [dorsalis pedis] 1+ B/P [blood pressure] R arm, 104/66 Neck: External jugular vein flat. Internal jugular pulsations present when supine and absent when elevated to 45 degrees. Precordium: Inspection: Apical impulse visible in fifth ICS, 7 cm left of midsternal line, no heave. Palpation: Apical impulse palpable in fifth and sixth ICSs. No thrill. Auscultation: Apical rate, 92 regular; S1–S2 are normal, not diminished or accentuated; no S3 or S4; grade III/VI systolic murmur present at left lower sternal border. ASSESSMENT Substernal chest pain Systolic murmur Ineffective tissue perfusion R/T interruption in flow Decreased cardiac output R/T reduction in stroke volume ABNORMAL FINDINGS 20-2 Clinical Portrait of Heart Failure Dilated pupils, a sympathetic nervous system response Skin pale, gray, or cyanotic Dyspnea, SOBOE is early symptom from pulmonary congestion Orthopnea, cannot breathe unless sitting up Crackles, wheeze are adventitious breath sounds Cough, frothy pink or white sputum Decreased blood pressure stimulates sympathetic nervous system, which acts on heart to increase rate and increase force of contraction Nausea and vomiting as peristalsis slows and bile and fluids back up into stomach Ascites, fluid in peritoneal cavity Dependent, pitting edema in sacrum, legs Anxiety, gasping from pulmonary congestion Falling O2 saturation Confusion, unconsciousness from decreased O2 to brain Jugular vein distention from venous congestion Infarct, may be cause of decreased cardiac output S3 gallop, tachycardia Enlarged spleen and liver from venous congestion, which causes pressure on breathing Decreased urine output as kidneys compensate for decreased cardiac output by retaining sodium and H2O Weak pulse Cool, moist skin as peripheral vasoconstriction shunts blood to vital organs In illustration: CO, cardiac output; SOBOE, shortness of breath on exertion. Abnormal Findings Decreased cardiac output occurs when the heart fails as a pump and the circulation becomes backed up and congested. Signs and symptoms of heart failure come from two basic mechanisms: (a) the heart's inability to pump enough blood to meet the metabolic demands of the body and (b) the kidney's compensatory mechanisms of abnormal retention of sodium and water to compensate for the decreased cardiac output. This increases blood volume and venous return, which causes further congestion. Onset of heart failure may be (a) acute, as after a myocardial infarction, when direct damage to the heart's contracting ability has occurred, or (2b) chronic, as with hypertension, when the ventricles must pump against chronically increased pressure. 508 UNIT 3 Physical Examination TABLE 20-3 Variations in S1 The intensity of S1 depends on three factors: (a) position of AV valve at the start of systole, (b) structure of the valve leaflets, and (c) how quickly pressure rises in the ventricle. Variation Loud (Accentuated) S1 S1 S2 Factor Examples 1. Position of AV valve at start of systole: wide open and no time for leaflets to drift together: Hyperkinetic states in which blood velocity is increased: exercise, fever, anemia, hyperthyroidism Mitral stenosis with leaflets still mobile 2. Change in valve structure: calcification of valve, increasing intraventricular pressure needed to close the valve against increased atrial pressure. Faint (Diminished) S1 S1 S2 Varying Intensity of S1 S1 S1 S2 S1 S2 1. Position of AV valve: delayed conduction from atria to ventricles. Mitral valve drifts shut before ventricular contraction closes it. 2. Change in valve structure: extreme calcification, which limits mobility. 3. More forceful atrial contraction into noncompliant ventricle; delays or diminishes ventricular contraction. First-degree heart block Mitral insufficiency Severe hypertension: systemic or pulmonary Mitral insufficiency Severe hypertension: systemic or pulmonary T M AV, atrioventricular. TABLE 20-4 Variations in S2 Accentuated S2 S1 S2 Diminished S2 S1 S2 Condition Example 1. Higher closing pressure Systemic hypertension, ringing or booming S2 Exercise and excitement Mitral stenosis, heart failure Aortic or pulmonic stenosis Abnormal Findings Factor: Change in Valve structure Pulmonic hypertension 4. Semilunar valves calcified but still mobile Diminished S2 S1 S2 1. Decrease in valve strength, caused by a fall in systemic blood pressure, shock 2. Semilunar valves thickened and calcified, with decreased mobility Shock Aortic or pulmonic stenosis CHAPTER 20 Heart and Neck Vessels TABLE 20-5 509 Variations in Split S2 Variation Condition Example A fixed split is unaffected by respiration; the split is always there. Atrial septal defect Right ventricular failure Conditions that delay aortic valve closure cause the opposite of a normal split. In inspiration, P2 is normally delayed so with a paradoxical split, the sounds fuse. In expiration you hear the split, in the order of P2A2. Aortic stenosis Left bundle branch block Patent ductus arteriosus When the right ventricle has delayed electrical activation, the split is very wide on inspiration and is still there on expiration. Right bundle branch block (which delays P2) Normal Splitting EXPIRATION S1 S2 INSPIRATION S1 S2 A2 P2 Fixed Split EXPIRATION S1 S2 A2 P2 INSPIRATION S1 S2 A2 P2 A 2 P2 Paradoxical Split EXPIRATION S1 INSPIRATION S2 S1 S2 P2 A2 Wide Split EXPIRATION S1 M INSPIRATION S2 S1 T S2 A2 P2 TABLE 20-6 A2 P2 Systolic Extra Sounds Early systolic Ejection click Aortic prosthetic valve sounds Mid-/late systolic Midsystolic (mitral) click Early Systolic EXPIRATION S1 S2 INSPIRATION S1 S2 Aortic ejection click (apex and base) Ej S1 Ej S2 S1 S2 Ej Continued Abnormal Findings Pulmonic ejection click (base only) 510 UNIT 3 Physical Examination TABLE 20-6 Systolic Extra Sounds—cont'd Ejection Click The ejection click occurs early in systole at the start of ejection because it results from opening of the semilunar valves. Normally, the semilunar valves open silently, but in the presence of stenosis (e.g., aortic stenosis, pulmonic stenosis), their opening makes a sound. It is short and high pitched, with a click quality, and is heard better with the diaphragm of the stethoscope. It is heard at the second right interspace and apex or at the apex. Its intensity does not change with respiration. The pulmonic ejection click is best heard in the second left interspace and often grows softer with inspiration. S1 S2 "Ball-in-cage" AO = aortic opening S1 AO S2 AC = aortic closes SEM AC AO Aortic Prosthetic Valve Sounds* As a sequela of modern technological intervention for heart problems, some people now have iatrogenically induced heart sounds. The opening of an aortic ball-in-cage prosthesis (e.g., Starr-Edwards prosthesis) produces an early systolic sound. This sound is less intense with a tilting disc prosthesis (e.g., Bjork-Shiley prosthesis) and is absent with a tissue prosthesis (e.g., porcine). Mid-/Late Systolic S1 C S2 S1 C S2 S1 C S2 Apex C = click Midsystolic (Mitral) Click Although it is systolic, this is not an ejection click. It is associated with mitral valve prolapse, in which the mitral valve leaflets not only close with contraction but balloon back up into the left atrium. During ballooning, the sudden tensing of the valve leaflets and the chordae tendineae creates the click. The sound occurs in mid- to late systole and is short and high pitched, with a click quality. It is best heard with the diaphragm of the stethoscope at the apex, but it also may be heard at the left lower sternal border. The click usually is followed by a systolic murmur. The click and murmur move with postural change; when the patient assumes a squatting position, the click may sound sooner after S2, and the murmur may sound louder and delayed. The Valsalva manoeuvre also moves the click sooner after S2. *In illustration: SEM, soft ejection murmur. TABLE 20-7 Diastolic Extra Sounds Early diastolic Opening snap Mitral prosthetic valve sound Mid-diastole Third heart sound Summation sound (S3 + S4) Late diastole Fourth heart sound Pacemaker-induced sound Early Diastole EXPIRATION S1 INSPIRATION S2 Opening Snap EXPIRATION OS S1 S2 OS A2 P2 Opening Snap Normally the opening of the AV valves is silent. In the presence of stenosis, increasingly higher atrial pressure is needed to open the valve. The deformed valve opens with a noise: the opening snap. It is sharp and high pitched, with a snapping quality. It sounds after S2 and is best heard with the diaphragm of the stethoscope at the third or fourth left interspace at the sternal border, less well heard at the apex. CHAPTER 20 Heart and Neck Vessels TABLE 20-7 511 Diastolic Extra Sounds—cont'd The opening snap (OS in the illustration) usually is not an isolated sound. As a sign of mitral stenosis, the opening snap usually ushers in the low-pitched diastolic rumbling murmur of that condition. S1 "Ball-in-cage" MO = mitral prosthesis opens MC = S1 S2 MC SEM MO Mitral Prosthetic Valve Sound* An iatrogenic sound, the opening of a ball-in-cage mitral prosthesis produces an early diastolic sound: an opening click just after S2. It is loud, it is heard over the whole precordium, and it is loudest at the apex and left lower sternal border. Mid-Diastole S1 LUB — S2 S3 LUB S2 S3 — dup pa Third Heart Sound The S3 is a ventricular filling sound. It occurs in early diastole during the rapid filling phase. Your hearing quickly accommodates to the S3, so it is best heard when you listen initially. It sounds after S2 but later than an opening snap would be. It is a dull, soft sound, and it is low pitched, like "distant thunder." It is heard best in a quiet room, at the apex, with the bell of the stethoscope held lightly (just enough to form a seal), and with the patient in the left lateral position. The S3 can be confused with a split S2. Use these guidelines to distinguish the S3:* Location: The S3 is heard at the apex or left lower sternal border; the split S2 is heard at the base. • Respiratory variation: The S3 does not vary in timing with respirations; the split S2 does. • Pitch: The S3 is lower pitched; the pitch of the split S2 stays the same. The S3 may be normal (physiological) or abnormal (pathological). The physiological S3 is heard frequently in children and young adults; it occasionally persists after age 40 years, especially in women. The normal S3 usually disappears when the patient sits up. In adults, the S3 is usually abnormal. The pathological S3 is also called a ventricular gallop or an S3 gallop, and it persists when the patient sits up. The S3 indicates decreased compliance of the ventricles, as in heart failure. The S3 may be the earliest sign of heart failure. The S3 may originate from either the left or the right ventricle; a left-sided S3 is heard at the left lower sternal border and varies with respiration, becoming louder with inspiration. The S3 is also found in states of high cardiac output in the absence of heart disease, such as hyperthyroidism, anemia, and pregnancy. When the primary condition is corrected, the gallop disappears. S1 S1 S2 S2 S3 S3 S1 S4 S4 S2 S1 S2 S3 S3 S4 S3 and Continued Abnormal Findings Summation Sound When both the pathological S3 and S4 are present, a quadruple rhythm is heard. Often, in cases of cardiac stress, one response is tachycardia. During rapid rates, the diastolic filling time shortens, and the S3 and S4 move closer together. They sound superimposed in mid-diastole, and you hear one loud, prolonged, summated sound, often louder than either S3 or S4. 512 UNIT 3 Physical Examination TABLE 20-7 Diastolic Extra Sounds—cont'd Late Diastole S4 S1 dA LUB S2 – dup S4 S1 S2 dLUB – dup Fourth Heart Sound The S4 is a ventricular filling sound. It occurs when the atria contract late in diastole. It is heard immediately before S1. This is a very soft sound, of very low pitch. You need a good bell, and you must listen for it. It is heard best at the apex, with the patient in a left lateral position. A physiological S4 may occur in adults older than 40 or 50 years with no evidence of cardiovascular disease, especially after exercise. A pathological S4 is termed an atrial gallop or an S4 gallop. It occurs with decreased compliance of the ventricle (e.g., coronary artery disease, cardiomyopathy) and with systolic overload (afterload), including outflow obstruction to the ventricle (aortic stenosis) and systemic hypertension. A left-sided S4 occurs with these conditions. It is heard best at the apex, in the left lateral position. A right-sided S4 is less common. It is heard at the left lower sternal border and may increase with inspiration. It occurs with pulmonary hypertension and pulmonic stenosis. Pacemaker-Induced Sound [illegible] Pericardial Friction Rub Inflammation of the precordium gives rise to a friction rub. The sound is high pitched and scratchy, like sandpaper being rubbed. It is best heard with the diaphragm of the stethoscope, with the patient sitting up and leaning forward, and with the breath held in expiration. A friction rub can be heard any place on the precordium but is best heard at the apex and left lower sternal border, places where the pericardium comes in close contact with the chest wall. Timing may have three components, one systolic and two diastolic. The friction rub of pericarditis is common during the first week after a myocardial infarction and may last only a few hours. *In illustration: SEM, soft ejection murmur. AV, atrioventricular. Abnormal Findings TABLE 20-8 Abnormal Pulsations on the Precordium Base A thrill in the second and third right interspaces occurs with severe aortic stenosis and systemic hypertension. A thrill in the second and third left interspaces occurs with pulmonic stenosis and pulmonic hypertension. Left Sternal Border A lift (heave) occurs with right ventricular hypertrophy, as found in pulmonic valve disease, pulmonic hypertension, and chronic lung disease. You feel a diffuse lifting impulse during systole at the left lower sternal border. It may be associated with retraction at the apex because the left ventricle is rotated posteriorly by the enlarged right ventricle. CHAPTER 20 Heart and Neck Vessels TABLE 20-8 513 Abnormal Pulsations on the Precordium—cont'd Apex Cardiac enlargement displaces the apical impulse laterally and over a wider area when left ventricular hypertrophy and dilation are present. This is volume overload, which occurs in mitral regurgitation, aortic regurgitation, and left-to-right shunts. The apical impulse is increased in force and duration but is not necessarily displaced to the left when left ventricular hypertrophy occurs alone without dilatation. This is pressure overload, which occurs in aortic stenosis or systemic hypertension. Images © Pat Thomas, 2006. TABLE 20-9 Congenital Heart Defects Condition Description Clinical Data Persistence of the channel joining left pulmonary artery to aorta. This is normal in the fetus and usually closes spontaneously within hours of birth. S: Usually no symptoms in early childhood; growth and development are normal. O: Blood pressure has wide pulse pressure and bounding peripheral pulses from rapid runoff of blood into low-resistance pulmonary bed during diastole. Thrill often palpable at left upper sternal border. The continuous murmur heard in systole and diastole is called a machinery murmur. Abnormal opening in the atrial septum, resulting usually in left-to-right shunting of blood and causing large increase in pulmonary blood flow. S: Defect is remarkably well tolerated. Symptoms in infants are rare; growth and development are normal. Affected children and young adults have mild fatigue and DOE. O: Sternal lift often present. S2 has fixed split, with P2 often louder than A2. Murmur is systolic ejection, medium pitch, best heard at base in second left interspace. Murmur caused not by shunting itself but by increased blood flow through pulmonic valve. Patent Ductus Arteriosus (PDA) Atrial Septal Defect (ASD) Abnormal Findings Continued 514 TABLE 20-9 UNIT 3 Physical Examination Congenital Heart Defects—cont'd Condition Description Clinical Data Abnormal opening in septum between the ventricles, usually subaortic area. The size and exact position vary considerably. S: Small defects are asymptomatic. Infants with large defects have poor growth, slow weight gain; later look pale, thin, and delicate. Affected infants may have feeding problems; DOE; frequent respiratory infections; and when the condition is severe, heart failure. O: Loud, harsh holosystolic murmur, best heard at left lower sternal border, may be accompanied by thrill. Large defects also produce soft diastolic murmur at apex (mitral flow murmur) as a result of increased blood flow through mitral valve. Four components: (a) right ventricular outflow stenosis, (b) VSD, (c) right ventricular hypertrophy, and (d) overriding aorta. Result: Large amount of venous blood is shunted directly into aorta away from pulmonary system, so that blood is never oxygenated. S: Severe cyanosis, not in first months of life but developing as infant grows and RV outflow (i.e., pulmonic) stenosis gets worse. Cyanosis initially with crying and exertion, then at rest. Affected child uses squatting posture after starts walking. DOE common. Growth and development are slowed. O: Thrill is palpable at left lower sternal border. S1 is normal; in S2, A2 is loud and P2 is diminished or absent. Murmur is systolic, loud, crescendo–decrescendo. Severe narrowing of the descending aorta, usually at the junction of the ductus arteriosus and the aortic arch, just distal to the origin of the left subclavian artery. Results in increased workload on left ventricle. Associated with defects of aortic valve in most cases, as well as associated patent ductus arteriosus and associated VSD. S: In infants with associated lesions or symptoms, diagnosis occurs in first few months as symptoms of heart failure develop. For affected children and adolescents without symptoms, growth and development are normal. Diagnosis is usually incidental, as a result of blood pressure findings. Adolescents may complain of vague lower extremity cramping that is worse with exercise. O: Upper extremity hypertension, with readings 20 mm Hg higher than those of lower extremity, is a hallmark of coarctation. Another important sign is absence of or greatly diminished femoral pulses. A systolic murmur is heard best at the left sternal border, radiating to the back. Ventricular Septal Defect (VSD) Tetralogy of Fallot Coarctation of the Aorta DOE, dyspnea on exertion; O, objective data; RV, right ventricular; S, subjective data. Abnormal Findings Images © Pat Thomas, 2006. CHAPTER 20 Heart and Neck Vessels TABLE 20-10 515 Murmurs Caused by Valvular Defects Types of Defect Description Clinical Data Abnormal Findings Murmurs Caused by forward flow through semilunar valves Midsystolic Ejection Murmurs ... Aortic Stenosis Calcification of aortic valve cusps restricts forward flow of blood during systole; LV hypertrophy develops. S: Fatigue, DOE, palpitation, dizziness, fainting, and anginal pain are present. O: Pallor, slow diminished radial pulse, low blood pressure, and auscultatory gap are common. Apical impulse is sustained and displaced to left. Thrill occurs in systole over second and third right interspaces and right side of neck. S1 is normal; ejection click is often present, and paradoxical split S2 is often present, and S4 is present with hypertrophy of LV. Murmur is loud, harsh, midsystolic, crescendo–decrescendo, and loudest at second right interspace; it radiates widely to side of neck, down left sternal border, or to apex. Calcification of pulmonic valve restricts forward flow of blood. O: Thrill occurs in systole at second and third left interspaces; ejection click is often present after S1; S2 is diminished and usually with wide split, and S4 is common with hypertrophy of RV. Murmur is systolic, medium pitch, coarse, crescendo–decrescendo (diamond shape), and best heard at second left interspace, and it radiates to left and neck. Pulmonic Stenosis Pansystolic Regurgitant Murmurs Caused by backward flow from area of higher pressure to one of lower pressure SYSTOLE S2 S1 S2 S1 S2 Continued Abnormal Findings 516 UNIT 3 Physical Examination TABLE 20-10 Murmurs Caused by Valvular Defects—cont'd Type of Defect Description Clinical Data Stream of blood regurgitates back into LA during systole through incompetent mitral valve. In diastole, blood passes back into LV again along with new flow; results in dilatation and hypertrophy of LV. S: Fatigue, palpitation, orthopnea, and PND are common. O: Thrill occurs in systole at apex. Apical impulse is displaced down and to left. S1 is diminished; S3 is accentuated. S3 at apex is often present. Murmur is pansystolic, often loud, blowing, and best heard at apex, and it radiates well to left axilla. Backflow of blood through incompetent tricuspid valve into RA. O: Neck veins are engorged and pulsating; liver is enlarged. Lift occurs at sternum if RV is hypertrophied; a thrill is often present at left lower sternal border. Murmur is soft, blowing, pansystolic, and best heard at left lower sternal border, and it increases with inspiration. Mitral Regurgitation Tricuspid Regurgitation Diastolic Rumbles of AV Valves Filling murmurs at low pressures, best heard with bell of the stethoscope Mitral Stenosis Abnormal Findings Calcified mitral valve does not open properly, impedes forward flow of blood into LV during diastole. Results in enlargement of LA; LA pressure is increased. S: Fatigue, palpitations, DOE, orthopnea are common; PND or pulmonary edema occasionally occur. O: Thrill in diastole is palpable at apex. S1 is accentuated; opening snap after S2 is heard over wide area of precordium, followed by murmur. Murmur is a low-pitched diastolic rumble, best heard at apex with patient in left lateral position. It does not radiate. CHAPTER 20 Heart and Neck Vessels TABLE 20-10 517 Murmurs Caused by Valvular Defects—cont'd Type of Defect Description Clinical Data Calcification of tricuspid valve impedes forward flow into RV during diastole. O: Arterial pulse is diminished; jugular venous pulse is prominent. Murmur is a diastolic rumble; it is best heard at the left lower sternal border and is louder in inspiration. Tricuspid Stenosis Early Diastolic Murmurs Due to semilunar valve incompetence SYSTOLE S1 S2 DIASTOLE S1 S2 S1 S2 Abnormal Findings Stream of blood regurgitates back through incompetent aortic valve into LV during diastole; LV dilatation and hypertrophy of LV are caused by increased stroke volume of LV. Large stroke volume is ejected rapidly into poorly filled aorta; then rapid runoff occurs in diastole as part of blood is pushed back into LV. S: Affected patients have only minor symptoms for many years and then rapid deterioration: DOE, PND, angina, dizziness. O: Bounding "water-hammer" pulse is present in carotid, brachial, and femoral arteries. Blood pressure has wide pulse pressure. Pulsations are palpable in cervical and suprasternal areas; apical impulse is displaced to left and down and feels brief. Murmur starts almost simultaneously with S2; it is soft, high-pitched, blowing diastolic, and decrescendo; best heard at third left interspace at base; patient sits up and leans forward; murmur radiates down. Blood flows backward through incompetent pulmonic valve, from pulmonary artery to RV. Murmur has same timing and characteristics as that of aortic regurgitation, and the two are hard to distinguish on physical examination. Aortic Regurgitation Pulmonic Regurgitation Abnormal Findings AV, atrioventricular; DOE, dyspnea on exertion; LA, left atrium; LV, left ventricle; O, objective data; PND, paroxysmal nocturnal dyspnea; RA, right atrium; RV, right ventricle; S, subjective data. Images © Pat Thomas, 2006. 518 UNIT 3 Physical Examination Summary Checklist: Heart and Neck Vessels Examination NECK 1. Carotid pulse: palpate, auscultate 2. Jugular venous pulse: observe 3. Jugular venous pressure: estimate PRECORDIUM 1. Inspection and palpation Describe location of apical impulse. Note any heave (lift) or thrill. 2. Auscultation Identify anatomical areas where you listen. Note rate and rhythm of heartbeat. Identify S1 and S2, and note any variation. Listen in systole and diastole for any extra heart sounds. Listen in systole and diastole for any murmurs. Repeat sequence with bell of stethoscope. Listen at apex with patient in left lateral position. Listen at base with patient sitting up and leaning forward. 3. Health Promotion and Teaching REFERENCES Canadian Diabetes Association. (2011). The prevalence and costs of diabetes. Retrieved from ... Cunningham, F. G., Leveno, K. J., Bloom, S. L., Hauth, J. C., Gilstrap, L. C., & Wenstrom, K. D. (2005). Williams' obstetrics (22nd ed.). New York: McGraw-Hill Professional. Fleg, J. L. (1990). Diagnostic evaluations. In W. R. Hazzard (Ed.), ... Health Canada. (2011). Canadian tobacco use monitoring survey 2010. Ottawa: Author. Heart and Stroke Foundation. (2009). Position statement: Access to ... Jacobs, L., et al. Sauder, D., McGee, S. (2007). Evidence based physical diagnosis (2nd ed.). Philadelphia: W. B. Saunders. Statistics Canada. (2010a). Canadian community survey, 2010. Ottawa: Author. Statistics Canada. (2010b). Canadian health measures survey: Adult obesity prevalence in Canada and the United States. Ottawa: Author. Statistics Canada. (2011). High blood pressure, by age group and sex. Ottawa: Author. Zipes, D., Libby, P., Bonow, R., & Braunwald, E. (2005). Braunwald's heart disease: A textbook of cardiovascular medicine (7th ed.). Philadelphia: W. B. Saunders. CHAPTER 21 Peripheral Vascular System and Lymphatic System Written by Carolyn Jarvis, PhD, APN, CNP Adapted by June MacDonald-Jenkins, RN, BScN, MSc • Animations • Bedside Assessment Summary Checklist • Case Study • Key Points • Printable Lab Guide • Quick Assessment for Common Conditions • Deep Vein Thrombosis OUTLINE Structure and Function 519 Arteries Veins Venous Flow Lymphatic Vessels Special Considerations for Advanced Practice 537 Modified Allen Test The Ankle-Brachial Index Documentation and Critical Thinking 539 Subjective Data 526 Inspect and Palpate the Arms Inspect and Palpate the Legs STRUCTURE AND FUNCTION The vascular system consists of the vessels of the body. Vessels are tubes for transporting fluid, such as blood or lymph. Any disease in the vascular system creates problems with delivery of oxygen and nutrients to the tissues or with elimination of waste products from cellular metabolism. ARTERIES The heart pumps freshly oxygenated blood through the arteries to all body tissues. The pumping heart makes a high-pressure system. The arteries are thick-walled, strong vessels that resist high pressure in order to withstand pressure demands. Arteries contain elastic fibres, which allow their walls to stretch with systole and recoil with diastole. Arteries also contain muscle fibres (vascular smooth muscle), which control the amount of blood delivered to the tissues. The vascular smooth muscle contracts and dilates, which changes the diameter of the arteries to control the rate of blood flow. Each heartbeat creates a pressure wave, which makes the arteries expand and then recoil. It is the recoil that propels blood through like a wave. All arteries have this pressure wave, or pulse, throughout their length, but you can feel it only at 519 Structure & Function 20-1 Physical Examination Brachiocephalic artery Common carotid artery Superficial temporal artery External iliac artery The temporal artery is palpable in front of the ear, as discussed in Chapter 14. PULSE SITE Carotid artery Femoral artery The carotid artery is palpable in the groove between the sternomastoid muscle and the trachea and is discussed in Chapter 20 in the section on great vessels. Arteries in the Arm The major artery supplying the arm is the brachial artery, which runs in the biceps–triceps furrow of the upper arm and surfaces at the antecubital fossa in the elbow medial to the biceps tendon (Figure 21-1). Immediately below the elbow, the brachial artery bifurcates into the ulnar and radial arteries. These run distally and form two arches supplying the hand; these are called the superficial and deep palmar arches. The radial pulse can be palpated just medial to the radius at the wrist; the ulnar artery is located in the same relation to the ulna, but it is deeper and often difficult to palpate. Arteries in the Leg The major artery in the leg is the femoral artery, which passes under the inguinal ligament (Figure 21-2). The femoral artery travels down the thigh. At the lower thigh, it courses posteriorly; from that point, it is termed the popliteal artery. Below the knee, the popliteal artery divides. The anterior tibial artery travels down the front of the leg on to the dorsum of the foot, where it becomes the dorsalis pedis. In back of the leg, the posterior tibial artery travels down behind the medial malleolus and in the foot divides into the plantar arteries. Popliteal artery PULSE SITE Anterior tibial artery Posterior tibial artery Dorsalis pedis artery Dorsal arch PULSE SITE 21-2 Arteries in the leg. © Pat Thomas, 2010. The function of the arteries is to supply oxygen and essential nutrients to the tissues. Ischemia is a deficiency in the supply of oxygenated arterial blood to a tissue, caused by obstruction of a blood vessel. A complete blockage leads to death of the distal tissue. A partial blockage causes the supply to be insufficient, and the ischemia may be apparent only during exercise, when oxygen needs increase. 521 Inferior vena cava Common iliac vein External iliac vein VEINS The course of veins parallels that of arteries, but the body has more veins, and they lie closer to the skin surface. The following veins are accessible to examination. Great saphenous vein Femoral vein Jugular Veins Assessment of the jugular veins is described in Chapter 20. Popliteal vein Veins in the Arm Each arm has two sets of veins: superficial and deep. The superficial veins are in the subcutaneous tissue and are responsible for most of the venous return. Small saphenous vein Anterior tibial vein Veins in the Leg The legs have three types of veins (Figure 21-3): 1. The deep veins run alongside the deep arteries and conduct most of the venous return from the legs. These are the femoral and popliteal veins. As long as these veins remain intact, the superficial veins can be excised without harming the circulation. 2. The superficial veins are the great and small saphenous veins. The great saphenous vein, the longest vein in the body, starts at the medial side of the dorsum of the foot. You can see it ascend in front of the medial malleolus; then it crosses the tibia obliquely and ascends along the medial side of the thigh. The small saphenous vein, in the outer portion of the leg, starts on the lateral side of the dorsum of the foot and ascends behind the lateral malleolus and up the back of the leg, where it joins the popliteal vein. 3. Perforators (not illustrated in Figure 21-3) are connecting veins that join the two sets. They also have one-way valves that route blood from the superficial veins into the deep veins. VENOUS FLOW Veins drain the deoxygenated blood and its waste products from the tissues and return it to the heart. Unlike the arteries, veins are a low-pressure system. Because veins do not have a pump to propel blood, the veins need a mechanism to keep blood moving (Figure 21-4). This movement is accomplished by (a) the contracting skeletal muscles that milk the blood proximally, back toward the heart; (b) the pressure gradient caused by breathing, in which inspiration makes the thoracic pressure decrease and the abdominal pressure increase; and (c) the intraluminal valves, which ensure Great saphenous vein Dorsal venous arch 21-3 Veins in the leg. © Pat Thomas, 2010. unidirectional flow. Each valve is a paired semilunar pocket that opens toward the heart and closes tightly when filled to prevent backflow of blood. In the legs, this mechanism is called the calf pump, or "peripheral heart." During walking, the calf muscles alternately contract (systole) and relax (diastole). In the contraction phase, the gastrocnemius and soleus muscles squeeze the veins and direct the blood flow proximally. Because of the valves, venous blood flows just one way: toward the heart. Besides the pressure of intraluminal valves, venous structure differs from arterial structure. Because venous pressure is lower, walls of the veins are thinner than those of the arteries. Veins have a larger diameter and are more distensible; they can expand and hold more blood when blood volume increases. This is a compensatory mechanism to reduce stress on the heart. Because of this ability to stretch, veins are called capacitance vessels. Efficient venous return is dependent on contracting skeletal muscles, competent valves in the veins, and a patent Structure & Function CHAPTER 21 Peripheral Vascular System and Lymphatic System Structure & Function 522 UNIT 3 Physical Examination 3 Inspiration: Thoracic pressure 1 3 Abdominal pressure Skeletal muscle pressure Intraluminal valves Open Closed MECHANISMS OF VENOUS FLOW 21-4 lumen. Problems with any of these three elements lead to venous stasis. The risk for venous disease is increased by prolonged standing, sitting, or bed rest because of the absence of the milking action that walking accomplishes. Hypercoagulable states and vein wall trauma are other factors that increase risk for venous disease. Also, dilated and tortuous (varicose) veins have incompetent valves, wherein the lumen is so wide the valve cusps cannot approximate. This condition increases venous pressure, which further dilates the vein. Some people have a genetic predisposition to varicose veins, but obesity and pregnancy are risk factors.

LYMPHATIC VESSELS The lymphatic vessels form a completely separate vessel system, which retrieves excess fluid from the tissue spaces © Pat Thomas, 2006. and returns it to the bloodstream (Figure 21-5). During circulation of the blood, somewhat more fluid leaves the capillaries than the veins can absorb. Without lymphatic drainage, fluid would build up in the interstitial spaces and produce edema. The lymphatic vessels converge and drain into two main trunks, which empty into the venous system at the subclavian veins (see Figure 21-5): 1. The right lymphatic duct empties into the right subclavian vein. It drains the right side of the head and neck, right arm, right side of thorax, right lung and pleura, right side of the heart, and right upper section of the liver. 2. The thoracic duct drains the rest of the body. It empties into the left subclavian vein. The functions of the lymphatic system are (a) to conserve fluid and plasma proteins that leak out of the capillaries, (b) 523 Superficial submandibular nodes Right lymphatic duct Thoracic duct Right subclavian vein Epitrochlear node Right lymphatic duct Thoracic duct Left subclavian vein Lateral axillary Superficial central axillary Subscapular (posterior) Pectoral (anterior) Cisterna chyli Lumbar lymph nodes Inguinal lymph nodes Upper Lower LYMPHATIC DUCTS AND DRAINAGE PATTERNS 21-5 to form a major part of the immune system that defends the body against disease, and (c) to absorb lipids from the intestinal tract. The immune system is a complicated network of organs and cells that work together to protect the body. The immune system detects and eliminates foreign pathogens, both those that come in from the environment and those arising from inside (abnormal or mutant cells). It accomplishes this (a) by phagocytosis (digestion) of the substances by neutrophils and by monocytes or macrophages and (b) by production of specific antibodies or specific immune responses by the lymphocytes. The lymphatic vessels have a unique structure. Lymphatic capillaries start as microscopic open-ended tubes, which siphon interstitial fluid. The capillaries converge to form small vessels. The small vessels, like veins, drain into larger ones. The vessels have valves, and so flow is in one direction from the tissue spaces into the bloodstream. The many valves make the vessels look beaded. The flow of lymph is slower © Pat Thomas, 2010. than that of the blood. Lymph flow is propelled by contracting skeletal muscles, by pressure changes secondary to breathing, and by contraction of the vessel walls themselves. Lymph nodes are small oval clumps of lymphatic tissue located at intervals along the vessels. Most nodes are arranged in groups, both deep and superficial, in the body. Nodes filter the fluid before it is returned to the bloodstream and filter out microorganisms that could be harmful to the body. The pathogens are exposed to lymphocytes in the lymph nodes. The lymphocytes mount an antigen-specific response to eliminate the pathogens. When local inflammation occurs, the nodes in that area become swollen and tender. The superficial groups of nodes are accessible to inspection and palpation and give clues to the status of the lymphatic system: • Cervical nodes drain the head and neck. They are described in Chapter 14. • Axillary nodes drain the breast and upper arm. They are described in Chapter 18. Structure & Function CHAPTER 21 Peripheral Vascular System and Lymphatic System UNIT 3 Physical Examination 200 Tonsils Pharyngeal (adenoid) Palatine Lingual 160 140 Lymph nodes Thymus gland Lymphoid type 180 Percentage Structure & Function 524 120 Neural type 100 80 Spleen 60 Lymphoid tissue in the intestines (Peyer's patches) 40 Bone marrow 20 0 General type Genital type 0 4 8 12 16 20 21-7 Comparison of growth rates of three types of tissue in the body. RELATED ORGANS IN IMMUNE SYSTEM 21-6 4 Age in years Lymph nodes © Pat Thomas, 2006. • The epitrochlear node is in the antecubital fossa and drains the hand and lower arm. • The inguinal nodes in the groin drain most of the lymph of the lower extremity, the external genitalia, and the anterior abdominal wall. Related Organs The spleen, tonsils, and thymus gland aid the lymphatic system (Figure 21-6). The spleen is located in the left upper quadrant of the abdomen. It has four functions: (a) to destroy old red blood cells, (b) to produce antibodies, (c) to store red blood cells, and (d) to filter microorganisms from the blood. The tonsils (palatine, pharyngeal, and lingual) are located at the entrance to the respiratory and gastrointestinal tracts and respond to local inflammation. The thymus gland is flat, pink-grey, and located in the superior mediastinum behind the sternum and in front of the aorta. It is relatively large in the fetus and young child and atrophies after puberty. It is important in developing the T lymphocytes of the immune system in children, but it serves no function in adults. The T and B lymphocytes originate in the bone marrow and mature in the lymphoid tissue. DEVELOPMENTAL CONSIDERATIONS Infants and Children The lymphatic system has the same function in children as in adults. Lymphoid tissue has a unique growth pattern in comparison with other body systems (Figure 21-7): It is well developed at birth and grows rapidly until age 10 or 11 years. By age 6 years, the lymphoid tissue reaches adult size; it surpasses adult size by puberty, and then it slowly atrophies. It is possible that the excessive antigen stimulation in children causes the early rapid growth. Lymph nodes are relatively large in children, and the superficial ones are often palpable even in healthy children. With infection, excessive swelling and hyperplasia occur. Enlargement of the tonsils is a familiar sign in respiratory infections. The excessive lymphoid response also may account for the common childhood symptom of abdominal pain with seemingly unrelated problems such as upper respiratory infections. Possibly, the inflammation of mesenteric lymph nodes produces the abdominal pain. Pregnant Women Hormonal changes cause vasodilation and the resulting drop in blood pressure in the first and second trimesters of the pregnancy, as described in Chapter 20. The growing uterus obstructs drainage of the iliac veins and the inferior vena cava. This condition lowers blood flow and increases venous pressure. These developments, in turn, cause dependent edema, varicosities in the legs and vulva, and hemorrhoids. Older Adults Peripheral blood vessels grow more rigid with age, which results in arteriosclerosis (once called hardening of the arteries). This condition produces the rise in systolic blood pressure discussed in Chapter 10. Do not confuse this process with another one, atherosclerosis, which is the deposition of fatty plaques on the intima of the arteries. With aging, the intramuscular calf veins progressively enlarge. Prolonged bed rest, prolonged sitting, and heart failure increase the risk of deep venous thrombosis (DVT) and subsequent pulmonary embolism. These conditions are 525 common in aging and also occur after myocardial infarction. However, care for myocardial infarction now includes early mobilization and low-dose anticoagulant medication, which reduce the risk of pulmonary embolism. As a result of the loss of lymphatic tissue, fewer numbers of lymph nodes are present in older people, and the size of remaining nodes decreases. 1. Leg pain or cramps 2. Skin changes on arms or legs 3. Swelling in the arms or legs 4. Lymph node enlargement 5. Medications HEALTH HISTORY QUESTIONS Examiner Asks 1. Leg pain or cramps. Any leg pain (cramps)? Where? • Describe the type of pain: Is it burning, aching, cramping, stabbing? Did this come on gradually or suddenly? • Is it aggravated by activity, walking? • How many blocks (stairs) does it take to produce this pain? • Has this amount changed recently? • Is the pain worse with elevation? Worse with cool temperatures? • Does the pain wake you up at night? • Tell me about your exercise pattern: Any recent change in exercise, a new exercise, increasing exercise? • Do you have a foot care routine? • Tell me about your job: Are you on your feet during the day or sitting at a desk? • What relieves this pain: dangling, walking, rubbing? • Is the leg pain associated with any skin changes? • Is it associated with any change in sensation of the legs? • Any history of vascular problems, heart disease, diabetes, obesity, pregnancy, smoking, trauma, prolonged standing, or prolonged bed rest? 2. Skin changes on arms or legs. Any skin changes in arms or legs? What colour: redness, pallor, blueness, brown discolorations? • Any change in temperature: excess warmth or coolness? • Do your leg veins look enlarged or crooked? Are these areas painful? • How have you treated these? Do you use support hose? Rationale Such pain and cramps are signs of peripheral vascular disease; see Table 21-4, p. 543. Claudication distance is the number of blocks walked or stairs climbed that produces pain. Note sudden decrease in claudication distance or pain not relieved by rest. Night leg pain is common in older adults. It may indicate the ischemic rest pain of peripheral vascular disease, severe night muscle cramping (usually the calf), or restless leg syndrome. Determine whether pain is of musculoskeletal origin rather than vascular. Chronic venous insufficiency, musculoskeletal pain of the lower back and feet, preterm birth, and spontaneous abortions are health risks associated with working conditions that required prolonged standing. Acrodiation occurs on red or white foot. • Any associated with arterial disease. Varicose veins are swollen, twisted, and sometimes painful veins that have filled with an abnormal collection of blood. Subjective Data SUB J E C T I V E DATA Structure & Function CHAPTER 21 Peripheral Vascular System and Lymphatic System 526 UNIT 3 Physical Examination Examiner Asks Rationale • Any sores or ulcers? Where on the leg? Any pain with the leg ulcer? did this swelling start? • What time of day is the swelling at its worst: morning, or after you have been up most of day? • Does the swelling come and go, or is it constant? • What seems to trigger it: trauma, standing all day, sitting? • What relieves swelling: elevation, support hose? • Is swelling associated with pain, heat, redness, ulceration, hardened skin? 4. Lymph node enlargement. Any "swollen glands" (lumps, kernels)? Where in body? How long have you had them? • Any recent change? • How do they feel to you: hard, soft? • Are the swollen glands associated with pain, or local infection? 5. Medications. What medications are you taking (e.g., oral contraceptives, hormone replacement, aspirin)? Objective Data Subjective Data 3. Swelling in the arms or legs. Do you have swelling in one or both legs? When? Legs ulcers occur with chronic arterial and chronic venous disease (see Table 21-1, p. 534). Edema is bilateral when caused by a systemic problem such as heart failure or unilateral when it is the result of a local obstruction or inflammation. Lymph nodes enlarge with infection, malignancies, and immunological diseases. OB J E C T I V E DATA PREPARATION During a complete physical examination, examine the arms at the very beginning when you are checking the vital signs and the patient is sitting. Examine the legs directly after the abdominal examination while the patient is still supine. Then have the patient stand up to evaluate the leg veins. Examination of the arms and legs includes peripheral vascular characteristics (described in this chapter), the skin (see Chapter 13), musculoskeletal findings (see Chapter 24), and neurological findings (see Chapter 25). A method of integrating these steps is discussed in Chapter 28. Room temperature should be approximately 22°C (72°F) and draft free to prevent vasodilatation or vasoconstriction. Use inspection and palpation. Compare your findings in one extremity with those in the opposite extremity. Normal Range of Findings E Q U I P M E N T N E E D E D Occasionally needed: Paper tape measure Tourniquet or blood pressure cuff Stethoscope Doppler ultrasonic stethoscope Abnormal Findings INSPECT AND PALPATE THE ARMS Lift both of the patient's hands in your hands. Inspect, then turn the patient's hands over, noting colour of skin and nail beds; temperature, texture, and turgor of skin; and the presence of any lesions, edema, or clubbing. Use the profile sign (viewing the finger from the side) to detect early clubbing. The normal nail bed angle is 160 degrees. (See Chapter 13 for a full discussion of skin colour, lesions, and clubbing.) With the patient's hands near the level of his or her heart, check capillary refill. This is an index of peripheral perfusion and cardiac output. Depress and blanch the nail beds; release and note how long it takes for colour to return. Usually, the vessels refill within a fraction of a second. Consider it normal if the colour returns in less than 1 or 2 seconds. Note conditions that can skew your findings: a cool room, decreased body temperature, cigarette smoking, peripheral edema, and anemia. Flattening of nail bed angle and clubbing (diffuse enlargement of terminal phalanges) occur with congenital cyanotic heart disease and cor pulmonale. Refill of more than 1 or 2 seconds signifies vasoconstriction or decreased cardiac output (hypovolemia, heart failure, shock). The hands are cold, clammy, and pale. CHAPTER 21 Peripheral Vascular System and Lymphatic System Normal Range of Findings The two arms should be symmetrical in size. Note the presence of any scars on hands and arms. Many occur normally with usual childhood abrasions or with occupations involving hand tools. Palpate radial pulses bilaterally, noting rate, rhythm, elasticity of vessel wall, and equal force (Figure 21-8). Grade the force (amplitude) on a four-point scale: 3+: increased, full, bounding 2+: normal 1+: weak 0: absent 527 Abnormal Findings Edema of upper extremities occurs when lymphatic drainage is obstructed, which may occur after breast surgery (see Table 21-3, p. 542). Needle tracks in antecubital fossae occur with intravenous drug use; linear scars in wrists may signify past selfinflicted injury. The pulse is full and bounding (3+) in hyperkinetic states (exercise, anxiety, fever), anemia, and hyperthyroidism. The pulse is weak and "thready" in shock and peripheral arterial disease. See Table 21-2 on p. 541 for illustrations of these and irregular pulse rhythms. Objective Data 21-8 It usually is not necessary to palpate the ulnar pulses. If doing so is indicated, palpate along the medial side of the inner forearm (Figure 21-9), although the ulnar pulses are not palpable in normal people. Palpate the brachial pulses; their force should be equal bilaterally (Figure 21-10). 21-9 528 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data 21-10 Check the epitrochlear lymph node in the depression above and behind the medial condyle of the humerus. Do this by "shaking hands" with the patient and reaching your other hand under the patient's elbow to the groove between the biceps and triceps muscles, above the medial epicondyle (Figure 21-11). This node is normally not palpable. The epitrochlear node becomes enlarged in infection of the hand or forearm. Epitrochlear nodes are palpable in conditions of generalized lymphadenopathy: lymphoma, chronic lymphocytic leukemia, sarcoidosis, infections, mononucleosis. 21-11 INSPECT AND PALPATE THE LEGS Uncover the patient's legs while keeping the genitalia draped. Inspect both legs together, noting skin colour, hair distribution, venous pattern, size (swelling or atrophy), and any skin lesions or ulcers. Normally, hair covers the legs. Even if leg hair is shaved, you will still note hair on the dorsa of the toes. The venous pattern normally is flat and barely visible. Note obvious varicosities, although these are best assessed while the patient is standing. Abnormalities include pallor with vasoconstriction, erythema with vasodilation, and cyanosis. In malnutrition, skin is thin, shiny, and atrophic; nails have thick ridges; hair loss occurs; and ulcers and gangrene may be present. Malnutrition, pallor, and coolness occur with arterial insufficiency. CHAPTER 21 Peripheral Vascular System and Lymphatic System Normal Range of Findings Both legs should be symmetrical in size without any swelling or atrophy. If the lower leg looks asymmetrical or if DVT is suspected, measure the calf circumference with a nonstretchable tape measure (Figure 21-12). Measure at the widest point, taking care to measure the other leg in exactly the same place: the same number of centimetres down from the patella or other landmark. If lymphedema is suspected, measure also at the ankle, distal calf, knee, and thigh. Record your findings in centimetres. 529 Abnormal Findings Diffuse bilateral edema occurs with systemic illnesses. Acute, unilateral, painful swelling and asymmetry of calves of 1 cm or more is abnormal; refer the patient to determine whether DVT is present. Asymmetry of 1 to 3 cm occurs with mild lymphedema; 3 to 5 cm, with moderate lymphedema; and more than 5 cm, with severe lymphedema (see Table 21-3, p. 542). Objective Data 21-12 In the presence of skin discoloration, skin ulcers, or gangrene, note the size and the exact location. Palpate for temperature (using the dorsa of your hand) along the patient's legs down to the feet, comparing symmetrical spots (Figure 21-13). The skin should be warm and of equal warmth bilaterally. Both feet may be cool because of environmental factors such as cool room temperature, apprehension, and cigarette smoking. If temperature is increased higher up the leg, note whether this increase is gradual or abrupt. 21-13 Brown discoloration occurs with chronic venous stasis as a result of hemosiderin deposits from red blood cell degradation. Venous ulcers occur usually at the medial malleolus because of bacterial invasion of poorly drained tissues (see Table 21-1 on p. 534). With arterial deficit, ulcers occur on tips of toes, metatarsal heads, and lateral malleoli. With arterial deficit, one foot or leg may be cool or the temperature may drop suddenly as you move down the leg. 530 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data Flex the patient's knee, then gently compress the gastrocnemius (calf) muscle anteriorly against the tibia; no tenderness should be present. Or you may sharply dorsiflex the foot toward the tibia. Flexing the knee first exerts pressure on the posterior tibial vein. Normally, this does not cause pain. Palpate the inguinal lymph nodes. It is not unusual to find palpable nodes that are small (1 cm or less), movable, and nontender. Palpate the femoral, popliteal, dorsalis pedis, and posterior tibial arteries in both legs. Grade the force on the four-point scale. Locate the femoral arteries just below the inguinal ligament, halfway between the pubis and anterior superior iliac spines (Figure 21-14). To help expose the femoral area, particularly in obese patients, ask the patient to bend his or her knees to the side in a froglike position. Press firmly and then slowly release, noting the pulse tap under your fingertips. Should this pulse be weak or diminished, auscultate the site for a bruit. The popliteal pulse is a more diffuse pulse and can be difficult to localize. With the leg extended but relaxed, anchor your thumbs on the knee, and curl your fingers around into the popliteal fossa (Figure 21-15). Press your fingers forward hard to compress the artery against the bone (the lower edge of the upper edge of the tibia). Often the pulse is just lateral to the medial tendon. If you have difficulty with this maneuver, turn the patient prone and lift up the lower leg (Figure 21-16). Let the leg relax against your arm, and press in deeply with your two thumbs. Often a normal popliteal pulse is impossible to palpate. 21-14 21-15 Calf pain with these maneuvers is a positive Homan's sign, which occurs in approximately 20% of cases of DVT. This test was once considered important but has lost its significance because of its low sensitivity in predicting the actual presence of a clot. A positive Homan's sign is also present in a variety of other conditions such as muscle injury, Achilles tendonitis, and plantar muscle injury. Venous ultrasonography is considered the highly sensitive diagnostic test to determine the presence or absence of a clot. Approximately half of all patients with DVT have no clinically detectable signs or symptoms. Nodes are not normally enlarged, tender, or fixed in area. A bruit occurs with turbulent blood flow, indicating partial occlusion (see Table 21-5, p. 544). Objective Data 21-16 CHAPTER 21 Peripheral Vascular System and Lymphatic System Normal Range of Findings 531 Abnormal Findings 21-16 For the posterior tibial pulse, curve your fingers around the medial malleolus (Figure 21-17). You will feel the tapping right behind it in the groove between the malleolus and the Achilles tendon. If you cannot feel it, try passive dorsiflexion of the foot to make the pulse more accessible. Objective Data 21-17 Posterior tibial pulse. Palpating the dorsalis pedis pulse requires a very light touch. Normally, the pulse is just lateral to and parallel with the extensor tendon of the big toe (Figure 21-18). Do not mistake the pulse in your own fingertips for that of the patient. In adults older than 45 years, occasionally either the dorsalis pedis or the posterior tibial pulse may be hard to find, but not on the same foot. 21-18 Dorsalis pedis pulse. 532 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data Firmly depress the skin over the tibia or the medial malleolus for 5 seconds and then release (Figure 21-19, A). Normally, your finger should leave no indentation, although a pit commonly is seen if the patient has been standing all day or during pregnancy. A bilateral, dependent, pitting edema occurs with heart failure, diabetic neuropathy, and hepatic cirrhosis (see Figure 21-19, B). B 21-19 A Checking for pretibial edema. B, Pitting edema. If pitting edema is present, grade it on the following scale: 1+: Mild pitting, slight indentation, no perceptible swelling of the leg 2+: Moderate pitting, indentation that subsides rapidly 3+: Deep pitting, indentation that remains for a short time, swelling of leg 4+: Very deep pitting, indentation that lasts a long time, gross swelling and distortion of leg This classical method of capturing pit depth and recovery time is commonly used. However, it has not proved to be an objective, reliable, or sensitive measurement for edema. The amount of pressure used is arbitrary, as is the judgement of the depth and rate of pitting. In a recent comparison of eight different methods of edema assessment, Brodovicz and colleagues (2009) found this traditional clinical assessment to be unreliable, with low to average interexaminer agreement. More reliable methods to quantify edema are the water displacement method (which is time consuming and cumbersome in clinical practice) and ankle circumference measurement. Ankle circumference was measured with a nonstretchable tape at a point 7 cm proximal to the midpoint of the medial malleolus. Because peripheral edema is a common clinical sign in a great number of conditions, it is important to detect true changes in the most accurate way available. Be aware of the limitations of traditional assessment methods, and check with your own institution to determine a consistently used scale. Unilateral edema occurs with occlusion of a deep vein. Unilateral or bilateral edema occurs with lymphatic obstruction. With these factors, it is "brawny" or nonpitting and feels hard to the touch. Obtaining daily weights on the same scale is a useful method for standardizing data about water retention in the form of edema in the legs or other parts of the body. (See the first Critical Findings box.) Ask the patient to stand so that you can assess the venous system. Note any visible, dilated, and tortuous veins. Varicosities occur in the saphenous veins (see Table 21-1, p. 534). CRITICAL FINDINGS An increase of weight of >2.5 kg in a single day is cause for immediate concern. A complete head-to-toe evaluation is necessary to determine the cause of such significant fluid accumulation. Daily weights are a much better indicator of fluid status than intake and output measurements in individuals with compromised cardiovascular or peripheral vascular status. Colour Changes If you suspect an arterial deficit, raise the legs approximately 30 cm off the table and ask the patient to wag the feet for approximately 30 seconds to drain off venous blood (Figure 21-20). The skin colour now reflects only the contribution of arterial blood. A light-skinned person's feet normally look a little pale but still should be pink. A dark-skinned person's feet are more difficult to evaluate, but the soles should reveal extreme colour change. Elevational pallor (marked) indicates arterial insufficiency. CHAPTER 21 Peripheral Vascular System and Lymphatic System Normal Range of Findings 533 Abnormal Findings 21-20 Test the lower legs for strength (see Chapter 24). Test the lower legs for sensation (see Chapter 25). A dependent rubor (deep blue-red colour) occurs with severe arterial insufficiency (see Figure 21-21, B). Chronic hypoxia produces a loss of vasomotor tone and causes blood to pool in the veins. Venous filling is delayed with arterial insufficiency (Table 21-1). Motor loss occurs with severe arterial deficit. Sensory loss occurs with arterial deficit, especially diabetes. B 21-21 A, Checking for colour by having the patient sit with legs dangling over the examination table. B, Dependent rubor. Objective Data Now have the patient sit up with the legs over the side of the table (Figure 21-21, A). Compare the colour of both feet. Note the time it takes for colour to return to the feet. Normally, this is 10 seconds or less. Note also the time it takes for the superficial veins around the feet to fill; the normal time is approximately 15 seconds. This test is unreliable if the patient has concomitant venous disease with incompetent valves. 