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Review

Optimizing Multimodal Post-Cesarean Analgesia: A Structured Narrative Review of Neuraxial Morphine, Systemic Adjuvants, and Regional Fascial Plane Blocks

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Abstract

Objective: This structured narrative review evaluates contemporary approaches to post-cesarean pain management, analyzing low-dose neuraxial opioids as the reference standard, scheduled nonopioid systemic baselines, and regional fascial plane blocks within the context of Enhanced Recovery After Surgery (ERAS) pathways and society guidelines. **Mechanism:** The analgesic modalities reviewed target distinct post-cesarean pain pathways: scheduled nonopioids provide synergistic central and peripheral baseline relief, neuraxial opioids act directly on spinal dorsal horn mu-receptors to control deep visceral and somatic pain, and fascial plane blocks anesthetize targeted peripheral nerves of the anterior abdominal wall. **Findings in Brief:** Synthesized evidence confirms that scheduled nonopioid baseline regimens reduce postoperative opioid requirements by 30% to 40%. Low-dose intrathecal morphine (ITM) remains the gold standard for post-cesarean analgesia. Advanced fascial plane blocks serve as vital secondary alternatives or adjuncts when neuraxial opioids are omitted or contraindicated. Global guidelines from 2019 to 2026 consistently prioritize low-dose neuraxial morphine as the baseline standard, reserving regional blocks for targeted incisional analgesia. Current literature remains limited by a lack of diverse clinical data from low- and middle-income countries (LMICs) with restricted ultrasound infrastructure. **Conclusions:** Optimal post-cesarean analgesia is best achieved through a scheduled nonopioid foundation combined with low-dose neuraxial morphine. Advanced regional fascial plane blocks provide valuable targeted incisional analgesia and serve as essential secondary options when central neuraxial analgesia cannot be administered.

Keywords: cesarean delivery; regional anesthesia; multimodal analgesia; opioid-sparing; Enhanced Recovery After Surgery

1. Introduction

Cesarean delivery (CD) is the most common major surgical procedure worldwide, with rates increasing in response to clinical needs and maternal preferences [1]. Despite advances in surgical and anesthetic techniques, postoperative pain management remains challenging, with approximately 58% of women experiencing severe pain and up to 25% reporting inadequate pain control despite adherence to clinical guidelines [2,3]. Post-cesarean pain involves complex mechanisms, including somatic pain from the abdominal incision and visceral pain resulting from uterine manipulation and involution [4]. Additionally, obstetric patients are expected to recover rapidly to care for their newborns, underscoring the need for effective and timely postoperative pain management [5].

Suboptimal postoperative analgesia is associated with a cascade of adverse clinical outcomes [6]. Severe acute pain can limit early mobilization, potentially increasing the risk of deep vein thrombosis and pulmonary embolism in the already hypercoagulable postpartum state [7]. Poorly controlled pain is also a well-documented risk factor for postpartum depression, maternal anxiety, and impaired maternal-infant bonding [8]. Furthermore, greater acute pain severity directly correlates with delayed onset of lactation, reduced breastfeeding success, and a significantly higher incidence of persistent, chronic post-cesarean pain [6,7,8].

Historically, post-cesarean analgesia relied heavily on systemic opioids or high-dose neuraxial opioids, such as intrathecal morphine (ITM) or epidural morphine (EM) [1,9]. Although these techniques provide robust, long-lasting pain control, they are associated with a substantial burden of bothersome and potentially dangerous adverse effects, including severe pruritus, postoperative nausea and vomiting (PONV), maternal sedation, and respiratory depression [3,9]. These adverse effects are inconsistent with the core principles of modern perioperative care [10].

Over the past decade, the introduction of Enhanced Recovery After Surgery (ERAS) pathways [10] and the Society for Obstetric Anesthesia and Perinatology (SOAP) Enhanced Recovery After Cesarean (ERAC) protocols has revolutionized obstetric anesthesia [11]. These frameworks advocate for a standardized, multidisciplinary, multimodal approach designed to minimize clinical variance, reduce hospital stay, and, most importantly, reduce maternal opioid exposure [3,12]. Central to this paradigm shift is the integration of advanced regional anesthesia techniques, in-

cluding transversus abdominis plane (TAP) blocks, quadratus lumborum blocks (QLBs), and transversalis fascia plane (TFP) blocks [13].

This review offers an evidence-based synthesis of contemporary post-cesarean pain management, integrating global clinical frameworks to compare systemic, neuraxial, and regional analgesic approaches. This paper outlines the clinical role of regional blocks as essential secondary modalities and targeted adjuncts when central neuraxial opioids are omitted or contraindicated. Ultimately, this review aims to integrate these diverse approaches into a practical, risk-stratified framework for developing personalized, opioid-sparing pathways that mitigate adverse effects and accelerate maternal recovery.

2. Literature Search Strategy and Methodological Framework

2.1 Search Strategy and Databases

This article is designed as a structured narrative review with a systematic search strategy to evaluate the contemporary clinical pathways for post-cesarean multimodal analgesia. A systematic literature search was conducted across PubMed/MEDLINE, EMBASE, the Cochrane Database of Systematic Reviews, and Scopus for articles published between January 1, 2010, and June 30, 2026. The search strategy combined Medical Subject Headings (MeSH) and free-text keywords:

PubMed/MEDLINE: ("Cesarean Section"[Mesh] OR "Cesarean delivery") AND ("multimodal analgesia" OR "intrathecal morphine" OR "transversus abdominis plane block" OR "quadratus lumborum block" OR "enhanced recovery after surgery").

EMBASE / Scopus / Cochrane: ("Cesarean delivery" OR "cesarean section") AND ("multimodal analgesia" OR "intrathecal morphine" OR "fascial plane block" OR "ERAS").

