

3D Visualization of Two Surgical Approaches for Correcting a Congenital Heart Defect

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Introduction

Transposition of the Great Vessels (TGV) is a congenital heart defect (CHD) in which the great vessels are reversed – the aorta arises off of the right ventricle and the pulmonary trunks arise off of the left ventricle. The Mustard Procedure and the Arterial Switch Operation (ASO) are two primary examples of surgical correction approaches that have been used for patients with TGV without other congenital anomalies. This project aims to present 3D visual reconstructions of these two approaches, to visually compare the final anatomy of the heart post-surgery, and to better understand why the ASO has been the preferred method over the Mustard procedure since 1975.

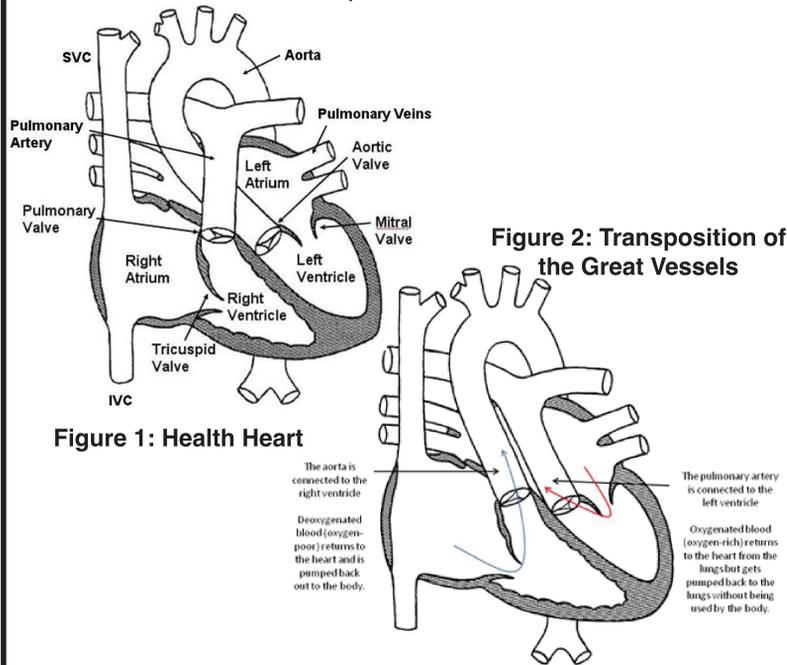


Figure 1: Health Heart

Figure 2: Transposition of the Great Vessels

Materials and Methods

Computerized tomography (CT) scans of two de-identified male patients were utilized to create 3D visual reconstructions. The first scan was a post-Mustard procedure correction and the second was a post-ASO correction, facilitated with the LeCompte Maneuver. The 3D computer reconstructions, animations, and 3D models were completed using a variety of 3D computer programs, including the image analysis software Amira, video editing software Camtasia, and object assembly software Adobe 3D toolkit. A thorough journal review was also conducted for the two surgical procedures in question.

