

Contents

1	Spin and the MR Phenomenon	1
2	Relaxation	7
	T1: Longitudinal Relaxation	7
	T2/T2*: Transverse Relaxation	8
3	Image Contrast	11
	Repetition Time (TR) and T1-Weighting	12
	Echo Time (TE) and T2-Weighting	14
	Saturation at Short Repetition Times	17
	Flip Angle	18
	Presaturation	18
	Magnetisation Transfer	19
4	Spatial Encoding	21
	Three-Dimensional Spatial Encoding	26
	K-Space	27
5	Factors Affecting the Signal-to-Noise Ratio	31
	Pixel, Voxel, Matrix	32
	Slice Thickness and Bandwidth	32
	Field of View and Matrix	34
	Number of Measurements	39
	Image Parameters	39
	Magnetic Field Strength	39
	Coils	40

6	The MR Scanner	43
	Magnets	45
	The Gradient System	46
	The RF System	47
	The Computer	48
7	Basic Pulse Sequences	49
	Spin-Echo Sequence (SE)	50
	Outflow Effect	52
	Multislice Imaging	52
	Inversion-Recovery Sequence	53
	STIR Sequence (Short T1-Inversion Recovery)	55
	Gradient-Echo Sequence	55
	Multi-Echo Sequences	58
8	Fast-Pulse Sequences	61
	Fast or Turbo Spin-Echo Sequences	61
	SSFSE and HASTE	63
	Fast or Turbo Inversion-Recovery Sequences	64
	Fast Gradient-Echo Sequences	64
	Echo-Planar (EPI) Sequence	64
	Hybrid Sequences	65
	GRASE (Gradient-Echo and Spin-Echo)	66
	Spiral Sequences	66
	Echo Time and T2-Contrast in Fast Sequences	66
9	Parallel Imaging	69
	Background	69
	Principles of Parallel Imaging	69
	Special Requirements	71
	Range of Application	71
10	Techniques for Imaging the Vascular System	75
	Time-of-Flight Angiography	76

	Phase-Contrast Angiography	78
	Contrast Enhanced 3D-Angiography	81
	Perfusion and Diffusion	83
11	MR Contrast Media	85
	Chemical Structure	88
	Relaxivity	89
	Pharmacological Properties	92
	Future Outlook	99
12	Artefacts in the MR Image	101
	Movement and Flow Artefacts	101
	Phase Wrapping	103
	Chemical Shift	105
	Susceptibility	106
	Truncation Artefacts	107
	Magic Angle	107
	Line Artefacts ("Zipper-Like Artefacts")	107
	Criss-Cross or Herring-Bone Artefacts	108
13	Safety, Risks and Contraindications	109
	Glossary	113
	Subject Index	125