Non-Obstetric Surgery During Pregnancy

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Objectives

- Describe the role of the obstetrician in the diagnosis and management of patients requiring non-obstetric surgery during pregnancy
- Outline common indications for non-obstetric surgery in the parturient
- Discuss anesthetic considerations, optimal timing and surgical approach to non-obstetric surgery during pregnancy
- Discuss indications for tocolytics, antenatal steroids, progesterone and the guidelines on fetal monitoring when non-obstetric surgery is performed during pregnancy
- Discuss effect of anesthesia and surgery on maternal and fetal outcome after non-obstetric surgery
Introduction

- Non-obstetric surgery during pregnancy
  - Performed in 1.5-2% of all pregnancies
  - More than 75,000 women in the US each year
  - Diagnosis and management complicated by altered anatomy and physiology
- Difficulty of conducting large-scale, randomized clinical trials in this population
- Information based on observational studies, expert opinion, and extrapolation from trials in non pregnant individuals
- ACOG: Insufficient data to allow for specific recommendations
Role of the Obstetrician

- ACOG
  - Obstetric consultation prior to performing non-obstetric surgery and some invasive procedures (cardiac catheterization, colonoscopy) during pregnancy
  - Multi-disciplinary approach
  - Obstetricians uniquely qualified to discuss aspects of maternal physiology and anatomy which may affect maternal-fetal well-being

- Obstetrician must be well informed on
  - Influence of surgical disorders on pregnancy and vice versa
  - Risk of diagnostic and therapeutic procedures
  - Management of preterm labor in immediate postoperative period
Indications for Non-Obstetric Surgery in Pregnancy
Indications for Non-Obstetric Surgery in Pregnancy

- Abdominal diseases and disorders
  - Appendicitis
  - Biliary disease: Cholecystitis and Cholelithiasis
  - Acute pancreatitis
  - Peptic ulcer disease
  - Acute intestinal obstruction
  - Spontaneous hepatic and splenic rupture
  - Spontaneous hepatic and splenic rupture
  - Ruptured splenic artery aneurysm

- Pelvic diseases and disorders
  - Ovarian masses
    - Torsion of the adnexa
    - Solid ovarian tumors
    - Carcinoma of the ovary
  - Leiomyomas
Indications for Non-Obstetric Surgery in Pregnancy

- **Cancer** in pregnancy
  - Breast cancer
  - Cervical cancer
  - Lymphomas and leukemias
  - Malignant melanoma
- **Cardiac disease**
- **Neurologic disease**
- **Hemorrhoids**
- **Trauma**
<table>
<thead>
<tr>
<th>Indication</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendicitis</td>
<td>1:1500 pregnancies</td>
</tr>
<tr>
<td>Cholecystitis</td>
<td>1:1500-1:10,000 pregnancies</td>
</tr>
<tr>
<td>Bowel obstruction</td>
<td>1:1500-1:3500 pregnancies</td>
</tr>
<tr>
<td>Adnexal torsion</td>
<td>1:3000-1:4000 pregnancies</td>
</tr>
<tr>
<td>Breast or cervical disease</td>
<td>1:3000-1:5000 pregnancies</td>
</tr>
<tr>
<td>Trauma</td>
<td>Variable (trauma complicates 4-8 percent of all pregnancies, but the incidence of severe life-threatening trauma possibly requiring surgery is 0.3-0.4 percent)</td>
</tr>
</tbody>
</table>
Fetal and Maternal Considerations
General Maternal Considerations

• Hematologic/CVS
  ▪ 30-50% increase in plasma volume → CO → drug distribution/lab test results
  ▪ Plasma volume ↑ more than red cell mass → Physiologic anemia
  ▪ ↓ Colloid osmotic pressure → increased interstitial fluid-edema
  ▪ Systolic and diastolic BP’s ↓ in the 2nd trimester, return to baseline by term
  ▪ SVR ↓
**General Maternal Considerations**

- **Respiratory**
  - FRC ↓ due to limitation of diaphragmatic excursion
  - MV ↑ due to ↑ TV and RR
  - Compensated mild respiratory alkalosis

