

may be quite accurate, it may be viewed as "hearsay" information. To overcome this obstacle to accurate reporting, it is best to insist upon first hand accounts of what transpired in the operating room.

4. All reports should be signed by the individual making such reports. The time and date of the report should also be included.

On the cutting edge

Most hospitals are not going to "jump" at the idea of a reporting system which identifies inappropriate behaviour on the part of surgeons. It smacks of confrontation, an aspect of management most people are inclined to avoid. This is unfortunate

since scalpel-throwing is as important as pathology and tissue findings in professional performance appraisals. Both reflect surgical judgement.

One may give impetus to a reporting system to report scalpel-throwing and similar outbursts to the nursing union representative. Since the surgeon's behaviour is making working conditions quite unacceptable, the stage is set for a grievance. Although this may be a backdoor approach to professional disciplinary action, it is likely to be very effective in getting management to take action.

Conclusion

This approach to managing unacceptable behaviour is not likely to be adopted overnight. It takes time to evaluate reporting structures, to train personnel how to make reports, and to teach medical advisory committees, senior management and the board how to handle such information. Physicians joining the medical staff must understand that scalpel-throwing and similar behaviour is grounds for privileges action. For the welfare of everyone concerned, it is up to operating room nurses to insist on such an approach. ■

About the authors

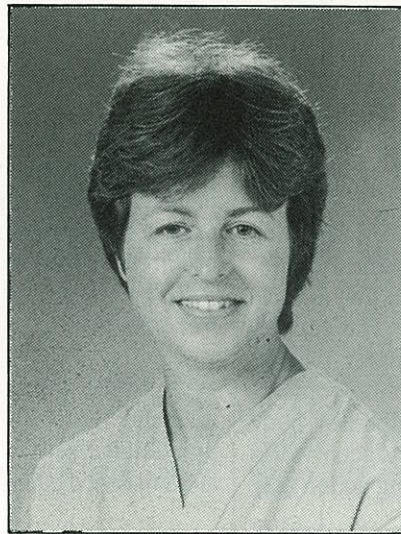
Lorne Rozovsky, is a Halifax lawyer with the firm of Patterson Kitz, and adjunct associate professor of law and medicine, Dalhousie University, Halifax.

Fay Rozovsky, M.P.H., president of LEFAR Health Associates, is a visiting lecturer in Health Law, Harvard School of Public Health.

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Identifying anaesthetic risks in pregnant surgical patients

By Janet Nelles, R.N., B.Sc.N.

The expectant arrival of a newborn is often the most exciting time a family can enjoy. However, pregnancy can precipitate medical conditions necessitating surgery. Trauma cannot be excluded simply because pregnancy exists. Literature suggests that approximately 0.2% to 2% of North American women will undergo surgery for conditions unrelated to their pregnancy.^{2,4}

Women of childbearing age are increasingly remaining in the workforce and continue to work until the final stages of pregnancy. The continuing trend for women to assume employment responsibility traditionally held by men, increases the risk for trauma during pregnancy.¹

This paper will examine special considerations for the pregnant surgical patient, focusing on aspects prior to labour and delivery. The pregnant woman presents the surgical team with special considerations not only for the well-being of maternal health but fetal health as well.

Maternal considerations

A number of conditions may be found during pregnancy requiring surgical intervention; however a few conditions occur more commonly than others. Ovarian cysts is the most common condition necessitating surgery and has been estimated to occur at rates up to 1:2,500 pregnancies.⁹

Acute appendicitis, occurring at a rate of 0.07%, is another more frequent surgical condition. Other medical conditions that may require surgery are:

- intestinal obstruction
- aneurysm, intracranial tumour
- incompetent cervix
- cholecystitis (inflammation of the gallbladder)

- ulcerative colitis
- nephrolithiasis (calculi in the kidney)
- hyperparathyroidism
- pheochromocytoma (cellular tumor of the sympatho-adrenal system)

What presents to the anaesthetist particular concern over the non-pregnant woman? Pregnant women have a number of changing dynamics occurring within. The anaesthetist not only must consider these dimensions but also the developing fetus.

