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Although regional anesthesia is the preferred technique for cesarean section in the healthy parturient, general anesthesia is still necessary in some cases. A relatively recent workforce survey suggests that approximately 15% of cesarean deliveries performed in the US are done under general anesthesia (1). That study was performed in 1996; it is likely that the percentage of general anesthetics is lower now. The frequency of use of general anesthesia for cesarean delivery is dependent on many factors including the country, the percentage patients in whom general anesthesia is contraindicated, the skills of the anesthesiologist and the percentage of women who receive labor epidurals. A recent Canadian study has found that hospitals with more epidural procedure providers during labor were less likely to have providers choose general anesthesia for cesareans and that larger regional and metropolitan hospitals were less likely to have providers choose general anesthesia (2).

This lecture will review the risks and benefits of general anesthesia and highlight the clinical scenarios where it is necessary.

INDICATIONS FOR GENERAL ANESTHESIA

1. Contraindications to regional anesthesia including massive hemorrhage and hemodynamic instability
2. Significant coagulopathy and recent intake of low molecular weight heparin
3. Severe fetal "distress" in the absence of a preexisting epidural or spinal catheter
4. Failure of regional technique intraoperatively
5. Cardiac diseases that would not tolerate acute sympathectomy
6. Patient refusal

The choice of general anesthesia in a "high risk" parturient must first include an airway examination, as many practitioners will try to avoid a general anesthetic in a parturient with a "difficult" airway. Relative contraindications to regional techniques, such as infection, must be weighed against the possible disadvantages of general anesthesia, including failed intubation and aspiration. A landmark study reviewing anesthesia related deaths during obstetric delivery in the US by Hawkins and colleagues reported that most maternal deaths due to complications of anesthesia occurred during general anesthesia for cesarean section. Furthermore, they found that the case-fatality risk ratio for general anesthesia was 2.3 times that for regional anesthesia before 1985, but increased to 16.7 times that after 1985 (3).

The physiologic changes of pregnancy, including relaxation of the lower esophageal sphincter tone, increased intra-abdominal pressure, increased gastric acid secretion, and the potential for decreased gastric and intestinal motility all combine to increase the risk of aspiration in the pregnant patient. The anatomic changes to the airway increase the risk of failed intubation. (4) An elegant photographic examination of airways of pregnant women documented worsening airway exam as pregnancy increased (5). In addition, certain diseases, such as preeclampsia may make intubation even more difficult (6).

When giving a general anesthetic for cesarean section, all efforts must be made to reduce the risk of aspiration and maximize the chances of successful intubation. In addition, every anesthesiologist providing anesthesia on obstetrics should be familiar with an algorithm for managing the failed intubation and should be familiar with location and use of accessory intubation devices such as the LMA, intubating LMA, Combitube, and fiberoptic scope. A 6 year review from the UK found that in 24 of the 26 cases of failed intubation for which the patient records could be reviewed there was no recording of the preoperative airway assessment, a failure to follow an accepted protocol for failed tracheal intubation, or no follow up (7). To decrease the risks associated with general anesthesia, it is vital to identify patients with difficult airways, so that appropriate steps can be taken, including the placement of an early neuraxial block with catheter. It has been reported that appropriate airway evaluation was not done in 10% of cases in which maternal mortality occurred (8). A review of the risk factors associated with difficult intubation in obstetrics suggested that the largest risks were associated with a Mallampati IV airway and mandibular recession (9).

Measures to reduce or alkalinize gastric contents are routinely used in the US, but are not standard throughout the world (10). Similarly, although NPO policies except for clear fluid are considered mandatory in the vast majority of hospitals in the US (11), this is also not universal. Although no agent can guarantee total prevention of aspiration risk, the administration of 30 ml of non-particulate antacid (0.3M sodium citrate) dramatically reduces the risk (12). The use of particulate antacids, while effective, increases the risk of aspiration pneumonitis due to the effect of the particulate matter. The administration of H₂ blockers such as ranitidine will maintain the alkalinization but the effect is not immediate (13). The advantage, however, of administering these drugs to patients at higher risk of failed intubation and aspiration even in emergent cases, is that they may make the period of extubation safer (and the period of attempted intubation may be prolonged). The use of metoclopramide may further reduce the risk by both emptying the stomach as well as increasing lower esophageal sphincter tone.

