# *Anesthesia & Other Precautions for Surgery During Pregnancy*

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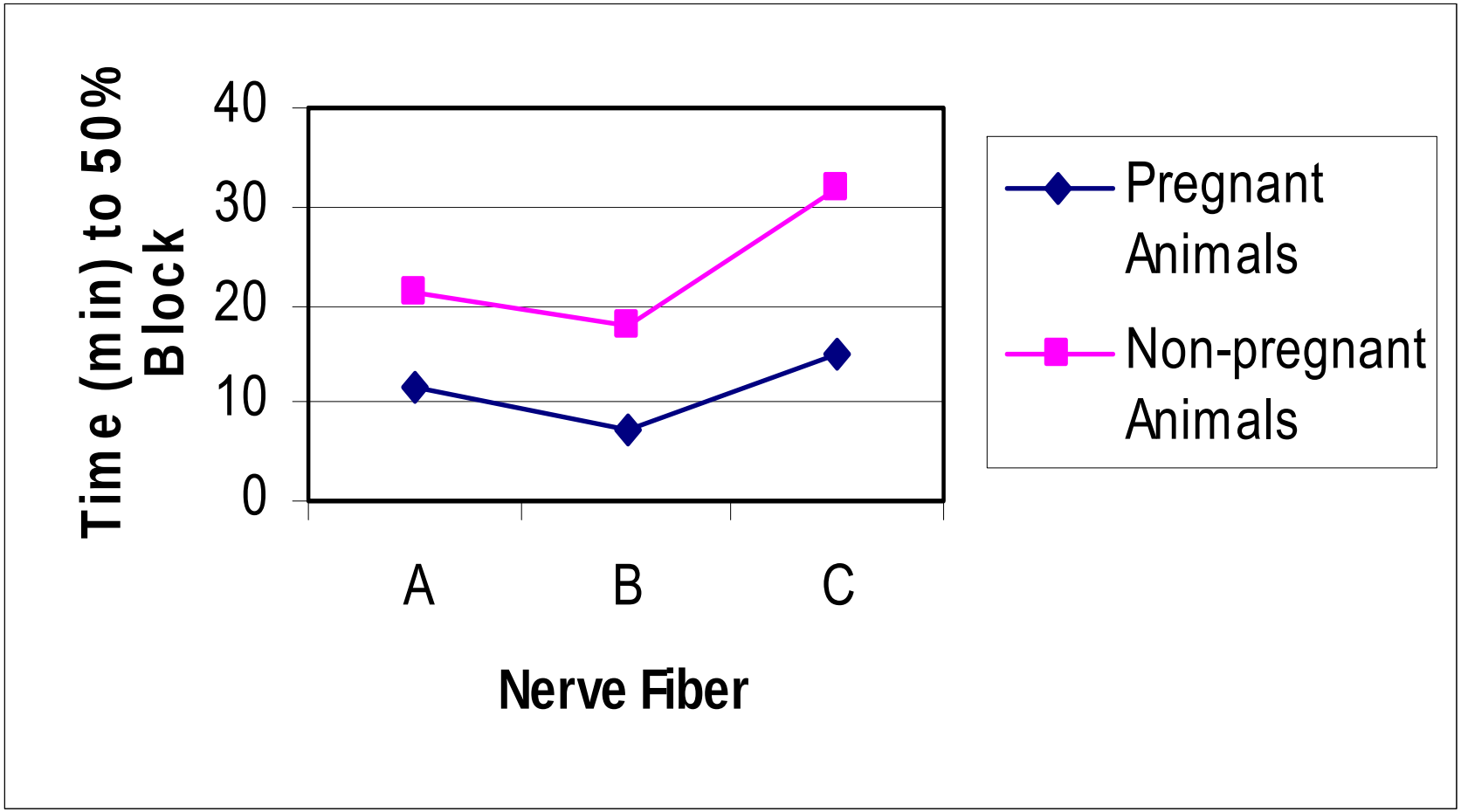
# *Surgery for Non-obstetric Reasons*

