

# Right Heart Failure Congenital Heart Disease

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As a result of major improvement of pediatric cardiology and cardiac surgery, more than 90% of congenital heart disease (CHD) patients reach the adult life (1). Therefore, the field of congenital heart disease is no longer reserved to pediatricians. It is therefore important for adult practitioners to integrate fundamental notions about CHD. In this rapidly growing field of CHD, right ventricle (RV) morphology and function is of paramount importance. Although echocardiography remains the first line imaging modality, CMR is now considered as the gold standard for quantitative assessment of RV anatomy, volume, and ejection fraction in CHD, both before and after reparative surgery. The course will review the role of CMR in the assessment of RV in CHD by discussing first the MR sequences and then some clinical conditions involving RV dysfunction.

Spin echo (black blood) sequences are used to depict the anatomy and gradient echo (white blood) sequences for assessment of RV function (2,3). Flow velocity mapping sequences allows for accurate assessment of valve regurgitation and stenosis as well as direction determination and quantification of shunts. MR angiography after contrast agent is invaluable for pulmonary arteries and veins anatomy as well as stenosis. Intramyocardial fibrosis can be detected by late gadolinium enhancement (4) whereas intramyocardial adipose tissue is best depicted by fat suppressed MR sequences. By comparison with adult imaging, MR sequences for neonates or infants needs to be adapted by increasing the temporal and spatial resolution (3). This is usually achieved by using the smallest available coil that covers the entire chest of the patients as well as a reduced FOV. The temporal resolution is increased accordingly by reducing the number of line per segment in the cine sequences. The strategy for respiratory motion attenuation needs also to be optimized, as multiple breatholds are frequently difficult to obtain in pediatric patients. Real time imaging will certainly be a major progress to this respect (5).

The applicability of these CMR methods will then be presented in two broad conditions of RV dysfunction in CHD: the volume loaded RV and the pressure loaded RV (6). Atrial septal defect, significant pulmonary valve regurgitation, and significant tricuspid regurgitation are associated with a volume loaded RV that can be perfectly assessed by CMR. Two major models exemplifying pressure loading of the RV will then be reviewed: RV outflow tract (RVOT) obstruction (7) and the RV supporting the systemic circulation (systemic RV). Practical examples of these pathologies including follow-up CMR examination after therapy will be discussed.

## References

1. Sommer R, Hijazi Z, Rhodes JJ. Pathophysiology of congenital heart disease in the adult: part I: Shunt lesions. *Circulation* 2008;117(8):1090-1099.
2. Marcu C, Beek A, Van Rossum A. Cardiovascular magnetic resonance imaging for the assessment of right heart involvement in cardiac and pulmonary disease. *Heart Lung Circ* 2006;15(6):362-370.
3. Kellenberger C, Yoo S, Buchel E. Cardiovascular MR imaging in neonates and infants with congenital heart disease. *Radiographics* 2007;27(1):5-18.
4. Harris MA, Johnson TR, Weinberg PM, Fogel MA. Delayed-enhancement cardiovascular magnetic resonance identifies fibrous tissue in children after surgery for congenital heart disease. *J Thorac Cardiovasc Surg* 2007;133(3):676-681.
5. Muthurangu V, Lurz P, Critchely JD, Deanfield JE, Taylor AM, Hansen MS. Real-time assessment of right and left ventricular volumes and function in patients with congenital heart disease by using high spatiotemporal resolution radial k-t SENSE. *Radiology* 2008;248(3):782-791.
6. Davlouros PA, Niwa K, Webb G, Gatzoulis MA. The right ventricle in congenital heart disease. *Heart* 2006;92 Suppl 1:i27-38.
7. Bashore TM. Adult congenital heart disease: right ventricular outflow tract lesions. *Circulation* 2007;115(14):1933-1947.