Suspected Bronchovenous Fistula is Successfully Managed with ECMO and Apnea

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Introduction
Systemic air embolism is a potentially devastating complication during the weaning process from cardio-pulmonary bypass. Fortunately, air entrainment in the pulmonary vasculature is typically short lived and resolves with ventilation and air venting. We would like to report a case in which ventilation could not be resumed following repair of Obstructed Total Anomalous Pulmonary Venous Connection (TAPVC) due to pulmonary vein air entrainment associated with ventilation.

Case
- Male neonate born at 39 weeks gestation by repeat cesarean section
- Family history significant for sibling born with TAPVC, tracheoesophageal fistula, and a single ventricle
- Due to RH, serial fetal ultrasounds were performed on our patient with no cardiac anomalies noted.
- Baby developed profound cyanosis after delivery, TAPVC suspected
- Intubated at outside hospital and transferred to The University of Michigan
- Pre-operative transthoracic echo confirmed the diagnosis of TAPVC
- Patient underwent surgical repair on day 1 of life

Intraoperative Course
- Procedures performed
  - Manuropulmonary intubation of the pulmonary venous confluence
  - Ligature of the vertical vein
  - Atrial septal defect closure
- Uneventful induction, cannulation, initiation and maintenance of cardiopulmonary bypass (CPB)
- Upon resumption of mechanical ventilation, the patient developed sudden cardiovascular collapse
- Transesophageal echocardiography:
  - Global cardiac hypokinesis
  - Air bubbles entering the coronary arteries
  - Large amounts of air entering the left atrium via the pulmonary veins
  - Increased amounts of air with each delivered breath
  - Upon cessation of ventilation, the air no longer was seen entering the left side of the heart
- Full cardio pulmonary bypass was restarted without ventilation
- The patient became hemodynamically stable on CPB
- Transesophageal echocardiography on full CPB
  - No air entering the left side of the heart
  - Good contractility of the left and right ventricles
- The patient was placed on Veno-Arterial Extracorporeal Membrane Oxygenation (VA ECMO) without ventilation
- The patient was transported to the intensive care unit

Postoperative Course
- Postoperative day one
  - Attempts made to ventilate the patient using low peak airway pressures
  - Entrance of air into the arterial circulation was observed
  - Ventilation was stopped
  - Patient remained on VA ECMO
- Postoperative day seven
  - High frequency oscillatory ventilation (HFOV) initiated
  - No air entrainment was seen in the arterial circulation
  - Patient remained hemodynamically stable
- VA ECMO was discontinued once the patient was adequately ventilated using HFOV

Discussion
Effective de--airing of the pulmonary circulation is always a priority while weaning from CPB. In our patient, this process was complicated by the continuous entrainment of air into the pulmonary veins with ventilation. Broncho-venous fistula is a rare complication of ventilation in neonates; it has been associated with the use of high peak pressures required to ventilate neonates with poor pulmonary compliance. In this case, the use of VA ECMO allowed us to avoid positive pressure ventilation for an extended period of time, thereby allowing the fistula to heal and enabling the eventual discontinuation of ECMO.

References