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Impact of Ductus Arteriosus Blood Flow on Neonatal Cardiac Function

Shiraz Maskatia*

Department of Cardiology, University of Michigan, Ann Arbor, USA

Corresponding author: Shiraz Maskatia, Department of Cardiology, University of Michigan, Ann Arbor, USA, E-mail: maskatia@gmail.com

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Description

As the newborn moves from fetal to neonatal circulation, the cardiovascular system experiences major alterations at delivery. The closure of the Ductus Arteriosus (DA), a fetal conduit that joins the aorta to the pulmonary arteries and permits blood to avoid the lungs while still inside the womb, is one of these alterations. One of the most important aspects of this transition is the closure of the DA, which happens in the first 24 h after birth in term babies. This closure, however, may be delayed in premature infants, which could impact cerebral blood flow and heart function. At the same time, vascular conditions such aortic aneurysms and pseudoaneurysms frequently require sophisticated surgical procedures in the adult population. With promising results for problems involving the body's major vessels, endovascular methods have become less invasive than traditional open surgeries. Through case studies, this paper intricacies of arterial repair, the effect of DA blood flow on neonatal cardiac function and novel endovascular techniques. Because the lungs are not yet fully developed, the DA acts as a conduit for blood to avoid them throughout fetal development. In order to restore normal neonatal circulation after birth, where the lungs are now in charge of oxygen exchange, the DA must close. A disease called Patent Ductus Arteriosus (PDA), which is more prevalent in premature infants, can arise from failure to close the DA.

Cardiovascular adaptation in neonatals

After birth, elevated oxygen levels and a drop in circulating prostaglandins typically cause the DA to close in term newborns. This physiological closure stabilizes the newborn's heart function by minimizing pulmonary overcirculation and maximizing systemic blood flow. A left-to-right blood shunt caused by an open DA in preterm newborns can result in a number of problems, including heart failure, pulmonary hypertension and decreased cerebral blood flow. A study that simulated the newborn cardiovascular system using a lumped parameter model found that the effects of DA blood flow differed significantly between term and preterm neonates. According to the model, the Mean Artery Pressure (MAP) rose from 41 mmHg to 53 mmHg in term infants and only from 33 mmHg to 43 mmHg in preterm infants within 24 h of birth. Because of the delayed closure of the DA, preterm newborns have a decreased MAP, which indicates their susceptibility to hypotension and other cardiovascular problems. Additionally, the study discovered that within the same time period, the right cardiac output of term newborns increased from 551 mL/min to 706 mL/min, whereas the left cardiac output declined from 911 mL/min to 721 mL/min. The stability of the pulmonary and systemic circulation depends on this balance between the left and right cardiac outputs. The open DA creates a tremendous strain on the neonatal heart, which may lead to heart failure if treatment is not received. In preterm infants, the right cardiac output increased from 369 mL/min to 484 mL/min, whereas the left cardiac output fell from 705 mL/min to 612 mL/min.

Cerebral blood low and its implications

Another important aspect that is impacted by DA blood flow is cerebral blood flow. Within 24 h of birth, the cerebral blood flow in term newborns rose from 115 mL/min to 147.4 mL/min, meeting the oxygen and nutritional needs of the growing brain. Conversely, the rise in cerebral blood flow from 29.65 mL/min to 38.92 mL/min was less pronounced in preterm newborns. The significance of treating PDA in preterm newborns is highlighted by the possibility that neurodevelopmental abnormalities could result from this lack of cerebral perfusion. Vascular repair presents serious difficulties in the adult population, especially for disorders like aortic aneurysms and pseudoaneurysms, but DA closure and its consequences are concerning in neonatology. If left untreated, these disorders may result in potentially fatal side effects include ischemia, rupture, or bleeding. Despite its effectiveness, traditional open surgery is frequently linked to significant morbidity and protracted recovery periods. Conversely, endovascular techniques offer a less intrusive option that is especially advantageous for individuals who are at high risk. In one noteworthy instance, a 64-year-old lady who had undergone dissection showed up with an expanding aneurysm. Prior to aneurysm surgery, endovascular repair was carried out employing a new direct aorta-to-segmental artery bypass. A polyester graft was sewed into the aorta using pledgeted sutures after an incision was made at the eighth intercostal gap. An entry needle was used to get direct access to the previously treated aorta section, enabling the implantation of a stent and angioplasty to restore blood flow.