2.2 Inclusion and Exclusion Criteria

Inclusion Criteria: Peer-reviewed, English-language publications focusing on post-cesarean analgesia, including randomized controlled trials (RCTs), network meta-analyses, systematic reviews, and consensus guidelines from major professional societies such as the ERAS Society, the Society for Obstetric Anesthesia and Perinatology (SOAP), the American College of Obstetricians and Gynecologists (ACOG), and the Procedure-Specific Postoperative Pain Management (PROSPECT) Working Group.

Exclusion Criteria: Non-obstetric clinical cohorts, animal studies, case reports and case series, editorial letters, non-English-language publications, and studies lacking quantitative data on primary outcomes, such as opioid consumption, pain scores, or adverse effects.

2.3 Quality Assessment and Synthesis

To enhance transparency while maintaining the scope of a structured narrative review, 1420 citation records were imported into reference management software (EndNote X9 Clarivate Analytics, Philadelphia, PA, USA) for automated duplicate identification. As this was a single-author review, the author independently conducted title and abstract screening, followed by full-text evaluation. Full-text exclusions resulted from non-post-cesarean cohorts (n = 72), duplicate datasets (n = 41), or the absence of quantified analgesic outcomes (n = 30), yielding 41 key publications and guidelines. The methodological structure and narrative quality were evaluated using the Scale for the Assessment of Narrative Review Articles (SANRA) framework.

3. The Pharmacological Foundation: Systemic Multimodal Analgesia

The key to modern post-cesarean recovery is the scheduled use of nonopioid systemic analgesics. Both the SOAP and PROSPECT guidelines emphasize that multimodal analgesia should be started intraoperatively or immediately postoperatively and administered on a scheduled basis rather than reserved for rescue therapy [11,13]. This approach establishes a pharmacological baseline that targets multiple pain pathways synergistically, reducing nociceptive signaling before pain peaks and decreasing postoperative opioid use by 30% to 40% [14]. The flowchart in Fig. 1 outlines a scheduled, nonopioid treatment protocol combining paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs), and dexamethasone to provide a comprehensive systemic baseline for multimodal analgesia.

Paracetamol: Acting primarily through central cyclooxygenase (COX) inhibition and modulation of the endogenous cannabinoid and serotonergic systems, paracetamol provides a reliable analgesic and antipyretic baseline. Modern ERAC protocols recommend a scheduled dose of 1000 mg administered orally or intravenously every 6 hours, with a maximum dose of 4 g per 24 hours [15].

NSAIDs: These agents inhibit COX enzymes, thereby reducing prostaglandins that sensitize peripheral nociceptors. Standard regimens include IV ketorolac (15–30 mg every 6 hours) or oral ibuprofen (600 mg every 6 hours) [16]. When combined, paracetamol and NSAIDs provide a greater opioid-sparing effect than when used alone. Importantly, both medications have minimal transfer into breast milk, supporting their safety during breastfeeding [17].

High-Risk Restrictions: Although routine NSAID administration remains a fundamental practice, severe preeclampsia with renal impairment, defined as a serum creatinine exceeding 1.1 mg/dL or a doubling of the baseline value, constitutes an absolute contraindication due to the potential to worsen acute kidney injury through afferent arteriolar vasoconstriction. Additionally, in patients experiencing severe postpartum hemorrhage, NSAID-induced reversible platelet dysfunction, although clinically insignif-