Changes occurring, from the maternal aspect, cover a variety of systems. The gastrointestinal system poses a difficult problem for anaesthetists, particularly for intubation. Due to the expanding uterus, gastrointestinal contents are pushed upwards and are bounded by an increasingly smaller spacial area. The result is for the stomach to eventually assume a horizontal position, with the pylorus displaced upward and posteriorly. This leads to gastric contents being left longer in the stomach.

Research has found that gastric emptying time of a watery meal can be prolonged by approximately 60%, from week 34 onward.⁹ Thus, surgically this patient is not a good anaesthetic risk simply because of aspiration and regurgitation factors impinging on intubation.

Muscle relaxants given to enhance intubation efforts multiply risks involved by relaxing protective reflexes, increasing intra-abdominal pressure and relaxing the cricopharyngeal sphincter.⁹ This small fact can potentially create long-term effects for the mother, and perhaps death. Studies have shown that as little as 25 ml gastric juice with pH less than 2.5 introduced to the lungs can cause aspiration pneumonia.⁸ To reduce this risk, cricoid pressure, which

can be performed by the circulating nurse, can ensure airway protection and significantly reduce the risk of regurgitation and aspiration and their sequelae. Antacids given to the patient prior to surgery can elevate pH of gastric juices above 2.5, and again, decrease the risks involved with intubation.³

The cardiovascular system & pregnancy

Cardiovascularly, a number of changes occur. Because of the growth of the fetus, maternal organs must compete for space; consequently, if organs are not displaced they can become compressed. This develops during the second trimester and continues until the birth.

The pregnant woman, in a supine position may have compression of the inferior vena cava (IVC) and aorta. A radiographic study has shown that complete obstruction of the IVC occurs in approximately 90% of women at term in the supine position. This affects venous circulation by diversion of venous blood, resulting in a decreased amount of regional anaesthetic required.⁹

ECG changes, resulting from displacement of the heart due to the upward compression of the diaphragm, may be seen. Premature contractions, sinus tachycardia and paroxysmal supraventricular tachycardia occur more frequently during pregnancy.

While these arrhythmias may not have any effect on maternal or fetal health, medical personnel should be aware of their occurrence.⁸ Women with a past history of thrombophlebitis are at risk for a repeat episode.⁴ Depending on the length of the surgical procedure, risks may be carried to all pregnant women due to decreased peripheral vascular resistance, increased cardiac output and vasodilation, all of which occur naturally during pregnancy.¹⁰

The respiratory system and pregnancy

The respiratory system is not without changes, as well. Again, compression due to the enlarged uterus, alters respiratory patterns and rates. Breathing becomes diaphragmatic rather than costal, and oxygen consumption increases. To compensate, hyperventilation occurs. Swelling in nasopharynx may make intubation difficult and carries the risk of bleeding if nasal intubation is necessary.^{4,9} Thus, administration of oxygen becomes a vital component to the well-being of mother and fetus, and should be considered when ventilating the patient. Tidal volume increases by 40%, respiratory rate by 15%, and alveolar ventilation increases approximately 70%.⁹

Another point of consideration is the role of fasting. Carbohydrate metabolism is essential to fetal

development. Thus the implications of low or nil caloric intake may not be realized until birth; in most cases for surgery, this is practical.

Maternal injury, depending on type and anatomical location, may have a direct effect on the fetus. The pregnant woman, experiencing blood loss due to trauma, has compensatory mechanisms that are activated. The uterus becomes a non-vital organ and consequently blood is shunted away from the uterus. For the fetus, the result is much the same as that occurring within the adult - blood is shunted away from the non-vital organs and quickly progresses to fetal hypoxia. If severe enough, this can result in fetal death, which occurs much quicker than in adults.¹

The introduction of drugs to a maternal circulatory system carries the risk of crossing the placental barriers. This area is difficult to research largely because of the ethical impact. In fetal development, organogenesis occurs during days 15 to 56. Central nervous system myelination (acquiring a sheath of myelin for nerve fibres) occurs during the seventh to ninth months. Avoiding exposure to anaesthetics during these periods is suggested. Potential lethal doses may occur in the administration of drug doses to the fetus causing teratogenesis (abnormal structures in the embryo resulting in a deformed fetus).⁴

Nursing interventions

Nursing management of the pregnant surgical patient can begin before the patient enters the surgical suite. Basic nursing care and judgement are a good beginning to providing adequate care. Because of the importance of oxygen consumption by the patient, nursing interventions aimed at alleviating any difficulties in this respect should be a priority. This can be done by providing oxygen by nasal specs to ensure adequate oxygenation of the mother and ultimately the fetus.

