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Review Article

Clinical practice of obstetric anesthesia: neuraxial techniques, general anesthesia and maternal safety

Adela A. Córdova Fernandez*

Hospital de Gineco-Obstetricia No. 4 "Dr. Luis Castelazo Ayala", Instituto Mexicano del Seguro Social (IMSS), Mexico City, Mexico

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***Correspondence:**
Dr. Adela A. Córdova Fernandez,
E-mail: adela1883@hotmail.com

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ABSTRACT

Obstetric anesthesia is a specialized field that integrates labor analgesia, anesthesia for cesarean delivery, and emergency peripartum care. Contemporary practice favors neuraxial techniques because they provide effective analgesia, avoid airway manipulation, and are associated with lower maternal morbidity and mortality compared with general anesthesia in many obstetric settings. Epidural analgesia remains the standard method for labor pain relief and can be titrated continuously while preserving maternal participation and minimizing dense motor block. Spinal anesthesia is commonly used for elective cesarean delivery because of its rapid onset, reliability, and dense surgical block, whereas combined spinal-epidural techniques provide both rapid onset and catheter-based flexibility. General anesthesia remains essential for selected emergencies, particularly Category 1 cesarean delivery when fetal or maternal compromise prevents timely regional anesthesia, but it carries higher risks of failed intubation, aspiration, awareness, and neonatal drug exposure. Safe obstetric anesthesia requires individualized technique selection, anticipation of maternal comorbidities, preparation for hemorrhage and failed airway, appropriate vasopressor use, and multidisciplinary crisis response. This review summarizes the clinical practice of obstetric anesthesia, emphasizing the rationale for neuraxial preference, the persistent role of general anesthesia, and practical considerations for maternal and neonatal safety.

Keywords: Obstetric anesthesia, Neuraxial anesthesia, Epidural analgesia, Spinal anesthesia, Cesarean delivery, General anesthesia

INTRODUCTION

Obstetric anesthesia encompasses pain management during labor, anesthesia for operative delivery, and anesthetic support during peripartum emergencies. Its clinical importance is based on the need to provide effective maternal analgesia while preserving maternal physiology, uteroplacental perfusion, fetal well-being, and the ability to respond immediately to hemorrhage, difficult airway, hypertensive crisis, cardiac disease, or fetal compromise.[1,2] Maternal request is considered a sufficient medical indication for labor analgesia, and contemporary practice no longer treats childbirth pain relief as optional or secondary.[3,4]

The modern obstetric anesthesia paradigm favors neuraxial blockade whenever feasible. This preference reflects both effectiveness and safety: neuraxial techniques provide superior labor analgesia, can be extended for cesarean delivery, and reduce the need for airway manipulation in a population at increased risk for aspiration and difficult intubation.

Nevertheless, general anesthesia retains an essential role in immediate emergencies and when neuraxial anesthesia is contraindicated, inadequate, or unavailable.[5]

NEURAXIAL ANESTHESIA AS THE PREFERRED STRATEGY

Neuraxial blockade includes epidural, spinal, and combined spinal-epidural techniques. In labor, epidural analgesia is the most flexible approach because medication can be titrated through an indwelling catheter, allowing adjustment of sensory block intensity over time. Modern low-concentration local anesthetic-opioid solutions provide excellent analgesia while limiting motor block, facilitating maternal mobility, pushing, and participation in delivery. Randomized and observational evidence supports that epidural analgesia provides superior pain relief without independently increasing the risk of cesarean delivery.[2,4,6]

For cesarean delivery, spinal anesthesia is commonly preferred in elective cases because it is technically efficient, produces rapid onset, and provides dense surgical anesthesia (Figure 1). Combined spinal-epidural anesthesia is useful when rapid onset is desired but procedural duration or maternal risk profile favors the security of an epidural catheter. The main adverse effects of neuraxial techniques include hypotension, pruritus, nausea, postdural puncture headache, and, rarely, high neuraxial block or local anesthetic systemic toxicity. These risks are mitigated by appropriate dosing, left uterine displacement, fluid and vasopressor strategies, pencil-point spinal needles, and vigilant monitoring.[7-10]

GENERAL ANESTHESIA IN OBSTETRICS

General anesthesia has declined in routine obstetric practice because neuraxial techniques avoid airway instrumentation and provide safer conditions for most cesarean deliveries. However, general anesthesia remains indispensable when delivery is urgently required and there is no functioning neuraxial catheter, when neuraxial anesthesia is contraindicated by coagulopathy or infection, or when maternal instability prevents regional technique placement. It is particularly relevant in Category 1 cesarean delivery, severe hemorrhage, failed neuraxial block, or immediate fetal compromise.[5,11]

The principal risks of obstetric general anesthesia are aspiration, failed intubation, rapid desaturation, accidental awareness, and neonatal respiratory depression from transplacental drug exposure. Rapid sequence induction with aspiration prophylaxis remains the standard when general anesthesia is required. Current evidence favors propofol over thiopental in many settings to reduce accidental awareness, while short-acting opioids and rocuronium may provide hemodynamic stability and acceptable intubating conditions without clearly worsening early neonatal Apgar outcomes when used appropriately.[11-13]

Population-level data support the safety advantage of neuraxial anesthesia. In low- and middle-income countries, a meta-analysis found that general anesthesia was associated with higher odds of maternal death and perinatal death compared with neuraxial blockade.[14] These findings do not imply that general anesthesia is inappropriate; rather, they reinforce that it should be reserved for situations in which its speed or necessity outweighs its risks and should be performed by teams prepared for obstetric airway difficulty.