- Required in 1-2% of all pregnancies
  - 42% occur during the 1st trimester
  - 35% during 2nd trimester
  - 23% during 3rd trimester
- Research indicates that 1/3 of anesthesia or surgery departments don't routinely screen for pregnancy for elective surgery
  - Estimated that approximately 10-30,000 surgical procedures are performed on pregnant women/year in patients that have either not been tested for pregnancy or have false negative HCG

# Considerations

- Physiological Changes
  - Cardiovascular Changes
    - Aortocaval Compression; clotting problems
      - Cardiac Output increases gradually beginning in the 8th week gestation and reaches a peak at the end of 2nd trimester (↑50%) & SVR decreases secondary to progesterone & presence of the low resistant placenta
      - Normal findings
        - Mild tricuspid regurgitation
        - LVH & EKG changes
  - Respiratory Changes
    - Elevation of diaphragm; ↑Aa-$DO_2$, ↓FRC& ↑CC, ↑$O_2$ consumption, ↓ buffering capacity→ susceptibility to hypoxia
      - MV ↑ 70% by term → Chronic respiratory alkalosis (PCO2 ↓ from 32 to 28 mmHg; pH ↑ 7.44)
      - FRC ↓ 20%
  - Gastrointestinal Changes
    - Full stomach (14??+wks); ↑ acidity ↓motility
  - Altered Response to Anesthesia secondary to pregnancy
    - ↓MAC 20-40%; ↑ sensitivity to LA

# Sensitivity of Nerve Fibers with Pregnancy



# *Conditions that may require surgical intervention*

- Gynecological problems
  - Ovarian cyst/tumor
    - Rupture/torsion/hemorrhage/infection
  - Torsion of fallopian tube
  - Uterine myoma
    - Degeneration/infection/torsion
- Non-gynecological problems
  - Acute appendicitis/cholecystitis/pancreatitis
  - Intestinal obstruction/renal calculi/peptic ulcer

# Considerations

- First “rule of thumb”
  - Answer questions concerning “what is best?”
    - Drugs should be administered to pregnant patients if benefits outweighs risk
- Planning Anesthetic regimen
  - Patient’s surgical condition
  - Present gestational age of the fetus
  - Pregnancy Induced Physiological Changes
  - Other “direct” and “indirect” effects

# *Considerations*

- **Patient's Surgical Condition**
  - **Emergencies will often outweigh concerns for the fetus**
    - *Primary patient is the parturient*
  - **Needs of the patient**
    - *Often dictates anesthetic regimen (physical and emotional condition)*
  - **Needs of the surgeon**
    - *Often needs anesthetic regimen which will optimize surgical view etc.*
  - **Needs of the Obstetrician**
    - *May need regimen to ensure uterine relaxation etc.*