Alleviating any anxieties or fears the patient may have decreases the risk of hyperventilation.¹ Also, good pain control will contribute to adequate oxygenation. Care should be taken not to oversedate the patient, thus avoiding respiratory depression.

Fetal heart rate

Fetal heart rate (FHR) monitoring can provide objective data not only pre-operatively but intra-operatively and during post-operative recovery. FHR monitoring enables the surgical team to detect onset of premature labour or fetal distress. Thus, depending on the surgical site, FHR monitoring should be in place during post-operative recovery.

Monitoring can become vital since the mother may not be able to feel any premature contractions.⁷

As stated earlier, compression of vena cava and aorta are synonymous with pregnancy. Thus, women in the second or third trimester should not be transported or positioned on the operating room table in a supine position.⁹ Rather, transport the patient in a semi-Fowler's position or place a wedge under the right hip; thus, the uterus will be sufficiently displaced, relieving any pressure on the aorta and vena cava.⁸ These positions may work well in the operating room suite, depending on the type of surgery.

Patient intubation

Intubation of the patient during pregnancy can be difficult. Earlier discussion revealed anatomical and physiological changes occurring within the gastrointestinal system. With these changes in mind, intubation should be rapid and with a cuffed tube to decrease the risk of aspiration. If possible, the mother may have had pre-operative antacid.

Application of cricoid pressure will minimize risk when performed during intubation. Use of nasogastric suction will ensure risk is minimized, especially if time patient last ate is unknown.¹

Intravenous therapy maintenance is of utmost importance. For the woman who has encountered trauma, she may have up to 30 to 35% loss of circulating blood volume before any signs and symptoms of shock may be seen. This can affect the fetus immensely. Hemostasis occurs within maternal circulation but the uterus is a non-vital organ; thus, blood is shunted away to more vital areas. Volume expanders such as Ringer's lactate are essential. Whole blood or packed cells, if necessary, can be used to increase the oxygen carrying capacity of maternal circulation.¹ Intravenous fluids may minimize risk of hypotension that could occur with spinal or epidural anaesthesia.⁸

Other risks to be aware of are the administration of drugs. Choose drugs with a long history of safe use associated with pregnancy. This may avoid long term problems, i.e. congenital defects, potential spontaneous abortion. ECG monitoring of the mother can monitor arrhythmias which may not be harmful to patient or fetus but allow the surgical team to stay on top of minute-to-minute changes.

Anaesthetic risks

Research in anaesthetics used during pregnancy in non-obstetrical procedures is diffuse. Ethical dilemmas concerned with this type of research under-

standably inhibit study on the effects of anaesthesia on pregnancy and fetal development. One study done in Manitoba, examined a number of women undergoing incidental surgery during pregnancy and compared them with women who had not undergone surgery during the course of their pregnancy. The researchers investigated type of surgery, type of anaesthesia and incidence of congenital anomalies.

Their findings were that there was no significant difference in the rate of congenital anomalies between the two groups, but they did find an increased risk of spontaneous abortion in those having a general anaesthetic during the first and second trimester. They also noted that the surgical site, i.e. obstetric or gynecological procedures, were more prone to risk of spontaneous abortion than other procedures. No difference was found in rate of congenital anomalies between the two groups of women.²

