Cardiac MRI in Pediatric Patients with Congenital Heart Disease: Comparison at 1.5T and at 3.0T
Kim-Lien Nguyen1,2, Sarah N Khan3, John Moriarty1, Kiyarash Mohajer3, Pierangelo Renella3, Gary Satou4, Swati Patel5, Ines Boechat3, and Paul J Finn3
1Laboratory of Cardiac Energetics, NHLBI, Bethesda, MD, United States, 2Division of Cardiology, David Geffen School of Medicine at UCLA, United States, 3Department of Radiology, David Geffen School of Medicine at UCLA, United States, 4Division of Pediatric Cardiology, David Geffen School of Medicine at UCLA, United States, 5Department of Anesthesiology, David Geffen School of Medicine at UCLA, United States

ABSTRACT

Background: Despite the theoretical advantages of higher field strength, the widespread adoption of cardiac MRI at 3.0T has been slow, largely due to the increased sensitivity of SSFP cine to off-resonance artifact. Furthermore, to the best of our knowledge, there have been no published reports on the use of 3.0T for imaging in pediatric congenital heart disease (CHD). We sought to assess the feasibility of cardiac MRI in pediatric patients with CHD at 3.0T and to compare the technical and diagnostic performance with an age-matched and clinically comparable control group at 1.5T.

Materials and Methods: Forty-six pediatric patients with suspected or known CHD were referred for clinical cardiac MRI evaluation. Twenty-three underwent imaging at 1.5T (age range 1 day to 7.8 years old, mean 28.7 ± 33 months) and twenty-three underwent imaging at 3.0T (age range 3 days to 8 years old, mean 47.8 ± 31.4 months). SSFP cine imaging, time-resolved magnetic resonance angiography (TR-MRA), and high resolution contrast-enhanced MRA (CE-MRA) were performed routinely. Two readers independently evaluated the data sets for overall image quality, thoraco-abdominal vessel and cardiac chamber definition, and presence of artifacts. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) from both data sets were calculated.

Results: 95% of SSFP cine images at 3T were rated as good or excellent image quality with 73% having mild and 24% having moderate artifacts (k = 0.07). SNR of myocardium at 3T and 1.5T were 45.0 ± 22.3 and 19.0 ± 6.3 (P < 0.01), respectively. CNR between myocardium and blood pool at 3T and 1.5T were 25.7 ± 20.0 and 7.8 ± 5.2 (P < 0.01). 100% of Arterial and 100% of venous phase CE-MRA images were considered good or excellent definition of the thoraco-abdominal vessels and cardiac chamber definition, and presence of artifacts. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) from both data sets were calculated.

Conclusions: Cardiac MRI of pediatric patients with CHD and vascular abnormalities at 3.0T is feasible. Relative to 1.5T, SNR and CNR are both improved at higher field strength and higher resolution CEMRA is achievable. Whereas SSFP artifacts at 3.0T are more prevalent, they rarely render cine imaging non-diagnostic. Both field strengths can be used successfully for cardiac and vascular imaging. The decision as to which to use is weighted by local availability and the relative requirement for detailed vascular vs intracardiac imaging.