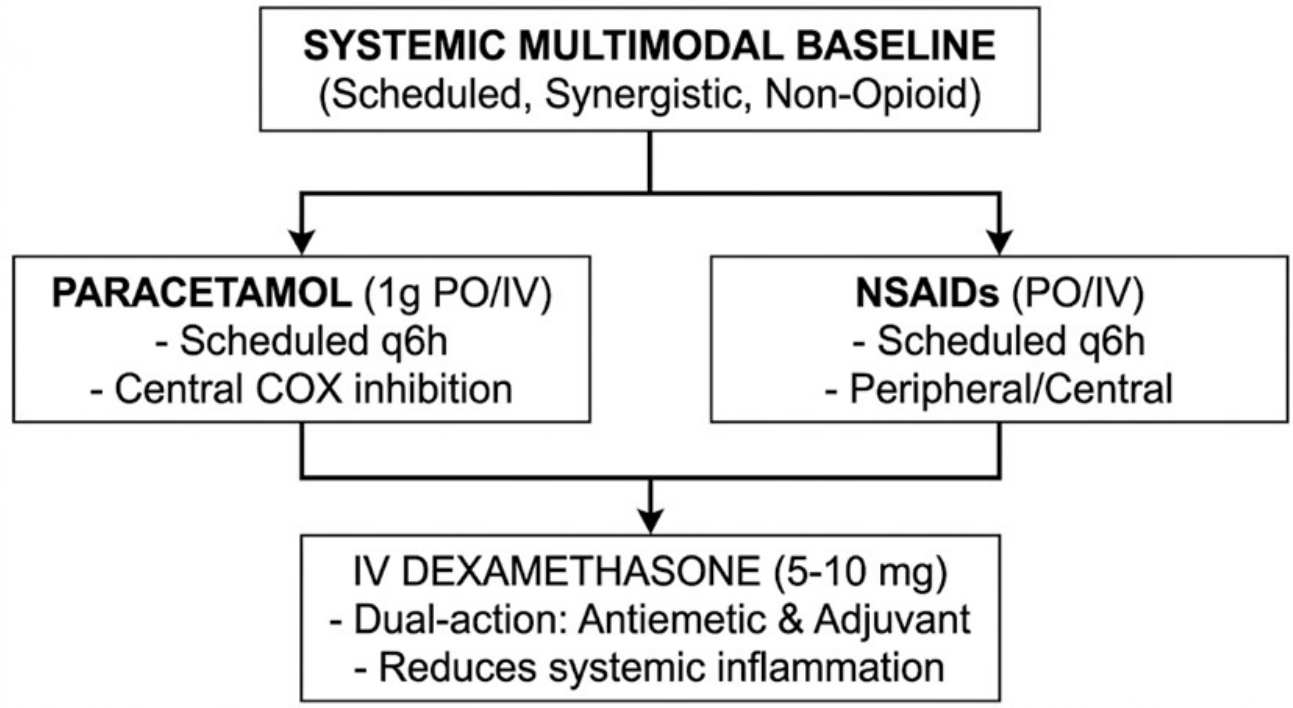

Fig. 1. Flowchart of the baseline multimodal analgesic system. Flowchart depicting the baseline multimodal analgesic system and its operational timeline. Bold, uppercase headers identify core classes like Paracetamol and NSAIDs, scheduled synchronously. The diagram sorts medications by their target sites and timing of administration, starting from the top box representing the main goal: a scheduled, synergistic, nonopioid baseline. Hierarchical lines show parallel, synergistic use of central and peripheral mechanisms, branching into two scheduled regimens (paracetamol for central pain pathways and NSAIDs for peripheral inflammation). These paths combine at the bottom block, introducing IV dexamethasone as an early intraoperative add-on. This structured combination ensures multiple pain pathways are blocked before spinal anesthesia wears off.

icant in healthy parturients, may exacerbate surgical coagulopathy, therefore requiring temporary suspension until complete hemostasis is achieved [18].

Adjuvant Therapy: The Multi-Faceted Role of Intravenous Dexamethasone. IV dexamethasone is a key adjuvant in ERAS pathways and is typically administered intraoperatively (5–10 mg after umbilical cord clamping). It serves two main roles: preventing PONV, which is especially relevant when neuraxial opioids are used, and enhancing pain control by suppressing inflammatory mediators such as interleukin-1 beta (IL-1β), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α). As an intraoperative adjuvant, IV dexamethasone may enhance analgesia. While direct obstetric data continue to evolve, indirect evidence extrapolated from non-obstetric cohorts, such as patients undergoing thoracoscopic surgery [19], suggests that it may prolong regional-block efficacy and reduce 24-hour opioid consumption.

Metabolic and Uterine Dynamics: Despite its strong antiemetic and anti-inflammatory effects, the timing and dose of IV dexamethasone should be carefully controlled. Glucocorticoids can temporarily increase systemic blood glucose levels; therefore, cautious use and active blood sugar monitoring are warranted in patients with poorly controlled gestational or pregestational diabetes. Although evidence from general diabetic surgical populations indicates that a single intraoperative dose is generally well tolerated, this evidence is indirect, and clinicians should exercise caution and apply appropriate glycemic monitoring when extrapolating these findings to parturients [20].

Routine administration of gabapentinoids, such as gabapentin or pregabalin, is not recommended in post-cesarean enhanced recovery pathways because obstetric-specific evidence demonstrates inconsistent or clinically limited analgesic benefits and raises concerns regarding maternal adverse effects, particularly sedation and dizziness, which may interfere with early neonatal bonding and maternal functional recovery [11,13]. Because these agents may be transferred into breast milk in small amounts, potential low-level infant exposure should also be considered [21].

IV ketamine offers minimal analgesic benefit when added to multimodal regimens that include neuraxial morphine and carries a risk of psychomimetic adverse effects like hallucinations, dysphoria, and vivid dreams, which may be distressing to the patient [22]. Systemic lidocaine infusions do not outperform standard regional blocks in post-cesarean recovery and pose risks of systemic toxic-

ity, especially when combined with nerve blocks. Overall, these agents are generally avoided in the postpartum period due to their unfavorable risk-benefit profiles [23].

4. Neuraxial Opioids: Refining the Gold Standard

Neuraxial opioid administration remains the standard for post-cesarean pain relief. Administration of opioids into the intrathecal or epidural space during spinal or combined anesthesia provides targeted, effective analgesia for visceral and somatic pain [24].

Mechanisms of Action: Morphine's hydrophilic nature results in a slow onset of action but prolonged effect in the central nervous system. When administered intrathecally, ITM reaches the subarachnoid space and binds directly to μ-opioid receptors in the substantia gelatinosa of the spinal dorsal horn. It inhibits presynaptic release of nociceptive neurotransmitters and hyperpolarizes postsynaptic membranes, thereby blocking pain signal transmission. Its low lipid solubility prevents rapid clearance, maintaining high-quality analgesic effect in the cerebrospinal fluid (CSF) for 18 to 24 hours [25]. EM, administered via an epidural catheter, acts similarly but requires higher doses (1.5–3.0 mg) to penetrate the dural barrier and reach the CSF. EM has more variable pharmacokinetics and slightly higher systemic absorption, which may contribute to differences in analgesic consistency and adverse-effect profile [26].

The primary challenge of neuraxial morphine is its adverse effects, linked to its slow cephalad migration through the CSF toward the brainstem. This rostral spread can activate μ-receptors in the trigeminal nucleus, causing pruritus; the area postrema, inducing nausea and vomiting; and the medullary respiratory centers, potentially resulting in delayed respiratory depression. Historically, higher doses of ITM (200–250 μg) were commonly used and were associated with severe pruritus in up to 80% of patients, requiring intensive monitoring for respiratory issues [27]. To reduce these complications, current SOAP and PROSPECT guidelines recommend a dose-reduction strategy using low-dose ITM (50–150 μg), with 50–75 μg considered optimal. Clinical trials have shown that dose reduction maintains effective analgesia without significantly affecting 24-hour pain scores or rescue medication use. This approach considerably decreases adverse effects, including pruritus, PONV, and the risk of delayed respiratory depression [11,13].

