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Quantitative myocardial blood flow in children with normal and abnormal coronary arteries using adenosine infusion magnetic resonance imaging

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Introduction

Little is known about myocardial blood flow (MBF) in normal children or those with either congenital or acquired heart disease.

Purpose

We used MRI to measure resting and adenosine induced (AI-cMRI) hyperemic absolute MBF (ml/min/g) in two groups of children: those with normal coronary arteries (NL, n = 19), and those with angiographically proven coronary artery disease (CAD n = 10).

Methods

Images were obtained on a 3 T scanner (Philips Achieva) and were analyzed by segmenting along endo- and epicardial borders and determining the changes of the average myocardial signal intensity during contrast transit in 6 myocardial regions in 2 short axis LV slices using deconvolution of the tissue curves with an arterial input, measured in the LV chamber to determine quantitative flow.

Results

Ages of the children were 8 ± 4.7 years. NL had trivial heart malformations (mild pulmonary stenosis, non-obstructive bicuspid aortic valve, or small ASD). CAD included infarction after arterial switch (1), anomalous coronary origin (4), Kawasaki disease with giant aneurysm (2), pulmonary atresia RV-dependent coronary circulation (2) and coronary stenosis (1). There were no complications during any study. In response to adenosine, heart rate increased in NL (+25%) as did rate-pressure product (+17%) and systolic BP decreased (-17%). In CAD the BP and RPP did not change significantly. In NL, MBF increased from 0.9 ± 0.2 (5^{th} & 95^{th} CI = 0.9 &1.0) to 2.5 ± 0.9 (5^{th} & 95^{th} CI = 2.0 & 2.8) ml/min/g ($p < 0.0001$) with significant increases observed in all regions.

Conclusion

CAD had two distinctly different MBF patterns compared to NL. In a "global" group, a minimal adenosine-induced increase in MBF occurred in all regions (n = 4, 0.8 ± 0.3 to 1.3 ± 0.6 ml/min/g, p = 0.8). This pattern occurred in those with Kawasaki disease or ventricular dependent coronary circulation. In 6 cases, the flow region of lowest hyperemic MBF was significantly lower than the lowest MBF region in the NL group during adenosine ($p < 0.05$) whereas the remote region MBF was within the normal range. Importantly, the low MBF regions were within the distribution of the coronary disease observed on angiography. This is the first normative data for pediatric AI-

cMRI. Quantitative MBF AI-cMRI may prove to be a sensitive method for detecting and monitoring CAD in children.