Neuraxial anesthesia and pain management for cesarean delivery

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Optimal neuraxial anesthesia for cesarean delivery requires a thorough understanding of patient, obstetrical, surgical, and anesthesia-related factors which can impact pain during and after cesarean delivery. While not all cesarean deliveries are the same from an obstetrical standpoint, not all anesthetics provide the same degree of anesthetic blockade and postcesarean analgesia; therefore, context is crucial to provide patients with a safe and pain-free experience. Communication between obstetrical and anesthesia teams is key to ensure that the anesthetic approach is tailored to the clinical scenario, particularly if emergency cesarean delivery is needed, and follows best practices for cesarean delivery anesthesia.

We propose several important considerations for the management of anesthesia and analgesia for cesarean delivery, focusing on patient-reported outcomes related to intraoperative and postoperative pain. Considerations include: (1) understanding the innervation of the uterus, peritoneum and abdominal wall, and the pain pathways involved with sensations and pain during and after cesarean delivery (eg, visceral sensations such as occurs with uterine manipulation may be very uncomfortable for some patients); (2) understanding the different neuraxial anesthetic and analgesic approaches (eg, epidural, spinal, combined spinal-epidural) with their specific advantages, limitations, and indications (eg, spinal anesthesia provides the most reliable neuraxial block, with the fastest onset but a limited duration, though it can be extended by the addition of adjuvants); (3) selecting the most appropriate anesthetic technique and neuraxial medications (eg, local anesthetics, opioids, adjuvants including alpha$_2$-adrenergic agonists) to prevent, mitigate, manage intraoperative discomfort, and optimize postoperative analgesia; (4) recognizing that intraoperative pain during cesarean delivery occurs in approximately 15% of cesarean deliveries and shivering in up to 50% of cesarean delivery (from a complex interplay of heat loss, disrupted thermoregulation, psychological stress, and surgical factors), necessitating multifaceted prevention approaches; (5) preoperatively identifying patient-specific risk factors for intraoperative pain (eg, opioid use disorder, chronic pain, previous traumatic childbirth experience, anxiety) to promote thorough counseling (eg, setting expectations, avoiding traumatizing circumstances, incorporating shared decision-making, offering general anesthesia if neuraxial block is inadequate) and tailored strategies; (6) optimizing interdisciplinary communication to identify inadequate labor epidural analgesia and allow replacement if intrapartum cesarean delivery becomes indicated, as well as adequate testing of neuraxial block by the anesthesia team and the obstetricians before proceeding with skin incision constitutes best practices; (7) recognizing the obstetric, surgical, and anesthesia-related factors associated with increased intraoperative and postoperative pain (eg, uterine exteriorization, intrapartum cesarean delivery, repeat cesarean delivery, use of an epidural anesthetic rather than a spinal or combined spinal-epidural anesthetic) should prompt specific approaches to enhance anesthesia and postoperative analgesia (eg, enhanced doses of neuraxial opioid, prolonged use of epidural analgesia with local anesthetic solutions or repeated doses of epidural morphine, abdominal wall blocks, particularly if neuraxial morphine could not be used); and (8) implementing stepwise opioid-sparing multimodal analgesia (eg, acetaminophen and nonsteroidal antiinflammatory drugs taken together) and personalized protocols for opioid prescriptions after cesarean delivery, since these have been shown to significantly reduce in-hospital opioid consumption and unnecessary opioid prescription without increasing postoperative pain.

Key words: abdominal wall blocks, active management of labor epidural analgesia, adjuvants, analgesia, bupivacaine, catheter, cesarean delivery, chloroprocaine, clonidine, combined spinal-epidural, dermatome, dexamethasone, dexmedetomidine, dural puncture epidural, enhanced recovery, epidural anesthesia, fentanyl, general anesthesia, intraoperative pain, intrathecal, ketamine, labor epidural analgesia, lidocaine, local anesthetics, morphine, multimodal analgesia, neuraxial anesthesia, opioids, opioid-sparing analgesia, pain, regional anesthesia, shivering, spinal anesthesia, somatic, top-up, visceral

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GLOSSARY OF TERMS (ANESTHETIC MEDICATIONS AND PROCEDURES)

Bupivacaine: A local anesthetic (amide-type) with intermediate to long duration of action — route of administration can be epidural (isobaric formulation typically used for labor epidural analgesia at low concentration), intrathecal (hyperbaric formulation most typically used in the United States for spinal anesthesia for cesarean delivery), or in abdominal wall block (isobaric formulation).

Chloroprocaine: A short-acting (ester-type) local anesthetic with rapid onset block — route of administration can be epidural or intrathecal.

Clonidine: An alpha2-adrenergic agonist used for its analgesic, anxiolytic, and anti-shivering effects — route of administration can be intravenous, epidural or intrathecal.

Combined spinal epidural (CSE): An anesthetic technique, that allows the administration of an intrathecal (spinal) dose of medication (usually a local anesthetic with opioids), followed by placement of an epidural catheter that can be used intraoperatively and postoperatively.

Continuous spinal anesthesia: An anesthetic technique whereby placement of a catheter in the intrathecal space allows intrathecal administration of local anesthetics and opioids (usually repeated doses) intraoperatively and postoperatively.

Dexamethasone: A potent long-acting corticosteroid used as an analgesic adjuvant — route of administration can be intravenous or added to local anesthetics in abdominal wall block.

Dexmedetomidine: A selective alpha2-adrenergic agonist used for its analgesic, sedative, anxiolytic, and anti-shivering effects — route of administration can be intravenous, epidural or intrathecal.

Dural puncture epidural (DPE): An anesthetic technique, similar to a CSE but without administration of intrathecal medication (no spinal dose), with placement of an epidural catheter that can be used intraoperatively and postoperatively.

Fentanyl: A lipophilic short-acting opioid — route of administration can be intravenous, epidural or intrathecal.

Intrathecal: Term referring anatomically to the thecal sac that contains the cerebrospinal fluid and spinal cord; used to indicate medication administration (spinal is used interchangeably, though spinal described the anesthetic technique, and intrathecal describes the route of administration).

Ketamine: Is a dissociative anesthetic causing sedation, analgesia, amnesia, and may cause hallucinations (recreational use). It has been shown to have antidepressant effects at sub-anesthetic doses, via its N-methyl-D-aspartate receptors antagonism, resulting it glutamate release and brain-derived neurotropic factor stimulation. Its route of administration is intravenous.

Lidocaine: An intermediate-acting (amide-type) local anesthetic with intermediate onset of action when given epidurally (onset can be shorted by the addition of sodium bicarbonate, duration can be increased by the addition of epinephrine) — route of administration can be epidural (most common for intrapartum cesarean delivery), intravenous infusion or via patch. The intrathecal route not recommended due to transient neurological symptoms (concerns for neurotoxicity with high concentrations).

Liposomal bupivacaine: A long-acting anesthetic formulation that consists of bupivacaine encapsulated in multivesicular liposomes, enabling sustained release over 72 hours.

Morphine: A hydrophilic long-acting opioid — route of administration can be intravenous, epidural or intrathecal.

Mutimodal analgesia: Refers to a pain management strategy combining two or more types of analgesic medications or interventions, each targeting different mechanisms of action or pain pathways.

Quadratus lumborum block (QLB): An ultrasound-guided abdominal wall block that provides somatic and visceral analgesia.

Shared decision making: A collaborative process in which patients are informed and actively involved in choices related to their care (e.g. pain management).

Spinal: An anesthetic technique that produces rapid onset and the most reliable anesthetic block for cesarean delivery (i.e. spinal anesthesia).