Tiered Rescue Management Protocols for Neuraxial Opioid Complications: Despite successful dose reduction, low-dose neuraxial morphine may still cause adverse reactions, including pruritus, nausea, and vomiting, necessitating structured rescue protocols. For severe opioid-induced pruritus, first-line treatment involves intravenous nalbuphine (2–4 mg every 4–6 hours) [28,29], leveraging its kappa-agonist and μ-antagonist properties to alleviate pruritus without reversing analgesia. If symptoms are refractory, options include low-dose continuous IV naloxone (0.25–1.0 μg/kg/hour) or low-dose IV propofol (10–20 mg) to suppress central pruritic signaling. PONV management begins with dual therapy using ondansetron (4 mg IV) and metoclopramide (10 mg IV) targeting multiple emetic pathways. If symptoms persist, escalation involves oral aprepitant (40–80 mg) or low-dose haloperidol (0.5–1.0 mg IV), alongside aggressive fluid resuscitation. For delayed respiratory depression, mild hypoventilation, defined as respiratory rate below 10 breaths per minute, mandates high-flow oxygen, cessation of sedatives, and small doses of IV naloxone (40–80 μg). Severe cases, such as apnea or unarousable somnolence, require immediate administration of full-dose rescue naloxone (400 μg), emergency team activation, and manual ventilation.

While delayed respiratory depression is exceedingly rare with low-dose ITM (50–100 μg), professional consensus guidelines recommend dose- and risk-stratified monitoring protocols rather than uniform 24-hour continuous surveillance. In low-risk parturients receiving low-dose ITM, protocolized monitoring such as assessment of sedation scores and respiratory rate every 2 hours for the first 12 hours, followed by assessment every 4 hours for for the first 12 to 24 hours, provides an effective balance between patient safety and maternal-infant bonding [27,28,29]. This demanding clinical monitoring requirement, together with contraindications such as coagulopathy, thrombocytopenia, and localized infection, has significantly accelerated the development of advanced regional fascial plane blocks as highly effective, opioid-sparing or completely opioid-free alternatives [11,13,27,28,29].

5. The Anatomical and Clinical Landscape of Regional Nerve Blocks

Fig. 2 illustrates the anatomy of lower abdominal wall pain and corresponding clinical analgesic targets. It depicts the primary nerve supply (T12–L1 anterior rami) and distinguishes between somatic innervation (for skin and incisions) and visceral innervation (for uterine cramping). The corresponding regional analgesic approaches are indicated for each pain type, illustrating that superficial blocks, such as TAP or TFP blocks, only target somatic pain, whereas deeper interventions like neuraxial opioids and QLB, are necessary to address deep uterine pain.

Neuraxial opioids act on the dorsal horn of the spinal cord, whereas regional nerve blocks target peripheral nerves supplying the abdominal wall. Sensory innervation of the lower abdomen is provided by the anterior rami of T12 (subcostal), L1 (iliohypogastric and ilioinguinal), and in some cases, L2 nerves, which traverse the fascial planes of the abdominal wall. Understanding the anatomy, targets, and coverage of these structures is vital for effective post-cesarean pain management [30].

TAP Blocks: Lateral, Posterior, and Petit-TAP. The TAP block involves injection of local anesthetic into the

