Role of MR imaging (MRI) and in vivo MR Spectroscopy (MRS) in Clinical Medicine

by
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The application nuclear magnetic resonance (NMR) in medicine is phenomenal in the last 3 decades with the most familiar application to a common man namely, the magnetic resonance imaging (MRI). It is a diagnostic tool that is used to produce anatomic images with exquisite details. MR images are the spatial display of the distribution of nuclei (such as protons) and provide a high-resolution morphological picture (anatomical information) with superior contrast resolution compared to other currently available imaging modalities. MRI is noninvasive, uses no ionizing radiation and images can be obtained in orthogonal and oblique planes.

It is a useful soft tissue diagnostic modality for several neurological, cardiac, musculoskeletal and other pathologies. Further, it covers a broad range of applications from fast noninvasive anatomical measurements to the study of tissue physiology, dynamic measurements in real time, metabolism, evaluation drugs, pharmaco-dynamics, kinetics, etc. Various MRI methods have been developed over the years for studying specific disease processes like contrast MRI, diffusion MRI, etc. Also functional MRI, called as ‘fMRI’, is used for studying several brain cognitive functions and has immense potential in unraveling the mystery of human brain. It has the capability of identifying specific anatomical sites involved in many cognitive processes.

The other important application of NMR in medicine is NMR spectroscopy investigation of living systems known as ‘in vivo MR spectroscopy’ (MRS). Together MRI and in vivo MRS can be used for repetitive measurements to study tumor response to therapy, the pharmacokinetics and efficacy of drugs, since it is a noninvasive technique.

In this talk, an overview of the potential of MRI and in-vivo MRS in clinical medicine and research and our experience in AIIMS for the past two decades will be highlighted.

N.R. Jagannathan is currently a Professor & Head of the Department of NMR & MRI Facility at the All India Institute of Medical Sciences, New Delhi. His research interests are in clinical and pre-clinical cancer research using molecular imaging methods like magnetic resonance imaging (MRI) and NMR Spectroscopy, metabolomics and Biophysics. He is author or co-author of over 300 publications and 5 edited volumes.

Prof. Jagannathan is a Fellow of Indian Academy of Sciences (FASc, Bangalore); Fellow of National Science Academy (FNASc, Allahabad); Fellow of National Academy of Medical Sciences India (FAMS), Fellow of Indian National Science Academy (FNA; INSA), Fellow, Indian Science Congress (FISC) and Fellow of International Society for Magnetic Resonance in Medicine (ISMRM). In 2017, Prof. Jagannathan was elected as Vice-President of the Indian National Science Academy (INSA), New Delhi.

Received the prestigious J. C. Bose National Research Fellowship of Department of Science and Technology (DST) for outstanding contribution to science in 2015. Dr. Jagannathan received the highly prestigious S. K. Mitra Birth Centenary Gold Medal Award for significant and lifetime contribution to the development of Science and Technology in the country of the Indian Science Congress Association on January 3, 2017 at Tirupati from the Hon’ble Prime Minister of India. Prof. Jagannathan is a recipient of Drs. Kunti & Om Prakash Oration Award for significant contribution in the field of biomedical sciences from Indian Council of Medical Research (ICMR). He delivered the Achanta Lakshmpathi Oration of National Academy of Medical Sciences, India and the A V Modi Birth Centenary Lecture, Bombay College of Pharmacy, University of Mumbai. Currently, he is an Associate Editor of Biophysical Reviews (Springer), an official journal of the International Union for Pure and Applied Biophysics (IUPAB) and a member of the Editorial Boards of: (i) NMR Biomedicine (John Wiley); (ii) MAGMA (Springer); (iii) Magnetic Resonance Imaging (Elsevier); (iv) Magnetic Resonance Insights (Libertas Academica); and (v) Biomedical Spectroscopy & Imaging (IOS Press).

Dr. Jagannathan serves/served as an expert member in many International and National medical and scientific organizations like Executive Council of International Union of Pure & Applied Biophysics; Council of ICMRBS; World Molecular Imaging Society, USA; International Society for Magnetic Resonance in Medicine (ISMRM), USA and National Cancer Institute (NCI) of NIH, USA. He was the past President of Asian Biophysics Association (ABA) and past President of Indian Biophysical Society (IBS).