Al-Mustaqbal University
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Magnetic Resonance Imaging

First Semester

Lecture 1,2: MRI Terms

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Introduction:

MRI technicians need to know MRI terms definitions for several reasons, including: Understanding medical terminology: MRI technicians need to have a basic understanding of medical terminology to communicate effectively with physicians and other healthcare professionals Mastering MRI procedures: MRI technicians need to understand and master MRI procedures, including the terminology used in MRI imaging, to perform their job effectively Ensuring MRI safety: MRI technicians need to have sound knowledge of the physical principles of the MRI scanner and understand the associated safety risks to avoid adverse events from occurring.

Encountering MRI terminology: MRI technicians are likely to encounter MRI terminology in the course of their work, and they need to be familiar with the terminology to perform their job effectively

2D volumetric acquisition: acquisition where a small amount of data is acquired from each slice before repeating the TR.

3D volumetric acquisition: acquisition where the whole imaging volume is excited so that the images can be viewed in any plane.

Actual TE the time between the echo and the next RF pulse in SSFP.

Aliasing artefact produced when anatomy outside the FOV is mismapped inside the FOV.

Alignment when nuclei are placed in an external magnetic field their magnetic moments line up with the magnetic field flux lines .

Ampere's law: determines the magnitude and direction of the magnetic field due to a current; if you point your right-hand thumb along the direction of the current, then the
magnetic field points along the direction of the curled fingers.

Angular momentum: the spin of MR active nuclei that depends on the balance between the number of protons and neutrons in the nucleus.

Anti-parallel alignment describes the alignment of magnetic moments in the opposite
direction to the main field atomic number sum of protons in the nucleus B0 the main magnetic field measured in tesla.

Acquisition: the process of measuring and storing image data.

Acquisition matrix : the total number of independent data samples in the frequency (f) and phase (f) directions.

Acquisition time : the period of time required to collect the image data. This time does not include the time necessary to reconstruct the image. ADC - analog-to-digital converter

Aliasing : the phenomenon resulting from digitizing fewer than two samples per period in a periodic function. Aliasing can occur in MR imaging whenever the area of anatomy extends beyond the field of view. These areas extending beyond the field of view boundaries are aliased back into the image to appear at artifactual locations.

Archiving : the storage of image and patient data for future retrieval.

Axial : a plane, slice or section made by cutting the body or part of it at right angles to the long axis. If the body or part is upright, the cut would be parallel to the horizon.

B or Bo : a conventional symbol for the constant magnetic field produced by the large magnet in the MR scanner.

B1 : the conventional symbol used for identifying the radio frequency (RF) magnetic field.

Band Width (BW) : an all-inclusive term referring to the preselected band or range of
frequencies which can govern both slice select and signal sampling.

Bipolar : describes a magnet with two poles, north and south.

Black blood imaging :acquisitions in which blood vessels are black

Blood oxygen level dependent (BOLD) : a functional MRI technique that uses the differences in magnetic susceptibility between oxyhemoglobin and deoxyhemoglobin to image areas of activated cerebral cortex.

Bright blood imaging acquisitions in which blood vessels are bright.

Brownian motion internal motion of the molecules.

Claustrophobia : a psychological reaction to being confined in a relatively small area.

Coherence : the act of maintaining a constant phase relationship between oscillating waves or rotating objects.

Contrast : the relative difference of signal intensities in two adjacent regions of an image. Image contrast is heavily dependent on the chosen imaging technique (i.e., TE, TR, TI), and is associated with such parameters as proton density and T1 or T2 relaxation times.

Contrast reversal : an image phenomenon where the darks become bright, and the brights become dark. This is usually most prevalent in sequences utilizing an extended TR.

Contrast - to -Noise Ratio (CNR) : the ratio of signal intensity differences between two regions, scaled to image noise. Improving CNR increases perception of the distinct differences between two clinical areas of interest.

Coronal : a plane, slice or section made by cutting across the body from side to side and
therefore parallel to the coronal suture of the skull.