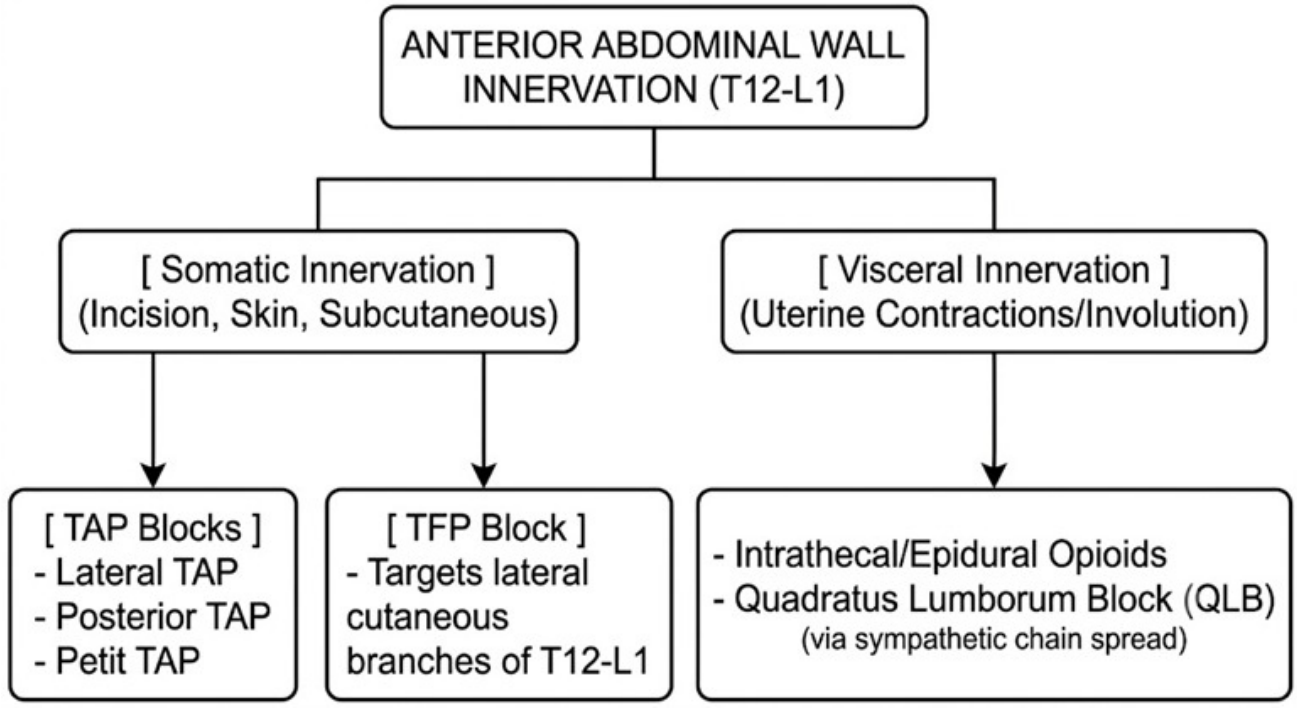

Fig. 2. Anatomical and regional analgesic targets for lower abdominal wall and uterine pain following cesarean delivery. The anterior rami of the T12–L1 nerves provide somatic innervation to the abdominal skin and surgical incision, which can be effectively managed with superficial fascial plane blocks such as the transversus abdominis plane (TAP) and transversalis fascia plane (TFP) blocks. Conversely, visceral innervation responsible for deep uterine cramping requires deeper analgesic interventions. Central neuraxial opioids or advanced deep fascial interventions, such as the quadratus lumborum block (QLB), are necessary to adequately target these deeper visceral and sympathetic pain pathways. T12-L1, thoracic 12 to lumbar 1; TAP, transversus abdominis plane; TFP, transversalis fascia plane; QLB, quadratus lumborum block.

fascial plane between the internal oblique and transversus abdominis muscles, where the T7–L1 intercostal nerves are located. The lateral TAP (L-TAP), guided by ultrasound along the midaxillary line, effectively blocks the lateral cutaneous branches of the intercostal nerves, providing effective somatic analgesia for transverse Pfannenstiel incisions. However, posterior spread is limited, offering minimal coverage of deep visceral uterine pain. The posterior TAP (P-TAP), performed near the lumbar triangle of Petit, allows local anesthetic to spread posteriorly into the lumbar interstitial space. Although P-TAP provides longer-lasting somatic relief than lateral TAP, its coverage of deep uterine visceral pain remains inconsistent across clinical trials and should not be considered a primary or reliable approach for treating visceral cramping [31,32].

Balanced Evaluation of Advanced Fascial Plane Blocks: QLB are advanced fascial plane techniques targeting the fascial space surrounding the quadratus lumborum (QL) muscle, allowing local anesthetic to spread medially toward the thoracic paravertebral space and splanchnic nerves, thereby providing potential visceral analgesia and broad somatic coverage [33]. However, their definitive superiority remains an active clinical debate. QLB I (Lateral) involves injection at the lateral border of the QL muscle near the transversus abdominis aponeurosis, offering reliable somatic coverage from T12 to L1. QLB II (Posterior) involves the deposition of local anesthetic superficial to the posterior QL muscle within the thoracolumbar fascia, allowing spread into the paravertebral space for extended somatic analgesia, often lasting more than 24 hours. The advanced QLB III (Anterior or Transmuscular) advances the needle through the QL muscle to deposit local anesthetic between the QL and the psoas major muscles. While anatomical studies suggest that this approach facilitates cranial spread into the thoracic paravertebral space, potentially blocking the T10–L1 nerves and sympathetic pathways [34] its visceral analgesic efficacy and consistency across clinical trials remain variable. These potential benefits must therefore be carefully weighed against significant real-world limitations. QLB III requires advanced ultrasound proficiency, exhibits a steep learning curve, and carries inherent risks of deep retroperitoneal hematoma or accidental bowel injury. Consequently, while promising, QLB III should not be considered universally superior to established, safer superficial alternatives, such as the posterior TAP block, but rather as a specialized technique for high-risk cohorts or settings in which intrathecal opioids are contraindicated.

Table 1. Comparative overview of postoperative analgesic modalities: targets, coverage, and clinical profiles.

Analgesic modality	Primary target	Somatic/Visceral coverage	Technical difficulty / learning curve	Hematoma / Bowel injury risk	Suggested single-procedure dose limits (subject to cumulative load)	Relative Procedural cost
ITM	Spinal Dorsal Horn	Excellent / Excellent	Low / Low	Negligible / None (Spinal hematoma risk <1:100,000)	N/A (Opioid: 50–100 μg total dose)	Low
EM	Spinal Dorsal Horn	Excellent / Excellent	Moderate / Low	Low (Epidural hematoma risk <1:150,000)	N/A (Opioid: 1.5–3.0 mg total dose)	Moderate
QLB III (Anterior)	Paravertebral Space / Sympathetic Chain	Excellent / Moderate to Good (Variable)	High / Steep	Moderate (Deep retroperitoneal vessel/bowel risk)	Bupivacaine: 2.5 mg/kg; Ropivacaine: 3.0 mg/kg	High (Requires US, sterile kits, advanced training)
QLB II (Posterior)	Thoracolumbar Fascia	Excellent / Variable	Moderate / Moderate	Low-Moderate (Superficial retroperitoneal space)	Bupivacaine: 2.5 mg/kg; Ropivacaine: 3.0 mg/kg	High
Posterior TAP (P-TAP)	Lumbar Interstitial Space	Excellent / Poor to Variable	Moderate / Low-Moderate	Low (Lumbar triangle approach)	Bupivacaine: 2.5 mg/kg; Ropivacaine: 3.0 mg/kg	Moderate
Lateral TAP (L-TAP)	Anterior Rami (T12-L1)	Good–Excellent / Poor	Low-Moderate / Low	Low (Intraperitoneal bowel injury risk if non-US guided)	Bupivacaine: 2.5 mg/kg; Ropivacaine: 3.0 mg/kg	Moderate
TFP Block	Transversalis Fascia	Good (Incision) / Poor	Moderate / Moderate	Low (Localized fascial target)	Bupivacaine: 2.5 mg/kg; Ropivacaine: 3.0 mg/kg	Moderate
WI	Surgical Incision	Moderate (Local) / None	Low / Low	Negligible / None	Bupivacaine: 2.5 mg/kg; Ropivacaine: 3.0 mg/kg	Very Low

Note: Listed dosages represent maximum single-procedure guidelines. Dosing must be individualized based on patient body weight, absorption kinetics at the specific anatomical injection site, and total cumulative local anesthetic load from all combined procedures (e.g., nerve block plus WI) to avoid LAST. ITM, intrathecal morphine; EM, epidural morphine; QLB, quadratus lumborum block; TAP, transversus abdominis plane block; TFP, transversalis fascia plane block; LAST, local anesthetic systemic toxicity; WI, wound infiltration.

