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# MDCT

## A Practical Approach

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# Preface

Multidetector-row computed tomography (MDCT) is currently the most rapidly evolving imaging technology. Within a decade of its commercial introduction, MDCT has become an indispensable imaging modality in routine clinical practice. Continuing improvements in MDCT technology make it easier, quicker and safer to detect and diagnose disease. Unfortunately the rapidity with which upgrades occur may sometimes make it difficult for radiologists to keep up to date. This has been the underlying motivation for this textbook on the technical aspects and clinical applications of state-of-the-art MDCT scanners. The book contains chapters prepared by recognized experts in the field of MDCT that describe the various clinical applications of MDCT in different regions of the body. Moreover, in describing the practical aspects of CT technology, this book also addresses concerns over radiation dose and contrast media safety and administration issues. The book contains numerous figures and tables and practical tips for MDCT scanning along with comprehensive details of scanning techniques, contrast medium administration techniques, image post-processing, study indications, and diagnostic applications.

This book has been prepared not only for the benefit of radiologists but also with the interests of radiology fellows and residents, radiology technologists, and medical physicists in mind. In order to organize this book for readers of different radiology sub-specialities or interests, the contents are divided into five sections, beginning with the physics and techniques of MDCT and extending to describe the important applications of MDCT pertaining to imaging of the abdomen, head and neck, cardiovascular system, and trauma.

Section I begins with “A Practical Approach to MDCT”, co-authored by Dr. Mannudeep K. Kalra and Professor Sanjay Saini. This chapter describes the history and growth of MDCT technology and outlines the fundamentals of MDCT physics and strategies for setting up effective scanning protocols. In the subsequent chapter, Dr. Kyongtae T. Bae provides an in-depth description of the “Principles of Contrast Medium Delivery and Scan Timing in MDCT” for state-of-the-art MDCT scanners. This chapter outlines the numerous factors associated with contrast medium delivery and scan timing and emphasizes the need to adjust scan timing on the basis of both patient-related factors (body weight, cardiac output) and contrast injection parameters (duration and rate of injection, iodine concentration). The modifications to protocol design that are necessary for optimized contrast enhancement in MDCT are discussed, along with clinical considerations for CT angiography (CTA) and hepatic imaging. In the third chapter of this section Professor Richard Solomon shares his immense experience in “Contrast-Induced Nephropathy: Managing At-Risk Patients”. Currently an area of much controversy among the radiological and cardiological communities, this chapter aims to address all of the issues related to contrast-induced nephropathy and to bring some perspective to the debate. In the final chapter of this section, Dr. Kalra highlights the increasing concern over “MDCT Radiation Dose”, providing valuable insight into the

risks associated with radiation exposure in MDCT and presenting useful practical tips for reducing the overall radiation dose. In all, section I provides a concise overview of the technical fundamentals of modern MDCT scanners.

Section II focuses primarily on MDCT of the abdomen, highlighting important practical approaches to MDCT imaging of the liver, hepatobiliary system, pancreas and spleen, as well as for MDCT angiography of the mesenteric and renal vasculature. In the first chapter of the section entitled “Dual-Phase Liver MDCT”, Drs. Dushyant V. Sahani and Anandkumar H. Singh provide a detailed description of scanning protocols, contrast media administration techniques, and clinical applications of dual-phase MDCT protocol for detecting and characterization of focal liver lesions. MDCT imaging of focal liver lesions is again addressed in the second chapter of this section prepared by Drs. Sebastian T. Schindera and Rendon C. Nelson. Entitled “Hepatobiliary Imaging by Multidetector Computed Tomography (MDCT)” this chapter also provides a comprehensive review of MDCT applications in the biliary system. In the third chapter entitled “Soft Organ MDCT Imaging: Pancreas and Spleen”, Drs. Sahani and Shah describe the role of modern MDCT for evaluation of pancreatic and splenic lesions. The authors cover important technical components and clinical indications for scanning patients with suspected or known pancreatic or splenic pathology. The final chapter of Section II addresses the role of MDCT angiography in patients referred for evaluation of the renal and mesenteric vasculature. Entitled “Mesenteric and Renal CT Angiography”, Drs. Lisa L. Wang, Christine O. Menias and Kyongtae T. Bae discuss common indications for which MDCT scanning of the abdominal vasculature is appropriate and provide practical approaches for staging and surgical management of tumors, evaluation for renal donor transplantation, work-up of renovascular hypertension, and assessment of mesenteric ischemia and inflammatory bowel disease.