Central lines : area of K space filled with the shallowest phase encoding slopes.

Chemical shift : artefact along the frequency axis caused by the frequency difference between fat and water .

Co-current flow : flow in the same direction as slice excitation .

Counter-current flow : flow in the opposite direction to slice excitation.

Cross excitation : energy given to nuclei in adjacent slices by the RF pulse .

Cross talk : energy given to nuclei in adjacent slices due to spin lattice relaxation .

Cryogen bath : area around the coils of wire in which cryogens are placed .

Cryogens substances used to supercool the coils of wire in a superconducting magnet .

Coherent the magnetic moments of hydrogen are at the same place on the precessional path .

Dephasing : the fanning out or loss of phase coherence of signals within the transverse plane.

Diffusion : a term used to describe moving molecules due to random thermal motion .

Dipole : a magnetic field characterized by its own north and south magnetic poles separated by a finite distance.

Display matrix : the total number of pixels in the selected matrix, which is described by the product of its phase and frequency axis.

Electromagnet : a type of magnet that utilizes coils of wire, typically wound on an iron core, so that as current flows through the coil it becomes magnetized. See also Resistive Magnet, Superconducting Magnet.

Equilibrium : a state of balance that exists between two opposing forces or divergent forms of influence.

Excitation : delivering (inducing, transferring) energy into the "spinning" nuclei via radiofrequency pulse(s), which puts the nuclei into a higher energy state. By producing a net transverse magnetization an MRI system can observe a response from the excited system.

Echo spacing : spacing between each echo in FSE .

Echo train : series of 180° rephasing pulse and echoes in a fast spin echo pulse sequence.

Echo train length (ETL) : the number of 180° RF pulses and or turbo factor resultant echoes in FSE .

Effective TE : the time between the echo and the RF pulse that initiated it in SSFP and FSE sequences .

Electrons orbit : the nucleus in distinct shells and are negatively charged.

External magnetic field (EMF) : drives a current in a circuit and is the result of a changing magnetic field inducing an electric field .

Entry slice phenomena : contrast difference of flowing nuclei relative to the stationary nuclei because they are fresh .

Even echo rephrasing : the use of evenly spaced echoes to reduce artefact .

Extrinsic contrast parameters :contrast parameters that are controlled by the system operator

Fast scanning : a specialized technique usually associated with short TR, reduced flip angle and repeated 180° rephasing pulses.

Fast Spin Echo (FSE) : a fast spin echo pulse sequence characterized by a series of rapidly applied 180° rephasing pulses and multiple echoes, changing the phase encoding gradient for each echo.

Fat Saturation (FAT-SAT) : A specialized technique that selectively saturates fat protons prior to acquiring data as in standard sequences, so that they produce negligible signal.

FAT Suppression : the process of utilizing specific parameters, commonly with STIR (short TI inversion recovery) sequences, to remove the deleterious effects of fat from the resulting images. See also STIR.

FDA : the United States Food and Drug Administration FID - see Free Induction Decay

Field of view (FOV) : defined as the size of the two or three dimensional spatial encoding area of the image. Usually defined in units of cm2.

FFT (Fast Fourier Transform) - a particularly fast and efficient computational method of performing a Fourier Transform, which is the mathematical process by which raw data is processed into a usable image.

Flare : Fast Low-Angle Recalled Echoes

Flip Angle (FA) : the angle to which the net magnetization is rotated or tipped relative to the main magnetic field direction via the application of an RF excitation pulse at the Larmor frequency. The Flip Angle is used to define the angle of excitation for a Field Echo pulse sequence.

Flow compensation : a function of specific pulse sequences, i.e., CRISP¿ (Complex Rephasing Integrated with Surface Probes) spin echo, wherein the application of strategic gradient pulses can compensate for the objectionable spin phase effects of flow motion.

