



The Current Role of General Anesthesia for Cesarean Delivery

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Abstract

Purpose of the Review The use of general anesthesia for cesarean delivery has declined in the last decades due to the widespread utilization of neuraxial techniques and the understanding that neuraxial anesthesia can be provided even in urgent circumstances. In fact, the role of general anesthesia for cesarean delivery has been revisited, because despite recent devices facilitating endotracheal intubation and clinical algorithms, guiding anesthesiologists facing challenging scenarios, risks, and complications of general anesthesia at the time of delivery for both mother and neonate(s) remain significant. In this review, we will discuss clinical scenarios and risk factors associated with general anesthesia for cesarean delivery and address reasons why anesthesiologists should apply strategies to minimize its use.

Recent Findings Unnecessary general anesthesia for cesarean delivery is associated with maternal complications, including serious anesthesia-related complications, surgical site infection, and venous thromboembolic events. Racial and socioeconomic disparities and low-resource settings are major contributing factors in the use of general anesthesia for cesarean delivery, with both maternal and perinatal mortality increasing when general anesthesia is provided. In addition, more significant maternal pain and higher rates of postpartum depression requiring hospitalization are associated with general anesthesia for cesarean delivery.

Summary Rates of general anesthesia for cesarean delivery have overall decreased, and while general anesthesia no longer is a contributing factor to anesthesia-related maternal deaths, further opportunities to reduce its use should be emphasized. Raising awareness in identifying situations and patients at risk to help avoid unnecessary general anesthesia remains crucial.

Keywords General anesthesia · Cesarean delivery · Rapid sequence spinal anesthesia · Maternal complications

Introduction

Despite global approaches to reduce the cesarean delivery rate worldwide [1], including recommendations to increase the use of elective inductions of labor [2] and promote trials of labor after previous cesarean delivery [3], the Center for Disease Control and Prevention (CDC) reported a 31.9% cesarean delivery rate in the USA in 2018 [4].

Striking the ideal balance between a reduction in the overall cesarean delivery rate without increasing the odds for urgent/emergent cesarean deliveries is complex, with clinical

obstetric decisions potentially resulting in unplanned scenarios that could significantly impact anesthetic options. If a cesarean delivery becomes emergent, the odds for general anesthesia increase, and safe provision of any anesthetic becomes more challenging. For obstetric anesthesiologists, predicting and preventing emergent situations is a constant concern driven by the desire to provide anesthesia in the safest manner to facilitate timely delivery of the neonate while ensuring a positive experience for the patient and family. With the common use of neuraxial anesthesia in obstetrics, and the corresponding decrease in use of general anesthesia, the risks associated with the latter have decreased over time, as has anesthesia-related maternal mortality. The availability of improved anesthesia devices and monitoring and the establishment of clinical recommendations for anesthesia management of obstetric patients are believed to explain the decrease in morbidity and mortality associated with general anesthesia [5, 6].

Though controversial, the decision-to-delivery interval remains a common auditing tool and has been deemed key to ensure optimal maternal and neonatal outcomes. Obstetric anesthesia practice has significantly evolved, and contemporary

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approaches for the provision of safe anesthesia in urgent circumstances include (1) neuraxial anesthesia; (2) appropriate communication between obstetricians, perinatologists, and anesthesiologists; and (3) ongoing training including drills and simulation [7]. A recent study evaluating the implementation of standardized team communication and processes to improve outcomes during unscheduled cesarean deliveries reported a significant decrease in decision to incision time intervals post-implementation [8].

Due to risks and complications associated with general anesthesia, even with the most recent devices facilitating endotracheal intubation [9] and clinical algorithms guiding anesthesiologists facing challenging scenarios such as ‘cannot ventilate, cannot intubate, cannot oxygenate’ [10], the current role of general anesthesia for cesarean delivery has been revisited.

In this review, we discuss how concerns associated with general anesthesia are different in the obstetric population as compared to the general population, why specific efforts should be undertaken to avoid general anesthesia for cesarean delivery, how to minimize the need for general anesthesia, and recent considerations, including those associated with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic.

