Anesthetic Management for Ex Utero Intrapartum Therapy (EXIT)

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Pediatric Anesthesiology

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Objectives

- Review indications for the EXIT procedure
- Discuss anesthetic requirements for the EXIT procedure
- Identify possible implications for anesthetic management in view of recent FDA warning.
Disclosures

None
Indications for the EXIT procedure

• Airway Obstruction: Most common

• EXIT-to-Airway Procedure: Neonate’s airway established on uteroplacental support
Difficult Airway

Source:
Bissonett B et al. Syndromes: rapid recognition and peri-operative implications
Google images
Airway Obstruction

- Head and Neck masses:
  - Cervical teratoma
  - Oral teratoma
  - Head and neck lymphangiommas

- Congenital High Airway Obstruction
  - Laryngeal atresia
  - Laryngeal web
Fetal Airway Obstruction: Diagnosis

Courtesy of TCH Fetal Center
Fetal Airway Obstruction: Diagnosis

Courtesy of TCH Fetal Center
Evolving Indications for the EXIT Procedure

• Cardio-respiratory compromise

• Other conditions
Indications for the EXIT Procedure

Fetal conditions associated with Cardio-respiratory compromise

• Thoracic space-occupying lesions:
  • Congenital cystic adenomatoid malformations (CCAM)
  • Bronchopulmonary sequestrations
• Mediastinal masses
Indications for the EXIT Procedure

Fetal conditions associated with Cardio-respiratory compromise

• Sacrococcygeal Teratoma
• Congenital Diaphragmatic Hernia
  – EXIT-to-ECMO
• Cardiac anomalies
  – Hypoplastic left heart with Intact atrial septum
Indications for the EXIT Procedure

Other Conditions

• Twin pregnancy with difficult intubation
• Conjoined Twins
• Micrognathia
Types of EXIT Procedure

- EXIT-to-Resection
- EXIT-to-Extracorporeal membrane oxygenation (ECMO)
- EXIT-to-Intervention
EXIT-to-Resection

• Large thoracic space-occupying lesions
• Congenital pulmonary airway malformations (CPAM)
  • Congenital cystic adenomatoid malformations
  • Bronchopulmonary sequestrations
  • Mediastinal masses
• Sacrococcygeal Teratoma
Lung Lesions

Congenital pulmonary airway malformation (CPAM)

- Abnormal development of the tracheo-bronchial tree
- Majority will shrink
- 10% may increase in size during pregnancy
- Rapid increase in size between 22-26 weeks gestation.
Management of Lung Masses

• Serial ultrasound examination:
  – CCAM volume ratio (CVR):
    Tumor volume/head circumference
    – CVR < 1.6 → observation
    – CVR > 1.6 → high risk of developing heart failure
Fetal MRI for Lung Lesions

Large cystic and solid right lung CCAM with ascites
In-Utero Management

• Serial monitoring for development of hydrops
• In–utero fetal surgery may be necessary.
• Use of maternal steroids has altered management
• Indications for EXIT-to-Resection:
  • Persistent mediastinal shift at term
  • CVR >2.0
Perinatal Management of Lung Masses

• CPAMs do not participate in effective gas exchange

• Air trapping may occur with institution of positive pressure ventilation during resuscitation

• Large masses compress normal lungs

• May result in cardiac arrest if unrecognized or undiagnosed
Evaluation and Case Selection

• Presentation at large multi-disciplinary fetal meeting

• All disciplines involved in fetal intervention

• Alternative options discussed

• Family conference
Pre-operative Family Conference

- Obstetrician (Maternal-Fetal Medicine Specialists)
- Pediatric/Fetal Surgeons
- Anesthesiologists + Fellow
- Cardiologists
- Radiologists
- Neonatologists
- Social Worker
- Fetal Center Nurse Coordinators
Pre-operative Family Conference

- Step-by-step discussion of procedure
- Questions posed & answered
- Patient & family member(s)
  - Team members introduce themselves & explain roles
  - Consent obtained
- Blood ordered:
  - 4 units packed red cells (Mother)
  - 60cc O- blood (Fetus)
Anesthesia for EXIT-to-resection