Free Induction Decay (FID) : loss of signal due to relaxation ; if transverse magnetization of the spins is produced, e.g., by a 90É RF pulse, a transient MR signal at the Larmor frequency results that decays toward zero with a characteristic time constant of T2*. This decaying signal is the FID.

Frequency : the number of cycles or repetitions of any periodic wave or process per unit time. In electromagnetic radiation, it is usually expressed in units of hertz (Hz), where 1 Hz = 1 cycle persecond.

Field of view (FOV) area of anatomy covered in an image

FLAIR (fluid attenuated inversion recovery) : IR sequences that nulls the signal from CSF

Flip angle : the angle of the NMV to *B*0 .

Flow encoding axes : axes along which bipolar gradients act in order to sensitize flow along the axis of the gradient; used in phase contrast MRA .

Flow phenomena : artefacts produced by flowing nuclei

Flow related enhancement : decrease in time of flight due to a decrease in velocity of flow .

Fresh spins : nuclei that have not been beaten down by repeated RF pulses .

Fringe field : stray magnetic field outside the bore of the magnet .

Functional MR imaging (fMRI) a rapid MR imaging technique that acquires images of the brain during.

Frequency encoding the process of locating an MR signal in one dimension by applying a magnetic field gradient along that dimension during the period when the signal is being received.

Gadolinium (Gd) : gadolinium is a non-toxic paramagnetic contrast enhancement agent utilized in MR imaging. When injected during the scan, gadolinium will tend to change signal intensities by shortening T1 in its surroundings.

Gradient coils :three paired orthogonal current-carrying coils located within the magnet which are designed to produce desired gradient magnetic fields which collectively and sequentially are superimposed on the main magnetic field (Bo) so that selective spatial excitation of the imaging volume can occur. Gradients are also used to apply reversal pulses in some fast-imaging techniques.

Gyromagnetic ratio (g) : a constant for any given nucleus that relates the nuclear MR frequency and the strength of the external magnetic field. It represents the ratio of the magnetic moment (field strength) to the angular momentum (frequency) of a particle. The value of the gyromagnetic ratio for hydrogen (1H) is 4,258 Hz/Gauss (42.58 MHz/Tesla).

Ghosting : motion artefact in the phase axis.

Gradient amplifier : supplies power to the gradient coils .

Gradient echo pulse sequence : one that uses a gradient to regenerate an echo.

Gradient echo : echo produced as a result of gradient rephrasing .

Gradient spoiling : the use of gradients to diphase magnetic moments; the opposite of rewinding.

Gyro-magnetic ratio: the precessional frequency of an element at 1.0 T .

Hertz : the standard unit of frequency equal to 1 cycle per second. The larger unit megahertz (MHz) = 1,000,000 Hz.

Homogeneity : uniformity of the main magnetic field.

Hydrogen density (H+) : the concentration of Hydrogen atoms in water molecules or in some groups of fat molecules within tissue. Initial MR signal amplitudes are directly related to H+ density in the tissue being imaged.

High velocity signal loss increase in time of flight due to an increase in the velocity of flow.

Image data acquisition time : the time required to gather a complete set of image data. The total time for performing a scan must take into consideration the additional image reconstruction time when determining how quickly the image(s) may be viewed.

Image reconstruction :the mathematical process of converting the composite signals obtained during the data acquisition phase into an image.

Inhomogeneity : lack of homogeneity or uniformity in the main magnetic field.

Inversion recovery (IR) : an imaging sequence that involves successive 180É and 90É pulses, after which a heavily T1-weighted signal is obtained. The inversion recovery sequence is specified in terms of three parameters, inversion time (TI), repetition time (TR) and echo time (TE).

Inversion time (TI) : the time period between the 180° inversion pulse and the 90° excitation pulse in an Inversion Recovery pulse sequence. ISOTOPE - Atomic nuclei that contain the same number of protons, but differ in the number of neutrons in the nucleus of the atom for the element concerned. K-SPACE - a data acquisition matrix containing raw image data prior to image processing. In 2DFT, a line of data corresponds to the digitized NMR signal at a particular phase-encoding level.

