P. Reimer · P. M. Parizel · F.-A. Stichnoth (Eds.)

Clinical MR Imaging

A Practical Approach

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Second, completely revised and updated edition

With 494 Figures and 141 Tables

Springer

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Foreword

Since the introduction of magnetic resonance imaging in the early 1980s, unprecedented developments have taken place that have catapulted this imaging modality to the forefront of modern medical imaging. During this development, complex novel techniques have been introduced, including diffusion imaging, perfusion imaging, functional MR imaging, and basic innovations in pulse sequence design and system hardware. Despite the myriad of publications and developments, it is frequently difficult for the practicing radiologist to stay ahead of the game and translate advances into clinical protocols and improvements.

The current book by Drs. Reimer, Parizel, and Stichnoth is an exercise in marrying technological advances and clinical radiology. The book has 17 chapters: basic, contrast agents, hemorrhage, head, ENT, spine, pelvis, abdomen, retroperitonium, vessels, joints, soft tissue, chest breast, cardiac, pediatrics, and interventional imaging. All the chapters have the same structure, including subchapters on coils, pulse sequences, imaging protocols, anatomy, and clinically relevant pathology. Each chapter also contains a succinct reference list. Overall there are over 500 pages with illustrations to highlight key concepts.

The authors have done a fine job and the current work certainly enriches the armamentarium for the clinical radiologist. The editors and contributors are to be commended for their efforts in achieving a clear synthesis of technological and clinical issues. This volume clearly represents an important contribution to the field of medical imaging.

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Preface

Magnetic resonance (MR) imaging has become the leading cross-sectional imaging method in clinical practice. Since the 1980s, continuous improvements in hardware and software have significantly broadened the scope of applications. At present, MR imaging is not only the most important technique in neuroradiology and musculoskeletal radiology, but has also become an invaluable diagnostic tool for abdominal, pelvic, cardiac, breast and vascular imaging.

Due to ongoing technical developments, the complexity of MR imaging has increased markedly. This often represents an obstacle not only to beginners (who find it difficult to get started), but also to more experienced users (who find it hard to keep up). Information about MR imaging can be found in many excellent textbooks and reference works, several of which have become encyclopaedic in scope and sheer volume. As editors and authors of this book, we have endeavoured to use a different approach. As a starting point for the first edition, we had taken into consideration that routine diagnostic questions account for more than 90% of examinations. This implies that by adopting a practical protocol-based approach the workflow in a MR unit can be streamlined considerably, which is critical in today's economic environment. We have aimed to provide the reader with such information, based on our combined experience.

The second edition of this book offers practical guidelines for performing efficient and cost-effective MR imaging examinations in daily practice. The authors and editors have reviewed all chapters, included new techniques, added new figures and replaced older ones. As editors, we hope that this work will lead to a better practical understanding of MR imaging and that new sequences and protocols will contribute to solving clinical problems. As such, we believe this book will continue to help beginners to advance their starting point in implementing the protocols and will aid more experienced users in updating their knowledge.

The editors:
P. Reimer, *P.M. Parizel*, and *F.-A. Stichnoth*

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Abbreviations

ADC	analog to digital converter
B0	main magnetic field strength in Tesla (T)
B1	magnetic component of the RF field
CE-T2-FFE	contrast-enhanced T2-W FFE sequence
CE-FAST	contrast-enhanced FAST sequence
CEMRA	contrast-enhanced magnetic resonance angiography
CHESS	chemical shift selective pulse
CISS	constructive interference steady-state sequence
CNR	contrast-to-noise ratio
CSF	cerebrospinal fluid
DESS	double-echo steady-state sequence
EPI	echo planar imaging
FAME	fast-acquisition multi-echo sequence
FAST	Fourier acquired steady-state sequence
FFE	fast-field echo sequence
FISP	fast imaging with steady-state precession sequence
FLASH	fast low-angle shot sequence
fMRI	functional magnetic resonance imaging
FOV	field of view
FSE	fast spin-echo sequence
FSPGR	fast spoiled GRASS sequence
GMR	gradient motion rephasing
GRASE	gradient and spin echo sequence
GRASS	gradient recalled acquisition in the steady state sequence
GRE	gradient echo sequence
HASTE	half Fourier acquired single-shot turbo spin-echo sequence
HASTIRM	half Fourier acquired single-shot turbo spin-echo sequence using inversion recovery and only the signal magnitude
IR	inversion-recovery sequence
IRM	inversion-recovery sequence that utilizes only the magnitude of the signal
MIN	minimum intensity projection
MIP	maximum intensity projection
MPGR	multi-planar GRASS sequence
MPRAGE	magnetization-prepared rapid acquired gradient echo sequence
MR	magnetic resonance
MRA	magnetic resonance angiography
MT	magnetization transfer
MTC	magnetization transfer contrast

MTS	magnetization transfer saturation
PC	phase contrast
PSIF	a backwards-running FISP sequence
RAM-FAST	rapidly acquired magnetization-prepared FAST sequence
RARE	rapid acquisition with relaxation enhancement
RF	radio frequency
SAR	specific absorption rate
SE	conventional spin-echo sequence
SNR	signal-to-noise ratio
SPGR	spoiled GRASS sequence
SSFP	steady-state free-precession sequence
SSFSE	single-shot fast spin echo sequence
STIR	short tau inversion recovery sequence
T1	tissue-specific spin-lattice relaxation time
T1-W	contrast is weighted by the T1 relaxation time
T2	tissue-specific spin-spin relaxation time
T2*	relaxation time T2 plus additional dephasing mechanism (signal decay) due to local field inhomogeneities or chemical shift
T2-W	contrast is weighted by the T2 relaxation time
TE	echo time
TFE	turbo field echo sequence
TGSE	turbo gradient and spin-echo sequence
TIR	turbo inversion recovery sequence
TIRM	turbo inversion recovery sequence that utilizes only the magnitude of the signal
TOF	time of flight
TONE	tilted optimized non-saturating excitation
TR	repetition time
TSE	turbo spin-echo sequence