Anesthesia for cesarean delivery

Neuraxial anesthesia has been, and continues to be, the gold standard anesthetic for cesarean delivery [11]. The avoidance of risks inherent to airway manipulation, namely, aspiration and “cannot intubate, cannot ventilate, cannot oxygenate” scenarios, has contributed to the widespread use of neuraxial techniques. It has long been known that the incidence of failed intubation in obstetrics is higher than in non-pregnant patients [12] and that aspiration pneumonitis, although rare, is one of the most serious complications associated with general anesthesia [13]. A recent multicenter observational study in over 2500 cesarean deliveries reported the incidence of failed intubation to be 1:312. The investigators defined “difficult airway” as either lack of success to intubate the trachea, more than 2 attempts by a senior anesthetist or written documentation of difficult intubation as entered by the provider in the medical record [14]. In addition, unique physiological changes in the obstetric patient’s respiratory system (decreased functional residual capacity, increased minute ventilation, and increased resting metabolic rate) complicate airway management with the risk of rapid onset profound hypoxemia [15]. The use of high-flow humidified nasal oxygen (up to 60 L/min) for preoxygenation of pregnant women is controversial, and its value remains to be confirmed [16, 17].

Although serious, aspiration remains a rare complication of general anesthesia, which has led to reevaluation of fasting instructions for the pregnant patient undergoing cesarean delivery in

the nascent protocols for enhanced recovery [18]. Circumstances where general anesthesia is deemed “unavoidable and necessary,” including obstetrical indications (e.g., postpartum hemorrhage), maternal indications (e.g., patient refusal to receive neuraxial anesthesia), and contraindications to neuraxial anesthesia (e.g., anticoagulation or coagulopathy), will continue to exist [19]. The Society for Obstetric Anesthesia and Perinatology (SOAP) in its Centers of Excellence benchmark metrics [20] considers that the overall rate of general anesthesia for cesarean deliveries should be lower than 5%, and the Royal College of Anaesthetists recommend a rate lower than 1% for elective cesareans and less than 5% for those classified as emergent [21].

Who receives general anesthesia?

According to state and national registry audits, general anesthesia has been estimated to be used in approximately 6% of cesarean deliveries in the USA [19, 22]. Patients with emergent indications for cesarean delivery (e.g., placental abruption, cord prolapse, antenatal placental bleeding, non-reassuring fetal tracing) are at increased risk of general anesthesia. In these situations, the rate of general anesthesia has been reported to be up to 20% [23]. In addition, an inverse relationship between gestational age and the odds of receiving general anesthesia was reported in a population-wide, prospective observational study in a cohort of 11,539 women with preterm cesarean delivery; for every 1 week decrease in gestational age at delivery, the adjusted odds of general anesthesia increased by 13% [24].

Racial, ethnic, and socioeconomic disparities also contribute to an increase use of general anesthesia. In the state of New York, privately insured patients were least likely to receive general anesthesia for their cesarean delivery compared to their counterparts covered by public insurance (Medicaid) (relative risk 0.73, 0.68–0.79) [25]. After analyzing over 51,000 women delivering in 19 labor and delivery units in the USA from 1999 to 2002, Black women were found to be more likely to have received general anesthesia compared to white women (adjusted odds ratio 1.7, 1.5–1.8). These findings remained unchanged after excluding women who received neuraxial analgesia prior to general anesthesia [26]. A recent study including close to 2 million pregnant women from 2007 to 2014 in New York City confirmed these numbers, with Black women being 44% more likely to receive general anesthesia during cesarean delivery [27].

Neuraxial anesthesia versus general anesthesia: when time is of the essence!

In emergent scenarios, whether for maternal, obstetric, or fetal indications, the perceived lack of time to place a neuraxial

block or achieved the required sensory level may be the reason for a general anesthetic to be selected [28]. Early data had demonstrated that exposure to general anesthesia at birth was associated with worse neonatal outcomes [29, 30]. Despite affording the shortest operating room to incision interval time, general anesthesia, even in urgent cesarean deliveries, is not associated with improved neonatal outcomes [31]. Unequivocally, multiple studies evidence worse neonatal outcomes among babies born to mothers receiving general anesthesia for cesarean delivery, even when deemed urgent [32, 33]. Of relevance, all these publications reported on retrospective data.