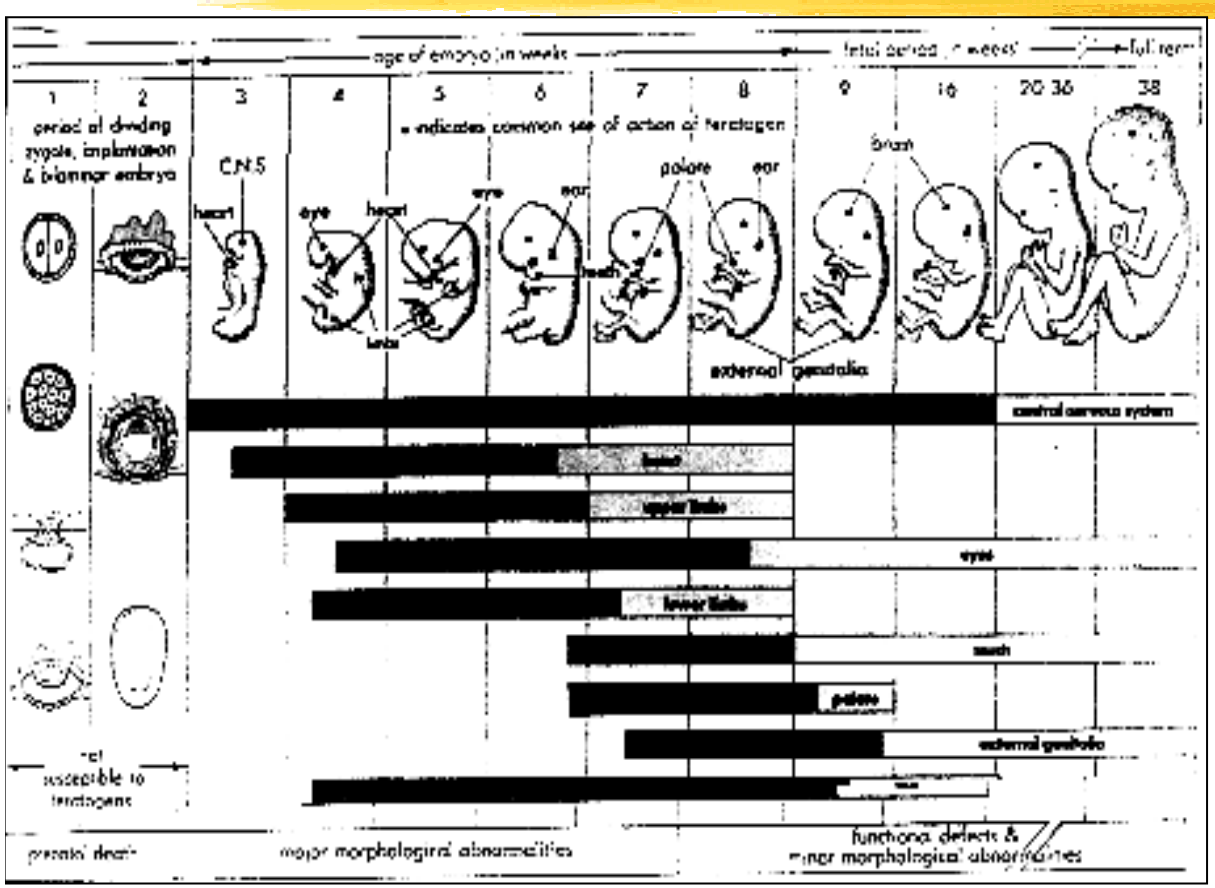
# *Anesthetic Management*

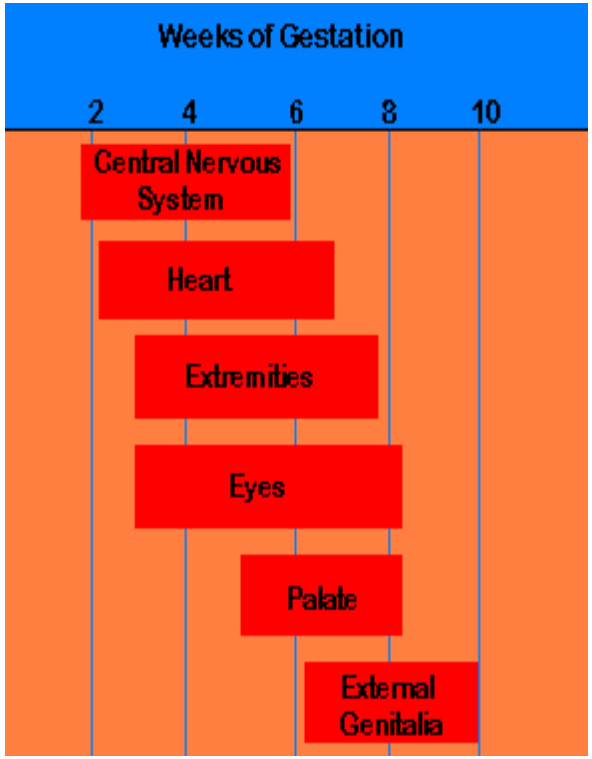
- Preoperative Management
  - Anxiolytic often indicated
  - Aspiration prophylaxis
    - 30 mL non-particulate; $H_2$ antagonist (together)
    - 10 mg Metoclopramide
- Choice of Anesthetic
  - Based on Maternal indications
  - Account for site & nature of surgery

# *Fetal Considerations*

- Maternal catastrophes *(hypoxemia, hypotension)* pose greatest risk to fetus; anesthetics have been implicated as possible abortifacients & teratogens
  - Difficult to perform human studies
    - Studies isolated to reproductive effects in animals
    - Epidemiologic studies in OR personnel etc.
    - Outcome studies on pregnant women who have undergone a surgical procedure during pregnancy