The training and experience of the anesthesiologist may play a role in the success of intubation in obstetrics (8). A 17 year review of experience at a teaching hospital in the UK revealed that most cases of failed intubation occurred when less experienced anesthesiologists were providing their care (14). Use of cricoid pressure (Sellick's maneuver) by a skilled assistant should be considered essential. A recent study by Bavani Shankar et al suggests that we are not teaching General Anesthesia for obstetric patients to our anesthesia trainees adequately since 13% of graduating US residents stated that they had never intubated a patient for cesarean section while 65% had performed less than 3 and 75% less than 5 (15).

The necessity of general anesthesia for "fetal distress" is controversial, but there is much evidence supporting the use of regional anesthesia in many of these cases. Neuraxial techniques are appropriate in many situations with a compromised non-anoxic fetus, however some cases such as uterine rupture, umbilical cord prolapse with profound bradycardia, and massive antepartum hemorrhage with maternal shock still require general anesthesia. If a functioning labor epidural is in-situ, it can be used in all but the most extreme cases by administration of a rapid onset local anesthetic such as 3% 2-chloroprocaine or 2% lidocaine with epinephrine.

Several authors have evaluated the risks and benefits of general anesthesia for the distressed fetus and the evidence supports the use of neuraxial anesthesia whenever clinically feasible. Comparison of neonatal status following various types of anesthesia for cesarean section have been reported. Most of these studies evaluated older general anesthetic agents and since general anesthesia is so seldom performed today and is considered to be associated with much greater risk to the parturient, these studies would be difficult to perform using the newer agents available today because of ethical issues and inability to get patients to volunteer. The risks and benefits of general anesthesia to the neonate has been well documented in several studies. A comparison of general and epidural anesthesia found that the general anesthesia group had lower pH values (16). Ong and colleagues (17) found that general anesthesia was associated with a higher incidence of low Apgar scores as compared to regional anesthesia. Similarly, Gale and colleagues (18) reported that the number of neonates needing "respiratory assistance" at birth was twice as high in the group whose mothers received general as compared to epidural anesthesia and Marx and colleagues (19) reported that despite the presence of fetal distress, 1 min Apgar scores were significantly better in the group receiving spinal as compared to general anesthesia. In sum, not every abnormal fetal heart rate pattern should be diagnosed as "fetal distress" and many of these cases can be safely performed under neuraxial block. The American College of Obstetricians and Gynecologists has supported the use of regional anesthesia in these cases in Committee Opinion 104 which states "Cesarean deliveries that are performed for a nonreassuring fetal heart rate pattern do not necessarily preclude the use of regional anesthesia."

Hundreds of Case Reports have been published describing the use of general anesthesia for cesarean section in rare disease states. While it is true that some conditions may be better managed with the patient under general anesthesia, that is rarely the case outside of the indications mentioned above. The benefits of general anesthesia (speed, control of airway, cooperative patient, lack of sympathectomy) must be weighed against the potential disadvantages (failed intubation, aspiration, intraoperative awareness) and an individual decision made in each case. To end, I would like to quote from a recent review of anesthesia for cesarean section, since these authors superbly summarized the subject in an eloquent paragraph. They say, "where possible, anaesthetic protocols and guidelines should exist in every centre, with obstetricians clearly informed of relevant features. Such an approach will prevent inconsistent advice being given to patients and dangerous mistakes occurring. With every aspect of maternity care, a multidisciplinary team approach is in patients' best interest and anesthesia for caesarean section is no exception" (20).

CONDUCT OF GENERAL ANESTHESIA

1. Metoclopramide 10 mg IV plus or minus H2 blocker.
2. Non-particulate antacid
3. Left uterine displacement
4. Denitrogenation with 100% O₂
5. Cricoid pressure
6. Rapid Sequence intravenous induction with thiopental and succinylcholine
7. Intubation
8. Verification of tube placement
9. Communication with surgeons to allow surgical start
10. Administration of 30-50% nitrous plus 0.5 MAC of volatile agent

After Delivery

11. Increase Nitrous oxide to 70%
12. Turn off (or turn down to very low levels) the volatile agent
13. Administer intravenous opioid and benzodiazepine
14. Administer muscle relaxant (short acting non-depolarizing or succinylcholine drip)
15. Empty stomach with oro-gastric tube
16. Reversal of muscle relaxant
17. Awake extubation after verification of intact airway reflexes

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