When time is of the essence, a standard spinal anesthetic approach can be transformed into a rapid sequence spinal (RSS) for urgent cesarean deliveries. This technique, first described in 2003, simplifies the process aiming to avoid the potential risks of general anesthesia [34]. Steps that are not indispensable for spinal anesthesia placement are omitted, which allows rapid delivery of surgical anesthesia with skin incision allowed as the anesthetic is achieving a T4 dermatomal block. The patient is positioned, standard monitoring is placed while the most experienced anesthesiologist is wearing sterile gloves, a single prep swab is performed without draping, skin infiltration with local anesthesia may be omitted, the introducer and spinal needle are inserted, and local anesthetic agent (hyperbaric bupivacaine) is injected with or without short and long-acting opioid (fentanyl, preservative-free morphine). Multiple attempts should be limited, and continuous fetal monitoring, preoxygenation, and preparations for general anesthesia should be made and maintained at all times [34]. In a retrospective review of 25 cases in which an RSS was utilized, the median time for anesthesia, after excluding cases with an identified delay or a prior epidural block, was 8 (6–8) minutes [35]. The urgency/emergency of a cesarean delivery will impact the time to induce general anesthesia or prepare and inject a spinal anesthetic, making these comparisons difficult. Appropriate dissemination, awareness, and training for RSS for those who work in obstetric anesthesia are crucial. A survey done in the UK on 120 trainees that undertook solo practice on obstetrical units found that up to 30% were not familiar with RSS and none had received training [36]. After creation of a detailed protocol, discussion of roles, and simulation with involved staff, the RSS technique has been successfully implemented and employed in institutions not familiar with the technique [37].

Why should general anesthesia be avoided?

Because general anesthetics in the obstetric population are rare, and because the circumstances which may provoke a general anesthesia in this population are frequently independently linked to morbidity or poorer outcomes for mother and

neonates, great care should be used in evaluating studies comparing outcomes of general and neuraxial anesthesia for cesarean delivery. Since the superiority of neuraxial anesthesia for most cesarean deliveries is largely thought to be a settled issue, these studies are almost uniformly retrospective in nature. Reliable studies must carefully control for confounding effects of why the patient underwent a cesarean delivery in the first place and why she received general anesthesia.

With these considerations in mind, in countries categorized as middle or low income by the World Bank, exposure to general anesthesia triples the odds of maternal deaths (odds ratio 3.3, 1.2–9) and doubles the odds of perinatal deaths (odds ratio 2.3, 1.2–4.1) [38]. Limitations from pooled studies include the lack of a uniform definition of anesthesia-related mortality, the heterogeneity of data (quality and quantity of reported data), and lack of detailed reports on characteristics of the population, setting, and type of providers involved. In the 2016 systematic review and meta-analysis which included 140 studies, meta-regression showed a significant difference in the overall anesthesia-attributed mortality rates by geographical region (sub-Saharan Africa had the most) and year of publication, with no differences by setting, study design, income level, or study quality [38].

These findings are consistent with reports of higher perioperative mortality when comparing general anesthesia versus spinal anesthesia in the general adult population in resource-limited settings. In a retrospective report from Médecins Sans Frontières of over 75,000 adult patients in a 6-year period, with obstetrics comprising 45% of the procedures, perioperative mortality of spinal anesthesia was 0.04% compared to general anesthesia with intubation (adjusted odds ratio, 0.10; 0.05–0.18) [39].

Unnecessary general anesthesia should be avoided whenever possible, as it has been associated with a significantly increased risk of anesthesia complications (adjusted odds ratio, 1.6; 95% CI, 1.4 to 1.9), severe complications (adjusted odds ratio, 2.9; 95% CI, 1.6 to 5.2), surgical site infection (adjusted odds ratio, 1.7; 95% CI, 1.5 to 2.1), and venous thromboembolism (adjusted odds ratio, 1.9; 95% CI, 1.3 to 3.0), but not of death or cardiac arrest [19].

Multiple studies have found that cesarean deliveries performed under general anesthesia result in higher blood loss than cesarean deliveries performed under neuraxial anesthesia. In a randomized prospective study on elective cesarean delivery cases, the hemoglobin of women who had general anesthesia dropped by an average of 1.4 g/dL versus 1.1 g/dL with spinal anesthesia [40]. Likewise, in a randomized prospective study of general versus neuraxial anesthesia in more than 300 patients, intraoperative blood loss was significantly higher, and postoperative hematocrit was significantly lower with general anesthesia [41]. In one large, multicenter prospective trial, general anesthesia was found to significantly increase the odds for blood transfusion (odds ratio 4.2, 95% CI

3.5 to 5.0) [42]. It has been suggested that the reason for the increased blood loss in cases of general anesthesia may relate to the uterine smooth muscle relaxing effects of volatile agents leading to less uterine smooth muscle contraction and, hence, more bleeding [43]. Comparisons of general to neuraxial anesthesia in other types of surgeries where uterine tone is not at issue (hip replacement, hysterectomy) have also shown lower blood loss in the regional group [44].