Two operating rooms

- One for mother
  - Consider pre-op dry epidural placement vs. Intrathecal duramorph administration
  - Venous access X 2
  - Invasive blood pressure monitoring
  - Deep volatile anesthesia for uterine relaxation

- One for baby
  - (usually adjacent to mothers operating room)

- Mother’s operating room:
  - Consider pre-op dry epidural placement vs. Intrathecal duramorph administration
  - Venous access X 2
  - Invasive blood pressure monitoring
  - Deep volatile anesthesia for uterine relaxation
Anesthetic Considerations

**Pre-operative considerations**
- Sequential compression devices
- Anti-emetic/aspiration prophylaxis
- Spinal Duramorph for post-operative pain management

**Intra-operative considerations**
- Rapid sequence intubation
- Venous access X 2
- Invasive blood pressure monitoring
Mothers Operating Room: Items for Fetus (Sterile Field)

- Pulse oximeter probe
- 24 G IV catheters
- Penrose drain (tourniquet)
- Saline flush with extension for attachment to IV catheter
- Resuscitation medications:
  - Three 1 ml syringes each of Epinephrine 1 mcg/kg & 10 mcg/kg
  - Two 1 ml syringes of Calcium gluconate 30

Drugs

- Three 1-cc syringes with 27-G needles for IM administration containing combination of:
  - Vecuronium (0.1-0.2 mg/kg)
  - Fentanyl 5-10 mcg/kg
  - Atropine 20 mcg/kg
- Three syringes of Atropine 20mcg/kg
- Two 10cc syringes of Albumin
- Two 10cc syringes of Saline

Garcia PJ et al. Anesthesiology 2009
Equipment Preparation
Maternal Considerations

- Pain management:
  - Pre-operative epidural placement vs. Intrathecal Duramorph
  - Intra-operative opioids as indicated

- Surgical requirements for relaxed uterine field
  - 2-3 x MAC inhalational agent (S/E Hypotension)
    - Intermittent bolus dosing of Phenylephrine or Ephedrine
    - Continuous infusion of phenylephrine
Anesthetic Management/Considerations

• **Considerations for Fetus**

• Intraoperative Temperature regulation:
  – Intermittent warm fluid administration into uterine cavity
  – Increased room temperature (80 degrees Farenheit)

• Intra-operative Monitoring:
  – Continuous Pulse oximeter monitoring
  – Continuous Echocardiography
  – Intramuscular Vecuronium, Atropine & Fentanyl

• Blood availability (EXIT-to- Resection) : O negative blood
EXIT-to-Resection: Management of Fetus

- Monitoring: Pulse oximetry and echocardiography
- Intravenous (IV) access: Peripheral or umbilical cord
- Intramuscular or IV administration of opioid, anticholinergic and muscle relaxant
- Secure airway: Manual ventilation withheld until after lung mass as been exteriorized
EXIT-to-Resection: Management of Fetus

• Fluid administration (albumin, lactated ringers solution)
  – Recommended before mobilization of mass from thoracic cavity

• Blood transfusion may be required:
  – O negative packed red blood cells

• Resection may be completed on mother’s operating field or in adjacent operating room
Outcomes
FDA Warning December 14, 2016

• General Anesthetic and Sedation Drugs: Drug Safety Communication
  - New Warnings for Young Children and Pregnant Women

• **ISSUE:** FDA is warning that repeated or lengthy use (> 3 hours) of general anesthetic and sedation drugs during surgeries or procedures in *children younger than 3 years* or in *pregnant women during their third trimester* may affect the development of children’s brains.
FDA Warning: April 27, 2017

[ 4-27-2017 ] The U.S. Food and Drug Administration (FDA) is notifying the public that we have approved previously announced label changes regarding the use of general anesthetic and sedation medicines in children younger than 3 years.

In the U.S., surgeries during the third trimester of pregnancy requiring general anesthesia are performed only when medically necessary and rarely last longer than 3 hours. We are advising that in these situations, pregnant women should not delay or avoid surgeries or procedures during pregnancy, as doing so can negatively affect themselves and their infants.