Incoherent : means that the magnetic moments of hydrogen are at different places on the processional path .

In-flow effect :another term for entry slice phenomenon .

Intra-voxel dephasing : phase difference between flow and stationary nuclei in a voxel .

Intrinsic contrast mechanisms : contrast parameters that do not come under the operators control .

K space :an area where raw data is stored .

Larmor equation : an equation that states that the frequency of precession of the nuclear magnetic moment is directly proportional to the product of the magnetic field strength (Bo) and the gyromagnetic ratio (g). This is stated mathematically as W = g Bo.

Larmor frequency : the frequency at which magnetic resonance in a nucleus can be excited and detected. The frequency varies directly with magnetic field strength, and is normally in the radio frequency (RF) range.

Lattice : in MRI, the magnetic and thermal environment through which nuclei exchange energy in longitudinal (T1) relaxation.

Longitudinal magnetization : the component (MZ) of the net magnetization vector in the direction of the static magnetic field. After RF excitation, this vector returns to its equilibrium value at a rate characterized by the time constant T1.

Longitudinal relaxation time : the time constant, T1, which determines the rate at which excited protons return to equilibrium within the lattice. A measure of the time taken for spinning protons to re-align with the external magnetic field. The magnetization will grow after excitation from zero to a value of about 63% of its final value in a time of T1.

Magnetic susceptibility : ability of a substance to become magnetized .

Magnetic moment : a measure of the net magnetic properties of an object or particle. A nucleus with an intrinsic spin will have an associated magnetic dipole moment so that it will interact with a magnetic field (as if it were a tiny bar magnet).

Magnetic resonance the absorption or emission of energy by atomic nuclei in an external magnetic field after the application of RF excitation pulses using frequencies which satisfy the conditions of the Larmor equation.

Magnetization vector (Mz) : the integration of all the individual nuclear magnetic moments which have a positive magnetization value at equilibrium versus those in a random state.

MR Imaging MAGING : the use of magnetic resonance principles in the production of diagnostic views of the human body where the resulting image is based upon three basic tissue parameters (proton density, T1 relaxation time, T2 relaxation time) and flow characteristics.

MRA - See Magnetic Resonance Angiography. MRS - See Magnetic Resonance Spectroscopy.

MR angiography method of visualizing vessels that contain flowing nuclei by producing a contrast between them and the stationary nuclei .

MR signal : the voltage induced in the receiver coil .

Net magnetization vector : a vector which represents the sum of all of the contributions of the magnetic moments within the magnetic field; the magnitude and direction of the magnetization resulting from this collection of atomic nuclei.

Noise : an undesirable background interference or disturbance that affects image quality.

NSA the number of signal averages performed during the scan.

Nuclear spin : also known as inherent spin, this defines the intrinsic property of certain nuclei (those with odd numbers of protons and/or neutrons in their nucleus) to exhibit angular momentum and a magnetic moment. Nuclei that do not exhibit this characteristic will not produce an NMR signal.

Number of signal averages : the number of times an echo is encoded with the same slope of phase encoding gradient .

Oblique : a plane or section not perpendicular to the xyz coordinate system, such as long and short axis views of the heart.

Orthogonal : a plane or section perpendicular to the xyz coordinate system.

Oscillation : rhythmic periodic motion.

Paramagnetic substance : a substance with weak magnetic properties due to its unpaired electrons. Researchers are developing certain paramagnetic materials, such as gadolinium, as MRI invasive contrast media

Partial echo : sampling only part of the echo and extrapolating the remainder in K space

Perfusion : a measure of the quality of vascular supply to a tissue

Permanent magnets : magnets that retain their magnetism

Phase contrast angiography : technique that generates vascular contrast by applying a bipolar gradient to stationary and moving spins thereby changing their phase .

Phase encoding locating a signal according to its phase

Phase image subtracted image combination of flow sensitized data .