Anesthesia-related complications and concerns

Securing maternal airway

An important point to understand when considering general anesthesia in the obstetric population is that procedural difficulty, complications, and failures are more prevalent in the obstetric versus general population. Besides a higher risk of difficult intubation, pregnant women have increased morbidity during extubation, emergence, and recovery [45]. Extubation failure is an event that is relatively rare in the non-pregnant population, but this comparison between the two populations is difficult to make due to differences in definitions and number and type of databases analyzed [46]. Unlike for general anesthesia, rates of major complications of neuraxial anesthesia (neurological injury, epidural hematoma, and/or abscess) have never been found to be worse in pregnancy; in fact, the risk for spinal epidural hematoma is likely lower in the obstetric versus general population, even in thrombocytopenic parturients [47, 48].

Over the last four decades, opportunities for training in obstetric anesthesia airway management have declined. A retrospective audit at a single institution in the UK reported a decrease in the use of general anesthesia for cesarean delivery from 76% in 1982 to 7.7% in 1998 and a further decrease to 4.9% in 2006 [49, 50]. With these low rates becoming more common worldwide, it has been estimated that many residents/trainees will graduate without performing a general anesthetic in a pregnant patient [28]. Lack of experience with general anesthesia raises the concern of patient safety, as individual providers' confidence is insufficient, and patients will be exposed to predictable complications related obstetric airway management. Simulation and advanced teaching modalities have been suggested to partly alleviate or prevent such complications by providing a structured approach to avoid or prepare for failed intubation scenarios in obstetrics [51–54]. In addition to knowledge and skill, simulation can improve behavioral aspects such as interdisciplinary communication and team management, which is highly relevant in the field of obstetric anesthesia [55].

Intraoperative awareness

Intraoperative awareness during general anesthesia for cesarean delivery remains a risk as anesthesiologists aim to limit maternal-fetal drug transmission and uterine atony with judicious administration of hypnotic drugs and volatile anesthetics. Much remains to be investigated regarding minimum alveolar concentration differences between the pregnant and non-pregnant population [56]. In the early era of nitrous oxide without additional amnestic agents, intraoperative recall during cesarean deliveries was estimated to be close to 26% [57]. As anesthetic techniques evolved, the incidence for awareness during cesarean delivery under general anesthesia decreased to less than 1% [58, 59], and adequate reporting is critical to further reduce the occurrence of this devastating complication [60]. National audit data on accidental awareness during general anesthesia for the UK reported an incidence of ~ 1:19 600 anesthetics (95% confidence interval 1:16 700–23 450), with considerable variation across subtypes of techniques or subspecialties. Specifically, the incidence of accidental awareness during cesarean delivery was ~ 1:670 (1:380–1300) [61]. Though rare, consequences of intraoperative awareness can be catastrophic, including post-traumatic stress disorder, sleep disturbances, and interference with activities of daily living [62]. Careful titration of doses and monitoring depth of anesthesia can aid in preventing this complication. However, the threshold to identify awareness using processed electroencephalographic monitoring requires validation in the obstetric population [63], and this type of monitoring has been reported to be used in less than 5% of general anesthetics for cesarean delivery according to a recent audit in the UK [14].

Post-cesarean pain and maternal health after general anesthesia

Suboptimal pain management during a cesarean delivery is an important cause for malpractice lawsuits in obstetric anesthesia, amounting to almost 20% of cases [64]. This should give special context to the decision to convert (or not) from neuraxial to general anesthesia in the event of patient discomfort. Ideally, if intrapartum neuraxial labor analgesia is suboptimal, a de novo single shot spinal anesthetic or the placement of a new epidural catheter is a preferable approach to attempting to dose the in situ epidural catheter and hope for a good outcome. Awareness of the risk, albeit low, of a high neuraxial block with a de novo spinal anesthetic provided immediately after dosing an epidural catheter is crucial and was reported in the serious complication repository project of the Society for Obstetric Anesthesia and Perinatology (SOAP) [65]. Even prior to any need for cesarean delivery, active identification and replacement of malfunctioning catheters that have required several (more than 2) physician-administered epidural boluses are recommended, as this

situation has been associated with failed conversion to a surgical block [66]. Inadequate testing of a block (density and extent) has been discussed as a cause for insufficient pain control after spinal anesthesia [67]. Dermatomal level testing to touch rather than cold appears to provide a more reliable assessment and better reflect the adequacy of the surgical block [68].

