Maternal morbidity and mortality: anesthetic causes

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A maternal death in labour and delivery is devastating to all involved; after all, only in the obstetric patient can mortality be 200%! Although infant mortality has declined steadily due to increased survival of preterm infants and prevention of SIDS, maternal mortality has remained approximately 7.5 maternal deaths per 100,000 live births over the last 15 years.[1] The reason for the lack of improvement is unclear. More than half of maternal deaths are preventable - hemorrhage, pregnancy-induced hypertension (PIH), infection, and ectopic pregnancy account for 59%.

Anesthetic causes have fallen to a "respectable" #6 on the list of causes for maternal mortality in the United States. The causes of pregnancy-related deaths are:[2]

Hemorrhage	29%
Embolism	20%
PIH	18%
Infection	13%
Cardiomyopathy	6%
Anesthesia	3%
Other	11%

Since about 1991, the Centers for Disease Control (CDC) has defined maternal deaths as those which occur within one year of delivery and are related to the pregnancy. Thus the percentage of deaths due to cardiomyopathy has increased because those deaths often occur after a lengthy illness. Many maternal deaths (probably over 30%) are missed because the cause of death on the death certificate does not reflect the fact the patient was pregnant. For example, if a woman dies of a pulmonary embolism but the death certificate does not note she was pregnant, it would not be classified as a maternal death. The CDC has begun asking states to link maternal death certificates with live birth or fetal death certificates, thus increasing identification of maternal deaths.

So what do we know about anesthetic maternal mortality in the United States? In 1987 the Centers for Disease Control and Prevention (CDC) established an ongoing National Pregnancy Mortality Surveillance System to monitor maternal deaths at the national level and conduct epidemiologic studies of the deaths of pregnant women.[3] Health departments in all 50 states, the District of Columbia, and New York City provide the CDC with copies of death certificates with patient and provider identification removed. When available, linked birth certificates and fetal death records are also included. These are available from 1979 through 1996. Anesthesia-related deaths are currently being reviewed for 1991–1996.

When these vital statistics data were reviewed,[4] the information was very limited, but we attempted to determine the cause of death, the relation to the type of anesthetic, the type of obstetric procedure, and any associated maternal conditions. Many (most?) times the data was woefully inadequate, but CDC has no legal power to obtain medical records, autopsy reports, or other information that might have been helpful.

However, several conclusions could be made. Anesthesia-related maternal mortality rates (per million live births) could be calculated and compared to rates in the United Kingdom since these rates are commonly quoted. They proved to be very similar.

Triennium	United States	United Kingdom
1979–81	4.3	8.7
1982–84	3.3	7.2
1985–87	2.3	1.9
1988–90	1.7	1.7
1991–93	1.4	3.5
1994–96	1.1	0.5

It also became clear that something had changed during the period of time being reviewed. Although the number of deaths from general anesthesia remained stable, the number of deaths associated with regional anesthesia declined markedly. This occurred despite the fact that regional anesthesia was being used more often for Cesarean delivery in virtually

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every hospital.[5] The decline in deaths associated with regional anesthesia occurred in the mid- 80's, coincident with the withdrawal of 0.75% bupivacaine and probably due to increasing awareness of local anesthetic toxicity and use of a test dose. Using the number of deaths in each six-year period and estimating the number of Cesarean deliveries done under regional or general anesthesia each year (note there are more and more calculations and assumptions!), case fatality rates and risk ratios could be calculated.

Number of deaths			Case Fatality Rate*			Risk Ratio		
79–84	85–90	91–96	79–84	85–90	91–96	79–84	85–90	91–96
GA								
33	32	13	20	32.3	16.8	2.3	16.7	6.7
REG								
19	9	14	8.6	1.9	2.5	1	1	1

* Per million general or regional anesthetics

Although the numbers calculated may not be entirely accurate because of all the missing data and assumptions involved, they do show that general anesthesia is riskier than regional in the obstetric patient. Why should that be?

1. During general anesthesia the airway must always be managed, and airway management is more difficult in the obstetric patient. Airway problems were by far the most common cause of anesthesia-related deaths.
2. General anesthesia is often chosen in emergencies when preparation and examination of the patient is not optimal.
3. General anesthesia is used in patients who have failed regional anesthesia (obese) or have contraindications to its use due to medical conditions (PIH, HELLP).
4. Residency training programs are not teaching general anesthesia to residents on their obstetric rotations because anesthesiologists, patients, and obstetricians prefer regional anesthesia.

