Surgical considerations in the pregnant patient

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Downstate University Hospital
Case Presentation

- 30 yo female presented to L&D triage (8/29) with 1 week hx of obstipation, nausea, bilious vomiting.

- G3P1 – 27 weeks pregnant
- PMHx: NSVD
- PSHx: laparoscopic salpingectomy for ectopic pregnancy
- Allergies: NKDA
- Meds: prenatal vitamin, iron
- SH: former smoker, EtOH prior to pregnancy, +marijuana

- Afebrile, HR 70-80s BP 110-120/60-70 SpO2 98-100% RR 18-20
- Abdomen: distended, tympanic, diffusely tender to palpation, gravid uterus

- Labs:
  - 8.4 11.2 122
  - 32.4
  - 3.5 105 0.34 91
Imaging
- Ultrasound – multiple fluid-filled bowel loops

GI evaluation (8/30)
- Constipation – treat with IVF and enemas/laxatives

Hospital Course
- Observation, IVF, tocolytics
- Surgery consult 9/1
  - NPO/NGT/IVF
  - MRI to evaluate for obstruction

Patient signed out AMA

Returned 9/3
- NGT placed
- MRI – markedly dilated small bowel with collapsed colon suggesting small bowel obstruction
To OR

- Pre-operative
  - NICU warmer and team on standby
  - OB attending/resident on standby
  - Pre-operative fetal monitoring
  - Magnesium drip to prevent preterm labor
  - Epidural anesthetic

- Exploratory laparotomy
- Adhesiolysis
- 4.5L of enteric contents
- EBL 10 mL
- 2.7L IVF
Post-op

• POD#0
  • Fetal monitoring immediately post-op
  • Fluid resuscitated for hypotension and tachycardia
• POD#1
  • To MICU for aggressive IVF hydration and electrolyte repletion
  • Epidural removed
  • Return of bowel function
  • C.diff positive– started on flagyl
• POD#2
  • NSVD in MICU (1260 grams)
  • PO diet
  • Foley removed
• POD#4
  • Discharged
Outline

- Epidemiology
- Specific adaptations to pregnancy
- Diagnostic challenges
- Surgical anesthesia
- Perioperative management
- Risk reduction
- Surgical Diseases
Epidemiology

• 1 in 500 women undergo non-obstetrical surgery during pregnancy (0.3-2.2%)

• Indications for non-obstetric related surgery
  • Abdominal disease
    • Appendicitis
    • Cholecystitis
    • Obstruction
  • Malignancies
  • Trauma
Maternal Physiology

- Increased concentrations of various hormones
  - First trimester
- Mechanical effects of gravid uterus
  - Second half of gestation
- Greater metabolic demand
- Hemodynamic consequences
  - Low-pressure placental circulation
Maternal Physiology

- Cardiovascular
  - Cardiac output up 50% due to increased HR and SV
  - Systemic and pulmonary vascular resistances decrease
  - Myocardial contractility is unaffected
  - IVC compression in second half of gestation from uterus
Maternal Physiology

- **Respiratory**
  - Additional CO2 load
  - Increase in tidal volume
  - Increased in minute ventilation
  - Increase in alveolar ventilation
  - Relative hyperventilation
  - Chronic mild respiratory alkalosis
  - Compensatory metabolic acidosis
  - Impingement of diaphragm
  - Decreased FRC
  - Decrease in total lung capacity
Maternal Physiology

- **GI changes**
  - Incompetence of LES – progesterone
    - Increased risk of GERD
    - Increased risk of aspiration pneumonitis
  - Displacement of intra-abdominal organs
  - Signs and symptoms, such as nausea, vomiting, may be normal findings in pregnancy
Maternal Physiology

- Blood volume and constituents
  - Increases by 30-45% by term.
  - Dilutional anemia (Hct 33)
  - Interstitial edema
  - Hypercoagulable state
    - Fibrinogen
    - Factors VII, VIII, X, XII
  - Enhanced platelet turnover
  - High risk for thromboembolic events
Maternal Physiology

- Renal
  - Increased renal blood flow and GFR
    - Increased plasma volume
    - Increased cardiac output
    - Vasodilation
  - Ureteral dilation
    - Progesterone
    - Extrinsic compression
    - Increase in urolithiasis
    - Increase in pyelonephritis
Patient presents with abdominal complaints with nausea, vomiting. Now what?

Normal symptoms of pregnancy or pathology?

- Differential
  - Round ligament pain
  - Contractions
  - Other Obstetric causes
    - Placental abruption
    - Torsion
    - Pre-term labor
  - Appendicitis
  - Cholecystitis
  - SBO
  - Pyelonephritis
  - PID

Diagnostic Imaging

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Diagnostic Imaging

- Safety of diagnostic radiologic tests in pregnancy
  - Potential of harm from ionizing radiation to fetus
  - Risk of delay in diagnosis can cause significant harm to the woman and her fetus.
- Effect of Ionizing radiation
  - Dose of radiation
  - Gestational age of exposure
- Teratogenicity
- Carcinogenic effect
  - Childhood leukemia
Imaging - teratogenicity

• Within the first 2 weeks
  • Significant cell damage from radiation results in miscarriages
  • Doses > 10 cGy leads to fetal demise
• Weeks 2 through 8
  • Period of organogenesis
  • Embryo is more resistant to radiation-induced death
  • Doses > 25 to 50 cGy leads to fetal demise
• Weeks 8 to 15
  • Fetal central nervous system is the most sensitive to radiation
  • Doses > 6 to 31 cGy lead to mental retardation and microcephaly
• Weeks 15-25
  • Fetal CNS risk persists
  • Doses > 2.5-15 cGy leads to mental retardation
• Over week 25
  • Fairly resistant to radiation-induced abnormalities
The patient should be reassured that the radiation exposure to the fetus from a diagnostic radiologic test does not confer a significant risk for fetal harm.

<table>
<thead>
<tr>
<th>RADIOLOGIC STUDY</th>
<th>ESTIMATED FETAL DOSE <em>(cGy)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest radiograph (posteroanterior, lateral)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Abdominal radiograph</td>
<td>0.1-0.3</td>
</tr>
<tr>
<td>Head computed tomography (CT)</td>
<td>0.0005</td>
</tr>
<tr>
<td>Chest CT</td>
<td>0.002-0.02</td>
</tr>
<tr>
<td>Abdominal CT</td>
<td>0.4-0.8</td>
</tr>
<tr>
<td><strong>Abdominopelvic CT</strong></td>
<td><strong>2.5-3.5</strong></td>
</tr>
<tr>
<td>Abdominopelvic CT (stone protocol)</td>
<td>1</td>
</tr>
<tr>
<td>Ventilation scan</td>
<td>0.007-0.05</td>
</tr>
<tr>
<td>Perfusion scan</td>
<td>0.04</td>
</tr>
<tr>
<td>Intravenous pyelography</td>
<td>0.6-1</td>
</tr>
<tr>
<td>Bone scan</td>
<td>0.3-0.5</td>
</tr>
<tr>
<td>Positron emission scan</td>
<td>1-1.5</td>
</tr>
<tr>
<td>Thyroid scan</td>
<td>0.01-0.02</td>
</tr>
<tr>
<td>Mammography</td>
<td>0.007-0.02</td>
</tr>
<tr>
<td>Small bowel series</td>
<td>0.7</td>
</tr>
<tr>
<td>Barium enema</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Imaging

• Reducing the effect of exposure of ionizing radiation to fetus
  • Abdominal lead shielding for non-pelvic studies
  • Other diagnostic modalities
    • Ultrasound
    • MRI
Imaging

• Ultrasound
  • Operator dependent
  • Ability to detect pathology decreases with increasing uterine size

• MRI
  • No teratogenic risk
  • Not to be used in trauma

• CT scan
  • Test of choice for trauma according to ATLS
  • Indicated in cases of appendicitis in which the diagnosis cannot be resolved by MRI or US
Anesthesia

• How will the plan change given that the patient is pregnant?
• Physiologic changes of pregnancy
  • Hormonal
  • Anatomical
Anesthetic considerations

• Aspiration precautions
• Antibiotic prophylaxis
  • Contraindicated
    • Tetracyclines
    • Fluroquinolones
    • Trimethoprim
    • Aminoglycosides
• Oropharyngeal edema and narrowing of the glottic opening.
Anesthetic considerations

- Ventilation
  - End tidal CO2 should be maintained at 32 - 34 mm Hg.
  - Excessive hyperventilation may impair uterine blood flow
  - Hypoventilation may increase the risk of fetal acidosis.

- Management of hypotension
  - Deliberate hypotension should be avoided to prevent decreased uteroplacental blood flow and fetal asphyxia.
  - Uterine displacement to relieve aortocaval compression
Anesthetic considerations

- Induction of inhalation anesthesia occurs more rapidly in pregnancy
  - Alveolar hyperventilation and decreased FRC lead to faster equilibration.
  - Decrease in minimum alveolar concentration speeds induction time.
- Emergence from anesthesia is a critical time period
  - Maternal deaths occur most frequently during extubation
  - Extubation should occur with steps to minimize gastric aspiration.
- Specific agents
  - No anesthetic agents have been directly identified as being teratogenic.
  - Exposure to anesthesia in utero has not been shown to cause learning disabilities in humans.
Anesthetic considerations

- **Induction agents** (Thiopental, propofol, and etomidate)
  - Rapidly transferred across the placenta
  - Metabolized quickly by the fetus
- **Opioids**
  - No evidence of teratogenicity with short term use
  - Do cross the placental barrier and can have effects on fetus
- **Benzos**
  - Not teratogenic and single dose during anesthesia is safe
  - No increased risk of cleft palate
Anesthetic considerations

- Local
  - Pregnant women are more sensitive
- Neuromuscular blockade
  - No effect on uterine relaxation
  - Do not cross placental barrier
  - Duration of succinylcholine reduced due to increased volume of distribution
- Nitrous oxide
  - Restrict administrative concentration to 50% or less before 8 weeks
  - Teratogenic in rats but no human proof
Perioperative Considerations

- Fetal Monitoring
- Laparoscopy
- Outcomes
- Risk Reduction
Fetal Monitoring

- Feasible beginning at approximately 18 to 20 weeks gestation
- Continuous intraoperative fetal monitoring is debatable
  - potential for changes in fetal heart rate and uterine activity
  - Potential to intervene for nonreassuring fetal status
  - Interpretation may be unreliable in very preterm fetuses
  - May lead to an unnecessary emergent cesarean delivery
- Association of Professors of Gynecology and Obstetrics
  - Monitor the fetus before and after the procedure
  - Consultation with an obstetrician
Surgical considerations

• Elective operations should be delayed until the patient has recovered fully in the postpartum period.

• Semi-elective operations
  • Prudent to defer surgery until after the first trimester
    • risk for spontaneous miscarriage is decreased
    • theoretical concerns of teratogenicity are avoided
  • Late-second and third trimesters
    • affect intraoperative visibility
    • increased risk for preterm birth
  • Early second trimester is considered the optimal time
Laparoscopy

- Pneumoperitoneum further decreases FRC
  - can cause ventilation-perfusion mismatch and hypercapnia
  - further exacerbated by Trendelenburg positioning
  - Respiratory acidosis

- Bhavani-Shanker and colleagues
  - maintaining an end-tidal CO\(_2\) of about 32 mm Hg
  - systolic blood pressure within 20% of baseline
  - effective in preventing respiratory acidosis

- Insufflation pressures below 15mm Hg
  - Higher pressures can lead to respiratory acidosis
Diagnostic laparoscopy is safe and effective when used selectively in the workup and treatment of acute abdominal processes in pregnancy.

Laparoscopic treatment of acute abdominal processes has the same indications in pregnant and non-pregnant patients.

Laparoscopy can be safely performed during any trimester of pregnancy.

Gravid patients should be placed in the left lateral recumbent position.

Initial access can be safely accomplished if the location is adjusted according to fundal height, previous incisions, and experience of the surgeon.

Intraoperative CO$_2$ monitoring by capnography should be used during laparoscopy in the pregnant patient.
SAGES

• Laparoscopic appendectomy, cholecystectomy, adrenalectomy, nephrectomy, and splenectomy are safe.
• Intraoperative and postoperative pneumatic compression devices and early postoperative ambulation are recommended prophylaxis for DVT in the gravid patient.
• Fetal heart monitoring should occur before and after operation in the setting of urgent abdominal surgery during pregnancy.
• Obstetrical consultation can be obtained before and after operation based on the acuteness of the patient's disease, gestational age, and availability of the consultant.
• Tocolytics should not be used prophylactically but should be considered perioperatively when signs of preterm labor are present in coordination with obstetrical consultation.
Outcomes - lap

- Easier recovery, less pain, earlier return of bowel function, and shorter hospital stay.
- Swedish Birth Registry
  - Compared fetal outcomes laparotomy vs. laparoscopy
  - No differences were noted in any of the fetal outcome parameters.
Outcomes - overall

• Morbidity & Mortality
  • No significant difference in overall morbidity or 30-day mortality rates in pregnant and nonpregnant propensity-matched women undergoing similar general surgical operations

• Spontaneous abortion
  • Higher incidence following surgery in the first or second trimester.
  • Uncomplicated surgery does not appear to increase the risk.

• Preterm labor
  • Higher incidence of preterm labor, preterm delivery, and intrauterine growth restriction following non-obstetric surgery.
  • Significant portion occurring within 1 week of surgery.
Risk reduction

• Communication among OB/GYN, surgery, anesthesiology, and neonatology is essential to coordinate management and optimize care.
• Elective surgery should be postponed until after delivery
• Nonemergent but nonelective surgery should be done in the second trimester when possible.
• Emergent surgery should be done according to the maternal disease process.
• Use fetal monitoring during surgery when appropriate and when personnel are available to interpret and treat.
• For fetuses in the third trimester, consideration may be given to cesarean delivery of the fetus before major surgery on the mother
Risk reduction

• Intra-op anesthesia
  • Prevent maternal hypoxia
  • Maintain normal pH
  • Treat hypotension aggressively
  • Left uterine displacement after 20 weeks gestation to avoid aortocaval compression.
• regional anesthesia when feasible
• Prepare for the possibility of difficult airway management
• Provide thromboprophylaxis, aspiration prophylaxis, and antibiotic prophylaxis when warranted
Non-obstetric surgery

- Small Bowel disease
- Appendicitis
- Gallbladder disease
- Breast disease
Small bowel disease

- Third most common etiology is intestinal obstruction
  - Adhesive disease
  - Midgut volvulus
    - 25% of all obstructions
    - Higher than in nonpregnant patients
- Presenting symptoms similar to nonpregnant patient
  - Non-operative NGT decompression initially
  - Lower threshold for operative intervention
    - Maternal mortality - 10% to 20%
    - Fetal mortality - 25% to 50%
Acute appendicitis

- Most common nonobstetric surgical problem
  - Most common in first 2 trimesters
- Typical symptoms to healthy pregnancy
- Infected appendix is more likely to rupture in pregnancy from delay in diagnosis
- Ultrasound modality of choice
  - [sn/sp]– 81%/86%
- MRI second line
  - If inconclusive -> CT scan
- Preterm labor – 15%
- Laparoscopy vs. open

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Gallbladder disease

- Cholecystectomy - 2nd most common non-obstetric procedure
- Similar presentation to non-pregnant cohort
- Ultrasound remains standard imaging study
- ERCP in choledocholithiasis
- Surgery should not be delayed if indicated
  - Fetal demise increased
Breast disease

• New masses should be evaluated
  • Pregnancy-associated breast cancer (PABC)
• Avoid mammography in the first trimester
• Routine breast MRI not supported by literature
• Ultrasound core-needle biopsy
• Breast and axillary surgery can be performed during any trimester
• MRM as a viable option in the first trimester
• More options in 2\textsuperscript{nd} and 3\textsuperscript{rd} trimester
  • Breast conservation for stage I and II
  • Neoadjuvent therapy to delay radiation
• Sentinel node with lymphoscintigraphy NOT isosulfan blue dye

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References