534 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data TABLE 21-1 Abnormal Findings Peripheral Vascular Disease in the Legs Chronic Arterial Insufficiency Chronic Venous Insufficiency Arterial (Ischemic) Ulcer Venous (Stasis) Ulcer Buildup of fatty plaques on intima (atherosclerosis) plus hardening and calcification of arterial wall (arteriosclerosis) S: Deep muscle pain in calf or foot, claudication (pain with walking), pain at rest (indicative of worsening of condition) O: Coolness, pallor, elevational pallor, and dependent rubor; diminished pulses; systolic bruits; trophic skin; signs of malnutrition (thin, shiny skin, thick-ridged nails, absence of hair, atrophy of muscles); xanthoma formation; distal gangrene Ulcers occur at toes, metatarsal heads, heels, and lateral ankle and are characterized by pale ischemic base, well-defined edges, and no bleeding. After acute DVT or chronic incompetent valves in deep veins S: Aching pain in calf or lower leg, worse at end of the day, worse with prolonged standing or sitting O: Firm, brawny edema; coarse, thickened skin; normal pulses; brown pigment discoloration; petechiae; dermatitis Venous stasis causes increased venous pressure, which then causes RBCs to leak out of veins and into the skin. The RBCs break down and leave hemosiderin (iron deposits) behind, which are the brown pigment deposits. A weepy, pruritic stasis dermatitis may be present. Ulcers occur at medial malleolus and are characterized by bleeding and uneven edges. Diabetes hastens changes described with ischemic ulcer, with generalized dysfunction in all arterial areas: peripheral, coronary, cerebral, retinal, and renal. Peripheral involvement is associated with diabetic neuropathy and local infection. Without careful vigilance of pressure points on the feet, an ulcer may go unnoticed. Pain and other sensation are decreased, and surrounding skin is callused. CHAPTER 21 Peripheral Vascular System and Lymphatic System 535 Abnormal Findings TABLE Peripheral Chronic21-1 Arterial InsufficiencyVascular Disease in the Legs—cont'd Chronic Venous Insufficiency Acute Venous Disease Superficial Varicose Veins Deep Venous Thrombophlebitis Incompetent valves allow reflux of blood, which causes veins to become dilated and tortuous. Unremitting hydrostatic pressure causes distal valves to be incompetent and causes worsening of the varicosity. After age 45 years, occurrence is three times more common in women than in men. S: Aching, heaviness in calf, easy fatigability, night leg or foot cramps O: Dilated, tortuous veins A deep vein is occluded by a thrombus, which causes inflammation, blockage of venous return, cyanosis, and edema. Virchow's triad consists of the classical three factors that promote thrombogenesis: stasis, hypercoagulability, and endothelial dysfunction (Osinbowale, Ali, & Chi, 2010). Cause may be prolonged bed rest; history of varicose veins; trauma; infection; cancer; and, in younger women, the use of oral estrogenic contraceptives. Note that upper extremity deep venous thromboplebitis is increasingly common because of the frequent use of invasive lines such as central venous catheters (Lancaster et al., 2010). S: Sudden onset of intense, sharp, deep muscle pain; may increase with sharp dorsiflexion of foot O: Increased warmth; swelling (to compare swelling, observe the usual size); redness; possibly mild dependent cyanosis; tenderness to palpation; Homan's sign, only in a few cases (hurt a poor diagnostic reason) CRITICAL FINDINGS Deep venous thrombophlebitis necessitates emergency referral because of risk of pulmonary embolism. RBCs, red blood cells; S, subjective data; O, objective data. 536 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data Use this device to detect a weak peripheral pulse, to monitor blood pressure in infants or children, or to measure a low blood pressure or in a lower extremity (Figure 21-22). The Doppler ultrasonic stethoscope magnifies pulsatile sounds from the heart and blood vessels. Position the patient supine, with the legs externally rotated so that the medial malleoli are accessible. Place a drop of coupling gel on the end of the handheld transducer. Place the transducer over a pulse site, swivelled at a 45-degree angle. Apply very light pressure; locate the pulse site by the swishing, whooshing sound. 21-22 DEVELOPMENTAL CONSIDERATIONS Infants and Children Transient acrocyanosis and skin mottling at birth are discussed in Chapter 13. Pulse force should be normal and symmetrical. Pulse force also should be the same in the upper and lower extremities. Lymph nodes are often palpable in healthy infants and children. They are small, firm (shotty), mobile, and nontender. Their palpability may be the sequelae of past infection, such as a diaper rash (inguinal nodes) or a respiratory infection (cervical nodes). Vaccinations also can produce local lymphadenopathy. Note characteristics of any palpable nodes and whether they are local or generalized. Pulses are weak with vasoconstriction or diminished cardiac output. Pulses are full and with patent ductus arteriosus as a result of the large left-to-right shunt. Diminished or absence of femoral pulses in the presence of normal upper extremity pulses are suggestive of coarctation of aorta. Enlarged, warm, tender nodes indicate current infection. Look for source of infection. Pregnant Women Expect diffuse bilateral pitting edema in the lower extremities, especially at the end of the day and into the third trimester. Varicose veins in the legs also are common in the third trimester. Older Adults The dorsalis pedis and posterior tibial pulses may become more difficult to find. Trophic changes associated with arterial insufficiency (thin, shiny skin, thickridged nails, loss of hair on lower legs) also occur normally with aging. Remain alert for generalized edema in addition to hypertension, which are suggestive of preeclampsia, a dangerous obstetric condition. CHAPTER 21 Peripheral Vascular System and Lymphatic System 537 SPECIAL CONSIDERAT I O N S F O R A DVA N C E D P R A C T I C E Normal Range of Findings Abnormal Findings MODIFIED ALLEN TEST The modified Allen test is used to evaluate the adequacy of collateral circulation before the radial artery is cannulated (Figure 21-23): (a) Firmly occlude both the ulnar and radial arteries of one hand while the patient makes a fist several times. This causes the hand to blanch. (b) Ask the patient to open the hand without hyperextending it; then release pressure on the ulnar artery while maintaining pressure on the radial artery. If circulation is adequate, the hand's normal colour returns in approximately 2 to 5 seconds. Although this test is simple and useful, it is relatively crude and subject to error; that is, you must occlude both arteries uniformly with 5 kg (11 lb) of pressure for the test result to be accurate. Ulnar artery Persistent pallor or a sluggish return to colour is suggestive of occlusion of the collateral arterial flow. Avoid radial artery cannulation until adequate circulation is shown. This test is not considered part of a basic health assessment. If Not Now, When? This test is not considered part of a basic assessment. This test is specifically a precannulation evaluation of a radial artery. It is commonly performed by respiratory therapists before blood gases are measured, to determine arterial competence. Advanced practitioners and health care practitioners in the critical care environment use this test as a means of determining arterial competence. Radial artery Palmar arches Depress radial and ulnar arteries— person opens and closes fist B Normal— blood returns via ulnar artery C Occluded ulnar artery— no blood return 21-23 Normal Range of Findings Abnormal Findings Manual Compression Test for Varicosities While the patient is still standing, test the length of the varicose vein to determine whether its valves are competent (Figure 21-24). Place one hand on the lower part of the varicose vein, and compress the vein with your other hand approximately 15 to 20 cm higher. Competent valves prevent a wave transmission, so that your distal (lower) fingers feel no change. This test is helpful in environments such as clinician's offices or other remote or rural areas where access to diagnostic testing is limited. It is not used to determine whether superficial or communicating veins are incompetent. Special Considerations for Advanced Practice A 538 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings A wave transmission is palpable when the valves are incompetent. This test is used in advanced practice as a means of monitoring for the progression of peripheral vascular disease. 1 Compress vein 2 Feel for wave No wave felt = Competent valves Wave felt = Incompetent valves 21-24 Manual compression test. © Pat Thomas, 2006. THE ANKLE–BRACHIAL INDEX Use of the Doppler stethoscope is a highly specific, noninvasive, and readily available way to determine the extent of peripheral vascular disease. Apply a regular arm blood pressure cuff above the ankle, and determine the systolic pressure in either the posterior tibial or dorsalis pedis artery. Then divide that figure by the systolic pressure of the brachial artery. Take brachial systolic pressures in both arms, and record the higher measurement. The normal ankle pressure is slightly greater than or equal to the brachial pressure; thus a normal ankle–brachial index is usually 1.0 to 1.2. For example, Special Considerations for Advanced Practice 132 ankle systolic pressure = 1.06 (1 106%), 124 arm systolic pressure which indicates no flow reduction. In people with diabetes mellitus, the ankle–brachial index may be less reliable because of calcification (which makes their arteries noncompressible) and may be falsely high. See the box Promoting Health: Foot Care. An ankle–brachial index of 0.90 (90%) or less indicates the presence of peripheral arterial disease (PAD). • 0.90 to 0.70: mild claudication • 0.70 to 0.40: moderate to severe claudication • 0.40 to 0.30: severe claudication, usually with rest pain except in the presence of diabetic neuropathy • 10 mm Hg) during inspiration and exhalation? ... expiration Aortic valve stenosis plus regurgitation Abnormal Findings Pulsus Bisferiens Two strong systolic peaks, with a dip in between, in each pulse; best assessed at the carotid artery A common finding in cardiac tamponade (pericardial effusion in which high pressure compresses the heart and blocks cardiac output); also in severe bronchospasm of acute asthma 542 TABLE 21-3 UNIT 3 Physical Examination Peripheral Vascular Disease in the Arms ◆ Raynaud's Phenomenon This condition is characterized by episodes of abrupt progressive tricolour change of the fingers in response to cold, vibration, or stress: (a) white (pallor; in top photo) from arteriospasm and resulting deficit in supply; (b) blue (cyanosis; in lower photo) from slight relaxation of the spasm that allows a slow trickle of blood through the capillaries and increased oxygen extraction of hemoglobin; (c) and red (rubor) in heel of hand because of return of blood into the dilated capillary bed or reactive hyperemia. Cold, numbness, or pain may accompany pallor or cyanosis stage; then burning, throbbing pain, and swelling occur with rubor. Lasts minutes to hours; occurs bilaterally. Several medications predispose to the episodes, and smoking can increase the symptoms. Abnormal Findings ◆ Lymphedema Lymphedema is high-protein swelling of the limb, most commonly caused by breast cancer treatment. Surgical removal of lymph nodes with breast surgery or damage to lymph nodes and vessels with radiation therapy for breast cancer can impede drainage of lymph. Protein-rich lymph builds up in the interstitial spaces, which further raises local colloid oncotic pressure and promotes more fluid leakage. Stagnation of lymphatic fluid can lead to infection, delayed wound healing, chronic inflammation, and fibrosis of surrounding tissue. Lymphedema after breast cancer is common (42%; Norman et al., 2009) but usually mild. Early symptoms include self-reported sensations of "tired," thick, heavy arm; tightness of jewellery; swelling; and tingling sensation. Objective data include a unilateral swelling and nonpitting brawny edema, with induration of overlying skin. Early recognition is important because evidence supports effectiveness of interventions, such as complete decongestive physiotherapy and compression bandaging (Poage, Singer, Armer, Poundall, & Shellabarger, 2008). Without treatment, lymphedema is chronic and progressive, which is psychologically demoralizing as a threat to body image and as a constant reminder of the cancer. CHAPTER 21 Peripheral Vascular System and Lymphatic System 543 TABLE 21-4 543 Pain Profiles of Peripheral Vascular Disease Subjective Data Abnormal Findings Intermittent Claudication (Chronic Arterial Symptom Analysis Chronic Symptoms Arterial Disease Causes symptoms and signs of oxygen deficit Location Deep muscle pain, usually in calf, but may be lower leg or dorsum of foot Character Intermittent claudication; feels like "cramp," "numbness and tingling," "feeling of cold" Onset and Chronic pain, steady Intensity and structure duration Aggravating Activity (walking, stairs) claudication distance: factors specific number of blocks, stairs it takes to produce pain Elevation (rest pain—indicates severe involvement) Relieving factors Rest (usually within 2 min; e.g., after standing) Dangling (severe involvement) Associated Cool, pale skin symptoms Risk factors Older age; male gender; inherited predisposition; history of hypertension, smoking, diabetes, hypercholesterolemia, obesity, or vascular disease Venous Disease Causes symptoms and signs of metabolic waste buildup Location Calf, lower leg Character Aching, tiredness, feeling of fullness Onset Chronic Pain Aggravating factors Relieving factors Associated symptoms Risk factors Chronic pain, increases at end of day Prolonged standing, sitting Elevation, lying, walking Edema, varicosities, weeping ulcers at ankle Acute Symptoms Varies: distal to occlusion, may involve entire leg Throbbing Sudden onset (within 1 hr) Rain Pain, pallor, pulselessness, paraesthesia, poikilothermia (coldness), paralysis (indicates severe) History of vascular surgery; arterial invasive procedure; abdominal aneurysm (emboli); trauma, including injured arteries; chronic atrial fibrillation Calf Intense, sharp; tenderness of deep muscle to touch Sudden onset (within 1 hr) Pain may increase with sharp dorsiflexion of foot Rest, warm, swollen leg Job involving prolonged standing or sitting; obesity; pregnancy; prolonged bed rest; history of heart failure, varicosities, or thrombophlebitis; crushing of veins by trauma or surgery Abnormal Findings 544 UNIT 3 Physical Examination TABLE 21-5 Physical Examination Arterial Disease ◆ Occlusions OCCLUSIONS Carotid artery Subclavian artery Popliteal artery Renal artery Aortic artery Junction Common iliac artery Internal iliac artery Junction Common iliac artery Renal artery (stenosis) Occlusion Atherosclerosis produces intermittent claudication, decreased femoral pulses, and impotence in males Abdominal aorta Occlusions in the arteries are caused by atherosclerosis, which is the chronic gradual buildup of (in order) fatty streaks, fibroid plaque, calcification of the vessel wall, and thrombus formation. Occlusions reduce blood flow, which reduces the availability of vital oxygen and nutrients. Risk factors for atherosclerosis include obesity, cigarette smoking, hypertension, diabetes mellitus, elevated serum cholesterol level, sedentary lifestyle, and family history of hyperlipidemia. Femoral bifurcation Femoral artery ANEURYSMS Popliteal artery Thoracic aneurysm Posterior tibial artery Aortic arch aneurysm Internal iliac artery Abdominal aortic aneurysm (AAA) Most common are fusiform in shape extending from below the renal arteries to involve the entire infrarenal aorta and often involve the common iliac arteries. Pressure causes lower abdominal pain and dull lower back pain. Abnormal Findings Aneurysms ▶ An aneurysm is a sac formed by dilation in the artery wall. Atherosclerosis weakens the middle layer (media) of the vessel wall. This stretches the inner and outer layers (intima and adventitia), and the effect of blood pressure creates the balloonlike enlargement. The most common site is the aorta, and the most common cause is atherosclerosis. The incidence increases rapidly in men older than 55 years and in women older than 70 years; the overall occurrence is four to five times more frequent among men. Popliteal artery aneurysm Femoral artery aneurysm Aortic aneurysm Pseudoaneurysm (relatively uncommon) Popliteal aneurysm accounts for 5%–20% of people with AAA CHAPTER 21 Peripheral Vascular System and Lymphatic System 545 For a PDA-downloadable version, go to . 1. Inspect arms for colour, size, any lesions. 2. Palpate pulses: radial, brachial. 3. Check epitrochlear node. 4. Inspect legs for colour, size, any lesions, trophic skin changes. 5. Palpate the skin for temperature of feet and legs. 6. Palpate inguinal nodes. 7. Palpate pulses in lower extremities: femoral, popliteal, posterior tibial, dorsalis pedis. 8. Conduct health teaching, promotion and REFERENCES Brodovicz, K. G., McNaughton, K., Uemura, N., Meininger, G., Girman, C. 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Demystifying lymphedema: Development of the lymphedema putting evidence into practice card. Clinical Journal of Oncology Nursing, 12(6), 951–964. Abnormal Findings Summary Checklist: Peripheral Vascular Examination CHAPTER 22 The Abdomen Written by Carolyn Jarvis, PhD, APN, CNP Adapted by Marian Luctkar-Flude, RN, MScN • Animations • Audio—Abdomen Sounds • Bedside Assessment Summary Checklist • Examination Review Questions • Key Points • Physical Examination Summary Checklist • Quick Assessment for Common Conditions: • Peptic Ulcer Disease • Video—Assessment: • Abdomen and Inguinal Hernia OUTLINE Structure and Function 546 Surface Landmarks Internal Anatomy Subjective Data 546 Percuss General Tympany, Liver Span, and Spleen Dullness Special Procedures for Advanced Practice Deep Areas Special Considerations for Advanced Practice Documentation and Critical Thinking 573 Health History Questions Objective Data 556 Abnormal Findings 575 Inspect the Abdomen Auscultate Bowel Sounds and Vascular Sounds STRUCT U R E A N D F U N C T I O N SURFACE LANDMARKS INTERNAL ANATOMY The abdomen is a large oval cavity extending from the diaphragm down to the top of the pelvis. It is bordered in back by the vertebral column and paravertebral muscles and at the sides and front by the lower rib cage and abdominal muscles (Figure 22-1). Four layers of large, flat muscles form the ventral abdominal wall. These are joined at the midline by a tendinous seam, the linea alba. One muscle, the rectus abdominis, forms a strip extending the length of the midline, and its edge is often palpable. The muscles protect and hold the organs in place, and they flex the vertebral column. Inside the abdominal cavity, all the internal organs are called the viscera. It is important that you know the location of these organs so well that you could draw a map of them on the skin (Figure 22-2). You must be able to visualize each organ that you listen to or palpate through the abdominal wall. The solid viscera are those that maintain a characteristic shape (liver, pancreas, spleen, adrenal glands, kidneys, ovaries, and uterus). The liver fills most of the right upper quadrant (RUQ) and extends over to the left midclavicular line. The lower edge of the liver and the right kidney may normally be 546 547 Xyphoid process Costal margin External oblique Internal oblique External oblique Linea alba Transversus Anterior superior iliac spine Inguinal ligament Symphysis pubis 22-1 palpable. The ovaries normally are palpable only on bimanual assessment during the pelvic examination. The shape of the hollow viscera (stomach, gallbladder, small intestine, colon, and bladder) depends on the contents. They are usually not palpable, although you may feel a colon distended with feces or a bladder distended with urine. The stomach is just below the diaphragm, between the liver and spleen. The gallbladder rests under the posterior surface of the liver, just lateral to the right midclavicular line. Note that the small intestine is located in all four quadrants. It extends from the stomach's pyloric valve to the ileocecal valve in the right lower quadrant (RLQ), where it joins the colon. The spleen is a soft mass of lymphatic tissue on the posterolateral wall of the abdominal cavity, immediately under the diaphragm (Figure 22-3). It lies obliquely with its long axis behind and parallel to the tenth rib, lateral to the midaxillary line. Its width extends from the ninth to the eleventh ribs, approximately 7 cm. It is normally not palpable. If it becomes enlarged, its lower edge moves downward and toward the midline. The aorta is just to the left of midline in the upper part of the abdomen (Figure 22-4). It descends behind the peritoneum, and at 2 cm below the umbilicus, it bifurcates into the right and left common iliac arteries opposite the fourth lumbar vertebra. You can palpate the aortic pulsations easily © Pat Thomas, 2006. in the upper abdomen just to the left of midline. The right and left iliac arteries become the femoral arteries in the groin area. Their pulsations are easily palpated as well, at a point halfway between the anterior superior iliac spine and the symphysis pubis. The pancreas is a soft, lobulated gland located behind the stomach. It stretches obliquely across the posterior abdominal wall to the left upper quadrant (LUQ). The bean-shaped kidneys are retroperitoneal, or posterior to the abdominal contents (Figure 22-5). They are well protected by the posterior ribs and musculature. The twelfth rib forms an angle, the costovertebral angle, with the vertebral column. The left kidney lies at that point, at the eleventh and twelfth ribs. Because of the placement of the liver, the right kidney rests 1 to 2 cm lower than the left kidney and is sometimes palpable. For convenience in description, the abdominal wall is divided into four quadrants by a vertical and a horizontal line bisecting the umbilicus (Figure 22-6). According to an older, more complicated scheme, the abdomen was divided into nine regions. Although the old system is generally not used, some regional names persist, such as epigastric for the area between the costal margins, umbilical for the area around the umbilicus, and hypogastric or suprapubic for the area above the pubic bone.) Structure & Function CHAPTER 22 The Abdomen Structure & Function 548 UNIT 3 Physical Examination Spleen Liver Stomach Gallbladder Small intestine Descending colon Ascending colon Cecum Appendix Sigmoid colon Bladder Pubic symphysis 22-2 Stomach Liver Gallbladder Duodenum Pancreas Small intestine Right ureter Left kidney Right kidney Duodenum Pancreas Small intestine Left ureter Aorta Common iliac artery Common iliac vein Inferior vena cava 549 Aorta Left kidney Right kidney Kidney Costovertebral angle 22-5 © Pat Thomas, 2006. Structure & Function CHAPTER 22 The Abdomen Structure & Function 550 UNIT 3 Physical Examination Epigastric Umbilical Hypogastric or Suprapubic RUQ LUQ RLQ LLQ Four quadrants 22-6 The anatomical location of each organ by quadrants is listed as follows: RIGHT UPPER QUADRANT (RUQ) Liver Gallbladder Duodenum Head of pancreas Right kidney and adrenal gland Hepatic flexure of colon Parts of ascending and transverse colon RIGHT LOWER QUADRANT (RLQ) Cecum Appendix Right ovary and fallopian tube Right ureter Right spermatic cord LEFT UPPER QUADRANT (LUQ) Stomach Spleen Left lobe of liver Body of pancreas Left kidney and adrenal gland Splenic flexure of colon Parts of transverse and descending colon LEFT LOWER QUADRANT (LLQ) Part of descending colon Sigmoid colon Left ovary and fallopian tube Left ureter Left spermatic cord MIDLINE Aorta Uterus (if enlarged) Bladder (if distended) DEVELOPMENTAL CONSIDERATIONS Infants and Children In newborns, the umbilical cord shows prominently on the abdomen. It contains two arteries and one vein. The liver takes up proportionately more space in the abdomen at birth than in later life. In healthy full-term newborns, the lower edge may be palpated 0.5 to 2.5 cm below the right costal margin. Age-related values of expected liver size are listed in the Objective Data section. The urinary bladder is located higher in the abdomen in newborns than in adults. It lies between the symphysis and the umbilicus. Also, during early childhood, the abdominal wall is less muscular, and so the organs may be easier to palpate. Children younger than 10 years are at highest risk for acute gastrointestinal illness involving vomiting or diarrhea (Majowicz, Horrocks, & Bocking, 2007). Children with gastroenteritis, particularly those younger than 1 year, are at increased risk for dehydration because of their relatively small body weights and high turnover of water and electrolytes. Signs of clinical dehydration that indicate increased risk of progression to shock include altered responsiveness (irritability, lethargy), sunken eyes, tachycardia, tachypnea, and reduced skin turgor (Khanna, Lakhanpaul, Burman-Roy, & Murphy, 2009). Pregnant Women Nausea and vomiting, or "morning sickness," is an early sign of pregnancy in many pregnant women, starting between the first and second missed periods. The cause is unknown but may be related to hormone changes, such as the production of human chorionic gonadotropin. Another symptom is "acid indigestion," or heartburn, caused by esophageal reflux. Elevated levels of progesterone relax all smooth muscle, which leads to a decrease in gastrointestinal motility and prolongation of gastric emptying time. As a result of decreased motility, more water is reabsorbed from the colon, which leads to constipation. The constipation, as well as increased venous pressure in the lower pelvis, may lead to the formation of hemorrhoids. The enlarging uterus displaces the intestines upward and posteriorly. The gradual upward displacement of the appendix during pregnancy was confirmed by two studies through the use of magnetic resonance imaging (Oto et al., 2006; Pates, Avendano, Zaretsky, McIntire, & Twickler, 2009); however, appendicitis-related pain during pregnancy may still be felt in the RLQ (Mourad, Elliott, Erickson, & Lisboa, 2000). Bowel sounds are diminished. Skin changes on the abdomen, such as striae and linea nigra, are discussed later in this chapter and in Chapter 13. Older Adults Aging alters the appearance of the abdominal wall. During and after middle age, some fat accumulates in the suprapubic area in women as a result of decreased estrogen levels. Men also show some fat deposits in the abdominal area, which results in the "big belly." This development is accentuated in adults with a sedentary lifestyle. With further aging, adipose tissue is redistributed away from the face and extremities and to the abdomen and hips, and the abdominal musculature relaxes. Changes of aging occur in the gastrointestinal system but do not significantly affect function as long as no disease is present. • Salivation decreases, causing dryness of the mouth and a decrease in the sense of taste. Further changes are discussed in Chapter 17. • Esophageal emptying is delayed. Feeding an older adult in the supine position increases risk of aspiration. • Gastric acid secretion decreases with aging. As a result, the absorption of orally administered drugs may be impaired or delayed. This may cause pernicious anemia (as a result of impaired vitamin B12 absorption), iron deficiency anemia, and malabsorption of calcium. • Older adults are more susceptible to dehydration because the ability to conserve water is reduced, as are the ability 551 to respond to changes in temperature and the acuteness of thirst. • Liver size decreases with age, particularly after 80 years, although most liver function remains normal. Drug metabolism may be impaired in older adults as a result of decreased blood flow to the liver and decreased oxidative processes (Howland, 2009). In addition, renal function decreases with age, which contributes to the increased risk for adverse or toxic effects, inasmuch as most drugs are eventually cleared through the kidneys after metabolism in the liver. Older adults who drink alcohol and take medications are at even greater risk for adverse medication reactions, including exacerbation of therapeutic and adverse effects and interference with effectiveness of medications (Moore, Whiteman, & Ward, 2007). • The incidence of gallstones increases with age, occurring in up to 20% of Canadian women and 10% of Canadian men by age 60 (Canadian Liver Foundation, 2011). • Age-related changes alone do not account for the frequent reports of constipation by older adults. Common risk factors in older adults include functional impairments such as decreased mobility, pathological conditions such as hypothyroidism, adverse medication effects, and poor dietary habits, including inadequate intake of fluids and fibre (Miller, 2012). Additional lifestyle factors that contribute to constipation include prolonged use and overuse of laxatives; ignoring the defecation urge; sedentary lifestyle; and polypharmacy (Registered Nurses Association of Ontario, 2005). Medications associated with constipation PROMOTING HEALTH: HEPATITIS RISK How's Your Liver Doing? The liver is the largest organ in the body. It has an immense capacity to heal and regenerate, but that capacity is not infinite. Unfortunately, signs of severe liver damage or disease usually do not become apparent until the liver has been significantly harmed. The best protection for the liver is to prevent damage before it occurs! Many self-management measures can be taken to protect the liver: • Practise safe sex. Do not have unprotected sex with a man or woman. • Do not share items that may have body fluids on them. This means needles, razors, nail clippers, cuticle scissors, and toothbrushes. If you are getting a tattoo, make sure that a new bottle of ink is opened and used only for you. Access clean needle exchange programs if you use injected drugs. • Be aware of your environment. Be careful with aerosol cleaners. Make sure rooms are well ventilated. Wear a mask, a hat, or protective clothing when you use insecticides, fungicides, paint, or other toxic chemicals. The liver can be damaged by what you breathe or absorb through your skin. • Monitor your diet and weight. Obesity can cause a condition called nonalcoholic fatty liver disease, which may include cirrhosis. • Travel wisely. Visit a travel medicine clinic before travelling. If you travel to an area with an increased rate of hepatitis A, such as Mexico, Central America, and the Caribbean, get vaccinated; avoid eating uncooked food, including raw vegetables; avoid drinking unboiled or unbottled water (including ice cubes); and brush your teeth with boiled or bottled water. • Use medications wisely. Use prescription and over-the-counter medications only when needed. Be sure to take only the recommended doses. • Do not mix medications without consulting a health care provider. Mixing certain medications can cause the formation of toxic compounds that can cause liver damage. Be certain that all medications, including over-the-counter and herbal preparations, are approved by a health care provider. • Drink alcohol in moderation. More than one drink a day for women or two drinks a day for men over many years may be enough to lead to cirrhosis. A cirrhotic liver shrinks to a fraction of its former size and ability. • Watch out for combinations. Acetaminophen can be toxic to the liver even if a person drinks alcohol in moderation. • Do not use illegal drugs. Cocaine is one of many illegal drugs known to cause liver damage. • Get vaccinated. A vaccine is available for both hepatitis A and hepatitis B. Universal immunization of children and adolescents against hepatitis B is now part of the publicly funded vaccine programs offered in all Canadian provinces and territories. • Be aware of your risk for hepatitis. Six hepatitis viruses have been identified, but three—hepatitis A (HAV), hepatitis B (HBV), and hepatitis C (HCV)—cause approximately 90% of acute hepatitis cases in Canada. The annual incidence of HAV illness has been estimated at 2.9 cases per 100,000 persons in Canada; the annual incidence of HBV illness is higher, at approximately 9 cases per 100,000 persons; and the annual Continued Structure & Function CHAPTER 22 The Abdomen Structure & Function Subjective Data 552 UNIT 3 Physical Examination PROMOTING HEALTH: HEPATITIS RISK—cont'd incidence of HCV illness is highest, at between 10 and 20 cases per 100,000 persons. HAV is spread primarily through food or water contaminated by feces from an infected patient. Risk factors for HAV infection include the following: • Eating food that has been prepared by someone who has HAV infection and poor hygiene • Eating raw or undercooked shellfish (such as oysters or clams) • Eating uncooked food, including unpeeled fruits and vegetables • Travelling to HAV-endemic areas • Having homosexual relations • Sharing a household with an HAV-infected person HBV is spread primarily through contact with infected blood or bodily fluids. Risk factors for HBV infection include the following: • Having unprotected sex, especially with someone with HBV infection or whose sexual history is unknown • Sharing needles or other drug-use equipment, including spoons, water, and cotton, to inject illegal drugs • Handling blood or bodily fluids as a routine part of your job (such jobs include those of nurses and other health care providers, as well as morticians and embalmers) • Getting body piercings or tattoos from a site in which infection control practices are poor • Travelling to HBV-endemic areas • Sharing a household with an HBV-infected patient HCV is spread primarily through contact with infected blood. Risk factors for HCV infection include the following: • Having received a transfusion before 1992 or clotting factors before 1987 • Using illegal intravenous drugs or intranasal cocaine • Handling blood or bodily fluids as a routine part of a job • Receiving dialysis treatment • Getting body piercings or tattoos from a site in which infection control practices are poor • Sharing a household with an HCV-infected patient Sources: Data from Canadian Liver Foundation. (2012). Viral hepatitis A, B, C. Retrieved from Health Canada. (2008). Hepatitis. Retrieved from and from Public Health Agency of Canada. (2006). Canadian immunization guide (Evergreen ed.). Retrieved from . include nonsteroidal anti-inflammatory drugs (NSAIDs), diuretics, calcium channel blockers, opioids, antiparkinsonian agents, antacids, and calcium or iron supplements (Mauk, 2005). • The risk for colorectal cancer increases with age. See Chapter 23 for screening recommendations. CULTURAL AND SOCIAL CONSIDERATIONS Lactase is the digestive enzyme necessary for absorption of the carbohydrate lactose (milk sugar). In some individuals, lactase activity is high at birth but declines to low levels by adulthood. These people are lactose intolerant and have abdominal pain, bloating, and flatulence when they consume milk products. Lactose intolerance affects as much as 70% of the world's population. The prevalence of lactose intolerance is higher among Aboriginal Canadians and Canadians of African, Asian, Middle Eastern, or South American descent, and it is rarer in Canadians of European descent. Rates of celiac disease have nearly doubled since the 1980s in Western countries; it has been diagnosed in more than 330,000 Canadians, including more than 73,000 children (Canadian Digestive Health Foundation, 2012). Celiac disease is an inherited autoimmune condition in which intestinal tissue is damaged in response to eating gluten, which creates a risk for malabsorption of nutrients, which in turn may result in conditions such as iron-deficiency anemia and osteoporosis (American Celiac Disease Alliance, 2013). Between 10% and 20% of the Canadian population experience the troublesome symptoms of heartburn and regurgitation associated with gastroesophageal reflux disease (GERD; Fedorak, van Zanten, & Bridges, 2010). Modifiable risk factors for GERD include obesity, smoking, and a high-cholesterol diet. Older adults and patients with cystic fibrosis are also at higher risk for developing GERD. Canada has the highest incidence of inflammatory bowel disease (IBD) in the world. Peptic ulcer disease occurs with frequent use of NSAIDS, alcohol, smoking, and infection with Helicobacter pylori. Eight to 10 million Canadians have H. pylori infection; approximately 75% of First Nations people are infected (Canadian Digestive Health Foundation, 2012). Canada also has one of the highest incidences of inflammatory bowel disease (IBD) in the world. More than 200,000 Canadians live with IBD: 112,000 with Crohn's disease and 88,500 with ulcerative colitis (Crohn's and Colitis Foundation of Canada, 2008). IBD can be diagnosed at any age, but usual onset is in the 20s for Chrohn's disease and throughout adulthood for ulcerative colitis; incidence for both diseases peaks by age 30 and does not decline until age 80. A diagnosis of IBD is associated with increased risk of colorectal cancer. Infectious diseases such as hepatitis A and gastrointestinal illnesses are often related to socioeconomic factors such as inadequate housing, sewage, and water treatment facilities (see the box Promoting Health: Hepatitis Risk). These conditions are often present in Aboriginal communities (Noël & Larocque, 2009). SUB J E C T I V E DATA 1. Appetite 2. Dysphagia 3. Food intolerance 4. Abdominal pain CHAPTER 22 The Abdomen 5. Nausea/vomiting 6. Bowel habits 7. Past abdominal history 553 8. Medications 9. Nutritional assessment HEALTH HISTORY QUESTIONS Examiner Asks 1. Appetite. Any change in appetite? Is this change a loss of appetite? 2. Dysphagia. Any difficulty swallowing? When did you first notice this? 3. Food intolerance. Are there any foods you cannot eat? • What happens if you do eat them: allergic reaction, heartburn, belching, bloating, indigestion? • Do you use antacids? How often? 4. Abdominal pain. Do you have any abdominal pain? Please point to it. • Is the pain in one spot, or does it move around? • How did it start? How long have you had it? • Is the pain constant, or does it come and go? Does it occur before or after meals? Does it peak? When? • How would you describe the character: cramping (colic type), burning in pit of stomach, dull, stabbing, aching? • Is the pain relieved by food, or is it worse after eating? • Is the pain associated with the menstrual period or menstrual irregularities, stress, dietary indiscretion, fatigue, nausea and vomiting, gas, fever, rectal bleeding, frequent urination, vaginal or penile discharge? • What makes the pain worse: food, position, stress, medication, activity? • What have you tried to relieve the pain: rest, heating pad, change in position, medication? 5. Nausea/vomiting. Any nausea or vomiting? • How often? How much comes up? What is the colour? Does it have an odour? • Is it bloody? • Are the nausea and vomiting associated with colicky pain, diarrhea, fever, chills? Anorexia is a loss of appetite that occurs with gastrointestinal disease, is a side effect of some medications, occurs with pregnancy, or occurs with psychological disorders. Loss of appetite and unexplained weight loss may be a sign of gastrointestinal cancers such as stomach, esophageal, and pancreatic cancer. Dysphagia occurs with disorders of the throat or esophagus, such as the later stages of esophageal cancer. Examples of food intolerance are lactose deficiency (resulting in bloating or excessive gas after ingesting milk products) and wheat allergy or gluten intolerance (resulting in abdominal pain, distension, or diarrhea). Pyrosis (heartburn) is a burning sensation in esophagus and stomach, caused by reflux of gastric acid. Excessive eructation (belching) may occur with food intolerance. Abdominal pain may be visceral from an internal organ (dull, general, poorly localized); parietal, from inflammation of overlying peritoneum (sharp, precisely localized, aggravated by movement); or referred, from a disorder in another site (see Table 22-2 on p. 577). Acute pain that necessitates urgent diagnosis occurs with appendicitis, cholecystitis, bowel obstruction, or perforation of an organ. Pain in the upper abdomen is a symptom that may occur in the later stages of gastrointestinal cancer such as stomach, liver, or pancreatic cancer. Chronic pain of gastric ulcers usually occurs on an empty stomach; pain of duodenal ulcers occurs 2 to 3 hours after a meal and is relieved by more food. Nausea/vomiting is a common side effect of many medications, and with gastrointestinal disorders, and in early pregnancy. Nausea/vomiting may occur in later stages of gastrointestinal neoplasms, such as stomach, liver, or pancreatic cancer. Hematemesis occurs with stomach or duodenal ulcers and esophageal varices. Subjective Data • Any change in weight? How much weight gained or lost? Over what time period? Is the weight loss due to diet? Rationale 554 UNIT 3 Physical Examination Subjective Data Examiner Asks • What did you eat in the past 24 hours? Where: at home, school, a restaurant? Has anyone else in the family had the same symptoms in the past 24 hours? 6. Bowel habits. How often do you have a bowel movement? • What is the colour? Consistency? • Any diarrhea or constipation? How long have you had it? • Do you use laxatives? Which ones? How often do you use them? Rationale Ingestion of contaminated food can cause gastrointestinal illness. A change in bowel habits, from constipation to diarrhea, or vice versa, may be a sign of colorectal cancer. Stools may be black and tarry because of occult blood (melena) from gastrointestinal bleeding, or they may be black but nontarry because of iron medications. Grey stools occur with hepatitis. Red blood in stools occurs with gastrointestinal bleeding or localized bleeding around the anus. A change in bowel habits, stools that are narrower than usual, blood in the stool, diarrhea, and constipation are possible symptoms of colorectal cancer and necessitate further investigations. 7. Past abdominal history. Any history of gastrointestinal problems: ulcer, gallbladder disease, hepatitis/jaundice, appendicitis, colitis, hernia? • Any family history of irritable bowel disease (IBD), colorectal cancer, or familial adenomatous polyposis (FAP)? • Ever had any operations in the abdomen? Please describe. • Any problems after surgery? • Any abdominal X-ray studies? How were the results? 8. Medications. What medications are you currently taking? • Do you take over-the-counter remedies? • Do you take natural or herbal supplements? 9. Alcohol and tobacco. How much alcohol would you say you drink each day? Each week? When was your most recent alcoholic drink? • Do you smoke? How many packs per day? How long have you smoked? 10. Nutritional assessment. Now I would like to ask you about your diet. Please tell me all the food you ate yesterday, starting with breakfast. • Does the diet follow Canada's Food Guide? FAP is caused by a genetic mutation that can be inherited. In individuals with FAP, the risk for colon cancer is 87% by age 45. Many prescription and over-the- counter medications, such as acetaminophen and salicylates, can have toxic effects on the liver. Peptic ulcer disease occurs with frequent use of NSAIDs, alcohol, smoking, and H. pylori infection. Herbal supplements such as ginkgo biloba may cause gastrointestinal upset, nausea and vomiting, or prolonged bleeding. Heavy alcohol drinking is a risk factor for esophageal cancer, liver cancer, and cirrhosis of the liver. Alcohol can also increase the toxic effects of medications such as acetaminophen on the liver. Smoking is a risk factor for esophageal, stomach, and pancreatic cancers. Nutritional assessment is based on a 24-hour recall (see Chapter 12 to compare with Canada's Food Guide). Additional History for Infants Children 1. Feeding infants. Are you breastfeeding the baby, or are you feeding the baby formula? If formula-feeding, how does the baby tolerate the formula? 2. Table foods. What table foods have you introduced? How does the infant tolerate each of the food? 3. Eating patterns. How often does your toddler/child eat? Does he or she eat regular meals? • Does the child's diet follow Canada's Food Guide? • How do you feel about your child's eating problems? • Please describe all that your child had to eat yesterday, starting with breakfast. What foods does the child eat for snacks? Consider a new food as a possible allergen. Adding only one new food at a time to the infant's diet helps identify allergies. Irregular eating patterns are common among children and a source of parental anxiety. As long as a child shows normal growth and development and only nutritious foods are offered, parents may be reassured. Refer to Canada's Food Guide in Chapter 12. CHAPTER 22 The Abdomen Examiner Asks • Does the toddler or child ever eat nonfoods (grass, dirt, paint chips)? 555 Rationale Although a toddler may attempt to eat nonfoods (pica) at some time, he or she should recognize which materials are edible by age 2 years. 4. Constipation. Does your child have constipation: How long? What are the number of stools per day? Stools per week? How much water or juice is in the diet? Does the constipation seem to be associated with toilet training? What have you tried in order to treat the constipation? 5. Abdominal pain. Does the child have abdominal pain? Please describe what you have noticed and when it started. 6. Overweight children. How long has the child been overweight? Did a change in diet pattern occur then? • What does the child eat? • What do you feel Canada's Food Guide being followed? • Describe the diet pattern now. • Do any other family members have a similar problem? • How does child feel about his or her own weight? This symptom is hard to assess with young children. The children cannot articulate specific symptoms and often focus on "the tummy." Abdominal pain accompanies inflammation of the bowel, constipation, urinary tract infection, and anxiety. Reduced physical activity and poor food marketing practices contribute to the current obesity epidemic (Keith, Redden, & Katzmarzyk, 2006). Assess for family history of obesity. Assess body image. Additional History for Adolescents 1. Schedule

and content. What do you eat at regular meals? Do you eat break- fast? What do you eat for snacks? • How many calories do you figure you consume? 2. Exercise. What is your exercise pattern? 3. Underweight. If weight is less than body requirements: How much have you lost? By diet, exercise, or how? • How do you feel? Tired, hungry? How do you think your body looks? • What is your activity pattern? • Is the weight loss associated with any other body change, such as menstrual irregularity? Adolescents take control of eating and may reject family values (e.g., skipping breakfast, consuming junk foods, soft drinks). The only control parents have is over what food is in the home. You probably cannot change an adolescent's eating pattern, but you can supply nutritional facts. Boys need, on average, 4000 calories/day to maintain weight and more calories if they participate in sports. Girls need 20% fewer calories and the same nutrients as boys. Fast food is high in fat, calories, and salt, and it has no fibre. Screen any extremely thin adolescent for anorexia nervosa, a serious psychosocial disorder that includes loss of appetite, voluntary starvation, and grave weight loss. Such patients may augment weight loss by purging (self-induced vomiting) and using laxatives. Denial of hunger and tiredness is common in anorexia. Although thin, such patients insist that they look fat and "disgusting." Body image is distorted. Patients with anorexia may have healthy activity and exercise, but many are hyperactive. Amenorrhea is common with anorexia nervosa. Subjective Data • • • • • 556 UNIT 3 Physical Examination Examiner Asks Rationale • What do your parents say about your eating? Your friends? This is a family problem involving control issues. Anyone at risk requires immediate referral to a physician or psychologist. Additional History for Older Adults Subjective Data 1. Food access. How do you acquire your groceries and prepare your meals? 2. Emotional characteristics. Do you eat alone or share meals with others? 3. Recall. Please tell me all that you had to eat yesterday, starting with Objective Data breakfast. • Do you have any trouble swallowing these foods? • What do you do right after eating: walk, take a nap? 4. Bowel movements. How often do your bowels move? • If the patient reports constipation: What do you mean by "constipation"? How much liquid is in your diet? How much bulk or fibre? • Do you take anything for constipation, such as laxatives? Which ones? How often? • What medications do you take? Assess risk for nutritional deficit: limited access to grocery store, limited income, or limited cooking facilities; physical disability (impaired vision, decreased strength, neurological deficit). Assess risk for nutritional deficit if the patient is living alone; he or she may not bother to prepare all meals. Assess for social isolation and depression. Note: 24-hour recall may not be sufficient because daily pattern may vary. The patient should attempt a week-long diary of intake. Food pattern may be different during a month if monthly income (e.g., Old Age Security pension cheque) runs out. To prevent constipation, fluid intake should be between 1500 and 2000 mL/day; dietary fibre intake should be from 25 to 30 g/day (Registered Nurses Association of Ontario, 2005). Consider gastrointestinal side effects (e.g., nausea, upset stomach, anorexia, dry mouth). OB J E C T I V E DATA PREPARATION The lighting should include a strong overhead light and a secondary stand light. Expose the patient's abdomen so that it is fully visible. Drape the genitalia and female breasts. The following measures will enhance abdominal wall relaxation: • Instruct the patient to empty the bladder, saving a urine specimen if needed. • Keep the room warm to avoid chilling and tensing of muscles. • Position the patient supine, with the head on a pillow, the knees bent or on pillow, and the arms at the sides or across the chest. (Note: Discourage the patient from placing his or her arms over the head, because this tenses abdominal musculature.) • To avoid abdominal tensing, warm the stethoscope endpiece and your hands, and keep your fingernails very short. • Inquire about any painful areas. Examine such an area last to avoid any muscle guarding. • Finally, learn to use distraction: enhance muscle relaxation through breathing exercises and/or emotive imagery; keep your voice low and soothing; and encourage the patient to relate his or her abdominal history while you palpate. E Q U I P M E N T N E E D E D Stethoscope Small centimetre ruler Skin-marking pen Alcohol wipe (to clean endpiece) CHAPTER 22 The Abdomen Normal Range of Findings 557 Abnormal Findings INSPECT THE ABDOMEN Contour Stand on the patient's right side and look down on the abdomen. Then stoop or sit to gaze across the abdomen. Your head should be slightly higher than the abdomen (Figure 22-7). Determine the profile from the rib margin to the pubic bone. The contour describes the nutritional state and normally ranges from flat to rounded (Figure 22-8). Scaphoid Rounded Protuberant Objective Data Flat A B C scaphoid abdomen caves in. Protuberant abdomen and abdominal distension (see Table 22-1, p. 575) are abnormal. 22-7 22-8 Symmetry Shine a light across the abdomen toward you, or shine it lengthwise across the patient. The abdomen should be symmetrical bilaterally. Note any localized bulging, visible mass, or asymmetrical shape. Even small bulges are highlighted by shadow. Step to the foot of the examination table to recheck symmetry. Ask the patient to take a deep breath to further highlight any change. The abdomen should stay smooth and symmetrical. You can also ask the patient to perform a sit-up without pushing up with his or her hands. Bulges, masses. Hernia: protrusion of abdominal viscera through abnormal opening in muscle wall (see Table 22-3, p. 578). Note any localized bulging. Hernia, enlarged liver, or spleen may show. Umbilicus Normally the umbilicus is midline and inverted, with no sign of discoloration, inflammation, or hernia. It becomes everted and pointing upward during pregnancy. The umbilicus is a common site for piercings in young women. The site should not be red or crusted. Everted: with ascites or underlying mass (see Table 22-3, p. 576). Deeply sunken: with obesity. Enlarged and everted: with umbilical hernia. Bluish periumbilical colour: with intra-abdominal bleeding (Cullen's sign), although rare. 558 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Skin The skin surface is smooth and even, with homogeneous colour. This area is helpful for judging pigment because it is often protected from sun. Objective Data One common pigment change is striae (linear striae)/lineae albicantes, which are silvery white, linear, jagged marks approximately 1 to 6 cm long (Figure 22-9). They occur when elastic fibres in the reticular layer of the skin are broken after rapid or prolonged stretching, as in pregnancy or excessive weight gain. Recent striae are pink or blue; then they turn silvery white. Redness: with localized inflammation. Jaundice shows best in natural daylight. Glistening and tautness of skin: with ascites. Striae also occur with ascites. Striae look purple-blue in patients with Cushing's syndrome (because excess adrenocortical hormone causes the skin to be fragile and easily broken from normal stretching). 22-9 Striae. Pigmented nevi (moles), which are circumscribed brown macular or papular areas, are common on the abdomen. Normally, no lesions are present, although you may note well-healed surgical scars. If a scar is present, draw its location in the patient's record, indicating the length in centimetres (Figure 22-10). (Note: Sometimes patients forget a past operation while providing their history. If you note a scar, ask about it.) A surgical scar alerts you to the possible presence of underlying adhesions and excess fibrous tissue. 11 cm 6 cm 22-10 Unusual colour or change in shape of mole (see Chapter 13). Petechiae. Cutaneous angiomas (spider nevi) occur with portal hypertension or liver disease. Lesions and rashes warrant investigation (see Chapter 13). Underlying adhesions are inflammatory bands that connect opposite sides of serous surfaces after trauma or surgery. CHAPTER 22 The Abdomen Normal Range of Findings Veins usually are not seen, but a fine venous network may be visible in thin patients. Good skin turgor reflects healthy nutrition. Gently pinch up a fold of skin; then release to note the skin's immediate return to original position. 