Section III comprises four chapters dedicated to MDCT of the cardiovascular system, which represents the fastest-growing application for MDCT scanning. The section begins with a chapter on “Imaging Protocols for Cardiac CT” by Drs. Frank J. Rybicki and Tarang Sheth. With the help of several exquisite images, the authors expound the key considerations for planning effective scanning protocols for cardiac MDCT angiography and illustrate the key applications for MDCT angiography in the coronary arteries. In the second chapter of the section entitled “MDCT Angiography of the Thoracic Aorta”, Drs. Geoffrey D. Rubin and Mannudeep K. Kalra highlight the value of state-of-the-art MDCT scanners and comprehensively discuss scanning techniques and clinical applications of MDCT aortography. Specifically, the improved temporal and isotropic resolution achievable on the most recent MDCT scanners enable volumetric acquisitions that provide clear anatomic delineation of thoracic aorta, its tortuous branches, and adjacent aneurysms and pseudo aneurysms. With the help of relevant two- and three-dimensional images the authors demonstrate conclusively that MDCT angiography has clear advantages over conventional aortography for evaluation of the thoracic aorta. An important application of MDCT in the emergency setting is presented in the third chapter of the section entitled “Pulmonary Embolism Imaging with MDCT”. In this chapter Drs. Joseph J. Kavanagh, Douglas R. Lake, and Philip Costello describe the many advantages of MDCT when compared with other available imaging modalities in the detection of pulmonary embolism. Principal among these advantages are the rapidity of the procedure and the possibility to detect and diagnose additional complications which may contribute to the patient's overall clinical presentation, such as congestive heart failure, pneumonia, interstitial lung disease, aortic dissection, malignancy and pleural disease. The final chapter of this section, again by Drs. Rubin and Kalra, describes the role of MDCT angiography in non-invasive imaging of peripheral vascular disease. Entitled “MDCT Angiography of Peripheral Arterial Disease”, the chapter presents the scanning parameters, contrast medium administration features, image post-processing tech-

niques, and many clinical applications (intermittent claudication, acute and chronic lower-limb ischemia, trauma, vascular mapping) of MDCT angiography in imaging of the lower extremities.

Section IV extends the clinical role of MDCT to include applications in the head and neck. In the first of two chapters in this section, entitled “CT Angiography of the Neck and Brain”, Dr. David S. Enterline discusses critical aspects of MDCT angiography in assessing neck and brain vasculature and provides several interesting cases to illustrate the full value of MDCT angiography in this setting. The second chapter by Drs. Sanjay K. Shetty and Michael H. Lev, entitled “MDCT Perfusion in Acute Stroke” focuses on applications of MDCT perfusion imaging in the evaluation of patients with acute stroke. The chapter is enhanced by the inclusion of effective scanning protocols and by detailed assessment of the value of CT perfusion relative to other techniques such as magnetic resonance perfusion.

The final section of the book, Section V, addresses the increasing use of MDCT in imaging of acute trauma. The two chapters included in the section consider the role of MDCT in assessing abdominal trauma and musculoskeletal trauma, respectively. In “MDCT of Abdominal Trauma” Dr. Robert A. Halvorsen gives practical advice on the use and interpretation of MDCT in patients with abdominal trauma. In particular, the varied manifestations of bleeding are emphasized while common mistakes and pitfalls in interpretation are also discussed. In the second chapter of the section and final chapter of the book, Drs. Sunit Sebastian and Hamid Salamipour outline the “Role of MDCT in the Evaluation of Musculoskeletal Trauma”, focussing on the various techniques and applications of MDCT and the specific value of 3-D reformations in the evaluation of orthopedic trauma.

The book concludes with a detailed appendix that presents optimized scanning protocols for MDCT imaging in a variety of indications.

In summary, *MDCT: A Practical Approach* provides a comprehensive evaluation of the technical developments and rapidly evolving clinical applications of MDCT in routine practice. We believe this textbook will guide radiology personnel and further propel development in the field of MDCT.

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