Essential Medical Imaging
CD-ROM operating instructions

Instructions
1. Insert CD
2. **Macintosh**: Double click the CD "MI" icon on the desktop
   **Windows PC**: Double click the CD "MI" icon in "My Computer"
3. **Macintosh**: Double click on "Medical Imaging"
   **Windows PC**: Double click on "Medical Imaging.exe"

Medical Imaging requires QuickTime* to operate.
If you do not have QuickTime available on your PC then use either the Mac or PC installers included on this CD (or download QuickTime from the web at http://www.apple.com/quicktime/download/).

Installing QuickTime
1. Select and open the folder with the QuickTime installer for your operating system.
2. **Macintosh**: Double click the "Quicktime.pkg" icon
   **Windows PC**: Double click the "Quicktimeinstaller.exe" icon
3. Follow the instructions within the QuickTime installer

*QuickTime and the QuickTime logo are trademarks used under license. The QuickTime logo is registered in the U.S. and other countries.

Minimum requirements
256 MB RAM, Screen Resolution 800 x 600, CD-ROM drive.

Windows
450 MHz Intel Pentium II processor (or equivalent)
Win 2000: Internet Explorer 5.01x, QuickTime 6
Win XP: Internet Explorer 6x, QuickTime 6

Macintosh
500 MHz PowerPc G3, OS 10.3.9 or above, Safari 2.0,
QuickTime 6
Essential Medical Imaging

Edited by
Robert N. Gibson
Associate Editor
Anne Mitchell
# Contents

<table>
<thead>
<tr>
<th>List of contributors</th>
<th>vii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>ix</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>x</td>
</tr>
</tbody>
</table>

## 1 Radiation and radiology – the basics 1
- Ionizing radiation 1
- Radiation hazards and protection 1
- Radiation and the pregnant patient 3
- The radiology department 5
- Requesting radiology tests 6

## 2 Imaging modalities and contrast agents 8
- Plain films 8
- Tomography 9
- Fluoroscopy 9
- Computed tomography (CT) 9
- Ultrasound (US) 12
- Magnetic resonance imaging (MRI) 14
- Angiography and interventional radiology 16
- Mammography 18
- Advantages and disadvantages of imaging modalities 18
- Contrast media 18

## 3 Normal images 22
- Head 22
- Spine 29
- Chest 41
- Abdomen 48
- Upper limb 55
- Pelvis and lower limb 57

## 4 Approach to systems imaging 63
- Chest X-ray 63
- Chest CT 68
- Plain abdominal X-ray 70
- Contrast studies of the gastrointestinal tract 71
- CT studies of abdomen and pelvis 73
- Cholangiography and pancreatography 74
- Intravenous urography 76
- Head CT 77
- Head MRI 78

## 5 Nuclear medicine 79
- Low level radiation exposure and health 79
- Nuclear medicine imaging hardware 80
- Nuclear cardiology 81
- Bone scintigraphy 86
- Positron emission tomography (PET) imaging 87
- Lung scans 88
- Thyroid imaging 89
- Parathyroid imaging 90
- Renal scintigraphy 90
- Hepatobiliary imaging – cholescintigraphy 91
- Gastrointestinal imaging 92
- Infection imaging 94
- Brain SPECT – cerebral blood flow imaging 95

## 6 Cardiorespiratory system 97
- Cardiac failure, pulmonary edema, and pulmonary hypertension 97
- Acute chest pain and aortic dissection 101
- Pulmonary embolism 102
- Lobar pulmonary processes 103
- Pulmonary infections 107
- Asthma and chronic obstructive pulmonary disease 109
- Interstitial lung disease 110
- Pleural disease 112
- Pneumothorax 113
- Lung tumors 114
- Interventional radiology in the chest 117

## 7 Trauma and musculoskeletal system 118
- Fractures – general principles 118
- Upper limb fracture and dislocations 119
- Pelvis and lower limb fractures and dislocations 122
- Head trauma 126
- Facial fractures 129
- Spinal trauma 130
- Chest trauma 133
- Abdominal trauma 137
- Bone tumors 139
- Paget’s disease 143
- Arthritis 144
- Osteomyelitis and septic arthritis 148
Contents