# Critical Periods of Susceptibility




***Critical time of organogenesis is between 15-56 days gestation***

****Between 15-56 days structural abnormalities can occur***

****Beyond 56 days structural abnormalities are rare but functional abnormalities can occur***

# FDA Pregnancy Risk Classification

| | |
|---|---|
| Category A | Controlled studies in women fail to demonstrate a risk to the fetus in the 1st trimester (and there is no evidence of a risk in later trimesters), and the possibility of fetal harm appears remote. |
| Category B | Animal studies do not indicate a risk to the fetus; there are no controlled human studies, **or** animal studies that do show an adverse effect on the fetus but well controlled studies in pregnant women have failed to demonstrate a risk to the fetus. |
| Category C | Studies have shown the drug to have animal teratogenic or embryocidal effects, but no controlled studies are available in women **or** no studies are available in either animals or women. |
| Category D | Positive evidence of human fetal risk exists, but benefits in certain situations (e.g., life-threatening situations or serious diseases for which safer drugs cannot be used are ineffective) many made use of the drug acceptable despite the risks. |
| Category X | Studies in human and animals have demonstrated fetal abnormalities, or evidence demonstrates fetal risk based on human experience, or both and the risk clearly outweighs any possible benefit. |

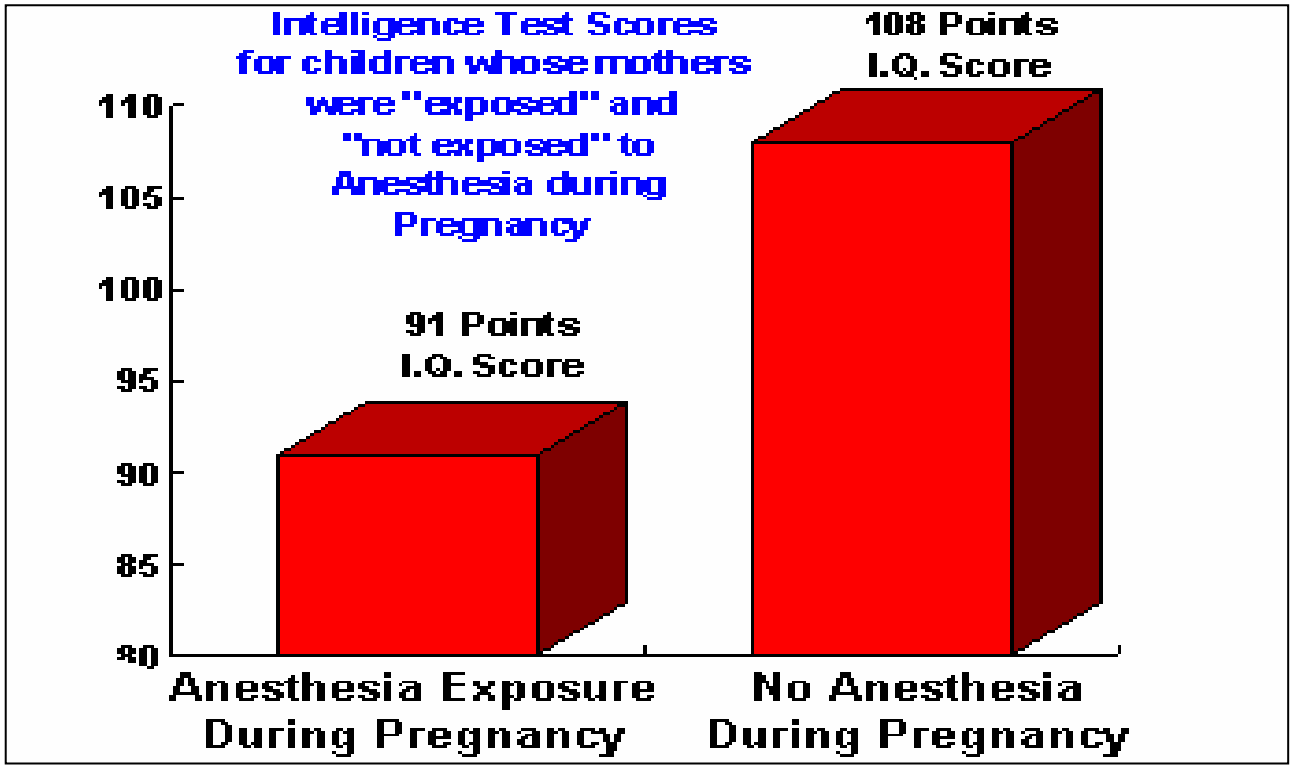