559 Abnormal Findings Veins are more prominent and dilated with portal hypertension, cirrhosis, ascites, or vena caval obstruction. Veins are more visible with malnutrition as a result of thinned adipose tissue. Turgor is poor with dehydration, which often accompanies gastrointestinal disease. Pulsation or Movement Normally, you may see the pulsations from the aorta beneath the skin in the epigastric area, particularly in thin patients with good muscle wall relaxation. Respiratory movement also shows in the abdomen, particularly in men. Waves of peristalsis are sometimes visible in very thin patients. They ripple slowly and obliquely across the abdomen. Marked pulsation of the aorta is detected with widened pulse pressure (e.g., hypertension, aortic insufficiency, thyrotoxicosis) and with aortic aneurysm. Markedly visible peristalsis, together with abdominal distension, indicates intestinal obstruction. Hair Distribution Patterns alter with endocrine or hair growth disorders. Demeanour A comfortable patient is relaxed quietly on the examining table, has a benign facial expression, and has slow, even respirations. AUSCULTATE BOWEL SOUNDS AND VASCULAR SOUNDS Depart from the usual examination sequence and auscultate the abdomen next. Auscultation is done first because percussion and palpation can increase peristalsis, which would give a false interpretation of bowel sounds. Also, if you hear a bruit during auscultation, you should avoid percussion and palpation. Use the diaphragm endpiece because bowel sounds are relatively high pitched. Hold the stethoscope lightly against the skin; pushing too hard may stimulate more bowel sounds (Figure 22-11). Listen in all four quadrants, beginning in the RLQ at the ileocecal valve area because bowel sounds are normally always present here. 22-11 Restlessness and constant turning to find comfort occur with the colicky pain of gastroenteritis or bowel obstruction. Absolute stillness, resisting any movement, occurs with the pain of peritonitis. Upward flexing of the knees, facial grimacing, and rapid, uneven respirations also indicate pain. Objective Data The pattern of pubic hair growth normally has a diamond shape in men and an inverted triangle shape in women (see Chapters 26 and 27). 560 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Bowel Sounds Note the character and frequency of bowel sounds. Bowel sounds originate from the movement of air and fluid through the small intestine. Depending on the time elapsed since eating, normal sounds range widely. Bowel sounds are high-pitched, gurgling, cascading sounds, occurring irregularly anywhere from 5 to 30 times per minute. Do not bother to count them. Judge whether they are normal, hypoactive, or hyperactive. One type of hyperactive bowel sounds is fairly common. This is the hyperperistalsis when you feel your "stomach growling," termed borborygmus. A perfectly "silent abdomen" is uncommon; you must listen for 5 minutes by your watch before deciding that bowel sounds are completely absent. Abnormal bowel sounds have two distinct patterns: 1. Hyperactive sounds are loud, highpitched, rushing, tinkling sounds that signal increased motility and may indicate bowel obstruction. 2. Sounds may be hypoactive or absent after abdominal surgery or with inflammation of the peritoneum (see Table 22-4, p. 579). Objective Data Vascular Sounds Using firmer pressure, listen with the bell of the stethoscope to check over the aorta and the renal arteries, iliac, and femoral arteries, especially in patients with hypertension (Figure 22-12). Note the presence of any vascular sounds or bruits. Usually, no such sound is present. Note location, pitch, and timing of a vascular sound. A systolic bruit is a pulsatile blowing sound and occurs with stenosis or occlusion of an artery. Venous hum and peritoneal friction rub are rare (see Table 22-5, p. 580 and the Critical Findings box below). CRITICAL FINDINGS Aorta Iliac Renal artery If a bruit is heard over the aorta, you should not palpate the area, to avoid rupturing a possible aortic aneurysm. Report findings immediately. Iliac artery Femoral artery 22-12 PERCUSS GENERAL TYMPANY, LIVER SPAN, AND SPLENIC DULLNESS Percuss to assess the relative density of abdominal contents, to locate organs, and to screen for abnormal fluid or masses. General Tympany First, percuss lightly in all four quadrants to determine the prevailing amount of tympany and dullness (Figure 22-13). Note general percussion outcome. Tympany should predominate because air in the intestines rises to the surface when the patient is supine. Dullness is heard over a distended bladder, adipose tissue, fluid, or a mass. Hyperresonance is heard with gaseous distension. CHAPTER 22 The Abdomen 561 Abnormal Findings Normal Range of Findings 22-13 Liver Span Next, percuss to map out the boundaries of certain organs. Measure the height of the liver in the right midclavicular line. (For a consistent placement of the midclavicular line landmark, remember to palpate the acromioclavicular and the sternoclavicular joints, and judge the line at a point midway between the two.) Begin in the area of lung resonance, and percuss down the intercostal spaces until the sound changes to a dull quality (Figure 22-14). Mark the spot on the patient's body, usually in the fifth intercostal space. Then find abdominal tympany and percuss up in the midclavicular line. Mark the spot on the patient's body where the sound changes from tympany to a dull sound, normally at the right costal margin. 22-14 Objective Data SPECIAL CONSIDERATIONS FOR ADVANCED PRACTICE 562 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Measure the distance between the two marks; the normal liver span in adults ranges from 6 to 12 cm (Figure 22-15). The height of the liver span is correlated with the height of the patient; taller people have longer livers. Also, men have a longer liver span than do women of the same height. Overall, the mean liver span is 10.5 cm in men and 7 cm in women. 22-15 One variation occurs in people with chronic emphysema, in which the liver is displaced downward by the hyperinflated lungs. Although you hear a dull percussion note over the right costal margin, the overall span is still within normal limits. Clinical estimation of liver span is important in screening for hepatomegaly and in monitoring changes in liver size. However, this measurement is a gross estimate; the liver span may be underestimated because of inaccurate detection of the upper border. Scratch Test. Another assessment technique is the scratch test, which may help define the liver border when the abdomen is distended or the abdominal muscles are tense. Place your stethoscope over the liver. With one fingernail, scratch short strokes over the abdomen, starting in the RLQ and moving progressively up toward the liver (Figure 22-16). When the scratching sound in your stethoscope becomes magnified, you will have crossed the border from over a hollow organ to over a solid one. 22-16 Abnormal Findings Elongation of the liver span indicates liver enlargement (hepatomegaly). Detection of liver borders is rendered inaccurate by dullness above the fifth intercostal space, which occurs with lung disease (e.g., pleural effusion or consolidation). Detection at the lower border is rendered inaccurate when dullness is pushed up with ascites or pregnancy or with gas distension in colon, which obscures the lower border. CHAPTER 22 The Abdomen Normal Range of Findings 563 Abnormal Findings Splenic Dullness Often the spleen is obscured by stomach contents, but you may locate it by percussing for a dull note from the ninth to eleventh intercostal spaces just behind the left midaxillary line (Figure 22-17). The area of splenic dullness normally is not wider than 7 cm in the adult and should not encroach on the normal tympany over the gastric air bubble. A dull note forward of the midaxillary line indicates enlargement of the spleen, as occurs with mononucleosis, trauma, and infection. Objective Data 22-17 You may also percuss in the lowest intercostal space in the left anterior axillary line. You should hear tympany. Ask the patient to take a deep breath. Normally, tympany remains through full inspiration. In the anterior axillary line, a change in percussion from tympany to a dull sound with full inspiration is a positive spleen percussion sign, indicating splenomegaly. This method helps detect mild to moderate splenomegaly before the spleen becomes palpable, as in mononucleosis, malaria, or hepatic cirrhosis. Costovertebral Angle Tenderness Indirect fist percussion causes the tissues to vibrate instead of producing a sound. To assess the kidney, place one hand over the twelfth rib at the costovertebral angle on the back (Figure 22-18). Thump that hand with the ulnar edge of your other fist. The patient normally feels a thud but no pain. Perform the assessment bilaterally. (Although this step is included here with percussion techniques, its usual sequence in a complete examination is with thoracic assessment, when the patient is sitting up and you are standing behind him or her.) 22-18 Sharp pain occurs with inflammation of the kidney or paranephric area. 564 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data PALPATE SURFACE AND DEEP AREAS Perform palpation to judge the size, location, and consistency of certain organs and to screen for an abnormal mass or tenderness. Review comfort measures on p. 559. Because most people are naturally inclined to protect their abdomen, you need to use additional measures to enhance complete muscle relaxation: 1. Bend the patient's knees. 2. Keep your palpating hand low and parallel to the abdomen. Holding the hand high and pointing down would make anyone tense up. 3. Teach the patient to breathe slowly (in through the nose, and out through the mouth). 4. Keep your own voice low and soothing. Conversation may relax the patient. 5. Try "emotive imagery." For example, you might say, "Now I want you to imagine you are dozing on the beach, with the sun warming your muscles and the sound of the waves lulling you to sleep. Let yourself relax." 6. With a very ticklish patient, keep the patient's hand under your own with your fingers curled over his or her fingers. Move both hands around as you palpate; people are not ticklish to themselves. 7. Alternatively, perform palpation just after auscultation. Keep the stethoscope in place and curl your fingers around it, palpating as you pretend to auscultate. People generally do not perceive a stethoscope as a ticklish object. You can slide the stethoscope out when the patient's focus is on your voice. 8. Palpate the tender area last. Light Palpation Begin with light palpation. With the first four fingers close together, depress the skin approximately 1 cm (Figure 22-19). Make a gentle rotary motion, sliding the fingers and skin together. Then lift the fingers (do not drag them) and move clockwise to the next location around the abdomen. The objective here is not to search for organs but to form an overall impression of the skin surface and superficial musculature. Save the examination of any identified tender areas until last. In this way, you avoid causing pain and the resulting muscle rigidity that would obscure deep palpation later in the examination. Muscle guarding. Rigidity. Large masses. Tenderness (see the Critical Findings box below). CRITICAL FINDINGS RLQ tenderness on palpation in a patient with acute abdominal pain migrating from the umbilicus to the RLQ is indicative of appendicitis, the most common abdominal surgical emergency (Flasar & Goldberg, 2006). Immediate referral to a surgeon is required. Associated symptoms include nausea, vomiting, fever, and loss of appetite. Additional signs include guarding, rigidity, rebound tenderness, and iliopsoas (see pp. 569–570). RLQ, right lower quadrant. 22-19 As you circle the abdomen, discriminate between voluntary muscle guarding and involuntary rigidity. Voluntary guarding occurs when the patient is cold, tense, or ticklish. It is bilateral, and you will feel the muscles relax slightly during exhalation. Use the relaxation measures described previously to try to eliminate this type of guarding, or it will interfere with deep palpation. If the rigidity persists, it is probably involuntary. Involuntary rigidity is a constant boardlike hardness of the muscles. It is a protective mechanism accompanying peritonitis, an acute inflammation of the peritoneum. It may be unilateral, and the same area usually becomes painful when the patient increases intra-abdominal pressure by attempting a sit-up. CHAPTER 22 The Abdomen Normal Range of Findings 565 Abnormal Findings SPECIAL CONSIDERATIONS FOR ADVANCED PRACTICE Deep Palpation If appropriate, perform deep palpation by using the same technique described earlier, but push down approximately 5 to 8 cm (Figure 22-20). Moving clockwise, palpate the entire abdomen. Objective Data 22-20 To overcome the resistance of a very large or obese abdomen, use a bimanual technique. Place your two hands on top of each other (Figure 22-21). The top hand does the pushing; the bottom hand is relaxed and can concentrate on the sense of palpation. With either technique, note the location, size, consistency, and mobility of any palpable organs and the presence of any abnormal enlargement, tenderness, or masses. 22-21 Making sense of what you are palpating is more difficult than it seems. Inexperienced examiners complain that the abdomen "all feels the same," as if they are pushing their hand into a soft sofa cushion. It helps to memorize the anatomy and visualize what is under each quadrant as you palpate. Also remember that some structures are normally palpable, as illustrated in Figure 22-22. 566 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Xiphoid process Normal liver edge Right kidney, lower pole Pulsatile aorta Rectus muscles, lateral borders Sacral promontory Ascending colon Objective Data Cecum Sigmoid colon Uterus (gravid) Full bladder NORMALLY PALPABLE STRUCTURES 22-22 Mild tenderness normally is present when the sigmoid colon is palpated. Any other tenderness should be investigated. If you identify a mass, first distinguish it from a normally palpable structure or an enlarged organ. Then note the following: 1. Location 2. Size 3. Shape 4. Consistency (soft, firm, hard) 5. Surface (smooth, nodular) 6. Mobility (including movement with respirations) 7. Pulsatility 8. Tenderness Tenderness occurs with local inflammation, with inflammation of the peritoneum or underlying organs, and with an enlarged organ whose capsule is stretched. Liver Next, palpate for specific organs, beginning with the liver in the RUQ (Figure 22-23). Place your left hand under the patient's back, parallel to the eleventh and twelfth ribs, and lift up to support the abdominal contents. Place your right hand on the RUQ, with fingers parallel to the midline. Push deeply down and under the right costal margin. Ask the patient to take a deep breath. It is normal to feel the edge of the liver bump your fingertips as the diaphragm pushes it down during inhalation. It feels like a firm, regular ridge. However, the liver is often not palpable, and you feel nothing firm. Hooking Technique. An alternative method of palpating the liver is to stand up at the patient's right shoulder and swivel your body to the right so that you face the patient's feet (Figure 22-24). Hook your fingers over the costal margin from above. Ask the patient to take a deep breath. Try to feel the liver edge bump your fingertips. Except with a depressed diaphragm, a liver palpated more than 1 to 2 cm below the right costal margin is enlarged. Record the number of centimetres it descends, and note its consistency (hard, nodular) and tenderness (see Table 22-6, p. 580). CHAPTER 22 The Abdomen Normal Range of Findings 567 Abnormal Findings 22-23 22-24 Normal Range of Findings Objective Data Spleen A 22-25 B CRITICAL FINDINGS The spleen becomes enlarged with mononucleosis and trauma (see Table 22-6, p. 581). If you feel an enlarged spleen, refer the patient, but do not continue to palpate it. An enlarged spleen is friable and can rupture easily with overpalpation. Describe the number of centimetres that the spleen extends below the left costal margin. Objective Data Normally, the spleen is not palpable and must be enlarged to three times its normal size to be felt. To search for it, reach over the abdomen with your left hand and behind the left side at the eleventh and twelfth ribs (Figure 22-25, A). Lift up for support. Place your right hand obliquely on the LUQ with the fingers pointing toward the left axilla and just inferior to the rib margin. Push your hand deeply down and under the left costal margin, and ask the patient to take a deep breath. You should feel nothing firm. When enlarged, the spleen slides out and bumps your fingertips (see the Critical Findings box to the right). It can grow so large that it extends into the lower quadrants. When this condition is suspected, start low on the abdomen so that you will not miss it. An alternative position is to roll the patient onto his or her right side to displace the spleen more forward and downward (see Figure 22-25, B). Then palpate as described earlier. 568 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Kidneys Enlarged kidney. Kidney mass. Objective Data Search for the right kidney by placing your hands together in a "duck bill" position at the patient's right flank (Figure 22-26, A). Press your two hands together firmly (you need deeper palpation than that used with the liver or spleen), and ask the patient to take a deep breath. In most people, you will feel no change. On occasion, you may feel the lower pole of the right kidney as a round, smooth mass slide between your fingers. Either condition is normal. The left kidney sits 1 cm higher than the right kidney and is normally not palpable. Search for it by reaching your left hand across the abdomen and behind the left flank for support (see Figure 22-26, B). Push your right hand deep into the abdomen, and ask the patient to breathe deeply. You should feel no change with the inhalation. A B 22-26 Aorta Using your opposing thumb and fingers, palpate the aortic pulsation in the upper abdomen slightly to the left of midline (Figure 22-27). In adults, it is normally 2.5 to 4 cm wide and pulsates in an anterior direction. Widened pulsation with aneurysm (see Tables 22-5 and 22-6, pp. 580–581). Prominent lateral pulsation with aortic aneurysm (see the Critical Findings box below). CRITICAL FINDINGS If a bruit was heard on auscultation, you should not palpate the area, to avoid rupturing an aortic aneurysm. Report findings immediately. 22-27 CHAPTER 22 The Abdomen Normal Range of Findings Abnormal Findings Rebound Tenderness (Blumberg's Sign). Assess rebound tenderness when the patient reports abdominal pain or when you elicit tenderness during palpation. Choose a site away from the painful area. Hold your hand 90 degrees, or perpendicular, to the abdomen. Push down slowly and deeply (Figure 22-28, A); then lift up quickly (see Figure 22-28, B). This makes structures that are indented by palpation rebound suddenly. A normal, or negative, response is no pain on release of pressure. Perform this test at the end of the examination, because it can cause severe pain and muscle rigidity. Pain on release of pressure confirms rebound tenderness, which is a reliable sign of peritoneal inflammation. Peritoneal inflammation accompanies appendicitis. Cough tenderness that is localized to a specific spot also signals peritoneal irritation. Refer the patient with suspected appendicitis for computed tomographic scanning. Objective Data A 569 B 22-28 Rebound tenderness. Inspiratory Arrest (Murphy's Sign). Normally, palpating the liver causes no pain. In a patient with inflammation of the gallbladder, or cholecystitis, pain occurs. Hold your fingers under the liver border. Ask the patient to take a deep breath. A normal response is to complete the deep breath without pain. (Note: This sign is less accurate in patients older than 60 years: Evidence shows that 25% of older patients do not have any abdominal tenderness; McGee, 2007.) Iliopsoas Muscle Test. Perform the iliopsoas muscle test when the acute abdominal pain is suspect for appendicitis. With the patient supine, lift the right leg straight up, flexing at the hip (Figure 22-29); then push down over the lower part of the right thigh as the patient tries to hold the leg up. When the test result is negative, the patient feels no change. (Note: Evidence shows that the obturator test, another technique that stretches the obturator muscle, does not work to diagnose appendicitis; Berry & Malt, 1984; McGee, 2012, p. 446.) 22-29 Iliopsoas muscle test. When the test result is positive, as the descending liver pushes the inflamed gallbladder onto the examining hand, the patient feels sharp pain and abruptly stops inspiration midway. When the iliopsoas muscle is inflamed (which occurs with an inflamed or perforated appendix), pain is felt in the RLQ. 570 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Ascites Ascites occurs with heart failure, portal hypertension, cirrhosis, hepatitis, pancreatitis, and cancer. Objective Data At times, you may suspect that a patient has ascites (free fluid in the peritoneal cavity) because the abdomen is distended, the flanks are bulging, and the umbilicus is protruding and displaced downward. You can differentiate ascites from gaseous distension by performing the following two percussion tests. Fluid Wave. First, test for a fluid wave by standing on the patient's right side. Place the ulnar edge of another examiner's hand or the patient's own hand firmly on the abdomen in the midline (Figure 22-30). (This will stop transmission across the skin of the upcoming tap.) Place your left hand on the patient's right flank. With your right hand, reach across the abdomen and give the left flank a firm strike. 22-30 Fluid wave. If ascites is present, the blow will generate a fluid wave through the abdomen, and you will feel a distinct tap on your left hand. If the abdomen is distended from gas or adipose tissue, you will feel no change. Shifting Dullness. The second test for ascites is percussing for shifting dullness. In a supine patient, ascitic fluid settles by gravity into the flanks, displacing the air-filled bowel upward. You will hear a tympanitic note as you percuss over the top of the abdomen because gas-filled intestines float over the fluid (Figure 22-31). Then percuss down the side of the abdomen. If fluid is present, the note will change from tympany to dull as you reach its level. Mark this spot on the patient's body. Tympany Dullness 22-31 A fluid wave occurs with large amounts of ascitic fluid. CHAPTER 22 The Abdomen Normal Range of Findings 571 Abnormal Findings Now turn the patient onto the right side (roll the patient toward you; Figure 22-32). The fluid will gravitate to the dependent (in this case, right) side, displacing the lighter bowel upward. Begin percussing the upper side of the abdomen and move downward. The sound changes from tympany to a dull sound as you reach the fluid level, but this time the level of dullness is higher, upward toward the umbilicus. This shifting level of dullness indicates the presence of fluid. Shifting dullness is present with a large volume of ascitic fluid; it cannot be detected when the amount of fluid is less than 500 mL. Tympany Objective Data Shifting level of dullness 22-32 Both the fluid wave and shifting dullness tests are not completely reliable. Ultrasonography study is the definitive tool for detecting ascites. DEVELOPMENTAL CONSIDERATIONS Infants Inspection. The contour of the abdomen is protuberant because of the immature abdominal musculature. The skin exhibits a fine, superficial venous pattern. This may be visible in lightly pigmented children until puberty. Inspect the umbilical cord throughout the neonatal period. At birth, it is white and contains two umbilical arteries and one vein surrounded by mucoid connective tissue, called Wharton's jelly. The umbilical stump dries within a week, hardens, and falls off by 10 to 14 days after birth. Skin covers the area by 3 to 4 weeks. The abdomen should be symmetrical, although two bulges are common. You may note an umbilical hernia. It appears 2 to 3 weeks after birth and is especially prominent when the infant cries. The hernia reaches maximum size at 1 month (up to 2.5 cm) and usually disappears by the age of 1 year. Another common variation is diastasis recti, a separation of the rectus muscles with a visible bulge along the midline. The condition is more common in infants of African descent, and it usually disappears by early childhood. The abdomen shows respiratory movement. The only other abdominal movement you should note is occasional peristalsis, which may be visible because of the thin musculature. Auscultation. Auscultation yields only bowel sounds, the metallic tinkling of peristalsis. No vascular sounds should be heard. Scaphoid shape: occurs with dehydration. Dilated veins. The presence of only one artery signals the possibility of congenital defects. Inflammation should be investigated. Drainage after cord stump falls off is abnormal and should be investigated. Refer for investigation any umbilical hernia that is larger than 2.5 cm (see Table 22-3, p. 578); that is continuing to grow after 1 month; or that lasts for more than 2 years in a child of European descent or for more than 7 years in a child of African descent. Refer for investigation diastasis recti that lasts more than 6 years. Marked peristalsis with pyloric stenosis (see Table 22-4, p. 579). Bruit. Venous hum. 572 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data Percussion. Percussion reveals tympany over the stomach (the infant swallows some air with feeding) and dullness over the liver. The spleen is not percussed in infants. The abdomen sounds tympanitic, although it is normal to percuss dullness over the bladder. This dullness may extend up to the umbilicus. Palpation. Aid palpation by flexing the baby's knees with one hand while palpating with the other (Figure 22-33). Alternatively, you may hold the upper back and flex the neck slightly with one hand. Offer a pacifier to a crying baby. The liver fills the RUQ. It is normal to feel the liver edge at the right costal margin or 1 to 2 cm below. Normally, you may palpate the spleen tip, both kidneys, and the bladder. Also easily palpated are the cecum in the RLQ and the sigmoid colon, which feels like a sausage in the left inguinal area. Make note of the newborn's first stool, a sticky, greenish black meconium stool within 24 hours of birth. By the fourth day, stools of breastfed babies are golden yellow and pasty and smell like sour milk, whereas those of formula-fed babies are brown-yellow, firmer, and more fecal smelling. 22-33 Children At ages younger than 4 years, the abdomen looks protuberant when the child is both supine and standing. After age 4 years, the potbelly remains when the child stands because of lumbar lordosis, but the abdomen looks flat when the child is supine. Normal movement on the abdomen includes respirations, which remain abdominal until 7 years of age. To palpate the abdomen, position a young child on the parent's lap as you sit knee to knee with the parent (Figure 22-34). Flex the child's knees up, and elevate the head slightly. You can ask the child to "pant like a dog" to further relax abdominal muscles. Hold your entire palm flat on the abdominal surface for a moment before starting palpation. This accustoms the child to being touched. If the child is very ticklish, hold his or her hand under your own as you palpate, or apply the stethoscope and palpate around it. The liver remains easily palpable 1 to 2 cm below the right costal margin. The edge is soft and sharp and moves easily. On the left, the spleen also is easily palpable as a soft, sharp, movable edge. Usually you can feel 1 to 2 cm of the right kidney and the tip of the left kidney. Percussion of the liver span reveals measurements of approximately 3.5 cm at age 2 years, 5 cm at age 6 years, and 6 to 7 cm during adolescence. A scaphoid abdomen is associated with dehydration or malnutrition. Before age 7 years of age, abdominal respirations are absent with inflammation of the peritoneum. CHAPTER 22 The Abdomen Normal Range of Findings 573 Abnormal Findings Objective Data 22-34 When asking young children about abdominal tenderness, remember that they often answer this question affirmatively no matter how the abdomen actually feels. Use objective signs to aid assessment, such as a cry changing in pitch as you palpate, facial grimacing, movement away from you, and guarding. The school-age child has a slim abdominal shape as he or she loses the potbelly. This slimming trend continues into adolescence. Many adolescents are easily embarrassed by exposure of the abdomen, and adequate draping is necessary. The physical findings are the same as those listed for adults. On inspection, you may note increased deposits of subcutaneous fat on the abdomen and hips because it is redistributed away from the extremities. The abdominal musculature is thinner and has less tone than that of younger adults; therefore, in the absence of obesity, you may note peristalsis. Because the abdominal wall is thinner and softer, the organs may be easier to palpate (in the absence of obesity). The liver is easier to palpate. Normally, you can feel the liver edge at or just below the costal margin. When the lungs are distended and the diaphragm is depressed, the liver is palpated lower, descending 1 to 2 cm below the costal margin with inhalation. The kidneys are easier to palpate. Abdominal rigidity with acute abdominal conditions is less common in older adults. Older adults with conditions that cause severe abdominal pain ("acute abdomen") often complain of less pain than do younger patients. D O CUMENTATION A N D C R I T I C A L T H I N K I N G Sample Charting SUBJECTIVE States appetite is good with no recent change, no dysphagia, no food intolerance, no pain, no nausea/vomiting. Has one formed BM [bowel movement]/day. Takes vitamins, no other prescribed or over-the-counter medication. No history of abdominal disease, injury, or surgery. Diet recall of past 24 hours listed at end of history. OBJECTIVE Inspection: Abdomen flat, symmetrical, with no apparent masses. Skin smooth with no striae, scars, or lesions. Auscultation: Bowel sounds present, no bruits. Documentation & Critical Thinking Older Adults 574 UNIT 3 Physical Examination Percussion: Tympany predominates in all four quadrants; liver span is 8 cm in right midclavicular line. Splenic dullness located at tenth intercostal space in left midaxillary line. Palpation: Abdomen soft; no organomegaly, no masses, no tenderness. ASSESSMENT Healthy abdomen, bowel sounds present Focused Assessment: Clinical Case Study 1 George E. is a 58-year-old unemployed, divorced man with chronic alcoholism who enters the chemical dependency treatment centre. SUBJECTIVE States past 6 months has been drinking 500 mL whisky/day. Last alcohol use 1 week PTA, with "5 or 6" drinks that episode. Estranged from family, lives alone. Makes a few meals on hot plate. States never has appetite. Has fatigue and weakness. OBJECTIVE Inspection: Appears older than stated age. Oriented, although verbal response time slowed. Weight loss of 5.5 kg in last 3 months. Abdomen protuberant, symmetrical, no visible masses. Poor skin turgor. Dilated venous pattern over abdominal wall. Hair sparse in axillary, pubic areas. Auscultation: Bowel sounds present. No vascular sounds. Percussion: Tympany predominates over abdomen. Liver span is 16 cm in right midclavicular line. No fluid wave. No shifting dullness. Palpation: Soft. Liver palpable 10 cm below right costal margin, smooth and nontender. No other organomegaly or masses. Documentation & Critical Thinking ASSESSMENT Alcohol dependence, severe, with physiological dependence Imbalanced nutrition: less than body requirements R/T impaired absorption Ineffective coping R/T effects of chronic alcoholism Social isolation Focused Assessment: Clinical Case Study 2 Edith J. is a 63-year-old, retired homemaker who has a history of lung cancer with metastasis to the liver. SUBJECTIVE Feeling "puffy and bloated" for the past week. States unable to get comfortable. Also short of breath "all the time now." Difficulty sleeping. "I feel like crying all the time now." OBJECTIVE Inspection: Weight increase of 3.7 kg in 1 week. Abdomen is distended with everted umbilicus and bulging flanks. Girth at umbilicus is 85 cm. Prominent dilated venous pattern present over abdomen. Auscultation: Bowel sounds present, no vascular sounds. Percussion: When supine, tympany present at dome of abdomen, dullness over flanks. Shifting dullness present. Positive fluid wave present. Liver span is 12 cm in right midclavicular line. Palpation: Abdominal wall firm, able to feel liver with deep palpation at 6 cm below right costal margin. Liver feels firm, nodular, nontender. 4+ pitting edema in both ankles. ASSESSMENT Ascites Grieving Ineffective breathing pattern R/T increased intra-abdominal pressure Pain R/T distended abdomen Risk for impaired skin integrity: R/T ascites, edema, and faulty metabolism Insomnia CHAPTER 22 The Abdomen 575 Focused Assessment: Clinical Case Study 3 Dan G. is a 17-year-old male high school student who enters the emergency department with abdominal pain of 2 days' duration. SUBJECTIVE 2 days PTA: Dan noted general abdominal pain in umbilical region. Now pain is sharp and severe, and Dan points to location in RLQ. No BM for 2 days. Nausea and vomiting off and on 1 day. OBJECTIVE Inspection: BP 112/70, temp 38°C, pulse 116, resp 18. Lying on side with knees drawn up under chin. Resists any movement. Face tight and occasionally grimacing. Cries out with any sudden movement. Auscultation: No bowel sounds present. No vascular sounds. Percussion: Tympany. Percussion over RLQ leads to tenderness. Palpation: Abdominal wall is rigid and boardlike. Extreme tenderness to palpation in RLQ. Rebound tenderness is present in RLQ. Positive iliopsoas muscle test. ASSESSMENT Acute abdominal pain in RLQ Nausea TABLE 22-1 Documentation & Critical Thinking ABNOR M A L F I N D I N G S Abdominal Distension* Tympany scattered dullness Air or Gas Inspection: Single round curve Auscultation: Depends on cause of gas (e.g., decreased or absent bowel sounds with ileus); hyperactive with early intestinal obstruction) Percussion: Tympany over large area Palpation: May have muscle spasm of abdominal wall Continued Abnormal Findings Obesity Inspection: Uniformly rounded; umbilicus sunken (it adheres to peritoneum, and layers of fat are superficial to it) Auscultation: Normal bowel sounds Percussion: Tympany; scattered dullness over adipose tissue Palpation: Normal; may be hard to feel through thick abdominal wall Tympany TABLE 22-1 Abdominal Distension—cont'd Tympany Dullness Tympany Dullness Ascites Inspection: Single curve; everted umbilicus; bulging flanks in supine position; taut, glistening skin; recent weight gain; increase in abdominal girth Auscultation: Normal bowel sounds over intestines; diminished over ascitic fluid Percussion: Tympany at top where intestines float; dull over fluid; produces fluid wave and shifting dullness Palpation: Limited by taut skin and increased intraabdominal pressure Fetal heart tones Pregnancy† Inspection: Single curve; umbilicus protruding; breasts engorged Auscultation: Fetal heart tones; diminished bowel sounds Percussion: Tympany over intestines; dull over enlarging uterus Palpation: Fetal parts; fetal movements Ovarian Cyst (Large) Inspection: Curve in lower half of abdomen, midline; everted umbilicus Auscultation: Normal bowel sounds over upper abdomen where intestines are pushed superiorly Percussion: Top dull over fluid; intestines pushed superiorly; large cyst produces fluid wave and shifting dullness Palpation: Aortic pulsation present (in ascites, it is not) Feces in colon Feces Inspection: Localized distension Auscultation: Normal bowel sounds Percussion: Tympany predominates; scattered dullness over fecal mass Palpation: Plastic-like or ropelike mass with feces in intestines ◀ Tumour Abnormal Findings Inspection: Localized distension Auscultation: Normal bowel sounds Percussion: Dull over mass if mass reaches up to skin surface Palpation: Used to define borders and distinguish from enlarged organ or normally palpable structure *A mnemonic device to recall the common causes of abdominal distension is the seven Fs: fat, flatus, fluid, fetus, feces, fetal growth, and fibroid. † Obviously a normal finding, pregnancy is included for comparison of conditions causing abdominal distension. TABLE 22-2 Common Sites of Referred Abdominal Pain Liver Pancreatitis Heart Perforated duodenal ulcer Penetrating duodenal ulcer GERD Biliary colic Cholecystitis, pancreatitis, duodenal ulcer Peptic ulcer Renal colic Small intestine pain, appendicitis Pancreatitis, renal colic Ureteral colic Rectal lesions Appendicitis Colon pain Cholecystitis RLQ, right lower quadrant; RUQ, right upper quadrant. Image © Pat Thomas, 2006. Abnormal Findings When a patient gives a history of abdominal pain, the location of the pain may not necessarily be directly over the involved organ. That is because the human brain has no felt image for internal organs. Rather, pain is referred to a site where the organ was located in fetal development. Although the organ migrates during fetal development, its nerves persist in referring sensations from the former location. The following are examples, not a complete list. Liver Stomach Hepatitis may produce mild to moderate, dull pain in Gastric ulcer pain is dull, aching, gnawing epigastric pain, RUQ or epigastrium, along with anorexia, nausea, usually brought on by eating; it radiates to the back or malaise, and low-grade fever. substernal area. Perforated ulcer produces burning epigastric pain of sudden onset that is referred to one or Esophagus both shoulders. Gastroesophageal reflux disease (GERD) is a complex of symptoms of esophagitis, including burning pain in Appendix midepigastrium or behind lower sternum that radiates Appendicitis typically starts as dull, diffuse pain in upward, or "heartburn." The pain occurs 30–60 minutes periumbilical region that later shifts to severe, sharp, after eating; it is aggravated by lying down or bending over. persistent pain and tenderness localized in RLQ (McBurney's point). Pain is aggravated by movement, coughing, and deep Gallbladder breathing; it is associated first with anorexia, then with Cholecystitis is biliary colic, sudden pain in right upper nausea and vomiting, and later with fever. quadrant that may radiate to the right or left scapula and that builds over time, lasting 2 to 4 hours, after ingestion Kidney of fatty foods, alcohol, or caffeine. It is associated with Kidney stones prompt a sudden onset of severe, colicky nausea and vomiting and a positive Murphy sign (sudden flank or lower abdominal pain. stop in inspiration with RUQ palpation). Small Intestine Pancreas Gastroenteritis produces diffuse, generalized abdominal Pancreatitis produces acute, boring midepigastric pain pain, with nausea and diarrhea. radiating to the back and sometimes to the left scapula or Colon flank, severe nausea, and vomiting. Large bowel obstruction produces moderate, colicky pain Duodenum of gradual onset in lower abdomen, with bloating. Duodenal ulcer typically produces dull, aching, gnawing Irritable bowel syndrome (IBS) is accompanied by sharp pain; it does not radiate, may be relieved by food, and or burning, cramping pain over a wide area; the pain, may awaken the patient from sleep. which does not radiate, is triggered by meals and relieved by bowel movement. 578 TABLE 22-3 UNIT 3 Physical Examination Abnormalities on Inspection ◀ Umbilical Hernia Umbilical hernia is a soft, skin-covered mass, which is the protrusion of the omentum or intestine through a weakness or incomplete closure in the umbilical ring. It is accentuated by increased intra-abdominal pressure, which occurs with crying, coughing, vomiting, or straining, but the bowel rarely becomes incarcerated or strangulated. It is more common in infants of African or Asian descent and in premature infants. Most umbilical hernias resolve spontaneously by age 1 year; parents should avoid affixing a belt or coin at the hernia because this will not speed closure and may cause contact dermatitis. In an adult, it occurs with pregnancy and chronic ascites, or it may result from chronic intrathoracic pressure (e.g., asthma, chronic bronchitis). Epigastric Hernia (Not Illustrated) Epigastric hernia is a small, fatty nodule at the epigastrium in the midline, through the linea alba. Usually it can be palpated rather than observed. It may be palpable only when the patient is standing. ◀ Incisional Hernia A bulge near an old operative scar that may not show when patient is supine but is apparent when the patient increases intra-abdominal pressure by a sit-up, by standing, or by performing the Valsalva manoeuvre. Abnormal Findings Diastasis Recti (Not Illustrated) Diastasis recti, a midline longitudinal ridge, is a separation of the abdominal rectus muscles. The ridge is revealed when intra-abdominal pressure is increased by raising the head while in the supine position. It occurs congenitally and as a result of pregnancy or marked obesity in which distension is prolonged or muscle tone has decreased. It is not clinically significant. CHAPTER 22 The Abdomen TABLE 22-4 579 Abnormal Bowel Sounds ◀ Succussion Splash Unrelated to peristalsis, this is a very loud splash auscultated over the upper abdomen when the infant is rocked side to side. It indicates increased air and fluid in the stomach, as occurs with pyloric obstruction or large hiatus hernia. Marked peristalsis, together with projectile vomiting in the newborn, is suggestive of pyloric stenosis, an obstruction of the stomach's pyloric valve. Pyloric stenosis is a congenital defect and appears in the second or third week after birth. After feeding, pronounced peristaltic waves cross from left to right, leading to projectile vomiting. Then the examiner can palpate an olive-sized mass in the RUQ midway between the right costal margin and umbilicus. Affected infants must be referred promptly because of the risk of weight loss. Hypoactive Bowel Sounds Diminished or absence of bowel sounds signal decreased motility that results from inflammation, as with peritonitis; from paralytic ileus, as after abdominal surgery; or from late bowel obstruction. It also occurs with pneumonia. Hyperactive Bowel Sounds Loud, gurgling sounds (borborygmi) signal increased motility. They occur with early mechanical bowel obstruction (high-pitched), gastroenteritis, brisk diarrhea, laxative use, and subsiding paralytic ileus. RUQ, right upper quadrant. Abnormal Findings 580 UNIT 3 Physical Examination TABLE 22-5 Abdominal Friction Rubs and Vascular Sounds ◀ Peritoneal Friction Rub A rough, grating sound, like two pieces of leather rubbed together, indicates peritoneal inflammation. Occurs rarely. Usually occurs over organs with a large surface area in contact with the peritoneum. Liver Friction rub over lower right rib cage, caused by abscess or metastatic tumour. Spleen Friction rub over lower left rib cage in left anterior axillary line, caused by abscess, infection, or tumour. Peritoneal friction rub Vascular sounds Abnormal Findings TABLE 22-6 Vascular Sounds Arterial A bruit indicates turbulent blood flow, as found in constricted, abnormally dilated, or tortuous vessels. Listen with the bell. Occurs with the following three conditions: • Aortic aneurysm: Murmur is harsh, systolic, or continuous and accentuated with systole. Note in patient with hypertension. • Renal artery stenosis: Murmur is midline or toward flank, soft, low-to-medium pitch. • Partial occlusion of femoral arteries: Murmur is heard in the inguinal region (groin). Venous Hum Occurs rarely. Heard in periumbilical region. Originates from inferior vena cava. Medium pitch, continuous sound; pressure on bell may obliterate it. A palpable thrill may be present. Occurs with portal hypertension and cirrhotic liver. Abnormalities Detected on Palpation of Organs Enlarged Liver The liver becomes enlarged, smooth, and nontender with fatty infiltration, portal obstruction or cirrhosis, obstruction high in the inferior vena cava, and lymphocytic leukemia. The liver feels enlarged and smooth but is tender to palpation with early heart failure, acute hepatitis, and hepatic abscess. Enlarged Nodular Liver The liver becomes enlarged and nodular with late portal cirrhosis, metastatic cancer, and tertiary syphilis. CHAPTER 22 The Abdomen TABLE 22-6 581 Abnormalities Detected on Palpation of Organs—cont'd Enlarged Spleen Because any enlargement superiorly is stopped by the diaphragm, the spleen enlarges downward and toward the midline. When enlargement is extreme, the spleen can extend down to the left aspect of the pelvis. It retains the splenic notch on the medial edge. When splenomegaly occurs with acute infections (mononucleosis), the spleen is moderately enlarged and soft, with rounded edges. When it is the result of a chronic cause, the enlargement is firm or hard, with sharp edges. An enlarged spleen is usually not tender to palpation; it is tender only if the peritoneum is also inflamed. Enlarged Kidney A kidney may become enlarged with hydronephrosis, cyst, or neoplasm. It may be difficult to distinguish an enlarged kidney from an enlarged spleen because they have a similar shape. Both extend forward and downward. However, the spleen may have a sharp edge, whereas the kidneys never do. The spleen retains the splenic notch, whereas the kidneys have no palpable notch. Percussion over the spleen yields dullness, whereas over the kidneys the sound is tympanic because of the overriding bowel. Aortic Aneurysm Most aortic aneurysms (more than 95%) are located below the renal arteries and extend to the umbilicus. Approximately 80% of these are detectable during routine physical examination. You will hear a bruit. Femoral pulses are present but decreased. An aortic aneurysm has a high risk for rupture. If you hear a bruit, you should not palpate the area, to avoid rupturing the aneurysm. Additional information on abdominal aneurysm is illustrated in Table 22-5. Abnormal Findings Enlarged Gallbladder An enlarged, tender gallbladder is suggestive of acute cholecystitis. It is palpated behind the liver border as a smooth and firm mass like a sausage, although it may be difficult to palpate because of involuntary rigidity of abdominal muscles. The area is exquisitely painful to fist percussion, and inspiratory arrest (Murphy's sign) is present. An enlarged, nontender gallbladder also feels like a smooth, sausage-like mass. This condition occurs when the gallbladder is filled with stones, as with obstruction of the common bile duct. 582 UNIT 3 Physical Examination Abnormal Findings Summary Checklist: Abdomen Examination For a PDA-downloadable version, go to . 1. Inspection Contour Symmetry Umbilicus Skin Pulsation or movement Hair distribution Demeanour 2. Auscultation Bowel sounds Any vascular sounds 3. Percussion All four quadrants Borders of liver, spleen 4. Palpation Light palpation in all four quadrants Deeper palpation in all four quadrants Palpation for liver, spleen, and kidneys 5. Health promotion and teaching

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CHAPTER 23 Anus, Rectum, and Prostate Written by Carolyn Jarvis, PhD, APN, CNP Adapted by Marian Luctkar-Flude, RN, MScN • Animations • Bedside Assessment Summary Checklist • Case Study: • Rectal Cancer • Examination Review Questions • Health Promotion Guide: • Colon and Rectal Cancer • Prostate Cancer • Key Points • Physical Examination Summary Checklist • Quick Assessment for Common Conditions: • Benign Prostatic Hypertrophy OUTLINE Structure and Function 583 Anus and Rectum Prostate Regional Structures Special Considerations for Advanced Practice 590 Palpate the Anus and Rectum Documentation and Critical Thinking 593 Subjective Data 585 Abnormal Findings 594 Health History Questions Objective Data 589 Inspect the Perianal Area STRUCTU R E A N D F U N C T I O N ANUS AND RECTUM The anal canal is the outlet of the gastrointestinal tract, and it is about 3.8 cm long in adults. It is lined with modified skin (which has no hair or sebaceous glands) that merges with rectal mucosa at the anorectal junction. The canal slants forward toward the umbilicus, forming a distinct right angle with the rectum, which rests back in the hollow of the sacrum. Although the rectum contains only autonomic nerves, numerous somatic sensory nerves are present in the anal canal and external skin, and so any trauma to the anal area will cause sharp pain. The anal canal is surrounded by two concentric layers of muscle called the sphincters (Figure 23-1). The internal sphincter is under involuntary control by the autonomic nervous system. The external sphincter surrounds the internal sphincter but also has a small section overriding the tip of the internal sphincter at the opening. It is under voluntary control. Except for the passing of feces and gas, the sphincters keep the anal canal tightly closed. The intersphincteric 583 Structure & Function 584 UNIT 3 Physical Examination Sigmoid colon Rectosigmoid junction Rectum Valves of Houston Peritoneum Rectal ampulla Levator ani muscle Anal canal Anal column Anal valve Anal crypt Anorectal junction Internal sphincter External sphincter Intersphincteric groove 23-1 Anatomy of the anal sphincters. groove separates the internal and external sphincters and is palpable. The anal columns (or columns of Morgagni) are folds of mucosa. These extend vertically down from the rectum and end in the anorectal junction (also called the mucocutaneous junction, pectinate line, or dentate line). This junction is not palpable, but it is visible on proctoscopy. Each anal column contains an artery and a vein. Under conditions of chronic increased venous pressure, the vein may enlarge, forming a hemorrhoid. At the lower end of each column is a small crescent fold of mucous membrane called the anal valve. The space above the anal valve (between the columns) is a small recess called the anal crypt. The rectum, which is 12 cm long, is the distal portion of the large intestine. It extends from the sigmoid colon, at the level of the third sacral vertebra, and ends at the anal canal. Just above the anal canal, the rectum dilates and turns posteriorly, forming the rectal ampulla. The rectal interior has three semilunar transverse folds called the valves of Houston. These cross half the circumference of the rectal lumen. Their function is unclear, but they may serve to hold feces as the flatus passes. The lowest is within reach of palpation, usually on the left side, and must not be mistaken for an intrarectal mass. © Pat Thomas, 2010. Peritoneal Reflection. The peritoneum covers only the upper two thirds of the rectum. In boys and men, the anterior part of the peritoneum reflects down to within 7.5 cm of the anal opening, forming the rectovesical pouch (Figure 23-2), and then covers the bladder. In girls and women, this area is termed the rectouterine pouch, and it extends down to within 5.5 cm of the anal opening. PROSTATE In boys and men, the prostate gland lies in front of the anterior wall of the rectum and 2 cm behind the symphysis pubis. It surrounds the bladder neck and the urethra and has 15 to 30 ducts that open into the urethra. The prostate secretes a thin, milky alkaline fluid that helps sperm viability. It is a bilobed structure that is round or heart-shaped. It measures 2.5 cm long and 4 cm in diameter. The two lateral lobes are separated by a shallow groove called the median sulcus. The two seminal vesicles project like rabbit ears above the prostate. The seminal vesicles secrete a fluid that is rich in fructose, which nourishes the sperm, and contains prostaglandins. The two bulbourethral (Cowper's) glands are each the size of a pea and are located inferior to the prostate on 585 Valves of Houston Seminal vesicles Peritoneal reflection Bladder Seminal vesicle Anorectal junction Rectal ampulla Prostate Bulbourethral gland 23-2 Peritoneal reflection. either side of the urethra (see Figure 23-5 on page 591). They secrete a clear, viscid mucus. REGIONAL STRUCTURES In girls and women, the uterine cervix lies in front of the anterior rectal wall and may be palpated through the wall. The combined length of the anal canal and the rectum is about 16 cm in the adult. The average length of the examining finger is 6 to 10 cm, and so many rectal structures are within reach. The sigmoid colon is named for its S-shaped course in the pelvic cavity. It extends from the iliac flexure of the descending colon and ends at the rectum. It is 40 cm long and is accessible to examination only through the colonoscope. The flexible fibreoptic colonoscope in current use provides a view of the entire mucosal surface of the sigmoid colon, as well as the colon itself. DEVELOPMENTAL CONSIDERATIONS The first stool passed by the newborn is dark green meconium; its occurrence, within 24 to 48 hours of birth, indicates anal patency. From that time on, the infant usually has a stool after each feeding. This response to eating is a wave of peristalsis called the gastrocolic reflex. It continues throughout life, although children and adults usually produce no more than one or two stools per day. The infant passes stools by reflex. Voluntary control of the external anal sphincter cannot occur until the nerves supplying the area have become fully myelinated, usually around 1½ to 2 years of age. Toilet training usually starts after age 2 years. At male puberty, the prostate gland undergoes a very rapid increase to more than twice its prepubertal size. During early adulthood, its size remains fairly constant. The prostate gland commonly starts to enlarge during the middle adult years. This enlargement, benign prostatic hypertrophy (BPH), is present in 1 per 10 men at the age of 40 years and increases with age. The hypertrophy is thought to be caused by a hormonal imbalance that leads to the proliferation of benign adenomas. These gradually impede urine output because they obstruct the urethra. The risk of developing prostate cancer also increases with age (see the box Health Promotion: Screening for Prostate Cancer, p. 587). SUBJ E C T I V E DATA 1. Usual bowel routine 2. Change in bowel habits 3. Rectal bleeding, blood in the stool 4. Medications (laxatives, stool softeners, iron) 5. Rectal conditions (pruritus, hemorrhoids, fissure, fistula) 6. Family history 7. Self-care behaviours (diet of high-fibre foods, most recent examinations) Subjective Data PROSTATE Lateral lobe Median sulcus Structure & Function CHAPTER 23 Anus, Rectum, and Prostate 586 UNIT 3 Physical Examination HEALTH HISTORY QUESTIONS Examiner Asks 1. Usual bowel routine. Do you defecate regularly? How often? What is the Subjective Data usual colour? Is it usually hard or soft? • Do you have any straining at stool, incomplete evacuation, or urge to have bowel movement but nothing comes? • Do you eat breakfast? • Do you have pain while passing a bowel movement? 2. Change in bowel habits. Any change in usual bowel habits? Do you have loose stools or diarrhea? When did this start? Is the diarrhea associated with nausea and vomiting, abdominal pain, something you ate recently? • Have you eaten at a restaurant recently? Anyone else in your group or family have the same symptoms? • Have you travelled to a foreign country during the past 6 months? • Do your stools have a hard consistency? When did this start? 3. Rectal bleeding, blood in the stool. Have you ever had? • When did you first notice blood in the stools? What is the colour: bright red or dark red-black? How much blood: spotting on the toilet paper or outright passing of blood with the stool? Do the bloody stools have a particular smell? • Have you ever had clay-coloured stools? • Have you ever had mucus or pus in stool? • Is your stool frothy? • Do you need to pass gas frequently? Rationale Assess usual bowel routine. Constipation is defined as three or fewer stools per week and is a common concern among older adults. Eating breakfast increases colon motility and prompts a bowel movement in many people. Pain with defecation (dyschezia) may be caused by a local condition (hemorrhoid, fissure) or constipation. Diarrhea occurs with gastroenteritis, colitis, and irritable bowel syndrome. Consider food poisoning. Consider parasitic infection. Constipation is characterized by stool hardness. Black or bloody stools (melena) should be investigated. Black stools may be tarry as a result of occult blood (melena) from gastrointestinal bleeding, or they may be nontarry as a result of ingestion of iron medications. Red blood in stools occurs with gastrointestinal bleeding or localized bleeding around the anus and also with colon and rectal cancer. Clay colour indicates absence of bile pigment. Steatorrhea is excessive fat in the stool, as occurs in malabsorption of fat. Excessive passing of gas (flatulence) should be investigated. 4. Medications. What medications do you take: prescription and over-the- counter? Laxatives or stool softeners? Which ones? How often? Iron pills? Do you ever use enemas to move your bowels? How often? 5. Rectal conditions. Do you have any problems in rectal area: itching, pain or burning sensation, hemorrhoids? How do you treat these? Do you use any hemorrhoid preparations? Ever had a fissure or fistula? How was this treated? • Have you ever had a problem controlling your bowels? 6. Family history. Any family history of polyps or cancer in the colon or rectum, inflammatory bowel disease, prostate cancer? 7. Self-care behaviours. What is the usual amount of high-fibre foods in your daily diet: cereals, apples or other fruits, vegetables, whole-grain breads? How many glasses of water do you drink each day? Pruritus (itching) can be caused by hemorrhoids. Such a problem is known as fecal incontinence. Mucoid discharge and soiling of underwear occur with prolapsed hemorrhoids. Assess risk factors for colon cancer, rectal cancer, prostate cancer. High-fibre foods of the soluble type (beans, prunes, barley, carrots, broccoli, cabbage) have been shown to lower cholesterol, and insoluble-fibre foods (cereals, wheat germ) reduce the risk of colon cancer. Also, high-fibre foods fight obesity, stabilize blood glucose levels, and help alleviate certain gastrointestinal disorders. CHAPTER 23 Anus, Rectum, and Prostate Examiner Asks 587 Rationale • What were the dates of your most recent digital rectal examination, stool blood test, colonoscopy, PSA blood test (for men)? For colon and prostate cancer screening guidelines for the early detection of cancer, refer to Table 23-1 and the Promoting Health boxes on the following pages. Additional History for Infants and Children 1. Skin problems. Have you ever noticed any irritation in your child's anal area: 2. Bowel movements. How are your child's bowel movements (BMs)? Fre- quency? Any problems? Any pain or straining with BM? TABLE 23-1 In children, pinworms are a common cause of intense itching and irritation of the anal skin. Assess usual stooling pattern. Constipation is a decrease in BM frequency, with difficult passing of very hard, dry stools. Encopresis is persistent passing of stools into clothing by a child older than age 4 years, at which age continence would be expected. Colon Cancer Screening Guidelines Level of Risk* Average risk: No affected family member Higher risk: One first-degree relative with cancer or polyp at age 60, or two or more second-degree relatives affected at any age Average-risk screening but beginning at age 40 One second-degree relative or third-degree relative affected Special screening: Hereditary nonpolyposis colorectal cancer (HNPCC) Familial adenomatous polyposis (FAP) Attenuated adenomatous polyposis (AAPC) Average-risk screening beginning at age 50 Colonoscopy every 1–2 years beginning at age 20 or 10 years younger than the youngest age at diagnosis of polyp or cancer in the family, whichever comes first Sigmoidoscopy annually beginning at age 10–12 years Colonoscopy annually beginning at age 16–18 years Source: Modified from Canadian Association of Gastroenterology and the Canadian Digestive Health Foundation. (2004). Guidelines on colon cancer screening.Retrieved from 20cancer%20screening%202004.pdf; and from Canadian Association of Gastroenterology. (2010). Position statement on screening individuals at average risk for developing colorectal cancer. Retrieved from . *First-degree relative is a parent, child, or sibling; second-degree relative is a grandparent, aunt, uncle, nephew, niece, or grandchild; third-degree relative is a cousin, great-grandparent, or great-grandchild. FIT, fecal immunochemical test; FOBT, fecal occult blood test. PROMOTING HEALTH: SCREENING FOR COLORECTAL CANCER Screening for Life Colorectal cancer is the third most common cancer among Canadian men and women. It is expected that colorectal cancer will be diagnosed in 1 per 14 Canadians during their lifetime (Canadian Cancer Society & Statistics Canada, 2011). Some factors that appear to increase the risk of developing it are being of older age, particularly >50 years; having polyps; having a family history of colorectal cancer, especially a parent, sibling, or child who developed it before the age of 45; having familial adenomatous polyposis or hereditary nonpolyposis colon cancer; having inflammatory bowel disease (ulcerative colitis or Crohn's disease); eating a diet high in red and processed meats; consuming alcohol; smoking; being physically inactive; being obese; and

