



Advances in Postoperative Analgesia for Cesarean Section: A Critical Review of PCA, TAP Block, and NSAIDs

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Abstract

Background: Cesarean delivery is one of the most commonly performed obstetric surgeries worldwide, and optimal postoperative analgesia is essential for early maternal recovery, breastfeeding success, mother–infant bonding, and reduced perioperative morbidity. Traditional opioid-based strategies, including patient-controlled analgesia (PCA), remain effective but are associated with well-recognized adverse effects such as nausea, pruritus, sedation, and delayed mobilization. To reduce opioid exposure and enhance recovery, multimodal analgesia has become a central component of enhanced recovery after cesarean (ERAC) pathways. Among regional techniques, the transversus abdominis plane (TAP) block has gained prominence for providing targeted somatic analgesia while minimizing systemic side effects. Concurrently, nonsteroidal anti-inflammatory drugs (NSAIDs) function as foundational agents in multimodal regimens due to their ability to reduce inflammatory pain and decrease opioid consumption.

Aim: This review aims to critically evaluate and compare the effectiveness, safety, advantages, and limitations of three key analgesic modalities used after cesarean section: patient-controlled analgesia, transversus abdominis plane block, and nonsteroidal anti-inflammatory drugs. The review synthesizes contemporary evidence regarding pain scores, opioid-sparing effects, maternal satisfaction, breastfeeding outcomes, recovery metrics, and adverse event profiles. It also identifies areas where current data are inadequate and highlights future research needs in optimizing multimodal analgesia protocols for diverse patient populations.

Methods: A narrative review of randomized controlled trials, meta-analyses, ERAC guidelines, and high-quality observational studies was conducted with a focus on literature published within the last two decades. Studies evaluating postoperative pain outcomes and maternal recovery metrics following PCA, TAP block, and NSAID use after cesarean delivery were included.

Key Findings: Evidence demonstrates that multimodal strategies incorporating NSAIDs significantly reduce opioid requirements and improve maternal comfort. TAP block provides effective early postoperative somatic pain control, particularly when neuraxial morphine is absent or contraindicated. PCA remains valuable for individualized analgesia but carries a higher burden of opioid-related side effects. Comparative studies show that combining regional blocks with scheduled NSAIDs yields superior pain relief and promotes faster mobilization.

Conclusion:

Optimizing post-cesarean analgesia requires individualized, multimodal strategies. TAP block and NSAIDs offer substantial opioid-sparing benefits, while PCA remains useful in selected cases. Future research should refine patient selection, assess long-term outcomes, and integrate analgesic strategies into standardized ERAC pathways.

Keywords: Postoperative Analgesia, Cesarean Section, PCA, TAP Block, and NSAIDs



Introduction

The rising global rates of cesarean delivery present both opportunity and challenge for maternal care. The procedure itself—undergoing abdominal incision, uterine manipulation, and surgical closure—predisposes patients to significant postoperative pain, which impedes early mobilisation, complicates maternal–infant bonding, interferes with breastfeeding, and may increase the risk of chronic postoperative pain syndromes. [1]

Despite this, pain after cesarean section remains widely under-recognized and under-treated. For instance, a large tertiary hospital study found that a considerable proportion of women reported moderate to severe pain, and analgesic regimens varied substantially, with many receiving no analgesia or only single-agent therapy. [2]

In recent years, three analgesic modalities have emerged as central to multimodal postoperative analgesia after cesarean delivery: patient-controlled analgesia (PCA), the transversus abdominis plane (TAP) block, and non-steroidal anti-inflammatory drugs (NSAIDs). PCA offers individualised control of systemic analgesia (often opioid-based) but carries well-known risks of opioid-related side-effects. The TAP block provides a regional analgesic technique targeting somatic afferent nerves of the anterior abdominal wall, thereby reducing systemic medication needs. NSAIDs, used in scheduled or as-needed fashion, address the inflammatory component of postoperative pain and contribute to opioid-sparing regimens. [3]

Aim. This review article aims to critically evaluate and synthesise contemporary evidence related to these three modalities — PCA, TAP block and NSAIDs — specifically in the context of post-cesarean analgesia. We examine their comparative effectiveness, safety profiles, influence on recovery, maternal satisfaction, breastfeeding outcomes and implications for adoption in enhanced recovery after cesarean (ERAC) pathways.

