2013 SPA PBLD: Hemodynamic and Ventilatory Concerns in a Neonate with Tetralogy of Fallot (TOF) Presenting for Omphalocele Repair

Moderators:

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Objectives:

1. Review important perioperative concerns for the low birth weight and very low birth weight neonate.

2. Appreciate the anesthetic consideration of omphalocele repair.

3. Understand the anesthetic considerations of a patient with congenital heart disease (CHD) presenting for noncardiac surgery.

4. Review the hemodynamic concerns for a patient with TOF during omphalocele closure.

Case History:
A 1300 gram, one day old, 29 week gestational age male with TOF presented to the operating room for omphalocele repair. The mother received one dose of betamethasone in preterm labor and was fully dilated on arrival to the hospital prior to delivering vaginally without complications (Apgars 6 and 9 at 1 and 5 minutes, respectively).

What are your concerns about a 1300 gram, 29 week gestation age newborn?

What are the anesthetic considerations for this patient given his weight and age?

Physical Examination:
Examination of the omphalocele demonstrated a large umbilical, tissue covered defect containing large intestine.

What is omphalocele?

What are the anesthetic concerns associated with it?
**Preoperative Studies:**
A chest x-ray taken shortly after intubation demonstrated air bronchograms consistent with respiratory distress syndrome (RDS). The preoperative transthoracic echocardiogram was significant for a large misalignment ventricular septal defect with an overriding aorta and mild subvalvar, valvar, and supravalvar pulmonary stenosis with normal biventricular systolic function and a tortuous patent ductus arteriosus.

What is TOF?

What are the anesthetic concerns associated with this congenital heart defect?

What are the hemodynamic considerations?

How, and when, is it repaired?

What are the long term issues associated with TOF after repair?

**Intraoperative Care:**
The patient arrived to the operating room with stable vital signs including an oxygen saturation of 97%. The patient had one 24G PIV. Induction of anesthesia was accomplished with rocuronium and fentanyl. The patient was intubated with a 3.0 endotracheal tube.

Does the patient need an RSI induction?

Will you place additional IV access?

Does the patient need an arterial line? A central line?

How will you maintain anesthesia?

You place a second 24G PIV, a dorsalis pedis 24 G arterial line, and an IJ central vein. Anesthesia was maintained with sevoflurane/oxygen/air. Patient was transiently hypotensive.

How will you treat hypotension?

During close of the abdominal wall defect, the patient begins to desaturate.

How will you treat desaturation?

What are the hemodynamic consequences of your treatment?

What are the anesthetic implications for a patient with a congenital heart defect undergoing noncardiac surgery?
**Postoperative Care:**

What are your concerns for this patient?

Will you attempt extubation? Why or why not?

**Discussion:**

Very low birth weight neonates (1000 – 1,499 grams) are at significantly increased risk of perinatal morbidity and mortality. Chronic lung disease, necrotizing enterocolitis, and intracranial hemorrhage are noteworthy causes of this increased risk. Additionally, these patients have major risk of electrolyte and glucose imbalances, temperature instability, congenital anomalies, retinopathy, and coagulation abnormalities. Furthermore, every organ system is susceptible to abnormalities which must be appreciated by the anesthesiologist. An understanding of the physiologic differences between a neonate and an older child is a must, including the increased metabolic rate, premature respiratory system, compliant noncalcified thorax, transition from fetal to extrauterine circulation, immature sympathetic system, increased total body water, reduced glomerular filtration rate, decreased serum protein concentration, decreased hepatic metabolism, and increased glucose consumption. A thorough history and physical exam focusing on each organ system is imperative prior to taking these patients to the operating room. A detailed anesthetic plan taking into consideration appropriate monitors, intravenous medication doses, heating and cooling methods, fluid and electrolyte management, intravenous access, as well as, airway, pulmonary, and cardiac management must be outlined prior to anesthesia. Patients with congenital heart disease, repaired or not, are at increased risk during noncardiac surgery and must be monitored closely perioperatively.

Tetralogy of Fallot is the most common cyanotic congenital heart defect and is associated with omphalocele. It is characterized on echocardiography by obstruction to right ventricular outflow (subvalvular, valvular, supravalvular, pulmonary arterial branches), right ventricular hypertrophy, an aorta that overrides the right and left ventricles, and a large single VSD (ventricular septal defect). Other abnormalities that may occur include a right aortic arch, an ASD (atrial septal defect), and coronary arterial anomalies.

Intraoperative considerations for TOF begin with a thorough review of cardiac function. The magnitude of a right-to-left intracardiac shunt can be increased by a decrease in systemic vascular resistance, an increase in pulmonary vascular resistance, and an increase in myocardial contractility (which accentuates infundibular obstruction to ejection of blood by the right ventricle. Resistance to ejection of blood into the pulmonary artery outflow tract is relatively fixed, and hence the magnitude of the shunt is inversely proportional to the systemic vascular resistance. Pulmonary blood flow decreases with positive pressure ventilation and PEEP. Anesthetic factors that decrease systemic vascular resistance increase the magnitude of right-to-left shunt and accentuate arterial hypoxemia. Intravascular fluid volume must be maintained with intravenous fluid administration because acute hypovolemia increases the magnitude of the right-to-left
intracardiac shunt. Phenylephrine is the classic drug used to treat undesirable decreases in systemic blood pressure.

Intraoperative considerations for omphalocele include meticulous fluid replacement and preservation of body temperature (these patients are at high risk of dehydration and hypothermia from fluid and heat loss from exposed abdominal viscera). Abdominal decompression is important as well as effective muscle relaxation for repair of large defects. Nitrous oxide is avoided because of it can interfere with the reduction of bowel back into the abdomen at the end of the case. Tight surgical abdominal closure can result in compression of the inferior vena cava and decreased diaphragmatic excursion which can worsen pulmonary compliance. Mechanical ventilation of the neonate’s lungs is often necessary for 24-to 48 hours following repair to avoid rupturing sutures.

During omphalocele repair, consequences of increased intraabdominal pressure often include decreased venous return from the lower body as well as desaturation from increased atelectasis and increased peak inspiratory and plateau pressures from decreased pulmonary compliance. In order to maintain tidal volumes and treat a desaturation event, one would typically increase ventilation pressures. The consequences of increased ventilatory pressures and decreased return to the right heart in a patient with TOF can be catastrophic.
References:


