

General Anesthesia for Cesarean Delivery

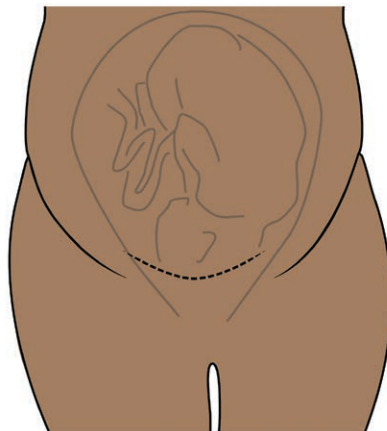
Occasionally Essential but Best Avoided

Jill M. Mhyre, M.D., Pervez Sultan, M.B.Ch.B., F.R.C.A., M.D. (Res)

Cesarean delivery is the most commonly performed operation in the United States, with more than one million women undergoing this procedure per year. Neuraxial anesthesia is widely considered safer than general anesthesia for cesarean delivery, but evidence to confirm this clinical impression is limited. Serious complications of general anesthesia, including failed intubation, intraoperative awareness, and fatal aspiration of gastric contents, are rare.¹

Although in the past, the risk of maternal death with general anesthesia was reported to be 17-fold greater than that of neuraxial anesthesia, the most recent U.S. mortality data, collected between 1997 and 2002, suggest that case fatality rates of general and neuraxial anesthesia have converged to become statistically indistinguishable.² One explanation for this convergence in risk of death is the increased use of neuraxial anesthesia for high-risk obstetric cases.

In this issue of *ANESTHESIOLOGY*, Guglielminotti *et al.* use administrative billing data from the State of New York to address the question of whether and to what extent case selection explains any differences (or lack of difference) in risk between general and neuraxial anesthesia for cesarean delivery.³ The authors identified a cohort of women with billing codes that suggest indications for general anesthesia, including conditions such as: umbilical cord prolapse, abruption, uterine rupture, maternal coagulopathy, and sepsis. One or more of these conditions complicated care for 46% of the 864,058 women who underwent cesarean delivery in New York between 2003 and 2014. Not only was this group more likely to receive general anesthesia



“...[I]n the absence of contraindications, neuraxial anesthesia has been and remains the gold standard anesthetic for cesarean delivery.”

when compared with women who did not have any documented indications for general anesthesia (8.6 vs. 5.7%), but they unsurprisingly experienced substantially greater rates of death or cardiac arrest (8-fold increase) and severe anesthesia-related complications (3-fold increase). Whether general anesthesia somehow mediates the association between maternal conditions that indicate general anesthesia and serious maternal harm is unknown.

To isolate any effect of the anesthetic technique on maternal safety, subsequent analyses excluded women with a documented indication for general anesthesia. Among this presumed-to-be “lower-risk” group, the risk of death or cardiac arrest was not different between those who underwent “potentially avoidable” general anesthesia (n = 26,500) and those who received neuraxial anesthesia only (n = 439,600). On the other hand, complications including anesthesia-related complications, severe anesthesia-related complications, surgical site infection, and venous thromboembolism were all increased, by 62%, 289%, 74%, and 92%, respectively. General, as opposed to neuraxial, anesthesia for caesarean delivery is associated with maternal harm. This finding reinforces existing literature showing that general anesthesia is associated with worse postoperative pain, delayed mobilization, impaired breastfeeding success, neonatal respiratory depression, and poorer Apgar scores.^{4,5} When possible, it is best to avoid general anesthesia with a well-conducted neuraxial anesthetic.

Subsequent analyses in the study identify risk factors for potentially avoidable general anesthesia. Most remarkably, in multivariable analysis, non-Hispanic black women were

Image: J. P. Rathmell.

This editorial accompanies the article on p. 912.

Accepted for publication February 28, 2019. From the University of Arkansas for Medical Sciences, Little Rock, Arkansas (J.M.M.); and the Stanford University School of Medicine, Palo Alto, California (P.S.).

Copyright © 2019, the American Society of Anesthesiologists, Inc. Wolters Kluwer Health, Inc. All Rights Reserved. *Anesthesiology* 2019; 130:864–6

27% and Hispanic women 15% more likely to be subjected to general anesthesia without a documented indication for it, when compared with white women. The disparity between white and black women has increased over time and has been previously described.⁶ In white women, “potentially avoidable” general anesthesia declined between 2003 and 2014, from 6.1 to 3.6%. Conversely, in non-Hispanic black women the use of general anesthesia increased from 5.4 to 6.0% between 2003 and 2014. Differential rates of exposure to general anesthesia may reflect differences in anesthetic decision-making, but may also reflect differences in decisions about the hospital selected for delivery, intended mode of delivery, and whether the patient opts to use neuraxial labor analgesia.

The study also found that institutions where fewer laboring women received neuraxial analgesia (less than 25% *vs.* greater than 75%) had a 3-fold increase in adjusted odds ratios of potentially avoidable general anesthesia. Conversion of epidural analgesia to cesarean anesthesia is one of the most important strategies to reduce the use of general anesthesia during emergency surgery, but requires high rates of indwelling epidural catheters, equipment availability, staff presence on the labor and delivery unit, and careful coordination between obstetricians and anesthesiologists.⁷ Care by an obstetric anesthesiologist, expert in this clinical scenario, has been shown to reduce the use of general anesthesia when compared with care by generalist anesthesiology colleagues.⁸ Indeed, the quality of the neuraxial analgesia service likely correlates with utilization rates, and both appear to be among the most important modifiable factors for reducing the use of general anesthesia, both within an institution and for vulnerable populations such as non-Hispanic black women.

