Anesthetic Management of High Risk Neonates Undergoing Single Ventricle Palliation with a Novel Hybrid Strategy
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Introduction: Stenting the ductus arteriosus and banding the pulmonary arteries is an alternative approach for the initial palliation of infants with hypoplastic left heart syndrome (HLHS) and other complex single ventricle lesions.1-6 At our institution, this approach is done in our cardiac catheterization laboratory in a combined (hybrid), single stage procedure during which a surgeon bands the branch pulmonary arteries (PAs) and an interventional cardiologist stents the ductus arteriosus. This management approach presents new challenges for the pediatric anesthesiologist working in an off-site location. We report our experience in the anesthetic management of nine patients with HLHS or similar complex single ventricle lesions who underwent this hybrid procedure.

Methods: After institutional review board approval, we reviewed the anesthetic records of nine patients with HLHS or a similar anomaly who underwent initial palliation by a hybrid approach. The hybrid procedure was performed in the cardiac catheterization laboratory for its superior imaging capabilities. Cardiac nursing staff, perfusionists, catheterization laboratory personnel, surgical and anesthesia staff were all present. Via a median sternotomy, branch PAs were banded using 3.5mm Gore-Tex rings and adjusted to achieve oxygen saturations of approximately 80% on 35% FiO2. Heparin 20 U/kg was administered after PA banding. Next, a 5-0 purse string suture was placed at the sinotubular junction of the main pulmonary artery (MPA). A 6 or 7 French sheath was then introduced into the MPA via direct puncture using a 0.021” gauge Cook needle. Once the ductus size was measured by initial angiography, the proper size 20 mm long self-expandable stent (Precise from Cordis or Protégé from ev3) was deployed over a wire positioned in the descending aorta via the ductus. In addition, two patients required placement of a stent in the atrial septum due to a restrictive communication. The stent was deployed via a sheath positioned in the left atrium via a direct atrial puncture. All patients had a right/common atrial catheter placed for central access.

Results: Preoperative diagnosis was HLHS (n = 7) or interrupted aortic arch with associated cardiac anomalies that precluded biventricular repair (n = 2). Patients ranged from 2-18 days of age (median = 4 days) with weight ranging from 2.3-3.6 kg (median = 3.0 kg). Five patients were on low dose inotropic support prior to the procedure. All patients had arterial catheters in place. All patients were mechanically ventilated and on prostaglandin. Average room and surgery time was 202 min (SD = 36 min) and 110 min (SD = 40 min) respectively. Estimated blood loss averaged 29.5 mL/kg (SD = 9.8 mL/kg). Blood loss occurred largely through the pulmonary arterial and atrial sheaths. All patients were transfused with pRBCs or whole blood to maintain the hematocrit at approximately 45%. One patient suffered a cardiac arrest that required CPR and urgent cannulation onto ECMO. One patient had marked bradycardia that required escalation of inotropic/sympathomimetic support but this resolved when the chest was reopened and the transthoracic atrial catheter was repositioned.

Discussion: The hybrid stage I palliation has become a valid option in managing neonates with HLHS and similar cardiac anomalies. This technique avoids cardiopulmonary bypass within the first few days of life and is well tolerated. A combined first and second stage palliation is then performed beyond the neonatal period.4,7 Because these procedures are performed in the cardiac catheterization laboratory, they present unique challenges to the anesthesia team in coordinating the resources and anesthetic care for an “open” cardiac procedure in a remote location.

References:
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