Phase the position of a magnetic moment on its processional path at any given time .

Precession : the secondary spin of magnetic moments around B0

Protons : particles in the nucleus that are positively charged .

Proton density the number of protons in a unit volume of tissue .

Proton density weighting image that demonstrates the differences in the proton densities of the tissues .

Pulse control unit : co-ordinates the switching on and off of the gradient and RF transmitter coils at appropriate times during the pulse sequence .

Pulse sequence : a series of RF pulses, gradients applications and intervening time periods; used to control contrast .

Phase : an angular relationship describing the degree of synchronism between two sinusoidal waveforms of the same frequency.

Phase encoding : the process of locating an MR signal by altering the phase of spins in one dimension with a pulsed magnetic field gradient along that dimension prior to the acquisition of the signal.

Pixel : acronym for a picture element, the smallest discrete two-dimensional part of a digital image display.

Precession : comparatively slow gyration of the axis of a spinning body so as to trace out a cone. Caused by the application of a torque tending to change the direction of the rotation axis and continuously directed at right angles to the plane of the torque.

Presaturation (PRE-SAT) : a specialized technique employing repeated RF excitation of structures adjacent to the ROI for the purpose of reducing or eliminating their phase effect artifacts.

Proton density weighted image : an image produced by controlling the selection of scan parameters to minimize the effects of T1 and T2, resulting in an image dependent primarily on the density of protons in the imaging volume.

Pulse sequence : a preselected set of defined RF and gradient pulses, usually repeated many times during a scan, wherein the time interval between pulses and the amplitude and shape of the gradient waveforms will control NMR signal reception and affect the characteristics of the MR images.

Radio frequency : an electromagnetic wave with a frequency that is in the same general range as that used for the transmission of radio and television signals. Abbreviated RF.

Receiver coil : a coil , or antenna, positioned within the imaging volume and connected to the receiver circuitry that is used to detect the NMR signal. In certain applications, the same coil can be used for both transmission and reception. Receiver coils types include solenoidal, planar, volume, quadrature and phased array coils.

Reconstruction : the mathematical process by which the displayed image is produced from the raw k-space data obtained from the receiver circuitry, typically utilizing Fourier transformation and selective filtering.

Region of interest (ROI) : the area of anatomy being scanned that is of particular importance in the image.

Relaxation time : after excitation the spins will tend to return to their equilibrium distribution in which there is no transverse magnetization and the longitudinal magnetization is at its maximum value and oriented in the direction of the static magnetic field. After excitation the transverse magnetization decays toward zero with a characteristic time constant T2, and the longitudinal magnetization returns toward equilibrium with a characteristic time constant T1.

Repetition time (TR) : the amount of time that exists between successive pulse sequences applied to the same slice. It is delineated by initiating the first RF pulse of the sequence then repeating the same RF pulse at a time t. Variations in the value of TR have an important effect on the control of image contrast characteristics. Short values of TR (< 1000 ms) are common in images exhibiting T1 contrast, and long values of TR (> 1500 ms) are common in images exhibiting T2 contrast. TR is also a major factor in total scan time. See also TR. MRI Fourth class 1st and 2nd lectures

Phase contrast angiography : technique that generates vascular contrast by applying a bipolar gradient to stationary and moving spins thereby changing their phase .

Quenching : process by which there is a sudden loss of the superconductivity of the magnet coils so that the magnet becomes resistive .

Ramp sampling : where sampling data points are collected when the gradient rise time is almost complete. Sampling occurs while the gradient is still reaching maximum amplitude, while the gradient is at maximum amplitude and as it begins to decline .

Readout gradient : the frequency encoding gradient .

Receive bandwidth : range of frequencies that are sampled during readout .

Recovery :growth of longitudinal magnetization.

Relaxation : process by which hydrogen loses energy .

Repetition time (TR) : time between each excitation pulse .

