



Contents

1 General notes

David M. Rosewarne

Radiology 1

Radionuclide Imaging 9

Radiopharmaceuticals 9

Computed Tomography 11

Magnetic Resonance Imaging 13

Safety in Magnetic Resonance Imaging 14

Ultrasonography 19

2 Intravascular contrast media

David M. Rosewarne

Historical Development of Radiographic Agents 21

Adverse Effects of Intravenous Water-Soluble Contrast Media 25

Toxic Effects on Specific Organs 25

Idiosyncratic Reactions 28

Mechanisms of Idiosyncratic Contrast Medium Reactions 30

Prophylaxis of Adverse Contrast Medium Effects 30

Contrast Agents in Magnetic Resonance Imaging 33

Historical Development 33

Mechanism of Action 33

Gadolinium 34

Gastrointestinal Contrast Agents 38

Contrast Agents in Ultrasonography 39

3 Gastrointestinal tract

Ingrid Britton

Methods of Imaging the Gastrointestinal Tract 43

Introduction to Contrast Media 43

Water-Soluble Contrast Agents 43

Gases 44

Barium 45

Pharmacological Agents 46

Contrast Swallow	49
Barium Meal	51
Small Bowel Follow-Through	55
Small-Bowel Enema	57
Barium Enema	60
Enema Variants	63
The 'Instant' Enema	64
Air Enema	64
Reduction of an Intussusception	65
Contrast Enema in Neonatal Low Intestinal Obstruction	68
Sinogram	69
Retrograde Ileogram	69
Colostomy Enema	70
Loopogram	70
Herniogram	70
Evacuating Proctogram	72
Coeliac Axis, Superior Mesenteric and Inferior Mesenteric Arteriography	73
Ultrasound of the Gastrointestinal Tract	74
Endoluminal Examination of the Oesophagus and Stomach	74
Transabdominal Examination of the Lower Oesophagus and Stomach	75
Hypertrophic Pyloric Stenosis	75
Small Bowel	75
Appendix	76
Large Bowel	76
Endoluminal Examination of the Anus	76
Endoluminal Examination of the Rectum	77
Computed Tomography of the Gastrointestinal Tract	78
Computed Tomographic Colonography	80
Complications	81
Aftercare	81
Magnetic Resonance Imaging of the Gastrointestinal Tract	82
Radionuclide Gastro-Oesophageal Reflux Study	85
Radionuclide Gastric-Emptying Study	87
Radionuclide Meckel's Diverticulum Scan	89
Radionuclide Imaging of Gastrointestinal Bleeding	90
Labelled White Cell Scanning in Inflammatory Bowel Disease	92

4 Liver, biliary tract and pancreas

Ingrid Britton

- Methods of Imaging the Hepatobiliary System 93
- Methods of Imaging the Pancreas 93
- Plain Films 94
- Ultrasound of The Liver 94
- Ultrasound of the Gallbladder and Biliary System 96
- Ultrasound of the Pancreas 98
- Computed Tomography of the Liver and Biliary Tree 99
- Computed Tomographic Cholangiography 101
- Computed Tomography of the Pancreas 102
- Magnetic Resonance Imaging of the Liver 103
- Magnetic Resonance Cholangiopancreatography 106
- Magnetic Resonance Imaging of the Pancreas 106
- Endoscopic Retrograde Cholangiopancreatography 107
 - Intraoperative Cholangiography 110
 - Postoperative (T-Tube) Cholangiography 111
- Percutaneous Transhepatic Cholangiography 112
 - External Biliary Drainage 115
 - Internal Biliary Drainage 115
 - Percutaneous Extraction of Retained Biliary Calculi (Burhenne Technique) 117
- Angiography 118
 - Coeliac Axis, Superior Mesenteric and Inferior Mesenteric Arteriography 118
- Radionuclide Imaging of Liver and Spleen 119
- Radionuclide Hepatobiliary and Gallbladder Radionuclide Imaging 121
- Investigation of Specific Clinical Problems 123
 - The Investigation of Liver Tumours 123
 - The Investigation of Jaundice 124
 - The Investigation of Pancreatitis 125
 - Pancreatic Pseudocysts 125

5 Urinary tract

Peter Guest

- Plain Film Radiography 128
- Intravenous Excretion Urography 128
- Ultrasound of the Urinary Tract 130
- Computed Tomography of the Urinary Tract 132

