

METHODS IN MOLECULAR BIOLOGY

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Preclinical MRI

Methods and Protocols

Edited by

María Luisa García-Martín

BIONAND, Andalusian Centre for Nanomedicine and Biotechnology, Junta de Andalucía, Universidad de Málaga, Málaga, Spain; Networking Research Center on Bioengineering, Biomaterials and Nanomedicine, CIBER-BBN, Málaga, Spain

Pilar López-Larrubia

Instituto de Investigaciones Biomédicas "Alberto Sols", CSIC/UAM, Madrid, Spain

Editors

María Luisa García-Martín
BIONAND, Andalusian Centre
for Nanomedicine and Biotechnology
Junta de Andalucía
Universidad de Málaga
Málaga, Spain

Pilar López-Larrubia
Instituto de Investigaciones Biomédicas “Alberto Sols”
CSIC/UAM
Madrid, Spain

Networking Research Center on Bioengineering
Biomaterials and Nanomedicine, CIBER-BBN
Málaga, Spain

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Preface

Magnetic resonance imaging (MRI), the most versatile of all *in vivo* imaging modalities, was born in 1973, when the Nobel Prize awardees, Paul C. Lauterbur and Peter Mansfield, at the State University of New York and the University of Nottingham, published their pioneering works on the use of magnetic field gradients to spatially localize the NMR signal. Lauterbur obtained images of two water filled tubes using magnetic field gradients and backprojection. He named this new imaging technique “zeugmatography,” derived from the Greek word *zeugma*, meaning “that which is used for joining,” in reference to the joint action of magnetic field gradients and radiofrequency to generate the image. In the same year, Mansfield published his work demonstrating how a linear field gradient, along with the Fourier transform, could be used to localize the NMR signal from different layers within a solid sample, which is the basis of the slice selection used nowadays. Later, in 1977, Mansfield and Maudsley obtained the first image of a part of the human body, a finger.

Since then, MRI has experienced a tremendous evolution thanks to the joint effort of scientists from many different fields. Today, MRI is undoubtedly the leading technique in diagnostic imaging. It has attracted a great deal of interest because of its unique combination of qualities. MRI uses non-ionizing radiation, which is harmless to human tissue; offers very high image quality, providing excellent anatomical detail; and additionally is also capable of providing functional and metabolic information. On the negative side, it was conventionally argued that MRI suffered from low sensitivity compared to other imaging modalities. However, a new generation of contrast agents based on nanotechnology is making it possible to overcome this limitation and bring MRI into the molecular imaging category.

Consequently, interest in MRI continues to grow and gain new adepts from different fields who see MRI as a very powerful tool capable of answering many of their scientific questions. Thus, in addition to the unquestionable growth of MRI use in clinical diagnosis, its applications in basic and translational research have also increased enormously in recent years, resulting in the creation of a multitude of preclinical imaging units worldwide.

This book was conceived with the idea of providing an update on a wide variety of preclinical MRI methods and protocols to help technicians and researchers interested in this technology to perform studies that have already been implemented by recognized experts in the field.

The book is organized in seven parts:

Part I covers the basics of MRI physics, relaxation, image contrast, and main acquisition sequences.

Part II describes updated methodology and protocols for diffusion, perfusion, and functional imaging.

Part III is dedicated to *in vivo* spectroscopy, covering both proton and heteronuclear spectroscopy, as well as spectroscopic imaging.

Part IV is intended to include some less common advanced techniques that we thought might be of high interest to the readers of this book.

Parts V and VI illustrate some applications of the methods described above.

Part VII includes theoretical chapters aimed at providing relevant information on anesthesia and contrast agents.

Finally, we would like to thank the collaboration of all the excellent experts who have generously contributed with their chapters to the elaboration of this book.