Stepwise opioid-sparing analgesia: A structured multimodal approach that prioritizes non-opioid medications and techniques, reserving opioids only for breakthrough or uncontrolled pain — scheduled non-opioid analgesics (acetaminophen and nonsteroidal anti-inflammatory drugs) are the first-line perioperative agents.

Top-up: Refers to administering an additional dose of medication, typically an epidural top-up (also called "top-off"), to increase or extend analgesia or anesthesia (for labor analgesia or conversion to epidural anesthesia for intrapartum cesarean delivery).

Transversus abdominis plane (TAP) block: an ultrasound-guided (or under direct intraoperative visualization) abdominal wall block that provides somatic analgesia.

Introduction

The global cesarean delivery rate is estimated to be 28.5% by 2030, involving millions of women worldwide.[1] Though the surgical procedure itself is relatively standard, the circumstances leading to the decision to proceed with a cesarean delivery are quite unique, with very specific patient factors, obstetric factors, and fetal or neonatal factors. Intended to provide an analytical framework to compare cesarean delivery rates worldwide, the Robson 10-Group Classification System highlights the different obstetric circumstances and clinical scenarios that may result in a cesarean delivery,[2] and allows us to think about cesarean deliveries in more specific ways,[3] which from an anesthetic standpoint is vitally important as: not all cesarean deliveries are the same.[4]

Though most clinical recommendations and guidelines published to date have focused on the anesthetic considerations and optimal postcesarean delivery pain management for scheduled cases,[5,6] trends worldwide and in the United States demonstrate that planned cesarean deliveries do not represent the majority of cases.[7,8] While not all cesarean deliveries are the same from an obstetrical standpoint, not all anesthetics provide the same degree of anesthetic blockade and postcesarean analgesia; therefore, context is crucial to provide patients with a pain-free experience.[9] Communication between obstetrical and anesthesia teams is key to ensure that the anesthetic approach is tailored to the clinical scenario, particularly if emergent delivery is needed, and follows best practices for cesarean delivery anesthesia.

In this expert review, we focus on considerations that are important for the management of anesthesia and analgesia for cesarean delivery, such as: (1) the pain pathways involved with sensations and pain during and after cesarean delivery, (2) the different neuraxial anesthetic and analgesic approaches, (3) neuraxial medications, (4) intraoperative and anesthetic elements of enhanced recovery, (5) pain outcomes and experiences during and after cesarean delivery, (6) strategies to prevent and manage intraoperative pain, (7) multimodal postoperative analgesia, and (8) tailored approaches to enhance anesthesia and postoperative analgesia.

TABLE 1
Nerves responsible for pain during and after cesarean delivery

Incisional pain	Residual sensations
Ilioinguinal nerve	Burning, shooting, hypersensitive pain around the scar (neuropathic pain). Pain located around the scar, groin and upper thigh
Iliohypogastric nerve	
Genitofemoral nerve	
Lateral femoral cutaneous nerve	
Uterine manipulation	**Acute symptoms**
Sympathetic nerves from the inferior hypogastric plexus (T10–L1)	Deep visceral pain, nausea, and vomiting
Parasympathetic fibers from the pelvic splanchnic nerves (S2–S4)	
Shoulder tip pain	**Referred pain**
Phrenic nerve (C3–C5)	Due to irritation of the diaphragm

Pathways involved with sensations and pain during cesarean delivery

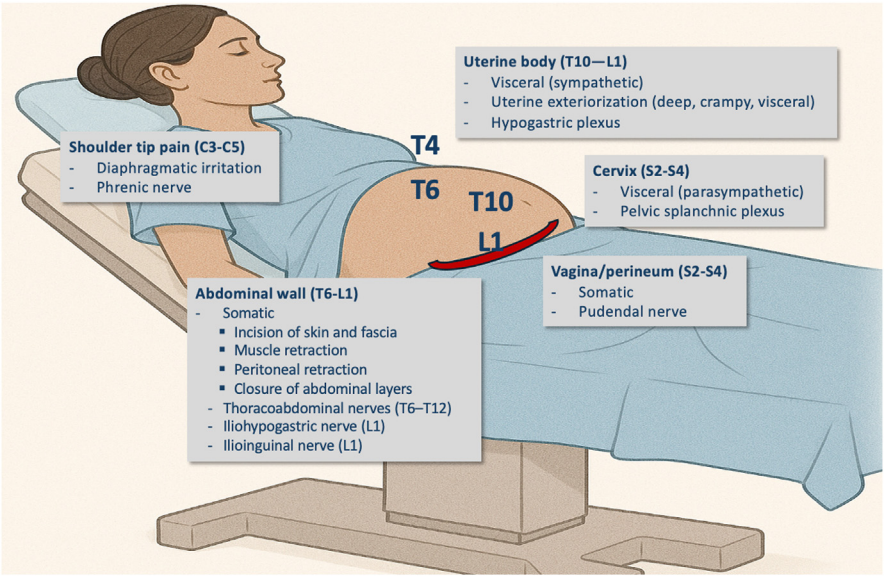
Effective anesthesia for cesarean delivery requires understanding of the innervation of the uterus and adjacent organs, the peritoneum, and the abdominal wall (Table 1).

The uterus receives both autonomic (sympathetic and parasympathetic) and somatic (sensory) innervation.[10] The sympathetic fibers, primarily from T10 to L1, travel via the hypogastric plexus and are responsible for the visceral pain reported by women during uterine manipulation. The somatic innervation transmits pain from the body and fundus of the uterus (T10–L2), and the cervix and lower uterine segment (S2–S4), with the cervix being the most innervated. In contrast to the cervix, the corpus uteri undergoes almost complete denervation by term pregnancy, a reversible hormone-driven adaptation.[11] The parasympathetic nerve fibers in the uterus arise from the pelvic splanchnic nerves (S2–S4) and promote uterine relaxation and blood flow regulation. The parietal peritoneum is innervated by somatic nerves (lower intercostal nerves from T6–T12, and upper lumbar nerves around L1) and is sensitive to pain, pressure temperature and touch.[12] The abdominal wall is similarly innervated by somatic nerves from T6 to L1. The visceral peritoneum is innervated by autonomic nerves (T6–L2), it is insensitive to touch, temperature, and cutting but sensitive to stretch. The lower vagina and perineum are innervated by the pudendal nerve (S2–S4), though more relevant for vaginal deliveries, this may be pertinent for cesarean delivery. Therefore, the usual target for neuraxial anesthesia is to achieve a dense dermatomal block from T4 to S1, which ensures both visceral and somatic coverage (Figure 1).

Exteriorization of the uterus is associated with intraoperative visceral pain, nausea, and vomiting, compared with in situ repair.[13] This is due to the increased traction and stretching of the uterine ligaments and parietal peritoneum, which are densely innervated and sensitive to manipulation. Uterine exteriorization is also associated with severe postoperative pain and persistent postcesarean delivery pain.[14]

Shoulder tip pain may occur during cesarean delivery or postoperatively and is usually caused by irritation of the diaphragm (secondary to air, blood, or amniotic fluid), triggering the phrenic nerve[15]; this referred pain is typically felt in the right shoulder and can be treated by removing the offending source.

