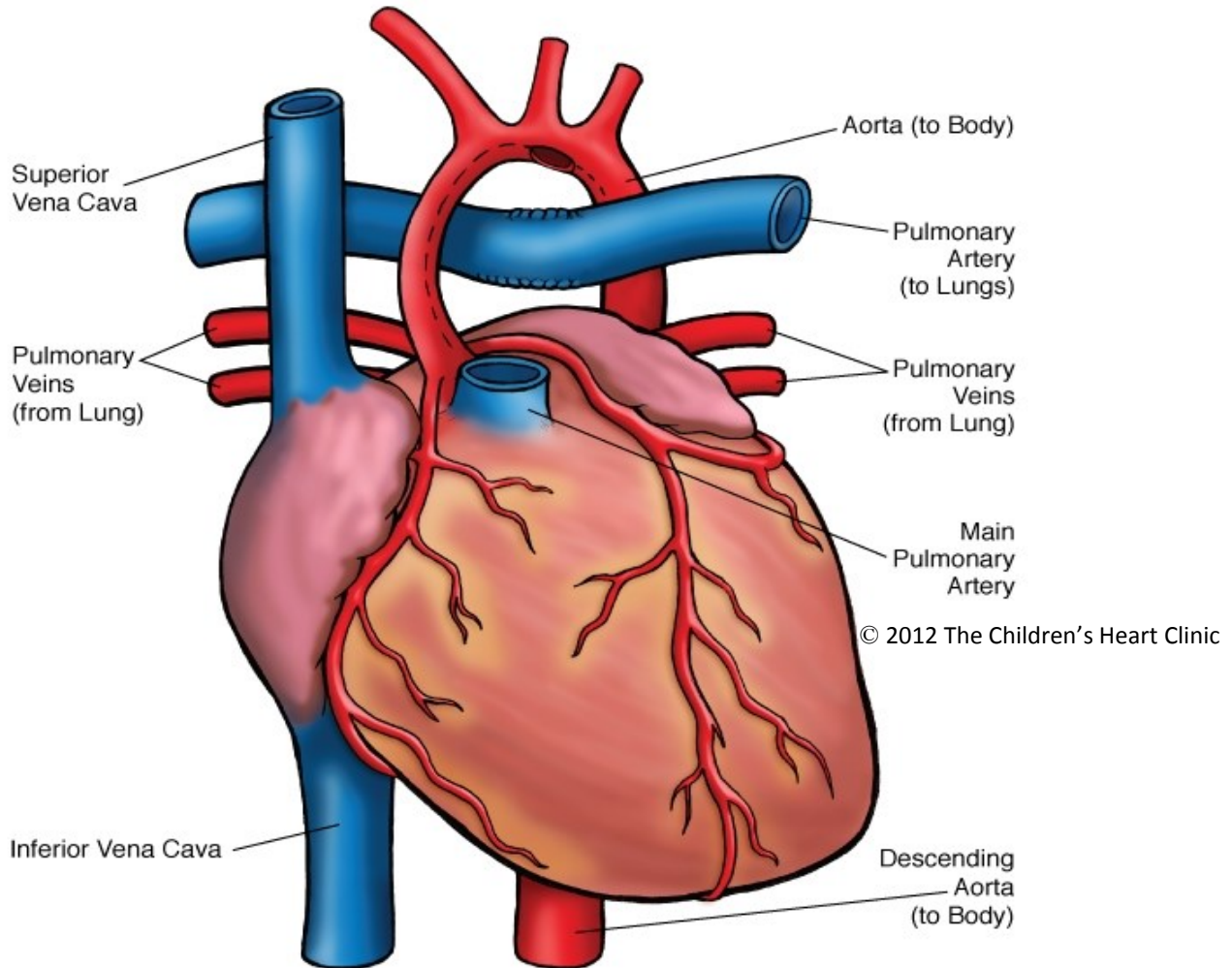
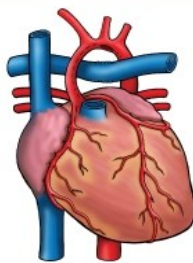