Málaga, Spain
Madrid, Spain

María Luisa García-Martín
Pilar López-Larrubia

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Contributors

- NURIA ARIAS-RAMOS • *Departament de Bioquímica i Biologia Molecular, Unitat de Bioquímica de Biociències, Edifici Cs, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain*
- PALOMA BALLESTEROS • *Facultad de Ciencias, Universidad Nacional de Educación a Distancia UNED, Madrid, Spain*
- BHANU PRAKASH KN • *Signal and Image Processing, Singapore Bioimaging Consortium, Agency for Science, Technology and Research, Biopolis Way, Singapore*
- DANIEL CALLE • *Instituto de Investigaciones Biomédicas “Alberto Sols”, CSIC/UAM, Madrid, Spain*
- SANTIAGO CANALS • *Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d’Alacant, Spain*
- JOSÉ MARÍA CARAMÉS • *Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d’Alacant, Spain*
- CARLOS CARO • *BIONAND, Andalusian Centre for Nanomedicine and Biotechnology, Junta de Andalucía, Universidad de Málaga, Málaga, Spain*
- SEBASTIÁN CERDÁN • *Instituto de Investigaciones Biomédicas “Alberto Sols”, CSIC/UAM, Madrid, Spain*
- MENGLIN CHENG • *Division of Cancer Imaging Research, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, USA; Sidney Kimmel Comprehensive Cancer Center, Johns Hopkins University School of Medicine, Baltimore, MD, USA*
- ANTOINE CHERIX • *Laboratory of Functional and Metabolic Imaging (LIFMET), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*
- BEGOÑA FERNÁNDEZ • *Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d’Alacant, Spain*
- LUIS MIGUEL FERNÁNDEZ-MOLLÁ • *Center for Biomaterials and Tissue Engineering, Universitat Politècnica de València, Valencia, Spain*
- ULRICH FLÖGEL • *Experimental Cardiovascular Imaging, Department of Molecular Cardiology, Heinrich Heine University, Düsseldorf, Germany*
- ANTOINE P. FOURNIER • *Normandie Univ, UNICAEN, INSERM, INSERM UMR-S U1237, PhIND, Physiopathology and Imaging of Neurological Disorders, Cyceron, Caen, France*
- MARÍA LUISA GARCÍA-MARTÍN • *BIONAND, Andalusian Centre for Nanomedicine and Biotechnology, Junta de Andalucía, Universidad de Málaga, Málaga, Spain; Networking Research Center on Bioengineering, Biomaterials and Nanomedicine, CIBER-BBN, Málaga, Spain*
- MAXIME GAUBERTI • *Normandie Univ, UNICAEN, INSERM, INSERM UMR-S U1237, PhIND, Physiopathology and Imaging of Neurological Disorders, Cyceron, Caen, France; Department of Diagnostic Imaging and Interventional Radiology, CHU Caen, Caen, France*

- KRISTINE GLUNDE • *Division of Cancer Imaging Research, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, USA; Sidney Kimmel Comprehensive Cancer Center, Johns Hopkins University School of Medicine, Baltimore, MD, USA*
- VENKATESH GOPALAN • *Signal and Image Processing, Singapore Bioimaging Consortium, Agency for Science, Technology and Research, Biopolis Way, Singapore*
- ROLF GRUETTER • *Laboratory of Functional and Metabolic Imaging (LIFMET), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; Department of Radiology, University of Geneva, Geneva, Switzerland; Department of Radiology, University of Lausanne, Lausanne, Switzerland*
- IRENE GUADILLA • *Instituto de Investigaciones Biomédicas “Alberto Sols”, CSIC/UAM, Madrid, Spain*
- TUBA GÜDEN-SILBER • *Experimental Cardiovascular Imaging, Department of Molecular Cardiology, Heinrich Heine University, Düsseldorf, Germany*
- TILL HUELNHAGEN • *Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC), Berlin, Germany*
- CHRISTOPH JACOBY • *Experimental Cardiovascular Imaging, Department of Molecular Cardiology, Heinrich Heine University, Düsseldorf, Germany*
- MIN-CHI KU • *Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC), Berlin, Germany*
- NYOMAN D. KURNIAWAN • *Centre for Advanced Imaging, The University of Queensland, St. Lucia, QLD, Australia*
- BLANCA LIZARBE • *Laboratory of Functional and Metabolic Imaging (LIFMET), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*
- SILVIA LOPE-PIEDRAFITA • *Servei de Resonància Magnètica Nuclear, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain; Networking Research Center on Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain*
- PILAR LÓPEZ-LARRUBIA • *Instituto de Investigaciones Biomédicas “Alberto Sols”, CSIC/UAM, Madrid, Spain*
- SVEN MACHOLL • *Centre for Molecular Oncology, Barts Cancer Institute, Queen Mary University of London, London, UK*
- GARY V. MARTINEZ • *Department of Cancer Imaging and Metabolism, H. Lee Moffitt Cancer Center & Research Institute, Tampa, FL, USA*
- SARA MARTINEZ DE LIZARRONDO • *Normandie Univ, UNICAEN, INSERM, INSERM UMR-S U1237, PhIND, Physiopathology and Imaging of Neurological Disorders, Cycleron, Caen, France*
- RALPH P. MASON • *Prognostic Imaging Research Laboratory, Department of Radiology, UT Southwestern Medical Center, Dallas, TX, USA*
- DAVID MORATAL • *Center for Biomaterials and Tissue Engineering, Universitat Politècnica de València, Valencia, Spain*
- ANDREA MORENO • *Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d’Alacant, Spain; Center for Biomaterials and Tissue Engineering, Universitat Politècnica de València, Valencia, Spain*
- JENNIFER MOROZ • *Department of Physics and Astronomy, The University of British Columbia, Vancouver, BC, Canada*
- ERIC R. MUIR • *Department of Ophthalmology, Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA*

