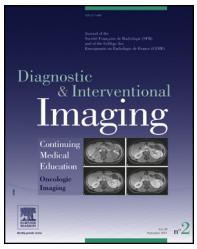
Diagnostic and Interventional Imaging (2016) **97**, 513—517



CONTINUING EDUCATION PROGRAM: FOCUS...

Cardiac CT or MRI in pediatric practice: Which one to choose?

C. Sorensen[a], P. Gach[a], H. Pico[a], N. Hugues[b], A. Dabadie[a], C. Desvignes[a], B. Bourlière[a], A. Aschero[a], N. Colavolpe[a], P. Petit[a], G. Gorincour[a,*]

[a] *Department of pediatric and prenatal imaging, La Timone Children's Hospital, 264, rue Saint-Pierre, 13385 Marseille cedex 05, France*
[b] *Medical and surgical pediatric cardiology department, La Timone Children's Hospital, 264, rue Saint-Pierre, 13385 Marseille cedex 05, France*

KEYWORDS
Congenital heart disease;
CT;
MRI;
Radiation protection;
Contrast medium

Abstract The different factors involved in the choice of the best cardiovascular imaging examination for pediatric patients are justification, radiation protection, sedation, resolutions (spatial and contrast), morphology or function, intervention and contrast enhancement. Computed tomography is preferable for all coronary artery conditions, any arterial or venous abnormalities in newborns and infants and in the preoperative assessment for tetralogy of Fallot. Magnetic resonance imaging is used for any tumoral or functional assessment, cardiomyopathy or arrhythmia or if the child's participation and/or size of the structures being examined allows using this technique.

Computed tomography (CT) and cardiac magnetic resonance imaging (MRI) have revolutionized the diagnostic approach for almost all medical and surgical congenital and acquired heart diseases during the last few years, following the development of cardiac synchronization techniques. Both techniques in particular can limit the need for invasive imaging procedures, thereby reducing their morbidity. This is particularly crucial in children, although echocardiography is undoubtedly more effective in children than in adults [1].

The respective indications for cardiac CT and MRI are still poorly explained, badly understood or poorly communicated. We offer a series of questions, which arise (and those which do not) before choosing which is the most appropriate investigation for each of our patients.

* Corresponding author.
E-mail address: guillaume.gorincour@ap-hm.fr (G. Gorincour).

http://dx.doi.org/10.1016/j.diii.2016.02.006

Is radiation justified?

Radiation protection is a central concern in pediatric imaging, although diagnostic quality remains the most important factor [2—5].

Obviously the Euratom directive and its transposition into French law has placed more pressure on the radiologists. The question is to justify an irradiating procedure, particularly in very small children, and especially as it may be expected that the imaging investigation in question will be repeated at regular frequencies over time with the child's growth and the problems which may occur with surgical cardiovascular connections or conduits and stents, which themselves do not increase in size.

Once the irradiating investigation (CT) has been decided as the investigation which will provide the best diagnostic information, the radiologist also has to make sure that the CT equipment is optimized: this is done partly in collaboration with our industrial CT manufacturing partners and secondly depending on the dose level recommendations (DLR) produced through a long and productive collaboration between the *Société francophone d'imagerie pédiatrique et prénatale* (SFIPP) and IRSN. These DLR propose appropriate protocols, and ALARA (as low as reasonably achievable) recommendations to use the lowest irradiation variables for optimal image quality both by anatomical region and patient weight [6—8].

Is sedation required?

Despite technical advances in speed of image acquisitions, sedation is often required after the age of 6 months old for both CT and MRI, up to approximately 4 years old for CT and 5—6 years old for MRI, although there are exceptions to these rules. This may involve conventional general anesthesia (in centers with pediatric anesthesiologists with dedicated sessions) usually using halogenated gases without orotracheal intubation, or ''mild'' sedation managed by the senior radiologist in the many other cases [9—16].

Other alternate techniques are beginning to emerge to reduce the need for sedation and include hypnosis, acupuncture and related techniques such as cutaneous energy resonance stimulation (CRES) or MRI ''simulation'' devices such as the ''playful MRI'' (Fig. 1), developed in Lyon in Prof. J.P. Pracros' Department where they have very substantially reduced the need for per-MRI sedation through the use of this system.

What is the clinical question?

This is the third decision-making factor and in our opinion is also essential although it is not possible to rank all of the factors involved [17—23].

Firstly, is the question primarily morphological or functional? If the question is morphological, CT becomes increasingly preferable with reducing size of the questioned anatomical structures. The spatial resolution of MRI does not equal that of CT even with the most recent machines using reasonable image acquisition time. The typical example is the preoperative assessment of patients with tetralogy of Fallot when ultrasound shows a doubt about coronary artery anatomy and a possible pre-infundibular conal branch or left anterior descending artery arising from the right coronary artery (Fig. 2).

Figure 1. ''Playful MRI'': this reproduces the movements and noise of MRI and the color code around the entry to the ring is reproduced on the ''true'' MRI.

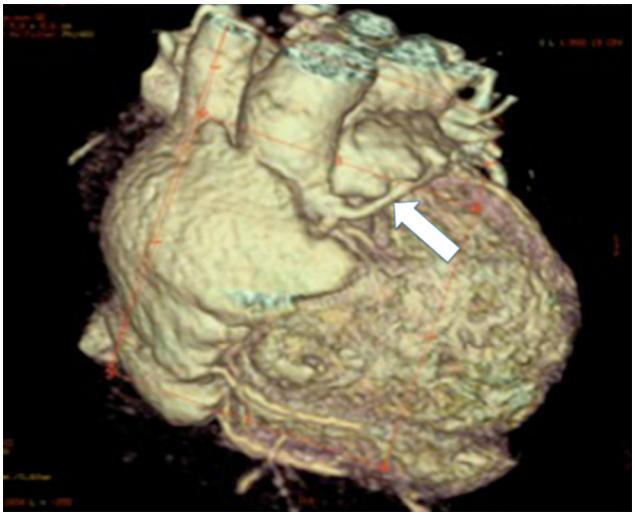


Figure 2. Preoperative CT angiography in an infant with tetralogy of Fallot, surface VR reconstruction showing the coronary artery abnormality: single coronary and left pre-infundibular branch (arrow).