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NEWS AND ANNOUNCEMENTS

Nobel Prize in Physiology or Medicine – 2003

The Nobel Assembly at Karolinska Institute has awarded the Nobel Prize in Physiology or Medicine for the year 2003, jointly to **Paul C Lauterbur** and **Peter Mansfield** for their discoveries concerning **'magnetic resonance imaging'**.

The imaging of body is needed for medical diagnosis, treatment, follow-up and is an indispensable tool for research in brain function. **Magnetic Resonance Imaging** (MRI) provides a precise and non-invasive method of imaging without any known ill effects on the body.

The nucleus of hydrogen atom in the water molecules has an intrinsic spin that generates a small magnetic field. Application of an external magnetic field causes alignment of nuclei either in lower energy state (i.e., in direction of applied magnetic field) or higher energy state (i.e., in direction opposite to that of applied magnetic field). The application of external magnetic field also causes the axis of spinning nucleus to rotate with a frequency called Lamour frequency, which is directly proportional to the strength of the applied magnetic field. The nuclei can jump from lower energy to higher energy after application of electromagnetic waves in MHz range (radio waves) with a frequency equal to Lamour frequency. On removal of the radio waves, the nuclei shift to lower energy states, a process called relaxation and in the process causes fluctuations in the magnetic field. These fluctuations can be detected and quantified.

The phenomenon of magnetic resonance was discovered in 1946 and for two decades it was used primarily for studies of chemical nature of substances. This year's Nobel Laureates in Physiology or Medicine have made seminal discoveries concerning the use of magnetic resonance to visualize different structures.

In 1970s, while at State University of New York at Stony Brook, **Paul C Lauterbur** developed methods to generate a 2D image of a structure from the nuclear magnetic resonance spectrum (NMR) by application of gradient magnetic field to a tissue. Gradient of external magnetic field causes different regions to experience different magnetic field so that different regions of the tissue have different resonating frequency. Thus the position is frequency encoded. The strength of signal is directly proportional to number of spins at that position. He then developed the technique of Backprojection to generate a 2D image. This technique involves successive application of unidirectional gradient and recording the NMR spectrum, and for angles between 0 to 359 degree. With the help of computation software, the 2D image can be generated.

The conventional MRI has inherent limitation of time required for imaging. About 5 minutes are required for conventional MRI for a single 2D scan. In 1977, **Peter Mansfield** described Echo-planar imaging (EPI), a data acquisition strategy to permitting very rapid data acquisition during MRI. With echo-planar methods the image can be acquired in milliseconds (40–150 milliseconds). He was responsible for creating a mathematical method of swiftly deciphering the signals coming back from the scanner, and turning them into three-dimensional. Multiple variations of this image acquisition strategy have been devised since its inception, but the basic concept is that multiple rather than single image lines are acquired after spin preparation. The hardware limitations delayed the routine use of this technique till early 1990s.

MRI is often superior to other imaging techniques and has significantly improved diagnostics in many diseases. It has replaced many conventional techniques. MRI is used to examine almost all organs of the body. The technique is especially valuable for detailed imaging of the brain and the spinal cord. Alteration in water content of a tissue due to pathologic process can easily be detected. High spatial resolution of MRI allows precise localization for surgery or placement of electrodes. Various modifications of MRI e.g., functional MRI and diffusion MRI have been developed. Functional MRI allows measure of brain activity by detecting oxygen levels in specific brain areas.

Professor Paul C Lauterbur, Ph.D in Chemistry, is the Director, Biomedical Magnetic Resonance Laboratory, University of Illinois and also works at Beckman Institute. Sir Peter Mansfield, Ph.D in Physics, is Emeritus Professor of Physics at Magnetic Resonance Centre, School of Physics and Astronomy, University of Nottingham.