- **Renal**
  - ↑ Renal blood flow → GFR, ↓ serum Cr, BUN

- **GI**
  - GI motility ↓, → gastric emptying and constipation

- **Anatomic**
  - Enlarging uterus → alters anatomic relationship among different organs
  - When supine enlarged uterus compresses vena cava → hypotensive vena cava compression syndrome
Fetal Considerations

- Assessment of risk to fetus challenging and should include risks associated with
  - Maternal disease
  - Diagnostic radiologic procedure
  - Therapeutic drugs
  - Anesthesia
  - Surgery
  - Fetal loss
  - Preterm labor/delivery
Fetal Considerations: Diagnosis

- Rely more on careful review of medical history, signs and symptoms and comprehensive physical exam
- Lab values often have altered normal values during pregnancy
- Imaging: Use abdominal shield whenever feasible
  - Adverse effects varies with GA and is dose dependent
  - Current evidence suggests no increased structural or developmental fetal risks with dose <5 rad
    - <8w: radiation induced IUGR
    - 8-15W: MR, 4% risk at 10 rad, 60% at 150 rad
    - ≥10 rad: microcephaly, MR, IUGR, eye abnormalities
- In utero exposure ↑ risk of childhood neoplasm-dose related
  - Fetal exposure of 1-2 rad translates to RR 1.5-2.0 for childhood leukemia
Fetal Considerations: ACOG Guidelines Regarding Radiation Exposure in Pregnancy

- Counseling; <5 rad, no increased risk for fetal anomalies or pregnancy loss
- Concern for radiation exposure should not prevent medically indicated diagnostic procedure when appropriate
- US and MRI are not associated with known adverse fetal effects so consider when appropriate
- Consult expert in dosimetry calculation to help estimated fetal dose in case of multiple radiologic studies
- Radioactive isotopes of iodine- avoid diagnostic or therapeutic use in pregnancy; Avoid iodinated contrast agents due to risk of neonatal hypothyroidism
- Radiopaque and paramagnetic contrast agents - unlikely to cause harm and may be of diagnostic benefit, use in pregnancy only if the potential benefit justifies potential fetal risk
Table 2. Estimated Fetal Exposure From Some Common Radiologic Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Fetal Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest X-ray (2 views)</td>
<td>0.02–0.07 mrad</td>
</tr>
<tr>
<td>Abdominal film (single view)</td>
<td>100 mrad</td>
</tr>
<tr>
<td>Intravenous pyelography</td>
<td>&gt;=1 rad*</td>
</tr>
<tr>
<td>Hip film (single view)</td>
<td>200 mrad</td>
</tr>
<tr>
<td>Mammography</td>
<td>7–20 mrad</td>
</tr>
<tr>
<td>Barium enema or small bowel series</td>
<td>2–4 rad</td>
</tr>
<tr>
<td>CT† scan of head or chest</td>
<td>&lt;1 rad</td>
</tr>
<tr>
<td>CT scan of abdomen and lumbar spine</td>
<td>3.5 rad</td>
</tr>
<tr>
<td>CT pelvimetry</td>
<td>250 mrad</td>
</tr>
</tbody>
</table>

*Exposure depends on the number of films
†Abbreviation: CT, computed tomography

Pregnancy Outcomes After Non-Obstetric Surgery
Maternal and Fetal Outcome After Surgery

- The indications for surgery and its timing are major determinants of maternal and fetal outcome.
- No evidence that surgery during pregnancy increases background risk for miscarriage (8-16% at < 13w for clinically recognized pregnancies, 2-4% at 13-20w).
Pregnancy Outcome After Non-Obstetrical Surgical Intervention

- Literature review of 54 papers including 12,452 subjects
  - Maternal death was rare .006% (<1/10,000)
  - Miscarriage rate was 5.8%; 10.5% in the first trimester (# difficult to interpret - no matched controls)
  - Elective termination 1.3%
  - Preterm labor 3.5% (specifically following appendectomy)
  - Fetal loss 2.5%
  - Preterm delivery 8.2%
Pregnancy Outcome After Non-Obstetrical Surgical Intervention

