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Distribution of Cardiac Output and Oxygen Delivery in a Single Ventricle Physiology Model in an Acute Animal Model

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Introduction

When single-ventricle physiology is established acutely (e.g., after a Norwood procedure), the combination of low cardiac output and hypoxemia may result in oxygen delivery to systemic organs being compromised. The geographical distribution of cardiac output and oxygen delivery after the establishment of single-ventricle physiology is investigated in this work. Eight piglets were given single-ventricle physiology, while eight more piglets were used as sham control animals. The left ventricle was able to support systemic and pulmonary circulations thanks to aorto pulmonary shunt, echocardiography-guided atrial septostomy, tricuspid valve avulsion, and pulmonary artery occlusion. At baseline, 30 and 120 minutes following conversion to single-ventricle physiology, physiologic parameters and regional blood flow were measured. One-way and two-way analysis of variance was used to compare parameters. To achieve a stable equilibrium between the systemic and pulmonary circulation, neonates with Single-Ventricle Physiology (SVP) generally require considerable surgical intervention in the newborn period (stage I Norwood palliation). Despite the fact that the procedure's death rates have dropped in recent years, the regular incidence of end-organ dysfunction, mainly involving the brain and gastrointestinal tract, remains a substantial cause of morbidity in the early postoperative period. Recent research reveals that reduced Cardiac Output (CO) and insufficient regional blood flow may cause severe organ dysfunction in infants with complicated congenital heart disease. Hypoxemia and low arterial oxygen content have been linked to an increase in this risk. Because of the combination of hypoxemia and poor CO reserve, neonates with SVP are especially vulnerable to insufficient end-organ oxygen supply. Yorkshire piglets weighing 3.7 0.4 kg were utilised. The study was authorised by the University of Miami's Animal Care and Use Committee and carried out in accordance with the National Research Council's guidelines for the Care and Use of Laboratory Animals from 1996. Piglets were given intramuscular ketamine (40 mg/kg) and xylazine (4 mg/kg) before being intubated and started on volumecontrol breathing (tidal volume, 25-30 mL/kg; rate, 25 breaths/min; inspired oxygen fraction, 0.25; Impact Instrumentation, West Caldwell, NJ). Fentanyl (50 mg kg1 h1), pancuronium (0.4 mg kg1 h1), and midazolam (0.2 mg kg1 h1) were used to maintain anaesthesia. For pressure monitoring and blood samples, a catheter was placed into the femoral artery. For fluid administration and subsequent placement of a balloon atrial septostomy catheter, a 6F introducer sheath was inserted in the femoral vein. Randsbaek and colleagues presented a singleventricle model that looked similar. 9, 11, and 12 Catheters were inserted into the right and left atriums via a median sternotomy. Heparin (150 U/kg) was given, and a 3.5 mm Gore-Tex shunt was placed between the aorta (near the innominate artery's takeoff) and the major pulmonary artery. A 2-ml balloon septostomy catheter (Medtronic Vascular, Danvers, Mass) was pushed from the right femoral vein into the right atrium after the shunt was created. The catheter was guided over the atrial septum and a pull-back septostomy was performed using epicardial 2-dimensional echocardiography. After that, the same catheter was inserted into the right ventricle.