FIGURE 1
Innervation and pathways involved with sensations and pain during and after cesarean delivery



The different anesthetic and analgesic approaches for cesarean delivery

Neuraxial anesthesia has been, and continues to be, the gold standard anesthetic for cesarean delivery and is recommended by numerous international professional societies including the Society for Obstetric Anesthesia and Perinatology (SOAP), the American Society of Anesthesiologists (ASA), the American Society of Regional Anesthesia, the United Kingdom National Institute for Health and Care Excellence, the Royal College of Obstetricians and Gynaecologists, and the American College of Obstetricians and Gynecologists. It is preferred to general anesthesia, to avoid the anesthetic risks associated with airway manipulation in obstetric patients, such as difficult oxygenation, ventilation, intubation (the dreaded "cannot intubate, cannot ventilate, cannot oxygenate" scenario), and aspiration of gastric contents, even though these are rare complications nowadays.[16–18] In fact, more than concerns related to airway and aspiration issues, as general anesthesia risks are comparatively low in contemporary practice, risks of increased maternal morbidity[19] and postpartum depression[20] have emerged as the major reasons to avoid general anesthesia (Table 1).[21–23] The role of general anesthesia should be limited to cases where it cannot be avoided. General anesthesia is deemed "unavoidable and necessary," with certain obstetrical complications (eg, postpartum hemorrhage), maternal indications (eg, severe hypoxemia or inability to lie supine), and contraindications to neuraxial anesthesia (eg, anticoagulation or coagulopathy or patient refusal to undergo neuraxial anesthesia).[19,22] Evidently, indications for emergency cesarean delivery (eg, placental abruption, cord prolapse, antenatal placental bleeding, and nonreassuring fetal tracing) are associated with increased odds of general anesthesia.[24] The SOAP Centers of Excellence benchmark metrics consider that the overall rate of general anesthesia for cesarean deliveries should be lower than 5%,[25] though the ratio of emergency versus scheduled cases, and labor epidural analgesia utilization rates will markedly influence the ability to reduce unnecessary and avoidable general anesthesia rates. General anesthesia rates are also a recommended quality metric.[26]

Neuraxial anesthesia for cesarean delivery

Historically, neuraxial anesthesia was limited to 2 techniques that were distinct from an anatomical standpoint: spinal anesthesia, where medication is given intrathecally as a "single shot" via a spinal needle, and epidural anesthesia, where medication is given via an epidural catheter in the epidural space (Figure 2).

With significant advances in neuraxial anesthesia equipment (needles and catheters), improving the safety and reducing the risk of neuraxial-associated headaches, and improved understanding of the pharmacology of neuraxial medication, there are now additional approaches that allow a more customized approach to cesarean delivery.

The different neuraxial anesthesia techniques

From a procedural standpoint, there are several neuraxial anesthetic approaches that allow neuraxial medication to be given epidurally, intrathecally, or as a combination of both (Table 2). There are 5 different neuraxial anesthetic techniques that can be provided for cesarean delivery cases: (1) the single shot spinal anesthetic (drugs administered in the intrathecal space directly into the cerebrospinal fluid), (2) the epidural anesthetic (typically the conversion for labor epidural analgesia for intrapartum cesarean delivery), (3) a combined spinal-epidural (CSE), (4) a dural puncture epidural (DPE) which is basically a CSE without administration of intrathecal drugs), and (5) continuous spinal anesthesia (intrathecal or spinal catheter) (Figure 2). They each have their specific advantages and disadvantages (Table 3).

Neuraxial medications

For patients undergoing cesarean delivery, spinal anesthesia most frequently involves the use of a local anesthetic (hyperbaric bupivacaine is the most used for its intermediate duration of action), combined with short- and long-acting opioids to enhance analgesia (Table 3). Fentanyl, a short-acting lipophilic

FIGURE 2
Neuraxial anesthesia techniques

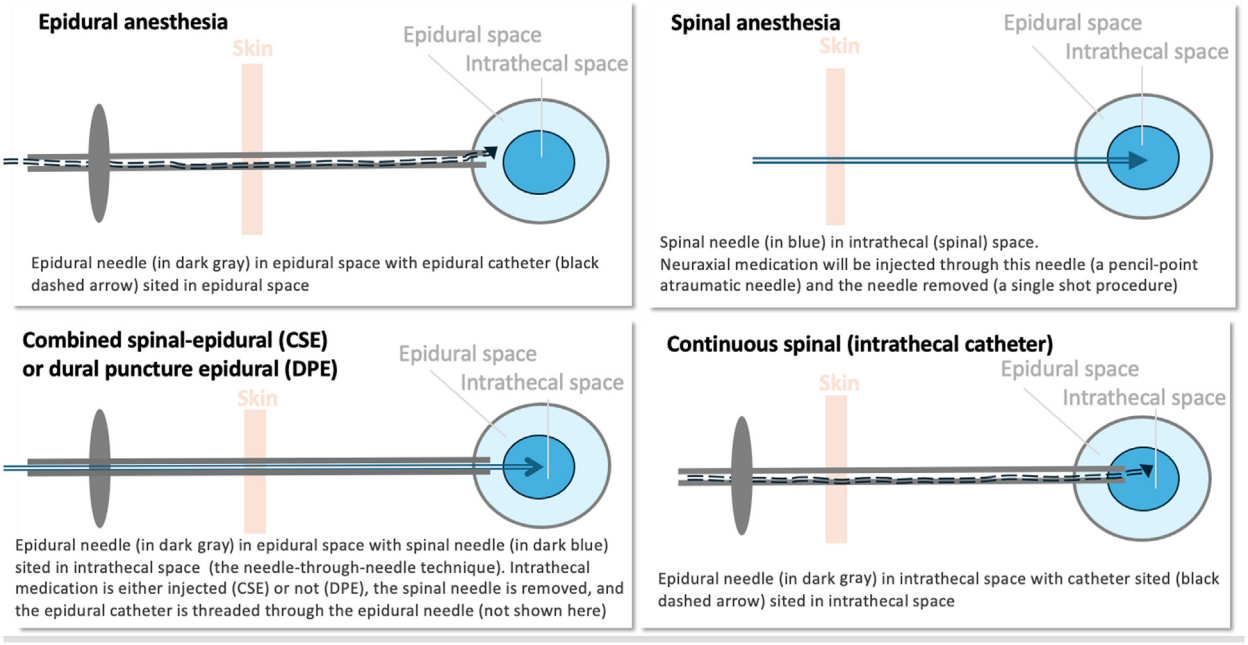


TABLE 2
Maternal and neonatal risks associated with general anesthesia during cesarean delivery (adapted from[23])

Maternal risks associated with general anesthesia
Serious adverse events related to induction of general anesthesia (eg, respiratory or cardiac complications, cardiac arrest)
Failed intubation, aspiration
Cerebrovascular injury from a severe hypertensive response to intubation in women with comorbidities (eg, preeclampsia, cardiac disease)
Awareness under general anesthesia
Intraoperative uterine atony and/or increased obstetric hemorrhage
Respiratory depression after emergence from general anesthesia
Inability to provide neuraxial opioids limiting opioid-sparing postcesarean analgesia
Surgical site infection
Thromboembolic events
Persistent pain after delivery
Postpartum depression
Reduced immediate postdelivery skin-to-skin bonding and breastfeeding
Decreased maternal and paternal participation, and satisfaction with birth experience
Fetal or neonatal risks associated with general anesthesia
In utero exposure to induction/inhalational agents with potential neurobehavioral impact
Respiratory depression at delivery, Apgar <7 at 5 min, and admission to neonatal intensive care unit in urgent cases
Reduced benefits of immediate breastfeeding with decreased likelihood of exclusive breastfeeding

TABLE 3
The different neuraxial anesthesia techniques

Anesthesia	Epidural dosing	Intrathecal (spinal) dosing	Onset	Effect or duration	Flexibility
Spinal anesthesia (single shot)	N/A	√	Quickest	- Most reliable block - Duration depends on neuraxial medication (type and dose) - Lowest rate of pain during cesarean delivery	- Titration or reinjection not possible
Epidural anesthesia (via catheter)	√	N/A	Not quick	- Incremental dosing required - If placed for labor epidural analgesia, can be used for intrapartum cesarean anesthesia - Block not as dense as spinal (might be patchy, one-sided, with sacral sparing) - Highest rate of pain during cesarean delivery	- Epidural catheter sited (may be used for labor epidural analgesia, for cesarean anesthesia, and for postoperative pain management) - Incremental and repeated dosing possible
Dural puncture epidural (DPE)	√	N/A (though dura punctured)	Not quick	- Incremental dosing required (similar to epidural anesthesia) - Block not as dense as spinal (but less patchy than epidural, less likely to be one-sided, less sacral sparing)	- Same procedure as CSE, but no intrathecal dosing (spinal needle inserted to identify CSF but no medication is injected) - Epidural catheter sited - Incremental, continuous, and repeated dosing possible
Combined spinal-epidural (CSE)	√	√	Can be quick (may depend on position)	- Intrathecal (spinal) dose followed by epidural catheter placement - Block not as reliable and predictable as spinal but more effective than DPE or epidural anesthesia	- Intrathecal (spinal) dose can be low, with incremental dosing of epidural - Epidural catheter sited - Incremental, continuous, and repeated dosing possible
Continuous spinal (intrathecal catheter)	N/A	√	Quick	- Intrathecal catheter sited - Allows titration small doses, incrementally	- Incremental, continuous, and repeated dosing possible - Risk of postdural puncture headache

CSF, cerebrospinal fluid; *N/A*, not applicable.

opioid, has a rapid onset of action and is added to enhance intraoperative pain relief without significantly prolonging recovery times. Morphine, a long-acting hydrophilic opioid, is used to extend postoperative analgesia, typically lasting 12 to 24 hours. Neuraxial adjuvants (eg, epinephrine and alpha$_2$-adrenergic agonists) can also be added to enhance the density and duration of the neuraxial block.

The combination of these drugs is effective in reducing intraoperative pain and the need for additional systemic analgesics postoperatively[27] and are consequently recommended by SOAP's and the European Procedure-Specific Postoperative Pain Management (PROSPECT) guidelines, in the absence of contraindications.[5,6] When used in combination with fentanyl (10−15 μg) and morphine (50−150 μg), the effective dose of isobaric and hyperbaric bupivacaine in 95% of the population is 13 mg and 11.2 mg, respectively.[28,29]

Other intrathecal local anesthetics for cesarean delivery include 2-chloroprocaine 3% (short-acting) or ropivacaine 0.5% (less potent than bupivacaine). Epidural lidocaine 2% with epinephrine or epidural 2-chloroprocaine 3% are used when an indwelling epidural catheter, placed for labor epidural analgesia, is used for intrapartum epidural anesthesia (often called an epidural top-up or top-off).

Anesthetic elements of enhanced recovery with spinal anesthesia

The SOAP Enhanced Recovery after Cesarean (ERAC) recommendations list 25 elements focusing on patient intraoperative comfort, optimizing maternal recovery, maternal-infant bonding, and perioperative outcomes after cesarean delivery.[6] Elements that anesthesiologists typically implement are: nil per os fasting guidelines that allow clear liquids until shortly before delivery, opioid-sparing multimodal analgesia, antibiotics, antiemetics, prevention of spinal hypotension, normothermia, analgesic or anxiolytic medication when needed, and uterotonics (Figure 3). Early resumption of oral diet, starting in the postanesthesia care unit in the absence of contraindications, and early removal of urinary Foley catheter and ambulation are key elements that can be implemented within 6 to 8 hours postoperatively after uncomplicated cesarean delivery.

Pain during and after cesarean delivery

Pain during cesarean delivery has only recently been thoroughly addressed,

FIGURE 3
Intraoperative and anesthetic elements of enhanced recovery for elective cesarean delivery with spinal anesthesia

Preoperatively
Fasting guidelines (solid food 6-8 hours, clear drinks up to 2 hours before)
Multimodal analgesia (preoperative oral acetaminophen)
Intraoperatively - before delivery
Antibiotics (eg, cefazolin ± azithromycin)
Antiemetics (eg, ondansetron, dexamethasone)
Spinal hypotension prevention (eg, phenylephrine infusion started)
Maintenance of normothermia (eg, warming blankets and fluid warmer) and anti-shivering medication (eg, intravenous dexmedetomidine)
Analgesic/anxiolytic supplementation (eg, intravenous fentanyl, dexmedetomidine, midazolam, ketamine)
Intraoperatively - after delivery
Uterotonics (oxytocin, methergine, carboprost, misoprostol, calcium)
Multimodal analgesia (eg, intravenous ketorolac)

with several recent clinical recommendations, from the French College of Obstetric Anesthesia,[30,31] the United Kingdom Obstetric Anaesthetists' Association,[32,33] and the ASA,[34,35] to raise awareness, prevent its occurrence, provide guidance if it occurs, and ultimately reduce childbirth-related trauma.[36–38] Shedding light on risk factors for pain during cesarean delivery, preventative and mitigating factors, and management strategies are key.[39,40]

Requirement for supplemental analgesia during cesarean delivery is a quality metric recommended by the ASA Committee on Obstetric Anesthesia.[26] The requirement of supplemental analgesia, either planned or unplanned, during cesarean delivery occurs in approximately 15% of elective cesarean deliveries.[41] Importantly, though, pain during cesarean delivery should be measured as a patient-reported outcome, and not with interventions that may have occurred to treat presumed pain. Several studies have shown that anesthesiologists and obstetricians do not correctly identify women who reported having experienced intraoperative pain, resulting in gaps between patients analgesic needs and their administration;[42–44] therefore, relying on measures of supplemental analgesia to evaluate the incidence of pain during cesarean delivery is inherently flawed.

The incidence of patient-reported pain during cesarean delivery was evaluated with a systematic review and meta-analysis including 34 studies published between 1990 and 2023; the crude overall incidence of patient-reported intraoperative pain was 10.8% (1229/11,351 total cases).[45] The pooled incidence for patient-reported pain was 14.0% with spinal anesthesia, 33.0% with epidural top-up, and 18.0% with CSE. The definition of pain was based on the patients' self-reported unpleasant sensory and emotional experience.

Known risk factors for intraoperative pain during cesarean delivery have been well-established.[39,40] These include patient-specific factors (eg, anxiety, substance use disorder), anesthesia factors (eg, indwelling epidural catheter used for intrapartum cesarean delivery), obstetric and surgical factors (eg, prolonged surgery, previous surgery, vertical incision), and fetal or neonatal factors, some of which may be modifiable (Figure 4).

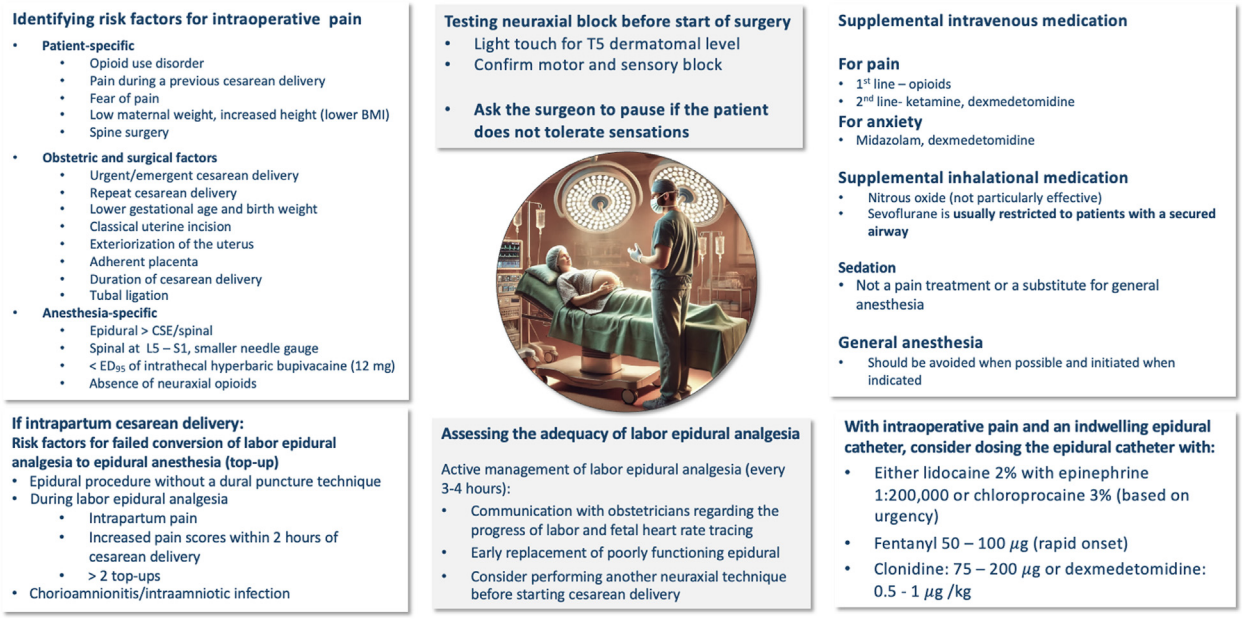
Strategies to prevent and manage intraoperative pain

Strategies to prevent and mitigate pain during cesarean delivery follow a continuum of care, from risk stratification (identifying risk factors) to preoperative counseling, to the choice of anesthesia modality and adjuvants, testing the block, use of analgesic supplementation, and conversion to general anesthesia (Figure 4).

One of the more important and overlooked approaches to prevent and mitigate intraoperative pain involves adequate counseling and patient information related to the anesthetic procedure itself, possible sensations and motor block during cesarean delivery. Most patients are unprepared and setting expectations and options are key.

It is also uniquely important for women undergoing a repeat cesarean delivery to gather information about their previous experience(s) and formulate a plan that considers their previous experiences of intraoperative pain, anxiety,

FIGURE 4
Strategies to prevent and manage intraoperative pain (adapted from 39)



shivering, and postoperative pain. If the patient experienced pain in the setting of an urgent intrapartum cesarean delivery, then spinal anesthesia will likely provide a denser block than the conversion of their indwelling labor epidural catheter to cesarean anesthesia, and neuraxial adjuvants can be added to prevent intraoperative pain. If women experienced pain with a previous spinal anesthetic, then enhancing the intrathecal doses (with higher doses of bupivacaine, fentanyl, morphine, and by adding an alpha-$_2$ agonist, such as clonidine) or placing a CSE may be beneficial options, through shared decision-making with the patient.

Counseling and patient information (setting expectations)

Providing written (or visual) information to help set expectations before cesarean delivery might be helpful. The process of counseling should follow these simple steps.

- No neuraxial anesthetic makes one "feel nothing".

Women need to be informed that there is no neuraxial anesthetic that will make them "feel nothing" during their cesarean delivery. They need to know that neuraxial blocks may need to be repeated (for complete failure, partial failure including patchy or one-sided block, or for catheter dislodgement). Clarifying that they will feel some sensations, including touch, pressure, and some visceral sensations, the "pulling and tugging" reported by many, is not the reassuring message that most anesthesiologists and obstetricians want to provide, particularly if the cesarean delivery is urgent, unplanned, and perhaps not desired by the patient. Reassuring patients that these sensations will be acknowledged, and medication can be given is key, with general anesthesia always as a safe backup option.

- The neuraxial block will be tested.

Women need to know that the quality of their anesthetic block will be checked by both the anesthesia and the obstetric teams, before proceeding with surgery.

- Additional medication can be given for discomfort or pain.

Women need to know that if they are uncomfortable at any time point, and cannot tolerate sensations (pressure or pain), their discomfort will be acknowledged. Supplemental analgesic and or anxiolytic medication may be given, and if not sufficient, general anesthesia will be offered and safely performed. Women need to be reassured that they will be heard, and supplemental analgesic or anxiolytic medications will be discussed before being given, as shared decision-making is key in these circumstances. General anesthesia should be offered, and women should feel empowered to speak up.

- Medication can be given for prevention or treatment of intraoperative shivering.

Intraoperative shivering is often reported and described as a very unpleasant and anxiety-provoking experience. Shivering affects approximately 50% of patients undergoing cesarean delivery under neuraxial anesthesia.[46,47] Shivering is a complex multifactorial physiological response influenced by both thermoregulatory and non-thermoregulatory mechanisms as outlined in Table 4.

The clinical implications of shivering include increased oxygen demand, interference with patient monitoring devices (including oxygen saturation

TABLE 4
Mechanisms of shivering during cesarean delivery under neuraxial anesthesia[47–54]

Thermoregulatory mechanisms	
Heat loss and hypothermia	Neuraxial anesthesia induces vasodilation. Heat is redistributed from the core to the periphery which causes heat loss. Hypothermia results in shivering to generate metabolic heat.
Environment and iatrogenic	Surgical exposure, cold ambient operating room temperature, and unwarmed intravenous fluid can exacerbate decreases in core temperature. The lowest temperatures are often observed after oxytocin administration.
Impaired thermoregulation	Neuraxial anesthesia disrupts central thermoregulation by blocking afferent temperature signals to the hypothalamus, lowering shivering threshold. Loss of thermoregulatory vasoconstriction below the level of the block may result in increased heat loss from the body surface.
Nonthermoregulatory mechanisms	
Psychological stress and anxiety	Preoperative anxiety correlates with incidence of shivering, which may be modulated by autonomic nervous system and lowered shivering threshold. Fear and stress. May activate adrenergic pathways, mimicking cold induced thermogenesis.
Pain	Pain from surgery or residual labor pain can provoke uninhibited spinal reflexes, contributing to shivering independent of temperature.
Sympathetic inhibition	Sympathetic inhibition from anesthesia may impact thermoregulatory control.
Hormonal and inflammatory factors	Rapid changes in hormonal levels (such as progesterone decrease following delivery) and release of inflammatory mediators during surgery may sensitize the shivering response.

probe, noninvasive blood pressure, and electrocardiogram readings), and increased risk of bleeding (when associated with hypothermia), increased serum lactate and potassium, and cardiac strain.[48–50] Intrapartum cesarean delivery compared to scheduled surgery is associated with increased risk of shivering (odds ratio, 2.9; 95% confidence interval, 1.45–5.79).[48] Other risk factors include prolonged surgery, lower operating room temperature, and hypotension,[46] which is associated with reduced peripheral perfusion and hypothermia.

Prevention of shivering can be optimized through environmental and pharmacological strategies including: 1) increasing operating room ambient temperature; 2) warming intravenous (IV) fluids and using forced-air warming to mitigate hypothermia[55]; 3) anxiolysis to address psychological triggers[50]; 4) administration of opioids (eg, intrathecal meperidine or morphine)[56]; and alpha$_2$-adrenergic agonists (eg, clonidine or dexmedetomidine)[57] to modulate spinal reflexes and thermoregulatory pathways.[47] A recent network meta-analysis including data from 20 randomized controlled trials (n=1983) reported that dexmedetomidine was the top ranked pharmacological agent for lower time to shivering control, shivering recurrence, and maternal nausea outcomes.[58] Tramadol, nalbuphine, and meperidine were also effective IV agents for these outcomes.[58]

Acknowledging this adverse effect of active labor, neuraxial drugs, and certain uterotonics, and informing that it can be prevented is often reassuring. IV dexmedetomidine at the time of spinal anesthesia has been shown to be effective in preventing intraoperative and postoperative shivering.[58–60] Intrathecal dexmedetomidine has also been evaluated and shown to be effective in preventing intraoperative shivering during cesarean delivery.[61–63]

Active management of labor epidural analgesia (prior to intrapartum cesarean delivery)

Since conversion of labor epidural analgesia to epidural anesthesia for intrapartum anesthesia is associated with the highest odds for pain during cesarean delivery (up to 20%–25% according to studies), it is essential to actively manage labor epidural analgesia and identify the "failing epidural catheter" prior to any decision-making regarding the need for cesarean delivery.[64] In other words, if an epidural catheter does not provide adequate labor analgesia, it will likely not provide adequate cesarean anesthesia. Therefore, active management of labor epidural analgesia is key, and requires regular assessments (every 3–4 hours) to confirm that the catheter is providing adequate analgesia.[64] If analgesia is inadequate, it could be due to catheter dislodgement (it is "out"), or analgesia may be one-sided (the catheter may need to be "pulled out," eg, by 1 cm and a top-up with additional local anesthetics should be given), analgesia may be patchy (adjuvants may help to improve block density in this scenario), or there may be sacral sparing (denser block and adjuvants may help). Ultimately, if analgesia cannot be rescued, the epidural catheter should be replaced. Epidural catheter replacement is one of the SOAP Centers of Excellence benchmark metrics, and it is estimated that 3% to 6% of epidural catheters may need to be replaced (usually after multiple top-ups and failure to provide adequate labor analgesia).[25]

There is robust evidence showing that labor epidural analgesia initiated with a standard epidural catheter, rather than a DPE[65] or CSE analgesia is more likely to result in inadequate neuraxial anesthesia

for cesarean delivery.[41,66] The premise for the improved labor analgesia and conversion to anesthesia with DPE and CSE is that the initial dural puncture (without intrathecal drug administration) helps confirm that the epidural needle is midline results in translocation of epidurally administered medication into the intrathecal space through the puncture created with the DPE. Consequently, epidural anesthesia for cesarean delivery initiated following a DPE technique results in faster onset and improved block quality compared with initiation with a standard epidural technique.[67]

Recent guidelines from the European Society of Anaesthesiology and Intensive Care provide step-by-step guidance on how to manage a failing epidural during labor analgesia, with two recommendations: (1) anesthesiologists should take responsibility for initiating and executing suitable corrective strategies for addressing the failing epidural catheter, and (2) each instance of failed conversion of labor epidural analgesia for intrapartum cesarean delivery should be addressed, with both neuraxial (such as epidural top-up, new spinal, or CSE techniques) and general anesthesia considered as appropriate choices.[68] Other clinical practice statements within this guideline emphasize proactive early management of failing epidural and institutional multidisciplinary protocols to detect and treat failing epidurals after initially adequate labor epidural analgesia is achieved.[68]

It has been shown that dedicated staffing, ensuring immediate availability for performing emergent cesarean deliveries, and the presence of obstetric anesthesiologists, will reduce the likelihood of failure to convert labor epidural analgesia to anesthesia for cesarean delivery and therefore reduce the risk of requirement for general anesthesia.[66,69,70] Team huddles, as recommended by the World Health Organization surgical safety checklist, are an important multidisciplinary tool that enhances communication, satisfaction within the care team, and patient safety in the setting of intrapartum cesarean deliveries.[71]

Testing the block

There remains some controversy about how to most appropriately test a neuraxial block and determine its adequacy for successfully providing anesthesia for cesarean delivery, with sufficient visceral and somatic coverage (Figure 1). An early study from the United Kingdom identified that among patients who underwent cesarean delivery under neuraxial anesthesia, no patients who had been tested to light touch with a dermatomal level above T5 had experienced intraoperative pain.[72] These findings form the basis for the current recommendations from the Obstetric Anaesthetists' Association regarding block testing,[32] which are comprehensive but emphasize that the optimal method of testing neuraxial block to predict full surgical anesthesia has not been determined. Recent ASA statements also recommend similar testing with a "light touch" modality with the T5 dermatomal level as the target, and for the block not to be tested too soon, and patients should be allowed to focus on the test and not be distracted (eg, during placement of the Foley urinary catheter or during preparation of the abdomen).[35,36,39] It should be confirmed by a second modality (such as degree of motor blockade with the patient unable to perform a straight leg raise). However, a recent study conducted in Ireland, with a low incidence of intraoperative pain (2.1%) showed that T5 dermatomal level testing with confirmation of motor block was not 100% predictive, as most individuals that experienced intraoperative pain had met criteria for adequate sensory and motor blockade.[73,74]

Analgesic supplementation incorporating shared decision-making

Patients' stated experience should supersede anesthesiologists' or surgeons' assessments of the surgical block.[33] Discomfort and pain should always be acknowledged, women should not have to feel that their pain is being dismissed, or that it is attributed to "pressure" or being normalized.[37]

There are several options for analgesia supplementation in situations of intraoperative discomfort or pain; these are well described in the recent 2024 ASA statement on the use of adjuvant medications and management of intraoperative pain during cesarean delivery.[35,39] With an indwelling epidural catheter, neuraxial medications (local anesthetics, opioids, alpha$_2$-adrenergic adjuvants) can be given. IV supplementation should be offered as well, and includes opioids, other analgesic medication (eg, ketamine, dexmedetomidine), and anxiolytics (eg, midazolam, dexmedetomidine). All the guidelines[30,32,35] emphasize that anxiolysis and sedation should not be used to manage intraoperative pain, and while it may be difficult to identify if anxiety is increasing the fear of experiencing pain, or pain is causing anxiety, analgesic supplementation should be the first-line approach when women report discomfort or pain during cesarean delivery.[39] Pain during cesarean delivery should be communicated to the obstetrician, and surgery should be paused until resolution of the pain is achieved (if possible).[40] If discomfort or pain do not resolve or timely recommencement of surgery is required (eg, delivery needs to occur emergently or in the case of ongoing hemorrhage), general anesthesia should be offered.

Multimodal postoperative analgesia

The latest evidence and professional guidance supports the use of a multimodal analgesia regimen for post-cesarean delivery pain management (Table 5). Multimodal analgesia refers to a pain management strategy that combines 2 or more types of analgesic medications or interventions, each targeting different mechanisms of action or pain pathways involved in pain processing. Multimodal postoperative analgesia should include a stepwise opioid-sparing analgesia regimen during hospital stay and judicious analgesic prescription after hospital discharge.

This can start preoperatively with an oral dose of acetaminophen (see ERAC). In the operating room, low-dose intrathecal morphine (150 μg or less)[75,76] or epidural morphine (2−3 mg) are opioid-sparing strategies for the postoperative period, providing analgesia for

TABLE 5
Multimodal opioid-sparing analgesia strategy for cesarean delivery

Interventions	Scheduled cesarean delivery	Intrapartum cesarean delivery	Cesarean delivery under general anesthesia (if neuraxial anesthesia is contraindicated or not avoidable)
Intraoperative analgesia			
Neuraxial local anesthetics	X	X	N/A
Neuraxial fentanyl	X	X	N/A
Neuraxial morphine	X	X	N/A
IV opioid	(X)	(X)	X
IV dexmedetomidine	(X)	(X)	(X)
Acetaminophen (PO or IV) (pre- or intraoperatively)	X	X	X
NSAIDs (eg, IV ketorolac)	X	X	X
Postoperative analgesia including tailored approaches to enhanced analgesia			
Acetaminophen (scheduled)	X	X	X
NSAID (eg, ibuprofen; scheduled)	X	X	X
Oral opioid (eg, oxycodone; as needed)	X	X	X
IV opioid PCA	(X)	(X)	(X)
Abdominal wall block (eg, TAP or QLB)	(X)	(X)	X
Lidocaine patch	(X)	(X)	(X)

IV, intravenous; *N/A*, not applicable; *NSAID*, nonsteroidal antiinflammatory drug; *PCA*, patient-controlled analgesia; *PO*, per os; *QLB*, quadratus lumborum block; *TAP*, transversus abdominis plane block; *X*, administer in the absence of contraindications; *(X)*, consider administering if analgesia is inadequate.

up to 24 hours following its administration. Its implementation is associated with improved recovery and reduced opioid consumption.[77] Of importance, low to moderate intrathecal morphine doses ($\leq$150 μg) do not require enhanced respiratory monitoring, and respiratory depression is rare regardless of body mass index.[78–80] The SOAP consensus statement on monitoring recommendations for the prevention and detection of respiratory depression associated with neuraxial morphine offers guidance for dose-adjusted risk stratification for the intensity, frequency, and duration of respiratory monitoring, which aims to reduce unnecessary interruptions from respiratory monitoring in healthy mothers while focusing vigilance in women at higher risk.[81]

Acetaminophen and nonsteroidal antiinflammatory drugs in combination should be administered in a scheduled rather than "as required" manner following cesarean delivery.[82–84] Efforts should be made to avoid scheduled or excessive dosing of opioids (eg, oxycodone >30 mg per day unless indicated) following cesarean delivery.[85]

A personalized protocol for opioid prescriptions after cesarean delivery have been shown to decrease the total morphine milligram equivalents and the number of opioid tablets at discharge, without hospital readmissions or need for rescue opioid prescriptions after discharge.[34] Since the overprescription of opioids at discharge after cesarean delivery is well-established, prescribing opioids at discharge based on inpatient utilization may be preferable for clinicians and patients who undergo cesarean delivery.[35]

Implementing stepwise opioid-sparing multimodal analgesia and personalized protocols for opioid prescriptions after cesarean delivery are key initiatives to reduce excessive and possibly unnecessary opioid use during delivery hospitalization,[86] and to promote judicious opioid prescribing at hospital discharge.[87] Overprescription of opioids carries the risk of persistent opioid use, which has been shown to occur in up to 2.2% of cases after cesarean delivery in the United States.[88] Opioid prescription at discharge should be tailored to each patient's pain trajectory and in-hospital opioid use and include shared decision-making for a patient-centric approach to postcesarean pain management.[89,90] In a recent multicenter randomized clinical trial from the Maternal-Fetal Medicine Units Network, individualized opioid prescription with shared decision-making resulted in fewer prescribed opioid tablets at discharge after cesarean delivery than a fixed amount, without increased pain.[91] In a secondary analysis, in-hospital opioid use was predicted by patient- and anesthesia-specific factors, with anxiety, depression, preterm birth, and no administration of spinal morphine increasing opioid use.[92] Furthermore, in-hospital opioid use could also guide opioid prescription at discharge, as most patients who do not use any opioids during hospitalization, continue to not take opioids after discharge (despite filling a prescription),

and do not experience more severe pain.[93]

Tailored approaches to enhanced anesthesia and postoperative analgesia

Acute pain after delivery is strongly associated with persistent and chronic pain,[94–97] and general anesthesia for cesarean delivery is a major risk factor for acute and persistent pain.[95,98,99] This underscores the recommendations that multimodal opioid-sparing analgesic strategies are important not only for early recovery pathways but also for long-term recovery after childbirth.

Patient-specific tailored approaches with analgesic adjuvants should be considered in patients with risk factors for severe acute postpartum pain.[95,100] Risk factors for severe acute pain after cesarean delivery and increased analgesic use include: opioid use during pregnancy,[101] poor sleep quality before delivery,[102] residual scar hyperalgesia from a previous cesarean delivery,[103] pain during local anesthesia infiltration,[104] maternal mental health issues including anxiety,[105] uterine exteriorization,[13] complex surgery including cesarean-hysterectomy, spinal anesthesia without long-acting opioids,[91] and general anesthesia.[106–108]

Patients with an opioid use disorder require uniquely tailored approaches that have been described in a recent multidisciplinary consensus statement on pain management for pregnant patients with opioid use disorder.[109,110]

Strategies for cesarean delivery cases with anticipated severe acute pain due to known risk factors include the following, which can be combined:

- enhanced neuraxial anesthesia including increased neuraxial opioids dosing (eg, intrathecal morphine 300 μg)[111]
- use of neuraxial adjuvants including alpha$_2$-adrenergic agonists (eg, intrathecal clonidine 30–50 μg)[112]
- keeping the epidural catheter in situ during the postoperative period (eg, up to day 3 postpartum)[113]
- rescue strategies including systemic analgesics (eg, IV opioids) and abdominal wall blocks, such as transversus abdominis plane (TAP) the block and or quadratus lumborum block (QLB)[114] which might include adjuvants to extend the analgesia duration (eg, epidural liposomal bupivacaine).[115]

Neuraxial and systemic alpha$_2$-agonists adjuvants

- *Clonidine.*

Clonidine was synthesized in 1962 as a nasal decongestant and its anesthetic properties were discovered in 1982, where it was found to enhance both general and regional anesthesia.[116] Clonidine is an alpha$_2$-adrenergic agonist with analgesic properties through direct activation of spinal cord alpha$_2$-adrenergic receptors in the dorsal horn, which inhibits pain signaling (blocking C-fiber transmission), and via synergistic effects with other analgesics.[117] Clonidine enhances the efficacy of opioids and local anesthetics by prolonging their duration of action.[118]

Epidural clonidine has been extensively studied as an adjuvant during labor epidural analgesia, either as a bolus for breakthrough pain[119,120] or added to the local anesthetic infusion.[121–126] It has been used for postcesarean delivery analgesia in patients with an opioid use disorder, added to a continuous infusion of low-concentration bupivacaine in lieu of fentanyl, with remarkable analgesic success.[127]

Intrathecal clonidine as an adjuvant for cesarean delivery anesthesia has also been extensively studied and provides prolonged analgesia, anxiolysis, sedation, and an antishivering effect.[112,128–134]

- Dexmedetomidine. Dexmedetomidine received the US Food and Drug Administration approval in 1999 as a sedative for mechanically ventilated critical care patients and in 2008, for procedural sedation for nonintubated patients. Dexmedetomidine, compared to clonidine, is a more selective α_2-agonist with a higher affinity for α_2-receptors (α_2:α_1 ratio is 1620:1 vs 220:1, respectively).[135,136] Dexmedetomidine's higher α_2-selectivity explains its increased sedative and analgesic effects.[137] Mediated by alpha$_{2A}$ receptor in the locus coerulus, dexmedetomidine causes sedation without significant respiratory depression. Its analgesic effect is mediated by activation of spinal and supraspinal alpha$_{2-}$ adrenergic receptor.

