Safety and Clinical Utility of Cardiovascular Magnetic Resonance in Neonates with Congenital Heart Disease

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Introduction

- Cardiovascular magnetic resonance (CMR) is an established advanced diagnostic modality in adult with congenital heart disease (CHD).
- CMR is being increasingly used also in young children with complex CHD, as complement to echocardiography.
- The aim of this study was to evaluate the indications, safety and clinical impact of CMR performed in neonates with CHD.

Conclusions

- **CMR is an effective and safe imaging tool in neonates with CHD, even in critically ill patients.**
- **Main indication for CMR at time of first diagnosis is visualization of the intrathoracic vasculature – aorta, pulmonary arteries and pulmonary veins.**
- **CMR findings have been crucial for further clinical management in most cases**

Methods

- All patients younger than 1month, who had undergone CMR in our institution were included in the study.
- Retrospective review of diagnosis, indication for CMR, complications and clinical relevance of CMR findings.
- In all cases CMR was performed as second-line diagnostic examination after transthoracic echocardiography, if completion of diagnosis was needed.
- All CMR examinations were performed in a 1.5T Signa MR/i Twinspeed scanner (GE),by using a quadrature head coil or customized newborn coil (figure 1)
- All images were acquired during breathholding by stopping ventilation

Figure 1. CMR coils used for imaging newborns. Quadrature head coil (left panel), custom built newborn multichannel – array coil (right)

- Steady State Free Precession sequence was used for anatomy and ventricular size and function.
- Phase-contrast velocity encoded cine sequence for blood flow measurement.
- Contrast-enhanced MR angiography (CE-MRA) used a 3D fast spoiled gradient echo sequence and contrast medium (dimeglumine gadopentate, off-label use) in a dose of 0.2mmol/kg i.v., bolus hand-injection, followed by a flush with physiologic saline solution. Automated timing (smart prep) of image acquisition.

Results

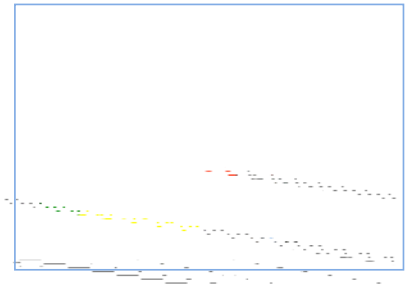
Patients characteristics:

- 78 CMR examinations in 77 neonates.
- Median age 4 days (range 1-29) , weight 3064±633 g.
  14 (18%) exams in the first day of life.
- CHD diagnosis are summarized in Table 1. 47 (60%) cyanotic CHD.
- Indications for CMR are shown Figure 2.

Table 1. Diagnosis

Aortic arch anomalies (%)	23 (29.5)
Pulmonary atresia/multicentric lung perfusion	16 (20.5)
Complex CHD with single ventricle	13 (17%)
Complex CHD with two ventricles	10 (13%)
Pulmonary vein anomalies	8 (10%)
Tetralogy of Fallot	2 (3%)
Tumour	2 (2.6)
Others	4 (5.1)

Figure 2. Main indications for CMR



CMR examinations

- Mean scanning time 30±12 min.
- CE MRA in all patients.
- Sedation / anaesthesia:
  neonatal intensive care team 57 (73%)
  anaesthesiology team 21 (27%)

Safety

- No significant complication during or immediately after examination.
- In two patients in critical condition breath-holding was avoided and the images acquired during free breathing.

Clinical relevance

- CMR findings had a major clinical impact in 67/77 (87%) of the cases.
- Decision for further treatment was based on CMR information in 63 (81%) cases (Table 2). In 7 children suspected diagnosis was confirmed and in other 4 ruled out.

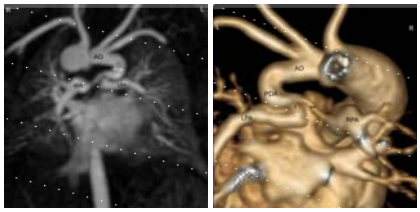
Table 2: Clinical impact of CMR findings

Cardiac surgery	54
Catheter-guided intervention	4
Palliative care	9
Suspected diagnosis confirmed	7
Suspected diagnosis ruled out	4

Cases

Case 1.
Newborn girl with **trans-position of the great arteries** and suspected aortic coarctation by echo-cardiography. CMR revealed an interrupted aortic arch. Continuity to the descending aorta was warranted by a large ductal arch (PDA)-

Case 2.
Truncus arteriosus com-munis. A common truncal valve (TR) overrides a septal defect between RV and LV. Ascending aorta (AO) and main pulmonary artery (MPA) have common origin above the truncal valve. Notice the course of the left pulmonary artery, crossing over the right pulmonary artery



Case 3.
Pulmonary atresia. The lung perfusion is warranted exclusively by a patent ductus arteriosus (PDA). Circumscript stenosis (*) is present at the origin of the left pulmonary artery (LPA); a long hypoplastic segment (**) connects PDA and right pulmonary artery (RPA). The findings were crucial for planning catheter guided PDA and RPA stenting
Left panel show a multi intensity projection image; right panel is the corresponding 3D reconstruction.

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