

CONTINUOUS INTRAOPERATIVE TEE MONITORING FOR A CHILD WITH FONTAN PATHWAY UNDERGOING POST SPINAL FUSION

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Abstract

The following case report describes a very challenging surgical case where the use of intraoperative, continuous TEE monitoring in the prone position was crucial for the anesthetic management (diagnosis and treatment) of a patient with single ventricle physiology. The use of TEE monitoring enabled the anesthesia team to continuously assess hemodynamic stability and respond immediately to hypotension and bradycardia in our patient, thereby providing optimal anesthetic care of the intraoperative spinal fusion patient with Fontan physiology.

Introduction

Improvement in the treatment of congenital heart disease has led to a rise in survival rates of patients with cardiac anomalies, thus patients are presenting more frequently for complex noncardiac surgical procedures. The following case report, with written parental consent, describes the continuous intraoperative use of transesophageal echocardiography in an adolescent with a Fontan circulation undergoing posterior spinal fusion for idiopathic thoracic scoliosis.

Case Description

A 15-year-old, 25 kg girl, with a history of idiopathic thoracic scoliosis (53 degree curve), presented for posterior spinal fusion T1-T10 with history of congenital hypoplastic left heart syndrome corrected by fenestrated Fontan procedure at 3 years of age.

In the OR, a 5-lead ECG was used to monitor ST segment changes. Anesthesia was induced with propofol 2 mg/kg followed by atracurium 0.5 mg/kg for intubation. She was intubated with a 6.0 oral endotracheal tube. An 18g peripheral IV, a 22g right radial arterial line, and a right IJ 5 french 12cm triple lumen catheter were inserted. Initial central venous pressure (CVP) reading

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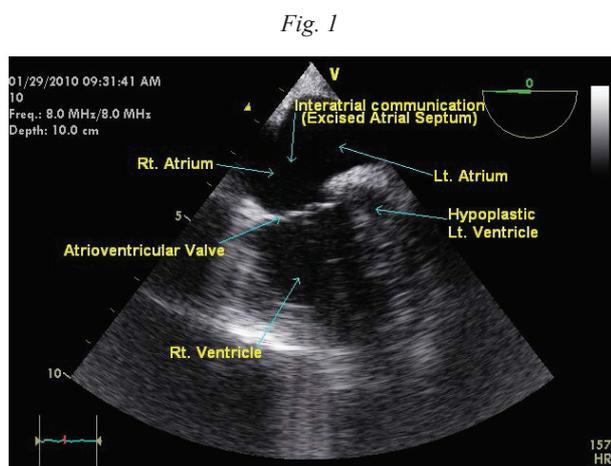
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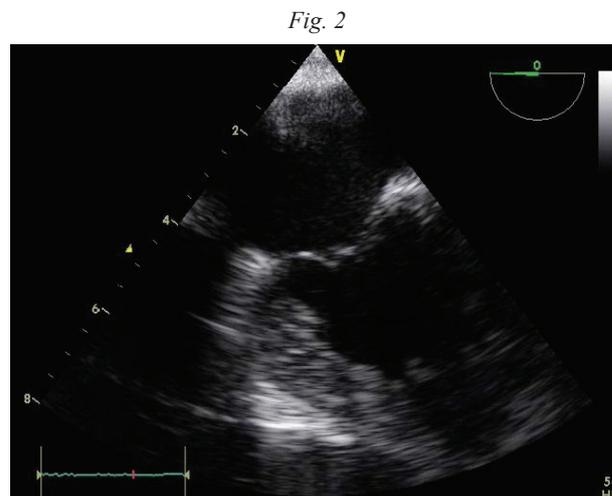
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was 13-15 mmHg. A transesophageal echocardiogram (TEE) probe (9T/9T-RSTEE) was placed through an endoscopic bite block (Inoris). Baseline readings showed good filling volumes of the right atrium (RA), well-functioning Fontan baffle with small fenestration, normal tricuspid valve function without regurgitation, and good right ventricular (RV) size and function (fig. 1). Anesthesia was maintained with O₂/Air with FiO₂ 0.5 Sevoflurane 1%.