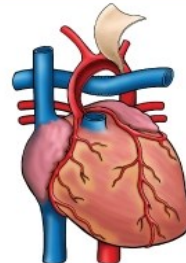
# Modified Norwood Procedure



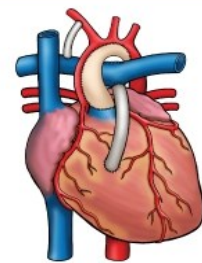
**NOTES:**



**Modified Norwood  
Part 1**



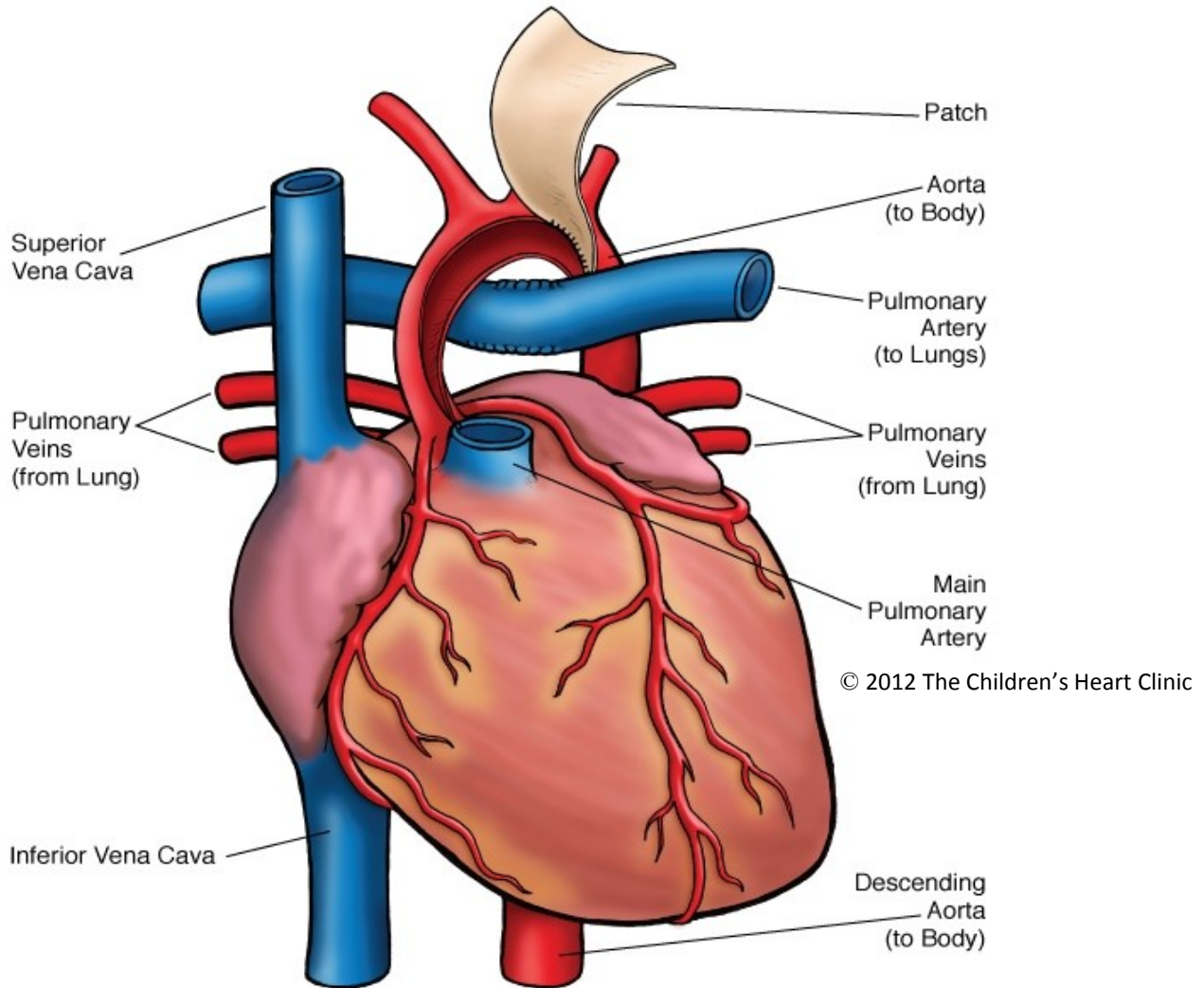
**Modified Norwood  
Part 2**



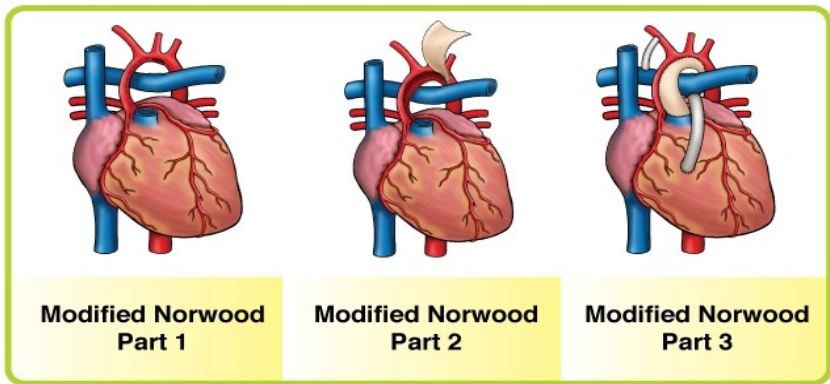
**Modified Norwood  
Part 3**

Children's Heart Clinic, P.A., 2530 Chicago Avenue S, Ste 500, Minneapolis, MN 55404  
 West Metro: 612-813-8800 \* East Metro: 651-220-8800 \* Toll Free: 1-800-938-0301 \* Fax: 612-813-8825  
 Children's Minnesota, 2525 Chicago Avenue S, Minneapolis, MN 55404  
 West Metro: 612-813-6000 \* East Metro: 651-220-6000