Studies suggest that post-cesarean pain may be worse or more difficult to treat in patients who had a cesarean delivery under general as compared to neuraxial anesthesia. Neuraxial, compared with systemic opioid analgesia, has been found to be the superior approach to analgesia. Beyond the analgesia itself, neuraxial analgesia is associated with earlier return of bowel function, earlier ambulation, and shorter lengths of stay than parenteral analgesia [69]. Although the use of truncal block techniques (transversus abdominal plane block, quadratus lumborum plexus block) may achieve improved analgesic results with regard to parenteral or oral opioids, they have been proven to not match the analgesic effect of neuraxial analgesia in patients who have had general anesthesia for their delivery.

Concerningly, long-term psychological outcomes may be associated with having general anesthesia for cesarean delivery. Several studies show an association between general anesthesia for cesarean delivery and persistent pain beyond the expected healing time [70]. Although quite controversial, a recent retrospective study using the New York State inpatient database suggested that general anesthesia for cesarean delivery is associated with severe postpartum depression requiring hospitalization as well as self-harm and suicidal ideation [71].

Neonatal outcomes

For urgent and emergent cesarean deliveries due to fetal concerns, general anesthesia can be seen as the technique of choice to facilitate an expedited delivery. However, general anesthesia for emergent cesarean delivery is associated with lower neonatal Apgar scores, assisted ventilation, and admission to the neonatal intensive care unit [33]. Of importance as well, and less often reported, failed maternal intubation is associated with increased neonatal intensive care unit admissions [72, 73]. Therefore, even though general anesthesia may appear to be saving time, maternal risks and neonatal outcomes may not justify such a choice [74]. A retrospective study of over 9000 patients undergoing emergent cesarean delivery evaluated operating room to incision intervals for general anesthesia, spinal, labor epidural analgesia conversion to anesthesia and combined spinal epidural (CSE) anesthesia. Despite general anesthesia being associated with shorter times to delivery (6 min versus 13, 11, and 24 min, respectively), poor neonatal outcomes, defined as lower Apgar scores at 5 min, were more frequent in the general anesthesia cohort [31]. In a 2019 meta-analysis of 46 studies which compared

neuraxial (spinal, epidural, and CSE) with general anesthesia, neonates born to mothers who were under general anesthesia had a lower umbilical vein pH and higher rate of Apgar scores below 6 at 1 min [75]. In fact, the time needed to initiate the anesthetic technique may not be the principal timing issue in question. One of the major factors associated with prolonged delivery time in emergent situations is transporting the patient to the operating room [76]. In a prospective study of 163 patients undergoing urgent cesarean delivery, decision-to-operating room time was 21.6 (\pm 19.8) minutes [77].

When general anesthesia was compared to epidural anesthesia for cesarean delivery in a cohort of 509 infants at 32 or less weeks' gestational age, the odds of low Apgar scores were increased (relative risk 2.9, 1.9–4.3) in the former group [30]. Conversely, the EPIPAGE study, which evaluated neonatal mortality in a cohort of 1440 preterm babies (< 33 weeks) delivered via cesarean delivery in France in 1997, found that spinal anesthesia for cesarean delivery was associated with a marginally higher neonatal death risk than general anesthesia (adjusted odds ratio, 1.7; 95% confidence interval 1.1 to 2.6) [78]. The relationship between anesthesia type and neonatal death was assessed using multiple logistic regression adjusting for gestational age and possible confounding variables such as maternal hypertension, preterm labor and preterm premature rupture of membranes, singleton or multiple pregnancy, antenatal steroid treatment, inborn status, onset of labor prior to cesarean delivery, abnormal heart rate tracing, gestational age, growth restriction, neonatal sex, and number of preterm births occurring annually in the hospital. After adjustment for gestational age, and also for all risk factors, spinal anesthesia was associated with a higher risk of neonatal death than general anesthesia. However, due to the study design notably the lack of randomization and standardized anesthetic approach in the spinal cohort, causality cannot be inferred, and use of contemporary anesthesia practices such as prevention of spinal-induced hypotension with vasoactive drugs rather than reactive management may show different results today.