The patient was placed prone with longitudinal bolsters. Chest and abdominal excursion, and TEE placement were confirmed. Heart function was assessed prone, which demonstrated no change from initial study. Vital signs remained stable, CVP reading was 18-20 mmHg, and surgery commenced.

For evoked potential monitoring, sevoflurane was reduced to 0.6%. Remifentanyl (0.1 mcg/kg/min) and propofol (50 mcg/kg/min) were started. Blood pressure dropped to 85/45 mmHg and heart rate dropped from 110 to 80bpm 2-3 minutes later. Despite reduction in sevoflurane to 0.2%, and infusion of dopamine at 5 mcg/kg/minute, blood pressure and heart rate further dropped to 60/40mm Hg and 60bpm. Heart function was assessed via TEE, showing dilated RA and RV, mild tricuspid valve regurgitation, and poor global RV contractility (fig. 2). Dopamine was increased to 10 mcg/kg/min Epinephrine was started at 0.05 mcg/kg/min, titrated to 0.15 mcg/kg/min. Remifentanyl was held, and propofol discontinued. Phenylephrine 80 mcg increased BP to 96/57 mmHg. Arterial blood gases remained normal.



Once blood pressure returned to 80/40 and heart function improved (TEE monitoring), dopamine was weaned to 3 mcg/kg/min and epinephrine was weaned to 0.04 mcg/kg/min. Fluid volume was titrated to maintain CVP readings of 18 mmHg. Once blood pressure stabilized to 90/50 mmHg, remifentanyl was restarted at 0.1 mcg/kg/min. Estimated blood loss was 200 cc.

At closure, remifentanyl, dopamine and epinephrine were weaned and discontinued. The patient was placed in the supine position and morphine was titrated for analgesia. TEE readings showed good volume status, tricuspid valve function and RV size and function. The TEE probe was removed. The patient became responsive, with good tidal volumes, and moved her extremities, and was extubated to 2L/min oxygen.

Discussion

Improved treatment of congenital heart disease has given patients opportunity to present as adolescents and adults for noncardiac surgical procedures. Idiopathic scoliosis occurs in 2-4% of the general population¹; though four times increased incidence in patients with cyanotic heart conditions². The anesthetic management of these patients presenting for spinal fusion and instrumentation can be very challenging. Only few cases have been reported describing their perioperative management. Patients who underwent a Fontan operation with palliations of their cardiac disease may present with significantly diminished

cardiac and pulmonary reserve³.

Patients undergoing spinal fusions lose nearly half of their blood volume intraoperatively, with the average blood loss estimated to be 800-1200 ml¹. This blood loss can result in significant hypotension and hemodynamic instability. Contributing factors for this substantial blood loss have been attributed to surgical technique, surgery duration, number of vertebral levels to be fused, and/or arterial pressure¹. Positioning the patient prone transmits pressure from the intrabdominal cavity to the epidural veins and increases bleeding; however, prone positioning with longitudinal bolsters relieves the sternal compression of the heart and limits subsequent increase in blood loss and hypotension^{1,4}. Fontan patients have potential for excessive blood loss secondary to elevated venous pressure¹.

Fontan patients possess a very fragile hemodynamic profile. They specifically require special attention to preload, contractility, cardiac output, and pulmonary vascular resistance (PVR)⁵. Since the systemic return directly enters the pulmonary circulation, preload is

vital for pulmonary blood flow and cardiac output. Pulmonary vascular blood flow may be impeded by hypothermia, hypoxia, hypercarbia, and sympathetic stimulation leading to increased PVR and decreased cardiac output³. Sluggish blood flow from the lack of pulsatile flow through pulmonary circulation poses a risk of thromboembolism⁶. However, preoperative thromboprophylaxis may contribute to blood loss⁷.

TEE provides a real time evaluation of preload, contractility, AV valve function, and cardiac output. Continuous qualitative evaluation utilizing the four chamber view can determine cause of hypotension. During blood loss, dynamic visualization of cardiac function and venous return enabled the maintenance of intravascular volume to maintain pulmonary blood flow and cardiac output. TEE is an effective adjunct to anesthesia monitoring. TEE enabled the anesthesia team to ascertain hemodynamic tolerance of positive pressure ventilation, administration of volatile agents and prone positioning.

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