Magnetic resonance—a new era of medical diagnostic imaging

This quarter's Radiology Feature introduces medical magnetic resonance, the newest of the computed medical imaging modalities. The principles of magnetic resonance were first reported in the chemistry literature in 1946 by Purcell and Block, for which they received the Nobel Prize in Chemistry in 1952. In the last ten years, rapid advances have been made in applying the principles of the "magnetic moment" of the hydrogen nucleus, as well as other nuclei, to medical diagnostic studies. Vast sums have been invested, and strong commitments by industry have been made.

The unique aspects of magnetic resonance are its wide dynamic range and enhanced contrast sensitivity for soft tissue identification. Less certain is the promise that magnetic resonance imaging might yield in vivo biochemical information about tissues and data concerning the biologic activity of cells. No medical hazards due to the magnetic fields or the radiofrequency are known to occur, yet caution is necessary to prevent metallic or electrosensitive devices from coming into the magnetic field.

Whereas computed tomography evaluates electronic density and ultrasound measures mechanical interfaces, magnetic resonance imaging depicts the physical and chemical properties of ions by measuring their response to radiofrequency waves when the substance in question is under the influence of a strong magnetic field. Multiple electromagnetic properties of the ions are determined, including T1 and T2 relaxation times, hydrogen ion density, and motion. The images produced reflect combinations of these magnetic properties and are under operator control.

Various normal tissues and organs can be identified as falling into a fairly narrow range of T1 and T2 values. Attempts to correlate T1 and T2 values with specific diseases and to differentiate between benignancy and malignancy have been only minimally successful to date. Studies are currently underway to determine the sensitivity and specificity of magnetic resonance for various organ-system abnormalities. Differentiation of cerebral tumors from edema, changes in tissue characteristics during therapy, and staging of neoplasms are a few of the areas under investigation. Food and Drug Administration full approval for magnetic resonance is still pending, and hence, all current studies are considered experimental. The following article explores the possibility of using magnetic resonance imaging of the pelvis to stage rectal tumors.

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