

## **Cardiac Computed tomography in Neonates with complex cardiac defects and 3D printed Heart model.**

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**OBJECTIVE:** The purpose of the study was to evaluate cardiac anatomy, in neonates with complex cardiac defects, by Target CTA scan mode prior to the cardiac Surgery. The secondary objective was to use 3D Printing technology to create accurate, realistic, and tangible heart model in neonates with complex cardiac defects.

**BACKGROUND:** The development of the latest generation multi slice computed tomography has increased the clinical use of cardiac CT imaging in patients with congenital heart defects. The Scan time and radiation dose has been significantly decreased with the new generation CT scanners. It is now possible to have high resolution images with the new generation CT scanners to create a heart model in neonates with complex cardiac defects.

**METHODS:** Cardiac CTA was performed on 4 neonates with complex congenital heart defects at Akron Children's Hospital. Age range was 3 days to 10 days. Two patients had Truncus arteriosus, one patient had Supra cardiac Total Anomalous Pulmonary Venous return and one patient with aortic arch hypoplasia and critical Coarctation. These studies were performed on a 320-multi slice CT machine manufactured by Toshiba (Aquilion One dynamic volume CT). Target CTA scan mode was adopted and volume scanning of the chest with attention to the cardiac structures was performed following administration of intravenous contrast agent. Scan time and radiation dose was recorded. All studies were ECG synchronized. All cardiac structures were visualized with specific evaluation of the cardiac defect. Reconstructions were obtained in axial, coronal and sagittal planes. 3-D reconstructions were performed on a separate Vitrea workstation from Vital images Inc. Toshiba. Each study was reviewed and analyzed by a CT trained cardiologist and radiologist. Image quality (IQ) 5-level score was used (1=non-diagnostic, 5=excellent). Images of the patient with Truncus Arteriosus type 11 were then electronically sent to "Materialise USA" Plymouth, MI for 3D Printing. Stereolithography, a 3D printing technology was used to create a rigid heart model with a high transparency.

**RESULTS:** Excellent images with high temporal resolution in all 4 patients were obtained Image quality score in all four patients was 5. Three dimensional printout heart model of one patient with Truncus Arteriosus type 11 was successfully achieved. The Heart model accurately showed the location of ventricular septal defect, morphology of the Truncal valve, location and course of the branch pulmonary arteries.

**CONCLUSION:** This study demonstrates that Cardiac CTA with latest generation multi slice computed tomography allows reliable assessment of Cardiac morphology in neonates with complex congenital defects. By 3D Printing technology an accurate, realistic, and tangible heart model can be created in neonates with complex cardiac defects. 3D printed heart models should help the Surgeon in pre-procedural planning. It will help physicians to consult, educate patients and families and Training of students