Rephasing : the process of returning out-of-phase magnetic moments back into phase coherence. Caused either by rapidly reversing a magnetic gradient (Field Echo) or by applying a 180É RF pulse (Spin Echo). In the spin-echo pulse sequence this action effectively cancels out the spurious T2* information from the signal., usually by using **RF amplifier** that supplies power to the RF transmitter coils.

Resistive magnet : a common type of magnet that utilizes the principles of electromagnetism to generate the magnetic field.

Resonance :a large amplitude vibration in a mechanical or electrical system caused by a relatively small periodic stimulus with a frequency at or close to a natural frequency of the system. The exchange of energy at a particular frequency between two systems. ROI - see Region Of Interest.

Sagittal : a plane, slice or section of the body cutting from front to back through the saggital suture of the skull, and continued down through the body in the same direction, dividing it into two parts, then turning one half to view it from its cut surface.

Shim coils : coils positioned near the main magnetic field that carry a relatively small current that is used to provide localized auxiliary magnetic fields in order to improve field homogeniety.

Signal to noise ratio (S/N, SNR) : The ratio between the amplitude of the received signal and background noise, which tends to obscure that signal. SNR, and hence image quality, can be improved by such factors as increasing the number of excitations, increasing the field of view, increasing slice thickness, etc. SNR also depends on the electrical properties of the patient being studied and the type of receiving coil used.

RF spoiling : the use of digitized RF to transmit and receive at a certain phase .

RF transmitter coil : coil that transmits RF at the resonant frequency of hydrogen to excite nuclei and move them into a high energy state .

Rise time : the time it takes a gradient to switch on, achieve the required gradient slope, and switch off again .

Sampling rate : rate at which samples are taken during readout .

Sampling time : the time that the readout gradient is switched on for saturation occurs when the NMV is flipped to a full 180°.

Sequential acquisition : acquisition where all the data from each slice are acquired before going on to the next .

Shimming : process whereby the evenness of the magnetic filed is optimized .

Slice : the term describing the planar region or the image slice selection region.

Slice encoding : relates to the addition of phase encoding steps for 3D volumetric imaging.

Slice selection : exclusive excitation of spins in one slice performed by the coincident combination of a gradient magnetic field and a narrow bandwidth or slice selective RF pulse at a specific Larmor frequency.

Slice thickness : the thickness of an imaging slice. Since the slice profile is not sharply edged, the distance between the points at half the sensitivity of the maximum (full width at half maximum) is used to determine thickness.

Spatial resolution : the ability to define minute adjacent objects/points in an image, generally measured in line pairs per mm.

Spin : the property exhibited by atomic nuclei that contain either an odd number of protons or neutrons, or both.

Spin Echo (SE) : re-appearance of the NMR signal after the FID has apparently died away, as a result of the effective reversal (rephasing) of the dephasing spins by techniques such as specific RF pulse sequences or pairs of field gradient pulses, applied in time shorter than or on the order of T2. Proper selection of the TE time of the pulse sequence can help control the amount of T1 or T2 contrast present in the image. Also a pulse sequence type that usually employs a 90° pulse, followed by one or more 180° pulses.

Spin lattice relaxation time - see T1 and Longitudinal Relaxation Time.

Spin- spin relaxation time SPIN-SPIN RELAXATION TIME - see T2 and Transverse Relaxation Time.

Steady state a situation when the TR is shorter than both the T1 and T2 relaxation times of all the tissues .

Stimulated-echo spatial localization technique used .

Spectroscopy provides a frequency spectrum of a given tissue based on the molecular and chemical structures of that tissue .

Superconductive magnet : a magnet whose field is generated by current in wires made of a superconducting material such as niobium-titanium, that has no resistance when operated at temperatures near absolute zero(-273°C, -459°F). Such magnets must be cooled by, for example, liquid helium. Superconducting magnets typically exhibit field strengths of >0.5T and have a horizontal field orientation, which makes them prone to missile effects without significant magnetic shielding. See also Quenching.