TFP Block and Wound Infiltration (WI). The TFP block targets the fascial space between the transversus abdominis muscle and transversalis fascia near the deep inguinal ring, mainly anesthetizing the iliohypogastric and ilioinguinal nerves for lower abdominal incisions while avoiding posterior structures [35]. WI involves injection of local anesthetic into the subcutaneous and fascial layers of the surgical site, either as a single injection before skin closure or through multi-orifice catheters. Although simple and low-risk, WI provides short-duration somatic pain relief (approximately 4–6 hours) without visceral or sympathetic analgesia [36].

Clinical Practicability and Risk Metrics. Although somatic and visceral coverage profiles indicate a modality's effectiveness, its practical application depends greatly on technical feasibility, risk-benefit considerations, and institutional resource availability. A recent comprehensive network meta-analysis evaluating 110 randomized controlled trials comprising 8871 participants and 17 distinct analgesic modalities found that intrathecal and epidural morphine provided the most favorable overall analgesic effects, whereas TAP and QLB techniques effectively reduced postoperative opioid requirements and remained valuable regional analgesic alternatives [37]. As shown in Table 1, traditional central neuraxial methods require minimal technical expertise. In contrast, advanced peripheral blocks like QLB III may provide excellent visceral coverage, though they involve steep learning curves and pose risks associated with deep retroperitoneal needle placement. Safety is primarily governed by controlling local anesthetic systemic toxicity (LAST) risks, especially when performing high-volume, bilateral fascial plane blocks in parturients. Stated dosage limits (e.g., bupivacaine 2.5 mg/kg or ropivacaine 3.0 mg/kg) represent a single-procedure ceiling dose referenced in the regional anesthesia literature rather than absolute or guaranteed safe thresholds. Due to altered plasma protein binding and rapid vascular absorption kinetics in pregnant patients, dosing must strictly account for the total cumulative local anesthetic exposure across all coadministered techniques (e.g., fascial plane block combined with WI or epidural top-ups) to minimize toxicity risks. Additionally, rescue protocols for neuraxial opioid-related side effects (e.g., IV nalbuphine 2–4 mg for pruritus; dual-agent antiemetics for PONV) are presented as evidence-based clinical options tailored to obstetric practice rather than rigid mandates [27,28].

5.1 Guidelines Alignment: Positioning Regional Blocks as Secondary and Opioid-Sparing Modalities

A critical analysis of global consensus guidelines published between 2019 and 2026 highlights a consistent hierarchy in post-cesarean pain management. Guidelines from the ERAS Society [38], SOAP [11], ACOG [12], and PROSPECT [39] consistently identify low-dose neuraxial morphine as the primary reference standard for baseline analgesia. Regional fascial plane blocks are recommended as essential secondary modalities when neuraxial morphine is omitted or contraindicated (e.g., severe coagulopathy, general anesthesia, or patient refusal), or as targeted adjuncts for incisional pain.

This longitudinal shift in clinical practice has unfolded over three distinct phases. The Reactive Alternative Phase (2019 to 2021) was characterized by early guidelines, including the 2019 ERAS Society recommendations and the 2021 PROSPECT directives, which treated regional techniques like the TAP block primarily as backup options. These techniques were reserved for cases in which low-dose ITM or EM was contraindicated or ineffective, especially in the context of general anesthesia. During this period, regional blocks were considered auxiliary measures, supplementing central neuraxial analgesia and balancing somatic pain relief against the limitations of peripheral local anesthetics. The Multimodal Integration Phase (2021 to 2024) marked a shift toward routine use of multidrug baseline protocols, driven by the 2021 SOAP ERAC consensus and evolving ACOG guidelines. As institutions recognized the operational challenges of mandatory 24-hour respiratory monitoring for neuraxial opioids and rising opioid-related readmissions, regional blocks began to be integrated into standard care pathways. They increasingly served as dynamic tools for high-risk patient groups, rather than just rescue interventions. The Proactive Risk-Stratified Phase (2025 to 2026) reinforces a targeted clinical approach. Recent consensus updates from the ERAS Society [38] and the PROSPECT Working Group [39] emphasize personalized, risk-stratified pathways. Within this modern framework, advanced fascial plane blocks, such as QL and TFP blocks, are recommended primarily as essential secondary alternatives when central neuraxial opioids are contraindicated or omitted, and as targeted, opioid-sparing adjuncts for severe incisional pain in select high-risk cohorts.

The concept of a "nonopioid" baseline has gained widespread support, with consensus guidelines from 2019 to 2026 advocating for scheduled paracetamol and NSAIDs [11,39,40] as essential components of care. Initially, regional anesthesia techniques such as the TAP block were recommended only as alternatives when neuraxial morphine was not used, according to the 2019 ERAS guidelines [10] and the 2021 PROSPECT recommendations [13]. Over time, organizations such as the 2021 SOAP ERAS [11], ACOG [12], and the ERAS Society 2025 Update (2026) [38] have increasingly recognized regional blocks and WI as important opioid-sparing options and rescue interventions (Table 2, Ref. [10,11,12,38,39]) [28,36]. The PROSPECT Working Group Recommendations (2026) [39] further expand this perspective by referencing advanced fascial plane blocks, such as the QLB [33,34] and erector spinae plane (ESP) blocks, as options when neuraxial opioids are contraindicated or unavailable [37].

Table 2. Chronological evolution of global guidelines for post-cesarean multimodal analgesia (2019–2026).

Clinical category / intervention	ERAS Recommendations 2019 [10]	SOAP Recommendations 2021 [11]	ACOG consensus 2021 [12]	ERAS Society 2025 Update (2026) [38]	PROSPECT Working Group 2026 [39]
Scheduled Paracetamol	• Recommended as part of multimodal design. • High Evidence / Strong Recommendation.	• Strongly Recommended. • Scheduled 1g IV or PO q6h.	• Strongly Recommended. • Core of stepwise postpartum pain approach.	• Strongly Recommended. • Scheduled regular administration. (Moderate Evidence/Strong Rec)	• Core baseline of the post-delivery triad.
Scheduled NSAIDs	• Recommended (unless contraindicated). High Evidence / Strong Rec	• Strongly Recommended. • Scheduled IV ketorolac or PO ibuprofen.	• Strongly Recommended. • Scheduled regular administration. • Safe to use in hypertensive disorders of pregnancy.	• Strongly Recommended. • Scheduled regular administration. High Evidence / Strong Rec	• Recommended. • Core baseline of the post-delivery triad.
Neuraxial Opioids	ITM • Recommended as gold standard. High Evidence / Strong Rec	Low-Dose ITM/EM • ITM: 50–150 µg. • EM: 1–3 mg.	• Recommended. • Stepwise escalation to parenteral/oral opioids as needed.	Standardized Side-Effect Rescue • Recommends formal protocols to treat ITM side effects. Moderate Evidence / Strong Rec	Intraoperative Standard • Pre-operative ITM (50–150 µg) or EM (2–3 mg) as first-line standard.
Regional Nerve Blocks	TAP Block • Recommended only if neuraxial morphine is omitted. Moderate Evidence / Strong Rec	TAP or QLB • Recommended as dynamic alternatives to ITM or for high-risk patients.	Regional Blocks / WI • Supported as valuable options for incisional pain.	Regional Blocks / WI • Supported as valuable opioid-sparing alternatives/ rescue.	QLB, TAP, ESP, II/IH, TFP, or WI recommended only when neuraxial opioids are omitted.
Systemic Adjuvants	Dexamethasone • Recommended for PONV prophylaxis.	Dexamethasone + 5-HT3 • Routine dual prophylaxis for PONV.	Antiemetic Protocols • Scheduled multi-drug PONV prophylaxis and rescue.	Antiemetic Protocols • Scheduled multi-drug PONV prophylaxis and rescue.	IV Dexamethasone • Dexamethasone (8–10 mg) post-delivery as part of baseline triad.
Discouraged Systemic Agents	Not explicitly detailed.	Gabapentinoids • Avoid routine use due to sedation/maternal side effects.	Gabapentinoids • Avoid routine use due to sedation and safety concerns.	Gabapentinoids • Avoid routine use due to sedation and safety concerns.	Avoid Routine Use: • Gabapentinoids, IV Ketamine, IV Lidocaine, Dexmedetomidine.
Early Postoperative Feeding	Early Oral Intake • Recommends clear fluids within 2 hours of surgery. Moderate Evidence / Strong Rec	Early Oral Intake • Rapid transition to solid food to prevent ileus.	Not addressed.	Early Drinking & Feeding • Initiate clear fluids/solids within 2 hours. Low Evidence / Strong Rec	Not addressed.
Urinary Catheter Removal	Early Removal • Urges removal to facilitate early mobility. Low Evidence / Weak Rec	Early Removal • Target removal within 6 to 12 hours post-delivery.	Not addressed.	Early Catheter Removal • Standardized removal within 6 to 12 hours. Low Evidence / Strong Rec	Not addressed.

ERAS, Enhanced Recovery After Surgery; SOAP, Society for Obstetric Anesthesia and Perinatology; ACOG, American College of Obstetricians and Gynecologists; PROSPECT, Procedure-Specific Postoperative Pain Management; IV, intravenous; PO, oral; NSAID, nonsteroidal anti-inflammatory drug; ITM, intrathecal morphine; EM, epidural morphine; TAP, transversus abdominis plane block; QLB, quadratus lumborum block; WI, wound infiltration; ESP, erector spinae plane block; TFP, transversalis fascia plane block; PONV, postoperative nausea and vomiting.

Risk Stratification and Personalized Analgesia. The 2021 SOAP ERAC [11] and 2025 ERAS Society Update [38] highlight a shift from standardized protocols toward personalized analgesic plans. Although a one-size-fits-all approach provides a safe baseline, it may undertreat high-risk patients or overtreat low-risk ones. Risk stratification helps clinicians identify patients needing targeted, multimodal pain management [14,40].

Postoperative pain is subjective and influenced by genetic, psychological, and surgical factors. Risk factors for severe acute pain after CD include psychological issues such as high preoperative anxiety, catastrophizing, and depression; maternal demographics like age under 25, which correlates with higher opioid needs; surgical factors such as emergency procedures, longer durations, vertical incisions, or extensive adhesiolysis; and prior pain history, including chronic conditions like fibromyalgia or preoperative opioid use and tolerance [8].