having Ashkenazi (Eastern European) Jewish ancestry. However, colorectal cancer develops in some people who have none of Continued Subjective Data redness, raised skin, frequent itching? PROMOTING HEALTH: SCREENING FOR COLORECTAL CANCER—cont'd these risk factors. A diet high in vegetables and fruit is known to lower the risk, and a diet high in fibre and low in animal fats may also decrease the risk. Colorectal cancer may not cause any symptoms in its early stages. Symptoms often appear once the tumour causes bleeding or blocks the bowel. Possible symptoms include a change in bowel habits, such as diarrhea or constipation; general abdominal discomfort (bloating, sensation of fullness, cramps); blood in the stool (either bright red or very dark); stools that are narrower than usual; a strong urge to defecate; a feeling that the bowel has not completely emptied; nausea or vomiting; fatigue; and weight loss. Currently in Canada, screening for colorectal cancer with stool tests is recommended at least every 2 years for people aged 50 and over (see Table 23-1). There are two types of stool tests used in Canada. The guaiac-based fecal occult blood test (gFOBT) is the most common type of FOBT, and uses a chemical reaction on a paper card to find traces of blood in the stool from adenomatous polyps or tumours. The immunochemical-based fecal occult blood test (iFOBT) or fecal immunochemical test (FIT) is a newer and more sensitive test that uses specific antibodies for human blood to find traces of blood in the stool. A positive FOBT or FIT result may be followed up with a colonoscopy, flexible sigmoidoscopy, or double-contrast barium enema (Canadian Cancer Society, 2013). FIT is a more expensive test that is being used by some, but not all, colorectal screening programs in Canada. The Canadian Association of Gastroenterology (CAG) recommends FIT as the preferred screening test for individuals at average risk for developing colorectal cancer. The CAG also recommends that flexible sigmoidoscopy screening for colon cancer for all average-risk individuals with an interval of 10 years or longer between normal sigmoidoscopies (Leddin et al., 2010). Individuals who are at higher than average risk of developing colorectal cancer may need to be tested more often and at an earlier age than people with average risk, and should talk to their doctor about a personal plan for testing. A personal plan for testing may include gFOBT or FIT, colonoscopy, flexible sigmoidoscopy, double-contrast barium enema, and genetic risk assessment/testing. Sources: Data from Canadian Cancer Society. (2011). Colorectal cancer: Understanding your diagnosis. Retrieved from Canada-wide/Publications/Alphabetical%20list%20of%20publications/Colorectal%20cancer%20Understanding%20your%20diagnosis.aspx?sc_lang=en; and from Canadian Cancer Society & Statistics Canada. (2011). Canadian cancer statistics 2011: Featuring colorectal cancer. Retrieved from /2Fmedia/CCS/Canada%20wide/Files%20List/English%20files%20heading/PDF%20-%20Policy%20-%20Canadian%20Cancer%20Statistics%20-%20English/Canadian%20Cancer%20Statistics%202011%20-%20English.ashx. PROMOTING HEALTH: SCREENING FOR PROSTATE CANCER Understanding Prostate Changes Prostate cancer is the most common cancer among Canadian men. A Canadian man has a 1 in 7 chance of receiving a diagnosis of prostate cancer during his lifetime (Izawa et al., 2011). Some factors that appear to increase the risk of developing it are being of older age, particularly >65 years; a family history of prostate cancer; a diet high in fat; and African ancestry. Obesity, physical inactivity, and exposure to cadmium are being studied as possible risk factors. Some men develop prostate cancer without any of these risk factors. Prostate cancer may not cause signs or symptoms, especially in the early stages. Symptoms may appear if the tumour enlarges the prostate and starts to press on the urethra, making the passage of urine difficult or painful or increasing the frequency of urination. Throughout much of a man's life, the prostate gland is typically the size of a walnut. However, by the time a man is 40, it may grow slightly larger, to the size of an apricot. By age 60, it may be the size of a lemon. Although the size varies between individuals, this gradual enlargement is considered to be a normal part of aging. This enlargement is termed benign prostatic hypertrophy (BPH). It does not increase an individual's risk for prostate cancer, but the symptoms for BPH can be very similar to those of prostate cancer. The risks and benefits of testing for prostate cancer should be discussed with men aged 50 years and older. Men who are at higher risk for prostate cancer because of family history or African ancestry should discuss the possibility of starting testing at a younger age. The digital rectal examination (DRE) and the prostate-specific antigen (PSA) blood test can help detect prostate cancer early, but they can also yield false-positive results or miss prostate cancer that is present (false-negative results). In some cases these tests can detect prostate cancer that may not pose a serious threat to a man's health. There is very little evidence to support the widespread use of PSA screening among men who have no symptoms; some evidence exists to support its use among men in moderate- to high-risk groups; and there is no evidence to support its use among men with life expectancies of less than 10 years (O'Rourke, 2011). It is important to talk to men about their personal risk of developing prostate cancer and about the benefits and risks of testing. PSA is a substance made by the normal prostate gland. When prostate cancer develops, the PSA level increases. However, benign or noncancerous enlargement of the prostate (e.g., BPH), age, and prostatitis can also cause PSA levels to increase. Ejaculation causes a temporary increase in PSA levels, and men need to be instructed to abstain from ejaculation for 2 days before having their PSA level tested. In addition, some medications, such as finasteride (Proscar) or dutasteride (Avodart), artificially lower PSA levels. If the PSA level is elevated, further laboratory work or transrectal ultrasonography and biopsy may be recommended. In the DRE, the examiner inserts a gloved, lubricated finger into the patient's rectum. The prostate gland is located just in front of the rectum, and so it is possible to palpate the surface of the gland manually for lumps or hard areas that may represent developing prostate cancer. Although the DRE is less effective than the PSA blood test in detecting prostate cancer, it can sometimes help detect cancers in men who have normal PSA levels. For this reason, it is recommended that PSA and DRE be performed together in screening for prostate cancer. A biopsy performed during transrectal ultrasonography is usually necessary to make a definitive diagnosis of cancer. More details are available from the Canadian Cancer Society (2010). Sources: Data from Canadian Cancer Society. (2007). Prostate cancer: Understanding your diagnosis. Retrieved from Canada-wide/Publications/Alphabetical%20list%20of%20publications/Prostate%20cancer%20Understanding%20your%20diagnosis.aspx?sc_lang=en; and from Canadian Cancer Society. (2010). Prostate cancer. Retrieved from 20 checked/Prostate%20cancer%20NEW.aspx?sc_lang=en. CHAPTER 23 Anus, Rectum, and Prostate 589 OBJ E C T I V E DATA P R EPARATION E Q U I P M E N T N E E D E D Perform a rectal examination on all adults and particularly for those in middle and older years. Help the patient assume one of the following positions (Figure 23-3): Examine a male patient in the left lateral decubitus or standing position. Instruct the standing male patient to point his toes together; this relaxes the regional muscles, making it easier to spread the buttocks. Place the female patient in the lithotomy position if you are examining genitalia as well; use the left lateral decubitus position for examination of the rectal area alone. These positions leave many patients feeling vulnerable and embarrassed. You can help the patient relax and retain a sense of control by using these measures: • Ensure privacy. • Explain each step in the examination before you perform it. • Use a gentle, firm touch and gradual movements. • Communicate throughout the examination. Maintain a dialogue to share information. Penlight Lubricating jelly Glove Guaiac test container Objective Data Left lateral Lithotomy Standing 23-3 Positions for rectal examination. Normal Range of Findings Abnormal Findings INSPECT THE PERIANAL AREA Spread the buttocks wide apart, and observe the perianal region. The anus normally looks moist and hairless, with coarse folded skin that is more pigmented than the perianal skin. The anal opening is tightly closed. No lesions are present. Inspect the sacrococcygeal area. Normally, it appears smooth and even. Instruct the patient to hold the breath and bear down (i.e., perform a Valsalva manoeuvre). No break in skin integrity or protrusion through the anal opening should be present. Describe any abnormality in clock face terms, with "12:00 position" as the anterior point toward the symphysis pubis and "6:00 position" toward the coccyx (Figure 23-4). Inflammation; lesions or scars. Linear split: fissure. Flabby skin sac: hemorrhoid. Shiny blue skin sac: thrombosed hemorrhoid. Small round opening in anal area: fistula (see Table 23-2 on p. 594). Inflammation or tenderness, swelling, tuft of hair, or dimple at tip of coccyx may indicate pilonidal cyst (see Table 23-2). Appearance of fissure or hemorrhoids. Circular red "doughnut" of tissue: rectal prolapse. 590 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings DEVELOPMENTAL CONSIDERATIONS Infants and Children To examine a newborn, hold the feet with one hand and flex the knees up onto the abdomen. Note the presence of the anus. Confirm patency of the rectum and anus by noting the first meconium stool passed within 24 to 48 hours of birth. To assess sphincter tone, check the anal reflex: Gently stroke the anal area and note a quick contraction of the sphincter. In an infant or child, note that the buttocks are firm and rounded with no masses or lesions. Recall that the mongolian spot is a common variation of hyperpigmentation in newborns of African, Asian, Mediterranean, or Aboriginal descent (see Table 13). Objective Data The perianal skin is free of lesions. However, diaper rash is common in children younger than 1 year and manifests as a generalized reddened area with papules or vesicles. Imperforate anus. Flattened buttocks, as in cystic fibrosis or celiac syndrome. Coccygeal mass. Meningocele (sac containing meninges that protrude through a defect in the bony spine). Tuft of hair or pilonidal dimple. Pustules indicate secondary infection of diaper rash. Signs of physical or sexual abuse include anal abrasions and perianal tears. Fissure is a common cause of constipation or rectal bleeding in children. (Because it is painful, the child does not defecate.) Omit palpation unless the history or symptoms warrant. When internal palpation is needed, position the infant or child on the back with the legs flexed, and gently insert a gloved, well-lubricated finger into the rectum. Your fifth finger usually is long enough, and its smaller size is more comfortable for an infant or child. However, you may need to use the index finger because of its better control and increased tactile sensitivity. On withdrawing the finger, scant bleeding or protruding rectal mucosa may be evident. Inspect the perianal region of a school-age child or adolescent during examination of the genitalia. Internal palpation is not performed routinely in patients of these ages. Older Adults Special Considerations for Advanced Practice As an older adult performs the Valsalva manoeuvre, you may note relaxation of the perianal musculature and decreased sphincter control. Otherwise, the full examination proceeds as described earlier for younger adults. SPECIAL CONSIDERATI O N S F O R A D V A N C E D P R A C T I C E Normal Range of Findings PALPATE THE ANUS AND RECTUM Drop lubricating jelly onto your gloved index finger. Inform the patient that palpation is not painful but that he or she may feel the need to move the bowels. Place the pad of your index finger gently against the anal verge (Figure 23-4). You will feel the sphincter tighten and then relax. As it relaxes, flex the tip of your finger and slowly insert it into the anal canal in a direction toward the umbilicus. Never approach the anus at right angles with your index finger extended. Such a jabbing motion does not promote sphincter relaxation and is painful. Abnormal Findings CHAPTER 23 Anus, Rectum, and Prostate 591 Abnormal Findings 23-4 Palpating the anal canal. Normal Range of Findings Abnormal Findings Rotate your examining finger to palpate the entire muscular ring. The canal should feel smooth and even. Note the intersphincteric groove circling the canal wall. To assess tone, ask the patient to tighten the muscle. The sphincter should tighten evenly around your finger without causing pain for the patient. Use a bidigital palpation technique, with your thumb against the perianal tissue (Figure 23-5). Press your examining finger toward it. This manoeuvre helps you detect any swelling or tenderness and helps you assess the bulbourethral glands. 23-5 Examiner's thumb against perianal tissue. Special Considerations for Advanced Practice Bulbourethral gland Decreased tone should be investigated. Increased tone occurs with inflammation and anxiety. Tenderness should be investigated. 592 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Above the anal canal, the rectum turns posteriorly, following the curve of the coccyx and sacrum. Insert your finger farther, and explore all around the rectal wall. It normally feels smooth with no nodularity. Promptly report any mass you discover for further examination. An internal hemorrhoid above the anorectal junction is not palpable unless it is thrombosed. A soft, slightly movable mass may be a polyp. A firm or hard mass with irregular shape or rolled edges may signify carcinoma (see Table 23-3, Abnormalities of the Rectum, p. 596). Prostate Gland. On the anterior wall in a male patient, note the elastic, bulging prostate gland (Figure 23-6). Palpate the entire prostate in a systematic manner, but note that only the superior surface and part of the lateral surface are accessible to examination. Press into the gland at each location, because when a nodule is present, it does not project into the rectal lumen. The surface should feel smooth and muscular; search for any distinct nodule or diffuse firmness. Ampulla of ductus deferens Bladder Special Considerations for Advanced Practice Seminal vesicle Prostate gland 23-6 Palpating the prostate gland. Note these characteristics: Size: 2.5 cm long by 4 cm wide; should not protrude more than 1 cm into the rectum Shape: Heart shape, with palpable central groove Surface: Smooth Consistency: elastic, rubbery Mobility: slightly movable Sensitivity: nontender to palpation Enlargement or atrophy. Flatness with no groove. Nodularity. Hardness or boggy, soft, fluctuant texture. Fixed position. Tenderness. Enlargement, firmness, and smoothness with central groove obliterated: suggestive of BPH. CHAPTER 23 Anus, Rectum, and Prostate Normal Range of Findings 593 Abnormal Findings Swelling and exquisite tenderness: accompanies prostatitis. Any stone-hard, irregular, fixed nodule: indicates carcinoma (see Table 23-4). In a female patient, palpate the cervix through the anterior rectal wall. It normally feels like a small round mass. You also may palpate a retroverted uterus or a tampon in the vagina. Do not mistake the cervix or a tampon for a tumour. Withdraw your examining finger; normally, no mucus or bright red blood is on the glove. To complete the examination, offer the patient tissues to remove the lubricant, and help the patient to a more comfortable position. Examination of Stool. Inspect any feces remaining on the glove. Normally, the colour is brown, and the consistency is soft. Test any stool on the glove for occult blood; use the specimen container that your agency directs. A negative response is normal. A positive Hematest result indicates occult blood. However, a false-positive finding may occur if the patient has ingested significant amounts of red meat within 3 days of the test. D O CUMENTATION A N D C R I T I C A L T H I N K I N G Sample Charting Subjective States has one BM daily, soft, brown; no pain, no recent change. No hemorrhoids. Has no history of pruritus, hemorrhoids, fissure, or fistula. Diet includes one to two servings daily each of fresh fruits and vegetables but no whole-grain cereals or breads. Objective No fissure, hemorrhoids, fistula, or skin lesions in perineal area. Sphincter tone good, no prolapse. Rectal walls smooth, no masses or tenderness. Prostate not enlarged, no masses or tenderness. Stool brown, Hematest result negative. ASSESSMENT Rectal structures intact, no palpable lesions Documentation & Critical Thinking Jelly-like shreds of mucus mixed in stool indicate inflammation. Bright red blood on stool surface indicates possible rectal bleeding. Black tarry stool with distinct malodour indicates upper gastrointestinal bleeding with blood partially digested. (More than 50 mL of blood from upper gastrointestinal tract must be lost for this stool to be considered melena.) Black stool also occurs with ingesting iron or bismuth preparations. Grey, tan stool indicates the absence of bile pigment, as in obstructive jaundice. Pale yellow, greasy stool is indicative of increased fat content (steatorrhea), as occurs with malabsorption syndrome. Occult bleeding usually indicates cancer of the colon. 594 UNIT 3 Physical Examination Focused Assessment: Clinical Case Study C.M. is a 62-year-old male with chronic obstructive pulmonary disease for 15 years, who today describes having had "diarrhea for 3 days." SUBJECTIVE • 7 days PTA: C.M. seen at this agency for acute respiratory infection that was diagnosed as acute bronchitis and treated with oral ampicillin. Took medication as directed. • 3 days PTA: Symptoms or respiratory infection improved. Ingesting usual diet. Onset of four to five loose, unformed, brown stools a day. No abdominal pain or cramping. No nausea. • Now: Diarrhea continues. No blood or mucus noticed in stool. No new foods or restaurant food in past 3 days. Has not vomited. OBJECTIVE Vital signs: Temp 37°C, HR 88, RR 18, BP 142/82. Respiratory: Respirations unlabored. Barrel chest. Hyperresonant to percussion. Lung sounds clear but diminished. No crackles or rhonchi today. Abdomen: Flat. Bowel sounds present. No organomegaly or tenderness to palpation. Rectal: No lesions in perianal area. Sphincter tone good. Rectal walls smooth, no masses or tenderness. Stool brown, Hematest result negative. ASSESSMENT Documentation & Critical Thinking Diarrhea R/T effects of antibiotic medication ABNO R M A L F I N D I N G S TABLE 23-2 Abnormalities of the Anal Region Fistula Sinus tract Abscess Pilonidal cyst External hemorrhoid Anal Findings Indurated cord Pilonidal Cyst or Sinus A hair-containing cyst or sinus located in the midline over the coccyx or lower sacrum. Often opens as a dimple with visible tuft of hair and, possibly, an erythematous halo, or may even appear as a hair-filled pouch. Although cyst may be present since birth, cyst does not appear until the ages of 15 and 30 years. Anorectal Fistula A chronically inflamed anterior/interior tract creates an abnormal passage from inner anus or rectum out to skin surrounding anus. Usually originates from a local abscess. The red, raised tract opening may drain serosanguineous or purulent matter when pressure is applied. Bidigital palpation may reveal an indurated spinal cord. CHAPTER 23 Anus, Rectum, and Prostate TABLE 23-2 595 Abnormalities of the Anal Region—cont'd Internal hemorrhoid Hypertrophic papilla Fissure Sentinel tag Thrombosed external hemorrhoid Hemorrhoids These painless, flabby papules are varicose veins of the hemorrhoidal plexus. An external hemorrhoid originates below the anorectal junction and is covered by anal skin. When thrombosed, it contains clotted blood and becomes a painful, swollen, shiny blue mass that itches and bleeds with defecation. When it resolves, it leaves a painless, flabby skin sac around the anal orifice. An internal hemorrhoid originates above the anorectal junction and is covered by mucous membrane. When the patient performs a Valsalva manoeuvre, it may appear as a red mucosal mass. It is not palpable. All hemorrhoids result from increased portal venous pressure, as occurs with straining at stool, chronic constipation, pregnancy, obesity, chronic liver disease, or the low-fibre diet common in Western society. Rectal Prolapse The rectal mucous membrane protrudes through the anus, appearing as a moist red doughnut with radiating lines. When prolapse is incomplete, only the mucous bulges. When complete, the anal sphincters also show. Pruritus Ani Intense perianal itching is manifested by red, raised, thickened, excoriated skin around the anus. Common causes are pinworms in children and fungal infections in adults. The area is swollen and moist, and with a fungal infection, it appears dull greyish pink. The skin is dry and brittle with psychosomatic itching. Pruritus ani is classified as idiopathic when no cause can be found (Markell & Billingham, 2010). Abnormal Findings Fissure A painful longitudinal tear in the superficial mucosa at the anal margin. Most fissures (>90%) occur in the posterior midline area. They are frequently accompanied by a papule of hyperplastic skin, called a sentinel tag, on the anal margin below. Fissures often result from trauma: for example, from passing a large, hard stool or from irritant diarrheal stools. Fissures cause itching, bleeding, and exquisite pain. A resulting spasm in the sphincters makes the area painful to examine; local anesthesia may be indicated. 596 TABLE 23-3 UNIT 3 Physical Examination Abnormalities of the Rectum Submucosal Pedunculated Sessile Perianal Ischiorectal Abscess A localized cavity of pus from infection in a pararectal space. Infection usually extends from an anal crypt. Characterized by persistent throbbing rectal pain. Termed according to the space it occupies (e.g., a perianal abscess is superficial around the anal skin) and appears red, hot, swollen, indurated, and tender. An ischiorectal abscess (lateral, between the anus and ischial tuberosity) is deep and tender to bidigital palpation. It is uncommon. Rectal Polyp A growth protruding from the rectal mucous membrane that is fairly common. The polyp may be pedunculated (on a stalk) or sessile (a mound on the surface, close to the mucosal wall). The soft nodule is difficult to palpate. Proctoscopy is needed, as is biopsy, to screen for malignancy. Rolled-edge neoplasm Abnormal Findings Fecal Impaction A collection of hard, desiccated feces in the rectum. The obstruction often results from decreased bowel motility, in which more water is reabsorbed from the stool. Also occurs when barium is retained after gastrointestinal x-ray examination. The patient may complain of constipation or of diarrhea as a fecal stream passes around the impaction. Carcinoma A malignant neoplasm in the rectum is asymptomatic; thus routine rectal palpation is important. An early lesion may be a single firm nodule. You may palpate an ulcerated centre with rolled edges. As the lesion grows, its shape is irregular, like cauliflower, and it is fixed and stone hard. Refer a patient with any rectal lesion for further study because about half of such lesions are malignant. CHAPTER 23 Anus, Rectum, and Prostate TABLE 23-4 597 Abnormalities of the Prostate Gland Benign Prostatic Hypertrophy (BPH) S: Urinary frequency, urgency, hesitancy, straining to urinate, weak stream, intermittent stream, sensation of incomplete emptying, nocturia. O: A symmetrical nontender enlargement, commonly occurs in men beginning in middle age. The prostate surface feels smooth, rubbery, or firm (like the consistency of the nose), and the median sulcus is obliterated. Prostatitis S: Fever, chills, malaise, urinary frequency and urgency, dysuria, urethral discharge; dull, aching pain in perineal and rectal area. O: Acute inflammation of the prostate gland causes the gland to become swollen, slightly asymmetrical, and quite tender to palpation. With a chronic inflammation, the signs can vary from tender enlargement with a boggy texture to isolated areas of firmness caused by fibrosis. Alternatively, the gland may feel normal. ● Carcinoma S: Frequency, nocturia, hematuria, weak stream, hesitancy, pain or burning on urination, continuous pain in lower back, pelvis, thighs. O: A malignant neoplasm often starts as a single hard nodule on the posterior surface (see diagram A), producing asymmetry and a change in consistency. As it invades normal tissue, multiple hard nodules appear, or the entire gland feels stone hard and fixed (see diagram B). The median sulcus is obliterated. A B S, Subjective data; O, objective data. Summary Checklist: Anus, Rectum, and Prostate Examination 1. Inspection perianal area 2. Inspecting during Valsalva manoeuvre 3. Palpating anal canal and rectum in all adults 4. Testing stool for occult blood 5. Teaching and health promotion Abnormal Findings Continued For a PDA-downloadable version, go to . 598 UNIT 3 Physical Examination REFERENCES Canadian Cancer Society. (2010). Prostate cancer. Retrieved from 20 checked/Prostate%20cancer%20NEW.aspx?sc_lang=en. Canadian Cancer Society & Statistics Canada. (2011). Canadian cancer statistics 2011. Retrieved from Canada-wide/About%20cancer/~/media/CCS/Canada%20wide/Files%20List/English%20files%20heading/PDF%20-%20Policy%20-%20Canadian%20Cancer%20Statistics%20-%20English.ashx. Canadian Cancer Society. (2013). Screening for colorectal cancer. Retrieved from cancer-type/colorectal/screening/?region=on Izawa, J. I., Klotz, L., Siemens, D. R., Kassouf, W., So, A., Jordan, J., ... & Iansavichene, A. E. (2011). 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Seminars in Oncology Nursing, 27, 4, 251–259. doi:10.1016/j.soncn.2011.07.003 CHAPTER 24 Musculoskeletal System Written by Carolyn Jarvis, PhD, APN, CNP Adapted by Marian Luctkar-Flude, RN, MScN • Animations • Bedside Assessment Summary Checklist • Case Study • Joint Pain • Numbness in Hands • Examination Review Questions • Health Promotion Guide: • Osteoporosis • Key Points • Physical Examination Summary Checklist • Quick Assessment for Common Conditions: • Degenerative Joint Disease (Osteoarthritis) • Fracture • Osteoporosis • Video—Assessment: • Lower Extremities • Musculoskeletal and Neurological Systems OUTLINE Structure and Function 599 Components of the Musculoskeletal System Special Considerations for Advanced Practice Knee 626 Spine Subjective Data 610 Special Considerations for Advanced Practice: Spine 632 Health History Questions Objective Data 613 Documentation and Critical Thinking 641 Order of the Examination Temporomandibular Joint Cervical Spine Upper Extremity Lower Extremity Abnormal Findings 642 STRUCTU R E A N D F U N C T I O N The musculoskeletal system consists of the body's bones, joints, and muscles. Humans need this system (a) for support to stand erect and (b) for movement. The musculoskeletal system also functions (c) to encase and protect the inner vital organs (e.g., brain, spinal cord, heart), (d) to produce the red blood cells in the bone marrow (hematopoiesis), and (e) as a reservoir for storage of essential minerals such as calcium and phosphorus in the bones. COMPONENTS OF THE MUSCULOSKELETAL SYSTEM The skeleton is the bony framework of the body. It has 206 bones, which support the body like the posts and beams of a building. Bone and cartilage are specialized forms of connective tissue. Bone is hard, rigid, and very dense. Its cells are continually turning over and remodelling. The joint (or articulation) is the place of union of two or more bones. 599 Structure & Function 600 UNIT 3 Physical Examination Tibia Cartilage Tendo calcaneus (Achilles tendon) Synovial membrane Synovial joint Synovial cavity Talus Capsular ligament Bursae Extensor tendon Flexor muscles Flexor tendon 24-1 Synovial joints. Joints are the functional units of the musculoskeletal system because they enable the mobility needed for activities of daily living (ADLs). Nonsynovial or Synovial Joints In nonsynovial joints, the bones are united by fibrous tissue or cartilage and are immovable (e.g., the sutures in the skull) or only slightly movable (e.g., the vertebrae). Synovial joints are freely movable because they have bones that are separated from each other and are enclosed in a joint cavity (Figure 24-1). This cavity is filled with a lubricant: synovial fluid. Just like grease on gears, synovial fluid allows sliding of opposing surfaces, and this sliding enables movement. In synovial joints, a layer of resilient cartilage covers the surface of opposing bones. Cartilage is avascular; it receives nourishment from synovial fluid that circulates during joint movement. It is a very stable connective tissue with a slow cell turnover. It has a tough, firm consistency and yet is flexible. Cartilage cushions the bones and provides a smooth surface to facilitate movement. Each joint is surrounded by a fibrous capsule and is supported by ligaments. Ligaments are fibrous bands running directly from one bone to another that strengthen the joint and help prevent movement in undesirable directions. A bursa is an enclosed sac filled with viscous synovial fluid, much like a joint. Bursae are located in areas of potential friction (e.g., subacromial bursa of the shoulder, prepatellar bursa of the knee) and help muscles and tendons glide smoothly over bone. Muscles Muscles account for 40% to 50% of the body's weight. When they contract, they produce movement. Muscles are of three types: skeletal, smooth, and cardiac. This chapter is concerned with skeletal, or voluntary, muscles, which are under conscious control. Each skeletal muscle is composed of bundles of muscle fibres (fasciculi). The skeletal muscle is attached to bone by a tendon, a strong fibrous cord. Skeletal muscles produce the following movements (Figure 24-2): 1. Flexion: bending a limb at a joint 2. Extension: straightening a limb at a joint 3. Abduction: moving a limb away from the midline of the body 4. Adduction: moving a limb toward the midline of the body 5. Pronation: turning the forearm so that the palm is down 6. Supination: turning the forearm so that the palm is up 7. Circumduction: moving the arm in a circle around the shoulder 8. Inversion: moving the sole of the foot inward at the ankle 9. Eversion: moving the sole of the foot outward at the ankle 10. Rotation: moving the head around a central axis 11. Protraction: moving a body part forward and parallel to the ground 12. Retraction: moving a body part backward and parallel to the ground 13. Elevation: raising a body part 14. Depression: lowering a body part Temporomandibular Joint The temporomandibular joint is the articulation of the mandible and the temporal bone (Figure 24-3). You can feel it in the depression anterior to the tragus of the ear. The temporomandibular joint enables jaw function for speaking and eating. 601 Pronation Flexion Supination Abduction Adduction Circumduction Extension Rotation Eversion Elevation Inversion Depression Protraction Retraction Structure & Function 602 UNIT 3 Physical Examination 24-2 Movements. Zygomatic arch of temporal bone Temporomandibular joint Zygomatic arch Upper joint cavity Articular disc Pterygoid muscle Lower joint cavity Joint capsule Synovial membrane SAGITTAL SECTION Condyle of mandible Joint capsule 24-3 External auditory meatus Structure & Function CHAPTER 24 Musculoskeletal System Structure & Function 602 UNIT 3 Physical Examination C7 T1 Scapula T7 T8 T12 L1 Iliac crest L4 Posterior superior iliac spine S2 Coccyx LANDMARKS OF THE SPINE 24-4 chewing. The joint allows three motions: (a) hinge action to open and close the jaws, (b) gliding action for protrusion and retraction, and (c) gliding action for side-to-side movement of the lower jaw. Spine The vertebrae are 33 connecting bones stacked in a vertical column (Figure 24-4). You can feel their spinous processes in a furrow down the midline of the back. The furrow has paravertebral muscles mounded on either side down to the sacrum, where it flattens. Humans have 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 3 to 4 coccygeal vertebrae. The following surface landmarks will orient you to their levels: • The spinous processes of C7 and T1 are prominent at the base of the neck. • The inferior angle of the scapula normally is at the level of the interspace between T7 and T8. • An imaginary line connecting the highest point on each iliac crest crosses L4. • An imaginary line joining the two symmetrical dimples that overlie the posterior superior iliac spines crosses the sacrum. A lateral view (Figure 24-5) shows that the vertebral column has four curves (a double S-shape). The cervical and lumbar curves are concave (inward or anterior), and the thoracic and sacrococcygeal curves are convex. The balanced 24-5 or compensatory nature of these curves, together with the resilient intervertebral discs, allows the spine to absorb a great deal of shock. The intervertebral discs are elastic fibrocartilaginous plates that constitute one fourth of the length of the column (Figure 24-6). Each disc centre has a nucleus pulposus, made of soft, semifluid, mucoid material that has the consistency of toothpaste in young adults. The discs cushion the spine like a shock absorber and help it move. As the spine moves, the elasticity of the discs allows compression on one side, with compensatory expansion on the other. If compression is too great, a disc can rupture, and the nucleus pulposus can herniate out of the vertebral column, compressing the spinal nerves and causing pain. The unique structure of the spine enables both upright posture and flexibility for motion. The motions of the vertebral column are flexion (bending forward), extension (bending back), abduction (to either side), and rotation. Shoulder The glenohumeral joint is the articulation of the humerus with the glenoid fossa of the scapula (Figure 24-7). Its balland-socket action allows great mobility of the arm in many axes. The joint is enclosed by a group of four powerful muscles and tendons that support and stabilize it. Together, these muscles and tendons are called the rotator cuff of the shoulder. The large subacromial bursa helps during abduction of the arm so that the greater tubercle of the humerus moves easily under the acromion process of the scapula. The bones of the shoulder have palpable landmarks to guide your examination (Figure 24-8). The scapula and the clavicle connect to form the shoulder girdle. You can feel the bump of the scapula's acromion process at the very top of the shoulder. Move your fingers in a small circle outward, Intervertebral disc Intervertebral foramen (exit of spinal nerves) 603 Spinous process Nucleus pulposus Ligaments Vertebral foramen (channel for spinal cord) Spinous process Body of lumbar vertebra Body of vertebra SUPERIOR VIEW SECTION Articular process T11 Costal facet Spinous process T12 Intervertebral disc L1 LATERAL VIEW Articular process 24-6 The vertebrae. Subacromial bursa Greater tubercle of humerus Acromion of scapula Clavicle Deltoid muscle Supraspinatus muscle Subacromial bursa Glenoid fossa of scapula Glenohumeral joint SHOULDER JOINT SUPERIOR VIEW SHOULDER WITH ARM ELEVATED 24-7 down, and around. The next bump is the greater tubercle of the humerus a few centimetres down and laterally, and from that the coracoid process of the scapula is a few centimetres medially. These surround the deeply situated joint. Elbow The elbow joint contains the three bony articulations of the humerus, radius, and ulna of the forearm (Figure 24-9). Its hinge action moves the forearm (radius and ulna) on one plane, allowing flexion and extension. The olecranon bursa lies between the olecranon process and the skin. Palpable landmarks are the medial and lateral epicondyles of the humerus and the large olecranon process of the ulna in between them. The sensitive ulnar nerve runs between the olecranon process and the medial epicondyle. The radius and ulna articulate with each other at two radioulnar joints, one at the elbow and one at the wrist. These Structure & Function CHAPTER 24 Musculoskeletal System Structure & Function 604 UNIT 3 Physical Examination Clavicle Acromion of scapula Supraspinatus muscle Subacromial bursa Greater tubercle of humerus Coracoid process of scapula Glenohumeral joint Biceps brachii muscle Joint capsule (shown transparent) BONY LANDMARKS OF THE SHOULDER – ANTERIOR VIEW 24-8 Lateral epicondyle at right angles: (a) flexion and extension and (b) side-to-side deviation. You can feel the groove of this joint on the dorsum of the wrist. The midcarpal joint is the articulation between the two parallel rows of carpal bones. It allows flexion, extension, and some rotation. The metacarpophalangeal and the interphalangeal joints enable finger flexion and extension. The flexor tendons of the wrist and hand are enclosed in synovial sheaths. Annular ligament Hip Right humerus Ulnar nerve Synovial membrane Medial epicondyle Olecranon process Olecranon bursa Radius Ulna RIGHT ELBOW – POSTERIOR VIEW 24-9 move together to enable pronation and supination of the hand and forearm. Wrist and Carpal Joints Of the body's 206 bones, more than half are in the hands and feet. The wrist, or radiocarpal joint, is the articulation of the radius (on the thumb side) and a row of carpal bones (Figure 24-10). Its condyloid action enables movement in two planes The hip joint is the articulation between the acetabulum and the head of the femur (Figure 24-11). As in the shoulder, ball-and-socket action enables a wide range of motion (ROM) on many axes. The hip has somewhat less ROM than the shoulder, but it has more stability, which befits its weightbearing function. Hip stability is enabled by powerful muscles that spread over the joint, by a strong fibrous articular capsule, and by the very deep insertion of the head of the femur. Three bursae facilitate movement. Palpation of these bony landmarks will guide your examination: You can feel the entire iliac crest, from the anterior superior iliac spine to the posterior superior iliac spine. The ischial tuberosity lies under the gluteus maximus muscle and is palpable when the hip is flexed. The greater trochanter of the femur is normally the width of the person's palm below the iliac crest and halfway between the anterior superior iliac spine and the ischial tuberosity. You can palpate it, when the person is standing, in a flat depression on the upper lateral side of the thigh. Articular cartilage 605 Radius Ulna Fibrous capsule Synovial membrane Synovial membrane of the radiocarpal joint JOINT DETAIL Synovial membranes between the carpal bones Metacarpophalangeal joint Interphalangeal joint BONES OF THE HAND – PALMAR VIEW 24-10 Anterior superior iliac spine Greater trochanter of femur Head of femur Articular capsule Acetabulum Iliopectineal bursa Pubis Obturator foramen Ischial tuberosity HIP JOINT 24-11 Knee The knee joint is the articulation of three bones—the femur, the tibia, and the patella (kneecap)—in one common articular cavity (Figure 24-12). It is the largest joint in the body and is complex. It is a hinge joint, enabling flexion and extension of the lower leg on a single plane. The knee's synovial membrane is the largest in the body. At the superior border of the patella, it forms a sac, called the suprapatellar pouch, that extends up as much as 6 cm behind the quadriceps muscle. Two wedge-shaped cartilages, the medial and lateral menisci, cushion the tibia and femur. The joint is stabilized by two sets of ligaments. The cruciate ligaments (not shown in Figure 24-12) crisscross within the Structure & Function CHAPTER 24 Musculoskeletal System Structure & Function 606 UNIT 3 Physical Examination Suprapatellar bursa Femur Femur Suprapatellar bursa Prepatellar bursa Prepatellar bursa Patella Patella Medial collateral ligament Infrapatellar fat pad Infrapatellar fat pad Medial meniscus Subcutaneous infrapatellar bursa Meniscus Joint capsule Gastrocnemius muscle Deep infrapatellar bursa Patellar ligament Tibia LEFT KNEE – MEDIAL VIEW Tibia SAGITTAL SECTION 24-12 Quadriceps muscle Lateral epicondyle of femur Patella Patellar ligament Lateral collateral ligament Medial condyle of tibia Lateral meniscus Lateral condyle of tibia Fibula Anterior cruciate ligament (joint opened to show detail) Tibial tuberosity LANDMARKS OF THE RIGHT KNEE JOINT 24-13 knee; they provide anterior and posterior stability and help control rotation. The collateral ligaments connect the joint at both sides; they provide medial and lateral stability and prevent dislocation. Numerous bursae prevent friction. One, the prepatellar bursa, lies between the patella and the skin. The infrapatellar fat pad is a small, triangular fat pad below the patella behind the patellar ligament. Landmarks of the knee joint start with the large quadriceps muscle, which you can feel on your anterior and lateral thigh (Figure 24-13). The muscle's four heads merge into a common tendon that continues down to enclose the round bony patella. Then the tendon inserts down on the tibial tuberosity, which you can palpate as a bony prominence in the midline. Move to the sides and a bit superiorly, and note the lateral and medial condyles of the tibia. Superior to these on either side of the patella are the medial and lateral epicondyles of the femur. Ankle and Foot The ankle, or tibiotalar joint, is the articulation of the tibia, fibula, and talus (Figure 24-14). It is a hinge joint, limited to flexion (dorsiflexion) and extension (plantar flexion) in one plane. Landmarks are two bony prominences on either side: the medial malleolus and the lateral malleolus. Strong, tight medial and lateral ligaments extend from each malleolus onto the foot. These help the lateral stability of the ankle joint, although they may be torn in eversion or inversion sprains of the ankle. Joints distal to the ankle provide additional mobility in the foot. The subtalar joint enables inversion and eversion of the foot. The foot has a longitudinal arch, so that weight bearing is distributed between the parts that touch the ground: the heads of the metatarsals and the calcaneus (heel). DEVELOPMENTAL CONSIDERATIONS Infants and Children By 3 months' gestation, a "scale model" of the skeleton that is made up of cartilage has formed. During succeeding months in utero, the cartilage ossifies into true bone and starts to grow. Bone growth continues after birth—rapidly during infancy and then steadily during childhood—and during adolescence, when both boys and girls undergo a rapid growth spurt. Long bones grow in two dimensions. They increase in width or diameter by deposition of new bony tissue around the shafts. Lengthening occurs at the epiphyses (growth 607 Tibia Fibula Medial malleolus Tibiotalar joint Navicular bone Cuneiform bones Talonavicular joint Deltoid ligament Lateral malleolus Talus Tarsometatarsal joint Subtalar joint Talocalcaneal interosseous ligament Calcaneofibular ligament Calcaneus Subtalar joint Abductor muscle Calcaneus Cuboid bone Talus Metatarsal Flexor muscle ANKLE JOINT IN SECTION Distal phalanx Proximal phalanx Middle phalanx DORSAL VIEW (TOP OF FOOT) 24-14 plates). These specialized growth centres are transverse discs located at the ends of long bones. Any trauma or infection at this location puts the growing child at risk for bone deformity. This longitudinal growth continues until closure of the epiphyses; the last closure occurs at about age 20 years. Skeletal contour changes are apparent at the vertebral column. At birth the spine has a single C-shaped curve. At 3 to 4 months, when the baby can raise the head from the prone position, the anterior curve in the cervical neck region develops. From ages 1 year to 18 months, standing erect causes the development of the anterior curve in the lumbar region. Although the skeleton contributes to linear growth, muscles and fat are significant for weight increase. Individual muscle fibres grow through childhood, but growth is marked during the adolescent growth spurt. At this time, muscles respond to increased secretion of growth hormone, to adrenal androgens, and, in boys, to further stimulation by testosterone. Muscles vary in size and strength in different people. This variation is attributable to genetic programming, nutrition, and exercise. All through life, muscles increase with use and atrophy with disuse. The term developmental dysplasia of the hip (DDH) refers to a number of congenital abnormalities of the hip joint, including dislocated hip and subluxation of the hip. The Canadian Task Force on Preventive Health Care (Patel & Canadian Task Force on Preventive Health Care, 2001) recommends clinical examination of the hips by a trained clinician in the periodic health examination of all infants during the first week of life, during the first month, and then at 2, 4, 6, 9, and 12 months of age. Potential risk factors for DDH include having a first-degree relative with DDH, breech delivery, and clinical evidence of joint instability. Girls are more predisposed than boys to DDH, and Canadian Aboriginal people have a high risk for DDH. The most common cause of childhood musculoskeletal pain is termed "growing pains," a noninflammatory pain syndrome affecting children mainly between the ages of 3 and 12 years (Uziel & Hashkes, 2007). The pain is usually nonarticular, bilateral, and located in the lower extremities; it occurs late in the day or is nocturnal, often awakening the child, and it frequently occurs on days of increased physical activity. The pain can be mild or very severe, lasting minutes to hours; is generally episodic but may occur daily; and usually resolves by late childhood. Pregnant Women Increased levels of circulating hormones (estrogen, relaxin from the corpus luteum, and corticosteroids) cause increases in mobility in the joints. Increased mobility in the sacroiliac, sacrococcygeal, and symphysis pubis joints in the pelvis contributes to the noticeable changes in maternal posture. The most characteristic change is progressive lordosis, which compensates for the enlarging fetus; otherwise, the centre of balance would shift forward. Lordosis compensates by shifting the weight farther back on the lower extremities. This shift in balance, in turn, creates strain on the low back muscles, which in some women is felt as low back pain during late pregnancy. Anterior flexion of the neck and slumping of the shoulder girdle are other postural changes that compensate for the lordosis. These upper back changes may put pressure on the ulnar and median nerves during the third trimester. Nerve pressure creates aching, numbness, and weakness in the upper extremities in some women. Older Adults Bone remodelling is a cyclic process of loss of bone matrix (bone resorption) and new bone growth (deposition). Deposition predominates until skeletal maturity at 25 to 35 years, when bone mass reaches its peak (Pigozzi et al., 2009). After age 40, resorption occurs more rapidly than does deposition. The net effect is a loss of bone density (osteoporosis). Although some degree of osteoporosis is nearly universal, women are more affected than are men because for 5 years after menopause, the lack of estrogen causes bone loss to accelerate. People of European descent are also more affected Structure & Function CHAPTER 24 Musculoskeletal System Structure & Function 608 TABLE 24-1 UNIT 3 Physical Examination Indications for Measuring Bone Mineral Density to Assess for Osteoporosis Older Adults (Age ≥ 50 Years) Younger Adults (Age < 50 Years) Age ≥ 65 yr (both women and men) Clinical risk factors for fracture in men aged 50-64 yr and in menopausal women: • Fragility fracture after age 40 yr • Prolonged use of glucocorticoids* • Use of other high-risk medications† • Parental hip fracture • Vertebral fracture or osteopenia identified on radiography • Current smoking • High alcohol intake • Low body weight (10% of body weight at age 25 yr) • Rheumatoid arthritis • Other disorders strongly associated with osteoporosis Fragility fracture Prolonged use of glucocorticoids* Use of other high-risk medication† Hypogonadism or premature menopause (age < 45 yr) Malabsorption syndrome Primary hyperparathyroidism Other disorders strongly associated with rapid bone loss and/or fracture Source: From Papaioannou, A., Morin, S., Cheung, A. M., Atkinson, S., Brown, J. P., Feldman, S., ... Scientific Advisory Council of Osteoporosis Canada. (2010). 2010 Clinical practice guidelines for the diagnosis and management of osteoporosis in Canada: Summary. Canadian Medical Association Journal, 182(17), 1864–1873. doi:10.1503/cmaj.100771 *At least 3 months of cumulative therapy in the previous year at a prednisone-equivalent dose of ≥7.5 mg daily. † For example, aromatase inhibitors or androgen deprivation therapy. than are people of African descent. Risk factors for fracture associated with osteoporosis are listed in Table 24-1. Postural changes are evident with aging, and decreased height is the most noticeable. Long bones do not shorten with age; decrease in height is caused by shortening of the vertebral column. This is caused by loss of water content and thinning of the intervertebral discs, which occurs more in middle age. Also, the height of individual vertebrae decreases, which occurs in later years as a result of osteoporosis. Both men and women can expect a progressive decrease in height beginning at age 30 years and accelerating with increasing age; cumulative height loss from ages 30 to 70 years averages about 3 cm for men and 5 cm for women, and by age 80 years, the cumulative height loss is 5 cm for men and 8 cm for women (Sorkin, Muller, & Andres, 1999). The decrease during the 70s and 80s is greater as a result of osteoporotic collapse of the vertebrae, which results in shortening of the trunk and the appearance of comparatively long extremities. Other postural changes are kyphosis, a backward head tilt to compensate for the kyphosis, and a slight flexion of hips and knees. The distribution of subcutaneous fat changes through life. Usually, men and women gain weight in their 40s and 50s. The body contour is different, even if the weight is the same as when they were younger. They begin to lose fat in the face and deposit it in the abdomen and hips. In the 80s and 90s, fat further decreases in the periphery, noticeably in the forearms and over the abdomen and hips. Loss of subcutaneous fat leaves bony prominences more marked (e.g., tips of vertebrae, ribs, iliac crests) and body hollows deeper (e.g., cheeks, axillae). An absolute loss in muscle mass occurs; some muscles decrease in size, and some atrophy, which causes weakness. The contour of muscles becomes more prominent, and muscle bundles and tendons feel more distinct. Lifestyle affects musculoskeletal changes; a sedentary lifestyle hastens the musculoskeletal changes of aging. However, physical exercise increases skeletal mass. This helps prevent or delay bone loss and osteoporosis in postmenopausal women (Schmitt, Schmitt, & Doren, 2009), and in older men (Cousins et al., 2010; see the box Promoting Health: Preventing Osteoporosis). In 2009, only 52.5% of Canadians were at least moderately active during their leisure time; their activity was equivalent to walking at least 30 minutes a day or taking an hour-long exercise class at least three times a week (Statistics Canada, 2011b). CULTURAL AND SOCIAL CONSIDERATIONS Arthritis is one of the most prevalent chronic health conditions and a leading cause of pain, physical disability, and health care utilization in Canada; in 2011, more than 4.7 million Canadians (14%) aged 15 and older reported that they had arthritis (Statistics Canada, 2012), and the number is expected to increase to 7 million (20%) by 2031, as a result of the aging of the population (Public Health Agency of Canada, 2010). Nearly two thirds of those affected were women. The prevalence of arthritis increases with age; however, of every five people with arthritis, nearly three were younger than 65 years, and their disability frequently resulted in loss of work and productivity. Prevalence of arthritis was higher among people with lower education and income level, and 1.3 to 1.6 times higher among First Nations and Métis adults. Osteoarthritis is the most prevalent type of arthritis, affecting more than 3 million Canadians (Arthritis Society, 2011a). Risk factors for osteoarthritis include increasing age, family history, excess weight, and joint injury. About 300,000 Canadians have rheumatoid arthritis; three times more women than men are affected (Arthritis Society, 2011b). The cause of rheumatoid arthritis is unknown, and it can occur at any age, including childhood, but it usually appears between the ages of 25 and 50. Hip fractures are a serious consequence of falls in older adults. More than 28,000 hospitalizations for hip fractures 609 PROMOTING HEALTH: PREVENTING OSTEOPOROSIS Don't Overlook Osteoporosis Bone is a living tissue that continually grows and changes. Every day old bone dissolves and is replaced with new, stronger bone. Until a person is 30 years old, new bone appears at a faster rate than the bone disappears. As people age, however, the opposite begins to occur. When this happens, bones can become "spongy," weak, and more likely to break with even the slightest of twists or bumps. This condition is called osteoporosis. The bones of the wrist, hip, and spine are most often affected. Osteoporosis is more common in women, slender people, and individuals of European descent. It has been estimated that one per four women and one per eight men in Canada have osteoporosis. Postmenopausal women are especially vulnerable because of hormonal changes. Osteoporosis tends to run in families, but lifestyle choices can increase the risk even in individuals without a family history. A person whose calcium intake is low or who lacks exercise, smokes, or consumes large quantities of alcohol is at higher risk for developing osteoporosis. Longterm use of proton pump inhibitor medications to treat acid-related conditions such as stomach ulcers has also been associated with an increased risk of osteoporosis-related fractures (Targownik et al., 2008). Osteoporosis Canada (Papaioannou et al., 2010) recommends that all women and men older than 50 be assessed for the presence of risk factors for osteoporosis and fracture. Bone mineral density (BMD) testing is used to diagnose osteoporosis and predict fracture risk. BMD testing is recommended for all women aged 65 and older and for those with clinical risk factors for fracture such as fragility fracture after age 40, prolonged use of glucocorticoids, or parental hip fracture (see Table 24-1). Prevention of osteoporosis is important because there is no cure, only treatment, for osteoporosis. The gold standard for treatment of osteoporosis has traditionally been hormone replacement therapy (HRT), which has been shown to prevent bone loss and to improve bone mineralization. However, new research indicates that HRT may carry an increased risk for breast cancer and myocardial infarction in women. Alternative therapies that include exercise and diet provide similar, if not equal, benefits for women at risk for osteoporosis. Recommendations for Bone Health 1. Diet. Adequate intake of calcium and vitamin D are necessary to maintain bone health. a. Dine on dairy. Low-fat and skim milk, nonfat yogourt, and reduced-fat cheese are healthy sources of calcium. Fortified milk products also contain vitamin D, which is needed to absorb calcium. b. Go fish. Salmon and sardines, which are canned with their bones, are also rich in calcium. Also, oily fish such as mackerel are rich in vitamin D. c. Eat greens with gusto. Leafy green vegetables have a lot of calcium. Fill up on broccoli, kale, Swiss chard, turnip greens, and bok choy. In addition to the calcium, these foods contain potassium and vitamin K, which help block calcium loss from bones. d. Try soy. Soy contains calcium and plant estrogens. Try substituting soy flour for regular flour in recipes, nibbling on soybean "nuts," or drinking soy milk. e. Limit caffeine. Caffeine causes the body to excrete calcium more readily. Caffeine is present in coffee, tea, hot chocolate, and many carbonated drinks (e.g., cola). f. Eat onions. Although onions are not known to have any nutritive value, they appear to reduce the bone breakdown process that can lead to osteoporosis. 