



EXPLORATORY LAPAROTOMY (OPERATING ROOM)

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| Surgical Specialty: | General Surgery |
| Author: | Carl Christenson, MD, Senthil Packiasabapathy, MD, MS Indiana University School of Medicine, Indianapolis, IN |

Background:

- General Considerations:
 - Abdominal exploratory laparotomy in the pediatric patient is utilized in numerous emergent (perforated NEC, malrotation, gastroschisis, trauma) and urgent (obstruction, Hirschsprung's, duodenal atresia, Meckel's diverticulum, etc.) situations.¹
 - Re-operations may entail bleeding due to adhesions and a lengthened surgical time due to poor visualization or the need for more involved dissection.¹
- Patient Considerations:
 - Determine specific pathology necessitating exploratory laparotomy.
 - Assess hemodynamics, including markers of perfusion, and assess for shock.^{2,3}
 - Consider decreased bowel motility and "full stomach".^{3,4}
 - Evaluate medical comorbidities with particular attention to cardiovascular and pulmonary pathologies.¹
- Potential/Associated Comorbidities/Syndromes:⁴
 - VACTERL
 - Prematurity
 - Congenital heart disease (CHD)
 - Trisomy 21

Anesthetic Planning:

- Pre-Anesthetic Evaluation
 - Complete physical examination:
 - Assessment of fluid status, capillary refill time.
 - Abdominal examination, looking for distension.²
 - Vital signs, including HR and BP/MAP.³
 - Signs of sepsis vs septic shock.²
 - Additional labs/tests indicated during work-up
 - Evaluate radiologic imaging of the abdomen.^{1,2}
 - Laboratory values: BMP, electrolytes, lactate, Hgb/Hct, ABG, PT/INR.^{1,2}
 - Echocardiogram should be reviewed if there is concern for CHD.
 - Discussions to have with the surgeon/family
 - Risks/benefits/alternatives to proceeding with parents and surgeon.
 - Proceeding with the case despite a "full stomach" status leading to potential for aspiration.⁴
 - Possible placement and use of invasive monitors.^{1,2,3}
 - Need for adequate intravenous access, including possible CVC.^{1,3}
 - Possible administration of blood products.¹
 - Possible intubated, ventilated, sedated status and ICU level of care in the post-operative period.

- Specific or Unique Room Set-Up Requirements
 - Airway
 - Endotracheal intubation with a cuffed endotracheal tube.^{1,3}
 - The patient may be at risk for reflux or aspiration.⁴
 - Drugs/Infusions
 - Anxiolysis:
 - Oral midazolam at a dose of 0.5 mg/kg or IV midazolam at a dose of 0.1 mg/kg
 - Dexmedetomidine and ketamine are other options for anxiolysis
 - Preoperative Sedative medications should be avoided in patients with bowel obstruction / abdominal distension or other instances with increased risk of aspiration.
 - Induction:
 - Propofol 1-2 mg/kg bolus as hemodynamically tolerated.
 - Ketamine 1-2 mg/kg vs Etomidate 0.3 mg/kg if hemodynamically unstable (avoid Etomidate if concern for sepsis).⁴
 - Rapid sequence induction and intubation might be necessary in urgent/ emergent laparotomies using succinylcholine at a dose of 2 mg/kg or rocuronium at a dose of 1.2 mg/kg.
 - Maintenance of anesthesia:
 - Volatile anesthetic titrated to effect and hemodynamic stability.
 - Total Intravenous anesthetic (especially if a ventilator other than an anesthesia machine is required).
 - Opioids, muscle relaxants.
 - Neuromuscular blocking medications:
 - Rocuronium 0.6 mg/kg (1.2 mg/kg for RSI in patients with a full stomach)
 - Cisatracurium bolus 0.1 - 0.2 mg/kg vs infusion 1- 3 mcg/kg/min.
 - Analgesia:
 - Opioids: consider for hemodynamically stable induction vs blunting of sympathetic response intra-op. Be aware that neonates are at increased risk for post-operative apnea.^{2,5}
 - Fentanyl 1mcg/kg bolus.
 - Morphine 0.05 mg/kg - 0.1 mg/kg bolus.
 - Hydromorphone 5-10 mcg/kg
 - Methadone 0.05-0.1 mg/kg
 - Acetaminophen 15 mg/kg: if no co-existing liver dysfunction⁴
 - Consider caudal/epidural placement for post-operative analgesia in collaboration with the surgical team and based on patient hemodynamic stability, co-existing coagulopathy/sepsis, and urgency of the case.⁴
 - Vasoactive infusions as clinically indicated. Patients who present in sepsis may require vasoactive infusions:³
 - Epinephrine 0.02 – 1 mcg/kg/min.
 - Norepinephrine 0.05 - 0.1 mcg/kg/min (max 2mcg/kg/min)
 - Vasopressin 0.3 – 2 milliunits/kg/min.
 - PONV prophylaxis:
 - Ondansetron 0.1-0.15 mg/kg,
 - Reversal of neuromuscular blockade (if appropriate for extubation):

- Sugammadex 2 mg/kg.
- Neostigmine 50 mcg/kg with glycopyrrolate 10mcg/kg.
- Monitors
 - Standard ASA monitors.
 - Consider arterial line placement if hemodynamically unstable or in the setting of known CHD.^{1,4}
- Access
 - 2 large-bore catheters, preferably upper extremity.^{1,4}
 - Consider placement of a central venous catheter (CVC).¹
- Blood Availability
 - Consideration of in-room availability of cross-matched and checked RBCs, FFP, and platelets.³
- Other Indicated Resources
 - Consider a rapid transfusion method (I.e., Belmont, Level 1, etc).⁴
 - Consider the need for intraoperative laboratory monitoring, including ABG, CBC, electrolytes, and TEG as necessary.

