Abstract

The concepts of magnetic resonance imaging are reviewed and its application to medical and biological systems is described. The magnetic resonance phenomenon can be described by both classical and quantum mechanical approaches. Magnetic resonance imaging is based on the techniques of nuclear magnetic resonance. The scanner first aligns the nuclear spins of hydrogen atoms in the patient and starts rotating them in a perfect concert. The nuclei emit maximum-strength electromagnetic waves at the start, but over time the rotating spins get out of synch, simply due to small differences in local magnetic fields. The unsynchronized spins cause the combined electromagnetic signal to decay with time, a phenomenon called relaxation. A slice is selected applying a gradient in a particular direction (X, Y or Z). Magnetic resonance signals are then formed by means of the application of magnetic field gradients along three different directions. Finally, the signals are acquired and Fourier transformed to form a two-dimensional or three-dimensional image. Important parameters determining the image quality such as signal-to-noise ratio, contrast and resolution are discussed too. A review of the most widely utilised imaging techniques is given including ultra-fast sequences.

Keywords

Magnetic resonance imaging; pulse sequences; ultra-fast imaging.