2. Exercise. Participate in weight-bearing activities. Bones and muscles must work against gravity to have a bone-building effect. A regular program of weight-bearing exercise for at least 30 minutes three times a week is recommended as the minimum. Try walking, low-impact aerobics, dancing, or stationary cycling. Resistance training with light weights or resistance bands are also recommended, and exercises that focus on posture and balance, such as tai chi, can help reduce the risk of falls. Sunshine also helps the body produce vitamin D. About 15 minutes of exposure to sunshine a day is all that is needed to maintain a good vitamin D supply. 3. Lifestyle. Avoid smoking and excessive alcohol, and seek help for depression. People who smoke have twice the risk of spinal and hip fractures. Furthermore, fractures heal more slowly in people who smoke and are more apt to heal improperly. Too much alcohol prevents the body from absorbing calcium. In addition, seek help for depression. Research has shown that women with clinical depression have lower bone densities. 4. Medical options. Talk to a health care provider about bone health. Although many people consider osteoporosis prevention to be important, fewer than half discuss the topic with health care providers or undergo BMD screening. Ask that your height be measured on an annual basis. A loss of 2-5 cm is an early sign of undiagnosed vertebral fractures and osteoporosis. Seek treatment for conditions that can jeopardize BMD, including thyroid disease, certain intestinal and kidney diseases, and some cancers. Also, remember that some medications may contribute to bone loss: for example, corticosteroids, anticoagulants, thyroid supplements, and certain anticonvulsants. 5. Supplements. When it is appropriate, take supplemental calcium. Adults need 1000 mg of elemental calcium daily during middle age. The need rises to 1500 mg daily after menopause in women and after age 50 years in men. Most people do not get enough calcium in their diets, and supplements may help achieve the minimum dosage. Make sure the supplement contains vitamin D, which helps your body absorb the calcium. The recommended daily dose of vitamin D is 400-1000 IU daily for younger adults and those at low risk for osteoporosis and 800-2000 IU daily for older adults and those at high risk for osteoporosis (Hanley, Cranney, Jones, Whiting, & Leslie, 2010). Sources: Data from Brown, J. P., Fortier, M., Frame, H., Lalonde, A., Papaioannou, A., Senikas, V., ... & Osteoporosis Guidelines Committee. (2006). Canadian Consensus Conference on Osteoporosis, 2006 update. Journal of Obstetrics and Gynaecology Canada, 28(2, Suppl. 1), S95– S112; and from Osteoporosis Canada. (2012). Osteoporosis & You. Retrieved from . Structure & Function CHAPTER 24 Musculoskeletal System Structure & Function Subjective Data 610 UNIT 3 Physical Examination occurred in Canada in the period 2005 to 2006; 88% of patients involved were aged 65 years and older (Canadian Institute for Health Information, 2007). Women are twice as likely as men to fracture a hip. Hip fractures can result in loss of mobility and independence, financial difficulties, and increased use of health care services. In a large Canadian study, adults aged 50 years and older with hip or vertebral fractures were more likely to die during the 5-year follow-up than were those without fractures (Ioannidis et al., 2009). Similarly, adults aged 65 or older accounted for the majority of joint replacements—63% of hip replacements and 64% of knee replacements—in Canada during the period 2006 to 2007 (Canadian Institute for Health Information, 2009). A high proportion of patients undergoing hip and knee replacement were obese, according to body mass index. Across the country, efforts have been initiated to reduce wait times for hip and joint replacement surgeries. About 4.27 million Canadians aged 12 or older suffered an injury severe enough to limit their usual activities in the period 2009 to 2010 (Statistics Canada, 2011a). The most common types of injury were sprains and strains (51%), followed by fractures and broken bones (17%). Most adolescent patients were injured playing sports (66%), younger and middle-aged adults were injured playing sports or at work (47%), and more than half of older adults' injuries occurred while they were walking or performing household chores. Falls were the leading cause of injury among older adults (63%), adolescents (50%), and younger and middle-aged adults (35%). SUB J E C T I V E DATA 1. Joints: Pain Stiffness Swelling, heat, redness Limitation of movement 2. Muscles: Pain (cramps) Weakness 3. Bones: Pain Deformity Trauma (fractures, sprains, dislocations) 4. Functional assessment (activities of ADLs) 5. Self-care behaviours HEALTH HISTORY QUESTIONS Examiner Asks 1. Joints. Any problems with your joints? Any pain? • Location: Which joints? On one side or both sides? • Quality: What does the pain feel like: aching, stiff, sharp or dull, shooting? • Severity: How strong is the pain? • Onset: When did this pain start? • Timing: What time of day does the pain occur? How long does it last? • How often does it occur? • Is the pain aggravated by movement, rest, position, weather? Is the pain relieved by rest, medications, application of heat or ice? • Is the pain associated with chills, fever, recent sore throat, trauma, repetitive activity? Rationale Joint pain and loss of function are the most common musculoskeletal concerns that prompt a person to seek care. Rheumatoid arthritis is symmetrical, involving the same joints on both sides; other musculoskeletal illnesses involve isolated or unilateral joints. Exquisite tenderness occurs with acute inflammation. Rheumatoid arthritis pain is worse in the morning on arising; osteoarthritis is worse later in the day; tendinitis is worse in the morning and improves during the day. Movement increases most joint pain except in rheumatoid arthritis, in which movement decreases pain. Joint pain 10 to 14 days after an untreated streptococcal infection ("strep throat") is suggestive of rheumatic fever. Joint injury is caused by trauma and repetitive motion. CHAPTER 24 Musculoskeletal System Examiner Asks • Any stiffness in your joints? • Any swelling, heat, redness in the joints? • Any limitation of movement in any joint? Which joint? • Which activities give you problems? (See Functional Assessment below.) muscles? • If pain is widespread: How long have you had this pain? Is the pain associated with fatigue? • If pain is in calf muscles: Does the pain occur with walking? Does it go away with rest? • Are your muscle aches associated with fever, chills, the "flu"? • Any weakness in muscles? • Location: Where is the weakness? How long have you noticed weakness? • Do the muscles look smaller there? Rationale Rheumatoid arthritis stiffness occurs in morning and after rest periods. These signs are suggestive of acute inflammation. Decrease in ROM may be caused by joint injury to cartilage or the capsule, or it may result from muscle contracture. Myalgia is usually felt as cramping or aching. Widespread musculoskeletal pain lasting 3 months or longer and associated with fatigue is suggestive of fibromyalgia (see Table 24-10). Calf pain may represent intermittent claudication (see Chapter 21). Symptoms of viral illness often include myalgia. Weakness may involve musculoskeletal or neurological systems (see Chapter 25). Decrease in muscle size is indicative of atrophy. 3. Bones. Any bone pain? Is the pain affected by movement? • Any deformity of any bone or joint? Is the deformity caused by injury or trauma? Does the deformity affect ROM? • Have any accidents or trauma ever affected the bones or joints: fractures, joint strain, sprain, dislocation? Which ones? • When did this occur? What treatment was given? Any problems or limitations now as a result? • Any back pain? In which part of your back? Is pain felt anywhere else, such as shooting down your leg? • Any numbness and tingling? Any limping? 4. Functional assessment. Do problems with your joints (muscle, bone) impose any limits on your usual ADLs? Which ones? (Note: Ask about each category; if the patient answers "yes," ask specifically about each activity in category.) • Bathing: getting in and out of the tub, turning faucets • Toileting: urinating, defecating, ability to get self on and off toilet, wiping self • Dressing: manipulating buttons and zippers, fastening openings behind the neck, pulling dress or sweater over head, pulling up pants, tying shoes, wearing shoes that fit • Grooming: shaving, brushing teeth, brushing or fixing hair, applying makeup • Eating: preparing meals, pouring liquids, cutting up foods, bringing food to mouth, drinking • Mobility: walking, walking up or down stairs, getting in and out of bed, getting out of the home • Communicating: talking, using phone, writing CRITICAL FINDINGS Fracture causes sharp pain that increases with movement (other bone pain usually feels "dull" and "deep" and is unrelated to movement). A fractured bone may also be misaligned. Report findings immediately. Never attempt to realign broken bones. Monitor vital signs and peripheral vascular circulation distal to the injury until the patient's care is transferred. Functional assessment is used to assess the safety of independent living, the need for home health care services, and quality of life (see Chapter 31). Assess any self-care deficit. Assess for impairment in physical mobility. Assess for impairment in verbal communication. Subjective Data 2. Muscles. Any problems in the muscles, such as any pain or cramping? Which 611 612 UNIT 3 Physical Examination Examiner Asks Subjective Data 5. Self-care behaviours. • Any occupational hazards that could affect the muscles and joints? Does your work involve heavy lifting? Or any repetitive motion or chronic stress to joints? Any efforts to alleviate these? • Tell me about your exercise program. Describe the type of exercise, frequency, the warm-up program. • Any pain during exercise? How do you treat it? • Have you had any recent weight gain? Please describe your usual daily diet. (Note the patient's usual caloric intake, all four food groups, daily amount of protein, calcium.) • Are you taking any medications for musculoskeletal system: aspirin, antiinflammatory, muscle relaxant, pain reliever? • If patient has chronic disability or crippling illness: How has your illness affected the following: Your interaction with family? Your interaction with friends? The way you view yourself? Rationale Assess risk for back pain or carpal tunnel syndrome. Assess self-care behaviours. • • • • • Assess for Self-esteem disturbance Loss of independence Body image disturbance Role performance disturbance Social isolation Additional History for Infants and Children 1. Birth trauma. Were you told about any trauma to the infant during labour and delivery? Did the baby come out head first? Were forceps needed? 2. Anoxia. Did the baby need resuscitation? Traumatic delivery increases risk for fractures (e.g., humerus, clavicle). A period of anoxia may result in hypotonia of muscles. 3. Milestones. Were the baby's motor milestones achieved at about the same time as those of siblings or other children the same age? 4. Bone injuries. Has your child ever broken any bones? Any dislocations? How were these treated? 5. Bone deformities. Have you ever noticed any bone deformity? Spinal curva- ture? Unusual shape of toes or feet? At what age? Have you ever sought treatment for any of these? Additional History for Adolescents 1. Athletics. Are you involved in any sports at school or after school? How frequently (times per week)? 2. Sports equipment. Do you use any special equipment? Does any training program exist for your sport? 3. Warming up. What is the nature of your daily warm-up? 4. Injury. What do you do if you get hurt? Assess safety of sport for the child. Note whether the child's height and weight are adequate for the particular sport (e.g., football). Use of safety equipment and presence of adult supervision decrease the risk for sports injuries. Lack of adequate warm-up increases risk of sports injury. Students may not report injury or pain for fear that their participation in the sport will be restricted. 5. Time management. How does your sport fit in with other school demands and other activities? Additional History for the Older Adult Use the functional assessment history questions in Chapter 5 (pp. 72 to 80) to elicit any loss of function, self-care deficit, or safety risk that may occur as a process of aging or musculoskeletal illness. (Review the complete functional assessment in Chapter 31.) 1. Weakness. Any change in weakness over the past months or years? 2. Injury. Any increase in falls or stumbling over the past months or years? 3. Mobility. Do you use any mobility aids to help you get around: cane, walker? Age-related changes in the musculo skeletal, neurological, and sensory systems increase the probability of falls and fractures in older adults. CHAPTER 24 Musculoskeletal System 613 OBJ E C T I V E DATA P R EPARATION Normal Range of Findings E QU I P M E N T N E E D E D Tape measure Skin marking pen Objective Data The purpose of the musculoskeletal examination is to assess function for ADLs and to screen for any abnormalities. By documenting the history, you already will have considerable data regarding ADLs. Note additional ADL data as the patient goes through the motions necessary for an examination: gait, posture, how the patient sits in a chair, raises from chair, takes off jacket, manipulates small object such as a pen, raises from supine position. A screening musculoskeletal examination suffices for most patients: • Inspection and palpation of joints, integrated with inspection of each body region • Observation of ROM as patient proceeds through motions described earlier • Age-specific screening measures, such as the Ortolani manoeuvre for infants or scoliosis screening for adolescents A complete musculoskeletal examination, as described in this chapter, is appropriate for patients with articular disease, a history of musculoskeletal symptoms, or any problems with ADLs. Nurses may work in collaboration with other health care providers (e.g., physiotherapists or occupational therapists) when performing these assessments in acute, rehabilitative, long-term, and home care settings. Make the patient comfortable before and throughout the examination. Drape for full visualization of the body part you are examining without needlessly exposing the rest of the patient's body. Use an orderly approach: head to toe, proximal to distal. The approach may need to be modified in patients with limitations in mobility, with pain, or with fatigue. Provide analgesics, rest periods, or both as required. Support each joint at rest. Muscles must be soft and relaxed in order for you to assess the joints under them accurately. Take care when examining any inflamed area, where rough manipulation could cause pain and muscle spasm. To avoid pain and spasm, use firm support, gentle movement, and gentle return to a relaxed state. Compare corresponding paired joints. Expect symmetry of structure and function and normal parameters for each joint. Abnormal Findings ORDER OF THE EXAMINATION Inspection Note the size and contour of the joint. Inspect the skin and tissues over the joints for colour, swelling, and any masses or deformity. The presence of swelling is significant and signals joint irritation. Swelling may be caused by excess joint fluid (effusion), thickening of the synovial lining, inflammation of surrounding soft tissue (bursae, tendons), or bony enlargement. Deformities include dislocation (one or more bones in a joint being out of position), subluxation (partial dislocation of a joint), contracture

(shortening of a muscle leading to limited ROM of joint), or ankylosis (stiffness or fixation of a joint). Palpation Palpate each joint, including its skin for temperature, its muscles, its bony articulations, and the area of the joint capsule. Note any heat, tenderness, swelling, or masses. Normally, joints are not tender to palpation. If any tenderness does occur, try to localize it to specific anatomical structures (e.g., skin, muscles, bursae, ligaments, tendons, fat pads, or joint capsule). Warmth and tenderness signal inflammation. 614 UNIT 3 Physical Examination Normal Range of Findings Normally, the synovial membrane is not palpable. When thickened, it feels doughy or boggy. A small amount of fluid is present in the normal joint, but it is not palpable. Abnormal Findings Palpable fluid is abnormal. Fluid is contained in an enclosed sac; therefore, if you push on one side of the sac, the fluid will shift and cause a visible bulging on another side. Objective Data Range of Motion Test for active ROM while stabilizing the body area proximal to that being moved. Familiarize yourself with each type of joint and its normal ROM so that you can recognize limitations. If you see a limitation, gently attempt passive motion: Anchor the joint with one hand while your other hand slowly moves it to its limit. The normal ranges of active and passive motion should be the same. If any limitation or any increase in ROM is present, use a goniometer to measure the angles precisely (Fig. 24-15). First, extend the joint to neutral or 0 degrees. Centre the 0 point of the goniometer on the joint. Keep the fixed arm of the goniometer on the 0 line, and use the movable arm to measure; then flex the joint and measure through the goniometer to determine the angle of greatest flexion. Limitation in ROM is the most sensitive sign of joint disease (McGee, 2007). The amount of limitation may give a clue to the cause of disease. Articular disease (inside the joint capsule, such as arthritis) produces swelling and tenderness around the whole joint, and it limits both active and passive ROM in all planes. Extra-articular disease (injury to a specific tendon, ligament, nerve) produces swelling and tenderness to that one spot in the joint and affects ROM in only certain planes, especially during active (voluntary) motion. 24-15 Joint motion normally causes no tenderness, pain, or crepitation. Do not confuse crepitation with the normal discrete "crack" heard as a tendon or ligament slips over bone during motion, such as a knee bend. Muscle Testing Test the strength of the prime mover muscle groups for each joint. Instruct the patient to repeat the motions you tested for active ROM. Now ask the patient to flex the muscle and hold as you apply opposing force. Muscle strength should be equal bilaterally and should fully resist your opposing force. (Note: Muscle status and joint status are interdependent and should be interpreted together. Chapter 25 discusses the examination of muscles for size, strength, tone, and involuntary movements.) Crepitation is an audible and palpable crunching or grating that accompanies movement. It occurs when the articular surfaces in the joints are roughened, as in rheumatoid arthritis (see Table 24-2, p. 642). CHAPTER 24 Musculoskeletal System Normal Range of Findings 615 Abnormal Findings Strength varies widely among people. You can use a system of grading from "no voluntary movement" to "full strength," such as the following: GRADE DESCRIPTION % NORMAL ASSESSMENT 5 Full ROM against gravity, full resistance 100 Normal 4 Full ROM with gravity 50 Fair 2 Full ROM with gravity eliminated (passive motion) 25 Poor 1 Slight contraction 10 Trace 0 No contraction 0 Zero TEMPOROMANDIBULAR JOINT INSTRUCTIONS TO PATIENT • Open mouth maximally. • Partially open mouth, thrust lower jaw, and move it side to side. • Stick out lower jaw. MOTION AND EXPECTED RANGE Vertical motion. You can measure the space between the upper and lower incisors. Normal space is 3 to 6 cm, or three fingers inserted sideways. Lateral motion. Normal extent is 1 to 2 cm (Figure 24-17). Protrusion without deviation. Instruct the patient to clench the teeth, and palpate the patient's contracted temporalis and masseter muscles. Compare right and left sides for size, firmness, and strength. Ask the patient to move the jaw forward and laterally against your resistance, and to open mouth against your resistance. This is also a test of the integrity of cranial nerve V (trigeminal nerve). 24-16 24-17 Swelling looks like a round bulge over the joint, although it must be moderate or marked to be visible. Crepitus and pain occur with temporomandibular joint dysfunction. Lateral motion may not occur with joint dysfunction. Objective Data With the patient seated, inspect the area just anterior to the ear. Place the tips of your first two fingers in front of each ear, and ask the patient to open and close the mouth. Drop your fingers into the depressed area over the joint, and note smooth motion of the mandible. An audible and palpable snap or click occurs in many healthy people as the mouth opens (Figure 24-16). Test ROM as follows: 616 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings CERVICAL SPINE Inspect the alignment of the head and neck. The spine should be straight and the head erect. Palpate the spinous processes and the sternomastoid, trapezius, and paravertebral muscles. They should feel firm, with no muscle spasm or tenderness. Test ROM as follows (Figure 24-18)*: INSTRUCTIONS TO PATIENT • Touch chin to chest. MOTION AND EXPECTED RANGE Flexion of 45 degrees (see Figure 24-18, A) Hyperextension of 55 degrees Lateral bending of 40 degrees (see Figure 24-18, B) • Lift the chin toward the ceiling. • Move each ear toward the corresponding shoulder. Do not lift up the shoulder. • Turn the chin toward each shoulder. Objective Data Head tilted to one side. Asymmetry of muscles. Tenderness and hard muscles with muscle spasm. Limited ROM. Pain with movement. Rotation of 70 degrees (see Figure 24-18, C) 0° Extension Flexion 0° 45° 40° Right Left 40° 55° A B Lateral bending 0° Right Left 70° C 70° Rotation 24-18 Normal Range of Findings Ask the patient to repeat the motions while you apply opposing force. The patient normally can maintain flexion against your full resistance. This is also a test of the integrity of cranial nerve XI (spinal nerve). *Do not attempt if you suspect neck trauma. CHAPTER 24 Musculoskeletal System Normal Range of Findings 617 Abnormal Findings UPPER EXTREMITY Shoulders Inspect and compare both shoulders posteriorly and anteriorly. Check the size and contour of the joint, and compare shoulders for equality of bony landmarks. Normally, no redness, muscular atrophy, deformity, or swelling is present. Check the anterior aspect of the joint capsule and the subacromial bursa for abnormal swelling. INSTRUCTIONS TO PATIENT • With arms at sides and elbows extended, move both arms forward and up in wide vertical arcs, and then move them back. MOTION AND EXPECTED RANGE Forward flexion of 180 degrees; hyperextension of up to 50 degrees (see Figure 24-19, A) Swelling. Hard muscles with muscle spasm. Tenderness or pain. Limited ROM. Asymmetry. Pain with motion. 180° Internal rotation 90° Up to 50° forward flexion Hyperextension A 0° B 24-19 Objective Data If the patient reports any shoulder pain, ask that he or she point to the spot with the hand of the unaffected side. Be aware that shoulder pain may have local causes, or it may be referred pain from a hiatal hernia or a cardiac or pleural condition, which is potentially serious. Pain from a local cause is reproducible during the examination by palpation or motion. While you stand in front of the patient, palpate both shoulders, noting any muscular spasm or atrophy, swelling, heat, or tenderness. Start at the clavicle and methodically explore the acromioclavicular joint, scapula, greater tubercle of the humerus, area of the subacromial bursa, the biceps groove, and the anterior aspect of the glenohumeral joint. Palpate the pyramid-shaped axilla; no adenopathy or masses should be present. Test ROM by asking the patient to perform four motions (Figure 24-19). Cup one hand over the shoulder during ROM to note any crepitation; normally, none is present. Redness. Inequality of bony landmarks. Atrophy, manifesting as lack of fullness. Dislocated shoulder: loses the normal rounded shape and looks flattened laterally. Swelling from excess fluid: best seen anteriorly; considerable fluid must be present to cause a visible distension because the capsule is normally loose (see Table 24-3, p. 643). Swelling of subacromial bursa is localized under the deltoid muscle and may be accentuated when the patient tries to abduct the arm. 618 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Crepitus with motion. Rotator cuff lesions may cause limited ROM, pain, and muscle spasm during abduction, whereas forward flexion stays fairly normal. • Rotate arms internally behind back; place back of hands as high as possible toward the scapulae. Internal rotation of 90 degrees (see Figure 24-19, B) • With arms at sides and elbows extended, raise both arms in wide arcs in the coronal plane. Touch palms together above head. • Touch both hands behind the head with elbows flexed and rotated posteriorly. Abduction of 180 degrees Adduction of 50 degrees (see Figure 24-19, C) External rotation of 90 degrees (see Figure 24-19, D) 180° Objective Data Abduction 90° External rotation C Adduction 50° 0° Normal Range of Findings D 24-19 Continued Abnormal Findings Test the strength of the shoulder muscles by asking the patient to shrug the shoulders, flex them forward and up, and abduct them against your resistance. The shoulder shrug is also a test of the integrity of cranial nerve XI (spinal nerve). Elbow Inspect the size and contour of the elbow in both flexed and extended positions. Look for any deformity, redness, or swelling. Check the olecranon bursa and the normally present hollows on either side of the olecranon process for abnormal swelling. Test the carrying angle. The forearm is normally in alignment with the upper arm. The normal carrying angle of the elbow is 5 to 15 degrees, with the arm extended in the anatomical position. The forearm is carried laterally (Figure 24-20). Use your left hand to support the patient's left forearm, and palpate the extensor surface of the elbow—the olecranon process and the medial and lateral epicondyles of the humerus—with your right thumb and fingers. In subluxation of the elbow, the forearm is dislocated posteriorly. Swelling and redness of olecranon bursa are localized and easy to identify because of the nearness of the bursa to skin. Effusion of synovial thickening manifests first as a bulge or fullness in groove on either side of the olecranon process, and it occurs with gouty arthritis. Epicondyles, head of radius, and tendons are common sites of inflammation and local tenderness, or "tennis elbow." CHAPTER 24 Musculoskeletal System Normal Range of Findings 619 Abnormal Findings 24-20 With your thumb in the lateral groove and your index and middle fingers in the medial groove, palpate either side of the olecranon process, using varying pressure. Normally, tissues and fat pads feel fairly solid. Check for any synovial thickening, swelling, nodules, or tenderness. Test ROM as follows: INSTRUCTIONS TO PATIENT • Bend and then straighten the elbow. • Hold the hand midway; then touch the front and back sides of the hand to the table. MOTION AND EXPECTED RANGE Flexion of 150 to 160 degrees; extension at 0 (Figure 24-21) Some healthy people lack 5 to 10 degrees of full extension, and others have 5 to 10 degrees of hyperextension. Movement of 90 degrees in pronation and supination (Figure 24-22) 0° 160° Flexion 0° Extension 24-21 Pronation 90° 24-22 90° Supination Objective Data Palpate the area of the olecranon bursa for heat, swelling, tenderness, consistency, or nodules. Soft, boggy, or fluctuant swelling in both grooves occurs with synovial thickening or effusion. Local heat or redness (signs of inflammation) can extend beyond the synovial membrane. Subcutaneous nodules are raised, firm, and nontender, and overlying skin moves freely. Common sites are in the olecranon bursa and along extensor surface of the ulna. These nodules occur with rheumatoid arthritis (see Table 24-4, p. 644). 620 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data While you test muscle strength, stabilize the patient's arm with one hand (Figure 24-23). Apply resistance just proximal to the wrist , and instruct the patient to flex the elbow against your resistance. Then ask the patient to extend the elbow against your resistance. 24-23 Wrist and Hand Inspect the hands and wrists on the dorsal and palmar sides, noting position, contour, and shape. In the normal functional position of the hand, the wrist is in slight extension. This way the fingers can flex efficiently, and the thumb can oppose them for grip and manipulation. The fingers lie straight in the same axis as the forearm. Normally, no swelling or redness, deformity, or nodules are present. The skin looks smooth, with knuckle wrinkles present and no swelling or lesions. Muscles are full, with the palm showing a rounded mound proximal to the thumb (the thenar eminence) and a smaller rounded mound proximal to the little finger. Palpate each joint in the wrist and hands. Face the patient, support the patient's hand with your fingers under it, and palpate the wrist firmly with both your thumbs on its dorsum (Figure 24-24). Make sure the patient's wrist is relaxed and in straight alignment. Move your palpating thumbs side to side to identify the normal depressed areas that overlie the joint space. Use gentle but firm pressure. Normally, the joint surfaces feel smooth, with no swelling, bogginess, nodules, or tenderness. 24-24 Subluxation of wrist. Ulnar deviation; fingers list to ulnar side. Ankylosis; wrist in extreme flexion. Dupuytren's contracture: flexion contracture of one or more fingers (see Table 24-5). Swan-neck or boutonnière deformity in fingers. Atrophy of the thenar eminence (see Table 24-5, p. 645). Ganglion cyst in wrist (see Table 24-5). Synovial swelling on dorsum. Generalized swelling. Tenderness. CHAPTER 24 Musculoskeletal System Normal Range of Findings 621 Abnormal Findings Palpate the metacarpophalangeal joints with your thumbs, just distal to and on either side of the knuckle (Figure 24-25). Objective Data 24-25 Use your thumb and index finger in a pinching motion to palpate the sides of the interphalangeal joints (Figure 24-26). Normally, no synovial thickening, tenderness, warmth, or nodules are present. 24-26 Heberden's and Bouchard's nodes are hard and nontender and occur with osteoarthritis (see Table 24-5, p. 646). 622 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Test ROM as follows (Figure 24-27): INSTRUCTIONS TO PATIENT • Bend the hand up at the wrist. MOTION AND EXPECTED RANGE Hyperextension of 70 degrees (see Figure 24-27, A) • Bend hand down at the wrist. • Bend the fingers up and down at metacarpophalangeal joints. • With palms flat on table, turn them outward and in. Palmar flexion of 90 degrees Flexion of 90 degrees; hyperextension of 30 degrees (see Figure 24-27, B) Ulnar deviation of 50 to 60 degrees; radial deviation of 20 degrees (see Figure 24-27, C) Abduction of 20 degrees; tight fist; equal bilateral responses (see Figure 24-27, D, E) Ability to perform this manoeuvre, and equal bilateral responses (see Figure 24-27, F) • Spread fingers apart; then make a fist. Objective Data • Touch the thumb to each finger and to the base of little finger. 70° 30° Hyperextension 0° Extension Flexion 0° Flexion A B 90° 0° Ulnar deviation 90° 20° Radial deviation 55° C D E F 24-27 Loss of ROM (in this location, the most common and most significant functional loss in the wrist). Limited motion. Pain on movement. CHAPTER 24 Musculoskeletal System Normal Range of Findings 623 Abnormal Findings For muscle testing, position the patient's forearm supinated (palm up) and resting on a table (Figure 24-28). Stabilize the patient's arm by holding your hand at the mid-forearm. Ask the patient to flex the wrist against your resistance at the palm. 24-28 Phalen Test. Ask the patient to hold both hands back to back while flexing the wrists 90 degrees. Acute flexion of the wrist for 60 seconds produces no symptoms in the normal hand (Figure 24-29). 24-29 Phalen test. Normal Range of Findings 24-30 Abnormal Findings LOWER EXTREMITY Hip Inspect the hip joint together with the spine a bit later in the examination as the patient stands. At that time, note symmetrical levels of iliac crests, gluteal folds, and equal-sized buttocks. A smooth, even gait reflects equal leg lengths and functional hip motion. Help the patient into the supine position, and palpate the hip joints. The joints should feel stable and symmetrical, with no tenderness or crepitation. Pain with palpation. Crepitation. Objective Data Tinel's Sign. Direct percussion of the location of the median nerve at the wrist produces no symptoms in the normal hand (Figure 24-30). The Phalen test reproduces numbness and burning sensation in a patient with carpal tunnel syndrome (see Table 24-5, p. 645). In carpal tunnel syndrome, percussion of the median nerve produces burning and tingling sensations along its distribution, which is Tinel's sign. 624 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Test ROM as follows (Figure 24-31): INSTRUCTIONS TO PATIENT • Raise each leg with knee extended. MOTION AND EXPECTED RANGE Hip flexion of 90 degrees (see Figure 24-31, A) Hip flexion of 120 degrees; the opposite thigh should remain on the table (see Figure 24-31, B) Objective Data • Bend each knee up to the chest while keeping the other leg straight. • Flex knee and hip to 90 degrees. (Examiner stabilizes by holding the thigh with one hand and the ankle with the other hand.) Swing the foot outward. Swing the foot inward. (Foot and thigh move in opposite directions.) • Swing leg laterally, then medially, with knee straight. Stabilize pelvis by pushing down on the opposite anterior superior iliac spine. Internal rotation of 40 degrees External rotation of 45 degrees (see Figure 24-31, C) Abduction of 40 to 45 degrees Adduction of 20 to 30 degrees (see Figure 24-31, D) Limited motion. Pain with motion. Flexion flattens the lumbar spine; if this reveals a flexion deformity in the opposite hip, it represents a positive sign of the Thomas test. Limited internal rotation of hip is an early and reliable sign of hip disease. Limitation of abduction of the hip in the supine position is the most common motion dysfunction in hip disease. 90° Hip flexion with knee flexed Hip flexion with knee straight Extension 0° 0° Extension A B 45° External rotation C 24-31 0° 40° Internal rotation D 45° Abduction 0° 30° Adduction 120° CHAPTER 24 Musculoskeletal System Normal Range of Findings • When standing (later in examination), swing straight leg back behind body. (Examiner stabilizes pelvis to eliminate exaggerated lumbar lordosis. The most efficient way is to ask patient to bend over the table and support the trunk on the table, or lie prone on the table.) 625 Abnormal Findings Hyperextension of 15 degrees when stabilized Knee The patient should remain supine with legs extended, although some examiners prefer the knees to be flexed and dangling for inspection. The skin normally looks smooth, with even colouring and no lesions. Inspect lower leg alignment. The lower leg should extend in the same axis as the thigh. Palpate the patient's knee in the supine position with complete relaxation of the quadriceps muscle. Start high on the anterior thigh, about 10 cm above the patella. Palpate with your left thumb and fingers in a grasping manner (Figure 24-32). Proceed down toward the knee, exploring the region of the suprapatellar pouch. Note the consistency of the tissues. The muscles and soft tissues should feel solid, and the joint should feel smooth, with no warmth, tenderness, thickening, or nodularity. 24-32 When swelling is present, you need to distinguish whether it represents soft tissue swelling or increased fluid in the joint. The tests for the bulge sign and ballottement of the patella aid in this assessment. Atrophy occurs with disuse or chronic disorders. It first appears in the medial part of the muscle, although it is difficult to note because the vastus medialis is relatively small. Fluctuant or boggy texture with synovitis of suprapatellar pouch. Objective Data Inspect the knee's shape and contour. Normally, distinct concavities (hollows) are present on either side of the patella. Check them for any sign of fullness or swelling. Check other locations, such as the prepatellar bursa and the suprapatellar pouch, for any abnormal swelling. Check the quadriceps muscle in the anterior thigh for any atrophy. Because it is the prime mover of knee extension, this muscle is important for joint stability during weight bearing. Shiny and atrophic skin. Swelling or inflammation (see Table 24-6, p. 648). Lesions (e.g., psoriasis). Angulation deformity: • Genu varum (bowlegs; see p. 636) • Genu valgum (knock knees) • Flexion contracture With synovial thickening or effusion, hollows disappear; then they may bulge. 626 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings SPECIAL CONSID E RAT I O N S F O R A DVA N C E D PRAC T I C E : K N E E Normal Range of Findings Abnormal Findings Bulge Sign. The bulge sign confirms the presence of small amounts of fluid in the suprapatellar pouch as you try to move the fluid from one side of the joint to the other. Firmly stroke up on the medial aspect of the knee two or three times to displace any fluid (Figure 24-33, A). Tap the lateral aspect (see Figure 24-33, B). Watch the medial side in the hollow for a distinct bulge from a fluid wave. Normally, none is present. The bulge sign occurs with very small amounts (4 to 8 mL) of fluid flowing across the joint (see Figure 24-33, C). A B C 24-33 Special Considerations for Advanced Practice Ballottement of the Patella. This test is reliable when larger amounts of fluid are present. Use your left hand to compress the suprapatellar pouch to move any fluid into the knee joint. With your right hand, push the patella sharply against the femur. If no fluid is present, the patella is already snug against the femur (see Figure 24-34, A). A If fluid has collected, your tap on the patella moves it through the fluid, and you will hear a tap as the patella bumps up on the femoral condyles (see Figure 24-34, B). B 24-34 Continue assessment with palpation of the tibiofemoral joint (Figure 24-35). Note smooth joint margins and absence of pain. Palpate the infrapatellar fat pad and the patella. Check for crepitus by holding your hand on the patella as the knee is flexed and extended. Some crepitus in an otherwise symptom-free knee is not uncommon. Irregular bony margins (present with osteoarthritis). Pain at joint line. Pronounced crepitus (a significant finding, occurs with degenerative diseases of the knee). CHAPTER 24 Musculoskeletal System Normal Range of Findings 627 Abnormal Findings 24-35 Test ROM as follows (Figure 24-36): INSTRUCTIONS TO PATIENT • Bend each knee. MOTION AND EXPECTED RANGE Flexion of 130 to 150 degrees • Extend each knee. A straight line of 0 degrees in some persons; a hyperextension of 15 degrees in others Limited ROM. Contracture. Pain with motion. Limpness. In sudden locking, the patient is unable to extend the knee fully. This usually occurs with a painful and audible "pop" or "click." Sudden buckling, or "giving way," occurs with ligament injury, which causes weakness and instability. • Ambulate. (Examiner checks knee ROM during ambulation.) 130° Flexion Special Considerations for Advanced Practice 15° Hyperextension 0° Extension 24-36 628 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Check muscle strength by asking the patient to maintain knee flexion while you oppose by trying to pull the leg forward. The patient demonstrates muscle extension by successfully rising from a seated position in a low chair or rising from a squat without using the hands for support. Special Test for Meniscal Tears McMurray Test. Perform this test when a patient has reported a history of A "click" is a positive result of the McMurray test that signifies a torn meniscus. Special Considerations for Advanced Practice trauma followed by locking, giving way, or local pain in the knee. Position the patient supine as you stand next to the affected side. Hold the heel, and flex the knee and hip. Place your other hand on the knee with fingers on the medial side. Rotate the leg in and out to loosen the joint. Externally rotate the leg and push a valgus (inward) stress on the knee. Then slowly extend the knee. Normally, the leg extends smoothly with no pain (Figure 24-37). 24-37 Normal Range of Findings Abnormal Findings Objective Data Ankle and Foot Inspect while the patient is in a sitting, non–weight-bearing position, as well as when standing and walking. Compare both feet, noting position of feet and toes, contour of joints, and skin characteristics. The foot should align with the long axis of the lower leg; an imaginary line would fall from mid-patella to between the first and second toes. Weight bearing should be borne on the middle of the foot, from the heel, along the midfoot, to between the second and third toes. Most feet have a longitudinal arch, although the arch can vary normally from "flat feet" to a high instep. The toes point straight forward and lie flat. The ankles (malleoli) are smooth bony prominences. Normally, the skin is smooth, with even colouring and no lesions. Note the locations of any calluses or bursal reactions because they reveal areas of abnormal friction. Examining well-worn shoes helps assess areas of wear and accommodation. In hallux valgus, the distal part of the great toe is directed away from the body midline (Figure 24-38). Hammertoes; claw toes. Swelling or inflammation. Calluses; ulcers (see Table 24-7, p. 650). 24-38 CHAPTER 24 Musculoskeletal System Normal Range of Findings 629 Abnormal Findings Support the ankle by grasping the heel with your fingers while palpating with your thumbs (Figure 24-39). Explore the joint spaces. They should feel smooth and depressed, with no fullness, swelling, or tenderness. Swelling or inflammation. Tenderness. 24-39 Swelling or inflammation; tenderness. Objective Data Palpate the metatarsophalangeal joints between your thumb on the dorsum and your fingers on the plantar surface (Figure 24-40). Using a pinching motion of your thumb and forefinger, palpate the interphalangeal joints on the medial and lateral sides of the toes. 24-40 Test ROM as follows (Figure 24-41): INSTRUCTIONS TO PATIENT • Point toes toward the floor. • Point toes toward your nose. • Turn soles of feet out, then in. (Examiner stabilizes the ankle with one hand and holds heel with the other to test the subtalar joint.) • Flex and straighten toes. MOTION AND EXPECTED RANGE Plantar flexion of 45 degrees Dorsiflexion of 20 degrees (see Figure 24-41, A) Eversion of 20 degrees Inversion of 30 degrees (see Figure 24-41, B) Assess muscle strength by asking the patient to maintain dorsiflexion and plantar flexion against your resistance. Limited ROM. Pain with motion. The patient cannot maintain flexion. 630 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings 20° Dorsiflexion 30° 20° Eversion 0° 0° A B Inversion 0° 24-41 Plantar flexion 45°of Findings Normal Range Abnormal Findings Objective Data SPINE The patient should be standing, draped in a gown open at the back. Place yourself far enough behind the patient so that you can see the entire back. Inspect and note whether the spine is straight by following an imaginary vertical line from the head through the spinous processes and down through the gluteal cleft; by noting equal horizontal positions for the shoulders, scapulae, iliac crests, and gluteal folds; and by noting equal spaces between the arm and lateral thorax on the two sides (Figure 24-42, A). The patient's knees and feet should be aligned with the trunk and should be pointing forward. A 24-42 B A difference in shoulder elevation and in level of scapulae and iliac crests occur with scoliosis (see Table 24-8, p. 651). CHAPTER 24 Musculoskeletal System Normal Range of Findings 631 Abnormal Findings From the side, note the normal convex thoracic curve and concave lumbar curve (see Figure 24-42, B). An enhanced thoracic curve, or kyphosis, is common in older adults. A pronounced lumbar curve, or lordosis, is common in obese people. Palpate the spinous processes. Normally, they are straight and not tender. Palpate the paravertebral muscles; they should feel firm with no tenderness or spasm. Lateral tilting and forward bending occur with a herniated nucleus pulposus (see Table 24-8, p. 651). Spinal curvature. Tenderness; spasm of paravertebral muscles. Chronic axial skeletal pain occurs with fibromyalgia syndrome (see Table 24-10, p. 654). Test ROM of the spine by asking the patient to bend forward and touch the toes (Figure 24-43). Look for flexion of 75 to 90 degrees and smoothness and symmetry of movement. Note that the concave lumbar curve should disappear with this motion, and the back should have a single convex C-shaped curve. Objective Data 0° 30° Extension Flexion 90° 24-43 If you suspect a spinal curvature during inspection, this may be more clearly seen when the patient touches the toes. While the patient is bending over, mark a dot on each spinous process. When the patient resumes standing, the dots should form a straight vertical line. If the dots form a slight S-shape when the patient stands, a spinal curve is present. 632 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Stabilize the pelvis with your hands. Test ROM as follows (Figure 24-44): INSTRUCTIONS TO PATIENT • Bend sideways. • Bend backward. • Twist shoulders to one side, then the other. 35° Right lateral bending MOTION AND EXPECTED RANGE Lateral bending of 35 degrees (see Figure 24-44, A) Hyperextension of 30 degrees Rotation of 30 degrees, bilaterally (see Figure 24-44, B) Limited ROM. Pain with motion. 0° 35° Left 30° 0° Objective Data Rotation Special Considerations for Advanced Practice A Normal Range of Findings B 24-44 Abnormal Findings These manoeuvres reveal only gross restriction. Movement is still possible even if some spinal fusion has occurred. Finally, ask the patient to walk on his or her toes for a few steps and then to walk on the heels. SPECIAL CONSID E RAT I O N S F O R A DVA N C E D PRAC T I C E : S P I N E Normal Range of Findings Straight Leg Raising: LaSègue Test. These manoeuvres reproduce back and leg pain and help confirm the presence of a herniated nucleus pulposus. Straight leg raising while keeping the knee extended normally produces no pain. Raise the affected leg just short of the point where it produces pain. Then dorsiflex the foot (Figure 24-45). Raise the unaffected leg while leaving the other leg flat. Inquire about the involved side. Abnormal Findings The result of the LaSègue test is positive if it reproduces sciatic pain. If lifting the affected leg reproduces sciatic pain, it confirms the presence of a herniated nucleus pulposus. If lifting the unaffected leg reproduces sciatic pain, it strongly suggests a herniated nucleus pulposus. CHAPTER 24 Musculoskeletal System Normal Range of Findings 633 Abnormal Findings 24-45 Unequal leg lengths. Special Considerations for Advanced Practice Measure Leg Length Discrepancy. Perform this measurement if you need to determine whether one leg is shorter than the other. For true leg length, measure between fixed points, from the anterior superior iliac spine to the medial malleolus, crossing the medial side of the knee (Figure 24-46). Normally, these measurements are equal or within 1 cm, indicating no true bone discrepancy. 24-46 Sometimes the true leg length is equal, but the legs still look unequal. For apparent leg length, measure from a nonfixed point (the umbilicus) to a fixed point (medial malleolus) on each leg. Normal Range of Findings True leg lengths are equal, but leg lengths may appear unequal as a result of pelvic obliquity or adduction or flexion deformity in the hip. Abnormal Findings DEVELOPMENTAL CONSIDERATIONS Objective Data Review the developmental milestones discussed on the Evolve Web site. Keep handy a concise chart of the usual sequence of motor development so that you can refer to expected findings for the age of each child you are examining. Use the Denver II test to identify the fine and gross motor skills expected for the child's age. Because some aspects of the musculoskeletal and neurological examinations overlap, assessment of muscle tone, resting posture, and motor activity are discussed in the next chapter. Infants Examine an infant with the infant fully undressed and lying on the back. Take care to place the newborn on a warming table to maintain body temperature. Feet and Legs. Start with the feet and work your way up the extremities. Note any positional deformities, a residual of fetal positioning. Often the newborn's feet are not held straight but in a varus (apart) or valgus (together) position. It is important to distinguish whether this position is flexible (and thus usually self-correctable) or fixed. Scratch the outside of the bottom of the foot. If the deformity is self-correctable, the foot assumes a normal right angle to the lower leg. Alternatively, immobilize the heel with one hand and gently push the forefoot to the neutral position with the other hand. If you can move it to neutral position, it is flexible. A true deformity is fixed and assumes a right angle only with forced manipulation or not at all. 634 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data Note the relationship of the forefoot to the hindfoot. Commonly, the hindfoot is in alignment with the lower leg and just the forefoot angles inward. This forefoot adduction is metatarsus adductus. It is usually present at birth and usually resolves spontaneously by age 3 years. Check for tibial torsion, a twisting of the tibia. Place the child's feet flat on the table, and push to flex up the knees. With the patella and the tibial tubercle in a straight line, place your fingers on the malleoli. In an infant, note whether an imaginary line connecting the four malleoli is parallel to the table. Tibial torsion may originate from intrauterine positioning and then may be exacerbated at a later age by continuous sitting in a reverse tailor position, the "W" sitting position (sitting with the buttocks on the floor and the lower legs splayed back and out on either side). Hips. Check the hips for congenital dislocation. The most reliable method is the Ortolani manoeuvre, which should be performed at every professional visit until the infant is 1 year old. With the infant supine, flex the knees by holding your thumbs on the inner mid-thighs and with your fingers outside on the hips, touching the greater trochanters. Adduct the legs until your thumbs touch (Figure 24-47, A). Then gently lift and abduct the legs, moving the knees apart and down so their lateral aspects touch the table (see Figure 24-47, B). This normally feels smooth and produces no sound. A Metatarsus varus: adduction and inversion of forefoot. Talipes equinovarus: inversion and adduction of forefoot, with downward pointing of foot (see Table 24-9, p. 653). Tibial torsion: more than 20 degrees of deviation or location of lateral malleolus anterior to medial malleolus. With a dislocated hip, the head of the femur is not cupped in the acetabulum but rests posterior to it. Hip instability feels like a clunk as the head of the femur pops back into place. This is a positive Ortolani sign and warrants referral. B 24-47 Ortolani manoeuvre. Normal Range of Findings The Allis test also is used to check for hip dislocation by comparing leg lengths (Figure 24-48). Place the baby's feet flat on the table, and flex the knees up. Scan the tops of the knees; normally, they are at the same elevation. 24-48 Allis test. Abnormal Findings The finding that one knee is significantly lower than the other is a positive Allis sign and is suggestive of hip dislocation. CHAPTER 24 Musculoskeletal System Normal Range of Findings 635 Abnormal Findings Note the gluteal folds. Normally, they are equal on both sides. However, some asymmetry may be present in healthy children. Hands and Arms. Inspect the hands, noting shape, number, and position of fingers and palmar creases. The palm usually has three strong horizontal lines (palmar flexion creases). A simian crease (single palmar crease) is often a normal finding, occurring in about 1 out of 30 people and twice as often in males (Kaneshiro, 2011). Palpate the length of the clavicles because the clavicle is the bone most frequently fractured during birth. The clavicles should feel smooth, regular, and without crepitus. Also note equal ROM of arms during the Moro reflex (see Chapter 25 for description). Back. Lift up the infant and examine the back. Note the normal single infant can lift the head while prone. This builds the concave cervical spinal curve and indicates normal forearm strength. Inspect the length of the spine for any tuft of hair, dimple in midline, cyst, or mass. Normally, none are present. A sacral dimple is often normal. 24-49 Observe ROM through spontaneous movement of extremities. Test muscle strength by lifting up the infant with your hands under the axillae (Figure 24-50). A baby with normal muscle strength wedges securely between your hands. 24-50 A baby who starts to "slip" between your hands shows weakness of the shoulder muscles. Objective Data C-shaped curve of the newborn's spine (Figure 24-49). By 2 months of age, the Unequal gluteal folds may accompany hip dislocation after 2 to 3 months of age. Polydactyly is the presence of extra fingers or toes. Syndactyly is webbing between adjacent fingers or toes (see Table 24-5, p. 647). A simian crease frequently occurs with other conditions such as Down syndrome or fetal alcohol syndrome, and is accompanied by short broad fingers, incurving of little fingers, and low-set thumbs. Fractured clavicle: Note irregularity at the fracture site, crepitus, and angulation. The site has rapid callus formation with a palpable lump within a few weeks. Observe limited arm ROM and unilateral response in the Moro reflex. A small dimple in the midline— anywhere from the head to the coccyx— suggests dermoid sinus. A tuft of hair, birthmark, or skin tag over a sacral dimple in the midline may indicate spina bifida. Mass, such as meningocele, necessitates referral. 