Echo-planar imaging

Echo planar imaging is performed using a pulse sequence in which multiple echoes of different phase steps are acquired using rephasing gradients instead of repeated 180o RF pulses following the 90°/180° in a spin-echo sequence. This is accomplished by rapidly reversing the readout or frequency-encoding gradient. This switching or reversal may also be done in a sinusoidal fashion. Echo planar sequences may use entirely gradient echos or may combine a spin echo with the train of gradient echos as illustrated in the diagram to the right.

In a single-shot echo planar sequence, the entire range of phase encoding steps, usually up to 128, are acquired in one TR. In multi-shot echo-planar imaging, the range of phase steps is equally divided into several “shots” or TR periods. For example an image with 256 phase steps could be divided into 4 shots of 64 steps each.

As a result an image can be acquired in 20-100 msec, allowing excellent temporal resolution such as that required in cardiac imaging. Each subsequent echo results in a progressively T2-weighted signal.

Benefits

reduced imaging time decreased motion artifact, ability to image rapid physiologic processes of the human body. Drawbacks

Sensitive to susceptibility effects Sensitive to main magnetic field inhomogeneity Long gradient echo train causes greater T2* weighting Requires high-performance gradients Applications

cardiac imaging abdominal imaging, i.e. breath-hold sequences and 3D MR angiography diffusion imaging perfusion imaging functional imaging