8 Gastrointestinal tract 151
   Dysphagia 151
   Acute abdominal pain 154
   Pancreatitis and pancreatic tumors 157
   Bowel obstruction 159
   Inflammatory bowel disease 163
   Colorectal cancer 165
   Colonic diverticular disease 167
   Radiology in gastrointestinal bleeding 168
   Mesenteric ischemia 169
   Chronic liver disease 171
   Jaundice 173
   Liver tumors and other focal pathologies 176

9 Genitourinary tract 180
   Renal failure and renal artery stenosis 180
   Urinary tract calculi 182
   Urinary tract infection (UTI) 185
   Hematuria and renal masses 186
   Prostate 187
   Scrotal masses and pain 189

10 Neuroscience, head, and neck 190
   Acute headache 190
   Stroke and transient ischemic attacks 191
   Intracranial tumors 195
   Multiple sclerosis 199
   Seizures 200
   Dementia 202
   Myeloradiculopathies 203
   Head and neck – other 210

11 Vascular system 213
   Lower limb arterial disease 213
   Abdominal aortic aneurysm 215
   Deep venous thrombosis and chronic venous insufficiency 216

12 Oncology 219
   Lymphoma 219
   Multiple myeloma 222

   Radiology in staging of malignant disease 223
   Imaging for investigation of an unknown primary carcinoma 225
   Interventional radiology in oncology 226
   Breast imaging 229

13 Immunocompromised patients 234
   The immunocompromised (non-HIV) patient 234
   Imaging in HIV infection 236

14 Endocrine disease 239
   Thyroid masses 239
   Hyperparathyroidism 241
   Pituitary masses/dysfunction 242
   Adrenal mass/dysfunction 242
   Osteoporosis 242
   Diabetes 243
   Pancreatic islet cell tumors 243
   Carcinoid tumors 243
   Paraneoplastic endocrine states 244
   Bone age 244

15 Pediatrics 245
   Chest 245
   Musculoskeletal 250
   Urinary tract 257
   Gastrointestinal tract 259
   Brain and head 263

16 Obstetrics and gynecology 267
   Introduction to ultrasound in obstetrics and gynecology 267
   Gynecology 268
   Obstetrics 273

Index 281
Contributors

Editor
Professor Robert N. Gibson
Department of Radiology
Royal Melbourne Hospital
University of Melbourne
Parkville, Australia

Associate Editor
Dr. L. Anne Mitchell
Department of Radiology
Austin Hospital
University of Melbourne
Heidelberg, Australia

Dr. Nik Barnes
Department of Radiology
Royal Liverpool Children's Hospital
Liverpool, UK

Dr. Jacqueline Brown
Department of Radiology
University of Melbourne
Parkville, Australia

Dr. Mark Brooks
Department of Radiology
Austin Hospital
Heidelberg, Australia

Dr. Tony Cullen
Department of Radiology
Austin Hospital
Heidelberg, Australia

Professor Patricia Desmond
Department of Radiology
Royal Melbourne Hospital
University of Melbourne
Parkville, Australia

Dr. A. Michelle Fink
Department of Radiology
Royal Children's Hospital
University of Melbourne
Parkville, Australia

Associate Professor Dr. Stefan Heinze
Department of Radiology
Royal Melbourne Hospital
University of Melbourne
Parkville, Australia

Professor Oliver Hennessy
Department of Radiology
St. Vincent's Hospital
University of Melbourne
Fitzroy, Australia

Dr. Renata Kukuruzovic
Department of General Medicine
Royal Children's Hospital
University of Melbourne
Parkville, Australia

Dr. Louise Kornman
Department of Obstetrics and Gynaecology
Royal Women's Hospital
University of Melbourne
Parkville, Australia

Dr. Elizabeth McCarthy
Department of Obstetrics and Gynaecology
Mercy Hospital for Women
University of Melbourne
Heidelberg, Australia

Associate Professor Peter Mitchell
Department of Radiology
Royal Melbourne Hospital
University of Melbourne
Parkville, Australia
Contributors

Dr. Graeme O'Keefe
Nuclear Medicine and Centre for PET
Austin Hospital
University of Melbourne
Heidelberg, Australia

Dr. Natalie Okun
Department of Radiology
University of Melbourne
Parkville, Australia