636 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Objective Data Preschool-Age and School-Age Children Once the infant learns to crawl and then to walk, the waking hours are spent seemingly in perpetual motion. This is convenient for your musculoskeletal assessment; you can observe the muscles and joints during spontaneous play before a table-top examination. Most young children enjoy showing off their physical accomplishments. For specific motions, coax the toddler: "Show me how you can walk to Mom"; "Climb the step stool." Ask the preschooler to hop on one foot or to jump. Back. While the child is standing, note the posture. From behind, you should note the plumb line from the back of the head, along the spine, to the middle of the sacrum. Shoulders are level within 1 cm, and scapulae are symmetrical. From the side, lordosis is common throughout childhood, appearing more pronounced in children with a protuberant abdomen. Legs and Feet. Anteriorly, note the leg position. A bowlegged stance (genu varum) is a lateral bowing of the legs (Figure 24-51, A). It is characterized by a persistent space of more than 2.5 cm between the knees when the medial malleoli are together. Genu varum is normal for 1 year after the child begins to walk. The child may walk with a waddling gait. Genu varum resolves with growth; no treatment is indicated. Knock knees (genu valgum) are characterized by a span of more than 2.5 cm between the medial malleoli when the knees are together (see Figure 24-51, B). It occurs normally between 2 and 3½ years of age. Treatment is not indicated for genu valgum. (Note: A mnemonic for distinguishing the two conditions is to link the rs and gs: genu varum—knees apart; genu valgum—knees together.) A Lordosis is marked in muscular dystrophy and rickets. Severe bowing or unilateral bowing also occurs with rickets. Genu valgum also occurs in rickets, poliomyelitis, and syphilis. B 24-51 Leg position. A, Genu varum. B, Genu valgum. Normal Range of Findings Often, parents tell you they are concerned about the child's foot development. The most common questions are about "flatfeet" and "pigeon toes." Flatfoot (pes planus) is pronation, or turning in, of the medial side of the foot. The young child may look flatfooted because the normal longitudinal arch is concealed by a fat pad until age 3 years. When standing begins, the child takes a broad-based stance, which causes pronation. Thus pronation is common between 12 and 30 months. You can see it best from behind the child, where the medial side of the foot drops down and in. Abnormal Findings Pronation beyond 30 months. CHAPTER 24 Musculoskeletal System Normal Range of Findings Abnormal Findings Pigeon toes, or toeing in, are demonstrated when the child tends to walk on the lateral side of the foot, and the longitudinal arch looks higher than normal. It often starts as a forefoot adduction, which usually resolves spontaneously by age 3 years, as long as the foot is flexible. Check the child's gait while the child walks away from and toward you. Let the child wear socks because a cold tile floor will distort the usual gait. In children 1 to 2 years of age, expect a broad-based gait, with arms out for balance. Weight bearing is borne on the inside of the foot. From 3 years of age, the base narrows, and the arms are kept closer to the sides. Inspect the shoes for spots of greatest wear to aid your judgement of the gait. Normally, the shoes show the most wear on the outside of the heel and the inside of the toe. Check for the Trendelenburg sign to screen for progressive subluxation of the hip (Figure 24-52, A). As you watch from behind, ask the child to stand on one leg, then on the other. Note the iliac crests; they should stay level when weight is shifted. The child may sit for the remainder of the examination. Start with the feet and hands of the child from 2 to 6 years of age because the child is happy to show these off, and proceed through the examination as described earlier. Toeing in from forefoot adduction that is fixed or lasts beyond age 3 years. Toeing in from tibial torsion. Limp, usually caused by trauma, fatigue, or hip disease. Abnormal gait patterns (see Chapter 25). The positive Trendelenburg sign occurs with severe subluxation of one hip. When the child stands on the "good" leg, the pelvis looks level. When the child stands on the affected leg, the pelvis drops toward the "good" side. The hip abductors on the standing side are too weak to hold the pelvis level (see Figure 24-52, B). Level iliac crests A B 24-52 Normal Range of Findings In particular, check the arm for full ROM and presence of pain. Look for subluxation of the elbow (head of the radius). This occurs most often between 2 and 4 years of age as a result of forceful removal of clothing or dangling while adults suspend the child by the hands. Palpate the bones, joints, and muscles of the extremities as described for the adult examination. Abnormal Findings Inability to supinate the hand while the arm is flexed, together with pain in elbow, indicates subluxation of the head of the radius. Pain or tenderness in extremities is usually caused by trauma or infection. Fractures usually result from trauma and are exhibited as an inability to use the area, a deformity, or an excess motion in the involved bone with pain and crepitation. Enlargement of the tibial tubercles with tenderness is suggestive of OsgoodSchlatter disease (see Table 24-6, p. 648). Objective Data Normal hip abductors 637 638 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Adolescents Objective Data Proceed with the musculoskeletal examination as for adults, with special attention to spinal posture. Kyphosis is common during adolescence because of chronic poor posture. Be aware of the risk of sports-related injuries with adolescents because sports participation and competition often peak in this age group. The Canadian Task Force on Preventive Health Care (Goldbloom, 1994) concluded that there was insufficient evidence to recommend the routine screening of symptom-free adolescents for idiopathic scoliosis; however, periodic visual inspection of the backs of adolescents seen for other reasons is reasonable. Inspect for scoliosis with the forward bend test (Figure 24-53). Seat yourself behind the standing child, and ask the child to stand with the feet shoulderwidth apart and to bend forward slowly to touch the toes. Expect a straight vertical spine while the child is both standing and bending forward. The posterior ribs should be symmetrical, with equal elevation of shoulders, scapulae, and iliac crests. You may wish to mark each spinous process with a felt marker. The lineup of ink dots highlights even a subtle curve. A B 24-53 Pregnant Women Proceed through the examination described for adults. Expected postural changes in pregnancy include progressive lordosis and, toward the third trimester, anterior cervical flexion, kyphosis, and slumped shoulders (Figure 24-54, A). At full term, the protuberant abdomen and the relaxed mobility in the joints create the characteristic waddling gait (see Figure 24-54, B). Scoliosis is most apparent during the preadolescent growth spurt. Asymmetry is suggestive of scoliosis: The ribs "hump up" on one side as the child bends forward, and landmark elevation is unequal (see Table 24-8, p. 651). CHAPTER 24 Musculoskeletal System Normal Range of Findings 639 Abnormal Findings Objective Data A B 24-54 Older Adults Postural changes include a decrease in height, which is more apparent in the eighth and ninth decades (Figure 24-55). "Lengthening of the arm–trunk axis" describes this shortening of the trunk with the appearance of comparatively long extremities. Kyphosis is common, with a backward head tilt to compensate. This creates the outline of a figure 3, as in the older adult pictured, viewed from the left side. Slight flexion of hips and knees is also common. Contour changes include a decrease of fat in the body periphery and fat deposition over the abdomen and hips. The bony prominences become more marked. With most older adults, ROM testing is performed as described earlier. ROM and muscle strength are much the same as in younger adults, provided that no musculoskeletal illnesses or arthritic changes are present. Functional Assessment. For patients with changes caused by advanced aging or arthritis and those with musculoskeletal disability, perform a functional assessment for ADLs. In this assessment, ROM and muscle strength are tested with regard to the accomplishment of specific activities. You need to determine adequate and safe performance of functions essential for independent home life. See Chapter 31 for further assessments. 640 UNIT 3 Physical Examination Objective Data Normal Range of Findings Abnormal Findings 24-55 INSTRUCTIONS TO PATIENT 1. Walk (with shoes on). 2. Climb up stairs. 3. Walk down stairs. 4. Pick up object from floor. 5. Rise up from sitting in chair. 6. Rise up from lying in bed. COMMON ADAPTATION FOR AGING CHANGES Shuffling pattern; swaying; arms out to help balance; broader base of support; watching own feet Holds tightly onto hand rail; may haul body up with arm; may lead with favoured (stronger) leg Holds hand rail tightly, sometimes with both hands With weakness, descending sideways, lowering the weaker leg first; with unsteadiness, watching the feet Often bends at the waist instead of at the knees; holds onto furniture for support while bending or straightening Uses arms to push off chair arms, upper trunk leans forward before body straightens, feet are planted wide in broad base of support May roll to one side, pushes with arms to lift up torso, grabs bedside table to increase leverage CHAPTER 24 Musculoskeletal System 641 D O CUMENTATION A N D C R I T I C A L T H I N K I N G Sample Charting SUBJECTIVE Reports no joint pain, stiffness, swelling, or limitation. No muscle pain or weakness. No history of bone trauma or deformity. Able to manage all usual daily activities with no physical limitations. Occupation involves no musculoskeletal risk factors. Exercise pattern is brisk walk 1½ km (1 mile) 5×/week. OBJECTIVE Joints and muscles symmetrical; no swelling, masses, deformity; normal spinal curvature. No tenderness to palpation of joints; no heat, swelling, or masses. Full ROM; movement smooth, no crepitation, no tenderness. Muscle strength: able to maintain flexion against resistance and without tenderness. ASSESSMENT Muscles and joints: healthy and functional Focused Assessment: Clinical Case Study M.T. is a 45-year-old female salesperson with a diagnosis of rheumatoid arthritis 3 years PTA who seeks care now for "swelling and burning pain in my hands" for 1 day. SUBJECTIVE OBJECTIVE Body joints within normal limits except joints of wrist and hands. Radiocarpal, metacarpophalangeal, and proximal interphalangeal joints are red, swollen, tender to palpation. Spindle-shaped swelling of proximal interphalangeal joints of third digit right hand and second digit left hand; ulnar deviation of metacarpophalangeal joints. ASSESSMENT Acute pain R/T inflammation Impaired physical mobility R/T inflammation Deficient knowledge about aspirin treatment R/T lack of exposure Noncompliance with exercise program R/T lack of perceived benefits of treatment Noncompliance with advised rest periods R/T lack of perceived benefits of treatment Documentation & Critical Thinking M.T. received a diagnosis of rheumatoid arthritis at age 41 years from staff at this agency. Since that time, her "flare-ups" seem to come every 6 to 8 months. Acute episodes involve hand joints and are treated with aspirin, which gives relief. Typically experiences morning stiffness, lasting ½ to 1 hour. Joints feel warm, swollen, tender. Has had weight loss of 7 kg (15 lb) over past 4 years and feels fatigued much of the time. States should rest more, but "I can't take the time." Daily exercises have been prescribed, but M.T. does not do them regularly. Takes aspirin for acute flare-ups, feels better in a few days, decreases dose herself. 642 UNIT 3 Physical Examination ABNO R M A L F I N D I N G S TABLE 24-2 Abnormalities Affecting Multiple Joints ◀ Rheumatoid Arthritis Inflammatory Conditions Articular cartilage Joint capsule Synovial membrane NORMAL JOINT (joint space enlarged for clarity) Inflamed synovial membrane Cyst Erosion Swelling of soft tissue Fibrous formation Ankylosing Spondylitis (Not Illustrated) Chronic progressive inflammation of spine, sacroiliac, and larger joints of the extremities, leading to bony ankylosis and deformity. A form of rheumatoid arthritis, this affects primarily men by a 10 : 1 ratio, starting in late adolescence or early adulthood. Spasm of paraspinal muscles pulls the spine into forward flexion, obliterating cervical and lumbar curves. The thoracic curve is exaggerated into a single kyphotic rounding. Manifestations also include flexion deformities of the hips and knees. ◀ Osteoarthritis (Degenerative Joint Disease) Degenerative Conditions Cartilage destruction This is a chronic, systemic inflammatory disease of joints and surrounding connective tissue. Inflammation of the synovial membrane leads to thickening; then to fibrosis, which limits motion; and finally to bony ankylosis. The disorder is symmetrical and bilateral and is characterized by heat, redness, swelling, and painful motion of the affected joints. Rheumatoid arthritis is associated with fatigue, weakness, anorexia, weight loss, low-grade fever, and lymphadenopathy. Associated signs are described in the following tables, especially Table 24-5, p. 646. Osteophyte or bone spur Noninflammatory, localized, progressive disorder involving deterioration of articular cartilages and subchondral bone and formation of new bone (osteophytes) at joint surfaces. Aging increases incidence; nearly all adults older than 60 years show some signs of osteoarthritis on radiographs. Asymmetrical joint involvement commonly affects hands, knees, hips, and lumbar and cervical segments of the spine. Affected joints have stiffness; swelling with hard, bony protuberances; pain with motion; and limitation of motion (see Table 24-5, p. 646). Loose cartilage bodies Abnormal Findings ◀ Osteoporosis Decrease in skeletal bone mass occurring when rate of bone resorption is greater than that of bone formation. The weakened bone state increases risk for stress fractures, especially at wrist, hip, and vertebrae. Occurs primarily in postmenopausal women of European descent. Osteoporosis risk also is associated with smaller height and weight, younger age at menopause, lack of physical activity, and lack of estrogen replacement therapy. Bone resorption CHAPTER 24 Musculoskeletal System TABLE 24-3 643 Abnormalities of the Shoulder Atrophy Loss of muscle mass is exhibited as a lack of fullness surrounding the deltoid muscle. In the case pictured (on the patient's left side), atrophy is caused by axillary nerve palsy. Atrophy also results from disuse, muscle tissue damage, or motor nerve damage. Dislocated Shoulder Anterior dislocation (95%) is exhibited when the shoulder is hunched forward and the tip of the clavicle dislocates. It occurs with trauma involving abduction, extension, and rotation (e.g., falling on an outstretched arm or diving into a pool). Joint Effusion Swelling is caused by excess fluid in the joint capsule: in the case pictured, from rheumatoid arthritis. It is best observed anteriorly. It is fluctuant on palpation. Considerable fluid must be present to cause a visible distension because the capsule normally is loose. Tear of Rotator Cuff Characteristics are a hunched position and limited abduction of arm (in the case pictured, on the patient's right side). Such tears are caused by traumatic adduction while the arm is held in abduction; by a fall on shoulder; by throwing; or by heavy lifting. In the drop arm test, the arm is passively abducted at the shoulder; a positive result is the patient's inability to sustain the position, and the arm falls to the side. ◀ Frozen Shoulder: Adhesive Capsulitis Fibrous tissues form in the joint capsule, causing stiffness, progressive limitation of motion, and pain. Abduction and external rotation are limited; affected patients cannot reach overhead. It may lead to atrophy of shoulder girdle muscles. The onset is gradual, and the cause is unknown. It is associated with prolonged bed rest or shoulder immobility. It may resolve spontaneously. Abnormal Findings Subacromial Bursitis (Not Illustrated) Inflammation and swelling of the subacromial bursa over the shoulder cause both limitation in range of motion and pain with motion. Localized swelling under the deltoid muscle may increase with partial passive abduction of the arm. This condition is caused by direct trauma, strain during sports, local or systemic inflammatory process, or repetitive motion injury. 644 Abnormal Findings TABLE 24-4 UNIT 3 Physical Examination Abnormalities of the Elbow Olecranon Bursitis Large soft knob, or "goose egg," and redness from inflammation of olecranon bursa. Localized and easy to see because bursa lies just under skin. Gouty Arthritis Joint effusion or synovial thickening, seen first as bulge or fullness in grooves on either side of olecranon process. Redness and heat can extend beyond area of synovial membrane. Soft, boggy, or fluctuant fullness to palpation. Limited extension of elbow. Subcutaneous Nodules Raised, firm, nontender nodules that occur with rheumatoid arthritis. Common sites are in the olecranon bursa and along extensor surface of arm. The skin slides freely over the nodules. Epicondylitis: Tennis Elbow Chronic, disabling pain at lateral epicondyle of humerus, radiates down extensor surface of forearm. Pain can be located by touching with one finger (as in illustration). Resisting extension of the hand will increase the pain. Occurs with activities combining excessive pronation and supination of forearm with an extended wrist (e.g., racket sports or using a screwdriver). Medial epicondylitis is rarer and is caused by activity of forced palmar flexion of wrist against resistance. TABLE 24-5 Abnormalities of the Wrist and Hand Ganglion Cyst Round, cystic, nontender nodule overlying a tendon sheath or joint capsule, usually on dorsum of wrist. Flexion makes it more prominent. A common benign tumour; it does not become malignant. Reprinted from the Clinical Slide Collection on the Rheumatic Diseases, © 1991, 1995, 1997. Used by permission of the American College of Rheumatology. Carpal Tunnel Syndrome with Atrophy of Thenar Eminence Atrophy (pictured) is caused by interference with motor function as a result of compression of the median nerve inside the carpal tunnel. Caused by chronic repetitive motion; occurs between 30 and 60 years of age and is five times more common in women than in men. Symptoms of carpal tunnel syndrome include pain, burning sensation and numbness, positive findings on Phalen test, positive Tinel's sign, and often atrophy of thenar muscles. Reprinted from the Clinical Slide Collection on the Rheumatic Diseases, © 1991, 1995, 1997. Used by permission of the American College of Rheumatology. Colles' Fracture (Not Illustrated) Nonarticular fracture of distal radius, with or without fracture of ulna at styloid process. Usually results from a fall on an outstretched hand; occurs most often in older women. Wrist looks puffy, with "silver fork" deformity, a characteristic hump when viewed from the side. Dupuytren's Contracture Chronic hyperplasia of the palmar fascia causes flexion contractures of the digits, first in the fourth digit, then the fifth digit, and then the third digit. Note the bands that extend from the mid-palm to the digits and the puckering of palmar skin. The condition occurs commonly in men older than 40 years and is usually bilateral. It occurs with diabetes, epilepsy, and alcoholic liver disease and as an inherited trait. The contracture is painless but impairs hand function. Continued Abnormal Findings Ankylosis Wrist in extreme flexion, as a result of severe rheumatoid arthritis. The affected hand is functionally useless because when the wrist is palmar flexed, a good deal of power is lost from the fingers, and the thumb cannot oppose the fingers. 646 TABLE 24-5 UNIT 3 Physical Examination Abnormalities of the Wrist and Hand—cont'd Conditions Caused by Chronic Rheumatoid Arthritis Swan-neck Boutonnière Reprinted from the Clinical Slide Collection on the Rheumatic Diseases, © 1991, 1995, 1997. Used by permission of the American College of Rheumatology. Swan-Neck and Boutonnière Deformity In swan-neck deformity, the flexion contracture resembles the curve of a swan's neck. Note flexion contracture of metacarpophalangeal joint, hyperextension of the proximal interphalangeal joint, and flexion of the distal interphalangeal joint. It occurs with chronic rheumatoid arthritis and is often accompanied by ulnar drift of the fingers. In boutonnière deformity, the knuckle looks as if it is being pushed through a buttonhole. It is a relatively common deformity and includes flexion of proximal interphalangeal joint with compensatory hyperextension of distal interphalangeal joint. Ulnar Deviation or Drift Fingers drift to the ulnar side because of stretching of the articular capsule and muscle imbalance (right hand in illustration). Also note subluxation and swelling in the joints and muscle atrophy on the dorsa of the hands. These are caused by chronic rheumatoid arthritis. Bouchard nodes Heberden nodes Abnormal Findings Degenerative Joint Disease or Osteoarthritis Osteoarthritis is characterized by hard, nontender nodules (osteophytes, or bony overgrowths), 2 to 3 mm or more in diameter. The osteophytes of the distal interphalangeal joints are called Heberden's nodes, and those of the proximal interphalangeal joints are called Bouchard's nodes. Acute Rheumatoid Arthritis Painful swelling and stiffness of joints, with fusiform or spindle-shaped swelling of the soft tissue of proximal interphalangeal joints. Fusiform swelling is usually symmetrical, the hands are warm, and the veins are engorged. The inflamed joints have a limited range of motion. CHAPTER 24 Musculoskeletal System TABLE 24-5 647 Abnormalities of the Wrist and Hand—cont'd Syndactyly Webbed fingers are a congenital deformity, usually necessitating surgical separation. The metacarpals and phalanges of the webbed fingers are different lengths, and the joints do not line up. Not correcting fused fingers would therefore limit their flexion and extension. Polydactyly Extra digits are a congenital deformity, usually occurring at the fifth finger or the thumb. Surgical removal is considered for cosmetic reasons. The sixth finger shown here was not removed because it had full range of motion and sensation and a normal appearance. ◀ Gout in the Thumb See explanation of gout in Table 24-7. Abnormal Findings 648 Abnormal Findings TABLE 24-6 UNIT 3 Physical Examination Abnormalities of the Knee Mild Synovitis Loss of normal hollows on either side of the patella, which are replaced by mild distension. Occurs with synovial thickening or effusion (excess fluid). Also note mild distension of the suprapatellar pouch. Prepatellar Bursitis Localized swelling on anterior knee between patella and skin. A tender fluctuant mass indicates swelling; in some cases, infection spreads to surrounding soft tissue. The condition is limited to the bursa, and the knee joint itself is not involved. Overlying skin may be red, shiny, and either atrophic or coarse and thickened. Swelling of Menisci Localized soft swelling from cyst in lateral meniscus shows at the midpoint of the anterolateral joint line (right leg in illustration). Semiflexion of the knee makes swelling more prominent. Osgood-Schlatter Disease Painful swelling of the tibial tubercle just below the knee, probably from repeated stress on the patellar tendon. Occurs mostly in puberty during rapid growth and most often in boys. Pain increases with kicking, running, bicycling, stair climbing, or kneeling. The condition is usually self-limited, and symptoms resolve with rest. TABLE 24-6 Abnormalities of the Knee—cont'd Chondromalacia Patellae (Not Illustrated) Degeneration of articular surface of patellae. Occurs most often in girls and women, in adolescents, and in young adults. Cause is unknown, but condition is associated with overuse and injury. May produce mild effusion. Joint motion is painless, but crepitus may be present. Kneeling causes onset of pain. Postpolio Muscle Atrophy Leg and foot muscle atrophy as a result of childhood polio (in illustration, the patient's right leg and foot). Poliomyelitis epidemics peaked in North America in the 1940s and 1950s. The development of the oral polio vaccine (1962) has almost eradicated the disease. However, thousands of polio survivors have this muscle atrophy. TABLE 24-7 Abnormalities of the Ankle and Foot Tophi With Chronic Gout In illustration, a hard, painless nodule (tophus) is over the metatarsophalangeal joint of the first toe. Tophi are collections of sodium urate crystals that develop in chronic gout in and around the joint that cause extreme swelling and joint deformity. They sometimes burst with a chalky discharge. Continued Abnormal Findings Achilles Tenosynovitis Inflammation of a tendon sheath near the ankle (in illustration, the Achilles tendon) produces a superficial linear swelling and a localized tenderness along the route of the sheath. Movement of the involved tendon usually causes pain. 650 Abnormal Findings TABLE 24-7 UNIT 3 Physical Examination Abnormalities of the Ankle and Foot—cont'd Acute Gout Acute episode of gout usually involves first the metatarsophalangeal joint. Clinical findings consist of redness, swelling, heat, and extreme tenderness. Gout is a metabolic disorder of disturbed purine metabolism, associated with elevated serum levels of uric acid. It occurs primarily in men older than 40 years. Hallux Valgus With Bunion and Hammertoes Hallux valgus is a common deformity caused by rheumatoid arthritis. It is a lateral or outward deviation of the great toe with medial prominence of the head of the first metatarsal. The bunion is the inflamed bursa that forms at the pressure point. The great toe loses power to push off while walking; this stresses the second and third metatarsal heads, and they develop calluses and pain. Chronic sequelae include corns, calluses, hammertoes, and joint subluxation. Note the hammertoe deformities in the second, third, fourth, and fifth toes. Often associated with hallux valgus, hammertoe includes hyperextension of the metatarsophalangeal joint and flexion of the proximal interphalangeal joint. Corns (thickening of soft tissue) develop on the dorsum over the bony prominence as a result of prolonged pressure from shoes. Callus Hypertrophy of the epithelium develops because of prolonged pressure, commonly on the plantar surface of the first metatarsal head in the hallux valgus deformity. The condition is not painful. Ingrown Toenail "Ingrown toenail" is a misnomer; the nail does not grow in, but the soft tissue grows over the nail and obliterates the groove. It occurs almost always on the great toe on the medial or lateral side. It is caused by trimming the nail too short or crowding of toes in tight shoes. The area becomes infected when the nail grows and its corner penetrates the soft tissue. CHAPTER 24 Musculoskeletal System TABLE 24-7 651 Abnormalities of the Ankle and Foot—cont'd ◀ Plantar Wart Vascular papillomatous growth is probably caused by a virus and occurs on the sole of the foot, commonly at the ball. The condition is extremely painful. TABLE 24-8 Abnormalities of the Spine ◀ Scoliosis Lateral curvature of thoracic and lumbar segments of the spine, usually with some rotation of involved vertebral bodies. Functional scoliosis is flexible; it is apparent on standing and disappears on forward bending. It may be compensatory for other abnormalities such as leg length discrepancy. Structural scoliosis is fixed; the curvature shows both on standing and on bending forward. In illustration, note rib hump with forward flexion. When the patient is standing, note unequal shoulder elevation, unequal scapulae, obvious curvature, and unequal hip level. At greatest risk are girls aged 10 years through adolescence, during the peak of the growth spurt. Abnormal Findings Continued 652 TABLE 24-8 UNIT 3 Physical Examination Abnormalities of the Spine—cont'd ◀ Herniated Nucleus Pulposus The nucleus pulposus (at the centre of the intervertebral disc) ruptures into the spinal canal and puts pressure on the local spinal nerve root. It is usually caused by stress, such as lifting, twisting, continuous flexion with lifting, or a fall onto the buttocks. It occurs mostly in men 20 to 45 years of age. Lumbar herniations occur mainly in interspaces L4-L5 and L5-S1. Note sciatic pain, numbness, and paraesthesia of involved dermatome; listing away from affected side; decreased mobility; low back tenderness; and decreased motor and sensory function in leg. Straight leg raising tests reproduce sciatic pain. TABLE 24-9 Common Congenital or Pediatric Abnormalities ◀ Congenital Dislocated Hip Abnormal Findings Head of the femur is displaced out of the cup-shaped acetabulum. The degree of the condition varies; subluxation may occur as stretched ligaments allow partial displacement of the femoral head, and acetabular dysplasia may develop because of excessive laxity of the hip joint capsule. Occurrence is 1 : 500 to 1 : 1000 births; more common in girls (7 : 1 ratio). Signs include limited abduction of flexed thigh, positive findings of Ortolani manoeuvre and positive Barlow's sign, asymmetrical skin creases or gluteal folds, limb length discrepancy, and positive indication of the Trendelenburg sign in older children. CHAPTER 24 Musculoskeletal System TABLE 24-9 653 Common Congenital or Pediatric Abnormalities—cont'd Talipes Equinovarus (Clubfoot) Congenital, rigid, and fixed malposition of foot, including (a) inversion, (b) forefoot adduction, and (c) foot pointing downward (equinus). A common birth defect, with an incidence of 1 : 1000 to 3 : 1000 live births. Boys are affected twice as frequently as girls. Spina Bifida Incomplete closure of posterior part of vertebrae results in a neural tube defect. Seriousness varies from skin defect along the spine to protrusion of the sac containing meninges, spinal fluid, or malformed spinal cord. The most serious type is myelomeningocele (shown in illustration), in which the meninges and neural tissue protrude. Most children with myelomeningocele are paralyzed below the level of the lesion. Coxa Plana (Legg-Calvé-Perthes Syndrome) (Not Illustrated) Avascular necrosis of the femoral head, occurring primarily in boys between 3 and 12 years of age, peaking at age 6 years. In the initial inflammatory stage, interruption of blood supply to femoral epiphysis occurs, halting growth. Revascularization and healing occur later, but significant residual deformity and dysfunction may be present. Abnormal Findings 654 UNIT 3 Physical Examination TABLE 24-10 Fibromyalgia Syndrome Occiput Lower cervical Trapezius Second rib Supraspinatus Lateral epicondyle Gluteal Greater trochanter Knee LOCATION OF TENDER POINTS © Pat Thomas, 2010. Abnormal Findings Chronic disorder of unknown cause characterized by widespread musculoskeletal pain lasting 3 months or longer, associated with fatigue, insomnia, and psychosocial distress. Most patients (90%) are women. There are two major diagnostic criteria (Wolfe et al., 1990): (a) pain on both sides of the body, above and below the waist, and axial skeletal pain (cervical, thoracic, lumbar spine, or anterior chest); and (b) point tenderness on digital palpation in 11 of 18 specific sites (shown in illustration). The examiner presses the thumb of the dominant hand with a force of 4 kg (same as needed to blanch or whiten the nail bed). The burden of illness is high: 25% to 33% of affected patients receive disability compensation. Summary Checklist: Musculoskeletal Examination For a PDA-downloadable version, go to . For each joint to be examined: 1. Inspection: Size and contour of joint Skin colour and characteristics 2. Palpation of joint area: Skin Muscles Bony articulations Joint capsule 3. Range of motion (ROM): Active Passive (if active ROM is limited) Measure with goniometer (if ROM is abnormal) 4. Muscle testing: 5. Teaching and health promotion REFERENCES Arthritis Society. (2011a). Osteoarthritis: Know your options. Retrieved from . Arthritis Society. (2011b). Rheumatoid arthritis: Know your options. Retrieved from . doc?id=87. Canadian Institute for Health Information. (2007). Health indicators 2007. Retrieved from products/hi07_health_indicators_2007_e.pdf. Canadian Institute for Health Information. (2009). Hip and knee replacements in Canada—Canadian Joint Replacement CHAPTER 24 Musculoskeletal System 655 Registry (CJRR) 2008-2009 annual report. Retrieved from en.pdf. Cousins, J. M., Petit, M. 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Browne, PhD, RN • Animations • Bedside Assessment Summary Checklist • Case Study: • Seizures • Examination Review Questions • Health Promotion Guide: • Stroke • Key Points • Physical Examination Summary Checklist • Quick Assessment for Common Conditions • Quick Assessment for Common Conditions Checklist • Video—Assessment: • Lower Extremities and Neuromuscular Function • Musculoskeletal and Neurological Examination Guide • Stroke Risk Factors • Musculoskeletal and Neurological Examination: Neurological Examination of the Lower Extremities and Lower Extremities: Musculoskeletal and Neurological Examination, Nervous System Assess the Sensory System Test the Reflexes Neurological Recheck Documentation and Critical Thinking 701 Subjective Data 666 Health History Questions Abnormal Findings 703 Objective Data 669 Test Cranial Nerves Inspect and Palpate the Motor System STRUCTURE A N D F U N C T I O N The nervous system can be divided into two parts: central and peripheral. The central nervous system (CNS) includes the brain and spinal cord. The peripheral nervous system includes the 12 pairs of cranial nerves, the 31 pairs of spinal nerves, and all their branches. The peripheral nervous system carries sensory (afferent) messages to the CNS from sensory receptors, motor (efferent) messages from the CNS out to muscles and glands, and autonomic messages that govern the internal organs and blood vessels. The meninges (dura, arachnoid, and pia mater) are the layers of membranes that envelope the CNS. The primary 656 function of the meninges and of the cerebrospinal fluid is to protect the CNS. THE CENTRAL NERVOUS SYSTEM Cerebral Cortex The cerebral cortex is the cerebrum's outer layer of nerve cell bodies; this layer looks like "grey matter" because it lacks myelin. Myelin is the white insulation on the axon that increases the conduction velocity of nerve impulses. Precentral gyrus—primary motor area Central sulcus trunk hand fingers face lips 657 Postcentral gyrus—primary sensory area PARIETAL LOBE—sensation Wernicke's area—speech comprehension OCCIPITAL LOBE—visual reception tongue FRONTAL LOBE—personality behavior emotion intellectual functions Broca's area—motor speech Lateral sulcus TEMPORAL LOBE—hearing taste smell CEREBRAL CORTEX Left Lateral View 25-1 The cerebral cortex (cerebrum) is the centre for humans' highest functions, governing thought, memory, reasoning, sensation, and voluntary movement (Figure 25-1). Each half of the cerebrum is a hemisphere; the left hemisphere is dominant in ~ 95%) of right-handed people, and in many who are left-handed. Each hemisphere is divided into four lobes: frontal, parietal, temporal, and occipital. The lobes have certain areas that mediate specific functions: • The frontal lobe has areas concerned with personality, behaviour, emotions, and intellectual function. • The precentral gyrus of the frontal lobe initiates voluntary movement. • The parietal lobe contains the postcentral gyrus, which is the primary centre for sensation. • The occipital lobe is the primary visual receptor centre. • The portion of the temporal lobe behind the ear has the primary auditory reception centre. • Wernicke's area in the temporal lobe is associated with language comprehension. When it is damaged in a person's dominant hemisphere, receptive aphasia results. The person hears sound, but it has no meaning, like hearing a foreign language. • Broca's area in the frontal lobe mediates motor speech. When it is injured in the dominant hemisphere, expressive aphasia results; the person cannot talk. The person can understand language and knows what he or she wants to say but can produce only a garbled sound. Damage to any of these specific cortical areas produces a corresponding loss of function: motor weakness, paralysis, loss of sensation, or impairment of the ability to understand CEREBELLUM— motor coordination equilibrium balance © Pat Thomas, 2006. and process language. Damage occurs when the highly specialized neurological cells are deprived of their blood supply, such as when a cerebral artery becomes occluded or when vascular bleeding or vasospasm occurs. Basal Ganglia The basal ganglia are additional bands of grey matter buried deep within the two cerebral hemispheres that form the subcortical associated motor system (the extrapyramidal system; Figure 25-2). They control automatic associated movements of the body, such as the arm swing that alternates with the leg movement during walking. Thalamus The thalamus is the main relay station for the nervous system. Sensory pathways of the spinal cord and brain stem form synapses (sites of contact between two neurons) on their way to the cerebral cortex. Hypothalamus The hypothalamus is a major control centre with many vital functions: controlling temperature, heart rate, and blood pressure; regulating sleep and the anterior and posterior pituitary gland; and coordinating autonomic nervous system activity and emotional status. Cerebellum The cerebellum is a coiled structure located under the occipital lobe that is concerned with motor coordination of voluntary movements, equilibrium (i.e., the postural balance of the body), and muscle tone. It does not initiate movement Structure & Function CHAPTER 25 Neurological System Structure & Function 658 UNIT 3 Physical Examination Plane of coronal section 8 Internal capsule Corpus callosum Thalamus Midbrain Pons Cerebellum Medulla Hypothalamus Pituitary BRAIN STEM Basal ganglia Spinal cord A. Medial view of right hemisphere Hypothalamus B. Coronal section COMPONENTS OF THE CENTRAL NERVOUS SYSTEM 25-2 but coordinates and smoothes it, such as the complex and quick coordination of many different muscles needed in playing the piano, swimming, or juggling. It is like the automatic pilot on an airplane in that it adjusts and corrects the voluntary movements but operates entirely below the conscious level. Brain Stem The brain stem is the central core of the brain consisting of mostly nerve fibres. It has three areas: 1. Midbrain: the most anterior part of the brain stem that still has the basic tubular structure of the spinal cord. It merges into the thalamus and hypothalamus. It contains many motor neurons and tracts. 2. Pons: the enlarged area containing ascending and descending fibre tracts. 3. Medulla: the continuation of the spinal cord in the brain that contains all ascending and descending fibre tracts connecting the brain and spinal cord. It has vital autonomic centres (respiratory, cardiac, gastrointestinal functions), as well as nuclei for cranial nerves VIII through XII. Pyramidal decussation (crossing of the motor fibres) occurs here (see p. 661). Spinal Cord The spinal cord is the long cylindrical structure of nervous tissue approximately as big around as the little finger. It occupies the upper two thirds of the vertebral canal from the medulla to between lumbar vertebrae L1 and L2. It is the main pathway for ascending and descending fibre tracts that connect the brain to the spinal nerves, and it mediates reflexes. Its nerve © Pat Thomas, 2006. cell bodies, or grey matter, are arranged in a butterfly shape with anterior and posterior "horns." Pathways of the Central Nervous System Crossed representation is a notable feature of the nerve tracts; the left cerebral cortex receives sensory information from and controls motor function to the right side of the body, whereas the right cerebral cortex interacts with the left side of the body. Knowledge of where the fibres cross the midline helps you interpret clinical findings. Sensory Pathways Millions of sensory receptors are embroidered into the skin, mucous membranes, muscles, tendons, and viscera. They monitor conscious sensation, internal organ functions, body position, and reflexes. Sensation travels in the afferent fibres in the peripheral nerve, then through the posterior (dorsal) root, and then into the spinal cord. In the spinal cord, it may take one of two routes: the spinothalamic tract or the posterior (dorsal) columns (Figure 25-3). Spinothalamic Tract. The spinothalamic tract contains sensory fibres that transmit the sensations of pain, temperature, and crude or light touch (i.e., touch not precisely localized). The fibres enter the dorsal root of the spinal cord and synapse with a second sensory neuron. The second-order neuron fibres cross to the opposite side and ascend to the spinothalamic tract to the thalamus. Fibres carrying pain and temperature sensations ascend the lateral spinothalamic tract, whereas those carrying sensations of crude touch form the anterior spinothalamic tract. At the thalamus, the fibres Arm 659 Trunk Hand Fingers Hip Knee Face Foot Lips Toes Tongue Thalamus A HOMUNCULUS Major Sensory Pathways Lateral spinothalamic tract—pain, temperature Anterior spinothalamic tract— crude touch Pons Posterior (dorsal) columns—fine touch B Medulla Posterior column Fine touch receptor Pain Pressure receptor receptor —crude touch Spinothalamic tract Anterior Lateral Posterior root of the spinal cord 25-3 Sensory pathways. synapse with a third sensory neuron, which carries the message to the sensory cortex for full interpretation. Posterior (Dorsal) Columns. These fibres conduct the sensations of position, vibration, and finely localized touch. • Position (proprioception): the sense of where your body parts are in space and in relation to each other, without your looking • Vibration: feeling vibrating objects • Finely localized touch (stereognosis): the ability to identify familiar objects by touch, without looking These fibres enter the dorsal root and proceed immediately up the same side of the spinal cord to the brain stem. At the medulla, they synapse with a second sensory neuron and then cross. They travel to the thalamus, synapse again, and proceed to the sensory cortex, which localizes the sensation and makes full discrimination. The sensory cortex is arranged in a specific pattern forming a corresponding "map" of the body (see Figure 25-3, A. The homunculus (Latin for "little man") is an illustration representing the proportion of the brain that is responsible for sensation in particular body parts). Pain in the right hand is perceived at its specific spot on the left cortex map. Some organs—such as the heart, liver, and spleen—are not © Pat Thomas, 2006. represented in the brain map. You know you have such organs, but you have no "felt image" of it. Pain originating in these organs is referred; that is, it is felt "by proxy" by another body part that does have a felt image. For example, pain in the heart is referred to the chest, shoulder, and left arm, which were its neighbours during fetal development. Pain originating in the spleen is felt on the top of the left shoulder. Motor Pathways Corticospinal or Pyramidal Tract. This area has been named pyramidal because it originates in pyramid-shaped cells in the motor cortex and travel to the brain stem, where they cross to the opposite or contralateral side (pyramidal decussation) and then pass down in the lateral column of the spinal cord. At each cord level, they synapse with a lower motor neuron contained in the anterior horn of the spinal cord. Ten percent of corticospinal fibres do not cross, and these descend in the anterior column of the spinal cord. Corticospinal fibres mediate voluntary movement, particularly very skilled, discrete, purposeful movements, such as writing. The corticospinal tract is a newer, "higher" motor system in humans that enables very skilled and purposeful Structure & Function CHAPTER 25 Neurological System Structure & Function 660 UNIT 3 Physical Examination Arm Trunk Hand Fingers Hip Sen o ry Nx Toe Leg Face Lips Tongue Motor Pathways Corticospinal (pyramidal) tract Corticospinal crossed tract Corticospinal uncrossed tract Extrapyramidal tracts Pons Medulla Cerebellum Lower motor neuron Spinal Cord 25-4 Motor pathways. movements. The origin of this tract in the motor cortex is arranged in a specific pattern called somatotopic organization. Another type of body map, a cortical homunculus (see Figure 25-3) shows the portion of the human brain directly responsible for the movement and exchange of sensory and motor information of the body; that is, body parts whose movements are relatively more important to humans (e.g., the hand) occupy proportionally more space on the brain map. Extrapyramidal Tracts. The extrapyramidal tracts include all the motor nerve fibres originating in the motor cortex, basal ganglia, brain stem, and spinal cord that are outside the pyramidal tract. They constitute a phylogenetically older, more primitive motor system. These subcortical motor fibres maintain muscle tone and control body movements, especially gross automatic movements, such as walking. Cerebellar System. This complex motor system coordinates movement, maintains equilibrium, and helps maintain posture. The cerebellum receives information about the position of muscles and joints—the body's equilibrium—and the kind of motor messages that are being sent from the cortex to the muscles. The information is integrated, and the cerebellum uses feedback pathways to exert its control back on the cortex or down to lower motor neurons in the spinal cord. This entire process occurs on a subconscious level. © Pat Thomas, 2010. Upper and Lower Motor Neurons Upper motor neurons are a complex of all the descending motor fibres that can influence or modify the lower motor neurons. Upper motor neurons are located completely within the CNS. The neurons convey impulses from the motor areas of the cerebral cortex to the lower motor neurons in the anterior horn cells of the spinal cord (Figure 25-5). Examples of upper motor neurons are corticospinal, corticobulbar, and extrapyramidal tracts. Examples of upper motor neuron diseases are cerebrovascular accident, cerebral palsy, and multiple sclerosis. Lower motor neurons are located mostly in the peripheral nervous system. The cell body of the lower motor neuron is located in the anterior grey column of the spinal cord, but the nerve fibre extends from there to the muscle. The lower motor neuron is the "final common pathway" because it funnels many neural signals and it provides the final direct contact with the muscles. Any movement is translated into action by lower motor neuron fibres. Examples of lower motor neurons are cranial nerves and spinal nerves of the peripheral nervous system. Examples of lower motor neuron diseases are spinal cord lesions, poliomyelitis, and amyotrophic lateral sclerosis. Motor area of the cerebral cortex 661 Cell body in dorsal root ganglion Pons Sensory nerve Decussation of the pyramids Axillary nerve Cranial nerve VII Muscle spindle Orbicularis oris muscle Deltoid muscle Motor nerve Patellar tendon REFLEX ARC 25-5 Upper motor neuron Lower motor neuron 25-5 Neural pathways. Reflexes Reflexes are basic defence mechanisms of the nervous system. They are involuntary, operating below the level of conscious control and permitting quick reactions to potentially painful or damaging events. Reflexes also help the body maintain balance and appropriate muscle tone. There are four types of reflexes: (a) deep tendon reflexes (myotatic), such as patellar or knee jerk; (b) superficial, such as corneal reflex, abdominal reflex; (c) visceral (organic), such as pupillary response to light and accommodation; and (d) pathological (abnormal), such as the Babinski (extensor plantar) reflex. The fibres that mediate the reflex are carried by a specific spinal nerve. In the most simple reflex, tapping the tendon stretches the muscle spindles in the muscle, which activates the sensory afferent nerve. The sensory afferent fibres carry the message from the receptor and travel through the dorsal root into the spinal cord (Figure 25-6). They synapse directly in the cord with the motor neuron in the anterior horn. Motor efferent fibres leave via the ventral root and travel to the muscle, stimulating a sudden contraction. The deep tendon (myotatic or stretch) reflex (DTR) has five components: (a) an intact sensory nerve (afferent); (b) a functional synapse in the cord; (c) an intact motor nerve fibre (efferent); (d) the neuromuscular junction; and (e) a competent muscle. Cranial Nerves Cranial nerves enter and exit the brain rather than the spinal cord (Figure 25-7). Cranial nerves I and II extend from the cerebrum; cranial nerves III to XII extend from the lower diencephalon and brain stem. The 12 pairs of cranial nerves supply primarily the head and neck, except the vagus nerve (from the Latin vagus, or wanderer, as in "vagabond"), which travels to the heart, respiratory muscles, stomach, and gallbladder. Spinal Nerves The 31 pairs of spinal nerves arise from the length of the spinal cord and supply the rest of the body. They are named for the region of the spine from which they exit: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal. They are "mixed" nerves because they contain both sensory and motor fibres. The nerves enter and exit the spinal cord Structure & Function CHAPTER 25 Neurological System Structure & Function 662 UNIT 3 Physical Examination CRANIAL NERVES I Olfactory II Optic III Oculomotor IV Trochlear VI Abducens V Trigeminal VII Facial VIII Acoustic IX Glossopharyngeal X Vagus XI Spinal Accessory XII Hypoglossal MOTOR Cranial Nerve XI Spinal Accessory Type Function I: Olfactory Sensory Smell II: Optic Sensory Vision III: Oculomotor Mixed* IV: Trochlear V: Trigeminal Motor Mixed VI: Abducens VII: Facial Motor Mixed VIII: Acoustic IX: Glossopharyngeal Sensory Mixed Smell Vision Motor—most EOM movement, opening of eyelids Parasympathetic—pupil constriction, lens shape Down and inward movement of eye Motor—muscles of mastication Sensory—sensation of face and scalp, cornea, mucous membranes of mouth and nose Lateral movement of eye Motor—facial muscles, close eye, labial speech, close mouth Sensory—taste (sweet, salty, sour, bitter) on anterior two thirds of tongue Parasympathetic—saliva and tear secretion Hearing and equilibrium Motor—pharynx (phonation and swallowing) Sensory—taste on posterior one third of tongue, pharynx (gag reflex) Parasympathetic—carotid reflex, chemoreceptors Motor—pharynx and larynx (talking and swallowing) Sensory—general sensation from carotid body, carotid sinus, pharynx, viscera Parasympathetic—carotid reflex Movement of trapezius and sternomastoid muscles Movement of tongue X: Vagus XI: Spinal XII: Hypoglossal Mixed Motor Motor *Mixed refers to a nerve carrying a combination of fibres: motor, sensory, motor parasympathetic; or motor sensory parasympathetic. 25-7 through roots: sensory afferent fibres through the posterior (dorsal) roots, and motor efferent fibres through the anterior (ventral) roots. The nerves exit the spinal cord in an orderly ladder shape. Each nerve innervates a particular segment of the body. © Pat Thomas, 2006. Dermal segmentation is the cutaneous distribution of the various spinal nerves. A dermatome is a circumscribed skin area that is supplied mainly from one spinal cord segment through a particular spinal nerve (Figure 25-8). The dermatomes overlap, which 663 C2 Cervical vertebrae C1–C7 Cervical spinal nerves C1–C8 C3 C4 Thoracic vertebrae T1–T12 C5—Front of neck C5 T1 T2 T3 T4 T5 T6 T7 T8 T9 Thoracic spinal nerves T1–T12 T4—Nipple C6 T10—Umbilicus T10 T11 C6—Thumb T12 C6 C7 Lumbar vertebrae L1–L5 Lumbar spinal nerves L1–L5 S2 S3 L3 C8—Right little finger L1 L2 C7 L3 L4 L4—Knee L5 S2 Sacral vertebrae S1–S5 Sacral spinal nerves S1–S5 Coccyx Coccygeal spinal nerve S1 S1 L5 SPINAL NERVES S2 L5—Anterior ankle and foot DERMATOMES 25-8 is a form of biological insurance; that is, if one nerve is severed, most of the sensations will continue to be transmitted by the one above and the one below. You do not attempt to memorize all dermatome segments; focus on just the following as useful landmarks: • The thumb, middle finger, and fifth finger are each in the dermatomes of C6, C7, and C8. • The axilla is at the level of T1. • The nipple is at the level of T4. • The umbilicus is at the level of T10. • The groin is in the region of L1. • The knee is at the level of L4. Peripheral Nervous System The peripheral nervous system is composed of cranial nerves and spinal nerves. These nerves carry fibres that can be divided functionally into two parts: somatic and autonomic. The somatic fibres innervate the skeletal (voluntary) muscles, cardiac muscle, and glands. The autonomic system mediates unconscious activity. A detailed description of the autonomic system is beyond the scope of this book; its overall function is to maintain homeostasis of the body. DEVELOPMENTAL CONSIDERATIONS Infants The neurological system is not completely developed at birth. Motor activity in newborns is under the control of the spinal cord and medulla. Very little cortical control exists, and the neurons are not yet myelinated. Movements are directed primarily by primitive reflexes. As the cerebral cortex develops during the first year, it inhibits these reflexes, and they disappear at predictable times. Persistence of the primitive reflexes is an indication of CNS dysfunction. Infants' sensory and motor development proceeds along with the gradual acquisition of myelin because myelin is needed to conduct most impulses. The process of myelination follows a cephalocaudal order and a proximal-to-distal order (head, neck, trunk, and extremities). This is the order observed in infants as they gain motor control (lifting head, lifting head and shoulders, rolling over, moving whole arm, Structure & Function CHAPTER 25 Neurological System Structure & Function 664 UNIT 3 Physical Examination using hands, walking). As the milestones are achieved, each movement is more complex and coordinated. Milestones occur in an orderly sequence, although the exact age at occurrence may vary. Sensation is also rudimentary at birth. Newborns need a strong stimulus and then respond by crying and with whole body movements. As myelination develops, later infants are able to localize the stimulus more precisely and to make a more accurate motor response. Older Adults The aging process causes a general atrophy with a steady loss of neurons in the brain and spinal cord. This causes a decrease in weight and volume with a thinning of the cerebral cortex, reduced subcortical brain structures, and expansion of the ventricles (Fjell, Walhovd, & Fennema-Notestine, 2009). Neuron loss leads many people over 65 to show signs that would be considered abnormal in the younger adult, such as general loss of muscle bulk; loss of muscle tone in the face, in the neck, and around the spine; decreased muscle strength; impaired fine coordination and agility; loss of vibratory sense at the ankle; decreased or absent Achilles reflex; loss of position sense at the big toe; and pupillary miosis, irregular pupil shape, and decreased pupillary reflexes. The velocity of nerve conduction decreases between 5% and 10% with aging, which slows the reaction time in some older adults. An increased delay at the synapse also occurs, so that the impulse takes longer to travel. As a result, touch and pain sensation, taste, and smell may be diminished. The motor system may show a general slowing down of movement. Muscle strength and agility decrease. A generalized decrease occurs in muscle bulk, which is most apparent in the dorsal hand muscles. Muscle tremors may occur in the hands, head, and jaw, along with possible repetitive facial grimacing (dyskinesias). Aging involves a progressive decrease in cerebral blood flow and oxygen consumption. In some people, this causes CULTURAL AND SOCIAL CONSIDERATIONS According to the Heart and Stroke Foundation of Canada (2012a), research has shown that in comparison with the general population, people of Aboriginal, African, or South Asian descent are more likely to have high blood pressure and diabetes and are at greater risk for heart disease and stroke. Reasons for this are complex and may relate to intersecting factors such as low socioeconomic status, poor access to health care and preventive services, and lack of opportunities for exercise. The foundation has translated and culturally adapted some health education resources into Ojibwe, Ojicree, Punjabi, Hindi, Mandarin, and Cantonese, among other languages, to help patients who speak those languages learn the risk factors and warning signs for heart disease and stroke. People's social circumstances influence their ability to manage after a stroke. Social resources have been found to have a buffering effect in survivors, serving to reduce the adverse effects of physical disability on subjective well-being after stroke (Clarke, Marshall, Black, & Colantonio, 2002). Stroke survivors with higher levels of education report a greater sense of personal growth, purpose in life, and environmental mastery than do survivors with fewer years of education. In comparison with men, women who have had a stroke are more likely to live alone and less likely to have social supports (Heart and Stroke Foundation of Canada, 2012b). HEALTH PROMOTION: HEALTH: STROKE PREVENTION Stroke is the third leading cause of death in Canada; 6% of all deaths in Canada are caused by stroke, and more women than men die of stroke (Heart and Stroke Foundation of Canada, 2012b). Almost 50,000 new cases of stroke occur in Canada each year, and the associated short-term mortality is approximately 20% to 25% (Côté et al., 2007). The prevalence of stroke increases with age and other risk factors, such as hypertension, smoking, and associated cardiac conditions such as atrial fibrillation. A stroke, or cerebrovascular accident, occurs when the blood flow is interrupted to part of the brain, which is why it is often referred to as a "brain attack." The most common type is an ischemic stroke, in which a blood clot blocks a blood vessel in the brain. Less common is a hemorrhagic stroke, which occurs when a blood vessel in the brain ruptures and causes bleeding. The symptoms and aftereffects of a stroke depend on which area of the brain is affected and to what extent. This can make a stroke difficult to diagnose. However, early recognition of symptoms and prompt treatment are essential so that appropriate treatments and interventions can be initiated as soon as possible. Only approximately 5% of patients with stroke receive appropriate therapy in a timely manner (Bergman, 2011). Time from symptom onset is the most important piece of information in the initial assessment (Bergman, 2011, p. 660). Early assessment is particularly important because symptoms of stroke or transient ischemic attack (TIAs) may be similar to those of other conditions, such as hypoglycemia, migraine, seizure, trauma, or medication overdose. The most common symptoms of stroke are as follows: 1. Sudden weakness or numbness in the face, arms, or legs, especially when it is on one side of the body HEALTH PROMOTION: HEALTH: STROKE PREVENTION—cont'd 2. Sudden confusion, trouble speaking, or understanding speech 3. Sudden changes in vision, such as blurry vision or partial or complete loss of vision in one or both eyes 4. Sudden trouble walking, dizziness, or loss of balance or coordination 5. Sudden severe headache with no reason or explanation Less common symptoms of stroke are as follows: 1. Nausea or vomiting 2. Brief loss of consciousness, including fainting Many Canadians continue to ignore, or fail to recognize, the symptoms of stroke. Stroke symptoms usually do not hurt, which is why many people ignore them or delay seeking medical attention. A "mini-stroke," or TIA, can also occur. In these cases, the stroke symptoms are only temporary and then disappear, often within an hour. Because the symptoms "go away," people too often do not report them or seek medical attention. However, a TIA is a warning sign that should not be ignored. The risk for an ischemic stroke is approximately 10% to 20% in the first year after a TIA (Côté et al., 2007). When people experience chest pain, they usually know to seek medical attention to rule out the possibility of a future "brain attack." One significant reason for delay is that patients consult with their physician or relatives at the onset of symptoms (Bergman, 2011, p. 664). Patients must be instructed to call an ambulance for immediate transportation to a hospital instead. Stroke can strike anyone without any warning. Preventing a stroke is still the best medicine. People need to be aware of their stroke risk and take steps to change the risk factors that they can control. Most risk factors for stroke, such as high blood pressure, diabetes, smoking, inactivity, and high cholesterol are equivalent for men and women and are potentially modifiable, depending on personal and social contexts. Gender, however, is an important risk factor. In Canada, the risk for stroke is higher for men than for women, but the mortality rate is 45% higher for women at all ages (Heart and Stroke Foundation of Canada, 2012c), and the gap is widening. In part, this is because women live longer on average than do men, but new research suggests that there may exist some risk factors that are uniquely important for women. For example, women who have migraines with visual disturbances, such as flashing dots or blind spots, can be up to 10 times more likely to have a stroke than those without visual disturbances; women who develop preeclampsia in pregnancy may have a 60% greater risk of non-pregnancy-related ischemic stroke; and women who smoke and are taking oral contraceptives or have high blood pressure, migraines, or blood clotting disorders have an increased risk of stroke. The following modifiable risk factors are recommended: 1. History of cardiovascular disease a. Coronary heart disease b. Cardiac failure c. Symptomatic peripheral artery disease (PAD) 2. Hypertension 3. Cigarette smoking or exposure to second-hand smoke 4. Diabetes 5. Atrial fibrillation 6. Other cardiac conditions a. Dilated cardiomyopathy b. Valvular heart disease (e.g., mitral valve prolapse, endocarditis, and prosthetic cardiac valves) c. Intracardiac congenital defects (e.g., patent foramen ovale, atrial septal defect, and atrial septal aneurysm) 7. Dyslipidemia 8. Asymptomatic carotid stenosis 9. Sickle cell disease 10. Postmenopausal hormone therapy 11. Diet and nutrition 12. Physical inactivity 13. Obesity and fat distribution 14. History of TIA Nonmodifiable risk factors for stroke may still help identify people who, in conjunction with well-documented modifiable risks, are at highest risk for stroke and who may benefit from more rigorous treatment of modifiable risk factors. Nonmodifiable risk factors for stroke include the following: 1. Age 2. Gender: Strokes are generally more prevalent in men than in women. However, the mortality rate for women is higher. 