- **Major birth defects** in women who had surgery in 1st trimester 3.9% (1-3% in gen pop)
- Sub-analysis of papers reporting on appendectomy during pregnancy revealed a high rate (4.6%) of surgery-induced labor
- Fetal loss associated with appendectomy was 2.6%; however, this rate was increased when peritonitis was present (10.9%)

- Surgery in the first trimester does not appear to increase major birth defects and should not be delayed when indicated; Acute appendicitis with peritonitis is associated with higher risk to the mother and fetus
Timing of Surgery

- Surgery is not generally recommended during the first trimester due to potential for pregnancy loss and teratogenicity.
- Early to mid 2nd trimester is optimal.
Timing of Surgery

• Pregnancy loss
  ▪ Cohen-Kerem et al reported 10.5% in 1st trimester
  ▪ Some other studies have reported higher rates
  ▪ Considerations include
    • Inherent rate of pregnancy loss is higher in 1st trimester
    • Surgical procedure
    • Underlying maternal condition (infection, high fever)
    • Maternal characteristics/comorbidities (smoking, AMA)

• Exposure to teratogens
  ▪ First 2 wks of gestation - all or none effect
  ▪ 3-8w during organogenesis - may cause major structural organ abnormalities
  ▪ Exposure at >8w - functional changes or growth retardation, structural abnormalities rare
Timing of Surgery

• Advanced gestation
  ▪ Difficulty maneuvering around gravid uterus
  ▪ Difficulty managing airway
  ▪ Increased chance of uterine irritability, preterm contractions and PTL

• ACOG
  ▪ A pregnant woman should never be denied indicated surgery, regardless of trimester
  ▪ Elective surgery should be postponed until after delivery
  ▪ If possible, non urgent surgery should be performed in the second trimester when preterm contractions and spontaneous abortion are least likely
Location for Surgical Procedure

- Perform at institution with neonatal and pediatric services
- An obstetric care provider with cesarean delivery privileges should be readily available
Laparoscopy vs. Laparotomy

- Data shows laparoscopy for non-obstetric surgery during pregnancy is as safe as laparotomy.

- Surgical approach should be based on skill of the surgeon and availability of appropriate staff and equipment.
Laparotomy

- Incision
  - Depends on surgical procedure and GA
  - In general, vertical incision recommended as GA advances - better exposure, allows for extension if necessary
Laparoscopy

- Increasing use during pregnancy in the past decade
- Most common uses
  - Exploration and treatment of adnexal masses
  - Appendectomy
  - Cholecystectomy
- Advantages
  - Decreased postoperative morbidity
  - Less pain
  - Shorter hospital stay and postoperative recovery time
- Drawbacks
  - Risk of injury to gravid uterus
  - Technical difficulty with exposure
  - Increased CO₂ absorption by mother and fetus
  - Decreased uterine blood flow due to excessive intra-abdominal pressure
Laparoscopy vs. Laparotomy

- Swedish study covering 2,015,000 deliveries from 1973-1993
- 2181 laparoscopies and 1522 laparotomies performed at 4-20w gestation for non-obstetric surgical indications during pregnancy
- Increased risk of preterm delivery prior to 37w, birth weight <2500g and IUGR in both groups compared with total population
- No difference in five fetal outcome variables, birth weight, gestational duration, growth restriction, infant survival up to 1 year, fetal malformations among laparoscopy and laparotomy groups
Laparoscopy vs. Laparotomy

- Retrospective review of open or laparoscopic cholecystectomy or appendectomy cases between 1998 and 2002; The outcomes were compared with the authors' previous data
- The laparoscopic management of symptomatic cholelithiasis and appendicitis during pregnancy increased from 54% to 97%
- No significant differences in PTD rates, birth weights, or 5-min Apgar scores were found between the two periods; No birth defects or uterine injuries occurred
**Laparoscopy vs. Laparotomy**

- Evaluated the effects of non-obstetric surgical procedures on maternal and fetal outcome
- Literature review of 54 papers including 12,452 subjects; 9 studies focused on laparoscopic
  - None of the studies came to the conclusion that laparoscopic procedures were harmful to the mother or fetus
  - In general, the most common conclusion was that laparoscopic surgery was safe and may benefit with the patient when compared to open procedures
Laparoscopy vs. Laparotomy

- **Koo et al** Laparotomy vs. laparoscopy for the treatment of adnexal masses during pregnancy, ANJZOG 2012; 52: 34–38
- Retrospective analysis of 262 pregnant women - laparotomy or laparoscopic surgery between 200-2009; 174 (66.4%) laparotomies, 88 (33.6%) laparoscopies
- The laparoscopy group
  - Shorter mean operative time (60.7 ± 27.1 vs. 69.7 ± 24.4 min, P = 0.002)
  - Shorter mean hospital stay (4.7 ± 1.7 vs. 6.6 ± 1.3 days, P < 0.001)
- No significant difference between the two groups in obstetric outcomes, including PTD and miscarriage rate, after adjusting for GA at surgery, emergency surgery and mass size
- Conclusions: Laparoscopic approach appears to offer a suitable alternative to laparotomy
Anesthesia for Non-Obstetric Surgery in Pregnancy

- Type determined primarily by planned surgical procedure (indication, nature, site)
- Choose technique which requires minimal quantity of drugs and minimizes fetal exposure (e.g. regional) that is appropriate for surgical procedure and patient’s condition
Anesthesia for Non-Obstetric Surgery in Pregnancy

- Regional anesthesia has better safety profile for mother so is preferred over GETA.
- However, most Non-obstetric surgeries in pregnancy are performed via laparoscopy or urgent exploratory laparotomy so GETA is utilized.
- Major anesthesia concerns:
  - Inherent increased risk associated with surgery and anesthesia during pregnancy.
  - Teratogenesis.
  - Untoward reaction to anesthetic agents.
<table>
<thead>
<tr>
<th><strong>System</strong></th>
<th><strong>Physiological change</strong></th>
<th><strong>Anesthetic implications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>↑ CO up to 50%</td>
<td>Uterine perfusion not auto regulated</td>
</tr>
<tr>
<td></td>
<td>↑ Uterine perfusion to 10% of CO</td>
<td>Hypotension common under regional and general anesthesia</td>
</tr>
<tr>
<td></td>
<td>↓ SVR, ↓ PVR, ↓ AP</td>
<td>Supine hypotensive syndrome requires left lateral tilt</td>
</tr>
<tr>
<td></td>
<td>Aortocaval compression from 13 weeks</td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>↑ Minute ventilation</td>
<td>Faster inhalation induction</td>
</tr>
<tr>
<td></td>
<td>Respiratory alkalosis ($P_{aco2}$ 3.7–4.2 kPa)</td>
<td>Maintain $P_{aco2}$ at normal pregnancy levels</td>
</tr>
<tr>
<td></td>
<td>↓ ERV, ↓ RV, ↓ FRC</td>
<td>Potential hypoxaemia in the supine and Trendelenburg positions</td>
</tr>
<tr>
<td></td>
<td>↑ V/Q mismatch</td>
<td>Breathing more diaphragmatic than thoracic</td>
</tr>
<tr>
<td></td>
<td>↑ Oxygen consumption</td>
<td>Difficult laryngoscopy and intubation; bleeding during attempts</td>
</tr>
<tr>
<td></td>
<td>Upward displacement of diaphragm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑ Thoracic diameter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mucosal edema</td>
<td></td>
</tr>
<tr>
<td>CNS</td>
<td>↑ Epidural vein engorgement</td>
<td>Bloody tap more common</td>
</tr>
<tr>
<td></td>
<td>↓ Epidural space volume</td>
<td>More extensive local anesthetic spread</td>
</tr>
<tr>
<td>Hematological</td>
<td>↑ Red cell volume 30%, ↑ WCC</td>
<td>Dilutional anemia</td>
</tr>
<tr>
<td></td>
<td>↑ Plasma volume 50%</td>
<td>Thromboembolic complications (DVT prophylaxis)</td>
</tr>
<tr>
<td></td>
<td>↑ Coagulation factors</td>
<td>edema, decreased protein binding of drugs</td>
</tr>
<tr>
<td></td>
<td>↓ Albumin and colloid osmotic pressure</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>↑ Intragastric pressure</td>
<td>↑ Aspiration risk</td>
</tr>
<tr>
<td></td>
<td>↓ Barrier pressure</td>
<td>Antacid prophylaxis, RSI after 18 weeks gestation</td>
</tr>
<tr>
<td>Renal</td>
<td>↑ Renal plasma flow, ↑ GFR</td>
<td>Normal urea and creatinine may mask impaired renal function</td>
</tr>
<tr>
<td></td>
<td>↓ Reabsorptive capacity</td>
<td>Glycosuria and proteinuria</td>
</tr>
</tbody>
</table>
General Anesthesia

- Issues related to GETA in pregnancy
  - Risk of difficult intubation
  - Risk of desaturation
  - Risk of aspiration
  - Risk of hemodynamic instability
  - Effects of mechanical ventilation (failure to account for physiologic respiratory alkalosis during GETA can result in hypoventilation → respiratory acidosis)

- Optimizes maternal and fetal oxygenation, reduces intraoperative uterine irritability
Regional Anesthesia

- Highly desirable when feasible
- Avoids problems related to GETA except HYPOTENSION
- Obesity and edema can obscure landmarks, hormonal effect on interspinal ligaments → epidural loss of resistance techniques
- Spread of local anesthetic in spinal or epidural space ↑, lower doses needed (mechanical effect of enlarging uterus, hormonal changes, increased sensitivity to local anesthetics)
- Sympathetic activity ↑ in pregnancy, sympathetic block → maternal hypotension in the presence of hypovolemia
- Treat hypotension with Left lateral tilt/vasoconstrictor administration/IVF
**Teratogenicity**

- Despite general safety of anesthetic agents; concern remains regarding teratogenicity in early gestation
  - Study of 572 women, operated at 4-5w gestation suggests possible increase in NTD’s
    - All but emergent surgery should be postponed until 2\textsuperscript{nd} trimester
- No evidence of adverse effect on human brain development or risk of learning disabilities later in life
- ? Increased risk of miscarriage in health care professionals with chronic exposure to nitrous oxide; Adverse effects of acute exposure has not been established
Teratogenicity

- All commonly used induction agents, opioids, neuromuscular blocking agents, and volatile anesthetics can be used in pregnancy; They are not teratogenic when used in clinical concentrations and when maternal physiology is maintained.
- ACOG: “No currently used anesthetic agents have been shown to have any teratogenic effects in humans when using standard concentrations at any gestational age.”
- Tocolytic effect: Potent inhalational agents decrease uterine tone.
Anesthesia for Non-Obstetric Surgery in Pregnancy

- Swedish population based study
  - 720,000 patients, 5405 patients underwent Non-obstetric surgery using general anesthesia during pregnancy
  - Specific types of anesthesia not associated with adverse outcome
  - Adverse effects including LBW (due to prematurity and IUGR) early neonatal death (within 7 days) increased in the surgery group. This increased risk thought to correlate with underlying condition that necessitated the surgical procedure rather than type of anesthesia
  - Rate of congenital malformations and unexplained stillbirths similar in women who underwent surgery requiring anesthesia when compared to those who did not suggests surgery and anesthesia are not associated with adverse effects in early pregnancy
Tocolytic Therapy

Efficacy during non-obstetric surgery is unproven and prophylactic use is controversial given potential maternal side-effects
Tocolytic Therapy