Magnetic Resonance Imaging of the Urinary Tract	135
Magnetic Resonance Imaging of the Prostate	136
Magnetic Resonance Urography	137
Magnetic Resonance Imaging of the Adrenals	138
Magnetic Resonance Renal Angiography	138
Micturating Cystourethrography	138
Ascending Urethrography in the Male	140
Retrograde Pyeloureterography	141
Conduitogram	142
Percutaneous Renal Cyst Puncture and Biopsy	143
Percutaneous Antegrade Pyelography and Nephrostomy	144
Percutaneous Nephrolithotomy	146
Renal Arteriography	148
Static Renal Radionuclide Scintigraphy	149
Dynamic Renal Radionuclide Scintigraphy	151
Direct Radionuclide Micturating Cystography	153
6 Image guided ablation techniques for cancer treatment	

Tze Min Wah

Types of Ablative Technology	155
Radiofrequency Ablation	155
Microwave Ablation	156
Cryoablation	157
Irreversible Electroporation	158
Tips	160
Key Challenges	160

7 Reproductive system

Balashanmugam Rajashanker

Hysterosalpingography	163
Ultrasound of the Female Reproductive System	166
Ultrasound of the Scrotum	168
Computerized Tomography of the Reproductive System	169
Magnetic Resonance Imaging of the Reproductive System	169
Gynaecological Malignancy	171
Cervical Cancer	171
Uterine Carcinoma	171
Ovarian Cancer	172
Omental Biopsy	173

Pet Computerized Tomography	174
Uterine Artery Embolization	174

8 Respiratory system

Nick Watson

Computed Tomography of the Thorax	177
Computed Tomography-Guided Lung Biopsy	179
Methods of Imaging Pulmonary Embolism	182
Radionuclide Lung Ventilation/Perfusion Imaging	183
Computed Tomography in the Diagnosis of Pulmonary Emboli	186
Pulmonary Arteriography	187
Magnetic Resonance of Pulmonary Emboli	188
Ultrasound of the Diaphragm—The 'Sniff Test'	190
Magnetic Resonance Imaging of the Respiratory System	191
PET and PET-CT of the Respiratory System	192

9 Heart

Hefin Jones

Angiocardiology	193
Coronary Arteriography	195
Cardiac Computed Tomography	198
Cardiac Magnetic Resonance	203
Radionuclide Ventriculography	206
Radionuclide Myocardial Perfusion Imaging	209

10 Arterial system

Chris Day

Noninvasive Imaging	217
Vascular Ultrasound	217
Computed Tomographic Angiography	218
Peripheral (Lower Limb) Computed Tomographic Angiography	218
Magnetic Resonance Angiography	219
Vascular Access	220
General Complications of Catheter Techniques	227
Angiography	229
Angioplasty	230
Stents	233
Catheter-Directed Arterial Thrombolysis	234
Vascular Embolization	236
Thoracic and Abdominal Aortic Stent Grafts	238

11 Venous system

Chris Day

Ultrasound 243

Lower Limb Venous Ultrasound 244

Upper Limb Venous Ultrasound 245

Computed Tomography 245

Magnetic Resonance 246

Peripheral Venography 247

Lower Limb 247

Upper Limb 249

Central Venography 250

Superior Vena Cavography 250

Inferior Vena Cavography 250

Portal Venography 251

Transhepatic Portal Venous Catheterization 253

Venous Interventions 254

Venous Angioplasty and Stents 254

Gonadal Vein Embolization 255

Inferior Vena Cava Filters 256

Thrombolysis 258

Pulmonary Embolism 260

12 Radionuclide imaging in oncology and infection

Peter Guest

Positron Emission Tomography Imaging 263

2-[¹⁸F]Fluoro-2-Deoxy-D-Glucose Positron Emission Tomography Scanning 264

Other Pet Radiopharmaceuticals 267

¹⁸F-Choline 267

¹⁸F-Fluoride 267

⁶⁸Gallium-Labelled Pharmaceuticals 267

⁶⁷Gallium Radionuclide Tumour Imaging 268

Radioiodine Metaiodobenzylguanidine Scan 268

Somatostatin Receptor Imaging 270

Lymph Node and Lymphatic Channel Imaging 272

Radiography 272

Ultrasound 272

Computed Tomography 272

Magnetic Resonance Imaging 273

Radiographic Lymphangiography	273
Radionuclide Lymphoscintigraphy	273
Radionuclide Imaging of Infection and Inflammation	276

