Turkish Journal of Medical Sciences

Volume 33 | Number 6 Article 1

1-1-2003

The Nobel Prize in Medicine for 2003 goes to magnetic resonance imaging

ÜSTÜN AYDINGÖZ

Turk J Med Sci
33 (2003) 345-346

NEWS IN BRIEF

The Nobel Prize in Medicine for 2003 goes to magnetic resonance imaging

Üstün AYDINGÖZ
Professor of Radiology, Hacettepe University School of Medicine, 06100 Ankara - Turkey
uaydingo@hacettepe.edu.tr

Received: October 30, 2003

Hardly anyone doubts the impact of magnetic resonance imaging (MRI) in the daily practice of medicine these days. Its superb contrast resolution and capability of imaging in any plane, as well as the lack of ionizing radiation, render this imaging modality a high-quality tool for depicting in detail most of the inner organs in the human body, obviating the need for some more invasive procedures (e.g., cerebral angiography, myelography and arthrography) in many patients. According to the Nobel Foundation, approximately 22,000 MRI systems were in use, as of 2002, all over the world and each year more than 60 million investigations with MRI are performed worldwide. A study among physicians published in 2001 placed MRI æ along with computed tomography (CT) æ at the top of a list of the most important medical innovations (1). Having revolutionized medical imaging after its advent in the early 1980s, MRI is arguably one of the most influential discoveries of not only medicine but humanity as well. Thus, it was not much of a surprise when the Nobel Assembly at the Karolinska Institute in Sweden awarded The Nobel Prize in Physiology or Medicine for 2003 jointly to Paul C. Lauterbur and Peter Mansfield "for their discoveries concerning magnetic resonance imaging" on October 6. Given the fact that MRI has been in clinical use for about 2 decades, some consider this rather belated recognition of an achievement with profound consequences. Seventy-year-old Mansfield told the Associated Press he had "given up all hopes and ideas of receiving anything in the way of an accolade of this type" (2).

Paul C. Lauterbur is a Professor of Medical Information Sciences, Chemistry, Bioengineering, Molecular and Integrative Physiology, Biophysics and Neuroscience at the University of Illinois in Urbana-Champaign, USA. Lauterbur did the work that earned the prize while at Stony Brook University on Long Island, New York. Interestingly, 74-year-old Lauterbur himself had undergone an MRI examination, during which he had not informed the performing technician that he was a developer of the technology. Peter Mansfield is an Emeritus Professor of Physics at the University of Nottingham, UK. The 2 investigators, who shared the $1.3 million-prize, worked separately to develop the medical applications of the magnetic resonance phenomenon in the early 1970s.

Actually, the scientific understanding of the magnetic resonance phenomenon was well-established before its medical applications. The development of a simple method in the 1940s for the observation of this phenomenon earned its discoverers, Felix Bloch and Edward M. Purcell, a Nobel Prize in Physics in 1952. The nuclear magnetic resonance (NMR) phenomenon utilizes very powerful magnets to force the atomic nuclei to align themselves in an orderly manner. Those atomic nuclei are then exposed to radio waves, which can make them resonate. By varying the amount of energy in the radio waves and then carefully measuring the energy released by the resonating nuclei, scientists can determine what kinds of atoms make up a substance under examination æ without destroying it. However, NMR by itself could give only information of the sample's composition, revealing nothing about the boundaries and structures within. In order to get that kind of information, "gradient coils," which vary the magnetic field strength across the sample being studied, were incorporated into the setting.

A very simple characteristic of the human body renders MRI especially useful in humans: the abundance of water molecules that make up a significant portion of the human body. The percentage of water is different, however, in various tissues and organs. MRI utilizes the hydrogen atoms in water molecules. Very subtle changes in water content caused by a disease process can be easily detected in an MRI exam.

The Nobel committee credited Lauterbur with discovering that gradient coils could give the information needed to differentiate among areas with different water content. Mansfield, on the other hand, was credited with developing some of the mathematical and technical advances that allowed the rapid translation of MR signals into visual images, a step crucial to making the technology practical for medical purposes (2).

In a seminal paper, Lauterbur presented crude MR images of 2 glass capillaries filled with heavy water immersed in a beaker of ordinary water (3). No other imaging technique at the time could distinguish between the 2 kinds of water, one made with normal hydrogen atoms and the other with deuterium atoms, which carry an extra neutron. Interestingly, his manuscript was initially rejected by Nature. Lauterbur persuaded the editors to reverse their decision. Such twists of the peer-review process in scientific journals are underlined in Lauterbur's words: "You could write the entire history of science in the last 50 years in terms of papers rejected by Science or Nature" (4).

This year's Nobel Prize in Physiology or Medicine was not without controversy, however. Dr. Raymond Damadian from the State University of New York Downstate Medical Center in Brooklyn, USA, claimed in newspaper ads that he was skipped over by the Nobel Assembly, which did not recognize his earlier efforts in the field of MRI (5). Still, while many scientists agree that Damadian took the early first steps in MRI, they maintain that Paul Lauterbur and Sir Peter Mansfield were the ones whose work led directly to the present technology (6). Controversy over the laureates notwithstanding, it is gratifying for us radiologists to know that a very major medical imaging tool, one of humanity's brilliant successes, is duly credited by a prestigious organization.

References

1. Fuchs VR, Sox HC Jr. Physicians' views of the relative importance of thirty medical innovations. Health Aff 2001; 20: 30-42.
2. Weiss R. Two developers of MRI awarded Nobel Prize. Washington Post, 7 October 2003, A02.
3. Lauterbur PC. Image formation by induced local interactions: examples employing nuclear magnetic resonance. Nature 1973; 242: 190-191.
4. Wade N. American and Briton win Nobel for using chemists' test for MRIs. New York Times, 7 October 2003, A22.
5. Damadian R. Tumor detection by nuclear magnetic resonance. Science 1971; 171(976): 1151-1153.
6. Judson HF. No Nobel Prize for whining. New York Times, 20 October 2003, A17.