Results

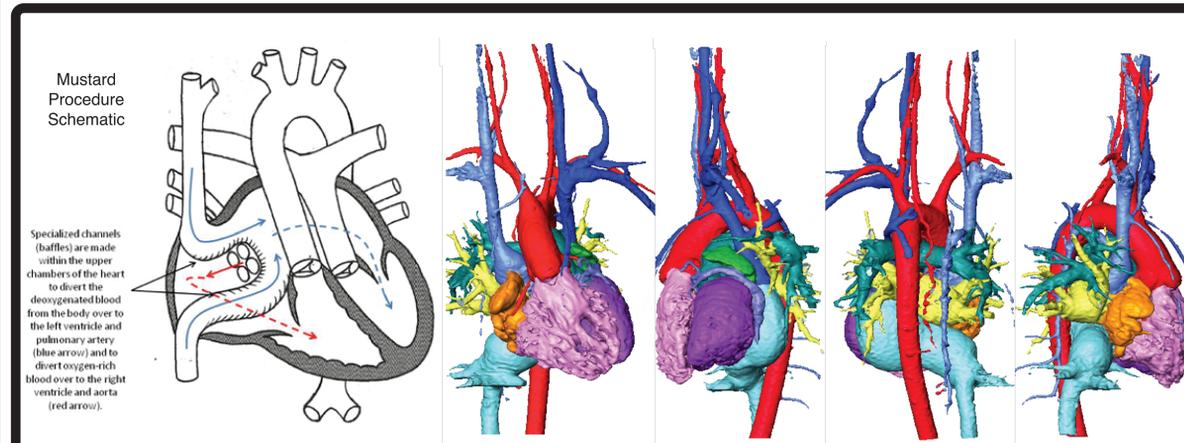


Figure 3: Post-Mustard Procedure

This procedure uses a baffle to redirect caval blood flow to the left atrium. The left side of the heart pumps deoxygenated blood to the lungs. The right side of the heart pumps oxygenated blood it receives from the pulmonary veins to the body. This individual was also born with bilateral superior vena cava and a dilated coronary sinus.

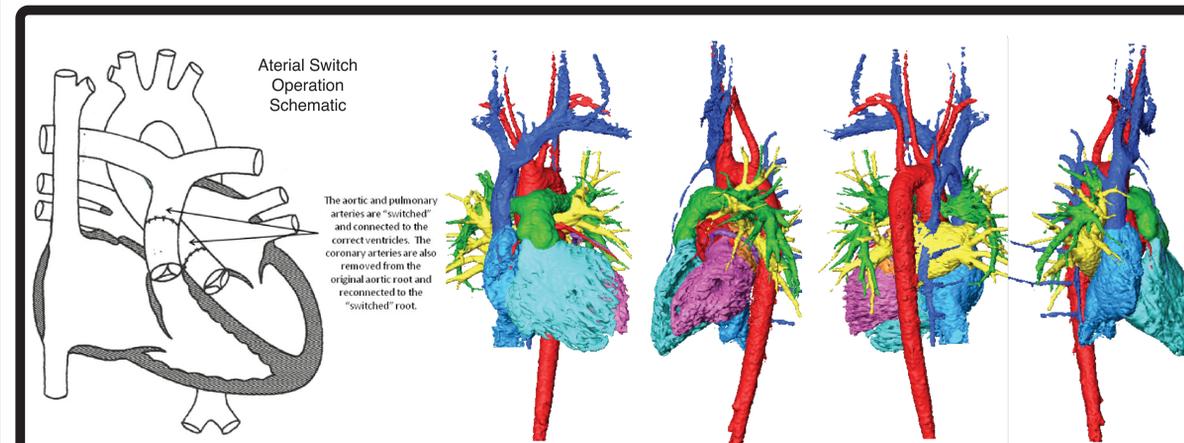


Figure 4: Post-Arterial Switch Operation with LeCompte Maneuver

In this procedure, the pulmonary trunk and the ascending aorta are both transected. Next, a maneuver named the LeCompte Maneuver, is utilized to bring the pulmonary trunk and its arterial branches forward, while the aorta is moved posteriorly. The pulmonary trunk is then joined to the right ventricle, while the aorta is joined to the left ventricle. The anatomy of the heart post-operation appears similar to a healthy heart, except the pulmonary arteries are now positioned anterior to the aorta due to the LeCompte Maneuver.

Discussion

The completion of the project demonstrated real life anatomy after two different and complicated surgical repairs and allowed for a comparison between the two. TGV has an incidence of 5% to 7% among the congenital heart defects, and therefore is the second most common cyanotic heart defect. Determining the safest and longer lasting procedure is of the utmost importance. Journal review revealed that the Mustard Procedure often results in long-term complications including baffle obstruction, right ventricle failure and atrial arrhythmias. In the Arterial Switch Operation, it is much more unusual to find cardiac arrhythmias, but will more likely see coronary artery complications. The use of 3D imaging allows for easier visualization of perhaps why these complications may occur, as the Mustard procedure results in the right ventricle abnormally becoming the main pump of the body and baffles being constructed through the atria. The benefits of 3D visualization of post-surgical congenital heart anomalies to health care professionals are vast. These techniques can aid students in learning CHDs, physicians in post-surgical treatment, and for patients in understanding their own disease.

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