13 Bones and joints

Philip Robinson and James Rankine

Musculoskeletal Magnetic Resonance Imaging—General Points	280
Arthrography—General Points	282
Arthrography	283
Arthrography—Site-Specific Issues	286
Knee	286
Hip	287
Shoulder	289
Elbow	294
Wrist	295
Ankle	296
Tendon Imaging	298
General Points	299
Ultrasound of the Paediatric Hip	299
Thermoablation of Musculoskeletal Tumours	300
Radionuclide Bone Scan	303

14 Brain

Amit Herwadkar

Computed Tomography of the Brain	308
Magnetic Resonance Imaging of the Brain	309
Imaging of Intracranial Haemorrhage	311
Computed Tomography	311
Magnetic Resonance Imaging	312
Imaging of Gliomas	313
Computed Tomography	313
Magnetic Resonance Imaging	313
Imaging of Acoustic Neuromas	314
Computed Tomography	314
Magnetic Resonance Imaging	314
Radionuclide Imaging of the Brain	315
Conventional Radionuclide Brain Scanning (Blood–Brain Barrier Imaging)	315
Regional Cerebral Blood Flow Imaging	315
Positron Emission Tomography	317

²⁰¹ Thallium Brain Scanning	318
Dopamine Transporter Ligands	319
Ultrasound of the Infant Brain	320
Cerebral Angiography	321

15 Spine

James Rankine

Imaging Approach to Back Pain and Sciatica	326
Conventional Radiography	327
Computed Tomography and Magnetic Resonance Imaging of the Spine	328
Myelography	330
Contrast Media	330
Cervical Myelography	330
Lumbar Myelography	332
Thoracic Myelography	335
Cervical Myelography by Lumbar Injection	336
Computed Tomography Myelography	336
Paediatric Myelography	336
Lumbar Discography	337
Intradiscal Therapy	340
Facet Joint/Medial Branch Blocks	340
Percutaneous Vertebral Biopsy	341
Bone Augmentation Techniques	343
Nerve Root Blocks	343
Lumbar Spine	343
Cervical Spine	344

16 Lacrimal system, salivary glands, thyroid and parathyroids

Polly S. Richards

Digital Subtraction and Computed Tomography	
Dacryocystography	345
Magnetic Resonance Imaging of Lacrimal System	346
Ultrasound	347
Conventional and Digital Subtraction Sialography	348
Magnetic Resonance Imaging Sialography	350
Contrast Enhanced Magnetic Resonance Imaging and Computed Tomography	350
Ultrasound of Thyroid	351
Ultrasound of Parathyroid	351

Computed Tomography and Magnetic Resonance Imaging of Thyroid and Parathyroid 352

Radionuclide Thyroid Imaging 352

Radionuclide Parathyroid Imaging 354

17 Breast

Hilary Dobson

Methods of Imaging the Breast 357

Mammography 357

Ultrasound 360

Magnetic Resonance Imaging 361

Radionuclide Imaging 363

Image-Guided Breast Biopsy 363

Preoperative Localization 365

18 Role of the radiographer and the nurse in interventional radiology

Dawn Hopkins and Nick Watson

Role of the Radiographer in Interventional Radiology 367

Role of the Nurse in Interventional Radiology 370

19 Patient consent

Floriana Coccia and Jonathan S. Freedman

Introduction 375

Voluntariness 375

Information 376

Capacity 378

Assessment of Capacity 378

Supporting Patients in Decision Making 379

Acting for a Person Who Lacks Capacity 380

Documenting Assessment of Capacity 382

Shared Decision Making 382

20 Sedation and monitoring

Zahid Khan

Sedation 385

Drugs 387

Local Anaesthesia 387

Inhalational Analgesia 387

Intravenous Analgesia 387

Sedative Drugs	389
Monitoring	392
Sedation and Monitoring for Magnetic Resonance Imaging	394
Recovery and Discharge Criteria	394

21 Medical emergencies

Zahid Khan

Equipment	395
Respiratory Emergencies	397
Respiratory Depression	397
Laryngospasm	397
Bronchospasm	397
Aspiration	398
Pneumothorax	398
Cardiovascular Emergencies	399
Hypotension	399
Tachycardia	399
Bradycardia	400
Adverse Drug Reactions	400
Contrast Media Reaction	400
Local Anaesthetic Toxicity	402

Appendix I Average effective dose equivalents for some common examinations 403

Appendix II Dose limits – the Ionising Radiation Regulations 1999 405

Appendix III The Ionising Radiation (Medical Exposure) Regulations 2000 with the Ionising Radiation (Medical Exposure) (Amendment) Regulations 2006 and the Ionising Radiation (Medical Exposure) (Amendment) Regulations 2011 407

Schedule 1	416
Schedule 2	417

Index 421