SPECIAL CLINICAL CONSIDERATIONS

Maternal comorbidity modifies anesthetic planning. Obesity increases technical difficulty, airway risk, aspiration risk, and rapid oxygen desaturation; therefore, early epidural placement during labor may reduce the need for emergency general anesthesia. Cardiac disease requires careful control of preload, afterload, heart rate, and sympathetic blockade. In selected high-risk patients, invasive arterial monitoring and slowly titrated epidural dosing may be safer than sudden sympathectomy from a dense single-shot spinal anesthetic.[10,15]

Systemic pharmacologic analgesia remains relevant when neuraxial techniques are unavailable or declined, but opioids cross the placenta and may cause dose-dependent neonatal respiratory depression. Multimodal non-opioid adjuncts may reduce opioid exposure, but they do not replace neuraxial analgesia when the goal is effective labor pain control. Obstetric anesthesia also requires preparation for emergencies beyond pain relief, including massive hemorrhage, local anesthetic systemic toxicity, high spinal block, failed intubation, eclampsia, and maternal cardiac arrest. Simulation, standardized protocols, and multidisciplinary communication improve team performance during these events.[12,16]

DISCUSSION

The preference for neuraxial anesthesia in obstetrics is based on a convergence of analgesic efficacy, maternal safety, and procedural adaptability. Epidural analgesia can begin as labor pain relief and later be extended for cesarean delivery, reducing the need for urgent general anesthesia. Spinal anesthesia provides reliable operative conditions for scheduled cesarean delivery, while combined spinal-epidural techniques preserve flexibility in patients at risk for prolonged surgery or hemodynamic instability. The role, advantages, and main limitations of each modality are summarized in Table 1.

General anesthesia should not be viewed as obsolete; rather, it is a high-risk but necessary rescue and emergency technique. Its safe use depends on rapid decision-making, airway expertise, aspiration prophylaxis, appropriate induction drugs, neonatal readiness, and clear communication with obstetric and pediatric teams. The greatest safety gains in obstetric anesthesia come from avoiding preventable emergency general anesthesia through early risk identification, timely neuraxial catheter placement, and institutional protocols for obstetric crises.

Table 1: Practical comparison of obstetric anesthetic modalities.

Techniques	Main role	Advantages	Main limitations
Labor epidural analgesia	First-line labor pain relief	Continuous titration, effective analgesia, can be extended for cesarean delivery	Hypotension, incomplete block, motor block if excessive dosing
Single-shot spinal anesthesia	Elective cesarean delivery	Rapid onset, dense surgical block, technically efficient	Finite duration, hypotension, postdural puncture headache
Combined spinal-epidural	Labor or cesarean cases requiring rapid onset and flexibility	Immediate intrathecal effect plus epidural catheter for extension	Greater technical complexity and need for careful dosing
General anesthesia	Category 1 emergency cesarean delivery or contraindication to neuraxial block	Fastest option when regional anesthesia is impossible or unsafe	Aspiration, failed intubation, awareness, neonatal drug exposure
Systemic analgesia	Adjunct or alternative when neuraxial analgesia is unavailable or declined	Avoids neuraxial procedure and may be rapidly administered	Inferior analgesia and potential neonatal respiratory depression with opioids



Figure 1: Subarachnoid block in a multigravid patient at 38 weeks of gestation.

*Scheduled for repeat cesarean delivery because of hypertensive disease of pregnancy and obesity (BMI 42.4), performed in the sitting position at the L2-L3 level with a 25G Whitacre needle; single-dose regimen of hyperbaric bupivacaine (9 mg) plus fentanyl (25 mcg).

CONCLUSION

Clinical practice in obstetric anesthesia is centered on neuraxial techniques because they provide effective labor analgesia and safe surgical anesthesia for most cesarean deliveries. Epidural analgesia is the preferred method for labor because it is titratable and does not independently increase cesarean delivery risk. Spinal anesthesia predominates for elective cesarean delivery because of its rapid onset and reliability, while combined spinal-epidural anesthesia provides additional flexibility. General anesthesia remains essential for immediate emergencies and selected contraindications to neuraxial blockade, but it carries higher airway and aspiration risks. Optimal outcomes require individualized planning, anticipation of maternal comorbidities, preparation for failed airway and hemorrhage, and multidisciplinary crisis readiness.

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