Breastfeeding success rates have been noted to be affected by mode of anesthesia. Breastfeeding in neonates born to mothers who received general anesthesia for cesarean delivery is more likely to be unsuccessful (longer time to first feeding, increased number of attempts before success, decreased likelihood of breast feeding at 6 months) [79].

It should be noted that while maternal exposure to general anesthesia has raised concerns about the possibility of fetal neurotoxicity and short- and long-term neurodevelopmental delays [80], there is still no robust evidence that the neonate born to a mother undergoing cesarean delivery under general anesthesia may be negatively impacted [81–83].

Special considerations related to the recent pandemic

It is impossible to consider the risks of general anesthesia in the obstetric population without also discussing risks associated with the coronavirus disease 2019 (COVID-19) [84, 85]. Some view the SARS-CoV-2 pandemic as an opportunity to further reduce the general anesthesia rate in the obstetric population [86].

Universal testing in the obstetric population has proven to be necessary in high prevalence areas since clinical screening was early on proven to be unreliable [87, 88]. In patients with an unknown severe acute respiratory syndrome coronavirus (SARS-CoV-2) status (pending polymerase chain reaction SARS-CoV-2 result or untested), there should be an increased imperative to avoid general anesthesia for two reasons. First, general anesthesia with SARS-CoV-2 infection may place pregnant women at increased risk of pulmonary complications [89, 90], by far the most common type of complications in SARS-CoV-2 positive patients undergoing surgery. Second, the process of inducing general anesthesia (an aerosolizing procedure) in SARS-CoV-2 infected patients increases the potential risk of infection for providers present in the operative room, although this risk may be well mitigated with appropriate personal protection equipment (PPE) [91]. Protocols and recommendations have been developed [92] that include minimizing the number of people in the room at the time of intubation, appropriate use of PPE, rapid sequence induction, and video laryngoscopy, but these steps will likely not bring the risk of transmission to as low as avoiding airway manipulation altogether.

How to minimize the need for general anesthesia

General anesthesia for cesarean delivery remains the “back-up plan” to the preferred neuraxial approach; however, there will be circumstances when it will be provided. In order to minimize the number of cesareans done under general anesthesia, and reduce the number of avoidable general anesthetics, anesthesiologists must be proactive rather than reactive when managing patients in the labor and delivery unit. This may require a culture change if interdisciplinary huddles with obstetricians, labor nurse, and neonatologists are not a routine and if members of the anesthesia team do not have “situational awareness” and are only informed of urgent cases when these have already been decided on and transported to the operating room by the obstetrical team. Strategies to reduce exceedingly high general anesthesia rates have been proposed and include antepartum education, ongoing education for anesthesiologists, access to adjuvants, and rapid onset local anesthetics [93].

In fact, approaches to reduce avoidable general anesthetics should include education of all stakeholders (obstetricians, labor nurses) about the risks of general anesthesia in the

obstetric population and ways in which they can help avoid it. Actions on their part, such as encouraging women to consider early neuraxial labor analgesia and maintaining open lines of communication with the anesthesia team as a parturient's labor or pain status changes, could impact the patient's mode of anesthesia should she require a cesarean delivery. The recommendation that an “early epidural analgesia for labor should be considered to mitigate risks associated with general anesthesia in the setting of an urgent cesarean” was further emphasized during the COVID-19 pandemic, in the Society for Maternal-Fetal Medicine (SMFM) and SOAP joint statement [94].

A patient's education, too, could have an effect on whether general anesthesia becomes necessary for cesarean delivery. An early anesthesia consultation should be planned for women with a trial of labor who are at increased risk for cesarean delivery (e.g., trial of labor after cesarean, twin gestation, morbid obesity, fetal macrosomia), either upon admission or in the antenatal period. Women should be informed about the possibility of requiring an intrapartum cesarean delivery, the likelihood that surgery might need to occur urgently or even emergently, and about the benefits of early neuraxial labor analgesia contributing to reduce the probability of requiring a general anesthetic, although one should not overstate the case for early epidural placement as it cannot absolutely rule out the need for general anesthesia, and anesthesia counseling should remain encouraging (but not coercive). For women who are ambivalent or decline neuraxial labor analgesia, it is important for the anesthesia team to remain available and involved, as needed.