# Common Drugs with Classification

| Drug | Classification |
|---|---|
| Succinylcholine | C |
| Rocuronium | C |
| Propofol | B |
| Sodium Thiopental | C |
| Fentanyl | B/D (if given for prolonged periods or at high doses) |
| Sufentanil | C |
| Morphine | B/D (if given for prolonged periods or at high doses) |
| Morphine | B/D (if given for prolonged periods or at high doses) |
| Meperidine | B/D (if given for prolonged periods or at high doses) |
| Remifentanil | C |
| Butorphanol (Stadol) | C/D(if given for prolonged periods or at high doses) |
| Nalbuphine HCL (Nubain) | C/D(if given for prolonged periods or at high doses) |
| Bupivacaine | C |
| Lidocaine | B/C |

# *Volatile Agents*

- Deemed safe to use
  - Some increase in rates of spontaneous abortions
  - No increase in congenital anomalies
  - Animal Studies do show “short term” decrease in postnatal learning
- One study indicates decrease in intelligence scores
  - Only one longitudinal study (retrospective & poorly controlled)

# *Effect of Anesthesia Exposure on Intelligence tests*




- ***Child Psychology and Human Development (1986)***

# *Other factors which could have detrimental effect on intellectual development*

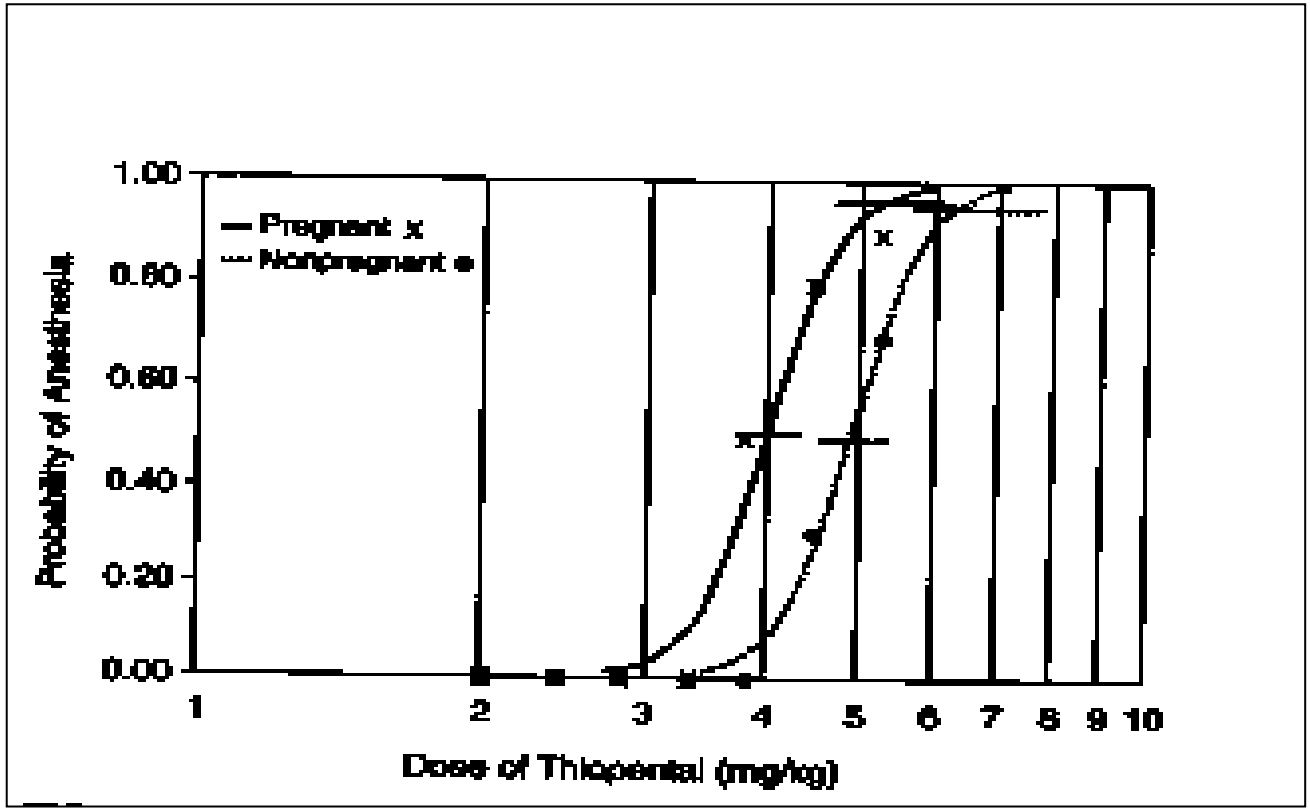
- Smoking
  - Nicotine & other toxic substances in cigarette smoke are not stopped by the placental barrier
  - Intelligence Testing
    - Studies have found that offspring from women who smoke during pregnancy score 15-20 points lower on intelligence tests