Surface coil : a type of receiver coil which is placed directly on or over the region of interest for increased magnetic sensitivity. These coils are specifically designed for localized body regions, and provide improved signal-to-noise ratios by limiting the spatial extent of the excitation or reception. T - tesla T1 - spin-lattice longitudinal relaxation time. The characteristic time constant for spins to realign themselves with the external magnetic field after excitation.

T1 weighted : an image created typically by using short TE and TR times whose contrast and brightness are predominately determined by T1 signals.

T1 relaxation : see Longitudinal Relaxation Time.

T2 - spin-spin or transverse relaxation time: The time constant for loss of phase coherence among spins oriented at an angle to the static magnetic field due to interactions between the spins. Results in a loss of transverse magnetization and the MRI signal.

T2* ("T-two-star") : the time constant for loss of phase coherence among spins oriented at an angle to the static magnetic field due to a combination of magnetic field inhomogeneities and the spin-spin relaxation. Results in a rapid loss of transverse magnetization and the MRI signal.T2* < T2.

T2 weighted : an image created typically by using longer TE and TR times whose contrast and brightness are predominately determined by T2 signals. TAU (t) – the interpulse times (time between the 90° and 180° pulse, and between the 180° pulse and the echo) used in a spin echo pulse sequence. TE (Echo Time) - represents the time in milliseconds between the application of the 90° pulse and the peak of the echo signal in Spin Echo and Inversion Recovery pulse sequences.

TE (Echo Time) : represents the time in milliseconds between the application of the 90° pulse and the peak of the echo signal in Spin Echo and Inversion Recovery pulse sequences.

TESLA (T) : the preferred unit of magnetic flux density. One tesla is equal to 10,000 gauss. The Tesla unit value is defined as a field strength of 1 Weber per meter 2, where 1 Weber represents 1 x 108 (100,000,000) flux lines.

Three dimensional imaging (3DFT) : a specialized imaging technique that uses computer processing to combine individual slice acquisitions together to produce an image that represents length, width and height. TI (Inversion Time) - the time between the initial (inverting) 180° pulse and the 90° pulse used in inversion recovery pulse sequences.

TR (Repetition Time) : the amount of time that exists between successive pulse sequences applied to the same slice.

Transceiver coil : an MRI surface coil that acts as both transmitter and receiver.

Transmitter : the portion of the MR scanner that produces the RF current and delivers it to the transmitting coil (antenna). The RF signal produced by the transmitter is used to excite the protons in the imaging volume.

Transverse magnetization : component of the net magnetization vector at right angles to the main magnetic field. Precession of the transverse magnetization at the Larmor frequency is responsible for the detectable NMR signal. In the absence of externally applied RF energy, the transverse magnetization will decay to zero with a characteristic time constant of T2, or more strictly T2*.

Time of flight angiography: technique that generates vascular contrast by utilizing the in-flow effect

Time of flight : rate of flow in a given time. Causes some flowing nuclei to receive one RF pulse only and therefore produce a signal void .

Transverse relaxation time: the time constant, T2, which determines the rate at which excited protons reach equilibrium, or go out of phase with each other. A measure of the time taken for spinning protons to lose phase coherence among the nuclei spinning perpendicular to the main field due to interaction between spins, resulting in a reduction in the transverse magnetization. The transverse magnetization value will drop from maximum to a value of about 37% of its original value in a time of T2.

Vector : a quantity that has both magnitude and direction and that is commonly represented by an arrow. The length of the line segment represents the magnitude, and its orientation in space represents its direction. Vector quantities can be added to or subtracted from one another.

Velocity speed in a particular direction.

Voxel volume element; the element of the three-dimensional space corresponding to a pixel, for a given slice thickness.

Volume coil : coil that transmits and receives signal over a large volume of the patient .

Voxel volume : volume of tissue in the patient

Watergrams : FSE sequence using very long TRs, TEs and ETLs to produce very heavy T2 weighting .