# Modified Norwood Procedure

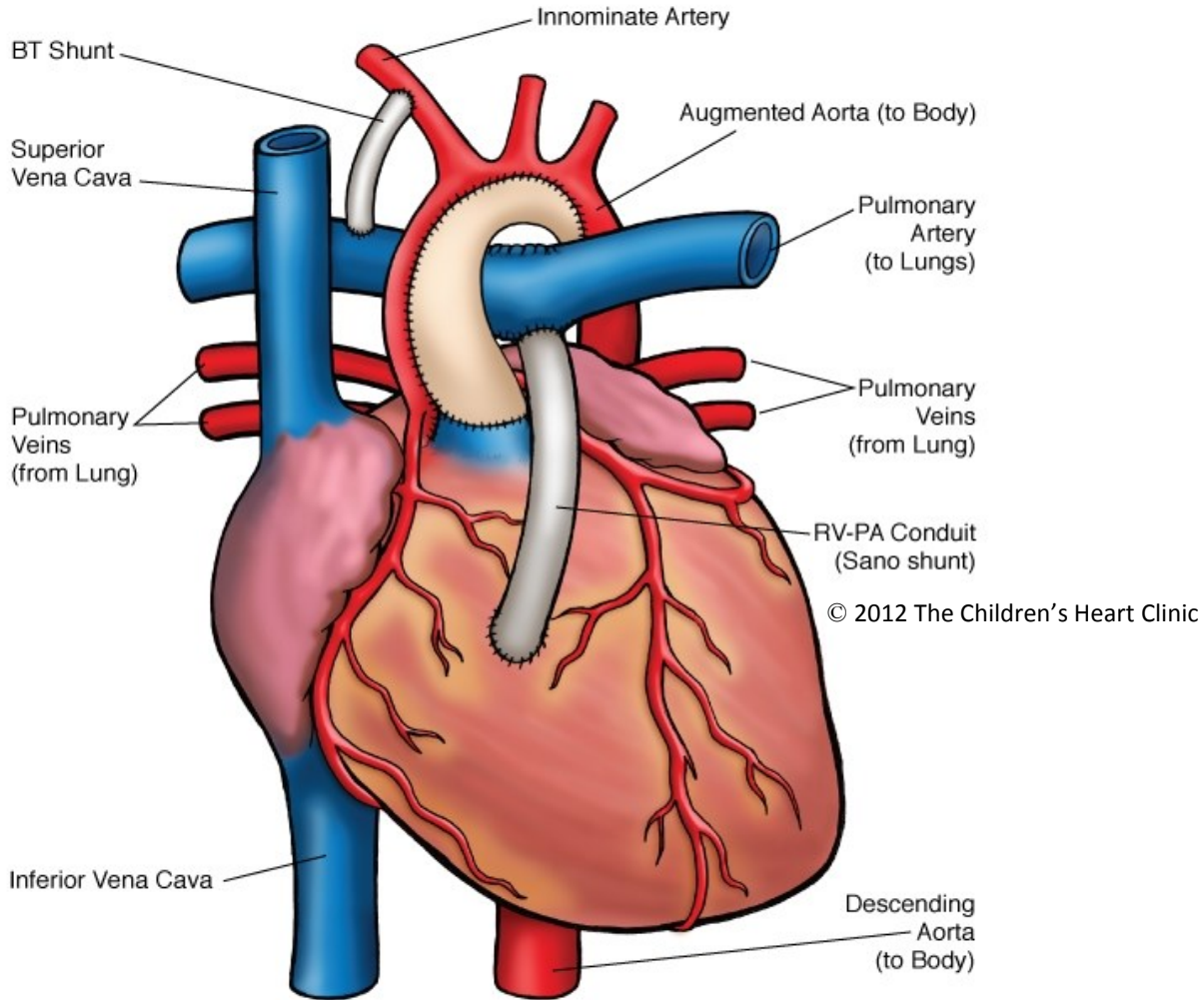



**NOTES:**

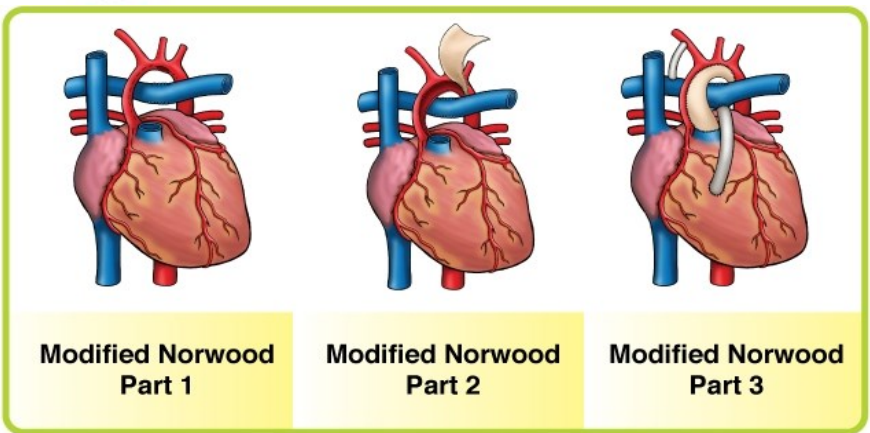


Children's Heart Clinic, P.A., 2530 Chicago Avenue S, Ste 500, Minneapolis, MN 55404  
 West Metro: 612-813-8800 \* East Metro: 651-220-8800 \* Toll Free: 1-800-938-0301 \* Fax: 612-813-8825  
 Children's Minnesota, 2525 Chicago Avenue S, Minneapolis, MN 55404  
 West Metro: 612-813-6000 \* East Metro: 651-220-6000

# Modified Norwood Procedure



 **NOTES:**



Children's Heart Clinic, P.A., 2530 Chicago Avenue S, Ste 500, Minneapolis, MN 55404  
 West Metro: 612-813-8800 \* East Metro: 651-220-8800 \* Toll Free: 1-800-938-0301 \* Fax: 612-813-8825  
 Children's Minnesota, 2525 Chicago Avenue S, Minneapolis, MN 55404  
 West Metro: 612-813-6000 \* East Metro: 651-220-6000

---

## Modified Norwood Procedure

The Norwood procedure is the first surgery (of three) for single ventricle palliation of hypoplastic left heart syndrome (see [HLHS](#)) and related anatomies. This procedure is done to create a new, adequate sized “neoaorta” to carry blood to the body, while providing a reliable source of pulmonary blood flow to maintain adequate oxygen saturations. Surgery is usually done within the first week of life.