Frydman M. (1996). The smoking addiction of pregnant women and the consequences on their offspring's intellectual development. *J Environ Pathol Toxicol Oncol, 15(2-4)*: 169-72.

# *Sedatives & Barbiturates*

- Barbiturates
  - Phenobarbital exposure during early development shown to cause long-term deleterious effects on cognitive performance
    - Reinisch JM, Sanders SA, Mortensen EL, Rubin DB. (1995). In utero exposure to phenobarbital and intelligence testing deficits in adult men. *JAMA 274(19);* 1518-25.
- Diazepam
  - Cleft Lip/Palate
    - Strong evidence with rodent studies
    - Some indication in retrospective human studies
      - Safra M. Oakley GP: Association between the cleft lip with or without cleft palate and prenatal exposure to diazepam *Lancet* 1975: 2:478
    - Not collaborated in other studies
      - Antenatal exposure to meprobamate and chlordiazepoxide in relation to malformation, mental development and childhood mortality. *N ew Engl J Med* 1975; 292: 726
    - Neurobehavioral Scores
    - Lower scores noted at delivery

# Dose Response Curves for Thiopental in Early Pregnancy




Gin T, Mainland P, Chan MT, et. al. Decreased thiopental requirements in early pregnancy. *Anesthesiology* 1997; 86: 73-78.

# *Opioids*

## Opioids

- Some evidence shows that opioids may cause delay in organ development secondary to inhibition of DNA synthesis *(speculative study with animals*)
- Can delay cholinergic development (only with long term chronic use)

### Fentanyl etc.

- No definitive studies linking anomalies (Class “C”)

### Morphine

- Designated as “class C” when given in therapeutic doses for surgery and postoperative pain control
- Some evidence linked to delay in CNS development in fetal rats but no definitive evidence found in humans
  - Vathy I (1999). Effects of prenatal morphine exposure on rat heterotypical sexual behavior. *Physio Behav 66(4)*: 667-71.

# *Local Anesthetics*

- No definitive effect on organogenesis
- Cocaine only local anesthetic which has been linked to teratogenicity
  - Delay in GU & GI development
- IV Regional (Bier) block not recommended because of possible toxic effect

# *Muscle Relaxants*

- Do not readily cross the uteroplacental barrier but can be detected in fetal circulation after large doses given
  - May necessitate need for post-delivery ventilatory support
  - No teratogenicity attributed to use
  - Parturients more sensitive to effects secondary to sensitized neural network

# *Surgery during pregnancy*

- Performance of surgery during pregnancy results in:
  - Low birth weight neonates (< 2500 grams)
  - Premature labor (especially if surgery performed in third trimester)
  - SGA babies
- Recommended to delay surgery until after delivery or in 2nd trimester if needed