3. Low birth weight 4. Ethnocultural background: Aboriginal people and people of African or South Asian descent are more likely to have high blood pressure and diabetes and are therefore at greater risk for heart disease and stroke than is the general population. 5. Genetic factors, genetic disorders, such as Marfan's syndrome, Fabry's disease, and cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL) The Canadian Best Practice Recommendations for Stroke Care (Lindsay et al., 2010) recommend that patients at risk for stroke and who have had a stroke focus on the following areas for prevention: eating a healthy balanced diet; adhering to the recommended daily limit of sodium intake, known as the Adequate Intake; moderate exercise; maintaining a healthy weight; smoking cessation or reduction; limiting alcohol intake; and managing underlying medical conditions such as hypertension, dyslipidemia, previous stroke or transient ischemic attack, atrial fibrillation and stroke, and carotid stenosis. Resources American Stroke Association. (2012). About stroke. Retrieved from . Heart and Stroke Foundation of Canada. (2012b). Stroke. Retrieved from . ikiQ,cMWRFKb3489933; Lindsay, M. P., Gubitz, G., Bayley, M., Hill, M. D., Davies-Schinkel, C., Singh, S., & Phillips, S. (2010). Canadian Best Practice Recommendations for Stroke Care (Update 2010). On behalf of the Canadian Stroke Strategy Best Practices and Standards Writing Group. 2010; Ottawa, Ontario Canada: Canadian Stroke Network. Retrieved from ticos.ca/wp-content/uploads/2011/04/2010BPR_ENG.pdf. Structure & Function CHAPTER 25 Neurological System Structure & Function Subjective Data 666 UNIT 3 Physical Examination SUBJECTIVE DATA 1. Headache 2. Dizziness or vertigo 3. Seizures 4. Tremors 5. Weakness 7. Incoordination 8. Numbness or tingling sensation 9. Difficulty swallowing 10. Difficulty speaking 11. Significant past history 12. Environmental and occupational hazards HEALTH HISTORY QUESTIONS Examiner Asks Rationale 1. Headache. Do you have any unusually frequent or severe headaches? • When did this start? How often does it occur? • Where in your head do you feel the headache? Do the headaches seem to be associated with anything? (Headache history is fully discussed in Chapter 14.) 2. Head injury. Have you ever had any head injury? Please describe. • What part of your head was hit? • Did you experience loss of consciousness? For how long? • Do you use a helmet consistently to prevent head injuries (e.g., helmet use with sports such as biking, skating, skiing, snowboarding)? 3. Dizziness/vertigo. Do you ever feel lightheaded, a swimming sensation, like feeling faint? • When have you noticed this? How does it occur: rotating or feel light-headed? (Note: Distinguish vertigo from dizziness.) Do you feel as if the room spins (objective vertigo)? Or do you feel that you are spinning (subjective vertigo)? Did this come on suddenly or gradually? 4. Seizures. Have you ever had any seizures? When did they start? How often do they occur? • Course and duration: When a seizure starts, do you have any warning sign? What type of sign? • Motor activity: Where in your body do the seizures begin? Do the seizures travel through your body? One side or both? Does your muscle tone seem tense or limp? • Any associated signs, such as colour change in face or lips, loss of consciousness (for how long), automatisms (eyelid fluttering, eye-rolling, lip smacking), incontinence? • Postictal phase: After the seizure, are you told that you spend time sleeping, or do you have any confusion, weakness, headache, or muscle ache? • Precipitating factors: Does anything seem to bring on the seizures: activity, discontinuing medication, fatigue, stress? • Are you taking any medication? • Coping strategies: How have the seizures affected daily life, your occupation? Syncope is a sudden loss of strength and a temporary loss of consciousness (fainting), caused by lack of cerebral blood flow, as occurs with low blood pressure. True vertigo is the sensation of rotational spinning, caused by a neurological disease in the vestibular apparatus in the ear or the vestibular nuclei in the brain stem. Seizures occur with epilepsy, a paroxysmal disease characterized by altered or loss of consciousness, involuntary muscle movements, and sensory disturbances. Aura is a subjective sensation that precedes a seizure; it could be auditory, visual, or motor. CHAPTER 25 Neurological System Subjective Data 5. Tremors. Do you have any shaking or tremors in the hands or face? When Rationale Tremor is an involuntary shaking, trembling, or trembling. Paresis refers to weakness of voluntary movements or impaired movement. Paralysis is a loss of motor function as a result of a lesion in the neurological or muscular system or loss of sensory innervation. Dysmetria is the inability to control range of motion of muscles. Paresthesia is an abnormal sensation, such as burning, tingling. Dysphagia refers to difficulty swallowing. Dysarthria is difficulty with language comprehension or expression (see Table 25-12). Review the patient's anticonvulsant, antitremor, antivertigo, and pain medications. Additional History for Infants and Children 1. Maternal health. Did you (the mother) have any health problems during the pregnancy: any infections or illnesses, medications taken, toxemia, hypertension, alcohol or drug use, diabetes? 2. Neonatal period. Please tell me about this baby's birth. Was the baby full term or premature? What was the birth weight? • Any birth trauma? Did the baby breathe immediately? • Were you told the baby's Apgar scores? • Any congenital defects? 3. Reflexes. What have you noticed about the baby's behaviour? Do the baby's sucking and swallowing seem coordinated? When you touch the cheek, does the baby turn his or her head toward the touch? Is the baby startled by a loud noise or shake of the crib? Does the baby grasp your finger? 4. Weakness and balance. Does the child seem to have any problem with balance? Have you noted any unexplained falling, clumsy or unsteady gait, progressive muscular weakness, problem with going up or down stairs, problem with getting up from lying position? 5. Seizures. Has this child had any seizures? Please describe. Did the seizure occur with a high fever? Did any loss of consciousness occur? For how long? How many seizures occurred with this same illness (if occurred with high fever)? Prenatal history may affect an infant's neurological development. If any of these signs occurs, it may not be noticed until child starts to walk (in late infancy). Screen for muscular dystrophy. 25. In infants and toddlers, seizures may occur with high fever. Seizures may also be a sign of neurological disease. Subjective Data did these start? • Do they seem to grow worse with anxiety, intention (purposeful movement), or rest? • Are they relieved by rest, activity, alcohol? Do they affect daily activities? 6. Weakness. Do you have any weakness, or problem moving, any body part? Is this generalized or local? Does weakness occur with any particular movement, such as difficulty getting up out of a chair or reaching for an object (proximal or large muscle weakness) or difficulty opening a jar, writing, using scissors, or walking without tripping (with distal or small muscle weakness)? 7. Incoordination. Do you have any problem with coordination? Any problem with balance when walking? Do you list to one side? Any falling? Which way? Do your legs seem to give way? Any clumsy movement? 8. Numbness or tingling. Do you have any numbness or tingling sensation in any body part? Does it feel like pins and needles? When did this start? Where do you feel it? Does it occur with any activity? 9. Difficulty swallowing. Do you have any problem swallowing? Does it occur with solids or liquids? Have you experienced excessive salivation, drooling? 10. Difficulty speaking. Do you have any problem speaking: with forming words or with saying what you intended to say? When did you first notice this? How long did it last? 11. Significant past history. Have you ever had a stroke (cerebrovascular accident), spinal cord injury, meningitis or encephalitis, congenital defect, or alcoholism? 12. Environmental and occupational hazards. Are you exposed to any environmental or occupational hazards: insecticides, organic solvents, lead? • Are you taking any medications now? • How much alcohol do you drink? Each week? Each day? • Do you take other mood-altering drugs, such as marijuana, cocaine, barbiturates, tranquilizers? 667 668 UNIT 3 Physical Examination Subjective Data 6. Physical development. Did this child's motor or developmental milestones Subjective Data seem to occur at approximately the right age? Does this child seem to be growing and maturing normally to you? How does child's development compare with that of siblings or other children the same age? 7. Environmental hazards. Do you know whether your child has any environmental exposure to lead? (Chronically elevated lead levels may cause developmental delays, loss of a newly acquired skill, or no clinical signs may be present. 8. Cognitive development. Have you been told about any learning problems in school; whether the child has problems with attention span, cannot concentrate, is hyperactive? 9. Family history. Any family history of seizure disorder, cerebral palsy, muscular dystrophy? Additional History for Older Adults 1. Risk for falls. Any problem with dizziness? Does this occur when you first sit or stand up, when you move your head, when you get up and walk just after eating? Does this occur with any of your medications? • (For men) Do you ever get up at night and then feel unable to urinate? • How does dizziness affect your daily activities? Are you able to drive safely and to maneuver within your house safely? • What safety modifications have you applied at home? 2. Cognitive function. Have you noticed any changes in memory, changes in mental function? Have you felt any confusion? Did this seem to come on suddenly or gradually? 3. Tremor. Have you ever noticed any tremor? Is this in your hands or face? Is this worse with anxiety, activity, rest? Does the tremor seem to be relieved with alcohol, activity, rest? Does the tremor interfere with daily or social activities? 4. Vision. Have you ever had any sudden vision change, fleeting blindness? Did this occur along with weakness? Did you have any loss of consciousness? CRITICAL FINDINGS Critical findings that necessitate immediate medical intervention or immediate transport to a hospital include the following signs and symptoms: • Sudden decline in alertness (loss of consciousness) • Sudden change in speech or a new onset of speech difficulties • Signs of stroke or transient ischemic attack (TIA) • Sudden onset of severe headache • Signs of raised intracranial pressure • Sudden onset of weakness, numbness, new movement problems, and double vision • Seizures • Lethargy that persists beyond appropriate times and circumstances These signs and symptoms are described in Tables 25-12 to 25-12. Diminished cerebral blood flow and diminished vestibular response may produce staggering and potential for falls. Microtrauma may cause falls. Microtrauma is unreliable in detection of syncope as well (not in a fall). Senile tremor is relieved by alcohol, although this is not a recommended treatment. Assess whether the patient is abusing alcohol in an effort to relieve tremor. Screen for symptoms of stroke. (See the box Critical Findings.) CHAPTER 25 Neurological System Objective Data 669 OBJ E C T I V E DATA P R E P A R A T I O N Normal Range of Findings E Q U I P M E N T N E E D E D Penlight Tongue blade Cotton swab Cotton ball Tuning fork (128 Hz or 256 Hz) Percussion hammer (Possibly) Familiar aromatic substances, such as peppermint, coffee, vanilla Objective Data Perform a screening neurological examination (items identified in the following sections) of seemingly healthy patients whose histories reveal no significant subjective findings. Perform a complete neurological examination of patients who have neurological concerns (e.g., headache, weakness, loss of coordination) or who have shown signs of neurological dysfunction. Perform a neurological recheck examination of patients with demonstrated neurological deficits who require periodic assessments (e.g., hospitalized patients or those in extended care facilities). Integrate the steps of the neurological examination with the examination of each particular part of the body, as much as you are able: For example, test cranial nerves while you assess the head and neck (recall Chapters 14 through 17) and superficial abdominal reflexes while you assess the abdomen (Chapter 22). When you record your findings, however, consider all neurological data as a functional unit, and record them all together. Use the following sequence for the complete neurological examination: 1. Mental health (see Chapter 6) 2. Cranial nerves 3. Motor system 4. Sensory system 5. Reflexes Ask the patient to sit up with the head at your eye level. Abnormal Findings TEST CRANIAL NERVES Cranial Nerve I: Olfactory Nerve Do not test routinely. Test the sense of smell in patients who report loss of smell, those with head trauma, and those with abnormal mental status and when the presence of an intracranial lesion is suspected. First, assess patency by occluding one nostril at a time and asking the patient to sniff. Then, with the patient's eyes closed, occlude one nostril and present an aromatic substance. Use familiar, conveniently obtainable, and nonnoxious smells, such as coffee, toothpaste, orange, vanilla, soap, or peppermint. Alcohol wipes smell familiar and are easy to find but are irritating. Anosmia (decrease or loss of smell) occurs bilaterally with tobacco smoking, allergic rhinitis, and cocaine use. Normally, a person can identify an odour through each nostril. Olfaction is often reduced bilaterally with aging. Unilateral loss of smell in the absence of nasal disease is neurogenic anosmia (see Table 25-2 on p. 703). Small cannot be tested when air passages are occluded, as in upper respiratory infection or sinusitis. Cranial Nerve II: Optic Nerve Test visual acuity, and test visual fields by confrontation (see Chapter 15). Using the ophthalmoscope, examine the ocular fundus to determine the colour, size, and shape of the optic disc (see Chapter 15). Visual field loss (see Table 15-5, p. 334). Papilledema with increased intracranial pressure; optic atrophy (see Table 15-9, p. 337). 670 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Cranial Nerves III, IV, and VI: Oculomotor, Trochlear, and Abducens Nerves Palpebral fissures are usually equal, or nearly so, in width. Check pupils for size, regularity, equality, direct and consensual light reactions, and accommodation (see Chapter 15). Assess extraocular movements with the cardinal positions of gaze (see Chapter 15). Nystagmus is a back-and-forth oscillation of the eyes. Endpoint nystagmus— a few beats of horizontal nystagmus at extreme lateral gaze—is normal. Assess any other nystagmus carefully, noting the following: • Presence of nystagmus: Document whether it is in one or both eyes. • Pendular movement (oscillations move equally left to right) or jerk (a quick phase in one direction, then a slow phase in the other): Classify the jerk nystagmus in the direction of the quick phase. • Amplitude: Judge whether the degree of movement is fine, medium, or coarse. • Frequency: Note whether the nystagmus is constant or whether it fades after a few beats. • Plane of movement: Note whether the nystagmus is horizontal, vertical, rotary, or a combination. Ptosis (drooping) occurs with myasthenia gravis, dysfunction of cranial nerve III, or Horner's syndrome (see Table 15-2, p. 330). Increasing intracranial pressure causes sudden, unilateral dilation and nonreactivity of a pupil. Strabismus (deviated gaze) or limited movement (see Table 15-4, p. 328). Nystagmus occurs with disease of the vestibular system, cerebellum, or brain stem. Cranial Nerve V: Trigeminal Nerve Motor Function Assess the muscles of mastication by palpating the temporal and masseter muscles as the patient clenches the teeth (Figure 25-9). Muscles should feel equally strong on both sides. Next, try to separate the jaws by pushing down on the chin; normally, you cannot. Decreased strength on one or both sides. Asymmetry in jaw movement. Pain with clenching of teeth. 25-9 Sensory Function. With the patient's eyes closed, test light touch sensation by brushing a cotton wisp on designated areas of the patient's face: forehead, cheeks, and chin (Figure 25-10). Ask the patient to say "Now" whenever the touch is felt. This tests all three divisions of the nerve: (a) ophthalmic, (b) maxillary, and (c) mandibular. Decreased or unequal sensation. CHAPTER 25 Neurological System Normal Range of Findings 671 Abnormal Findings 1 2 3 25-10 25-11 No blink occurs with a lesion of cranial nerve V or with cranial nerve VII paralysis. 25-11 Cranial Nerve VII: Facial Nerve Motor Function. Note mobility and facial symmetry as the patient responds to your requests to smile (Figure 25-12), frown, close eyes tightly (against your attempt to open them), lift eyebrows, show teeth, and puff cheeks (Figure 25-13). Then, press the patient's puffed cheeks in, and note whether the air escapes equally from both sides. Sensory Function. Do not test routinely. Test only when you suspect facial nerve injury. When it is indicated, test sense of taste by applying to the tongue a cotton applicator soaked in a solution of sugar, salt, or lemon juice (sour). Ask the patient to identify the taste. Muscle weakness is demonstrated by flattening of the nasolabial fold, drooping of one side of the face, lower eyelid sagging, and escape of air from only one cheek that is pressed in. Loss of movement and asymmetry of movement occur both with CNS lesions (e.g., a cerebrovascular accident that affects the lower face on one side) and with lesions of the peripheral nervous system (e.g., causes of Bell's palsy that affect the upper and lower portions of one side of the face). Objective Data Corneal Reflex. (Omit this test, unless the patient has abnormal facial sensation or abnormalities of facial movement.) Ask the patient to remove any contact lenses. With the patient looking forward, bring a wisp of cotton in from the side (to minimize defensive blinking) and lightly touch the cornea, not the conjunctiva (Figure 25-11). Normally, a person will blink bilaterally. The corneal reflex may be decreased or absent in people who have worn contact lenses. This procedure tests the sensory afferent fibres in cranial nerve V and the motor efferent fibres in cranial nerve VII (muscles that close the eye). 672 UNIT 3 Physical Examination Normal Range of Findings 25-12 25-13 Abnormal Findings Cranial Nerve VIII: Acoustic (Vestibulocochlear) Nerve Test hearing acuity by determining the patient's ability to hear normal conversation, by the whispered voice test, and by Weber and Rinne tuning fork tests (see Chapter 16). Cranial Nerves IX and X: Glossopharyngeal and Vagus Nerves Motor Function. Depress the tongue with a tongue blade, and note pharyngeal movement as the patient says "ahhh" or yawns; the uvula and soft palate should rise in the midline, and the tonsillar pillars should move medially. Touch the posterior pharyngeal wall with a tongue blade, and note the gag reflex. Also note that the voice sounds smooth and not strained. Absence or asymmetry of soft palate movement. Deviation of uvula to side. Asymmetry of tonsillar pillar movement. Hoarseness or brassy quality of the voice occurs with vocal cord dysfunction; nasal twang occurs with weakness of soft palate. Sensory Function. Cranial nerve IX does mediate taste on the posterior one third of the tongue, but technically this sensation is too difficult to test. Cranial Nerve XI: Spinal Accessory Nerve Examine the sternomastoid and trapezius muscles for equal size. Check equal strength by asking the patient to rotate the head forcibly against resistance applied to the side of the chin (Figure 25-14). Then ask the patient to shrug the shoulders against resistance (Figure 25-15). These movements should feel equally strong on both sides. 25-14 Atrophy. Muscle weakness or paralysis. 25-15 CHAPTER 25 Neurological System Normal Range of Findings 673 Abnormal Findings Cranial Nerve XII: Hypoglossal Nerve Inspect the tongue. No wasting or tremors should be present. Note the forward thrust in the midline as the patient protrudes the tongue. Also ask the patient to say "light, tight, dynamite," and note that lingual speech (sounds of letters t, l, d, n) is clear and distinct. Atrophy; fasciculations. Tongue deviates to side with lesions of the hypoglossal nerve. (When this occurs, deviation is toward the paralyzed side.) INSPECT AND PALPATE THE MOTOR SYSTEM Muscles Size. As you proceed through the examination, inspect all muscle groups for size. Compare the right side with the left. Muscle groups should be within the normal size limits for age and should be symmetrical bilaterally. When muscles in the extremities look asymmetrical, measure each in centimetres, and record the difference. A difference of 1 cm or less is not significant. Note that it is difficult to assess muscle mass in very obese patients. Strength. (See Chapter 24.) Test the power of homologous muscles simultaneously. Test muscle groups of the extremities, neck, and trunk. 25-16 Involuntary Movements. Normally, no involuntary movements occur. If they are present, note their location, frequency, rate, and amplitude. Note whether the movements can be controlled at will. Tic, tremor, fasciculation, myoclonus, chorea, and athetosis (see Table 25-4, p. 705). Objective Data Tone. Tone is the normal degree of tension (contraction) in voluntarily relaxed muscles. It is demonstrated as mild resistance to passive stretch. To test muscle tone, move the extremities through a passive range of motion. First, persuade the patient to relax completely, to "go limp like a rag doll." Move each extremity smoothly through a full range of motion. Support the arm at the elbow and the leg at the knee (Figure 25-16). Normally, you will note a mild, even resistance to movement. Atrophy: abnormally small muscle with a wasted appearance; occurs with disuse, injury, lower motor neuron disease such as polio, diabetic neuropathy. Hypertrophy: increased size and strength; occurs with isometric exercise. Paresis (weakness) is diminished strength; paralysis (plegia) is absence of strength. Limited range of motion. Pain with motion. Flaccidity: decreased resistance, hypotonicity. Spasticity and rigidity: types of increased resistance (see Table 25-5, p. 707). 674 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Cerebellar Function Balance Tests Gait. Observe as the patient walks 3 to 6 m, turns, and returns to the starting point. Normally, a person moves with a sense of freedom. The gait is smooth, rhythmic, and effortless; the opposing arm swing is coordinated; the turns are smooth. The step length is approximately 30 cm from heel to heel. Objective Data Ask the patient to walk a straight line in a heel-to-toe manner (tandem walking; Figure 25-17). This decreases the base of support and accentuates any problem with coordination. Normally, a person can walk straight and stay balanced. You may also test for balance by asking the patient to walk on the toes and then on the heels for a few steps. The Romberg Test. Ask the patient to stand up with feet together and arms at the sides. Once he or she is in a stable position, ask the patient to close the eyes and to hold the position (Figure 25-18). Wait approximately 20 seconds. Normally, a person can maintain posture and balance even with the visual orienting information blocked, although slight swaying may occur. (Stand close to catch the patient in case he or she falls.) 25-17 Tandem walking. 25-18 Romberg test. Stiff, immobile posture; staggering or reeling; wide base of support. Lack of arm swing or rigid arms. Unequal rhythm of steps; slapping of foot; scraping of toe of shoe. Ataxia: uncoordinated or unsteady gait (see Table 25-5, p. 707). Crooked line of walk. Widening of base to maintain balance. Staggering, reeling, loss of balance. Lack of ability to walk on toes and then on heels. Loss of balance with opening the eyes is a positive Romberg sign. Loss of balance occurs with cerebellar ataxia, and loss of proprioception. Ataxia that did not appear with regular gait may appear now. Inability to tandem walk is a sensitive sign of upper motor neuron lesion, such as multiple sclerosis, or acute cerebellar dysfunction, such as alcohol intoxication. Widening of base as the patient also closes the eyes. Advantage of orientation with the eyes open, which had compensated for sensory loss. A positive Romberg sign occurs with cerebellar ataxia (caused by multiple sclerosis, alcohol intoxication), loss of proprioception, and loss of vestibular function. CHAPTER 25 Neurological System Normal Range of Findings 675 Abnormal Findings Ask the patient to perform a shallow knee bend or to hop in place, first on one leg, then the other (Figure 25-19). This demonstrates normal position sense, muscle strength, and cerebellar function. Note that some individuals cannot hop because of aging or obesity. Inability to perform knee bend because of weakness in quadriceps muscle or hip extensors. Objective Data 25-19 Coordination and Skilled Movements Rapid Alternating Movements. Ask the patient to pat the knees with both hands, lift up and turn over the hands, and pat the knees with the backs of the hands (Figure 25-20). Then ask the patient to do this faster. Normally, this is done with equal turning and a quick rhythmic pace. Alternatively, ask the patient to touch the thumb to each finger on the same hand, starting with the index finger, then reverse direction (Figure 25-21). Normally, this can be done quickly and accurately. 25-20 25-21 Lack of coordination. Slow, clumsy, and sloppy response is termed dysdiadochokinesia and occurs with cerebellar disease. Lack of coordination (Figure 25-21). Lack of coordination occurs with cerebellar disease. 676 UNIT 3 Physical Examination Normal Range of Findings Finger-to-Finger Test. With the patient's eyes open, ask the patient to use the index finger to touch your finger and then his or her own nose (Figure 25-22). After a few times, move your finger to a different spot. The patient's movement should be smooth and accurate. Abnormal Findings 25-22 Finger-to-Nose Test. Ask the patient to close the eyes and to stretch out the arms. Ask the patient to touch the tip of his or her nose with each index finger, alternating hands and increasing speed. Normally, this movement is accurate and smooth. Heel-to-Shin Test. Test lower extremity coordination by asking the patient, in a supine position, to place the heel on the opposite knee, and run it down the shin from the knee to the ankle (Figure 25-23). Normally, the person moves the heel in a straight line down the shin. 25-23 The patient's finger misses the nose. Worsening of coordination when the eyes are closed occurs with cerebellar disease or alcohol intoxication. Lack of coordination (heel falls off shin) occurs with cerebellar disease. CHAPTER 25 Neurological System Normal Range of Findings 677 Abnormal Findings ASSESS THE SENSORY SYSTEM Now whether the topographical pattern of sensory loss is distal—that is, over the hands and feet in a "glove and stocking" distribution—or whether it is over a specific dermatome. The patient's eyes should be closed during each of the tests. Take time to explain what will be happening and exactly how you expect the patient to respond. Spinothalamic Tract Pain. Pain is tested by the patient's ability to perceive a pinprick. Break a tongue blade lengthwise, forming a sharp point at the fractured end and a dull spot at the rounded end. Lightly apply the sharp point or the dull end to the patient's body in a random, unpredictable order (Figure 25-24). Ask the patient to say "sharp" or "dull," depending on the sensation felt. (Note that the sharp edge is used to test for pain; the dull edge is used as a general test of the patient's responses.) Let at least 2 seconds elapse after each stimulus, to avoid summation. With summation, frequent consecutive stimuli are perceived as one strong stimulus. When you are done, discard the tongue blade. A 25-24 B Hypoalgesia: decreased pain sensation. Analgesia: absence of pain sensation. Hyperalgesia: increased pain sensation. Objective Data To test the integrity of the peripheral nerve fibres, the sensory tracts, and higher cortical discrimination, ask the patient to identify various sensory stimuli. Ensure the validity of sensory system testing by making sure the patient is alert, cooperative, and comfortable and has an adequate attention span; otherwise, you may get misleading and invalid results. Testing of the sensory system can be fatiguing. You may need to repeat the examination later or to conduct only parts of it when the patient is tired. You do not need to test the entire skin surface for every sensation. Routine screening procedures include testing superficial pain, light touch, and vibration in a few distal locations, and testing stereognosis. This will suffice for all patients who have not demonstrated any neurological symptoms or signs. Complete testing of the sensory system is warranted in patients with neurological symptoms (e.g., localized pain, numbness, and tingling sensation) or when you discover abnormalities (e.g., motor deficit). In those cases, test all sensory modalities, and cover most dermatomes of the body. Compare sensations on symmetrical parts of the body. When you find a definite decrease in sensation, map it out by systematic testing in that area. Proceed from the point of decreased sensation toward the sensitive area. By asking the patient to tell you where the sensation changes, you can map the exact borders of the deficient area. Note your results on a diagram. Avoid asking leading questions, such as "Can you feel this pinprick?" This creates an expectation of how the patient should feel the sensation, which is called suggestion. Instead, use unbiased directions. 678 UNIT 3 Physical Examination Normal Range of Findings Objective Data Temperature. Test temperature sensation only when pain sensation is abnormal; otherwise, you may omit it because the fibres carrying pain and temperature run the same. Fill two test tubes, one with hot water and one with cold water, and apply the bottom ends to the patient's skin in a random order. Ask the patient to say which temperature is felt. Alternatively, you could place the flat side of a tuning fork on the skin; its metal always feels cool. Light Touch. Apply a wisp of cotton to the skin. Ask the patient to say "now" or "yes" when touch is felt. Compare symmetrical points. Abnormal Findings Hypoaesthesia: decreased touch sensation. Anesthesia: absent touch sensation. Hyperesthesia: increased touch sensation. 25-25 Posterior Column Tract Vibration. Test the patient's ability to feel vibrations of a tuning fork over bony prominences. Use a low-pitch tuning fork (128 or 256 Hz) because its vibration has a slower decay. Strike the tuning fork on the heel of your hand, and hold the base on a bony surface of the patient's fingers and great toe (Figure 25-26). Ask the patient to indicate when the vibration starts and stops. If the patient feels the normal vibrations at these distal sites, you may assume that the proximal spots are normal, too, and proceed no further. If no vibrations are felt, move proximally and test ulnar processes, ankles, patellae, and iliac crests. Compare responses on the right side with those on the left side. If you find a deficit, note whether it is gradual or abrupt. 25-26 Inability to feel vibration: Loss of vibration sense occurs in peripheral neuropathy such as diabetes and alcoholism. Often, this is the first sensation lost. Peripheral neuropathy is worst at the feet, and sensation gradually improves up the leg, whereas a specific nerve lesion produces a clear zone of deficit for its dermatome. CHAPTER 25 Neurological System Normal Range of Findings Position (Kinaesthesia). Test the patient's ability to perceive passive movements of the extremities. Move a finger or the big toe up and down, and ask the patient to tell you which way it is moved (Figure 25-27). Test to ensure that the patient's eyes closed, and to be sure it is abnormal, repeat a few trials first. Vary the sequence of the movements to avoid making a pattern. Normally, a person can detect movement of a few millimetres. 679 Abnormal Findings Loss of position sense. Objective Data 25-27 Tactile Discrimination (Fine Touch). The following tests also measure the ability of the sensory cortex to correlate, analyze, and interpret sensations. As a prerequisite, the patient needs a normal or near-normal sense of touch and a normal position sense. Stereognosis. Test the patient's ability to recognize objects by feeling their forms, sizes, and weights. With the eyes closed, place a familiar object (key, cotton ball, or pencil) in the patient's hand and ask the patient to identify it (Figure 25-28). Normally, a person's fingers explore the object, and then the person correctly names it. Test a different object in each hand; testing the left hand helps you assess functioning of the right parietal lobe. 25-28 Problems with tactile discrimination occur with lesions of the sensory cortex or posterior column. Astereognosis (inability to identify object correctly) occurs with sensory cortex lesions such as in cerebrovascular attack (stroke). 680 UNIT 3 Physical Examination Normal Range of Findings Graphesthesia. Graphesthesia is the ability to "read" a number by having it traced on the skin. Ask the patient to close the eyes, and use a blunt instrument to trace a single-digit number or a letter on the patient's palm (Figure 25-29). Ask the patient to tell you what the character is. Graphesthesia is a good measure of sensory loss if the patient cannot make the hand movements needed for stereognosis, as occurs in arthritis. Inability to distinguish number occurs with lesions of the sensory cortex. Objective Data 25-29 Testing for graphesthesia. Two-Point Discrimination. Test the patient's ability to distinguish the separation of two simultaneous pinpoints on the skin. Apply the two points of an opened paper clip lightly to the skin in ever-closing distances. Note the distance at which the patient no longer perceives two separate points. The level of perception varies considerably with the region tested; it is most sensitive in the fingertips (2 to 8 mm) and least sensitive on the upper arm, thighs, and back (40 to 75 mm). Extinction. Simultaneously touch both sides of the body at the same point. Ask the patient to state how many sensations are felt and where they are. Normally, both sensations are felt. Point Location. Touch the skin, and withdraw the stimulus promptly. Tell the patient, "Put your finger where I touched you." You can perform this test simultaneously with light touch sensation. TEST THE REFLEXES Stretch (Deep Tendon) Reflexes Measurement of the stretch reflexes reveals the intactness of the reflex arc at specific spinal levels, as well as the normal override on the reflex of the intact cerebral cortex. Technique The stretch reflexes are affected by the patient's state of relaxation. Nervousness or poor positioning inhibits the reflex response. Remember the patient will relax and better cooperate when distracted. When you elicit a reflex, use a slight, controlled strike from the wrist. Place the limb in a slightly flexed position, with the muscle's tendon area exposed. Strike the tendon directly, with a quick, light blow, and observe the response. Use a relaxed wrist so that the hammer swings freely; tap the tendon briskly with a quick tap, and do not let the hammer rest on the tendon. Use the pointed end of the reflex hammer when aiming at a smaller target, such as your thumb, on the tendon site; use the flat end when the target is wider or to diffuse the impact and prevent pain. Use just enough force to get a response. Compare responses on the right and left sides; they should be equal. The reflex response is graded on a five-point scale: The distance it normally takes to identify two separate points is increased with sensory cortex lesions. The ability to recognize only one of stimuli occurs with sensory cortex lesion; the stimulus is extinguished on the side opposite the cortex lesion. With a sensory cortex lesion, the sensation cannot be localized accurately, even though light touch sensation may be retained. CHAPTER 25 Neurological System Normal Range of Findings 4+ Very brisk, hyperactive with clonus, indicative of disease 3+ Brisker than average, may indicate disease 2+ Average, normal 1+ Diminished, low normal 0: No response This is a subjective scale, and its use requires some clinical practice. Even then the scale is not completely reliable because no standard exists to say how brisk a reflex should be to warrant a grade of 3+. Also, normally in reflex responses has a wide range. Healthy people may have diminished or brisk reflexes. Your best plan is to interpret the DTRs only within the context of the other results of the neurological examination. 25-30 Reinforcement. Biceps Reflex (C5 to C6). Support the patient's forearm on yours; this position relaxes, as well as partially flexes, the patient's arm. Place your thumb on the biceps tendon, and strike a blow on your thumb. You can feel as well as see the normal response, which is contraction of the biceps muscle and flexion of the forearm (Figure 25-31). 681 Abnormal Findings Clonus is a set of rapid, rhythmic contractions of the same muscle. Hyperreflexia is the exaggerated reflex seen when the monosynaptic reflex arc is released from the usually inhibiting influence of higher cortical levels. This occurs with upper motor neuron lesions, such as a cerebrovascular accident. Hyporeflexia is the reduced functioning of a reflex. In some cases, the reflex may be absent. Hyporeflexia is a lower motor neuron problem. It results from interruption of sensory afferent fibres or destruction of motor efferent fibres and anterior horn cells, as in spinal cord injury. Objective Data Sometimes the reflex response fails to appear. Try further encouragement of relaxation, varying the patient's position, or increasing the strength of the blow. Reinforcement is another technique to relax the muscles and enhance the response (Figure 25-30). Ask the patient to perform an isometric exercise in a muscle group somewhat distant from the one being tested. For example, to enhance a patellar reflex, ask the patient to lock the fingers together and "pull." Then strike the tendon. To enhance a biceps response, ask the patient to clench the teeth or to grasp the thigh with the opposite hand. 681 682 UNIT 3 Physical Examination Objective Data Normal Range of Findings 25-31 Biceps reflex. Triceps Reflex (C7 to C8). Tell the patient to let the arm "just go limp" as you suspend it by holding the upper arm. Strike the triceps tendon directly just above the elbow (Figure 25-32). The normal response is extension of the forearm. Alternatively, hold the patient's wrist across the chest to flex the arm at the elbow, and tap the tendon. 25-32 Triceps reflex. Brachioradialis Reflex (C5 to C6). Hold the patient's thumbs to suspend the forearms in relaxation. Strike the forearm directly, approximately 2 to 3 cm above the radial styloid process (Figure 25-33). The normal response is flexion and supination of the forearm. Abnormal Findings CHAPTER 25 Neurological System Normal Range of Findings 683 Abnormal Findings 25-33 Brachioradialis reflex. 25-34 Quadriceps reflex. To test this reflex with the patient in the supine position, use your own arm as a lever to support the weight of one of the patient's legs against the other leg (Figure 25-35). This manoeuvre also flexes the knee. Objective

Data Quadriceps or Patellar ("Knee Jerk") Reflex (L2 to L4). Let the patient's lower legs dangle freely to flex the knee and stretch the tendons. Strike the tendon directly just below the patella (Figure 25-34). Extension of the lower leg is the expected response. Contraction of the quadriceps will also be palpable. 684 UNIT 3 Physical Examination Normal Range of Findings Objective Data 25-35 Supine quadriceps reflex. Achilles ("Ankle Jerk") Reflex (L5 to S2). Position the patient with the knee flexed and the hip externally rotated. Hold the patient's foot in dorsiflexion, and strike the Achilles tendon directly (Figure 25-36). Feel the normal response as the foot plantar flexes against your hand. 25-36 Achilles reflex. To test this reflex with the patient in the supine position, flex one of the patient's knees and support that lower leg against the other leg so that it falls "open." Dorsiflex the foot, and tap the tendon (Figure 25-37). 25-37 Supine Achilles reflex. Abnormal Findings CHAPTER 25 Neurological System Normal Range of Findings 685 Abnormal Findings Clonus. Test for clonus, particularly when the reflexes are hyperactive. Support one of the patient's lower legs in one of your hands. With your other hand, move the foot up and down a few times to relax the muscle. Then stretch the muscle by briskly dorsiflexing the foot. Hold the stretch (Figure 25-38). A normal response is no further movement. When clonus is present, rapid rhythmic contractions of the calf muscle and movement of the foot are visible and palpable. Clonus is repeated reflex muscular movements. A hyperactive reflex with sustained clonus (lasting as long as the stretch is held) occurs with upper motor neuron disease. Objective Data 25-38 Superficial (Cutaneous) Reflexes For cutaneous reflexes, the sensory receptors are in the skin rather than in the muscles. The motor response is a localized muscle contraction. Abdominal Reflexes: Upper (T8 to T10) and Lower (T10 to T12). Have the patient assume a supine position, with the knees slightly bent. Use the handle end of the reflex hammer, a wood applicator tip, or the end of a split tongue blade to stroke the skin. Move from the side of the abdomen toward the midline at both the upper and lower abdominal levels (Figure 25-39). The normal response is ipsilateral contraction of the abdominal muscle, with an observed deviation of the umbilicus toward the stroke. When the abdominal wall is very thick, pull the skin to the opposite side; the muscle palpably contracts toward the stimulus. Abdominal reflex Cremasteric reflex 25-39 Superficial reflexes are absent with diseases of the pyramidal tract (e.g., they are absent on the contralateral side with cerebrovascular accident). 686 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings This reflex is absent in both upper and lower motor neuron lesions. Except in infancy, the abnormal response is dorsiflexion of the big toe and fanning of all toes, which is a positive Babinski sign, also called upgoing toes (see Figure 25-40, B). This occurs with upper motor neuron disease of the corticospinal (or pyramidal) tract. Objective Data Cremasteric Reflex (L1 to L2). This reflex is not routinely tested. On a male patient, lightly stroke the inner aspect of the thigh with the reflex hammer or tongue blade (see Figure 25-39). Note the elevation of the ipsilateral testicle. Plantar Reflex (L4 to S2). Position the thigh in slight external rotation. With the reflex hammer, stroke lightly up the lateral side of the sole of the foot and inward across the ball of the foot, in an upside-down J shape (Figure 25-40, A). The normal response is plantar flexion of the toes and inversion and flexion of the forefoot. B A 25-40 A, Plantar reflex. B, Babinski sign. Normal Range of Findings Objective Data DEVELOPMENTAL CONSIDERATIONS Infants (Birth to Age 12 Months) The neurological system undergoes dramatic growth and development during the first year of life. Assessment includes noting that milestones you normally would expect for each month have indeed been achieved and that the early, more primitive reflexes are eliminated from the baby's repertory when they are supposed to be. At birth, the newborn is very alert, with the eyes open, and demonstrates strong, urgent sucking. The normal cry is loud and lusty and may even sound angry. The next 2 or 3 days may be spent mostly sleeping as the baby recovers from the birth process. After that, the pattern of sleeping and waking activity is highly variable; it depends on the baby's individual body rhythm, as well as external stimuli. The behavioural assessment should include your observations of the infant's spontaneous waking activity, responses to environmental stimuli, and social interaction with the parents and others. By 2 months of age, the baby smiles responsively and recognizes the parent's face. Babbling begins at 4 months, and one or two words (mama, dada) are used nonspecifically after 9 months. The cranial nerves cannot be tested directly, but you can infer their proper functioning by the manoeuvres shown in Table 25-5. Failure to attain a skill by expected time. Persistence of reflex behaviour beyond the normal time. With CNS damage, the cry may be high-pitched or shrill or sound like a feline screech. With respiratory distress, the cry may be weak or groaning, or an expiratory grunt occurs. Lethargy, hypoactivity, hyperirritability, and parent's report of significant change in behaviour all warrant referral. CHAPTER 25 Neurological System Normal Range of Findings TABLE 25-5 687 Abnormal Findings Testing Cranial Nerve Function of Infants Cranial Nerve Responses II, III, IV, VI Optical blink reflex: shine light in open eyes, note rapid closure Size, shape, equal-sized pupils Looking at face or close object Eyes follow movement V Rooting reflex, sucking reflex VII Facial movements (e.g., wrinkling forehead and nasolabial folds) symmetrical when crying or smiling VIII Moro reflex (until age 4 mo): elicited by loud noise Acoustic blink reflex: infant blinks in response to a loud hand clap 30 cm (12 in.) from head (avoid creating air current) Eyes follow direction of sound IX, X Swallowing, gag reflex Coordinated sucking and swallowing XII In response to pinching of nose, infant's mouth opens and tongue rises in midline 25-41 Motor activity is delayed with brain damage, intellectual disability, peripheral neuromuscular damage, prolonged illness, and parental neglect. Frog position: hips abducted and almost flat against the table, externally rotated (normal only after breech delivery). Opisthotonos: head arched back, stiffness of neck, and extension of arms and legs; occurs with meningeal or brain stem irritation and kernicterus (see Table 25-10, p. 712). Extension of limbs: may occur with intracranial hemorrhage. Continual asymmetry of any type (e.g., asymmetry of upper limbs, which occurs with brachial plexus palsy). Objective Data The Motor System Observe spontaneous motor activity for smoothness and symmetry. Smoothness of movement suggests proper cerebellar function, as does the coordination involved in sucking and swallowing. To screen gross and fine motor coordination, use the Nipissing District Developmental Screen (NDDS), or other parent-reported screening tool (as discussed in Chapter 2), with its age-specific developmental milestones. You also can assess movement by testing the reflexes listed in the following section. Note their smoothness of response and symmetry. Also, note whether their presence or absence is appropriate for the infant's age. Assess muscle tone by first observing resting posture. The newborn favours a flexed position; extremities are symmetrically folded inward, the hips are slightly abducted, and the fists are tightly flexed (Figure 25-41). Infants born by breech delivery, however, will not immediately demonstrate flexion in the lower extremities. 688 UNIT 3 Physical Examination Normal Range of Findings Objective Data After 2 months of age, flexion gives way to gradual extension, beginning with the head and continuing in a cephalocaudal direction. Now is the time to check for spasticity; none should be present. Test for spasticity by flexing the infant's knees onto the abdomen and then quickly releasing them. They should unfold but not too quickly. Also, gently push the head forward; the baby should comply. The fists normally are held in tight flexion for the first 3 months. Then the fists open for part of the time. A purposeful reach for an object with both hands occurs at approximately 4 months of age; a transfer of an object from one hand to the other hand, at 7 months of age; a grasp with fingers and opposing thumb, at 9 months of age; and a purposeful release, at 10 months of age. Babies are normally ambidextrous for the first 18 months. Head control is an important milestone in motor development. You can incorporate the following two movements into every infant assessment to check the muscle tone necessary for head control. First, holding the wrists, pull the baby up to the sitting position and note head control (Figure 25-42). The newborn will hold the head almost in the same plane as the body; the head will balance briefly when the baby reaches the sitting position and then flop forward. (Even premature infants demonstrate this.) At 4 months of age, the head stays in line with the body and does not flop. 25-42 Second, lift up the baby in a prone position, with one of your hands supporting the baby's chest (Figure 25-43). The full-term newborn holds the head at an angle of 45 degrees or less from horizontal, the back is straight or slightly arched, and the elbows and knees are partly flexed. 25-43 Spasticity is an early sign of cerebral palsy. In affected infants, after you release the flexed knees, the legs quickly extend and adduct, even to a "scissoring" motion. Also, affected infants often resist head flexion and extend back against your hand. Note persistent one-hand preference in baby younger than 18 months of age, which may indicate a motor deficit on the opposite side. Because development progresses in a cephalocaudal direction, a lag in head control is an early sign of brain damage. Any baby who cannot hold the head in midline when sitting after 4 months of age should be referred for neurological evaluation. CHAPTER 25 Neurological System Normal Range of Findings At 3 months of age, the baby raises the head and arches the back, as in a swan dive. This is the Landau reflex, which persists until 1½ years of age (Figure 25-44). 689 Abnormal Findings Head lag, a limp floppy trunk, and dangling arms and legs are abnormal signs. Absence of the Landau reflex indicates motor weakness, upper motor neuron disease, or intellectual disability. Objective Data 25-44 Assess muscle strength by noting the strength of sucking and of spontaneous motor activity. Normally, no tremors are present, and in a baby aged 4 months or older, continual quivering of the chin occurs when the baby reaches for an object. The Sensory System You will perform very little sensory testing with infants and toddlers. The newborn normally has hypoesthesia, and a stimulus must be strong to elicit a response. The baby responds to pain by crying and a general reflex withdrawal of all limbs. By 7 to 9 months of age, the infant can localize the stimulus and shows more specific signs of withdrawal. Other sensory modalities are not tested. Reflexes Infantile automatisms are reflexes that have a predictable timetable of appearance and disappearance. The reflexes most commonly tested are listed in the following section. For the screening examination, you need check only the rooting, grasp (palmar and plantar), tonic neck, and Moro reflexes. Rooting Reflex. Brush the infant's cheek near the mouth. Note whether the infant turns the head toward that side and opens the mouth (Figure 25-45). This reflex is present at birth and disappears at ages 3 to 4 months. Sucking Reflex. Touch the lips and offer your gloved little finger to suck. Note strong sucking reflex.