It would appear that maternal mortality will decrease further only by continuing to increase use of regional anesthesia and providing organized airway management programs for our residents so they are prepared for obstetric airway emergencies.[6] Even deaths during regional anesthesia may involve airway management. Several of the deaths during regional anesthesia occurred when the block became too high and the airway could not be secured leading to hypoxia and/or aspiration.

On the other hand, there are times when general anesthesia is the most appropriate choice for the patient and it should not be avoided. After all, the mortality rate was 17 per ***million*** general anesthetics most recently! That's a remarkable safety record. And we would expect that number to go down even further as additional tools for managing difficult airways [laryngeal mask airway (LMA), Combitube] become more widely available and as the ASA Difficult Airway Algorithm becomes familiar to all practitioners.

Above all, we need more information! We need access to all cases of maternal mortalities in an environment free of concerns about liability issues to understand why they occurred and how to prevent them in the future. And we need to know about "near misses" and how mortalities were avoided. In an area as important as this, we should learn from each other's mistakes so as not to repeat them.

Anesthetic causes of maternal mortality

Management of the difficult airway in obstetrics

The incidence of failed intubation in obstetric patients is 1:280 while the incidence of failed intubation in the general operating room is 1:2230.[7,8] Therefore you have over seven times the chance of dealing with a failed intubation while you are providing general anesthesia on the labour and delivery ward (L&D). KNOW THE DIFFICULT AIRWAY ALGORITHM! Do some advance planning:

- Put together a difficult airway box for L&D[9]
- Place a "prophylactic regional anesthetic" when you anticipate a difficult airway[10]
- Administer aspiration prophylaxis as soon as operative delivery is anticipated
- Have extra, experienced hands available at induction of general anesthesia

If you can't ventilate:

- Have an LMA or Combitube available?[11,12]

If you can ventilate and need to proceed:

- Use a drying agent such as glycopyrrolate
- Elevate head of bed
- Administer metoclopramide to increase gastroesophageal sphincter tone
- Consider spontaneous *vs* controlled ventilation
- Decide on inhaled *vs iv* anesthesia after delivery (uterine atony)

Aspiration of gastric contents

This is still the #1 cause of death in obstetric anesthesia;[4] and almost always associated with a difficult or failed intubation, so much of the preceding discussion pertains here. How can we prevent this complication?

- Encourage use of regional anesthesia
- Perform awake intubation for obese patients or the anticipated difficult airway
- Decrease the volume and acidity of gastric contents; combination therapy?

- Institute appropriate oral intake policies during labour (ASA Practice Guidelines)
- Reduce the use of opiates for analgesia
- Train personnel in the correct performance of Sellick's manoeuver

Local anesthetic toxicity

Local anesthetic toxicity is the leading cause of death when a regional anesthetic is used, however its occurrence has decreased markedly in the last decade. Prevention centres around incremental dosing and the "test dose". What is an appropriate test dose in obstetrics?

- Epinephrine (dose? effect on uterine blood flow? reliability? maternal consequences?)[13,14]
- Chloroprocaine[15]
- Air[16]
- Fentanyl or sufentanil[17]
- Aspiration and fractionation only, without a marker[18]
- Isoproterenol (theoretical only)[19]

Should test dosing be different for the labouring patient *vs* the parturient for elective Cesarean delivery? Probably - for elective Cesarean delivery there is less heart rate variability to confuse interpretation of an epinephrine response, and more chance of toxicity with a higher, more concentrated dose of local anesthetic. Does injecting fluid through the needle help decrease the incidence of intravascular catheter placement? Probably - if you use at least a 10-mL volume.[20]

High spinal or epidural block

More test dose issues... Think about the number of milligrams and the volume you use in your subarachnoid test dose; 60 mg of isobaric lidocaine (3 mL of 2%) will give you a high block. Likewise, even though 10 mL of 0.125% bupivacaine is only 12.5 mg, its isobaricity and volume will cause extensive spread in the cerebrospinal fluid (CSF). Probably the best indicator of a subarachnoid injection is onset; if they are comfortable in one contraction, you're in the CSF until proven otherwise!

