Cardiac Arrest at Induction of Anesthesia in a Child with Undiagnosed Right-Ventricular Dependent Coronary Circulation

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Introduction: Cardiac arrest during pediatric anesthesia is an uncommon, but life-threatening perioperative complication. The etiology is unknown in less than 1% of cases. We report a cardiac arrest in a child with pulmonary atresia and intact ventricular septum (PAIVS), possibly due to right-ventricular dependent coronary circulation (RVDCC). The recognition of abnormal coronary flow in these patients can enhance the preparation for surgery and anesthesia and improve their perioperative outcome.

Case Presentation: The patient is a 3.5 year old male with pulmonary atresia with an intact ventricular septum (PAIVS). He is status post placement of a left Blalock-Taussig shunt, left pulmonary artery reconstruction and a bidirectional caval-pulmonary shunt. He was scheduled for a right heart catheterization with balloon dilation of a stenosed left pulmonary artery. Preoperative information included SaO2 85%, Hgb 14.7 g/dl and BP 88/40. Monitors included pulse oximetry, ECG, noninvasive blood pressure, bispectral index and end-tidal CO2. A mask induction proceeded using sevoflurane, during which the pulse oximeter, end-tidal CO2 and ECG tracing were stable. Following loss of consciousness, intravenous access was obtained and propofol 15mg and rocuronium 15mg were administered. Shortly thereafter the patient developed severe bradycardia with loss of palpable pulse and the oximetry signal. Chest compressions were begun and the patient intubated. A total of atropine 0.5 mg and epinephrine 20 mcg were administered with return of the pulse and oxygen saturation. Chest compressions were continued for a total of 4 minutes. There was no apparent etiology for the cardiac arrest. Following stabilization, anesthesia was maintained with sevoflurane and fentanyl. Following the cardiac arrest, the bispectral index (BIS®) reading decreased from 23 to 0, then gradually increased to 30, where it stabilized. The BIS reading was used to help titrate the amount of anesthetic given, especially in the immediate post-arrest period (Figure 1). The catheterization and angioplasty were accomplished without complication. A right ventriculogram was performed, which revealed significant coronary sinusoids and filling of the right coronary artery branches. A left heart catheterization was then performed which confirmed the diagnosis of RVDCC. (see figures 2-3). The remainder of the anesthetic course was unremarkable and the patient was extubated at the end of the case. The patient was discharged on the first postoperative day in stable condition and without neurological deficit.

Discussion: In the Pediatric Perioperative Cardiac Arrest (POCA) registry, Morray et al reported the incidence of pediatric cardiac arrest related to anesthesia at 1.4 per 10,000 cases with a mortality rate of 26%. Analysis of closed claims between 1985 and 1991 implicates the respiratory system in 43% of cases compared to 27% reported more recently. Cardiovascular causes have varied from 13% to 36%. Medication-related issues, including those caused by inhalational agents, was implicated in 37% of cases, but has declined to 20% from 1998 to 2003. Cardiac arrest of unclear etiology has a reported incidence of less than 1%. PAIVS is an uncommon complex congenital cardiac defect affecting 1-3% of patients with congenital heart disease. In this lesion, there is complete pulmonary atresia with varying degrees of right ventricular hypoplasia, tricuspid abnormalities and often, coronary artery anomalies. These infants have a fistulous communication between the right ventricle and coronary artery in 30-60% of cases. In the absence of forward coronary flow from the aortic root, these fistulae function as the only source of coronary perfusion, which occurs in 9% of patients. Coronary circulation in these patients is dependent on RV preload. A significant decrease in preload will also decrease coronary perfusion, causing a decrease in contractility and a further decrease in coronary perfusion. This can quickly lead to cardiac decompensation, as in our patient. Prevention of cardiac arrest in patients with PAIVS and a RVDCC involves maintaining an adequate preload, resulting in adequate coronary circulation. When patients with a diagnosis of pulmonary atresia with an intact ventricular septum require and operative procedure, investigations to identify the presence of RVDCC should be pursued, and extra caution in maintaining preload is warranted. Bispectral index monitoring during cardiac arrest has been previously reported. It has been shown that the BIS readings reached a plateau 30 minutes after return of spontaneous circulation and may be predictive of neurological outcome following an arrest. BIS values appear to follow our patient’s recovery of cerebral function and as such, may be a useful monitor during cardiac arrest.
References: