Optimal Pain Management After Cesarean Delivery

Caitlin Dooley Sutton, MD, Brendan Carvalho, MBCh, FRCA*

INTRODUCTION

The rate of cesarean delivery in the United States has been increasing over the past decades and now exceeds 32% of births. Effective postoperative analgesia is critical, because women who undergo cesarean delivery rank avoidance of pain during and after surgery as their highest priority. Management of postcesarean pain may have lasting effects, and severe acute postoperative pain is associated with persistent pain, greater opioid use, delayed functional recovery, and increased postpartum depression. Effective pain relief after cesarean delivery improves a woman’s ability to function and interact with her newborn infant.

An individual patient’s specific plan should be determined in the context of any medical and psychiatric comorbidities, chronic pain, and prior postoperative or postpartum experiences. The American Pain Society recommends that planning for

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KEYWORDS

Cesarean delivery • Pain management • Intrathecal opioids • Multimodal analgesia

KEY POINTS

Effective pain management is a key priority of women undergoing cesarean delivery, and severe postoperative pain is associated with persistent pain, greater opioid use, delayed functional recovery, and increased postpartum depression.

Intrathecal morphine is the gold standard for postcesarean pain, providing excellent and prolonged postoperative analgesia.

Multimodal analgesia should include scheduled nonsteroidal antiinflammatory drugs and acetaminophen, with opioids reserved for severe breakthrough pain.

Wound infiltration and transversus abdominis plane blocks play an important role in multimodal analgesia for patients who are unable to receive neuraxial opioids or whose pain is not adequately controlled.

Analgesics can potentially transfer to breastfeeding infants, but transfer can be minimized by careful drug selection and optimal timing of administration.

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postoperative pain management should begin in the preoperative period. Physicians should focus on individualizing perioperative pain management, often through a multimodal approach. Compared with other surgeries, formulating a plan for optimal anesthesia and analgesia for cesarean delivery involves several distinct considerations:

- Surgical anesthesia is almost exclusively neuraxial and is performed in awake, unsedated patients
- Preemptive analgesic use is limited because of concerns for in-utero fetal drug transfer
- The potential transfer of analgesic drugs to breastfeeding neonates should be considered
- Maximal postoperative mobility of mothers in order to facilitate optimal neonatal care is extremely important

Multimodal analgesia options for providing optimal postoperative pain relief for women undergoing uncomplicated cesarean delivery with neuraxial anesthesia are summarized in this article. Analgesic options are appropriate for most parturients, but there are many women whose medical comorbidities require special consideration. Conditions that require alterations to pain management include chronic pain, obstructive sleep apnea, and a contraindication to neuraxial anesthesia. Although several key points are highlighted, detailed management of these conditions is beyond the scope of this article.

### NEURAXIAL MEDICATIONS

- Intrathecal morphine
- Epidural morphine
- Intrathecal hydromorphone
- Continuous and patient-controlled epidural infusions
- Nonopioid neuraxial adjuncts

The American Society of Anesthesiology's Obstetric Anesthesia Practice Guidelines and the American Pain Society's Clinical Practice Guidelines both recommend the routine use of neuraxial anesthesia for cesarean delivery. The use of neuraxial anesthesia for cesarean delivery is promoted because of decreased maternal risk and improved fetal outcomes, but the additional benefit of superior postoperative analgesia with the use of neuraxial opioids deserves emphasis. Standard regimens for intraoperative cesarean anesthesia consist of a combination of local anesthetic and a lipophilic opioid (eg, fentanyl). Although neither drug provides prolonged postoperative analgesia, they provide analgesia in the early postoperative recovery period until the onset of longer-acting neuraxial opioids; neuraxial morphine has an analgesic onset of approximately 60 to 90 minutes.

### Intrathecal Morphine

Intrathecal morphine is the gold standard single-shot drug for postcesarean pain, providing long-lasting analgesia for 14 to 36 hours. The optimal dose of intrathecal morphine appropriate for all patients has not been determined. Variations in dose seem to be more closely related to duration of analgesia as opposed to more effective pain relief or less opioid use. A recent meta-analysis showed that higher doses (>100 μg) of intrathecal morphine prolong analgesia by a mean difference of 4.5 hours, with time to first request for additional analgesia of 9.7 to 26.6 hours for doses of 50 to 100 μg versus 13.8 to 39.5 hours for doses greater than 100 to 250 μg. Pain scores and opioid use in the first 24 hours after cesarean delivery were similar between
groups. However, higher doses present a trade-off of longer analgesic duration versus increased side effects of nausea, vomiting, and pruritus. Side effects can be minimized with the selection of an appropriate dose of intrathecal morphine, as well as with appropriate prophylactic and treatment strategies (Table 1). Patients experience

<table>
<thead>
<tr>
<th>Side Effect</th>
<th>Prophylaxis Strategies</th>
<th>Treatment Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea and vomiting</td>
<td>Use low doses (eg, ≤150 μg intrathecal morphine)</td>
<td>Ideally use a drug with a different mechanism of action than was used for prophylaxis</td>
</tr>
<tr>
<td></td>
<td>Unimodal options   93–95:</td>
<td>Treatment options</td>
</tr>
<tr>
<td></td>
<td>• Ondansetron 4–8 mg IV</td>
<td>• Ondansetron 4–8 mg IV</td>
</tr>
<tr>
<td></td>
<td>• Metoclopramide 10 mg IV</td>
<td>• Metoclopramide 10 mg IV</td>
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<tr>
<td></td>
<td>• Dexamethasone 4–8 mg IV</td>
<td>• Propofol 10–20 mg IV</td>
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<td></td>
<td>• Droperidol 0.625 mg IV</td>
<td>• Promethazine 6.25–12.5 mg IV</td>
</tr>
<tr>
<td></td>
<td>• Scopolamine 1.5 mg patch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combination of drugs for improved efficacy 97:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ondansetron 4 mg IV + metoclopramide 10 mg IV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Dexamethasone 8 mg IV + droperidol 0.625 mg IV</td>
<td></td>
</tr>
<tr>
<td>Pruritus</td>
<td>Use low doses (eg, ≤150 μg intrathecal morphine)</td>
<td>Treatment options 98–101:</td>
</tr>
<tr>
<td></td>
<td>Ondansetron 4–8 mg IV may reduce incidence, severity, and</td>
<td>• Nalbuphine 2.5–5 mg IV</td>
</tr>
<tr>
<td></td>
<td>need for rescue treatment 102</td>
<td>• Naloxone 100–200 μg IV</td>
</tr>
<tr>
<td></td>
<td>Pretreatment with nalbuphine or naloxone is not effective</td>
<td>• Ondansetron 4–8 mg IV</td>
</tr>
<tr>
<td></td>
<td>103</td>
<td>• Butorphanol 1 mg IV, infusion of 0.2 mg/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pentazocine 15 mg IV</td>
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<tr>
<td></td>
<td></td>
<td>Treatment comparisons 101, 104:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Nalbuphine has better efficacy than naloxone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pentazocine is more effective than ondansetron</td>
</tr>
<tr>
<td>Respiratory depression</td>
<td>Use low doses; eg, ≤150 μg intrathecal morphine</td>
<td>Naloxone bolus followed by low-dose naloxone infusion to avoid recurrence of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>respiratory depression and minimize pain from opioid antagonism 105</td>
</tr>
<tr>
<td></td>
<td>Identify patients at risk 106, 107:</td>
<td>Supplemental oxygen only for treatment because prophylactic oxygen may mask</td>
</tr>
<tr>
<td></td>
<td>• Obstructive sleep apnea</td>
<td>respiratory depression</td>
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<td></td>
<td>• Obesity</td>
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<tr>
<td></td>
<td>• Chronic pain/opioid tolerance</td>
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<tr>
<td></td>
<td>Caution if receiving sedating drugs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Magnesium sulfate</td>
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<tr>
<td></td>
<td>• Diphenhydramine</td>
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<td></td>
<td>• Promethazine</td>
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Abbreviation: IV, intravenous.
a lower incidence of nausea/vomiting (odds ratio [OR], 0.44 [0.27, 0.73]) and pruritus (OR, 0.34 [0.20, 0.59]) when receiving lower (50–100 mg) versus higher (>100–250 mg) intrathecal morphine doses. Importantly, none of the studies in this meta-analysis reported respiratory depression in any patient. Although women with obstructive sleep apnea and morbid obesity are potentially at increased risk for respiratory depression, intrathecal and epidural morphine should not be avoided in these patients, because neuraxial opioids provide greater analgesic efficacy at a lesser risk of respiratory depression than intravenous opioids.

**Epidural Morphine**

Although most elective cesarean deliveries in the United States are performed with spinal anesthesia, unplanned cesarean deliveries are often performed on laboring patients with epidurals in situ. For these patients, epidural catheters can be used for administration of epidural morphine for postoperative analgesia. The optimal dose is 2 to 4 mg, with larger doses not definitively providing superior analgesia. Studies that have compared epidural with intrathecal morphine have found similar analgesic efficacy and side effects. However, intrathecal morphine is generally preferred to epidural administration given its lower opioid dose and therefore less potential neonatal drug transfer.

**Intrathecal Hydromorphone**

With recent shortages of preservative-free morphine in the United States, providers have gained more experience with the use of intrathecal hydromorphone. A recent dose-finding study identified the dose ratio of intrathecal morphine to intrathecal hydromorphone to be 2:1. Both medications provided high patient satisfaction rates, and adverse effects of nausea and pruritus did not differ between groups. Given that morphine is more hydrophilic, morphine is anticipated to have a longer duration of analgesia after single-dose administration compared with hydromorphone.

**Continuous and Patient-Controlled Epidural Infusions**

Although continuous and patient-controlled epidural analgesia infusions have been used for postcesarean analgesia, their use decreases maternal mobility, complicates anticoagulation prophylaxis, increases nursing workload, and adds to cost. For most young, healthy women desiring a timely recovery to baseline activity after uncomplicated cesarean delivery, the marginal benefits compared with single-shot intrathecal or epidural opioids given at the time of surgery do not warrant the routine use of continuous epidural infusion after cesarean delivery. However, these epidural catheter-based techniques should be considered in special circumstances (eg, women with chronic pain).

**Nonopioid Neuraxial Adjuncts**

Neuraxial clonidine may improve postcesarean analgesia when used as an adjunct to local anesthetics and opioids, but it is associated with hypotension and sedation. A black box warning noting the risk of hemodynamic instability in obstetric, postpartum, and perioperative patients highlights the need for special consideration before use of this drug. If used, clonidine should be reserved for patients at high risk for uncontrolled postoperative pain, such as those with a history of poorly controlled postoperative pain or chronic pain. Neostigmine has historically not been recommended for neuraxial administration because of the high incidence of nausea. The 2016 American Pain Society guidelines for postoperative pain management recommend against...
the use of neostigmine as a neuraxial adjuvant medication, citing a lack of clear benefit and insufficient evidence of safety.  

ORAL AND INTRAVENOUS ANALGESIC ADJUVANTS

- Acetaminophen
- Nonsteroidal antiinflammatory drugs (NSAIDs)
- Combining acetaminophen and NSAIDs
- Dexamethasone
- Gabapentinoids
- Ketamine
- Opioids

Neuraxial opioids provide the greatest analgesic effect size for post–cesarean delivery pain management, but most women still require additional analgesia. Supplemental nonopioid medications should be used to improve analgesia and decrease the side effects of opioids. Minimizing the use of intravenous and oral opioids with nonopioid medication is particularly critical, because up to 1 in 300 opioid-naive women become persistent users of opioids after cesarean delivery. Through distinct mechanisms at multiple receptor sites, multimodal analgesia has been associated with superior pain relief and decreased opioid use compared with the use of a single analgesic.

Acetaminophen

Acetaminophen is used extensively in the postoperative period and provides an opioid-sparing effect of approximately 20%. Its ability to provide effective analgesia with minimal adverse effects supports the routine use of scheduled acetaminophen for 2 to 3 days after cesarean delivery. In 2009, the US Food and Drug Administration changed the recommended maximum daily dose of acetaminophen from 4000 mg to 3250 mg. Avoiding opioid/acetaminophen combination pills is recommended in order to decrease unnecessary opioid use and avoid exceeding recommended maximum doses of acetaminophen.

Nonsteroidal Antiinflammatory Drugs

NSAIDs are a key component of multimodal postoperative pain management. NSAIDs decrease pain scores, particularly related to visceral cramping pain. They have a 30% to 50% opioid-sparing effect and therefore can reduce the incidence of opioid-related side effects. The use of nonselective NSAIDs has been associated with a statistically significant increase in surgical bleeding, and they should be used cautiously in patients at increased risk for bleeding. Evidence does not show an effect of NSAIDs on cardiovascular events, gastrointestinal bleeding, or renal impairment in patients with normal preoperative renal function, but clinicians should consider these potential NSAID effects in at-risk patients (eg, women with preeclampsia with renal impairment). For healthy patients with good intraoperative hemostasis, NSAIDs should be given routinely in the immediate postpartum period. No studies have evaluated the relative efficacy of one NSAID compared with another, so use can be based on drug availability and breastfeeding safety data.

Selective cyclooxygenase (COX) 2 inhibitors such as celecoxib were designed to decrease the gastrointestinal and hematologic risks associated with non-selective NSAIDs. To date, no trials have compared the outcomes of selective versus nonselective NSAIDs for cesarean delivery analgesia. Studies of COX2
inhibitors for post–cesarean delivery analgesia have shown limited analgesic efficacy, and their use should be reserved for patients who are intolerant of nonselective NSAIDs.

**Combining Acetaminophen and Nonsteroidal Antiinflammatory Drugs**

Acetaminophen and NSAIDs are more effective when used together and should be used in combination for postcesarean analgesia in patients without contraindications. Staggered dosing of around-the-clock acetaminophen and NSAIDs increases the number of patient interruptions and increases nursing workload without proven benefit, so consideration should be given to administering the two drugs simultaneously at set time points (eg, every 6 hours). Given the higher cost and lack of clear evidence for improved analgesia, intravenous administration of NSAIDs and acetaminophen is not recommended compared with oral administration. However, intravenous formulations offer a good alternative for patients not yet tolerating oral intake or experiencing nausea or vomiting.

**Dexamethasone**

Glucocorticoids have analgesic and antiemetic properties in addition to their antiinflammatory effects. The use of a single perioperative dose of dexamethasone has been shown to improve pain relief compared with placebo for patients undergoing surgery under general anesthesia, but is associated with marginally higher blood glucose levels at 24 hours postoperatively and should be avoided in patients with insulin resistance. Wound healing and infection rates have not been found to be increased after single-dose perioperative dexamethasone administration. For patients undergoing cesarean delivery under spinal anesthesia using low-dose intrathecal morphine, a single dose of dexamethasone before surgery significantly decreased the incidence of nausea and vomiting and improved analgesia on the first postoperative day. Doses between 1.25 and 20 mg have been described, and the optimal dose has not been determined.

**Gabapentinoids**

Although more commonly used in the management of chronic pain, gabapentin has an analgesic and opioid-sparing effect in the acute postoperative period. Gabapentin has also been shown to decrease opioid-associated vomiting and pruritus, but the drug has its own side effects, especially sedation (Number needed to harm [NNH] = 8–35) and dizziness (NNH = 12). Initial enthusiasm for a single preoperative dose of gabapentin 600 mg to decrease postcesarean pain and increase maternal satisfaction has been tempered by subsequent studies that did not show a significant analgesic effect. Even a 2-day perioperative course of gabapentin did not improve postcesarean analgesia and was associated with increased sedation. The use of pregabalin for postcesarean analgesia has not been studied, and doses of 75 and 150 mg did not reduce opioid use after abdominal hysterectomy. Pregabalin administration in the perioperative period has been associated with side effects such as visual disturbances and dizziness.

Gabapentin is a neurotropic drug and has a high umbilical vein to maternal vein ratio, which limits preemptive administration in the cesarean delivery setting. Breast milk transfer is also a potential concern. Given the lack of strong evidence for significantly improved acute or chronic postoperative pain relief in the cesarean delivery setting, as well as the potential adverse effects and unclear neonatal safety profile, gabapentinoids are not recommended for routine postcesarean analgesia. In patients with a history of chronic pain or pain not relieved by standard treatment protocols, gabapentin can be considered as part of a multimodal analgesic regimen to improve pain relief and decrease opioid consumption.
**Ketamine**

Low-dose ketamine (10–15 mg) has analgesic and opioid-sparing effects in the first 24 hours after nonobstetric surgery and cesarean delivery with general anesthesia. For patients undergoing cesarean delivery with spinal anesthesia using intrathecal morphine, a single dose of ketamine after delivery did not offer any analgesic benefit. However, ketamine has been associated with improved analgesia in patients undergoing cesarean delivery without intrathecal morphine. Hallucinations or disturbing dreams associated with low-dose ketamine are reported but are infrequent, whereas complaints of dizziness, lightheadedness, or visual effects are common. A single intraoperative dose of ketamine 10 mg has been associated with lower pain scores 2 weeks post-partum, and the drug may have a role in patients at risk for chronic pain after surgery.

**Opioids**

Opioids should be reserved for treatment of breakthrough pain when pain relief from the combination of neuraxial opioids and nonopioid adjuncts outlined earlier is inadequate. Intravenous opioids have not been found to provide superior analgesia compared with oral opioids, are associated with more side effects, and limit mobility after cesarean delivery; therefore, the use of oral opioids is generally preferred. Oxycodone, hydrocodone, and tramadol are oral opioids commonly used in the cesarean delivery setting. Codeine is not recommended because maternal and neonatal pharmacogenomic and metabolic variability can affect both efficacy and side effects. Intravenous opioids should be reserved for patients in extreme pain or intolerant of oral intake. When intravenous opioids are required for a sustained period of time, patient-controlled analgesia (without the use of a basal infusion) is preferable because of greater analgesic efficacy and higher patient satisfaction.

**LOCAL ANESTHETICS**

- Wound infiltration
- Transversus abdominis plane (TAP) and quadratus lumborum blocks
- Other local anesthetic options

**Wound Infiltration**

Wound infiltration of local anesthetics is a commonly used method of supplemental analgesia for abdominal surgery. A meta-analysis comparing wound infiltration with epidural analgesia for abdominal surgery showed comparable pain scores at 24 and 48 hours, but the trials included were heterogeneous. Women who undergo cesarean delivery with general anesthesia may benefit from local anesthetics delivered via wound infiltration or TAP block. However, in patients who receive spinal anesthesia and neuraxial opioids, the benefit of single-dose local anesthetic wound infiltration is minimal. Single-dose local anesthetic wound infiltration at the time of surgery is unlikely to last beyond the duration of the neuraxial block, affects only somatic (not visceral) pain, and has variable efficacy.

Catheter-based local anesthetic instillation has been suggested as an alternative to single-dose infiltration. Continuous wound instillation of local anesthetic reduces pain scores, opioid use, and opioid-related nausea and vomiting for up to 48 hours postoperatively. However, the analgesia from local anesthetic techniques in isolation is less effective than neuraxial opioids or NSAIDs. If used, wound instillation should be considered part of a multimodal treatment plan, and the catheter should be placed subfascially rather than subcutaneously or suprafascially for optimal efficacy.
Several medications have been studied as possible adjuvants to wound instillation of local anesthetics. Dexamethasone 16 mg added to local anesthetic instilled subcutaneously into the wound prolongs analgesia compared with local anesthetic alone.61 Diclofenac (300 mg over 48 hours) instilled into cesarean delivery incisions provided more pain relief than the same dose given intravenously.55 Instillation of magnesium sulfate (750 mg as an adjunct to ropivacaine) prolonged analgesia compared with local anesthetic alone and was not associated with any significant side effects.62 The addition of ketorolac (30 mg over 48 hours), but not hydromorphone, to local anesthetic wound instillation has been associated with lower levels of inflammatory mediators as well as less pain and analgesic use after cesarean delivery.63 Studies comparing the safety of wound instillation versus systemic administration of drugs such as NSAIDs or glucocorticoids should be performed before wound instillation of these adjuvant medications can be recommended as standard practice.

Transversus Abdominis Plane and Quadratus Lumborum Blocks

There is no significant analgesic and opioid-sparing benefit of routine TAP block after cesarean delivery in patients who receive intrathecal morphine.64,65 In patients who undergo general anesthesia or spinal anesthesia without intrathecal or epidural morphine, TAP blocks can significantly improve postoperative pain and reduce opioid consumption.56,64–66 TAP blocks have been found to provide similar analgesia after cesarean delivery compared with continuous wound site local anesthetic instillation.67–69 The duration of sensory blockade for single-shot TAP block is limited to 6 to 12 hours, with a mean analgesic effect of 9.5 hours (8.5–11.9 hours).70 TAP blocks have been used effectively for rescue analgesia in the postanesthesia care unit for patients with severe postoperative incisional pain who are not responding to routine analgesics and rescue opioids.71 Before using TAP blocks for rescue analgesia, clinicians should evaluate the nature and location of pain because, as with wound infiltration of local anesthetic, TAP blocks are effective primarily for somatic incisional pain rather than visceral or cramping pain. Studies comparing TAP blocks with intrathecal morphine have found that TAP blocks provide inferior analgesia, but they have a lower incidence of opioid-related side effects, such as nausea.64,65

Although the addition of sufentanil to TAP block has been shown to decrease opioid requirements after cesarean delivery,72 fentanyl added to TAP block did not provide additional analgesia compared with systemic administration of the same dose. These conflicting results suggest that systemic absorption may account for the improved analgesia when opioids are added to local anesthetics for TAP block.73 The addition of clonidine to the local anesthetic in TAP blocks did not improve short-term or long-term cesarean delivery analgesia.74 On balance, current evidence does not support the use of adjuvants for TAP blocks until safety and efficacy are proved. Larger volumes are associated with greater spread and improve the analgesic effect of TAP blocks.75 There is concern for local anesthetic toxicity with TAP block,76 with several cases reported in the setting of cesarean delivery.67,77 Local anesthetic concentration should be adjusted as necessary to avoid exceeding maximum recommended doses (eg, ropivacaine 0.25% 20–25 mL per side). A recent study evaluating quadratus lumborum block after cesarean delivery with spinal anesthesia (without intrathecal morphine but with a multimodal regimen including acetaminophen and NSAIDs) found reduced opioid requirements and pain scores.78

Other Local Anesthetic Options

Liposomal bupivacaine for wound infiltration or TAP blocks has not been evaluated in the cesarean delivery setting. However, subfascial wound infiltration of liposomal
bupivacaine after open total abdominal hysterectomy provided superior pain relief at rest and with coughing at 6 hours compared with TAP blocks. The analgesic efficacy and safety of liposomal versus standard bupivacaine for post-cesarean delivery pain must be determined before routine administration can be recommended. Bupivacaine-soaked absorbable gel sponges have been reported to decrease pain scores, analgesic consumption, and side effects after cesarean delivery compared with controls.

NONPHARMACOLOGIC TECHNIQUES

Cognitive and behavioral treatment modalities including guided imagery, hypnosis, and music have limited analgesic effects, but they are noninvasive and lack side effects and therefore can be considered as part of a multimodal analgesic regimen that may reduce anxiety and potentially improve pain. Transcutaneous electrical nerve stimulation (TENS) is thought to modulate pain by activating descending inhibitory pathways. TENS has been shown to be more effective than placebo stimulation in reducing incisional pain associated with movement, although evidence is insufficient to recommend specific TENS regimens for cesarean pain management. Physicians occasionally recommend the use of abdominal binders after cesarean delivery based on anecdotal reports of improved pain, but a recent randomized controlled trial comparing the use of abdominal binders with controls after cesarean delivery showed no difference in pain scores or postoperative distress.

SUGGESTED ANALGESIC PROTOCOL

Table 2 shows a suggested analgesic protocol for routine cesarean delivery performed with neuraxial anesthesia. Analgesic protocols should include a standard protocol for most patients, with modifications for patients who require general anesthesia, experience severe pain not responding to standard management, or have a preexisting diagnosis of chronic pain. Patient-centered analgesic protocols with various options may provide superior maternal analgesia and satisfaction compared with a one-size-fits-all approach.

BREASTFEEDING CONSIDERATIONS

More than 70% of women in the United States attempt breastfeeding, and the rate continues to increase. Good analgesia promotes successful breastfeeding and maternal-neonatal bonding, but analgesics have the potential to transfer to the breast-feeding infant. Neonatal drug exposure is typically expressed as relative infant dose (RID). The RID takes into account maternal and neonatal weights, and an RID greater than 10% is generally considered a level of concern. Table 3 shows the RID of analgesics that are commonly used for cesarean delivery pain management.

An in-depth discussion of the physiology and pharmacokinetics of drug transfer through breastfeeding is outlined in several reviews. Clinicians should have a basic understanding of breastfeeding physiology when managing post-cesarean delivery analgesia. Postoperative analgesics for women who are breastfeeding should be prescribed with several general principals taken into account:

- Opioid-sparing multimodal analgesia is preferable, because opioids are associated with breast milk transfer and may cause neonatal sedation.
- The amount of drug in breast milk parallels maternal blood levels. Clinicians should use the lowest effective dose and administer opioids intrathecially or epidurally rather than intravenously when possible.
- Drugs with a short half-life, inactive metabolites, and long record of safe use are the best choice in this setting.
Lipophilic drugs are most likely to cross into the breast milk, whereas highly protein-bound drugs (eg, NSAIDs, local anesthetics) have limited drug transfer. Drugs with low oral bioavailability have limited transfer to breastfeeding infants. Timing breastfeeding to coincide with maternal blood drug trough levels is optimal if it can be achieved without compromising maternal analgesic needs. So-called “pump and dump” is not necessary for routine post–cesarean delivery patients. The amount of colostrum in the first few days after delivery is small, so the amount of drug transfer is small compared with several days after birth. Women should be informed about potential transfer of pain medications on breastfeeding newborns.

### Table 2
Suggested analgesic protocol for post–cesarean delivery in-hospital pain management

<table>
<thead>
<tr>
<th>Setting</th>
<th>Drug</th>
<th>Dose and Route</th>
<th>Prescribing Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard care (prescribed at time of surgery)</td>
<td>Neuraxial morphine</td>
<td>Preferred: intrathecal morphine 100–150 µg or epidural morphine 2–3 mg after delivery</td>
<td>With intrathecal hyperbaric bupivacaine 12 mg and fentanyl 15 µg With epidural 2% lidocaine 15–25 mL (± bicarbonate and epinephrine) ± fentanyl 50–100 µg</td>
</tr>
<tr>
<td>NSAIDs</td>
<td>Ibuprofen 600 mg PO (or ketorolac 15 mg IV if NPO)</td>
<td>Every 6 h (scheduled) for 48–72 h after cesarean delivery</td>
<td></td>
</tr>
<tr>
<td>Acetaminophen</td>
<td>Acetaminophen 650 mg PO (or IV if NPO)</td>
<td>Every 6 h (scheduled) for 48–72 h after cesarean delivery</td>
<td></td>
</tr>
<tr>
<td>Oral opioids</td>
<td>Oxycodone 5–10 mg PO</td>
<td>As needed for breakthrough pain: VNPS &lt; 4/10: 5 mg VNPS &gt; 4/10: 10 mg</td>
<td></td>
</tr>
<tr>
<td>Ongoing or severe postoperative pain</td>
<td>IV opioids</td>
<td>IV morphine, fentanyl, or hydromorphone</td>
<td>Intermittent IV boluses or IV patient-controlled analgesia</td>
</tr>
<tr>
<td>Regional anesthesia</td>
<td>Bilateral TAP block</td>
<td>0.25% ropivacaine 20–25 mL per side</td>
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</tr>
<tr>
<td>Oral adjuvants</td>
<td>Gabapentin</td>
<td>600 mg PO rescue dose (300 mg PO every 8 h for ongoing severe pain)</td>
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<tr>
<td></td>
<td>Dexamethasone</td>
<td>4–8 mg PO</td>
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</table>

Based on the analgesic protocol used at Lucile Packard Children’s Hospital, Stanford University, California.

**Abbreviations:** NPO, nil per os, not tolerating oral medication, or vomiting; PO, per os administration; VNPS, verbal numerical pain score (0–10).

* For women identified to be at risk for severe postoperative pain (eg, chronic pain, opioid tolerant) consider the following analgesic options: (1) postoperative patient-controlled epidural analgesia with local anesthetic and opioid (preferred) or higher initial dose of intrathecal morphine (200–300 µg). (2) Local anesthetic wound instillation (0.5% ropivacaine 5 mL/h subfascially for 48–72 h after cesarean). (3) Additional adjuvants: subanesthetic ketamine 10 to 15 mg IV and/or dexamethasone 4 to 8 mg IV after delivery of the baby.

* Approximately 5% to 10% of patients managed by standard care analgesics listed above may require additional analgesic interventions for breakthrough pain.
Cesarean delivery rates are increasing worldwide, and effective pain relief is a key priority of women undergoing cesarean delivery. Pain management in women after cesarean delivery is unique among surgeries in that initial anesthesia is almost exclusively neuraxial, preemptive analgesic use is limited by fetal drug transfer, and postoperative analgesics given to the mother have the potential for transfer to the breastfeeding neonate. In addition to pain relief, optimal management of patients after cesarean delivery should address the goals of maximizing maternal mobility and rapid recovery to baseline functionality. Multimodal analgesia should include neuraxial morphine in conjunction with nonopioid adjuncts such as scheduled NSAIDs and acetaminophen, with additional opioids reserved for severe breakthrough pain.

### REFERENCES


### Table 3

Relative infant doses of analgesics commonly used after cesarean delivery

<table>
<thead>
<tr>
<th>Medication</th>
<th>RID (%)</th>
</tr>
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<tbody>
<tr>
<td>Acetaminophen</td>
<td>1.3–6.4</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>0.1–0.7</td>
</tr>
<tr>
<td>Ketorolac</td>
<td>0.2–0.4</td>
</tr>
<tr>
<td>Celecoxib</td>
<td>0.3</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>No data</td>
</tr>
<tr>
<td>Gabapentin</td>
<td>1.3–6.5</td>
</tr>
<tr>
<td>Pregabalin</td>
<td>No data</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>1.6–3.7</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>1.5–8</td>
</tr>
<tr>
<td>Tramadol</td>
<td>2.4–2.9</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>0.9–3</td>
</tr>
<tr>
<td>Morphine</td>
<td>5.8–10.7</td>
</tr>
</tbody>
</table>

The RID is expressed as a percentage and is weight adjusted for the infant, normalizing that amount of drug to which the neonate is exposed relative to the mother’s dose.

### SUMMARY

Cesarean delivery rates are increasing worldwide, and effective pain relief is a key priority of women undergoing cesarean delivery. Pain management in women after cesarean delivery is unique among surgeries in that initial anesthesia is almost exclusively neuraxial, preemptive analgesic use is limited by fetal drug transfer, and postoperative analgesics given to the mother have the potential for transfer to the breastfeeding neonate. In addition to pain relief, optimal management of patients after cesarean delivery should address the goals of maximizing maternal mobility and rapid recovery to baseline functionality. Multimodal analgesia should include neuraxial morphine in conjunction with nonopioid adjuncts such as scheduled NSAIDs and acetaminophen, with additional opioids reserved for severe breakthrough pain.