Nevertheless, in this retrospective analysis of administrative data, cases of “avoidable” general anesthesia may in fact be cases in which the indication for general anesthesia was not coded. For example, emergency cesarean delivery is a frequent indication for general anesthesia, and emergency surgery likely confounds the association between general anesthesia and increased rates of surgical site infection and venous thromboembolism. In emergency cesarean delivery, antibiotics are more likely to be deferred and sequential compression devices omitted. The impact of differential coding practices among the 165 hospitals contributing to this dataset remains unclear. It is certainly possible that among the 46% of women with coded indications for general anesthesia, there were some whose true clinical picture did not justify the use of general anesthesia; this would produce over-exclusion, biasing the analysis to the null hypothesis. For example, some high-risk conditions do not have specific International Classification of Diseases, Ninth Revision codes (*e.g.*, placenta accreta), so the authors relied on surrogate codes to reflect these diagnoses (*e.g.*, 667.0, the code for retained placenta without hemorrhage, was used as a proxy for placenta accreta). The typical patient experiencing

retained placenta with insignificant hemorrhage does not require general anesthesia. Conversely, a small number of unwell women with missing diagnostic codes may have driven the effect sizes seen in this study. Finally, as noted above, the group exposed to “avoidable” general anesthesia included two subgroups: women who had undocumented indications for general anesthesia and women who had failed neuraxial anesthesia converted to general anesthesia. The portion of truly elective general anesthetics is unknown. A massive clinical dataset would be needed to distinguish outcomes for women receiving intended neuraxial anesthesia (including those ultimately completing delivery under general anesthesia) from those outcomes for women who underwent planned general anesthesia from the outset.⁹

The primary findings of this study confirm contemporary standards of care, namely that in the absence of contraindications, neuraxial anesthesia has been and remains the gold standard anesthetic for cesarean delivery. This analysis of administrative data does provide further evidence that general anesthesia is associated with increased risk of anesthetic complications, when compared with neuraxial anesthesia, but cannot distinguish the extent to which these increased risks are attributable to missing data, human factors, surgical or personnel factors, or mode of anesthetic alone. Regardless, anesthesiologists should engage obstetricians and obstetric nurses in the important work of systems solutions to optimize the availability and quality of neuraxial anesthesia for labor, the timeliness of communication about unplanned cesarean delivery, and workflow to ensure reliable and safe transfer to the operating room for emergency cesarean delivery, regardless of anesthetic technique. In particular, interdisciplinary simulation of emergency cesarean delivery is essential to ensure that not only anesthesiologists, but also nurses and obstetricians, are well prepared to support the safe induction of neuraxial or general anesthesia in this challenging scenario.

Competing Interests

The authors are not supported by, nor maintain any financial interest in, any commercial activity that may be associated with the topic of this article.

Correspondence

Address correspondence to Dr. Mhyre: jmmhyre@uams.edu

References

1. Devroe S, Van de Velde M, Rex S: General anesthesia for caesarean section. *Curr Opin Anaesthesiol* 2015; 28:240–6
2. Hawkins JL, Chang J, Palmer SK, Gibbs CP, Callaghan WM: Anesthesia-related maternal mortality in the

- United States: 1979–2002. *Obstet Gynecol* 2011; 117:69–74
3. Guglielminotti J, Landau R, Li G: Adverse events and factors associated with potentially avoidable use of general anesthesia in cesarean deliveries. *ANESTHESIOLOGY* 2019; 130:912–22
 4. Palmer E, Ciechanowicz S, Reeve A, Harris S, Wong DJN, Sultan P: Operating room-to-incision interval and neonatal outcome in emergency caesarean section: A retrospective 5-year cohort study. *Anaesthesia* 2018; 73:825–31
 5. Tsen LC: Anesthesia for cesarean delivery, Chestnut's *Obstetric Anesthesia Principles and Practice*, 5th edition. Edited by Chestnut DH, Wong CA, Tsen LC, Ngan Kee WD, Beilin Y, Mhyre JM. Philadelphia, Elsevier, 2014, pp 559–60
 6. Butwick AJ, Blumenfeld YJ, Brookfield KF, Nelson LM, Weiniger CF: Racial and ethnic disparities in mode of anesthesia for cesarean delivery. *Anesth Analg* 2016; 122:472–9
 7. Bauer ME, Mhyre JM: Active management of labor epidural analgesia is the key to successful conversion of epidural analgesia to cesarean delivery anesthesia. *Anesth Analg* 2016; 123:1074–6
 8. Cobb BT, Lane-Fall MB, Month RC, Onuoha OC, Srinivas SK, Neuman MD: Anesthesiologist specialization and use of general anesthesia for cesarean delivery. *ANESTHESIOLOGY* 2019; 130:237–46
 9. Butwick AJ, Palanisamy A: Mode of anaesthesia for caesarean delivery and maternal morbidity: Can we overcome confounding by indication? *Br J Anaesth* 2018; 120:621–3