ANESTHETIC MANAGEMENT FOR APPENDECTOMY IN A SINGLE VENTRICLE PATIENT S/P FONTAN COMPLETION- PBLD # 16

Steven R. Tosone, MD and Paul R. Hickey, MD

Objectives:
Participants in this problem-based learning discussion will:

Discuss the physiology of the mature single-ventricle patient after staged palliation

Discuss the preoperative evaluation of such patients

Understand the impact of different surgical strategies (open vs. laparoscopic) on anesthetic management

Develop appropriate plans for the anesthetic and postoperative management of such a patient

Stem case and questions:

An 8 year old girl is admitted via the Emergency Room with a 48 hour history of abdominal pain, fever and more recently, vomiting. On exam, she has extreme guarding and locates her most severe pain to the right lower quadrant. Lab results include leukocytosis with a WBC count of 18,600 and a C-reactive protein of 12. Surgeons plan an appendectomy. History reveals a diagnosis of hypoplastic left heart syndrome and that the patient has undergone all 3 stages of the Norwood palliation, the last (Fontan completion) at age 2 years. No other procedures have been required.

What are the anatomic features of the single ventricle circulation after Fontan completion and how do they affect the physiology?

How might one evaluate the patient’s cardiovascular status in this urgent setting?

How might fever, increased metabolic demand and dehydration impact this patient differently than one with a normal circulatory pattern?

The patient appears in the holding room of the operating suite, somewhat sleepy from morphine she received in the Emergency Room. A small-bore IV is infusing D5 ¼ NS at a maintenance rate. She remains flushed and febrile.

What monitors, in addition to ASA standard monitoring, are indicated here?
If you plan a rapid-sequence induction, what agent(s) would you select and how much of each? Is RSI essential? Discuss how/why one might modify this approach?

What are your considerations for maintaining the anesthetic? Are inhaled agents suitable? Do you plan for postoperative ventilation or prompt extubation?

**The surgeon plans a laparoscopic approach to the procedure, involving insufflation pressures of 15 cm H2O. Estimated surgical time is predicted to be between 30 and 60 minutes.**

Do you have any reason to object to this plan in this patient? Would your answer be different if the patient was barely active and being considered for cardiac transplantation?

What might you predict the effects of peritoneal CO2 insufflation to be on this patient’s cardiovascular and respiratory physiology?

Should you insist that blood for transfusion be available?

**End-tidal carbon dioxide shortly after insufflation rises to 52 mmHg on standard ventilator settings (tidal volume of 12 cc/kg, rate of 12/min resulting in a peak pressure of 24 cm H2O). Mean arterial pressure is down from 70 to 50 mmHg. Pulse oximetry has decreased from 92 % to 85%.**

What if any changes would you make to your care at this point? What is an acceptable end-tidal CO2 here?

What is the effect on pulmonary vascular resistance (PVR) of (a) elevated PaCO2, (b) reduced lung volumes, and (c) elevated mean airway pressures?

What is the effect of increased PVR on cardiac output in this patient? Is there any relationship between arterial saturation and cardiac output here?

What interventions might be expected to lower PVR in this setting?

Might positive end-expiratory pressure (PEEP) be helpful or harmful? How would you know which?

Would you consider suggesting conversion to an open procedure?

**In addition to local infiltration of bupivacaine at trochar sites, the patient has received fentanyl 2 mcg/kg at the end of the case. She is now in PACU and complaining of pain, though not entirely awake.**

How would you manage her pain now and for the remainder of her acute phase recovery?
Is Patient-Controlled Analgesia contraindicated in this setting?

Is this patient at increased risk for hemorrhage and is so, why?

Were this to become a major abdominal procedure, how might an epidural infusion affect her cardiovascular status?

Are there unique concerns in this patient related to coagulation that affect consideration of continuous regional anesthetic techniques?

**Suggested Reading:**

1. McGowan FX: Perioperative Issues in Patients with Congenital Heart Disease, ASA Annual Meeting Refresher Course Lecture (#238), 2005

Discussion Outline for “Anesthetic Management for Fontan/Appendectomy”
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1. Anatomy and physiology of the palliated single ventricle
   a. Surgical sequence and rationale
   b. Passive pulmonary blood flow and hemodynamics
   c. Factors controlling natural history of Fontan patients
   d. Evaluation of individual Fontan patient – high vs. low risk

2. Anesthetic planning
   a. Rapid sequence induction: risks vs. advantages
   b. Invasive monitoring?
   c. Selection of agents for maintenance – issues

3. Physiology of laparoscopy
   a. Absorption of CO2 and pneumoperitoneum effects
   b. End-tidal CO2 monitoring and PaCO2 in CHD
   c. Factors affecting PVR
   d. Ventilatory strategy in Fontan patients
   e. Management of reduced cardiac output, hypoxemia

4. Postoperative recovery and pain control
   a. Early vs. late extubation
   b. Increased bleeding from systemic venous hypertension
   c. Patient controlled analgesia in Fontan patients
   d. Continuous epidural for open laparotomy
   e. Venous stasis, pro and anticoagulant tendencies