A median sternotomy (incision through the middle of the chest) is done. A Gore-tex® tube graft (Gore) is sewn onto the innominate artery ([see modified Blalock-Taussig shunt](#)). The patient is placed on cardiopulmonary bypass (the heart-lung machine). The patent ductus arteriosus (PDA) is tied with suture and divided. The main pulmonary artery is divided. The resulting opening at the branch pulmonary arteries is oversewn. The right atrium is opened and an atrial septectomy (removal of the septum between the two upper chambers of the heart) is done. The patient is then placed on antegrade cerebral perfusion. This is a type of bypass where blood is circulated through the Gore-tex® shunt (Gore) on the innominate artery to give oxygenated blood to the head during the creation of the “neoaorta” or aortic arch reconstruction. Occasionally, an additional arterial cannula is placed in the descending aorta to perfuse the body (regional perfusion). The aorta is then incised from the ascending aorta all the way to the insertion site of the PDA. All ductal shelf tissue is removed. The adjacent walls of the ascending aorta and descending aorta are sewn together, forming the back wall of the aorta. The pulmonary artery root is then sewn to the aortic incision, just above the level of the coronary arteries. A patch of pulmonary homograft (cadaver pulmonary artery) is cut to fit and is sewn to the “neoaorta”. Once complete, normal cardiopulmonary bypass is commenced.

If the Norwood procedure employs a modified Blalock-Taussig shunt for pulmonary blood flow, the Gore-tex® tube graft (Gore) used during antegrade cerebral perfusion is then sewn to an incision on the right pulmonary artery. If the Norwood procedure employs a right ventricle to pulmonary artery conduit as a source of pulmonary blood flow (known as the Sano modification of the Norwood procedure), a Gore-tex® tube graft (Gore) is sewn onto an incision on the pulmonary artery and the other end is sewn over a hole created in the right ventricle. Once complete, the patient is weaned off of cardiopulmonary bypass. The chest is left open as a matter of routine, and the sternal incision is covered with a piece of Gore-tex® (Gore) or similar material. The chest is usually closed within 1-3 days of the operation (this is termed delayed sternal closure).

### Typical Post-Operative Course:

- **Surgery Length:** 5-6 hours
- **Typical Lines:** Most children will return to the Cardiovascular Care Center after surgery with a breathing tube, an arterial line to monitor blood pressure, a central venous line (for giving IV medicines and drawing labs), a peripheral IV, chest tubes to drain fluid, a foley catheter to drain urine, and temporary pacemaker wires.
- **Typical Post-Operative Recovery:** It is common for newborns to get slightly “puffy” after complex neonatal surgery. Delayed sternal closure is done when the patient is near their pre-operative weight and fluid status. The breathing tube is usually removed within a few days following the delayed sternal closure. The arterial line is usually removed once the breathing tube is out and most IV medicines are stopped. The central venous line is usually removed once most IV medicines are stopped and labs no longer need to be drawn. Chest tubes are usually removed within 24-48 following chest closure, once the output of fluid is minimal. Shortly after surgery, the patient is placed on heparin to prevent clotting in the shunt. Once the patient is eating, they are placed on aspirin and the heparin is stopped. Aspirin is continued at home until the next heart surgery.
- **Typical Length of Stay:** The average hospital stay following a Norwood Procedure is around 2-4 weeks. Length of stay is often dictated by the time it takes for the infant to learn to eat. It is not uncommon for babies to take a few weeks to learn to eat following surgery.

**Typical Home Medications:** Children will require one or more medications at home following a Norwood procedure such as:

- Diuretics (Lasix) to control fluid
- Anticoagulant (Aspirin, Lovenox) to prevent clotting
- Afterload reducing agent (Enalapril, Captopril)