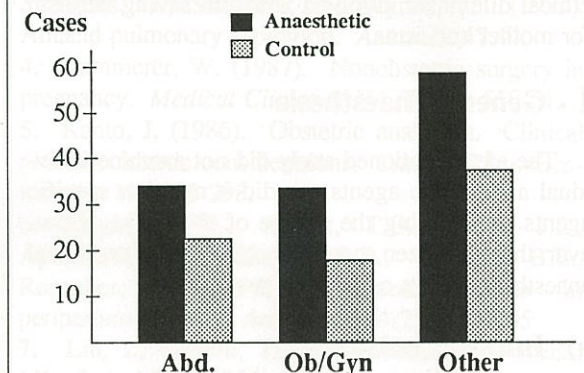


Fig. 1 Abortions by surgery site with general anaesthetic (Duncan et al; *Anaesthesiology*: 793)

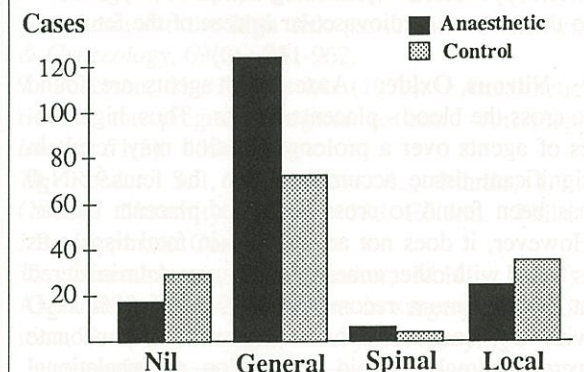


Fig. 2 Abortions by anaesthetic type. (Duncan et al; *Anaesthesiology*: 792)

A number of studies have been conducted on operating room personnel exposed to occupational anaesthetic gases and effects on offspring. It is difficult to correlate these findings to the pregnant surgical patient due to the direct concentration of anaesthetic agent inhaled and absorbed systemically. The

general consensus is that anaesthetics are not good for the developing fetus. However, there is some disagreement about the direct effects and implications of teratogenesis, or the development of abnormal structures in the embryo resulting in deformed fetuses. It is important to remember that in the course of fetal development, organogenesis (the formation of organs) occurs during days 15 to 56, and central nervous system myelination occurs during the seventh to ninth months. During these periods of development the fetus may be particularly susceptible to the teratogenic effects of anaesthesia.

Of course, the ethical dilemmas abound when considering the pregnant surgical patient. Because of the lack of research on human development with short-term use of anaesthetic agents, the anaesthetist is faced with a number of choices. One must evaluate the importance of two lives at risk and the ethical dilemmas involved with life saving heroism for mother and fetus.

I - General anaesthesia

The aforementioned study did not examine individual anaesthetic agents nor did it mention specific agents used during the course of the study. However, there has been some individual study on several anaesthetic agents on animals:

a) Inhalational agents:

- **Oxygen:** Benefits of oxygen therapy for the pregnant patient have already been discussed. Of utmost importance is providing adequate oxygenation to the tenuous cardiovascular system of the fetus.

- **Nitrous Oxide:** Anaesthetic agents are found to cross the blood - placenta barrier. Thus, high doses of agents over a prolonged period may result in significant tissue accumulation in the fetus.⁵ N₂O has been found to cross the blood-placenta barrier. However, it does not accumulate in fetal tissues as is found with other anaesthetic agents. Administered at the maximum recommended dose of 50% N₂O with O₂, concentrations measured in the neonate were minimal. Rapid elimination of inhalational anaesthetic agents are a definite value over parenteral anaesthesia.⁵ When N₂O is administered over a long period, one to two days, at 50% concentration, profound effects were noted in pregnant rats and chicken embryos. These were:

- increased incidence of spontaneous abortions
- skeletal deformities, and
- smaller off-spring.⁹

- **Halothane:** Chronic exposure to halothane gases by operating room nurses has suggested an increased risk of congenital deformities and spontaneous abortion.⁴ Animal studies have shown increased rates of skeletal anomalies as well as spontaneous abortion following relatively brief periods of exposure during gestation - 3 to 12 hours.⁹

- **Enflurane:** No evidence has been shown to date that enflurane (Ethrane) has any profound effects on teratogenesis. However, this inhalational agent does have side effects that one must consider for maternal health. We know ECG changes may occur during pregnancy. Ethrane has been observed to cause increased heart rate, hypotension, decreased seizure threshold and, at high enough concentrations, create arrhythmias.¹¹