# Preterm Labor

- Prevention of Preterm labor
  - Studies indicate that following abdominal surgery on women between 24-36 wks gestation 22% will deliver within 1 week of surgery
    - 2nd trimester procedures & those that don't involve uterine manipulation carry lowest risk of PTL
  - Volatile agents depress myometrium but don't decrease risk of PTL
  - Prophylactic tocolysis controversial
  - Monitoring for PTL should be for several days postoperatively
    - Tocolysis initiated if indicated

# *Surgery during pregnancy*

- Pregnancy was once considered contraindication to laparoscopy
  - $CO_2$ was seen as a “trigger” to premature labor
  - Insufflation would decrease cardiac output
  - Trochars “too dangerous” to use around uterus
- New techniques/equipment has eliminated most of these fears/concerns

# *Surgery during pregnancy*

- Most common surgical procedures that are performed on pregnant parturients are:
  - Appendectomy
  - Cholecystectomy
    - Laparoscopy now preferred method for cholecystectomy; appendectomy evenly split between mini-lap and laparoscopy

# *Surgery during pregnancy*

- Laparoscopy
  - Advantages
    - Lower risk of wound complications
    - Less postoperative pain
      - Less fetal depression
    - Faster maternal recovery
  - Disadvantages
    - Requires General Anesthesia
    - Risk of CO2 embolus
    - Higher intraoperative drug exposure to mother & fetus
    - Possible decrease in Cardiac parameters

# Hemodynamics during laparoscopy

**Table 1.** Hemodynamics During Laparoscopic Cholecystectomy in Four Pregnant Patients

| Time | T1 (preinduction) | T2 (preinsufflation) | T3 (insufflated 5 min) | T4 (insufflated 15 min) | T5 (postextubation) |
|---|---|---|---|---|---|
| CI ($L \cdot min^{-1} \cdot m^{-2}$) | 5.2 (0.4) | 4.8 (0.7) | 3.8 (0.6)*† | 4.1 (0.6)* | 5.8 (1.5)*‡ |
| MAP (mm Hg) | 86 (16) | 70 (14)* | 81 (7)† | 83 (7)† | 89 (10)† |
| SVR ($dynes \cdot s \cdot cm^{-5}$) | 1324 (381) | 1197 (162) | 1384 (133)† | 1319 (184) | 1046 (311)‡ |
| HR (bpm) | 74 (8) | 68 (7) | 70 (8) | 68 (3)* | 111 (15)*‡ |

Values are mean (SD).
CI = cardiac index; MAP = mean arterial blood pressure; SVR = systemic vascular resistance; HR = heart rate.
* $P < 0.05$ with respect to T1; † $P < 0.05$ with respect to T2; ‡ $P < 0.05$ with respect to T4.

Barone JE et. al. (1999). Outcome study of cholecystectomy during pregnancy. *Am J Surg 177(3)* : 232-6.

# *Anesthetic Management*

- Appendectomy
  - Foremost consideration is gestational age of the fetus
  - Occurrence is the same in gravid as non-gravid population
    - 1 in 800 to 1 in 2000
  - Management of the case is more important than the agents used for the anesthetic

# Cholecystectomy

- Risk of
- Difficult to perform under regional anesthesia
  - Regional anesthesia increases risk of aspiration
    - Secondary to upper abdominal incision
- Better postoperative outcomes noted when performed using laparoscopy

# *Anesthetic Management*

- Physiological changes that occur in pregnancy will often dictate your technique
  - No anesthetic technique is precluded because of these physiological changes but some lead to less impact on maternal/fetal hemodynamics than others
    - Regional anesthesia is preferable over general anesthesia

# *Anesthetic Management*

- Basic principles that apply to all anesthetics administered to a pregnant surgical patient
  - Discuss risk/benefits for each anesthetic technique
  - Start large bore IV of crystalloid solution
    - Ensure LUD/RUD maintained (after 20 wk gestation)
    - Give sufficient fluids to offset preoperative N/V and provide prophylaxis against sympathectomy if choosing regional technique
      - New evidence indicates better to initiate bolus 5 minutes before SAB injected and at least 5-10 minutes after injection/re-positioning
  - Non-particulate antacid
    - Important after 11-12th week gestation
    - Metoclopramide 10 mg IV/Ranitidine (controversial?)

