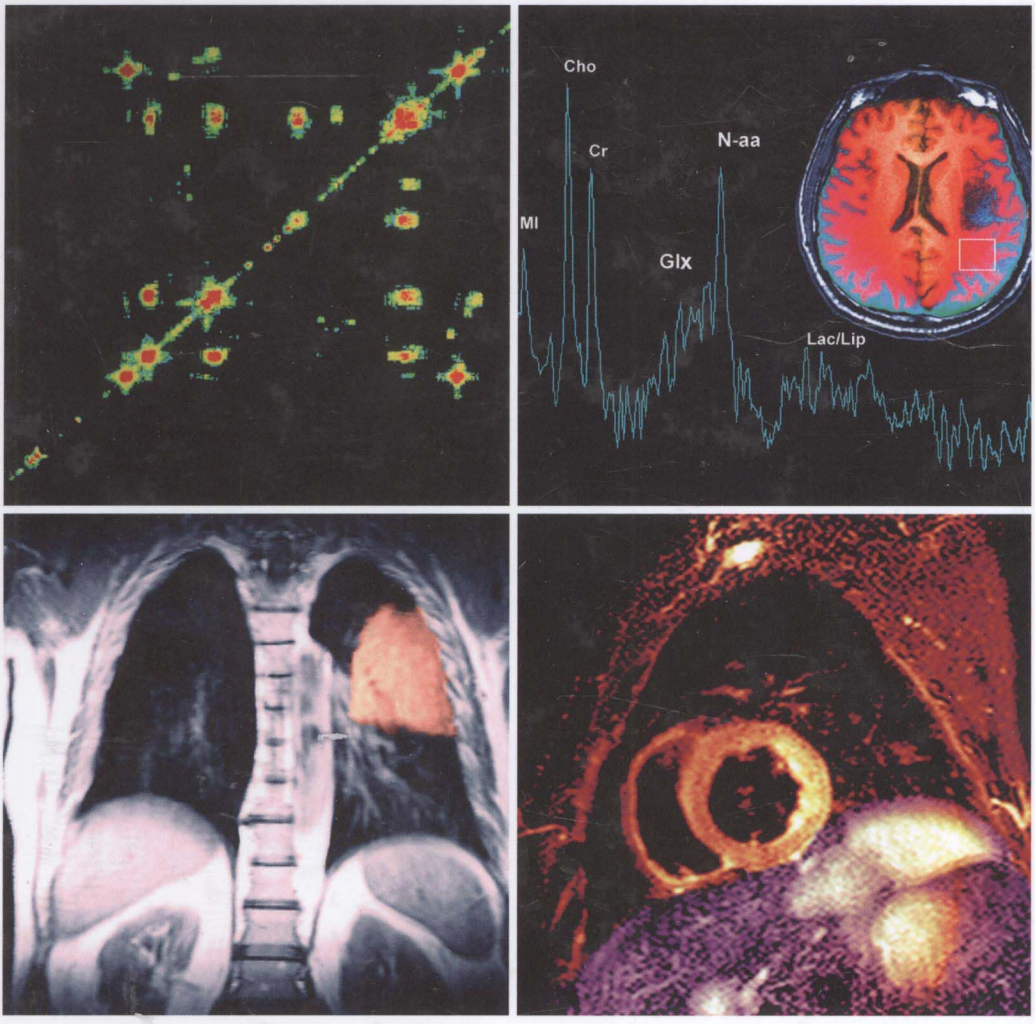
New Developments in NMR

Edited by Leoncio Garrido and Nicolau Beckmann

New Applications of NMR in Drug Discovery and Development



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Edited by

Leoncio Garrido
Consejo Superior de Investigaciones Científicas, Spain
Email: lgarrido@cetef.csic.es

Nicolau Beckmann
Novartis Institutes for BioMedical Research, Switzerland
Email: nicolau.beckmann@novartis.com

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Preface

Nuclear Magnetic Resonance (NMR) is a most informative tool for gaining insight into the inner workings of nature and is useful in many fields of applied science. The gained knowledge allows us to develop advanced medical methods of treating diseases and to develop preventive procedures. Often NMR represents even the ultimate tool of insight in drug discovery and development, for example. The information gained by NMR is in the correct form expected by a medical scientist and it can be applied directly for discovering new potential drugs and for working out prescriptions of their optimum application to treat diseases.

The comprehension of biomedical effects, induced by drugs, requires a molecular view. Molecules are interacting and are leading to beneficial results or to harmful side effects. In this sense, pharmaceutical science is part of applied chemistry where molecules are the objects of central interest. Without a molecular view, it is difficult to understand the functioning of drugs. There is a fortuitous match between the demands of pharmaceutical practice and the outstanding features of NMR as an investigative tool. The results of NMR experiments are also best understood in terms of molecular interactions. This is one of the reasons for the unique importance of NMR in biomedicine. Comprehension is often a question of using the correct language and the proper terms that can be understood and applied directly in the relevant biomedical context.

The match between measurement results and the biomedical needs is implemented rather perfectly in the various chapters of this comprehensive treatise. The *Part I. Small Molecules, Proteins, Cellular Systems*, reflects the fact that many of the most potent drugs are small molecules. Indeed, nature takes advantage of small molecules as agents and transporters with their multivariate functions that adapt well to the needs of the biomedical organism. Small molecules are easier to tailor-make to match the requirements, their

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synthesis is manageable in an industrial environment and they are easier to comprehend. Small proteins are the first choices of nature as well as of the drug designer who has to take into account the specific properties of the cellular environment where the drugs must exert their action.

In many, if not in most circumstances, an extreme reductionist approach of analytical science is inappropriate. Physiological action involves the entire biological organism and can not be understood solely in terms of its parts. This view is reflected in *Part II. The Whole Organism in Vivo*, where it is attempted to balance an analytical approach with a holistic view of the entire organism. Again, NMR is astonishingly adaptive to the various degrees of focusing. NMR technology acts like a universal microscope that can be adapted to macroscopic objects, such as a human heart or a brain, or focused onto nano-scale objects, such as cells and tissues, or used to explore truly molecular processes, like the interaction of proteins and nucleic acids. Various tools of magnetic resonance allow the focusing onto the features of actual interest. Many of them are described in this book. They lead to the remarkable adaptability of NMR to the actual practical situation.

In *Part III. Translational drug discovery: From Biological Models to the Clinics*, the possibilities of NMR and MRI are discussed in the context of a number of relevant clinical applications of magnetic resonance techniques, from tissue engineering, to the exploration of psychiatric disorder, to neuro-degenerative diseases, to respiratory diseases, to cardiac MR, and finally to MR applications in cancer.

This volume convincingly demonstrates the enormous breadth of MRI applications in biomedicine. The utility of modern NMR and MRI becomes even more impressive when one realizes that biomedicine is only one of the potential fields of fruitful application of magnetic resonance technology. Other fields are developing equally rapidly today, including magnetic resonance studies of battery materials, NMR in the context of nanotechnology, and materials research in general, to mention just a few. One of the most important fields is and will remain the study of protein and nucleic acid interactions for biomedical understanding and for drug design.

In summary, the volume "New Applications of NMR in Drug Discovery and Development" represents an important addition to the bookshelf of anybody seriously interested in drug discovery and development. It will remain a reliable source of information in this important field for many years to come. I would like to congratulate and thank Nicolau Beckmann and Leoncio Garrido for their efforts towards such a comprehensive survey on this field of remarkable current activity.

Richard R. Ernst
Laboratorium für Physikalische Chemie
ETH Zürich, Switzerland

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