Anesthesia for EXIT Procedures

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Disclosures
- None

Outline
- Classic and newer evolving indications
- Guiding principles of an EXIT procedure
- Anesthetic considerations during key portions
- Potential complications and management

Ex Utero Intrapartum Treatment
- Allows successful transition to extra uterine life
  - Potentially fatal neonatal emergency
  - Controlled clinical environment
  - Better outcomes

Indications for EXIT
- Reversal of tracheal occlusion
  - Following FETO
- Giant Fetal neck masses
  - Cervical teratoma
  - Lymphatic malformation
- EXIT to airway for severe micrognathia
  - EXIT to resection
  - CPAM/Mediastinal teratomas

Newer Indications for EXIT
- EXIT to ECMO
  - CDH with LHR <1.0 and liver up
  - HLHS with IAS
  - CHD and CDH, LHR <1.2
- EXIT to Separation for conjoined twin
- CHAOS
  - Tracheal atresia
  - Laryngeal atresia
Goals During EXIT

- Preserve utero-placental circulation
- Controlled uterine hypotonia
- Continuous fetal monitoring
- Maintain uterine volume

Uteroplacental Blood Flow

- Decreased uterine blood flow
- Hemorrhage/hypovolemic shock
- Aorto caval compression
- Endogenous catecholamines
- Venocaval compression
- Hypotension from deep anesthesia
- Sympathetic blockade from neuraxial block
- Uterine contractions
- Uterotonic drugs
- Valsalva maneuver
- Hemorrhage
- Hypotension from deep anesthesia
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- Aorto caval compression

Pitfalls

- Failure to maintain adequate maternal BP
- Failure to position with uterine displacement
- Failure to achieve adequate uterine relaxation

Compromised uteroplacental gas exchange

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Anesthesia for EXIT Procedures
**Tocolysis**

Desflurane, Sevoflurane, Halothane > Isoflurane

50% decrease in contractile amplitude at 1-1.5 MAC

Almost complete inhibition of tension at 2-3 MAC


**Goals During EXIT**

- Preserve utero placental circulation
- Controlled uterine hypotonia
- Continuous fetal monitoring
- Maintain uterine volume

**Fetal Monitoring**

- Sterile pulse oximeter on hand, covered by foil
- Normal range- 50-70%

**Fetal Monitoring**

- Continuous fetal echocardiography

Fetal distress
- Bradycardia
- Decreased filling
- Ductal constriction
- AV valve incompetence

**Fetal Distress**

- Umbilical cord compression
- Placental abruption
- Uterine contractions
- Fetal hypovolemia

**Pitfalls**

- Inadequate fetal monitoring
- Failure to recognize cord compression
- Unrecognized fetal distress
- Failure to recognize placental abruption
Goals During EXIT
- Preserve utero-placental circulation
- Controlled uterine hypotonia
- Minimize fetal cardiac dysfunction
- Maintain uterine volume

Maintain Uterine Volume
- Decreases likelihood of uterine contractions and placental abruption
  1. Infusion of warm Ringer’s lactate solution
  2. Partially delivering the fetus

Securing the Airway
- First fetal intervention
- What if the EXIT has to end abruptly?
- Flexible bronchoscopy to confirm position
- Surfactant administration
- No ventilation

EXIT Airway Algorithm
- Direct laryngoscopy
- Intubation
- Rigid bronchoscopy
- EXIT complete
- Successful tracheoscopy
- Elevate mass off airway
- Airway secured
- Open neck, release strap muscles
- EXIT complete
- Tracheostomy, retrograde intubation

Pitfalls
- Failure to secure airway first
- Loss of fetal airway
- Neonatal demise
- Failure to be prepared for every airway challenge
- Failure to use armored ETT

Conclusion of EXIT
- Close communication between surgeon & anesthesiologist is critical
- Volatile agent decreased or turned off
- Administration of oxytocin
- Manual uterine massage
- Uterine atony
- Maternal hemorrhage
Summary

- EXIT procedures allow successful transition to extrauterine life
- Indications continue to evolve
- Significant complications can occur
- Prompt recognition and management is critical
Fetal Surgery and ENT Airway

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Disclosure

- We have nothing to disclose
- We are not discussing any off label usage of pharmaceuticals or devices.

Colorado Fetal Care Case Numbers

- Comparison of a MFM center vs typical hospital.
  - Nager syndrome: EXIT vs OOPS vs OMG!
    - EXIT Intrapartum Treatment
      - Uterine relaxation, preservation of uterine volume and deep anesthesia for the baby
    - Operation On Placental Support
      - Inconsistent relaxation and uncontrolled timed support
    - Unexpected salvage operation (OMG!)

EXIT to Tracheotomy

- History of CB presentation
  - Fetal MRI
- EXIT to Tracheotomy
  - Video of procedure
- Follow up picture/3D model

Case CB/EB

- CB is a 37 year old G2P1 mother and wife.
  - 30 week gestation found abnormalities on ultrasound: micrognathia, arm anomalies, cardiac question.
  - Amniocentesis: Normal fetal karyotype, AFP, chromosomal microarray
Case CB/EB

- On 9/19/13 at CFCC
  - Cardiology: Fetal ECHO: AV tunnel, mild LV dilation
  - Ultrasound: SGA, severe micrognathia/retrognathia, abnormal upper extremities, abnormal ears, small VSD
  - Fetal MRI: Severe micrognathia, microstomia but otherwise patent airway, limb anomalies
  - Genetic Counseling: consistent with Nager Syndrome: expect normal cognition
  - OB, ENT(future jaw distraction), NICU expectations
  - Recommendations: EXIT-to-Airway at 36 weeks, expect cardiac surgery in first week, gastrostomy tube, future mandibular distraction

Case CB/EB

- Appointments
  - 9/25/13 Met with Neonatologist to review expectations of delivery, baby.
  - Weekly Ultrasounds
  - 10/9/13 Perinatologist meeting: Plan delivery 36 weeks (10/30/13). If labor occurs before, transport to CHMFCUnit if possible. If not able to transport, teams to go to her community hospital (143 beds).
  - 10/23/13 Admitted for hypertension – d/c home with normal urine values
  - 10/28/13 Admitted for hypertension – d/c home
  - 10/30/13 Admitted for EXIT to Airway

Fetal MRI CB/EB

- MFM team meets:
  - Phone tree for 45 days of 24/7 accountability
  - Discussion of procedure
  - Walk through, physically each person and space
- EXIT-to-Airway 7:00am in room - 11:40am to PACU
  - Mother Intubated 8:39am
  - Skin incision 9:38am
  - Uterine incision 9:59am
  - Trach placed 10:23am

EXIT-to-Trach Video

Exit to Tracheotomy Incision
EXIT to Tracheotomy Sutures

EXIT to Tracheotomy Placed

EXIT-to-Trach CB/EB

Findings:
- Normal neck anatomy
- Normal trachea
- 3.0 neonatal Shiley snug in trachea and touching carina
- Intact mandibular and maxillary ridges
- No mandibular excursion
- Large cleft of secondary palate
- Patent nares
- Tongue present – filling nasal cavity
- Posterior pharynx, hypopharynx, larynx unable to be visualized.

EXIT-to- Tracheotomy Conclusion

- Oral intubation would not have been successful.
- Nasotracheal intubation would not have been successful.
- Nasal trumpet would not have been sufficient.
- Laryngeal mask would not have made successful airway.
- EXIT-to-Tracheotomy was the only airway option – the only option for survival.