



Original contribution

# Cardiovascular magnetic resonance is successfully feasible in many patients aged 3 to 8 years without general anesthesia or sedation ☆, ☆ ☆



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## Abstract

**Objectives:** Patients younger than 8 years are usually examined by cardiovascular magnetic resonance (CMR) under general anesthesia (GA) or sedation without intubation. Therefore, we sought to study the feasibility of CMR in patients aged 3 to 8 years without GA or sedation.

**Patients:** Data sets of 71 consecutive patients aged 3 to 8 years were studied retrospectively.

**Design:** The total cohort was divided into 2 groups: a no-GA or sedation without intubation group (no-GA or sedation) and a GA or sedation without intubation group (GA or sedation).

**Measurements:** The patients' age, scan durations for each group, successfully answered clinical question, and number of sequences per study were compared between both groups.

**Main results:** Scan duration in the no-GA or sedation group (n = 44) was 35 ± 20 minutes, and that in the GA or sedation group (n = 27) was 60 ± 31 minutes ( $P < .001$ ). The percentage of successful reports was 95% (42/44) in the no-GA or sedation group and 89% (24 of 27) in the GA or sedation group ( $P = .29$ ).

**Conclusion:** CMR in patients aged 3 to 8 years is usually successfully feasible without GA or sedation.

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## 1. Introduction

The advancement in cardiovascular magnetic resonance (CMR) is an ongoing process that has led to a marked rise of

routine clinical CMR of pediatric patients with congenital and acquired heart disease [1–3].

To face the increased rise of CMR demands and to provide an applicable modality, CMR must provide solutions to overcome its limitations. One of its great limitations is long scan time, and, simultaneously, the fact that patients have to lay down motionless inside the confined magnet space.

Furthermore, patients younger than 8 years are usually sent to CMR either under general anesthesia (GA) with intubation or sedation without intubation. The main reason why CMR is performed under either GA or sedation is to acquire good quality scans and acceptable results.

The drawbacks of GA include laryngospasm, prolonged stay in the hospital, and administration of anesthesia drugs, which add more costs [4]. Risk of sedations includes respiratory depression [5], hypoxemia, and failed or inadequate sedation. Prolonged scan time may increase such hazards.

As a result of the debate in choosing between GA and sedation without intubation [6] in such a confined space as the magnetic resonance scanner, the decision depends often on the anesthesiologists' preferred method and not a solid standard protocol. Therefore, large practice variations occur in different centers and even within the same center.

However, it is also known that children between 3 and 8 years can undergo noncardiovascular magnetic resonance imaging (MRI) without the use of GA or sedation [7].

Therefore, since 2007, we have implemented the possibility of undergoing CMR without the need of GA or sedation for children between 3 and 8 years old into our routine clinical practice.

The aim of this study was to study the feasibility of CMR in patients aged 3 to 8 years without GA or sedation by comparing CMR studies of children between 3 and 8 years old either using or not using GA or sedation.

## 2. Materials and methods

The study consisted of all 71 consecutive patients aged 3 to 8 years receiving routine clinical CMR between January 2007 and July 2012 at the Department of Pediatric Cardiology and Congenital Heart Disease at the Deutsches Herzzentrum München.

All patients were divided into 2 groups: patients who did not receive GA or sedation without intubation (no-GA or sedation group) and the second group who received either GA with intubation or sedation without intubation (with GA or sedation group).

### 2.1. Demographic data

The age of the 71 patients ranged from 3 years and 5 months to 7 years and 10 months.

Forty-four patients represent the total number of patients in the no-GA or sedation group, and 27 in the GA or sedation group, with a subdivision of 22 undergoing GA and 5 sedated without intubation.

The study population showed various diagnoses and clinical questions (Table 1).

Thirty-one (70%) patients of the “no-GA or sedation” group were operated on and undergoing a follow-up study. Twenty-four (89%) patients of the “with GA or sedation” group were operated on and undergoing their follow-up.

### 2.2. Patient preparation prior to CMR examination

In all cases, an expert in congenital heart disease CMR (C.M., S.F.) spoke to the patients and their parents or accompanying adults, days before the scheduled CMR examination. During this visit, the expert explained the CMR examination, took the history, checked for pacemakers or metal in the patients' body, informed the patient that one of the parents may accompany the child inside the CMR room, and that music or audio books could be listened to during the CMR examination. Depending on this conversation with the patient and the parents, the expert and the parents mutually decided if the patient could be scanned without GA or sedation (no-GA or sedation group) or not (with GA or sedation group).

**Table 1** Diagnosis and clinical questions in no GA or sedation

Diagnosis	No.	Clinical question
Myocarditis	1	Myocardial edema. Late contrast enhancement pattern
Truncus arteriosus	2	Cardiac volumes and function. Pulmonary flow assessment.
ASD	2	Cardiac volumes and function. Shunt volume (Qp:Qs)
TGA	3	Cardiac ventricular volumes and function. Detection of postoperative leakage
Ebstein	4	Cardiac ventricular volumes and function. Assessment of tricuspid valve regurgitation
Double-outlet right ventricle	4	Cardiac ventricular volumes and function
Pulmonary atresia	6	Cardiac ventricular volumes and function. Assessment of pulmonary flow
Aortic anomalies (coarctation of the aorta and interrupted aortic arch)	6	Morphology and diameter of the aorta (eg, isthmus residual stenosis)
TOF	7	Cardiac ventricular volumes and function. Pulmonary valve regurgitation fraction
Others (eg, rhabdomyoma, tricuspid dysplasia, Kawasaki syndrome)	9	Cardiac ventricular volumes and function. Tumor characterization. Morphology of coronary arteries

TOF = tetralogy of Fallot; TGA = transposition of great arteries; ASD = atrial septal defect.

Cardiovascular magnetic resonance was successful in answering clinical question in 95% (42/44) of the patients.

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