Meeting abstract

219 Feasibility of whole-heart steady-state free precession magnetic resonance coronary angiography (MRCA) in infants and children with congenital heart disease

Tarinee Tangcharoen*, Sanjeet Hegde, Aaron Bell, Philip Beerbaum, Tobias Schaeffter, Reza Razavi and Gerald Greil

Address: King's College London, London, UK
* Corresponding author

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Introduction
The whole-heart Steady-State Free Precession (SSFP) MRCA has been used in adult patients for imaging coronary tree[1]. However, its routine use to image coronary arteries in children with congenital heart disease has not been proven yet. Since an abnormal course of coronary arteries is not uncommon in complex congenital heart and relevant for surgical planning.

Purpose
This study demonstrates the capability of this technique in imaging the origin and course of coronary arteries in children with complex congenital heart disease.

Methods
100 patients (median age 3 years, age range 4 months–11 yrs) with congenital heart disease were imaged with Philips Intera 1.5 T MR scanner under general anesthesia. After injection of contrast (Magnevist 0.2 mmol/kg), a vector cardiogram-triggered, free-breathing, 3D-SSFP whole-heart approach with navigator gating (3 mm) was used with nearly isotropic image resolution (table 1). The acquisition window was adapted to the resting period of the heart. Image quality of the left and right coronary arteries were assessed by two independent observers using a score ranging from 0 (nonvisible) to 4 (excellent quality). The coronary arteries were reformatted using Soap-Bubble tool[2] for vessel length measurements.

Echocardiography findings and surgical findings were reference standards for assessment of coronary origins and proximal course.

Results
All studies were completed without adverse effects. The origins of both left and right coronary arteries were imaged in 89 patients (89%). Only one coronary artery was imaged in 8 patients and 3 patients (age 4 months and 5 months old) were not able to visualized the coronary arteries. Average image quality of left main, left anterior descending, left circumflex and right coronary arteries are described in table 2. Left circumflex artery showed lowest image quality compared with other coronary segments. 9 patients with single coronary artery were cor-

Table 1: Relevant parameters using in whole-heart SSFP MRCA

Parameters	
Repetition time (msec)	4.7 – 5.1
Echo time (msec)	2.4
Field of view (mm)	240 – 310
Flip angle (degree)	90
Matrix	256
Slice thickness (mm)	1.0 – 1.3
Number of slices	70 – 130
Voxel size (mm)	1.0 × 1.0 × 1.0 – 1.3 × 1.3 × 1.3
Acquisition window (msec)	40 – 70

Table 2: Image quality score and vessel length in each coronary segment

Coronary artery segments	Image quality score	Vessel length(mm.)
I. LMT	2.94 ± 1.20	8.4 ± 4.7
2. LAD	2.69 ± 1.24	28.8 ± 17.4
3. LCX	1.77 ± 1.34*^\	17.9 ± 16.2
4. RCA	2.78 ± 1.42	49.2 ± 25.0

LMT indicates left main trunk coronary artery, LAD indicates left anterior descending coronary artery, LCX indicates left circumflex coronary artery, RCA indicates right coronary artery. * indicates statistically significant ($p < 0.001$) different from LMT. ^indicates statistically significant ($p < 0.001$) different from LAD. \ indicates statistically significant ($p < 0.001$) different from LCX.

rectly detected from MRCA compared to echocardiography findings.

Conclusion

Using this technique we were able to delineate the coronary artery anatomy in 97% of children with congenital heart disease with the youngest being 4 months old. Abnormal origin and course of the coronary arteries were clearly demonstrated in 9 cases. Further application may include diagnoses of abnormal size, origin and course of the coronary arteries in with Kawasaki disease.
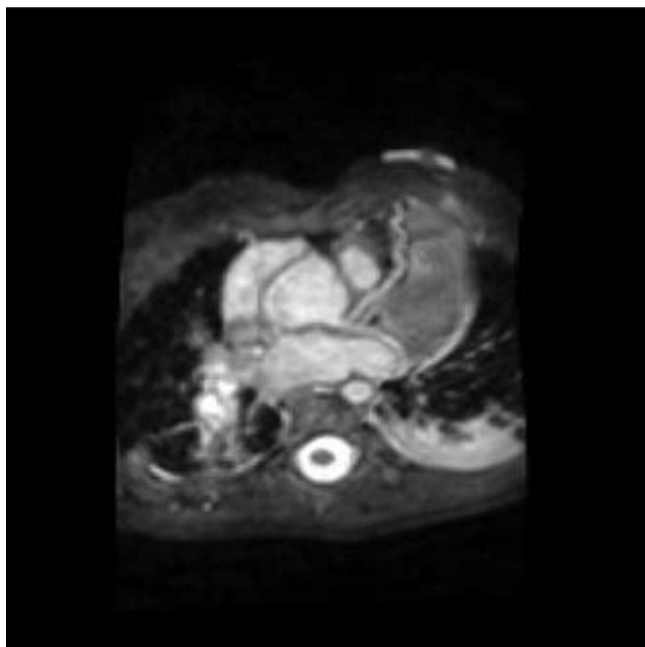

Figure 1
Soap-bubble reconstructed the left coronary system in 10 month old patient.

Figure 2
Soap-bubble reconstructed reconstructed from right coronary MRCA in 6 months patient with post-Norwood I operation.

References

1. Weber OM, Martin AJ, Higgins CB: **Whole-heart steady state free precession coronary artery magnetic resonance angiography.** *Magn Reson Med* 2003, **50:**1223-8.
2. Etienne A, Botnar RM, Van Muiswinkel AM, Boesiger P, Manning WJ, Stuber M: **"Soap-Bubble" visualization and quantitative analysis of 3D coronary magnetic resonance angiograms.** *Magn Reson Med* 2002, **48:**658-66.