Anesthesia for Open Fetal Surgery—Myelomeningocele Repair

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Fetal Anesthesia Workshop – Saturday, March 14, 2015
Disclosures

None
Objectives

Describe myelomeningocele and associated morbidity

Review history of MOMS trial

Discuss open fetal surgery for myelomeningocele

Identify new frontiers
Myelomeningocele

- Most common open neural tube defect
- May occur anywhere along length of spinal cord (commonly lumbar and sacral region)
- Exposure of spinal cord to amniotic fluid = two hit theory
Myelomeningocele (MMC)

• Leakage of cerebrospinal fluid (CSF) →
  – Herniation of brain structures

  • Chiari II malformation

• Obstruction → Impaired drainage of CSF with resulting hydrocephalus and need for ventriculo-peritoneal shunt placement

• Motor dysfunction; neurogenic bladder and bowel
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MOMS Trial

- Pregnant mothers < 26 wks GA randomized:
  - Prenatal repair (in utero repair)
  - Post natal repair
  - 200 patients to be enrolled

- Primary outcome: Death or need for shunt at 12 months of age

- Secondary outcomes: Mental development and motor function @ 30 months
MOMS Trial

• Babies assessed at non-treating center for need for ventriculo-peritoneal shunt

• Trial stopped early due to efficacy of prenatal surgery compared to post natal repair

• Recruitment of 183/200 patients
# MOMS Trial Results

<table>
<thead>
<tr>
<th>Primary Outcomes</th>
<th>Pre-natal Repair</th>
<th>Post-natal Repair</th>
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<tbody>
<tr>
<td>Death</td>
<td>68%</td>
<td>98%</td>
</tr>
<tr>
<td>Need for shunt</td>
<td>40%</td>
<td>82%</td>
</tr>
<tr>
<td>Mental development</td>
<td>✓ ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Motor function</td>
<td>✓ ✓</td>
<td>✓</td>
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<table>
<thead>
<tr>
<th>Secondary Outcomes</th>
<th></th>
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<tbody>
<tr>
<td>Hindbrain herniation at 12 months</td>
<td>Reversed</td>
<td>Persistent</td>
</tr>
<tr>
<td>Ambulation by 30 months</td>
<td>Improved</td>
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Fetal MMC Pre & Post

- Hindbrain herniation
- Low CSF

- Reversal of hindbrain herniation
- Increased CSF
Management of Myelomeningocele

• Revolutionized care of fetuses with Myelomeningocele

• Increased number of centers adopting the proposed surgical approach to treatment

• Disadvantages:
  – Premature delivery
  – Uterine dehiscence
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Open Fetal Surgery for Myelomeningocele (MMC) Repair

• 22-26 weeks gestation

• Hysterotomy with special staplers (decrease bleeding)

• Relaxed uterus is imperative

• Close supervision for remainder of pregnancy
Anesthetic Considerations

Pre-operative considerations

• Anti-emetic/aspiration prophylaxis

• Lumber epidural placement for post-operative pain management

Intra-operative considerations

• Regular anesthetic (Sevoflurane) concentration at beginning of procedure

• Gradually increase anesthetic agent concentration after skin incision
Anesthetic Considerations

• Prior to uterine incision: 2-3 MAC for uterine relaxation
• Relaxation determined by manual palpation of the uterus
• Intraoperative monitoring of fetus by Cardiologist using Echocardiography
• Combination intramuscular fetal injection administered: – Fentanyl, Vecuronium & Atropine
• Time out prior to fetal skin incision
Anesthetic Considerations

Intra-operative considerations

• Continuous leakage of amniotic fluid during surgery
  – Intermittent infusion of warm fluid
    (Lactated ringers into uterine cavity)
    • Keeps uterus full, prevents expulsion of fetus
    • Judicious administration of intravenous fluid to mother (<500cc)

• MgSO₄ administered during closure of uterine incision
Anesthesia for MMC Repair

• MgSO₄ loading dose: 4-6 g with infusion of 2 g/hour
  – Caution: interaction of MgSO₄ and muscle relaxant

• Stepwise decrease in concentration of anesthetic agent
  – Alternative: IV anesthesia- Propofol & Remifentanil
Anesthesia for MMC Repair

• Incremental dosing of epidural catheter: 0.2% Ropivicaine or 0.25% Marcaine
  – T4-T6 sensory level

• Epidural infusion: opioid with local anesthetic
  – 0.1% Ropivicaine + high concentration Fentanyl

• Local anesthetic + regular concentration of opioid
Post-operative Management

- Premature labor is Achilles heel of in-utero surgery
  - Comfort for both mother & baby
  - High plasma concentration of opioid

- Pain management via epidural x 3-4 days
Drawbacks to Open in Utero Repair?

- Premature labor/delivery
- Uterine dehiscence
- Cesarean section for all subsequent pregnancies
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Fetoscopic Approach with CO$_2$ Insufflation

Partial amniotic carbon dioxide insufflation (PACI) facilitates fetoscopic interventions in complicated monochorionic twin pregnancies


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Fetoscopic Approach

• Investigational Review Board approved study

• Pfannestiel abdominal incision, Uterus is exteriorized

• Two small ports in the uterus (no uterine incision)

• Intrauterine CO$_2$ insufflation
  – To increase surgical visibility
  – To allow use of monopolar cautery
Fetoscopic MMC Repair
Anesthetic Management: Fetoscopic Approach

• Same as for open MMC repair

• Extra vigilance for CO$_2$ insufflation
  – Monitor end-tidal CO$_2$
  – Frequent arterial blood gases
Summary

• Reviewed clinical course of myelomeningocele

• Discussed MOMS trial and impact of results

• Anesthetic management of in utero surgery for MMC

• Potential new frontier in the in-utero management of this condition
Thank you!

Questions?
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