Breast MRI is becoming an increasingly important diagnostic tool for evaluating breast cancer disease extent, monitoring therapy response and for screening women that are at high risk. The most common imaging protocol includes initial T2-weighted bright-fluid and pre-contrast T1-weighted 3D gradient-echo (GE) sequences, followed by the injection of a gadolinium (Gd) contrast agent and a series of 3D-GE images: dynamic contrast enhanced MRI (DCE-MRI).

Because of the high background signal in T1-weighted images due to fatty tissues, it is preferred that all sequences be acquired with fat-suppression. For images acquired without fat-suppression, it is essential that image subtraction (post-injection minus pre-injection) be used to assure adequate contrast-enhancement sensitivity.

The sensitivity of DCE-MRI for detecting cancerous lesions is determined by the degree of contrast enhancement that can be achieved relative to the surrounding normal tissues. The specificity of DCE-MRI, for distinguishing malignant from benign lesions, relies upon the DCE-MRI kinetic data. Malignant lesions generally exhibit rapid uptake and washout while benign lesions typically have a slower uptake that gradually increases with time.

In an effort to achieve both the high sensitivity and specifically, breast MRI pulse sequences should be optimized to achieve high gadolinium contrast enhancement, high three-dimensional spatial resolution (< 1 mm in-plane) as well as adequate temporal resolution. The evolution of breast MR imaging has lead to the general use of fat-suppressed, 3D T1-weighted GE pulse sequences that can be acquired with a temporal resolution of approximately 60-90 seconds.

Learning Objectives

1) Review protocols and pulse sequences used for breast MR imaging.

2) Review the MRI timing diagram used for T1-weighted, fat-suppressed, 3D gradient echo-pulse sequences.
3) Understand how k-space sampling and parallel imaging affect temporal resolution.
4) Review how parallel imaging can be used to help achieve the temporal resolution needed for breast DCE-MRI.
5) Discuss issues related to data acquisition and post-acquisition image processing.