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Meeting abstract

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410 How to image adult congenital heart disease?

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Introduction

A simple, standardized clinical imaging protocol is used for imaging normal adults which can be followed in a vast majority of patients. However, imaging patients with adult congenital heart disease (CHD) requires a flexible, and comprehensive approach for demonstrating complex cardiac anatomy as well as the frequently associated pathologies.

While a step-by-step approach that is suitable for imaging all types of congenital heart disease pathologies is difficult to describe, there are some general principles one can apply when imaging adult CHD patients. The purpose of this paper is to describe a general imaging approach that we apply at our institution for the evaluation of adult patients with CHD. This imaging protocol enables the technologist to cover the majority of the pathologies commonly encountered in adults, viz., atrial and ventricular septal defects, Tetralogy of Fallot, and transposition of great vessels.

Methods

The comprehensive imaging approach comprises of three modules:

(a) Cine imaging of the entire heart

A stack of cine short axis views from covering the *entire* heart from ventricular apex to the atria posteriorly (average 18 to 20 slices) are then obtained without gaps. A stack of 4-chamber cine images (approximately 6 slices without gap) as well as a stack of left ventricular outflow tract images (3–4) slices are also obtained. The above views will cover the majority of the septal defects, including conal-septal, ventricular-septal as well as sinus venosum defects as well as several other repairs, such as the Senning/Mustard procedure.

(b) Valvular assessment

Echo-planar cine images are performed to qualitatively assess all cardiac valves for regurgitation and stenosis, including a 4-chamber, left ventricular outflow tract and right ventricular outflow tract views. Flow quantification is performed though the ascending aorta and main pulmonary artery to quantify any inter-cardiac shunt. Similarly, any stenotic lesions should also be quantified by flow quantification with the appropriate velocity encoding to obtain the peak velocity and gradient of across the lesions.

(c) Contrast-Enhanced MRI

A non-ECG gated, gadolinium-enhanced 3-D magnetic resonance angiography (MRA) of the great arteries and great vein is obtained in the coronal projection to assess lesions in the thoracic aorta, pulmonary arteries and the pulmonary veins. The angiogram is crucial to detection of any abnormal systemic and venous connection, such as partial anomalous pulmonary venous return, as well as any vascular abnormality, such as a left-sided superior vena cava and right-sided aortic arch and any prior repairs in the great vessels.

Recommended pulse sequences

1. Breath – hold segmented cine steady state free precession (SSFP)

Slice thickness is 8 mm with in-plane spatial resolution of 2 mm × 2 mm. Temporal resolution is approximately 35–40 msec with 25 phases. Parallel imaging can be used to shorten acquisition time.

2. Contrast – enhanced 3-D MRA with parallel imaging

T1 spoiled gradient echo with centric K-space acquisition. In-plane resolution is between 1 – 1.5 × 1 – 1.5 mm. The coronal projection should be used to cover both the great arteries and veins. The pulmonary arteries are covered in the first dynamic and two more acquisitions should be performed.

3. Segmented gradient echo with echo-planar imaging

Fast gradient echo cine with TE long enough (≥ 6 msec) to qualitatively detect valvular regurgitation. EPI factor of 5–7 is employed.

4. Flow quantification by phase-contrast MRA

This imaging plane is obtain perpendicular to the flow by ECG-gated phase contrast sequence with velocity encoding of 250 cm/sec at the thoracic aorta and/or main pulmonary artery.

Conclusion

The imaging approach described above will enable a comprehensive assessment of the commonly seen pathologies in adult patients with congenital heart disease.