

Cardiac CTA

Background: Previously, pediatric cardiac computed tomography angiography (CTA) was limited by relatively long acquisition times and high radiation doses. However, the advent of prospective ECG gating, ultrafast gantry rotation times, dual source technology/volume acquisition, variable pitch (higher pitch with fast heart rate), and dose modulation has enabled successful pediatric cardiac CTA with low radiation doses (approximately 1- 3mSv or less), frequently without sedation or breath-holding (2). Although high heart rates (>100 bpm) are typical in infants and young children, beta blockade and vasodilation agents are not used routinely.

Indications: Common applications of pediatric cardiac CTA include evaluation for anomalous coronary arteries, congenital aortic anomalies such as vascular rings, interruption, and coarctation, anomalous pulmonary venous return, branch pulmonary artery stenosis, pulmonary artery atresia with major arterio-pulmonary collateral vessels (MAPCAs), aortic root dissection, and post operative complications of congenital heart disease repairs. Less common applications of pediatric cardiac CTA includes cardiac function and volume evaluation in pediatric patients who have an absolute contraindication to cardiac MR imaging.

Risks and Benefits: CTA enables the angiographic depiction of virtually any vessel in the cardiovascular system without the invasive methods employed in cardiac catheterization. Similar to catheterization, CTA requires ionizing radiation and intravascular contrast medium, however in general both radiation doses and contrast volume used in CTA are much less than required for catheterization. Radiation doses can be further minimized by understanding and tailoring the CTA parameters to the specific need. Important individual parameters to be considered include tube current (mA), peak kilovoltage (kVp), gantry rotation time and pitch. In general lower kVp,

faster gantry rotation times and higher pitches result in lower radiation doses, traditionally at the expense of increased noise in the acquired images. However newer reconstruction methods such as iterative reconstruction can dramatically reduce the noise in the reconstructed images enabling significant radiation dose savings. The radiation dose also depends on the length of the CTA acquisition, which is why acquiring large portions of the cardiac cycle in children should be avoided unless clinically necessary.

Nonionic, low osmolar or non-osmolar contrast agents are most appropriate with an iodine concentration of approximately 300mgI/ml. The contrast dose is usually 1.5-3 ml/kg with 2ml/kg usually sufficient. Injection rates depend on the angiocatheter size and power injection is preferable to standardize rate control. The occurrence of adverse reactions to the low osmolar contrast media used in CTA is rare, with a frequency of approximately 0.18%; however personnel should be trained to handle serious contrast reactions should they occur.

If there is an appropriate clinical indication and exposure to radiation and contrast is minimized then the benefits should outweigh the risks.

Limitations: Optimal depiction of cardiovascular contrast depends on the presence of contrast material within the vessel at the time of imaging. If the contrast bolus has passed the vessel of interest (delayed acquisition) or if the contrast has not reached the vessel of interest (premature triggering) then the resultant images will be suboptimal. Methods targeted in reducing this limitation and more accurate timing include power injection of contrast followed by an adequate saline flush, bolus triggering or timed bolus techniques.