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978-1-107-01404-6 - Practical Body MRI: Protocols, Applications, and Image Interpretation

David J. Grand, Courtney A. Woodfield and William W. Mayo-Smith

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To Charlie and Zoe: May you never need an MRI.

David J. Grand, MD

To my husband, Roland, and my parents, Karen and Richard, thank you for all your love and support.

To my children, Sophia and Liam, the joys of my life. You were both by my side while I worked on this book.

Courtney A. Woodfield, MD

To Margaret and Bill, who cultivated intellectual curiosity and prepared me for the world.

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And to James, Andrew, and Chris, who keep it all in perspective.

William W. Mayo-Smith, MD

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Preface

Body Imaging Divisions in the United States tend to be biased to either CT or MRI. This was the case at Brown/Rhode Island Hospital where CT dominated. Our Chairman, John Cronan, sought to remedy this imbalance by hiring recently trained experts in body and pelvic MRI, Drs. Grand and Woodfield.

My job as division director was to encourage the development of imaging algorithms and MRI protocols that optimized patient care. Like many academic institutions, we had had no hesitation about adding the latest sequence, but seldom took any away. Thus our protocols were lengthy and often it was not clear exactly what each sequence was used for. We needed to pare down extra sequences, minimizing imaging time without sacrificing quality or patient care. If we couldn't explain why we were running a sequence or

if it was redundant, it was eliminated. This is a subjective matter and, like making sausages, not always a pretty scene.

What started as a handout for residents on their first tour of duty in body MRI became this book. It is not intended to be a reference and cover all aspects of every disease, but rather to quickly get a neophyte from "zero to fifty." David and Courtney have done a great job of writing a short, practical book that teaches residents, fellows (and attendings) with minimal exposure to body MRI the most common MRI findings in the abdomen and pelvis. It is punctuated with David's subtle sense of humor. We hope you enjoy it!

William W. Mayo-Smith, MD FACR

To the reader

Reading abdominal and pelvic MRI isn't that hard. Yet I still have colleagues who let body MRIs languish on the worklist. And, too often, normally brash, fearless residents (and fellows) arrive at the MRI service looking as though their mother is about to leave them on their first day of kindergarten. I was one of them.

MRI has all the ingredients to instill fear into the bravest radiology warrior. The underlying physics is complicated and, to make matters worse, it is often taught by people to whom it comes naturally. I wish I were one of them.

Toss in a spattering of seemingly incomprehensible abbreviations, lengthy lists of protocols each with more series than the next, and more adjustable parameters than a modern office chair, and it's no wonder that the uninitiated can be intimidated. Sadly, when we allow ourselves to be intimidated, we miss out on the wonder of MRI and its evolution into a powerful problem-solving tool.

This book is for the inexperienced. It is an accessible introduction to abdominal and pelvic MRI. It is short, but it is not particularly abbreviated. It is simply written, but it is not simplified.

It is simply what you need to know to interpret abdominal and pelvic MRI.

In it you will find all the background, protocols, and imaging features that you need to approach MRI with confidence.

When you're finished, we think you'll agree: it just isn't that hard.

Each chapter of this book follows the same format:

- (1) Name of the imaging protocol.
- (2) Pulse sequences in each protocol and a brief description of why each is done.
- (3) Approach to image interpretation and specific pathologic entities.

David J Grand, MD

Acknowledgments

No book is written in a vacuum and, while there are three authors listed, many people contributed to the text. We thank our families for their support and our Chairman, John Cronan, who has been a constant champion of academics at Brown. We also thank all our radiologic colleagues, particularly John Pezzullo,

who granted us academic time to complete this task. And finally, we thank the medical students, residents, and fellows who keep asking the questions that make academics so stimulating.

WWM-S

Glossary of terms and abbreviations used in Body MRI

2D FL	Two-dimensional FLASH (fast low-angle shot)	POST	Post administration of intravenous contrast
3D	Three-dimensional	PRE	Before administration of intravenous contrast
ACR	American College of Radiology	PSC	Primary sclerosing cholangitis
ADC	Apparent diffusion coefficient	RCC	Renal cell carcinoma
AML	Angiomyolipoma	SE	Spin echo
AVM	Arterio-venous malformation	SMA	Superior mesenteric artery
B	B value	SPEN	Solid and papillary epithelial neoplasm
BH	Breath-hold	SPGR	Spoiled gradient echo
DWI	Diffusion-weighted imaging	STIR	Short-tau inversion recovery
ERCP	Endoscopic Retrograde Cholangiopancreatography	SUB	Subtracted sequence (subtract pre-contrast image from post-contrast image)
FISP	Fast imaging with steady precession	T	Tesla
FNA	Fine needle aspiration	T1	Time required for tissue to recover longitudinal magnetization
FNH	Focal nodular hyperplasia	T1W	T1 weighted: Sequence in which TE and TR are set to accentuate T1 characteristics of tissue
FS	Fat saturation	T2	Time in which tissues lose phase coherence
FSE	Fast-spin echo	T2*	T2-star weighted sequence, highly dependent on magnetic field inhomogeneity and the decay of transverse magnetization
GAD(O)	Gadolinium	T2W	T2 weighted: Sequence in which TE and TR are set to accentuate T2 characteristics of tissue
HASTE	Half-Fourier acquisition single-shot turbo spin echo	TE	Echo time
HCC	Hepatocellular carcinoma	TNF	Tumor necrosis factor
IMA	Inferior mesenteric artery	TOF	Time of flight
IP	In phase	TR	Repetition time
IPMN	Intraductal papillary mucinous neoplasm	True FISP	True fast imaging with steady-state precession
IV	Intravenous	TSE	Turbo spin echo
IVC	Inferior vena cava	UAE	Uterine artery embolization
L	Liter	VIBE	Volumetric interpolated breath-hold examination
MIP	Maximum intensity projection		
MRCP	Magnetic Resonance Cholangiopancreatography		
MRA	Magnetic resonance angiography		
MRV	Magnetic resonance venography		
MS	milliseconds		
NSF	Nephrogenic systemic fibrosis		
OOP	Out of phase		
PCKD	Polycystic kidney disease		
PD	Proton density		