Intraoperative Considerations:

- General
 - If septic, the patient may rapidly decompensate following the induction of anesthesia.
 - Patients can be acutely ill and require significant fluid resuscitation prior to and during anesthetic management.^{3,4}
 - Fluids
 - Third space and evaporative fluid losses can be significant and range from 6-10 mL/kg per hour; consider isotonic maintenance fluid infusion to offset losses.^{1,4}
 - Blood losses are preferably replaced with RBC and blood products at a 1:1 ratio. Adequacy of perfusion assessed by capillary refill and urine output (over 0.5 mL/kg/hr) can guide fluid administration. Lab values, including hematocrit and lactate levels, can also be a useful guide.
 - Significant heat loss can occur due to exposure of the open peritoneum. Consider the use of an underbody forced air warmer, fluid warmer, airway heater/humidifier, and ensure any blood products are appropriately warmed.^{1,2,4,5}
 - Reduction of FiO₂ as tolerated to help prevent free radical formation, particularly in neonates.^{1,4}
- Induction
 - Consider rapid sequence induction. However, inhalational, IV, or balanced can be utilized.^{1,4}
 - Can consider placement of a nasogastric tube pre-operatively.³ If an NG is in place, consider gentle aspiration prior to induction.¹ Can also consider placement of nasogastric vs orogastric tube post-induction for stomach decompression in discussion with the operative team.⁴
 - Avoid nitrous oxide in most cases.^{2,4}
 - Patients with intravenous access can have IV induction with propofol, ketamine, or etomidate.⁴
 - Deep muscle relaxation throughout the case.
- Positioning
 - Supine, arms often tucked
 - Possible need for Trendelenburg positioning.³
- Maintenance/Hemodynamic/Physiologic goals

- Adequate anesthetic depth with deep neuromuscular blockade to facilitate surgical view and operating conditions.¹
- Patient may be hemodynamically unstable if presenting with severe pathology, MAPs to be maintained appropriate for age.³
- Emergence/Disposition
 - For neonates, continued endotracheal intubation may be indicated.
 - In the older child, consider a dexmedetomidine bolus at 0.5 mcg/kg to facilitate a smooth wake-up as clinically indicated.⁴
 - Ensure appropriate reversal of neuromuscular blocking agents if planning to extubate
 - Ensure adequate analgesia to help facilitate inspiratory effort and successful extubation as appropriate.
 - PACU vs ICU setting based on patient hemodynamic status, course of case, and discussion with the surgical team.
- Postoperative Care
 - Patients may have significant pain following the procedure, leading to poor inspiratory effort or “splinting.”
 - Multi-modal approach to analgesia should be considered within the context of the patient and the case.^{1, 3}
 - Caudal or lumbar epidural anesthesia can provide excellent intra- and postoperative pain relief but may not be tolerated in some pediatric patients.¹
 - Careful use of opioids.¹
 - Continued evaluation of the patient's labs: Hct/Hgb, PT/INR, lactate, and BMP.
 - Continued evaluation of the patient's fluid balance and hemodynamics.

Case-Specific Complications/Pitfalls

- Aspiration
 - Volvulus, intussusception, trauma, etc., can lead to retention of gastric contents or a full stomach. This increases the risk of aspiration on induction. Minimize duration/pressure of bag and mask ventilation during induction, to minimize gastric distension, have suction prepared. Consider preoperative NG decompression prior to induction and rapid sequence induction and intubation in high-risk population.⁴
- Hemorrhage
 - Blood loss can be sudden and unanticipated.⁴
- Abdominal Compartment Syndrome:
 - Acute intra-abdominal pathology can result in increased abdominal pressures and lead to hypoperfusion of the kidneys, liver, and/or bowel. This can manifest as decreased renal/hepatic functioning, leading to coagulopathy and altered metabolism of medications. Reperfusion injury of the ischemic tissues, organ dysfunction can continue even after laparotomy.³

References

1. Chandrashekhar, Shishir, et al. "Anaesthesia for Neonatal Emergency Laparotomy." *BJA Education*, vol. 15, no. 4, 2015, pp. 194–198., <https://doi.org/10.1093/bjaceaccp/mku031>.
2. Caliskan, Esra. "Anesthetic Management of Neonatal Emergency Abdominal Surgery". *Actual Problems of Emergency Abdominal Surgery*, edited by Dmitry Garbuzenko, IntechOpen, 2016. 10.5772/63567.
3. Coté, Charles J., et al. *Coté and Lerman's a Practice of Anesthesia for Infants and Children*. Elsevier/Saunders, 2013.
4. Davis, Peter J., et al. *Smith's Anesthesia for Infants and Children*. 9th ed., Elsevier, 2022.
5. Boyer TJ, Kitzmire SM. *Neonatal Anesthesia*. [Updated 2022 Apr 30]. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK541030/>

Reviewed by:

Reviewer #1: Jessica S. Dominic, MD, Texas Children's Hospital

Reviewer #2: Young May Cha, MD, Children's Hospital Colorado

Reviewer #3: Amy Burns, MD, Nemours Children's Health, Jacksonville

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