Provision of neuraxial labor analgesia, with placement of an epidural catheter, does not guarantee that it will provide timely and effective surgical anesthesia for cesarean delivery. Early recognition of a dysfunctional epidural catheter is key, and the safe and effective management of the failed conversion from labor epidural analgesia to cesarean anesthesia remains controversial [95–97]. Factors associated with conversion success and reduced general anesthesia rate for unplanned cesarean deliveries include initiating neuraxial labor analgesia with a combined spinal epidural (rather than an epidural) [98–100] and the presence of an obstetric anesthesia fellowship trained anesthesiologist [101]; conversely, risk factors for failure are an increasing number of epidural boluses administered during labor, an enhanced urgency for cesarean delivery, and care being provided by a non-obstetric anesthesiologist [102]. Although parturients requesting frequent analgesic redosing may be experiencing dysfunctional and painful labor which in itself may predict a cesarean delivery, this may also be an early sign of a dysfunctional epidural catheter. When unsure, a low threshold for replacing the epidural catheter is recommended. Regular assessments of dermatomal level and analgesic response should help identify epidural catheters providing patchy or one-sided analgesia. Replacement of

neuraxial labor analgesia will not only improve intrapartum maternal comfort and satisfaction but also reduce the odds for general anesthesia and possibly anesthesia-related complications (e.g., high neuraxial block if de novo spinal for cesarean delivery) [65].

In the operating room, strategies to detect failed neuraxial anesthesia for cesarean delivery are critical to avoid intraoperative pain and suffering, as well as conversion to general anesthesia for maternal discomfort. As mentioned, assessing the block level is key [68], with a recommended dermatomal level to T4 to either touch or pin-prick. To ensure adequate intraoperative anesthesia and postoperative analgesia, the addition of neuraxial opioids (short and long acting) to local anesthetics is absolutely recommended. The addition of non-opioid analgesic adjuvants, such as neuraxial clonidine [103] or dexmedetomidine [104, 105], or intravenous ketamine may be helpful as well. Although there are no studies evaluating the direct impact of non-opioid adjuvants on the reduction of general anesthesia rates for maternal intraoperative discomfort, neuraxial clonidine has been shown to reduce the need for intraoperative analgesic supplementation [106]. Of importance, intraoperative analgesic supplementation for management of maternal discomfort due to insufficient neuraxial anesthesia could likely reduce general anesthesia rates [107], although potential risks with such approaches should also be accounted for (e.g., excessive maternal sedation and airway complications, or post-traumatic stress, postpartum depression, or litigation). Therefore, striking the right balance between maternal discomfort with delayed conversion to general anesthesia (if at all) with risks associated with general anesthesia (before or after the delivery of the neonate) should always take into account maternal preferences [108]. Shared decision-making should allow the patient and her support person to express their preference if the anesthesia team is considering intraoperative conversion to general anesthesia.

Taken together, patient counseling, early neuraxial labor analgesia, regular assessments of intrapartum epidural analgesia, replacement of epidural catheter if suboptimal analgesia and/or inadequate anesthesia, interdisciplinary huddles, and “situational awareness” to help the anesthesia team identify clinical scenarios that may result in cesarean delivery are key to reduce the odds for general anesthesia.

Conclusion

Understanding the clinical scenario resulting in a cesarean delivery is fundamental for the provision of safe and effective anesthesia and should take into account the level of urgency and maternal preferences. Factors associated with general anesthesia for cesarean delivery include patient-specific factors (e.g., ethnic and socioeconomic disparities), obstetric factors (e.g., urgent or preterm cesarean), anesthesia factors (e.g.,

dysfunctional intrapartum neuraxial analgesia), and provider specific factors (e.g., non-obstetric anesthesiologist). Some of these factors are actionable and could contribute to reduce avoidable general anesthetics.

To improve maternal and neonatal outcomes associated with unavoidable general anesthesia for cesarean delivery, ongoing anesthesiologists’ education to ensure adequate training and proficient skills is key as well as access to devices that have been shown to facilitate airway manipulation in the obstetric population. Maintaining optimal communication between all providers (obstetricians, nurses, and anesthesiologists) is paramount, and ensuring that mother’s preferences are heard will promote a safe and positive childbirth experience.

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Declarations

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