Research Gap. While many studies address individual analgesic techniques, there remains incomplete understanding of how these modalities compare head-to-head in the post-cesarean population, how they perform in combination, and how patient-specific factors (such as pain sensitivity, obesity, co-morbidities) influence analgesic response. Additionally, despite growing evidence, standardised protocols integrating these modalities into ERAC remains inconsistent across obstetric institutions. The heterogeneity of patient populations, analgesic regimens, and outcome measures complicates translation of findings into practice. [4]

Thus, this review will bridge the gap by providing a structured, comparative overview of PCA, TAP block and NSAIDs in cesarean analgesia — highlighting strengths, limitations and research needs — from the obstetrics and gynecology vantage point, with the ultimate goal of informing optimal analgesic pathway design for maternal care.

1. Overview of PCA in the Post-Cesarean Setting

Patient-Controlled Analgesia (PCA) allows the mother to self-administer bolus doses of analgesic (typically opioid) via an infusion pump under preset safety parameters. This modality gives patients more agency over pain relief, theoretically enabling lower overall opioid usage by tailoring the demand to individual pain levels. Its adoption in post-surgical obstetric care has focused on the key goals of effective comfort, early mobilization and minimal opioid-related side-effects. In the cesarean section context, where pain includes both somatic incision pain and visceral uterine manipulation discomfort, PCA offers a flexible systemic analgesic approach. [1]

2. Efficacy and Limitations

Clinical trials and meta-analyses in broader perioperative settings show that PCA often reduces pain scores compared to scheduled intramuscular or continuous infusion opioids and improves patient



satisfaction. [2] However, in obstetric populations specific to cesarean delivery, high-quality data remain limited. One older study comparing PCA morphine vs PCA fentanyl after cesarean found that both gave effective pain relief, but the morphine group required fewer adjustments and fewer supplementary boluses. [3] Meanwhile, a recent guideline review by NICE questioned routine use of intravenous opioid PCA after cesarean births because of safety concerns and changes in practice (e.g., increased neuraxial opioids, enhanced recovery protocols). [4] Thus, while PCA remains useful, its limitations in this population (opioid side-effects, maternal sedation, breastfeeding concerns) must be acknowledged.

3. Comparative Role in Cesarean Analgesia

Within multimodal analgesia strategies for cesarean delivery, PCA remains a useful “rescue” or second-line modality when regional blocks or non-opioid adjuncts are contraindicated or insufficient. For example, combined use of patient-controlled epidural analgesia (PCEA) plus intrathecal morphine improved post-cesarean analgesia compared to intrathecal morphine alone. [5] However, in many institutions pursuing enhanced recovery after cesarean (ERAC) pathways, reliance on PCA alone is decreasing, in favour of regional and non-opioid adjuncts.

4. Safety Considerations and Maternal-Infant Implications

The use of PCA in postpartum women demands heightened attention to maternal respiratory depression (especially with concomitant neuraxial opioids), monitoring of sedation, and potential transfer of opioids/metabolites to breast milk. For example, a study found that PCA meperidine was associated with significant neonatal neurobehavioral depression compared to maternal PCA morphine after cesarean section. [6] Institutional protocols must include clear patient education, nursing oversight, and monitoring of both mother and neonate for sedation or respiratory compromise. In addition, mobility and maternal–infant interaction may be impeded by excessive opioid sedation – a significant concern in the postpartum context.

5. Gaps and Research Needs

Despite its established role, PCA in the cesarean context lacks large dedicated randomized controlled trials (RCTs) comparing PCA head-to-head with regional techniques (e.g., TAP block) or scheduled NSAIDs within enhanced recovery pathways. There is limited data on optimal bolus dosing, lock-out intervals, background infusion usage in obstetric populations, and how maternal factors (such as obesity, chronic pain, opioid tolerance) modify outcomes. Further research should include patient-reported outcomes (maternal satisfaction, ability to ambulate, breast-feeding initiation), cost-effectiveness and long-term outcomes such as persistent post-cesarean pain. [7]

Transversus Abdominis Plane (TAP) Block

1. Background and Mechanism of Action

The Transversus Abdominis Plane (TAP) block is a regional anesthetic technique that provides somatic analgesia to the anterior abdominal wall by targeting the thoracolumbar nerves (T6–L1) located between the internal oblique and transversus abdominis muscles. Its introduction into obstetric anesthesia gained momentum after McDonnell et al. demonstrated significant postoperative analgesic benefit in patients undergoing lower abdominal surgery. The technique is particularly advantageous in cesarean delivery because it directly addresses the somatic incisional component of postoperative pain, which systemic opioids may inadequately treat. Ultrasound guidance, popularized by Hebbard and colleagues, has improved precision, reduced complications, and increased block success rates in postpartum patients. [8]

2. Effectiveness in Cesarean Delivery Without Neuraxial Morphine

The analgesic benefit of TAP block is most pronounced when neuraxial morphine is not administered. A pivotal randomized controlled trial by McDonnell et al. demonstrated that bilateral TAP block significantly reduced postoperative morphine consumption and improved early pain scores after cesarean section performed under general anesthesia. Subsequent meta-analyses, including the work of Abdallah et al., confirmed that TAP block provides clinically meaningful opioid-sparing effects and enhances maternal comfort when intrathecal morphine is absent or contraindicated, such as in patients



with opioid intolerance, severe pruritus history, or those undergoing cesarean under general anesthesia. [9]

3. Limited Role When Neuraxial Morphine Is Used

In contrast, when intrathecal morphine is administered—currently considered the gold standard in post-cesarean analgesia—the incremental benefit of TAP block diminishes markedly. Multiple randomized studies have shown that TAP block fails to improve pain scores or reduce opioid consumption in women who already received neuraxial morphine. The systematic review by Champaneria et al. in *BJOG* reaffirmed these findings, concluding that TAP block offers minimal additional analgesic value in this setting. As a result, many enhanced recovery after cesarean (ERAC) protocols reserve TAP block for patients who cannot receive neuraxial opioids. [10]

4. Safety Profile and Technical Considerations

TAP block is considered a safe and well-tolerated procedure when performed under ultrasound guidance. Complication rates are low, but rare events—such as liver trauma, peritoneal puncture, or local anesthetic systemic toxicity (LAST)—have been reported in the literature. The risk increases with landmark-based (blind) techniques, reinforcing the necessity of ultrasound visualization. Studies by Tran and colleagues have highlighted that block success and spread of local anesthetic correlate strongly with accurate deposition in the neurofascial plane. The choice of local anesthetic (bupivacaine, ropivacaine, or levobupivacaine), volume, and concentration all influence clinical duration, which typically ranges from 8 to 12 hours. [11]

5. Newer Approaches and Research Gaps

Emerging variants of the TAP block—such as the quadratus lumborum (QL) block and subcostal TAP block—may achieve wider dermatomal spread and longer analgesic duration, though evidence in cesarean delivery remains limited. Continuous TAP catheter techniques have also been explored but require more complex postoperative management. Current research gaps include optimal dosing regimens in obstetric patients, safety profiles in obese individuals, effectiveness in repeat cesarean deliveries with dense scar tissue, and the role of TAP block within multimodal ERAC pathways. More robust trials focusing on patient-reported outcomes, breastfeeding initiation, mobilization, and long-term pain trajectories are needed to better define the TAP block's role in modern obstetric analgesia. [12]

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

1. Background and Rationale for NSAID Use After Cesarean Delivery

Non-steroidal anti-inflammatory drugs (NSAIDs) are foundational components of multimodal analgesia after cesarean delivery due to their analgesic, antipyretic, and anti-inflammatory properties. They target the prostaglandin-mediated inflammatory cascade that contributes substantially to post-surgical uterine and incisional pain. In cesarean patients, NSAIDs reduce both resting and movement-related pain, facilitating early mobilization and enhancing maternal comfort during breastfeeding and infant care. Their opioid-sparing effects are well established, making them particularly beneficial in ERAC (Enhanced Recovery After Cesarean) pathways aimed at minimizing opioid exposure. [13]

2. Evidence Supporting NSAID Efficacy in Post-Cesarean Pain Control

Multiple randomized trials and systematic reviews have demonstrated NSAIDs' superior analgesic effectiveness compared with placebo and opioid-only regimens. One of the earliest high-quality trials, conducted by Dahl et al., showed that ketorolac significantly reduced post-cesarean opioid requirements and improved pain scores. Subsequent meta-analyses reinforced these findings, with Hofmeyr et al. demonstrating that NSAIDs provide significant improvements in pain control and maternal satisfaction when used as part of multimodal strategies. Scheduled rather than “as-needed” NSAID dosing produces more consistent analgesia and greater opioid-sparing effects in the postoperative period. [14]

3. NSAIDs and Opioid-Sparing Benefits

The opioid-sparing benefits of NSAIDs have major clinical implications in obstetric patients, where opioid-induced nausea, vomiting, pruritus, and sedation can interfere with breastfeeding, bonding, early



ambulation, and maternal-infant interaction. A landmark randomized trial by Olofsson et al. demonstrated that diclofenac combined with paracetamol reduced morphine consumption by nearly 50% after cesarean section. Reduced opioid use also decreases the risk of maternal respiratory depression, improves alertness, and enhances maternal participation in newborn care. These opioid-sparing effects contribute significantly to the success of ERAC protocols. [15]

4. Safety Considerations and Potential Contraindications

Although NSAIDs are generally safe in postpartum women, their use requires careful consideration of renal function, bleeding risk, and gastrointestinal tolerance. A common concern is postpartum hemorrhage, but multiple studies—including large population-based analyses—have found no clinically significant increase in bleeding with standard NSAID dosing after cesarean delivery. Nonetheless, women with renal impairment, severe preeclampsia, or postpartum hemorrhage may require alternative analgesic strategies. NSAIDs should also be used cautiously in patients with asthma, gastric ulcers, or known NSAID hypersensitivity. Overall, their safety profile in obstetric patients is favorable when used judiciously. [16]

5. NSAIDs and Breastfeeding Safety

NSAID transfer into breast milk is minimal for ibuprofen, ketorolac, diclofenac, and naproxen, making them compatible with breastfeeding. According to the American Academy of Pediatrics and LactMed, ibuprofen is considered the preferred NSAID for breastfeeding mothers due to its very low milk-to-plasma ratio and short half-life. Ketorolac also appears safe when used in short courses, though some guidelines recommend caution with prolonged high-dose administration. Effective pain control itself improves breastfeeding initiation and continuation, and NSAIDs contribute significantly to this benefit by minimizing sedation and enhancing maternal mobility. [17]

6. Gaps in Research and Future Directions

Despite robust evidence supporting NSAID use after cesarean delivery, several gaps persist. Few studies compare different NSAID classes head-to-head in this population, and optimal dosing regimens specifically tailored to ERAC pathways remain unclear. Limited data exist on NSAID effectiveness in high-risk obstetric groups—including obese patients, women with hypertensive disorders of pregnancy, and those undergoing repeat cesarean deliveries. Furthermore, their role in chronic post-cesarean pain prevention has not been adequately studied. Research exploring scheduled multimodal NSAID combinations, intravenous formulations, and individualized analgesic dosing would advance optimization of post-cesarean pain protocols. [18]

Comparative Analysis of PCA, TAP Block, and NSAIDs

A core principle of modern post-cesarean analgesia is multimodal therapy, in which PCA, TAP block, and NSAIDs are viewed not as competitors but as complementary tools that target distinct pain pathways. PCA provides systemic analgesia, mainly through μ -opioid receptor activation; TAP block offers regional somatic blockade of the anterior abdominal wall; and NSAIDs modulate prostaglandin-mediated inflammatory pain. When combined thoughtfully, these modalities can reduce opioid consumption, improve pain scores, and enhance maternal functional recovery compared with any single technique alone. This concept underpins many enhanced recovery after cesarean (ERAC) protocols and has been echoed in consensus statements from anesthetic and obstetric societies. [19]

Direct head-to-head comparative data between PCA and TAP block are relatively limited, but available evidence suggests a context-dependent hierarchy. When neuraxial morphine is not used, bilateral TAP block plus scheduled NSAIDs often yields similar or superior pain relief with less systemic opioid exposure compared with PCA-based regimens. McDonnell and Abdallah both demonstrated significant opioid-sparing effects and improved early pain scores with TAP block, whereas traditional PCA approaches typically rely on higher opioid doses to reach similar levels of comfort. In contrast, when intrathecal morphine is administered, studies and meta-analyses show that TAP block contributes little additional benefit, and PCA becomes mainly a rescue measure rather than a primary modality. [9,10,12,20]



NSAIDs occupy a unique position because they are effective across virtually all analgesic strategies and can be safely combined with either PCA or TAP block. Randomized trials have shown that adding NSAIDs reduces opioid requirements by 30–50% after cesarean section, regardless of whether patients receive neuraxial morphine, PCA, or regional blocks. For example, Olofsson's work combining paracetamol and NSAIDs with opioids demonstrated marked reductions in morphine consumption and improved maternal satisfaction. Consequently, guidelines from ERAC and obstetric anesthesia groups consistently recommend scheduled NSAIDs (plus paracetamol) as a baseline for all cesarean patients, with PCA or TAP block layered on top according to individual needs and contraindications. [13–15,18,21]

From a safety and side-effect perspective, the three modalities differ substantially, influencing their relative roles in clinical pathways. PCA is associated with higher rates of opioid-related side-effects such as nausea, vomiting, pruritus, sedation, and, rarely, respiratory depression; these adverse effects may delay ambulation, impair breastfeeding, and necessitate antiemetic or antipruritic therapy. TAP block, by contrast, provides localized analgesia with minimal systemic exposure, and serious complications are rare when ultrasound guidance is used, though it is limited by finite duration and procedural requirements. NSAIDs have a favourable safety profile in most postpartum women but require caution in those with renal dysfunction, severe preeclampsia, hemorrhage risk, or gastrointestinal disease. Thus, risk–benefit assessment frequently favours NSAIDs and regional blocks as first-line components and reserves PCA-opioids for breakthrough pain or selected high-pain patients. [11,13,16,19,22]

When maternal recovery and functional outcomes are considered (early mobilization, breastfeeding, and mother–infant interaction), regimens emphasizing NSAIDs and regional techniques tend to be superior to opioid-heavy PCA strategies. Reduced sedation and nausea translate into greater willingness to ambulate, earlier participation in newborn care, and improved breastfeeding initiation and continuation. Observational data from ERAC implementations indicate that protocols based on neuraxial morphine (or TAP block when neuraxial is unavailable), plus scheduled NSAIDs and paracetamol, with limited rescue opioids, shorten hospital stay and improve patient-reported satisfaction compared with traditional postoperative care dominated by systemic opioids and PCA. Nevertheless, individual variability in pain perception means that some women will still require PCA support despite optimized multimodal therapy, emphasizing the need for flexible, patient-tailored pathways. [19–21,23]

Cost and resource utilization also influence the comparative positioning of these modalities. PCA requires pumps, consumables, and nursing time for education and monitoring; TAP block demands ultrasound equipment and skilled providers but adds little ongoing resource use; NSAIDs are inexpensive and easily administered on standardized schedules. Economic analyses in other surgical fields suggest that reducing opioid-related complications and shortening hospital stay can offset the procedural cost of TAP blocks and structured multimodal regimens. Although dedicated cost-effectiveness studies in cesarean populations are sparse, extrapolation from ERAS and ERAC programs supports the conclusion that combining NSAIDs with regional techniques and selective PCA use is likely to be economically favourable while improving quality of care. [19,22,24]

Side-Effects and Satisfaction Comparison Between PCA, TAP Block, and NSAIDs

Post-cesarean analgesic techniques differ significantly in their side-effect profiles, which directly influence maternal comfort, recovery, and satisfaction. PCA—typically opioid-based—remains associated with higher rates of nausea, vomiting, pruritus, sedation, and decreased alertness compared with regional analgesia or non-opioid strategies. In contrast, TAP block and NSAIDs generally demonstrate more favourable side-effect profiles due to reduced systemic opioid exposure. Multiple comparative trials confirm that opioid-related adverse events are substantially less frequent with TAP block–based or NSAID-based regimens. [25]

Maternal gastro-intestinal symptoms such as nausea and vomiting tend to be more prevalent in PCA opioid regimens, often necessitating rescue antiemetics. Studies comparing TAP block to PCA show



significantly lower nausea scores and reduced emesis episodes in the TAP group. For example, Kanazi et al. demonstrated that TAP block recipients had markedly fewer opioid-related symptoms, leading to improved feeding tolerance and earlier ambulation. NSAIDs, by mitigating inflammatory pain without sedation, also contribute to lower nausea and vomiting incidence, though they may cause mild gastric irritation in sensitive individuals. [26]

Sedation and impaired alertness—critical considerations for early bonding and breastfeeding—are more commonly reported with PCA opioids. Postoperative drowsiness can interfere with newborn handling and maternal–infant interaction during the first hours after birth. TAP block, by comparison, provides localized analgesia with minimal central nervous system impact, promoting a clearer level of consciousness. NSAIDs similarly lack sedative properties, enhancing maternal engagement and supporting early breastfeeding success. Research consistently shows that mothers express higher satisfaction and “feeling in control” when opioid sedation is minimized. [27]

Pruritus and respiratory depression, although relatively uncommon, are well-known opioid-specific adverse effects that can occur with PCA or neuraxial morphine. While intrathecal morphine is more frequently associated with pruritus, PCA contributes to persistent itching and discomfort in some patients, sometimes requiring antihistamine therapy. TAP block nearly eliminates this risk, given the absence of opioids. NSAIDs also avoid these side-effects, making them essential elements in reducing the overall itch burden in postpartum analgesia plans. Reduced pruritus correlates strongly with higher maternal comfort scores in comparative obstetric analgesia studies. [28]

When overall satisfaction is assessed, multimodal analgesia regimens incorporating regional blocks and NSAIDs consistently outperform PCA-dominant approaches. Mothers rate their pain control as “more adequate” and “less burdensome” when opioid consumption is minimized, and when side-effects like sedation, nausea, and constipation are reduced. For example, a prospective evaluation by Wrench et al. showed significantly higher satisfaction ratings among women managed within an ERAC pathway emphasizing NSAIDs and regional analgesia, compared with traditional opioid-heavy postoperative care. [23,29]

Breastfeeding satisfaction and readiness are also influenced by analgesic side-effects. Excessive opioid sedation may delay breastfeeding initiation or reduce feeding quality, whereas TAP block and NSAID-based regimens promote breastfeeding success through alertness, comfort during positioning, and reduced gastrointestinal symptoms. A study by Nissen et al. found that women experiencing fewer opioid-related symptoms reported significantly higher breastfeeding confidence and were more likely to continue breastfeeding at discharge. These findings reinforce the value of opioid-sparing strategies for postpartum well-being. [30]

Finally, patient-reported outcome measures (PROMs) demonstrate higher global satisfaction scores when analgesia techniques prioritize functional recovery and minimal side-effects. Across randomized trials and observational cohorts, regimens combining NSAIDs and regional analgesia correlate with better maternal emotional state, improved mobility, and higher likelihood of recommending the analgesia method to others. In contrast, PCA is often rated lower due to pump complexity, required monitoring, and side-effect burden, despite providing effective analgesia. The consistent preference for opioid-sparing approaches highlights the importance of integrating TAP block and scheduled NSAIDs into routine post-cesarean pain pathways. [31]

Conclusion

Effective postoperative analgesia after cesarean delivery is essential for optimizing maternal recovery, supporting early mobilization, enhancing breastfeeding success, and improving overall postpartum well-being. Patient-controlled analgesia, transversus abdominis plane block, and non-steroidal anti-inflammatory drugs each offer distinct advantages, limitations, and roles within a modern multimodal pain management framework. PCA provides reliable systemic analgesia and individualized dose titration but is limited by its opioid-related side-effects, need for monitoring, and potential to impede maternal–infant interaction. TAP block offers targeted regional analgesia with minimal systemic burden,



demonstrating its greatest benefit when neuraxial opioids are not employed or contraindicated. NSAIDs underpin nearly all contemporary multimodal regimens, offering robust analgesia, significant opioid-sparing effects, and favourable maternal functional outcomes.

Across comparative analyses, opioid-sparing approaches consistently outperform opioid-dominant strategies in safety, satisfaction, and functional recovery. Regimens centred on regional anesthesia and NSAIDs lead to less nausea, sedation, pruritus, and gastrointestinal discomfort, allowing mothers to engage more fully in newborn care and breastfeeding. Multimodal pathways—especially those aligned with Enhanced Recovery After Cesarean (ERAC) principles—demonstrate superior outcomes by integrating the strengths of each modality while minimizing their limitations. Importantly, flexibility remains essential; individual patient characteristics such as prior pain sensitivity, comorbidities, obesity, or contraindications to neuraxial or NSAID therapy necessitate tailored analgesic plans.

Future progress in post-cesarean pain management will require closing evidence gaps in comparative effectiveness, defining optimal dosing strategies, and improving personalization of analgesia through predictive modelling, pharmacogenomics, and expanded evaluation of patient-reported outcomes. As obstetric practice continues to evolve, the integration of balanced multimodal strategies—embracing NSAIDs as foundational, TAP block as context-specific, and PCA as a rescue or individualized option—will remain central to improving maternal comfort, safety, and satisfaction. Ultimately, sustained refinement of these analgesic pathways will advance both clinical outcomes and the childbirth experience for women worldwide.

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