Is it safe to perform spinal anesthesia for Cesarean delivery or tubal ligation after a fully dosed but failed epidural anesthetic?[21] There are a number of case reports of excessively high blocks requiring intubation in this setting; perhaps because the expanded epidural space volume compresses the CSF and forces the local anesthetic dose higher. After a failed epidural you are balancing the risk of airway management during general anesthesia with the risk of a high block that may also require intubation. If you choose to proceed with spinal anesthesia, anticipate there may be a problem and be prepared for rapid airway intervention.

Anesthetic causes of maternal morbidity

Treatment of postdural puncture headache (PDPH)

Remember that the natural history of a PDPH is to resolve spontaneously in about one week.[22] Therefore it may be appropriate initially to handle the situation conservatively with reassurance, oral analgesics, and po caffeine- containing fluids as tolerated.[23] However, if the patient is unable to leave the hospital or care for her newborn due to the severity and postural nature of her headache, more aggressive intervention may be indicated. Intravenous caffeine usually provides at least temporary relief, an epidural blood patch is almost always effective, and oral muscle relaxants and/or physical therapy may be helpful with any cervical musculoskeletal component.

"Headache" was the #3 cause of malpractice suits in obstetric patients in the Closed Claims analysis, accounting for 15% of claims. Don't underestimate the importance of this problem to the patient!

Postpartum neurologic deficits

A 1987 review of neurologic deficits after 23,827 deliveries revealed the following:[24]

- The overall incidence of paresthesias and/or motor dysfunction was 0.2%
- All were transient and none lasted over 72 hr
- The incidence was similar in patients who received general or epidural anesthesia (~ 1:280) but patients had a lower incidence of neurologic symptoms if they received no analgesia (1:4099) or inhalation analgesia (1:1589)
- However, the survey was too small to pick up rare neurologic injuries

A 1995 review of Closed Claims nerve injuries in obstetrics found the most common cause of block-related injury was direct trauma associated with severe paresthesia.[25] They also found injuries were more common in Cesarean delivery *vs* labour, epidural *vs* spinal, and with a paresthesia *vs* without. No cases of epidural hematoma were identified in the entire database!

Prior to placing a regional anesthetic, ask the patient if she has had any changes in sensory or motor function of the lower extremities during this pregnancy, and perform a brief neurologic exam of the lower extremities to document motor function, sensation, and reflexes.

Postpartum back pain

Although tenderness at the site of epidural placement lasting a few days is common (as after any injection), back pain occurs with equal frequency with or without use of regional anesthesia. The incidence of back pain is 50% one or two months after delivery[26] and 45%

12–18 months after delivery without relationship to the type of anesthesia received.

Side effects of spinal and epidural opiates

Pruritus is most common and can be treated with nalbuphine (2.5–10 mg), propofol (10–20 mg), naltrexone (6 mg), or naloxone (40 μg increments or an infusion). Since the itching is unrelated to histamine release, diphenhydramine is unlikely to be helpful except in providing sedation.

Nausea is most intense after meperidine and lasts longest after morphine. Treatments include nalbuphine, metoclopramide (probably best prophylactically), naloxone, droperidol, possibly propofol, and probably ondansetron.

Closed Claims analysis of obstetric (OB) anesthesia malpractice claims

Critical events involving the respiratory system were the most common precipitating events leading to adverse outcome in both the obstetric and nonobstetric closed-claim files.[27] Failed intubation and pulmonary aspiration are more common during administration of general anesthesia in pregnant women than in nonpregnant women.

Maternal closed-claim files include a much higher proportion of relatively minor injuries (e.g., headache, pain during anesthesia, back pain, emotional distress) than do the nonobstetric files.[28] In reviewing these records, many patients were unhappy with the intraoperative anesthetic or follow-up care provided and felt themselves ignored, mistreated, or assaulted. Caring and comprehensive discussion with the patient during the preoperative evaluation improves the image of the anesthesiologist and reduces the likelihood of dissatisfaction and possible litigation after unanticipated complications.

Although payments were made in a similar proportion of OB and non-OB claims (52% and 59% respectively), when payments were made, the median payment for OB claims was significantly greater than for non-OB claims ($200,000 *vs* $100,000 respectively). General anesthesia claims received a higher median payment than regional ($345,426 *vs* $77,500).

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