Dr. Patrick Page
Department of Radiology
University of Melbourne
Parkville, Australia

Professor Michael Permezel
Department of Obstetrics and Gynaecology
Mercy Hospital for Women
University of Melbourne
Heidelberg, Australia

Dr. Aurora Poon
Nuclear Medicine and Centre for PET
Austin Hospital
Heidelberg, Australia

Associate Professor Christopher Rowe
Nuclear Medicine and Centre for PET
Austin Hospital
University of Melbourne
Heidelberg, Australia

Dr. Damien Stella
Department of Radiology
Royal Melbourne Hospital
University of Melbourne
Parkville, Australia

Dr. Colin Styles
Department of Radiology
Peter MacCallum Cancer Centre
University of Melbourne
East Melbourne, Australia

Dr. Paul Tauro
Department of Radiology
University of Melbourne
Parkville, Australia

Professor Brian Tress
Department of Radiology
Royal Melbourne Hospital
University of Melbourne
Parkville, Australia

Dr. Rohan White
Department of Radiology
University of Melbourne
Parkville, Australia

Dr. Kerry Whyte
Department of Radiology
Austin Hospital
Heidelberg, Australia

Dr. Susan Walker
Department of Obstetrics and Gynaecology
Mercy Hospital for Women
University of Melbourne
Heidelberg, Australia
Preface

Medical imaging has come to occupy a pivotal role in the delivery of patient care. Apart from the major area of medical diagnosis, imaging is integrated into basic and clinical research and in the teaching of anatomy. This text evolved from the development of an integrated medical imaging curriculum for undergraduate medical students at The University of Melbourne. The contents also meet the needs of a much broader group of readers, including trainee physicians and surgeons, general practitioners, junior radiology trainees, and nursing and allied health professionals. As the curriculum is delivered via a web-browser interface, a CD-ROM is included, which includes an expanded version of the text and images, as well as a search engine.

The aim of this text is to provide a comprehensive but manageable coverage of medical imaging in clinical medicine, and assumes no prior knowledge of imaging modalities. All areas of general and specialist adult medicine and surgery are included, as well as obstetrics and gynecology, and pediatrics.

The emphasis is on placing medical imaging in clinical context and enabling the reader to learn how best to use imaging. The topics describe the role of imaging in common clinical presentations, and the important imaging features of common or important diseases. In addition, substantial sections outline the principles of image generation and interpretation, risks, benefits, and costs. We have included a comprehensive overview of nuclear medicine techniques and some of its common clinical applications, an area sometimes not covered in similar texts.

A section with annotated normal radiological images is included to act as a reference with which to compare the abnormal and to aid in the learning of anatomy. This section can be viewed on the CD-ROM in self-test mode.

Readers can use this text from any starting point, depending on the clinical situation. A useful place to start for many will be with the sections outlining how images are produced, how normal images appear, and how to develop a systematic way of looking at images.

The accompanying CD-ROM is an expanded version of the text. It is a comprehensive resource that provides a number of ways to browse its content and locate relevant information. Users should spend a few minutes reading the introduction for orientation and can then select topics of current interest, use the search engine to generate links to particular subjects, and use the library of normal images as a reference as well as using it in self-test mode.

Robert N. Gibson
and
L. Anne Mitchell
(Associate Editor)
Acknowledgments

This text has been reliant on the contributions from numerous expert people in medical imaging, listed in the contributors' list. Pivotal support for development of the curriculum, and hence the content of this text and accompanying CD-ROM, was provided by Brian Tress, Richard Larkins, Susan Elliott, and Peter Harris in the Faculty of Medicine, Dentistry, and Health Sciences of The University of Melbourne.

I am very grateful for the support of my Associate Editor, Anne Mitchell and the assistance of Merilyn Denning, Angela Alexiou, and Annabella Zupan.

Many people in the Faculty brought the CD-ROM to fruition and they are listed in its credits. Special thanks are due to Melinda Jones, Natalie Okun, Tom Petrovic, Kevin Sweeney, Greg Nelson, Stephanie Bysouth, Terry Judd, Andrew Bonollo, and Wai Chan.

Thank you to the patient staff of Cambridge University Press.

Finally, I am forever grateful to my family and to Bill Hare, who have supported me and inspired me.

Robert N. Gibson