# *Anesthetic Management*

- Subarachnoid Blockade
  - Best performed with parturient in lateral position using 25-27g pencil point needle
  - Use supplemental oxygen
  - Treat hypotension aggressively
  - Hyperbaric local anesthetic preferable
    - Lidocaine 60-80 mg or Bupivacaine 7.5-15 mg
      - Can co-administer with opioids (MSO4, fentanyl, sufenta)
  - Give sufficient amount to achieve at least a T4 level

# Anesthetic Management

## Subarachnoid Blockade

### Advantages

- Minimal amount of local anesthetic
- Rapid onset of anesthesia
- Definitive end point
- Easy to administer
- More profound level of anesthesia than with epidural blockade

### Disadvantages

- Precipitous Hypotension (can be severe)
  - Treat immediately with LUD, 7.5-10 mg IV ephedrine, IV bolus infusion
- Non-rectifiable dermatomal level
- PDPHA
- ITN's provide less analgesia than epidurally administered opioids
- ITN's associated with increased incidence of pruritis, N/V

# *Anesthetic Management*

- Epidural Anesthesia
  - Follow basic principles
  - Local anesthetics
    - 2% Lidocaine, 0.5% Bupivacaine*, Chloroprocaine
      - 2% Lidocaine with/without epinephrine
      - 0.5% Bupivacaine may be insufficient
      - 2 or 3% Chloroprocaine
  - Epinephrine linked with increase in fetal acidosis
    - intervillous vasoconstriction

# *Anesthetic Management*

- Epidural Anesthesia
  - Advantages
    - Risk of severe hypotension decreased
    - Rectifiable dermatomal level
    - Better postoperative pain control techniques can be employed
    - No danger of PDPHA
  - Disadvantages
    - Increased complexity of technique
    - Higher incidence of failure
    - Slower onset of anesthesia
    - Less profound anesthesia
    - Larger dose requirements

# *Anesthetic Management*

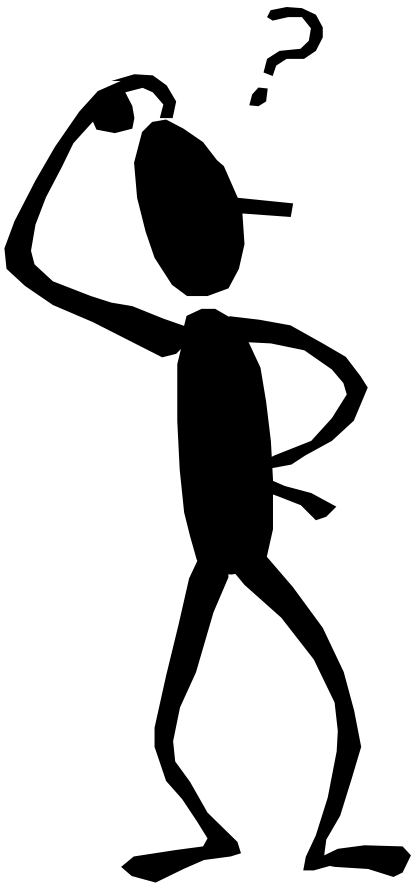
- General Anesthesia
  - Place supine with parturient head slightly elevated (10-20 degrees)
  - Ensure all monitors in place prior to induction
    - Include fetal monitors and OB personnel
  - Pre-oxygenate with 100% oxygen for 3-5 min
  - Always consider parturient as full stomach
  - Apply basic principles
    - Can decrease crystalloid bolus to 5ml/kg

# *Anesthetic Management*

- General Anesthesia
  - Advantages
    - Definitive
    - Easily to titrate based on desired depth
    - If laparoscopy performed is the #1 technique (required)
    - Better uterine relaxation
    - More stable hemodynamics
    - Best tolerated in 3rd trimester
  - Disadvantages
    - Possible teratogenic effects
    - Maternal aspiration risk
    - Increased immediate postoperative pain
    - N20 can increase uterine tone and risk of damage to embryo

# Summary

- Employ technique that is best suited for individual patient
- Inform patient, surgeon, and obstetrician concerning your rationale for choosing one technique over another
- Continuous fetal monitoring may be required throughout surgery
- Be meticulous



# Questions?

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