Similarly, surgeries or procedures in children younger than 3 years should not be delayed or avoided when medically necessary. Consideration should be given to delaying potentially elective surgery in young children where medically appropriate.
EXIT procedure

• Approximately 3-4 cases/year

• Duration of utero-placental support: 15 – 90 minutes
What do we tell our patients?
Anesthesia and Your Pregnancy

Who needs anesthesia during pregnancy?

While most women will not need surgery during their pregnancy, approximately one in 50 women will undergo surgery on a procedure requiring anesthesia at some point during pregnancy. When surgery or other procedures are necessary, anesthesia or sedation is necessary to prevent pain, stress, and anxiety.

Pregnant women in 3 main categories may require anesthesia:

1. Anesthesia for Obstetric Surgery (pregnant women undergoing surgery related to their pregnancy such as cervical cerclage or cesarean delivery):
   - These surgical procedures are performed to deliver the baby (cesarean delivery) or to prevent miscarriages. In cervical cerclage surgery, a stitch around the cervix (cerclage), is performed to allow babies to have more time to grow and develop in the womb.
   - Cesarean deliveries are most often performed under general (total body) anesthesia. The FDA safety announcement only applies when general anesthesia is used.
   - In some instances (for example, emergency cesarean delivery), general anesthesia may be the best choice for the safety of the mother or baby.
   - Studies have shown that children exposed to general anesthesia during cesarean delivery are more likely to develop learning disabilities compared to children delivered vaginally. This suggests that brief exposure to anesthesia around the time of delivery does not adversely affect long-term developmental outcomes.

2. Anesthesia for Non-Obstetric Surgery (pregnant women undergoing surgery unrelated to their pregnancy, such as appendectomy or gallbladder removal):
   - Elective surgery is not performed during pregnancy. The decision to perform a surgical procedure during pregnancy is determined by emergency conditions or situations where a delay in surgery would increase risk to mother and possibly baby. No woman should be denied a procedure that is necessary simply because she is pregnant.
   - You will receive the amount of anesthesia necessary to keep you comfortable during the procedure.

3. Anesthesia for Fetal Surgery (women undergoing surgery for conditions related to their unborn child):
   - Fetal surgery is performed on babies with rare conditions who will benefit from surgical treatment before they are born.
   - While the exposure to anesthesia in some cases may be lengthy or repeated, anesthetics for fetal interventions has not been specifically determined to be associated with neurodevelopmental impairment in childhood.
   - Some studies have shown that certain fetal interventions may be associated with neurological impairment if left untreated.

Become an Informed Patient

- Ask for information about the planned surgery or procedure, including the need for anesthesia or sedation, the duration, and the need for anyrepeat procedures.
- Talk to your surgeon and anesthesiologist about potential adverse effects of anesthesia on the brain development of your child or unborn child. This discussion can occur at any time before the surgery.
- For obstetric or non-obstetric surgery, call the Pre-Anesthesia Testing Clinic at 832-626-3800.
- For surgery related to a fetal condition, call 832-626-5800 to speak with a fetal anesthesiologist.

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Select an Area of Research and a Protocol, then click 'Go' to get started.

Area of Research: Anesthesiology

Protocol: Fetal Anesthesia

Selected Protocol Title: Fetal Anesthesia Database
International Fetal Anesthesia Database

• Clinical Trials.gov identifier: NCT02591745
  – Ali Hassanpour: database optimization

• >100 patients recruited
International Fetal Anesthesia Database

- Participating institutions (Governing board):
  - Texas Children’s Hospital
  - University of Texas, Houston
  - Cincinnati Children’s Hospital
  - University of Belgium, Leuven
Fetal Anesthesia Team

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Pediatric Anesthesiology
Summary

• Identified indications for the EXIT procedure
• Reviewed different types of the EXIT procedure
• Discussed peri-operative & intra-operative anesthetic considerations
• FDA warning and implications for fetal interventions.
Thank You

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