- Prophylactic therapy can be considered in the 3rd trimester in patients undergoing lower abdominal or pelvic surgery for inflammatory conditions
  - Efficacy unproven, use controversial
- The use of volatile anesthetic agents has been advocated as they relax the uterus, although high concentrations can cause undesirable hypotension
- Reduction of uterine manipulation during surgery
- Monitor uterine activity following surgery, if premature labor occurs, tocolysis will be necessary to preserve the pregnancy
**Tocolytic Therapy**

- Prophylactic tocolysis administered to 13 patients who had surgery in 2\textsuperscript{nd} and 3\textsuperscript{rd} trimester
- 6/13 had preterm delivery, only 2 delivered within 2 weeks of laparotomy
- Potential for preterm delivery unresponsive to tocolysis
Antenatal Steroid Administration

- Given negligible risk of steroids and potential for preterm delivery consideration should be given to prophylactic course of steroids for FLM if surgery performed between 24-34 weeks
- Consider the increase in patient’s risk of PTB due to underlying disease and planned surgery
- Avoid in setting of systemic infection such as sepsis or ruptured appendix
Thromboprophylaxis

- Pregnancy $\rightarrow$ hyper-coagulable state
- Protective against excessive blood loss while increasing risk for thromboembolic event in postsurgical period
- Place pneumatic compression devices on all women undergoing surgery during pregnancy
- Pharmacologic thrombo-prophylaxis should be individualized based on
  - Additional risk factors for VTE
  - Length of procedure
  - Scope of procedure
Antibiotic Prophylaxis

- Depends on specific procedure
- Cephalosporins, penicillins, erythromycin, azithromycin, clindamycin - Good safety profile
- Aminoglycosides - relatively safe - risk of fetal and maternal ototoxicity and nephrotoxicity
- Doxycycline - generally avoided – other tetracyclines associated with transient suppression of bone growth and staining of developing teeth
- Trimethoprim - dihydrofolate reductase inhibitor – affects folic acid metabolism - avoid during first trimester - potential increase in incidence of congenital malformation
- Fluoroquinolones - avoid during pregnancy and lactation - toxic to developing cartilage in animal studies. Has not been documented in humans
Fetal Monitoring

Individualize Based On

- GA
- Type of surgery
- Facilities available
Fetal Monitoring

• Preivable fetus
  - FHR by Doppler before and after procedure.
  - In rare cases, intraop fetal monitoring may be performed for a preivable fetus to facilitate positioning and oxygenation intervention.
  - Intraop FHR more sensitive assessment of maternal cardiorespiratory status than vital signs.

• Viable fetus
  - Cardiotocographic monitoring before and after procedure
  - Continuous CTG or Doppler US
  - Decreased FHR variability and baseline (remains within normal range) with general anesthesia.
  - Continuous intraoperative CTG monitoring if
    • It is physically possible to perform (TVS if feasible)
    • Provider with appropriate skills is available and willing to intervene during the surgical procedure for fetal indication
    • Patient signs informed consent for emergency CD
    • Nature of surgery allows for safe interruption or alteration to provide access for CD
Progestosterone Supplementation

- Csapo et al; 1972, Scott et al 1991
  - Removal of the corpus luteum up to 47 days of pregnancy (dating by LMP) resulted in a high rate of abortion
  - Removal after 61 days only resulted in a transient decrease in progesterone, without a high rate of abortion
- Supplement if corpus luteum is removed at 7-9 w gestation
- Luteal placental shift starts at about 9 weeks
  - Progesterone 50 to 100 mg vaginal suppository every 8 to 12 hours
  - Daily intramuscular injection of 1 mL [50 mg] progesterone in oil
  - Oral progesterone appears to be less effective
Post-Op Pain Management

- Short term postop use of narcotic analgesic agents ± acetaminophen or NSAID generally appears to produce no adverse fetal effects.
- Avoid NSAID use after 32w- risk of premature closure of DA if given for >48hrs.
- Epidural analgesia- effective and reasonable alternative. ↓risk of opioid induced hypoventilation when compared to IV OPIOIDS.
Mode of Delivery

- Reserve CD for Obstetric Indications
References

References