- M. CARMEN MUÑOZ-HERNÁNDEZ • *BIONAND, Andalusian Centre for Nanomedicine and Biotechnology, Junta de Andalucía, Universidad de Málaga, Málaga, Spain*
- EMMA MUÑOZ-MORENO • *Experimental 7T MRI Unit, IDIBAPS, Barcelona, Spain*
- TERESA NAVARRO • *Instituto de Investigaciones Biomédicas “Alberto Sols”, CSIC/UAM, Madrid, Spain*
- THORALF NIENDORF • *Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC), Berlin, Germany; DZHK (German Centre for Cardiovascular Research), Berlin, Germany*
- JESÚS PACHECO-TORRES • *Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d’Alacant, Spain*
- DANIEL PADRO • *Molecular Imaging Unit, CIC biomaGUNE, Donostia-San Sebastián, Spain*
- LAURA PÉREZ-CERVERA • *Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d’Alacant, Spain*
- ELENA PÉREZ-MONTOYO • *Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d’Alacant, Spain*
- MANUEL PERNIA LEAL • *Departamento de Química Orgánica y Farmacéutica, Universidad de Sevilla, Sevilla, Spain*
- ANDREAS POHLMANN • *Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC), Berlin, Germany*
- MARILENA PREDÀ • *Buffalo Neuroimaging Analysis Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, The State University of New York, Buffalo, NY, USA; Center for Biomedical Imaging, Clinical and Translational Science Institute, University at Buffalo, The State University of New York, Buffalo, NY, USA*
- PEDRO RAMOS-CABRER • *Molecular Imaging Unit, CIC biomaGUNE, Donostia-San Sebastián, Spain; Ikerbasque, Basque Foundation for Science, Bilbao, Spain*
- STEFAN A. REINSBERG • *Department of Physics and Astronomy, The University of British Columbia, Vancouver, BC, Canada*
- RITA MARIA ROCHA OLIVEIRA • *Instituto de Investigaciones Biomédicas “Alberto Sols”, CSIC/UAM, Madrid, Spain*
- FERDINAND SCHWESER • *Buffalo Neuroimaging Analysis Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, The State University of New York, Buffalo, NY, USA; Center for Biomedical Imaging, Clinical and Translational Science Institute, University at Buffalo, The State University of New York, Buffalo, NY, USA*
- RUI V. SIMÕES • *Fetal i+D Fetal Medicine Research Center, BCNatal-Barcelona Center for Maternal-Fetal and Neonatal Medicine (Hospital Clínic and Hospital Sant Joan de Déu), Institut Clínic de Ginecologia, Obstetrícia i Neonatologia, Institut d’Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Universitat de Barcelona, and Centre for Biomedical Research on Rare Diseases (CIBER-ER), Barcelona, Spain; Champalimaud Foundation, Lisbon, Portugal*
- GUADALUPE SORIA • *Experimental 7T MRI Unit, IDIBAPS, Barcelona, Spain; Networking Research Center on Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Barcelona, Spain*
- JANE K. SOSABOWSKI • *Centre for Molecular Oncology, Barts Cancer Institute, Queen Mary University of London, London, UK*

- SEBASTIAN TEMME • *Experimental Cardiovascular Imaging, Department of Molecular Cardiology, Heinrich Heine University, Düsseldorf, Germany*
- JORDI L. TREMOLEDA • *Centre for Trauma Sciences, Blizard Institute, Queen Mary University of London, London, UK*
- RAÚL TUDELA • *Networking Research Center on Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Barcelona, Spain*
- DANIEL H. TURNBULL • *Department of Radiology, Bernard and Irene Schwartz Center for Biomedical Imaging, New York University (NYU) School of Medicine, New York, NY, USA; Department of Pathology, NYU School of Medicine, New York, NY, USA; Kimmel Center for Biology and Medicine at the Skirball Institute of Biomolecular Medicine, NYU School of Medicine, New York, NY, USA*
- S. SENDHIL VELAN • *Metabolic Imaging Group, Singapore Bioimaging Consortium, Agency for Science, Technology and Research, Biopolis Way, Singapore*
- SANJAY K. VERMA • *Signal and Image Processing, Singapore Bioimaging Consortium, Agency for Science, Technology and Research, Biopolis Way, Singapore*
- DENIS VIVIEN • *Normandie Univ, UNICAEN, INSERM, INSERM UMR-S U1237, PhIND, Physiopathology and Imaging of Neurological Disorders, Cyceron, Caen, France; Clinical Research Department, CHU Caen, Caen, France*
- SONIA WAICZIES • *Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC), Berlin, Germany*
- DAN WU • *Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, USA*
- JADEGOUD YALIGAR • *Signal and Image Processing, Singapore Bioimaging Consortium, Agency for Science, Technology and Research, Biopolis Way, Singapore*
- JIANGYANG ZHANG • *Department of Radiology, Bernard and Irene Schwartz Center for Biomedical Imaging, New York University (NYU) School of Medicine, New York, NY, USA*
- HELING ZHOU • *Prognostic Imaging Research Laboratory, Department of Radiology, UT Southwestern Medical Center, Dallas, TX, USA*
- ROBERT ZIVADINOV • *Buffalo Neuroimaging Analysis Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, The State University of New York, Buffalo, NY, USA; Center for Biomedical Imaging, Clinical and Translational Science Institute, University at Buffalo, The State University of New York, Buffalo, NY, USA*