Cardiac magnetic resonance imaging (MRI) has emerged as a highly reproducible and accurate imaging methodology for evaluating a wide variety of congenital and acquired heart diseases, including cardiac masses, myocardial ischemia or infraction, cardiomyopathies, valvular disease, coronary artery disease, pericardial disease, and complex congenital anomalies. The high soft-tissue contrast, multiplanar acquisition capability, and lack of ionizing radiation are particularly appealing features of cardiac MRI. As a consequence, cardiac MRI is an ideal technique in the diagnostic workup, as it provides comprehensive information on cardiac morphology, function, and tissue characterization in a single examination.

Of course, there are certain technical challenges unique to cardiac MRI. Most notably is the rapid and complex motion of the heart and pulsatility of the great vessels due to normal contractility. Moreover, numerous pulse sequences have been applied to cardiac MRI. To select the optimal protocol and to interpret cardiac MRI studies, the radiologist should understand the basic pulse sequences. In addition, the radiologist interpreting cardiac MRI studies should be familiar with basic cardiac anatomy and standard imaging planes.

Pulse sequences

The main pulse sequences used for cardiac imaging include GRE and the more recently introduced, but related, technique termed steady-state free precession (SSFP). Using cine SSFP sequences qualitative and quantitative wall motion analysis becomes possible, regional wall motion anomalies can be detected reliably and furthermore cardiac functional parameters like end-diastolic and end-systolic volumes, stroke volume as well as ejection fraction can be calculated. Using contrast enhanced techniques like inversion recovery pulse sequences myocardial scar tissue, inflammation due to myocarditis as well as fibrosis can be assessed reliably. The most common use of this technique is to null the signal from normal “healthy”

myocardium during late gadolinium enhanced (LGE) imaging. The nulled normal myocardium will be dark in contrast to the enhanced abnormal myocardium.

Imaging planes

The standard cardiac imaging planes usually include short axis, horizontal long axis (four-chamber view), and vertical long axis (two-chamber view). These planes are prescribed along a line extending from the cardiac apex to the center of the mitral valve (long axis of the heart) using the axial body plane images. The short-axis plane extends perpendicular to this true long axis of the heart at the level of the mid left ventricle. The horizontal long axis is generated by selecting the horizontal plane that is perpendicular to the short axis, whereas the vertical long axis is prescribed along a vertical plane orthogonal to the short-axis plane. Ventricular volumetric measurements are routinely derived from the short-axis views.

Learning objectives

Learning objectives are to become familiar with cardiac anatomy and morphology, to understand what kind of pulse sequences are usually used for cardiac MRI and how to asses cardiac function qualitatively as well as quantitatively. Furthermore, examination strategies as well as clinical MRI protocols will be discussed.