- **Isoflurane** - A relatively new inhalational agent whose effects on teratogenesis are unknown to date.⁵ However, side effects of this agent include increased heart rate.¹¹

b) Intravenous agents

- **Diazepam:** Studies from the effects of long term use of valium has been generated mainly from data gathered from the general population of women giving birth, who were habitual users. Several reports have correlated a relationship between valium and oral clefts. However, short-term use and its effects are unknown.⁹

- **Thiopental sodium:** No direct effects of congenital anomalies have been noted as a result of pentothal use. However, this agent may have effects on intubation. It is an extremely short-acting drug and allows the patient rapid recovery. Thus, it may cause apnea when used for induction anaesthesia.¹² Therefore, risks lie in intubation with respect to aspiration pneumonia and adequate oxygenation of the fetus.

II - Muscle relaxants

- **Succinylcholine:** This non-depolarizing muscle relaxant is especially useful for intubation with rapid onset and short duration. It is the most widely used muscle relaxant and does not appear to have any effects on the fetus.^{6,9} However, because of a decrease in serum cholinesterase activity during pregnancy, it has been found that the duration of action of succinylcholine is longer in pregnant women. This increases the length of paralysis which may have implications if airway problems arise.⁶

III Local/regional anaesthesia

These anaesthetic agents (local and regional) are discussed together, as regional anaesthesia employs the use of local anaesthetic agents.

- **Bupivacaine:** Marcaine is a commonly used local anaesthetic agent. Extensive studies done on marcaine have shown that the fetus can metabolize the drug well. However, it is unknown how the metabolites act on the fetus/neonate. It has been reported that administration of marcaine in concentrations of 0.75% can cause cardiac arrhythmias following a rapid intravenous injection. Thus, it is no longer recommended for use in obstetric patients.⁵

- **Lidocaine:** This agent has been shown to have effects on the central nervous system in animal studies following direct infusion of a large dose. This is dependent on the time at which the drug is utilized during various stages of fetal development.⁹ No evidence has been shown for human teratogenesis.

In general, no evidence has been shown that use of local anaesthetics have teratogenic effects. In fact, it has been recorded that they are quite safe when used for subarachnoid injection. In this case, it has been shown that fetal blood levels of local anaesthetic agents are low. However, peridural, caudal anaesthesia or accidental intravascular injection may have effects on the central nervous system and/or myocardium of the fetus. As well, these types of anaesthesia may create vasodilation which can cause fetal hypoxia by decreasing placental blood flow.⁴ Thus, local anaesthetics, depending on use, are not without some risk to the fetus.

Conclusion

From the data presented, it is easy to see the difficulty researchers have in identifying anaesthetic risks for the pregnant surgical patient. The pregnant woman has a number of changing variables the surgical team must consider when making the decision to operate. The well-being of the fetus is dependent on maternal factors. Thus, choices become difficult, especially when fetal or maternal life is at stake.

The anaesthetic/surgical team must face ethical and perhaps moral dilemmas when considering anaesthetic choice. Research into teratogenic effects of various anaesthetic agents is diffuse largely because of ethical concerns in gathering data related to humans. However, general consensus is that surgery during pregnancy should be avoided, especially during critical periods, i.e., organogenesis and central nervous system myelination. Another alternative is

to delay the surgery as long as possible. However, the choice is not easy when the decision to operate becomes essential for survival of mother and fetus.

As seen from the data presented, the greatest risk lies in the increased rate of spontaneous abortion. This risk lies mainly in general anaesthesia; however, it may be attributable to other types as well, as seen from animal studies. Nurses can play an important role in reducing risk factors apparent when presented with the pregnant surgical patient by using nursing judgement and skill.

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About the author

Janet Nelles, B.Sc.N., R.N., is a recent graduate of the Post Graduate O.R. Technique and Management Course, Hotel Dieu Hospital, Kingston. She is a graduate of the Bachelor of Nursing program, Queen's University School of Nursing. Currently, she is a staff member of the medical/surgical unit at Belleville General Hospital, Belleville, Ontario.