Dexmedetomidine may be given as an IV infusion and is also given (off-label use) as an epidural or intrathecal adjuvant. Given epidurally, it has been shown to reduce visceral sensations caused by peritoneal traction during surgery[138,139] and is suggested as a rescue strategy for intraoperative in the 2024 ASA statement on the use of adjuvant medications and management of intraoperative pain during cesarean delivery.[35] Low-dose IV dexmedetomidine reduces neuraxial-induced shivering, which may be particularly uncomfortable during cesarean delivery.[140]

In a recent systematic review with network meta-analysis evaluating intrathecal adjuvants for perioperative pain management for cesarean delivery, intrathecal morphine alone or in combination with meperidine, neostigmine, epinephrine, or nalbuphine significantly increased the duration of effective analgesia and decreased opioid use, and dexmedetomidine with morphine considerably prolonged the duration of motor blockade.[141]

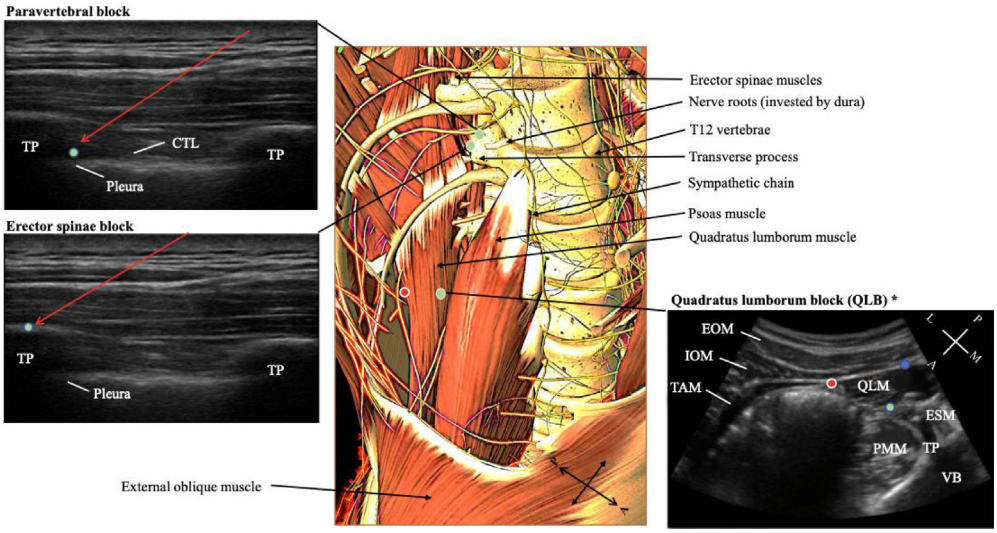
Abdominal wall blocks

Systemic opioids have been considered the usual "rescue" strategy for postoperative breakthrough pain, particularly in the United States; however, special consideration should be given with an opioid-balanced or even opioid-free strategy. Opioids should be reserved for breakthrough pain, and other modalities for an opioid-balanced (even opioid-free) approach might be preferable to avoid persistent opioid use.

Therefore, regional techniques can be proposed for postcesarean analgesia to improve postpartum recovery either as a rescue strategy or when general anesthesia has been the sole mode of

FIGURE 5
Approaches to ultrasound-guided abdominal wall nerve blocks 139 (reproduced with permission by John Wiley and Sons)

A



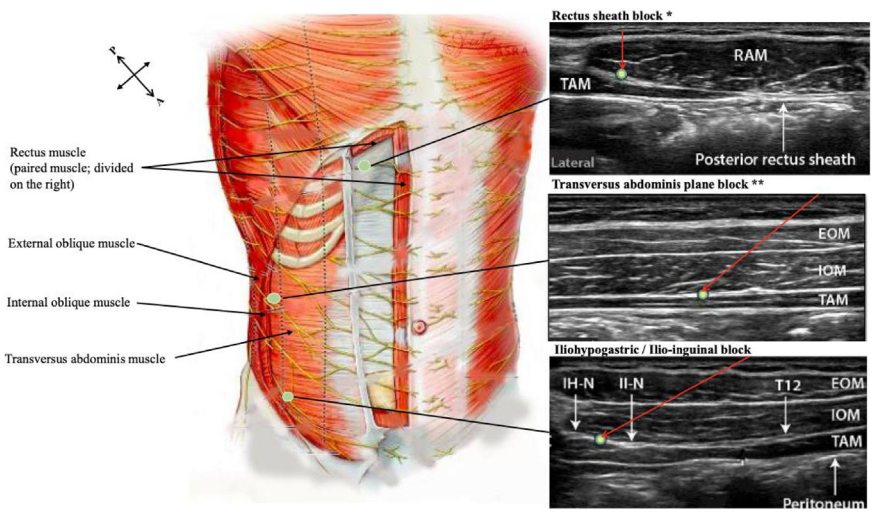
Anatomical and ultrasound representation of injection sites for paravertebral, erector spinae and QLB nerve blocks.

For erector spinae and paravertebral blocks, the green dots in the ultrasound images represent sites of optimal local anesthetic deposition; red lines depict possible needle path.

*QLB approaches: green dot represents site of local anesthetic deposition for anterior QLB; red dot for lateral QLB injection and blue dot for posterior QLB injection. The posterior QLB injection site is not visible on middle anatomical view shown.

CTL, costotransverse ligament; TP, transverse process; EOM, external oblique muscle;
IOM, internal oblique muscle; QLM, quadratus lumborum muscle; PMM, psoas major muscle; ESM, erector spinae muscle; VB, vertebral body. A, anterior; P, posterior; L, lateral; M, medial

B



Anatomical and ultrasound representations of injection sites for rectus sheath, transversus abdominis plane and iliohypogastric and ilio-inguinal nerve blocks.
Green dot represents site for optimal placement of local anesthetic; red arrows in
ultrasound images indicate possible needle path to desired target.

*paired muscle therefore bilateral injections required;
**denotes correct plane however posterior injection at the origin of the EOM and IOM muscles provides more complete coverage.

RAM, rectus abdominis muscle; TAM, transversus abdominis muscle; EOM, external oblique muscle; IOM, internal oblique muscle; IH-N, iliohypogastric nerve; II-N, ilio-inguinal nerve; P, posterior; A, anterior.

anesthesia.[142] Approaches to ultrasound-guided abdominal wall nerve blocks (paravertebral, erector spinae, QLB, rectus sheath, TAP, and iliohypogastric and ilioinguinal) are illustrated in Figure 5.[143] By minimizing opioid use, these blocks can facilitate earlier discharge as part of enhanced recovery protocols.[143] These blocks may be performed if neuraxial long-acting opioid analgesia is not possible or if rescue analgesia is needed; however, their duration of action is usually limited (15–24 hours).[144–146] Therefore, extending the duration of a regional block with the use of IV dexamethasone[147] or liposomal bupivacaine may be beneficial.[115,148–152] Liposomal bupivacaine is a long-acting anesthetic formulation that consists of bupivacaine encapsulated in multivesicular liposomes, enabling sustained release of the drug over 72 hours.

Conclusions

There has been much progress in the provision of cesarean delivery anesthesia in the recent decades, with stepwise opioid-sparing multimodal anesthesia and enhanced recovery protocols resulting in improved maternal outcomes, and reduced reliance on systemic opioids for management of acute postcesarean delivery pain. However, pain during cesarean delivery has emerged as a pressing issue, and though recent awareness surrounding this topic has resulted in robust guidance to prevent, recognize and manage pain during cesarean delivery, the patient-reported incidence remains high (15%). Since not all cesarean deliveries are scheduled and expected, counseling women during pregnancy (even if a cesarean delivery is not in the birth plan), and setting expectations for what sensations might be felt intraoperatively is crucial. Optimizing interdisciplinary communication to identify inadequate labor epidural analgesia and allow replacement strategies if intrapartum cesarean delivery becomes indicated, appropriate selection of neuraxial anesthesia (including adjuvants in patients are at increased risk for pain), adequate testing of neuraxial blockade, acknowledging patients' discomfort, and responding with appropriate analgesic interventions including escalation to general anesthesia if indicated, are key to providing a safe and comfortable experience during and after cesarean delivery. ■

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