

NON-OBSTETRIC SURGERY DURING PREGNANCY

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Approximately 2% of women will need surgery and anesthesia during pregnancy. The anesthetic management must take into account the maternal physiological changes as well as the fetus well-being, and it differs with the type and urgency of the surgery and stage of pregnancy.

What are the main maternal physiological changes with anesthetic implications?

Respiratory

- Decreased FRC – (~ 20% at term) which results in decreased oxygen reserve.
- Increased oxygen consumption (~ 20% at term).
- Pregnant patients develop hypoxia more rapidly with hypoventilation or apnea.
- Increased minute ventilation.
- Increased airway mucosal vascularity with potential bleeding with laryngoscopy or naso/oro gastric tube insertion.
- Airway edema; significantly increased incidence of difficult airway/failed intubation.

Cardiovascular

- Aorto-caval compression in supine position (becomes significant in the 2nd half of pregnancy ~ 20 W of gestation). Aortocaval compression by the gravid uterus can lead to a reduction in cardiac output by ~ 25% (in supine position.)

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- Increased blood volume (~30-45% end of 1st trimester).
- Increased cardiac output (begins to rise by 5 W of gestation and reaches ~ 30-50% at term).
- Dilutional anemia.
- Hypercoagulable state - increases the risk of venous thrombosis .
- Fibrinogen is increased to 400-650 mg/dl

Gastrointestinal

- Pressure from the enlarging uterus increases intragastric pressure.
- Gastro-esophageal sphincter tone is reduced.
- Reflux symptoms – very frequent.
- It is unclear whether gastric volume, pH, and emptying are altered during pregnancy.

Responses to anesthetic agents

- MAC for volatile anesthetics is reduced by 30 % already during early pregnancy (sedative effect of progesterone, increased CNS serotonergic activity, increased beta-endorphins).
- Increased sensitivity to local anesthetics (reduced capacity of the epidural space due to venous engorgement, enhanced pharmacodynamic neuronal sensitivity to local anesthetics).
- Reduction in plasma cholinesterase levels (however, succinylcholine neuromuscular blockade is not prolonged because of the increase in volume of distribution).
- During first trimester, ketamine (> 2 mg/kg) may cause uterine hypertonus (ketamine may increase uterine vascular resistance, which decreases uteroplacental perfusion).

When to proceed with anesthesia and surgery?

Purely elective surgery should not be performed during pregnancy.

- *First trimester*

Concerns for **teratogenicity** exist during the first trimester when the embryogenesis is taking place. The commonly used anesthetics have never been proved to be teratogenic in humans. The existing evidence is mostly based on animal studies, and these data have significant limitations when extrapolating to humans.

First trimester maternal exposure to general anesthesia has been associated with an increased risk of hydrocephalus and eye defects (1). However, a recent systematic review of the English literature analyzing 12,452 pregnant women undergoing surgery during pregnancy reported no increase in the risk of major birth defects (2).

Reviews on this subject use very careful wording to express the lack of

evidenced-based knowledge on this extremely sensitive subject. (e.g. "... no anesthetic drug has been shown to be clearly dangerous to the human fetus and there is no optimal anaesthetic technique")(3).

- *Second trimester*

The 2nd trimester was considered the safest period during pregnancy for surgery and anesthesia. That was recently challenged by Palanisamy (4) questioning the influence of the anesthetic agents on the intense **fetal neuro-development** during the 2nd trimester.

- *Third trimester*

Surgery (especially intraperitoneal) and anesthesia during the 3rd trimester are associated with an increased risk of **premature labor**.

Preoperative preparations

- *Consultation by an obstetrician.*
- *Inform neonatology service, if needed.*
- *Aspiration prophylaxis*
- *Optimizing laryngoscopy conditions*

The Mallampati score increases during pregnancy and every pregnant patient should be considered to have a potential difficult airway. Therefore, correct patient positioning is very important for optimal glottic visualization under direct laryngoscopy. ("sniffing position").

Proper positioning of the overweight patient (shoulders elevated with several pads, the head and neck extended, the external auditory meatus in line with the sternal notch) is of critical importance.

- *Avoidance of aorto-caval compression*

The patient should be positioned in left lateral tilt to avoid aorto-caval compression, beginning with *20 weeks of pregnancy*.

When is rapid sequence induction indicated in elective surgery?

Rapid sequence induction with cricoid pressure should be performed after 18 weeks of pregnancy.

What are the intra-operative factors that can impair uteroplacental perfusion?

- Maternal hypoxia
- Maternal hyperventilation
- Maternal hypotension

(sympathectomy with high levels of neuroaxial blockade, aortocaval compression, hypovolemia etc.)

- High levels of circulating catecholamines (preoperative anxiety, insufficient anesthetic depth).
- Drugs that cause uterine hypertonus (e.g. ketamine)
- Alpha-adrenergic agonists.

When is fetal monitoring indicated?

Fetal monitoring is practical from 18-20 weeks of gestation. Fetal heart rate (FHR) variability can be observed after 25 weeks of pregnancy. Perioperative FHR monitoring has a great clinical value and should be used whenever feasible. At a minimum FHR should be documented before and after surgery. Most anesthetics cross the placenta and can decrease short-term variability. The American College of Obstetricians and Gynecologists (ACOG) recommendations are "The decision to use fetal monitoring should be individualized and each case warrants a team approach for optimal safety of the woman and her baby" (5).

Post-operative management

Because of an increased risk of thromboembolism, early mobilization is highly recommended.

If mobilization is not possible, prophylactic anticoagulation should be administered. Uterine displacement should be maintained and FHR monitoring continued.

Laparoscopic surgery during pregnancy

Laparoscopic surgery is increasing in popularity. The most common causes for laparoscopic surgical procedures during pregnancy are: appendicitis, cholecystitis, ovarian torsion, and symptomatic adnexal masses (6). Laparoscopic surgery can be safely performed in any trimester of pregnancy, however the intra-abdominal pressure should be maintained at 10-15 mm Hg (6,7).

Summary

- Elective surgery should not be performed during pregnancy
- General anesthesia should be avoided if possible
- After 20 weeks of pregnancy the patient should be positioned in left lateral tilt
- Rapid sequence induction is recommended after 18 weeks of pregnancy
- FHR should be monitored when feasible
- Early postoperative ambulation is very important
- Laparoscopic surgery can be safely performed

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