26-4 2 cm long and 1 cm wide. Their size increases only slightly during the prepubertal years. Adolescents Puberty begins sometime between the ages of 9½ and 13½. The first sign is enlargement of the testes. Next, pubic hair appears, and then penis size increases. The stages of development are documented in Tanner's sexual maturity rating (Table 26-1). The complete change in development from a preadolescent to an adult takes approximately 3 years; the normal range is 2 to 5 years (Figure 26-4). The chart shown in Figure 26-4 is useful in teaching a boy the expected sequence of events and in reassuring him about the wide range of ages when these events normally occur. Adults and Older Adults The level of sexual development at the end of puberty remains constant through early and middle adulthood, with no further genital growth and no change in circulating sex hormone. Men do not experience a definite end to fertility, as women do. At approximately age 40 years, the production of sperm begins to decrease, although production continues into the 80s and 90s. After age 55 to 60 years, testosterone production declines very gradually so that resulting physical changes are not evident until later in life. Aging changes also result from decreased muscle tone, decreased subcutaneous fat, and decreased cellular metabolism. In older men, the amount of pubic hair decreases, and the remaining hair turns grey. Penis size decreases. Because of decreased tone of the dartos muscle, the scrotal contents hang lower, the rugae decrease, and the scrotum looks pendulous. The testes decrease in size and are less firm to palpation. Increased connective tissue is present in the tubules, and so these become thickened and produce less sperm. In general, declining testosterone production leaves older men with a slower and less intense sexual response. Although a wide range of individual differences can occur, an older man may find that an erection takes longer to develop and that it is less full or firm. Once obtained, the erection may be maintained for longer periods without ejaculation. Ejaculation is shorter and less forceful, and the volume of seminal fluid is less than when the man was younger. After ejaculation, detumescence (return to the flaccid state) is rapid, especially after 60 years of age. This occurs in a few seconds, in comparison with minutes or hours in a younger man. The refractory state—when the man is physiologically unable to ejaculate—lasts longer (from 12 to 24 hours) than in a younger man (2 minutes). Sexual Expression in Later Life. Chronological age by itself should not halt sexual activity. The aforementioned physical changes need not interfere with libido or pleasure from sexual intercourse. An older man is capable of sexual function as long as he is in reasonably good health and has an interested, willing partner. Even chronic illness does not put a complete end to sexual desire or activity. An older man may misinterpret normal age changes as sexual failure. Once this idea occurs, it may demoralize the man and place undue emphasis on performance rather than on pleasure. In the absence of disease, older men may withdraw from sexual activity for various reasons: loss of spouse; depression; preoccupation with work; marital or family conflict; side effects of medications such as antihypertensives, psychotropics, antidepressants, antispasmodics, sedatives, tranquilizers or narcotics, and estrogens; heavy use of alcohol; lack of privacy (living with adult children or in a nursing home); economic or emotional stress; poor nutrition; or fatigue. CULTURAL AND SOCIAL CONSIDERATIONS On occasion, parents ask about whether to circumcise an infant boy. Common reasons given in favour of circumcision are hygiene, avoidance of a later need for circumcision, medical indications, the father's circumcision status, and religious and cultural values. Since 1975, the policy of the Canadian Paediatric Society is that there is no medical indication for male neonatal circumcision. A statement issued by the Canadian Paediatric Society in 1996 and reaffirmed in 2002 strongly recommended that nontherapeutic neonatal circumcision not be routinely performed, and the procedure is no longer covered by provincial health insurance plans. Neonatal circumcision rates in Canada declined from about 48% in 1970 to about 31.99% in the period 2006 to 2007 (Public Health Agency of Canada, 2009). Research has demonstrated, however, that circumcision reduces acquisition of the human immunodeficiency virus (HIV) in men by 53% to 60% (Gray, Wawer, Serwadda, & Kigozi, 2009; Viscidi & Shah, 2010) and reduces HIV transmission to uninfected female sexual partners (Wawer et al., TABLE 26-1 719 Sexual Maturity Ratings in Boys Developmental Stage Pubic Hair Penis Scrotum No pubic hair; fine body hair on abdomen (vellus hair) continues over pubic area Preadolescent; size and proportion are the same as during childhood Preadolescent; size and proportion are the same as during childhood Few straight, slightly darker hairs at base of penis are long and downy Little or no enlargement Enlargement of testes and scrotum; scrotal skin reddens and changes in texture Sparse growth over entire pubis; hair is darker, coarser, and curly Enlargement, especially in length Further enlargement Thick growth over pubic area but not on thighs; hair coarse and curly, as in adult Continued enlargement in length and diameter, with development of glans Testes almost fully grown; scrotum darker Growth spread over medial thighs, although not yet up toward umbilicus; after puberty, pubic hair growth continues until the mid-20s, extending up the abdomen toward the umbilicus Adult size and shape Adult size and shape 1 2 3 4 5 Source: Adapted from Tanner, J. M. (1962). Growth at adolescence. Oxford, UK: Blackwell Scientific Publications. 2009). Circumcision also significantly reduces the incidence of herpes simplex virus type 2 (HSV-2) acquisition; the prevalence of human papillomavirus (HPV) (Tobian et al., 2009); and the risk for other sexually transmitted infections (STIs), such as Trichomonas vaginalis and bacterial vaginosis, in women with circumcised partners (Sobngwi-Tambekou et al., 2009). Circumcision carries a very small risk of complications. Most are minor and treatable: pain, bleeding, swelling, or inadequate skin removal. Serious complications are rare and include excess bleeding, wound infections, and Structure & Function CHAPTER 26 Male Genitourinary System Structure & Function Subjective Data 720 UNIT 3 Physical Examination urinary retention (Weiss, Larke, Halperin, & Schenker, 2010). Neonates are capable of perceiving pain; therefore, parents need to be apprised of pain-relief measures for the circumcision procedure, including oral and transdermal pain medication, dorsal penile nerve block, and comfort measures such as sucrose pacifier, stroking the infant, talking, and rocking (Stratman-Lucey & Caldwell, 2006). For an uncircumcised newborn, assess parental knowledge about care of the uncircumcised penis. The infant's penis should be cleansed with soap and water, but the foreskin should not be forcibly retracted. When the foreskin retracts easily, the area under the foreskin should be cleansed occasionally. By the age of 3 or 4 years, a boy can be taught to clean under his foreskin. When a boy reaches puberty, he needs to clean under his foreskin daily. Infection with HPV is common in boys and men, causes most cases of genital warts, and is associated with cancers of the penis, anus, and head and neck. The quadrivalent HPV vaccine previously approved for the prevention of cervical cancer in girls and women (see p. 753) has demonstrated efficacy in preventing HPV infection and diseases in boys and men (Giuliano et al., 2011). The vaccine has been approved for the prevention of genital warts in boys and men aged 9 to 26 in Canada (Public Health Agency of Canada, 2011). SUB J E C T I V E DATA 1. Frequency, urgency, and nocturia 2. Dysuria 3. Hesitancy and straining 4. Urine colour 5. Past genitourinary history 6. Penis: pain, lesion, discharge 7. Scrotum: self-care behaviours, lump 8. Sexual activity and contraceptive use 9. STI contact HEALTH HISTORY QUESTIONS Examiner Asks 1. Frequency, urgency, and nocturia. Are you urinating more often than usual? • When you need to urinate, do you feel as if you cannot wait? • Do you awaken during the night because you need to urinate? How often? Is this a recent change? 2. Dysuria. Any pain or burning sensation with urinating? 3. Hesitancy and straining. Any trouble starting the urine stream? • Do you need to strain to start or maintain the stream? • Any change in force of stream: narrowing, becoming weaker? • Do you experience dribbling, so that you must stand closer to the toilet? • Afterward, do you still feel you need to urinate? • Have you ever had any urinary tract infections? Rationale The average adult voids five to six times per day; this amount varies with fluid intake, individual habits. Polyuria: excessive quantity Oliguria: diminished quantity, 38°C, change in character of urine (bloody, foul smell, increased sediment), positive dipstick for leukocytes, worsening of mental or functional status. Drainage or excoriation of urethral orifice. CRITICAL FINDINGS 26-13 Indwelling urinary catheter. SELF-CARE: TESTICULAR SELF-EXAMINATION The overall incidence is rare, but testicular cancer occurs most commonly in men aged 15 to 49. Other risk factors include delayed descent of the testicles (if not corrected early), family or personal history of testicular cancer, and abnormal development of the testicle. Some men develop testicular cancer without having any of these risk factors. Some authorities consider teaching TSE controversial because the harm of causing anxiety and unwarranted medical costs exceed benefits of detection of a relatively rare lesion (Joffe, 2009). If detected early by palpation and treated, the cure rate is almost 100%; therefore, all men aged 15 years and older should be aware of how their testicles normally look and feel and should report any of the following changes (Canadian Cancer Society, 2011) to a doctor: • A lump on the testicle • A painful testicle • A feeling of heaviness or dragging in the lower abdomen or scrotum • A dull ache in the lower abdomen and groin Points to include during health teaching are as follows: • T = timing, once a month • S = showering; warm water relaxes scrotal sac • E = examining, checking for changes, reporting changes immediately Objective Data Decreased urine output may be a sign of renal or systemic problems such as dehydration, renal failure or hypovolemic shock. In an adult, urine output of less than 30 mL/hour can indicate decreased renal perfusion and should be reported (Perry & Potter, 2010, p. 168). 730 UNIT 3 Physical Examination Normal Range of Findings Abnormal Findings Phrase your teaching something like this (Figure 26-14): Objective Data 26-14 Instruct patients to check each testicle by feeling it in a systematic pattern, such as the one shown. A good time to examine the testicles is during the shower or bath, when your hands are warm and soapy and the scrotum is warm. Cold hands stimulate a muscle (cremasteric) reflex, which causes the the scrotal contents to retract. The procedure is simple. Hold the scrotum in the palm of your hand and gently feel each testicle, using your thumb and first two fingers. If it hurts, you are using too much pressure. The testicle is egg-shaped and movable. It feels rubbery with a smooth surface, like a peeled hard-boiled egg. The epididymis is on top and behind the testicle; it feels a bit softer. If you ever notice a firm, painless lump, a hard area, or an overall enlarged testicle, call your physician for a further check. DEVELOPMENTAL CONSIDERATIONS Infants and Children For an infant or toddler, perform this procedure right after the abdominal examination. In preschool-age and young school-age children (3 to 8 years of age), leave underpants on until just before the examination. In an older schoolage child or adolescent, offer an extra drape, as with an adult. Reassure the child and parents of normal findings. Inspect the penis and scrotum. Penis size is usually small in infants (2 to 3 cm; Figure 26-15) and in young boys until puberty. In obese boys, the penis looks even smaller because of folds of skin covering the base. 26-15 In rare cases, a very small penis may be an enlarged clitoris in a genetically female infant. Enlarged penis is indicative of precocious puberty. Redness, swelling, and lesions should be investigated. Urethral discharge occurs with infection. CHAPTER 26 Male Genitourinary System Normal Range of Findings 731 Abnormal Findings In the circumcised infant, the glans looks smooth with the meatus centred at the tip. During the diaper-wearing stage, the meatus may become ulcerated from ammonia irritation. This is more common in circumcised infants. If possible, observe the newborn's first voiding to assess strength and direction of stream. Objective Data If the infant is uncircumcised, the foreskin is normally tight during the first 3 months and should not be retracted because of the risk of tearing the membrane attaching the foreskin to the shaft. This leads to scarring and, possibly, to adhesions later in life. In infants older than 3 months of age, retract the foreskin gently to check the glans and meatus. It should return to its original position easily. The scrotum looks pink in light-skinned infants and dark brown in darkskinned infants. Rugae are well formed in full-term infants. Size varies with ambient temperature, but overall, the infant's scrotum looks large in relation to the penis. No bulges, either constant or intermittent, are present. Palpate the scrotum and testes. The cremasteric reflex is strong in the infant, pulling the testes up into the inguinal canal and abdomen from exposure to cold, touch, exercise, or emotion. Take care not to elicit the reflex; to prevent it, (a) keep your hands warm and palpate from the external inguinal ring down, and (b) block the inguinal canals with the thumb and forefinger of your other hand to prevent the testes from retracting (Figure 26-16). Hypospadias, epispadias (see Table 26-5, p. 737) should be corrected. Stricture is a narrowed opening. On occasion, ulceration may produce a stricture, evidenced by a pinpoint meatus and a narrow stream. This increases the risk of urine obstruction. Poor stream is significant because it may indicate a stricture or neurogenic bladder. In phimosis, the foreskin is tight and cannot be retracted. In paraphimosis, the foreskin cannot be slipped forward once it is retracted. Dirt and smegma may collect under the foreskin. 26-16 Normally, the testes are descended and equal in size bilaterally (1.5 to 2 cm until puberty). It is important to document that you have palpated the testes. Once palpated, they are considered descended, even if they have retracted momentarily at the next visit. If the scrotal half feels empty, search for the testes along the inguinal canal and try to milk them down. Ask the toddler or child to squat with the knees flexed up; this pressure may force the testes down. Another manoeuvre is have the young child sit cross-legged to relax the reflex (Figure 26-17). Cryptorchidism: undescended testes (those that have never descended). Undescended testes are common in premature infants. They occur in 3% to 4% of fullterm infants, although in most cases, they have descended by 3 months of age. Physicians have different opinions concerning the age at which an affected child should be referred (see Table 26-6, p. 738). 732 UNIT 3 Physical Examination Objective Data Normal Range of Findings Abnormal Findings 26-17 Migratory testes (physiological cryptorchidism) are common because of the strength of the cremasteric reflex and the small mass of the prepubertal testes. Note that the affected side has a normally developed scrotum (with true cryptorchidism, the scrotum is atrophic) and the testis can be milked down. These testes descend at puberty and are normal. Palpate the epididymis and spermatic cord as described for adults. A common scrotal finding in the boy younger than 2 years is a hydrocele (fluid in the scrotum). It appears as enlargement of the scrotum and glows faint pink under transillumination. It usually disappears spontaneously. Inspect the inguinal area for a bulge. If you do not see a bulge but the parent gives a positive history of one, try to elicit it by increasing intra-abdominal pressure. Ask the boy to hold his breath and strain down, or have him blow up a balloon. If a hernia is suspected, palpate the inguinal area. Use your little finger to reach the external inguinal ring. Adolescents Adolescents show wide variation in normal development of the genitals. Using the sexual maturity rating charts, note (a) enlargement of the testes and scrotum; (b) pubic hair growth; (c) darkening of scrotal colour; (d) roughening of scrotal skin; (e) increase in penis length and width; and (f) axillary hair growth. Be familiar with the normal sequence of growth. Older Adults In older men, you may note thinner, greying pubic hair and decreased size of the penis. Testes may decrease in size and feel less firm. The scrotal sac is pendulous, with fewer rugae. The scrotal skin may become excoriated if the man continually sits on it. A hydrocele is a cystic collection of serous fluid in the tunica vaginalis, surrounding the testis (see Table 26-6, p. 740). CHAPTER 26 Male Genitourinary System 733 D O CUMENTATION A N D C R I T I C A L T H I N K I N G Sample Charting SUBJECTIVE Urinates four to five times per day; urine clear, straw-coloured. No nocturia, dysuria, or hesitancy. No pain, lesions, or discharge from penis. Does not perform TSE. No history of genitourinary disease. Sexually active in a monogamous relationship. Sexual life satisfactory to self and partner. Uses birth control via barrier method (partner uses diaphragm). No known STI contact. OBJECTIVE No lesions, inflammation, or discharge from penis. Scrotum: testes descended, symmetrical, no masses. No inguinal hernia. ASSESSMENT Genital structures normal. Focused Assessment: Clinical Case Study R.C. is a 19-year-old student who 2 days PTA noted acute onset of painful urination, frequency, and urgency. Noted some thick penile discharge. States has no side pain, no abdominal pain, no fever, no genital skin rash. R.C. is concerned he has an STI because of episode of unprotected intercourse with a new partner 6 days PTA. Has no known allergies. OBJECTIVE Vital signs: Temp 37°C; HR72; RR-16. No lesions or inflammation around penis or scrotum. Urethral meatus has mild edema with purulent urethral discharge. No pain on palpation of genitalia. Testes symmetrical with no masses. No lymphadenopathy. ASSESSMENT Urethral discharge Deficient knowledge about STI prevention R/T lack of information recall Documentation & Critical Thinking SUBJECTIVE 734 UNIT 3 Physical Examination ABNO R M A L F I N D I N G S TABLE 26-2 Urine Colour and Discolorations • Medication side effect: amitriptyline, indomethacin (Indocin) • Foods: asparagus • Dye after prostate surgery Blue • Urine contains melanin, melaninuria Dark • Liver disease, especially with pale stools, jaundice • Myoglobinuria • Some medications or food dyes • Blood in urine Gre y Pale Yellow Pink • Clear, watery with excess liquids • Acute viral hepatitis, cirrhosis a Te Cl ou dy • Urinary tract infection • Kidney stones l Ye Re d w lo • Natural yellow is urochrome excretion, a pigment in blood • Bright neon yellow with vitamin supplements ge Amb er Abnormal Findings n Ora • Gold coloured or concentrated with dehydration • Some laxatives • Food or supplements with B-complex vitamins • Medication side effect: rifampin for meningitis, phenazopyridine (Pyridium), warfarin (Coumadin) • Some foods, food dyes, laxatives • Dehydration • Jaundice (bilirubinemia) • Some foods: beets, berries, food dyes • Some laxatives • Kidney stones • Urinary tract infection • Blood in urine • Nephritis, cystitis • Cancer • Following prostate surgery CHAPTER 26 Male Genitourinary System TABLE 26-3 735 Urinary Problems ◀ Urethritis (Urethral Discharge and Dysuria) Infection of urethra causes painful burning urination or pruritus. Meatus edges are reddened, everted, and swollen with purulent discharge. Urine is cloudy with discharge and mucous shreds. Cause determined by culture: (a) In gonococcal urethritis, discharge is thick, profuse, and yellow or grey-brown; (b) in nonspecific urethritis, discharge may be similar but often is scanty and mucoid. Of these infections, about 50% are caused by Chlamydia organisms. This is important to differentiate because antibiotic treatment is different. Reprinted from Emond, R. (1995). Colour atlas of infectious diseases (3rd ed., p. 161). St. Louis: Mosby. Renal Calculi (Not Illustrated) Renal stones (crystals of calcium oxalate or uric acid) form in kidney tubules and then migrate. Their presence becomes an emergency when they pass into the ureter, become lodged, and obstruct urine flow. They cause abrupt, severe flank pain, which radiates to the groin or abdomen; nausea and vomiting; restlessness; and gross or microscopic hematuria. Acute Urinary Retention (Not Illustrated) Affected patients experience abrupt inability to pass urine, with bladder distension and lower abdominal pain. This is much more common in men than in women because of bladder outlet obstruction, such as benign prostatic hyperplasia (see Chapter 23). Catheterization must be performed to relieve acute discomfort; then the underlying problem must be managed. TABLE 26-4 Male Genital Lesions Genital Herpes: HSV-2 Infection Clusters of small vesicles with surrounding erythema, which are often painful, erupt on the glans or foreskin. These rupture to form superficial ulcers. Genital herpes is a sexually transmitted infection (STI); the initial manifestation lasts 7–10 days. The virus remains dormant indefinitely; recurrent manifestations last 3–10 days with milder symptoms. Continued Abnormal Findings Tinea Cruris A fungal infection in the crural fold, not extending to scrotum, occurring in postpubertal boys and men ("jock itch") after sweating or wearing layers of occlusive clothing. It forms a red-brown half-moon shape with well-defined borders. 736 TABLE 26-4 UNIT 3 Physical Examination Male Genital Lesions—cont'd ◀ Syphilitic Chancre Manifests within 2–4 weeks of infection as a small, solitary, silvery papule that erodes to a red, round or oval, superficial ulcer with a yellowish serous discharge. Palpation reveals a nontender, indurated base that can be lifted like a button between the thumb and the finger. Lymph nodes enlarge early but are nontender. Syphilis, an STI, is easily treated with penicillin G, but if untreated, it leads to cardiac problems, neurological problems, and blindness. Abnormal Findings Reprinted from Emond, R. (1995). Colour atlas of infectious diseases (3rd ed., p. 173). St. Louis: Mosby, by permission of the publisher. Genital Warts Soft, pointed, moist, fleshy, painless papules may be single or multiple in a cauliflower-like patch. Colour may be grey, pale yellow, or pink in White men and black or translucent grey-black in Black men. They occur on the shaft of the penis, behind the corona, or around the anus, where they may grow into large grapelike clusters. These are caused by the human papillomavirus (HPV), which is one of the most common STIs. The HPV infection is correlated with early onset of sexual activity, infrequent use of contraception, and multiple sexual partners. Carcinoma Begins as red, raised warty growth or as an ulcer, with watery discharge. As it grows, it may necrose and slough. It is usually painless. It almost always appears on the glans or inner lip of the foreskin and after chronic inflammation. Enlarged lymph nodes are common. CHAPTER 26 Male Genitourinary System TABLE 26-5 737 Abnormalities of the Penis ◀ Phimosis Nonretractable foreskin forms a pointy tip with a tiny orifice. Foreskin is advanced and so tight that it is impossible to retract over glans. May be congenital or acquired from adhesions secondary to infection. Poor hygiene leads to retained dirt and smegma, which increases risk of inflammation, calculus formation, and obstructive uropathy. Paraphimosis (Not Illustrated) Foreskin is retracted and fixed. Once retracted behind glans, a tight or inflamed foreskin cannot return to its original position. Constriction impedes circulation, and so glans swells. A medical emergency; the constricting band prevents venous and lymphatic return from the glans and compromises arterial circulation. Epispadias Meatus opens on the dorsal (upper) side of glans or shaft above a broad, spadelike penis. Rare; less common than hypospadias but more disabling because of associated urinary incontinence and separation of pubic bones. Corrective surgery is usually done in early childhood. Continued Abnormal Findings Hypospadias Urethral meatus opens on the ventral aspect (underside) of glans or shaft or at the penoscrotal junction. A groove extends from the meatus to the normal location at the tip. This congenital defect should be recognized at birth. Affected newborns should not be circumcised because surgical correction may entail use of foreskin tissue to extend urethral length. 738 TABLE 26-5 UNIT 3 Physical Examination Abnormalities of the Penis—cont'd Urethral Stricture (Not Illustrated) Pinpoint, constricted opening at meatus or inside along urethra. Occurs congenitally or secondary to urethral injury. Gradual decrease in force and calibre of urine stream is the most common symptom. Shaft feels indurated along ventral aspect at the site of the stricture. Priapism (Not Illustrated) Prolonged painful erection of penis without sexual stimulation and unrelieved by intercourse or masturbation, most common in men in 30s and 40s. This condition is rare, but when it lasts 4 hours or longer, it can cause ischemia of penis, fibrosis of tissue, and erectile dysfunction. Can occur as a side effect of some medications and street drugs and with sickle cell trait or disease; with leukemia, when increased numbers of white blood cells produce engorgement; with malignancy; and as a result of local trauma or spinal cord injuries with autonomic nervous system dysfunction. Abnormal Findings TABLE 26-6 Peyronie's Disease Hard, nontender, subcutaneous plaques palpated on dorsal or lateral surface of penis. May be single or multiple and asymmetrical. They are associated with painful bending of the penis during erection. Plaques are fibrosis of covering of corpora cavernosa. Usually occurs after age 45 years. Its cause is trauma to the erect penis, such as an unexpected change in angle during intercourse. More common in men with diabetes, gout, and Dupuytren's contracture of the palm. Abnormalities in the Scrotum Disorder Clinical Findings Discussion Absence of Testis (Cryptorchidism) S: Empty scrotal half. O: Inspection: in true maldescent, atrophic scrotum on affected side. Palpation: no testis. A: Absence of testis. True cryptorchidism: testes that have never descended. Incidence at birth is 3%–4%; in half these cases, the testes descend in first month. Incidence in premature infants is 30%; in adults, 0.7%–0.8%. True undescended testes undergo a histological change by 6 years, causing decreased spermatogenesis and infertility. Small Testis S: None. O (palpation): small and soft (in rare cases, may be firm). A: Small testis. Smallness with softness (12 cm, bituberous diameter >8 cm. Spacious gynecoid pelvis proven to 3.5 kg. ASSESSMENT Intrauterine pregnancy 10 weeks by good dates, size = dates Rosa and husband happy with pregnancy; she feels well PLAN Prenatal vitamins to begin Prenatal blood screen and urinalysis HIV screen offered and accepted Reviewed comfort measures for nausea Reviewed warning signs: vaginal bleeding and abdominal pain Informed of genetic screening options Return visit in 4 weeks Focus Assessment: Clinical Case Study 2 Kadija is a 30-year-old Ethiopian woman, Grav 5 TPAL 3204, who presents with an interpreter and her eldest daughter for her first prenatal visit. CHAPTER 30 Pregnancy 841 SUBJECTIVE Kadija runs a daycare facility within her home. She immigrated to Canada with her family 5 years ago. Her husband is employed. She lives in a three-bedroom townhouse in a subsidized housing complex with her family. Her LMP was May 28th of this year, with an EDB of March 5th next year; thus she is at 11 weeks' gestation today. She finds it challenging to remember details of her births in Ethiopia, other than the fact that one child "died in childbirth." She gave birth to her youngest child after coming to Canada; she delivered vaginally, without complications, after 5 hours of labour. She is unsure of the baby's weight at birth. She had a female circumcision as a child, so has scarring from her previous births. She is having nausea with occasional vomiting, has breast tenderness, and 1 week ago experienced "pink" vaginal spotting. She is unsure of her family health history. Both parents are deceased, as are all but one of her seven siblings. This pregnancy is unplanned, but she accepts it. She is concerned about transportation to her appointments because her husband works days and she does not drive. OBJECTIVE ASSESSMENT Intrauterine pregnancy at 11 weeks' gestation by ultrasonography today with positive fetal cardiac activity. Size = dates. Mother aware of potential language and cultural issues. Via interpreter, understands advised prenatal testing, clinic routine, and warning signs and symptoms in pregnancy. Physical examination findings within normal limits. PLAN Prenatal vitamins to begin Routine prenatal blood screening, plus thyroid function tests, vitamin D level, sickle cell screen, and thalassemia screen HIV, hepatitis B, and rubella screening discussed, offered, and accepted Reviewed integrated prenatal screening with US [ultrasonography] for NT [nuchal translucency] understands need to complete within 2 weeks and will discuss with her husband and let us know Reviewed clinic routines and whom to contact after hours Reviewed comfort measures for nausea and vomiting; offered medication; declined at this time Reviewed warning signs: vaginal bleeding, abdominal pain, pain with urination Will return to clinic within 2 weeks if desires prenatal screening, or 4 weeks if does not Refer to social worker for financial planning and transportation services Obtain records from previous pregnancy and birth Documentation & Critical Thinking General: Appears well nourished and is carefully groomed. English is her second language, but she understands some. Daughter who is present is well groomed and speaks English. Skin: Dark tan in colour, smooth surface, small scarring on left arm and both legs. No lesions or tattoos. Mouth: Poor dentition. Oral mucosa pink, some gum hypertrophy. Thyroid gland small and smooth. Chest: Expansion equal, respiration effortless. Lung sounds clear bilaterally with no adventitious sounds. No CVA tenderness. Heart: Rate 84 bpm, regular rhythm; S1 and S2 are normal, not accentuated or diminished, with soft, blowing systolic murmur grade II/VI at second left interspace. Breasts: Tender, no masses; large everted nipples. No drainage present. Breast self-examination reviewed. Abdomen: No masses; bowel sounds present in four quadrants. No hepatomegaly or splenomegaly. Uterus nonpalpable. No inguinal lymphadenopathy noted. No healed incisions noted. Extremities: No lower extremity varicosities, edema, or redness noted. Negative Homan's sign. 1+ DTRs. BP 124/76 mm Hg. Pelvic: Female circumcision present with scarring noted. Bartholin's glands, urethra, and Skene's glands negative for discharge. Vagina pink, with white, creamy, nonodorous discharge. Cervix pink, not friable, closed, and approximately 3 cm long and soft. Vaginal wall muscles lax. No evidence of a cystocele or rectocele. Uterus: Approximately 11-week size and nontender. Dextrorotated. FHTs not heard with Doppler. Confirmed on ultrasound studies along with dating. Pelvis: Pubic arch wide; side walls straight, spines blunt, interspinous diameter >12 cm, bituberous diameter >8 cm. Spacious, proven, gynecoid pelvis to ≈8 pounds. 842 UNIT 4 Integration of the Health Assessment ABNO R M A L F I N D I N G S TABLE 30-3 Pre-eclampsia Pre-eclampsia is a condition specific to pregnancy that rarely occurs before 20 weeks' gestation except in the presence of a molar (gestational trophoblastic) pregnancy. The cause remains unknown, but theories include coagulation abnormalities, vascular endothelial damage, cardiovascular maladaptation, immunological phenomena, dietary deficiencies or excess, and genetic predisposition. Predisposing conditions include a family or personal history of pre-eclampsia; nulliparity; obesity; multifetal gestation; and preexisting medical genetic conditions such as chronic hypertension, renal disease, type 1 (insulin-dependent) diabetes, factor V Leiden, and thrombophilias such as antiphospholipid antibody syndrome (Gabbe et al., 2007). The classic symptoms of pre-eclampsia are elevated BP and proteinuria. Edema is common in pregnancy and is no longer considered a part of the diagnosis of pre-eclampsia (Gabbe et al., 2007). However, when edema of the face (see photo) is of sudden onset and is associated with sudden weight gain, the diagnosis of pre-eclampsia should be considered. Proteinuria is a late development in pre-eclampsia and is an indicator of the severity of the disease. The Canadian guidelines for managing hypertension in pregnancy (SOGC, 2008) define hypertension as a diastolic BP of >90 mm Hg, by office measurement, with the patient sitting and her arm at the level of the heart according to the fifth Korotkoff sound. The presence of hypertension is necessary for the diagnosis of pre-eclampsia, but pre-eclampsia may occur without the edema or proteinuria. Onset and worsening of symptoms may be sudden. Subjective signs may include headaches and vision changes (seeing spots, blurring, or seeing flashing lights), caused by cerebral edema, and right upper quadrant or epigastric pain, caused by liver enlargement in which the liver also becomes necrotic and hemorrhagic. Liver enzyme levels become elevated. Hematocrit usually increases, and the platelet levels drop. Serum creatinine and blood urea nitrogen levels become elevated. Hemolysis occurs, at least partly as a result of vasospasm. A serious variant of pre-eclampsia, the HELLP syndrome, involves hemolysis, elevated liver enzyme levels, and low platelet count, and represents an ominous clinical picture. Untreated pre-eclampsia may progress to eclampsia, which is manifested by generalized tonic-clonic seizures. Eclampsia may develop as late as 10 days post partum. Before the syndrome becomes clinically manifested, it affects the placenta through vasospasm and a series of small infarctions. The placenta's capacity to deliver oxygen and nutrients to the fetus may be seriously diminished, and fetal growth may be restricted. Abnormal Findings BP, blood pressure. CHAPTER 30 Pregnancy TABLE 30-4 843 Fetal Size Inconsistent With Dates Size Fundal Height Measures Smaller Than Expected for Dates. Small for Dates Fundal height measures less than expected for dates. Inaccuracy of dates Conception may have occurred later than originally thought. Reconsider the woman's menstrual history, sexual history, contraceptive use, early pregnancy testing, early measurement of the uterus, ultrasonography results, timing of pregnancy symptoms (including the date of quickening), and the fundal height measurements. If, after this review, the EDB is correct, then further investigation is required. Preterm birth occurs before 37 weeks' gestation; it affected 7.9% of pregnancies in Canada in 2008 (Public Health Agency of Canada, 2012). The cause of preterm labour is not known, and 50% of preterm births occur in the absence of any known risk factors. The following preexisting factors are associated with preterm birth: maternal history of previous preterm birth, three of more pregnancy losses in the first trimester (habitual abortion), second trimester loss, uterine anomalies, and cervical conization. Current pregnancy risks include multiple pregnancy, preterm rupture of membranes, polyhydramnios, antepartum hemorrhage, intra-abdominal surgery, urinary tract infection, tobacco or cocaine use, serious maternal infection, and physical or emotional trauma (Public Health Agency of Canada, 2012). Prevention strategies include bed rest, tocolysis, home uterine monitoring, and hydration. Group prenatal care known as "centring pregnancy" facilitated by midwives has decreased rates of preterm birth in a high-risk population in the United States (Ickovics et al., 2007). Serial ultrasonographic assessments of cervical effacement and the use of fetal fibronectin sometimes reassure women who present with threatened preterm labour that they are not likely to give birth immediately; however, the ability to predict who will proceed to have a preterm birth is not yet possible. IUGR, a syndrome in which the fetus fails to meet its growth potential, is associated with an increase in fetal and neonatal mortality and morbidity. Its origin may be fetoplacental, as with chromosomal abnormalities, genetic syndromes, congenital malformations, infectious diseases, and placental disorders; or its origin may be maternal, as with decreased uteroplacental blood flow (as occurs with hypertensive disorders), poor maternal weight gain, poor maternal nutrition, and a previous pregnancy with an IUGR infant. Other contributing factors include infectious diseases (rubella, cytomegalovirus); multiple gestation; and environmental toxins such as cigarette smoke and maternal drug and alcohol use. Fetal position varies until approximately 34 weeks, when the vertex should settle into the pelvis and remain there. The position of the fetus in a transverse lie, or shoulder presentation, results in a widening of the maternal abdomen from side to side and a decrease in fundal height. Fetal malposition may occur with lax maternal abdominal musculature (inability to hold the baby in close), an abnormality in the fetus (e.g., the enlarged head of the hydrocephalic infant), placenta previa (implantation of the placenta over the cervix, blocking fetal descent), or a restricted maternal pelvis. Preterm labour and birth Intrauterine growth restriction (IUGR) or fetal growth restriction Fetal position Fundal height measures more than expected for dates. Inaccuracy of Dates Hydatidiform mole Review the same findings as listed for "Small for Dates." Also termed gestational trophoblastic neoplasia, this condition is a result of abnormal proliferation of trophoblastic tissue associated with pregnancy. In 50% of cases, uterine size is excessive; in these cases, the gestational age and uterine size do not coincide. Continued Abnormal Findings Large for Dates 844 TABLE 30-4 UNIT 4 Integration of the Health Assessment Fetal Size Inconsistent With Dates—cont'd Size Fundal Height Measures Smaller Than Expected for Dates. Multiple gestation The incidence of multiple gestations is rising in Canada (≈20% since 1995) and other developed countries, mostly because of assisted reproductive technologies and advanced maternal age (Blackburn, 2007; Schuurmans, Senikas, & Lalonde, 2009). Up to 12% of twin pregnancies become singletons by the loss of one embryo without symptoms early in the pregnancy (Blackburn, 2007). Twin gestations are either monozygotic (division of a single ovum after fertilization) or dizygotic (simultaneous fertilization of two ova). Higher order multiple gestations are rarer; they can be monozygotic or dizygotic or a combination (Blackburn, 2007). The placenta and fetal membranes also differ according to the type of twin pregnancy: (a) monoamniotic or diamniotic and (b) monochorionic or dichorionic. The placentas may be separate or fused. Multifetal pregnancies have many risks: preterm birth and increased risks for congenital anomalies, maternal anemia, or placenta previa. Prenatal care includes more frequent visits to assess fetal growth and development, maternal coping, and amniotic fluid volume. More frequent ultrasound studies are used to determine fetal health (Lowdermilk, Perry, Cashion, & Alden, 2012). Mothers and families need support to cope with the need for more prenatal care and increased needs of their infants after birth. Breastfeeding support by a lactational consultant is beneficial if this is the woman's choice. An amniotic fluid volume is a maximum volume pocket >8.0 cm or an amniotic fluid index (AFI) >95th percentile or ≥20 cm. The cause is usually idiopathic but may result from fetal anomalies, diabetes in pregnancy, or the presence of multiple fetuses (Creasy et al., 2009). Oligohydramnios is a reduction in amniotic fluid volume (i.e., an AFI

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