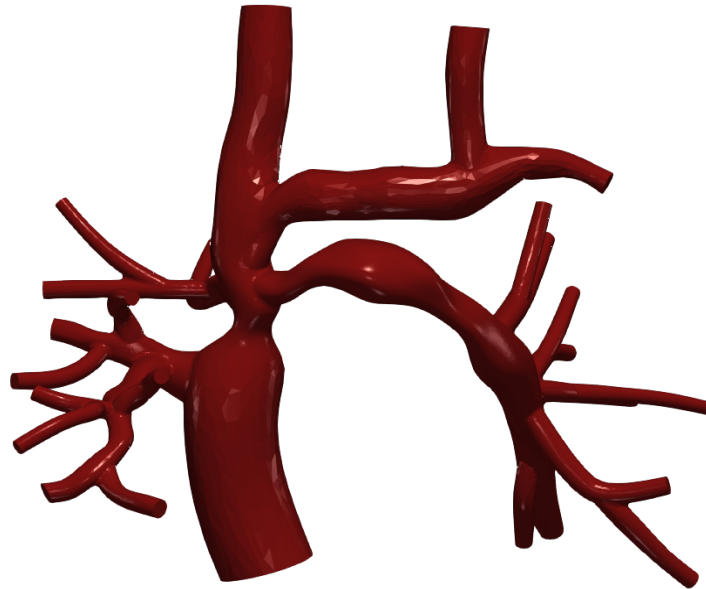


Vascular Model Repository

Specifications Document



0065_0001

Species	Human
Anatomy	Pulmonary
Disease	Congenital Heart Disease Single Ventricle Defect Tricuspid Atresia
Procedure	Fontan

Clinical Significance and Background

Pulmonary

The pulmonary circulation involves blood flowing from the right ventricle of the heart into the pulmonary arteries. From the pulmonary arteries, the blood then reaches the lungs, performs a gas exchange, and then continues to the pulmonary veins which then lead to the left atrium of the heart.

By definition, an artery is a blood vessel that carries blood away from the heart. This usually means arteries carry oxygenated blood to the rest of the body, but since the pulmonary arteries are transporting blood from the right side of the heart to the lungs to perform respiration, that makes the pulmonary arteries the only arteries in the body that actually carry deoxygenated blood. Similarly, the pulmonary veins, which carry blood that has been freshly oxygenated from the lungs back to the heart, are the only veins that actually carry oxygenated blood.

Congenital Heart Disease

Congenital heart disease is one or more problems with the heart's structure that exist since birth. Congenital means that you're born with the condition. Congenital heart disease in adults and children can change the way blood flows through the heart. Some types of congenital heart disease may be mild. But complex defects may cause life-threatening complications. However, advances in diagnosis and treatment continue to improve survival for those with congenital heart disease. People with congenital heart disease need lifelong medical care. Treatment may include regular checkups (watchful waiting), medications or surgery.

Single Ventricle Defect

A single ventricle defect (SVD) is a type of heart defect that a child is born with. It occurs when one of the two pumping chambers in the heart, called ventricles, isn't large enough or strong enough to work correctly. In some cases, the chamber might be missing a valve. Single ventricle defects are rare, affecting only about five out of 100,000 newborns. They are also one of the most complex heart problems, usually requiring at least one surgery. There are several types of single ventricle defects which include but are not limited to: tricuspid atresia, hypoplastic left heart syndrome (HLHS), mitral valve atresia (usually associated with HLHS), single left ventricle, double inlet left ventricle (DILV), double outlet right ventricle (DORV), pulmonary atresia with intact

ventricular septum (PA/IVS), Ebstein's anomaly, and atrioventricular canal defect (AV Canal).

Tricuspid Atresia

Tricuspid atresia is a birth defect of the tricuspid valve, which is the valve that controls blood flow from the right atrium (upper right chamber of the heart) to the right ventricle (lower right chamber of the heart). Tricuspid atresia occurs when this valve doesn't form at all, and no blood can go from the right atrium through the right ventricle to the lungs for oxygen.

In tricuspid atresia, since blood cannot directly flow from the right atrium to the right ventricle, blood must use other routes to bypass the unformed tricuspid valve. Babies born with tricuspid atresia often also have an atrial septal defect, which is a hole between the right and left atria, or a ventricular septal defect, which is a hole between the right and left ventricles. These defects allow oxygen-rich blood to mix with oxygen-poor blood, so that oxygen-rich blood has a way to get pumped to the rest of the body.

Fontan

The Fontan procedure is a type of open-heart surgery. Children who need this surgery usually have it when they're 18 - 36 months old. The Fontan procedure is done for children who are born with heart problems like hypoplastic left heart syndrome (HLHS), tricuspid atresia, and double outlet right ventricle, and depending on the heart problem, children may need the Norwood procedure and Glenn procedure before the Fontan surgery.

After the Fontan procedure, the blood from the lower body goes directly to the lungs. The blood with high oxygen goes into the heart. This way the single ventricle only pumps blood to the body and only pumps blood with high oxygen to the body. There is no more mixing of oxygen-rich blood and oxygen-poor blood.

During the Fontan procedure, the surgeon first disconnects the inferior vena cava (IVC) from the heart and connects it to the pulmonary artery using a conduit (tube). Then, the surgeon makes a small hole between the conduit and the right atrium. This hole (or fenestration) lets some blood still flow back to the heart. It prevents too much blood from flowing to the lungs right away so they have time to adjust. Doctors can close the

fenestration later by doing a cardiac catheterization procedure.

Clinical Data

General Patient Data

Age (yrs)	5
Sex	Female

Specific Patient Data

BSA (m ²)	0.68
CI (L/min/m ²)	2.8
P IVC MP cath	11
P SVC MP cath	11
P LPA MP cath	7
P RPA MP cath	9

Notes

Paper patient "F". See [DOI](#) for more details. See below for information on the image data and boundary conditions associated with the model.

Image Modality: CT

Image Type: DICOM

Image Source: TLAB

Image Manufacturer: SIEMENS

Boundary Conditions: Refer to boundary conditions in the SimVascular file.

Publications

See the following publications which include the featured model for more details:

Marsden, A. L., Reddy, V. M., Shadden, S. C., Chan, F. P., Taylor, C. A., & Feinstein, J. A. (2010). A new multiparameter approach to computational simulation for Fontan assessment and redesign. *Congenital Heart Disease*, 5(2), 104-117.
<http://www.doi.org/10.1111/j.1747-0803.2010.00383.x>

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AND/OR

N.M. Wilson, A.K. Ortiz, and A.B. Johnson, "The Vascular Model Repository: A Public Resource of Medical Imaging Data and Blood Flow Simulation Results," J. Med. Devices 7(4), 040923 (Dec 05, 2013) doi:10.1115/1.4025983.

AND/OR

Reference the official website for this data: www.vascularmodel.com

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