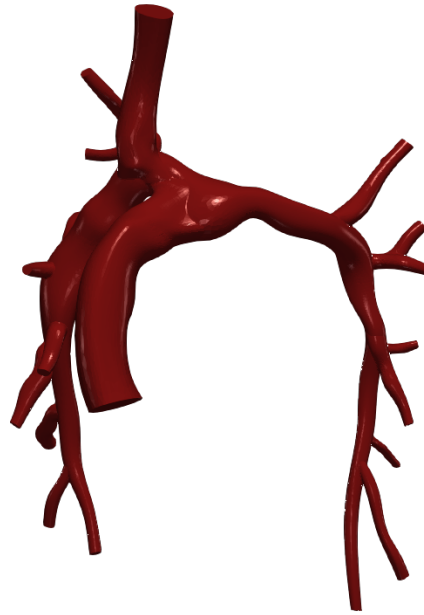


Vascular Model Repository

Specifications Document



0076_0001

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

Clinical Significance and Background

Pulmonary

The pulmonary arteries are blood vessels that carry systemic venous blood returning to the right side of the heart through to the microcirculation of the lungs. Unlike in other organs where arteries supply oxygenated blood, the blood carried by the pulmonary arteries is deoxygenated, as it is venous blood returning to the heart. The main pulmonary arteries emerge from the right side of the heart, and then split into smaller arteries that progressively divide and become arterioles, eventually narrowing into the capillary microcirculation of the lungs where gas exchange occurs.

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).

Pulmonary Atresia

Pulmonary atresia is a birth defect of the pulmonary valve, which is the valve that

controls blood flow from the right ventricle (lower right chamber of the heart) to the main pulmonary artery (the blood vessel that carries blood from the heart to the lungs). Pulmonary atresia is when this valve didn't form at all, and no blood can go from the right ventricle of the heart out to the lungs.

In pulmonary atresia, since blood cannot directly flow from the right ventricle of the heart out to the pulmonary artery, blood must use other routes to bypass the unformed pulmonary valve. The foramen ovale, a natural opening between the right and left upper chambers of the heart during pregnancy that usually closes after the baby is born, often remains open to allow blood flow to the lungs.

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)	26
Sex	Female

Specific Patient Data

BSA (m ²)	0.68
CI (L/min/m ²)	3.8
P IVC MP cath	15
P SVC MP cath	15
P LPA MP cath	14
P RPA MP cath	14
P aorta SP cath	140
P aorta DP cath	95
P aorta MP cath	108

Notes

See below for information on the image data and boundary conditions associated with the model.

Image Modality: MR

Image Type: DICOM

Image Source: TLAB

Image Manufacturer: GE MEDICAL SYSTEMS

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>

License

Copyright (c) Stanford University, the Regents of the University of California, Open Source Medical Software Corporation, and other parties.

All Rights Reserved.

Permission is hereby granted, free of charge, to any person obtaining a copy of this data to use the data for research and development purposes subject to the following conditions:

The above copyright notice and the README-COPYRIGHT file shall be included in all copies of any portion of this data. Whenever reasonable and possible in publications and presentations when this data is used in whole or part, please include an acknowledgement similar to the following:

"The data used herein was provided in whole or in part with Federal funds from the National Library of Medicine under Grant No. R01LM013120, and the National Heart, Lung, and Blood Institute, National Institutes of Health, Department of Health and Human Services, under Contract No. HHSN268201100035C"

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

THE DATA IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE DATA OR THE USE OR OTHER DEALINGS IN THE DATA.