Tailoring the Analgesic Pathway for High-Risk Patients. This approach involves preemptively targeting multiple pain pathways [14]. Fig. 3 shows how to customize pain management according to patient risk level. The chart categorizes patients into two groups: Low-to-Moderate Risk and High-Risk Profile. While both cohorts benefit from a scheduled nonopioid baseline and low-dose neuraxial morphine, clinicians managing high-risk patients may consider individualized escalation strategies. These may include adding targeted regional blocks (e.g., QLB or posterior TAP) or adjusting antiemetic or anti-inflammatory regimens as part of a tailored, institutional care plan. This includes adding target-specific nerve blocks (QLB III or posterior TAP) and a larger dose of IV dexamethasone, providing a clear framework for patients who are more sensitive to severe postoperative pain. For patients with severe pre-existing pain, opioid tolerance, or significant risk factors for severe postoperative pain, clinicians may consider individualized, multimodal escalation strategies [14]. However, combining low-dose ITM with deep bilateral fascial plane blocks remains an author-proposed conceptual framework rather than an established consensus recommendation. Step 1 of the clinical decision framework focuses on preoperative assessment, risk stratification, and identification of contraindications. As outlined in Fig. 4, the QLB III is recommended as a highly effective alternative for visceral pain when ITM is contraindicated for structural or patient-related reasons (e.g., patient refusal or spinal abnormalities). However, if the contraindication to ITM is severe coagulopathy, deep fascial plane blocks like QLB III remain unsuitable due to the risk of retroperitoneal bleeding, and superficial blocks or systemic alternatives should be prioritized. In such coagulopathic phenotypes, intraoperative management should favor general anesthesia combined cautiously with low-risk, superficial somatic options (e.g., lateral TAP or WI) when mechanical compression can be applied. Step 2 details distinct intraoperative management pathways based on neuraxial feasibility. Although it emphasizes low-dose ITM as the first-line gold standard [25], it utilizes clear algorithmic branches to guide standard contraindicated or general anesthesia cases toward advanced regional nerve blocks like the QLB Type III (QLB III) or posterior TAP block [28,37]. However, in the high-bleeding phenotype associated with severe coagulopathy, deep retroperitoneal techniques such as QLB III are also avoided due to the risk of hemorrhage in a noncompressible space. Instead, the algorithm directs patients toward general anesthesia combined with low-risk, superficial somatic techniques, such as ultrasound-guided lateral TAP, TFP blocks, or simple WI, which allow direct compression if a hematoma develops. Finally, Step 3 incorporates modern ERAS protocols for postoperative ward management [38]. This involves combining a scheduled nonopioid baseline [17] with a structured, step-up approach for breakthrough pain rescue. For moderate-to-severe breakthrough pain inadequately controlled by the nonopioid baseline, clinical consensus supports the administration of short-acting oral opioids, specifically, oral oxycodone 5 to 10 mg every 4 to 6 hours as needed, rather than intravenous alternatives, to provide reliable rescue analgesia while minimizing maternal sedation [11,12]. This targeted step-up protocol works alongside functional recovery metrics [40], and structured side-effect mitigation [27]. Rather than using a static checklist, this framework organizes side-effect mitigation into explicit tiered branches. For severe opioid-induced pruritus, Tier-1 involves low-dose continuous naloxone infusions or IV nalbuphine (2–4 mg), escalating to Tier-2 low-dose propofol or antihistamines for refractory cases. For PONV, Tier-1 mandates scheduled dual prophylaxis combining a 5-hydroxytryptamine 3 (5-HT3) receptor antagonist (ondansetron 4 mg) with a prokinetic dopamine antagonist (metoclopramide 10 mg), escalating to Tier-2 neurokinin-1 receptor antagonists (aprepitant) or low-dose haloperidol when baseline therapy fails to provide adequate control, thereby supporting maternal recovery.

Implementation Barriers and Real-World Solutions. Although substantial evidence supports multimodal, region-based analgesic pathways, implementing these across diverse hospital environments remains challenging due to technological, structural, and socioeconomic barriers [40]. Mastery of advanced regional blocks like transmuscular QL (QLB III) demands advanced ultrasound skills and in-depth knowledge of retroperitoneal anatomy [32,34], which may discourage clinicians due to perceived risks such as hematoma or bowel injury. Hospitals should create structured simulation training and supervised workshops for obstetric anesthesiologists. When QLB III is not feasible, safer and more accessible ultrasound-guided options like posterior TAP [31] or TFP blocks [35], with simpler learning curves, should be considered. In low-resource or rural centers without immediate access to high-resolution ultrasound equipment, reliance on ultrasound-based proto-

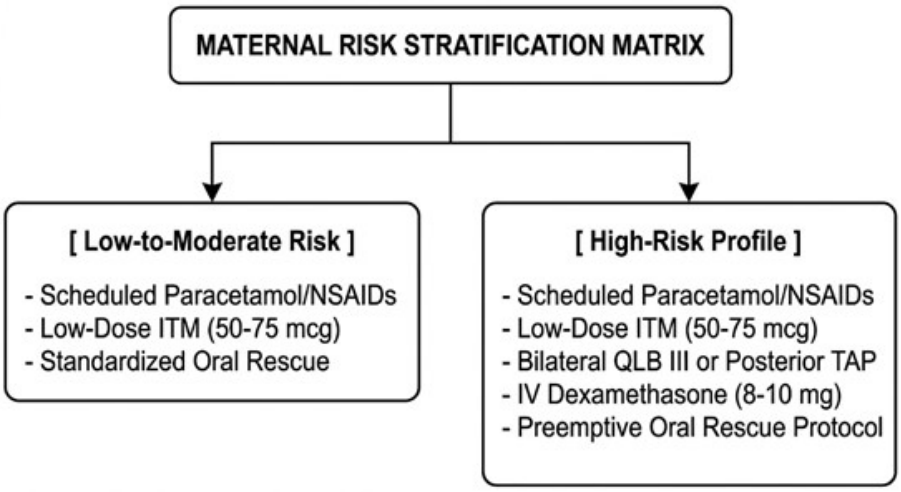

Fig. 3. Conceptual maternal risk-stratification matrix. This matrix represents an author-proposed decision-support tool illustrating potential multimodal analgesic escalation strategies for high-risk cohorts based on a synthesis of clinical trial evidence. It is intended for institutional consideration and does not represent a mandated universal standard. NSAID, nonsteroidal anti-inflammatory drug; ITM, intrathecal morphine; QLB, quadratus lumborum block; TAP, transversus abdominis plane block.

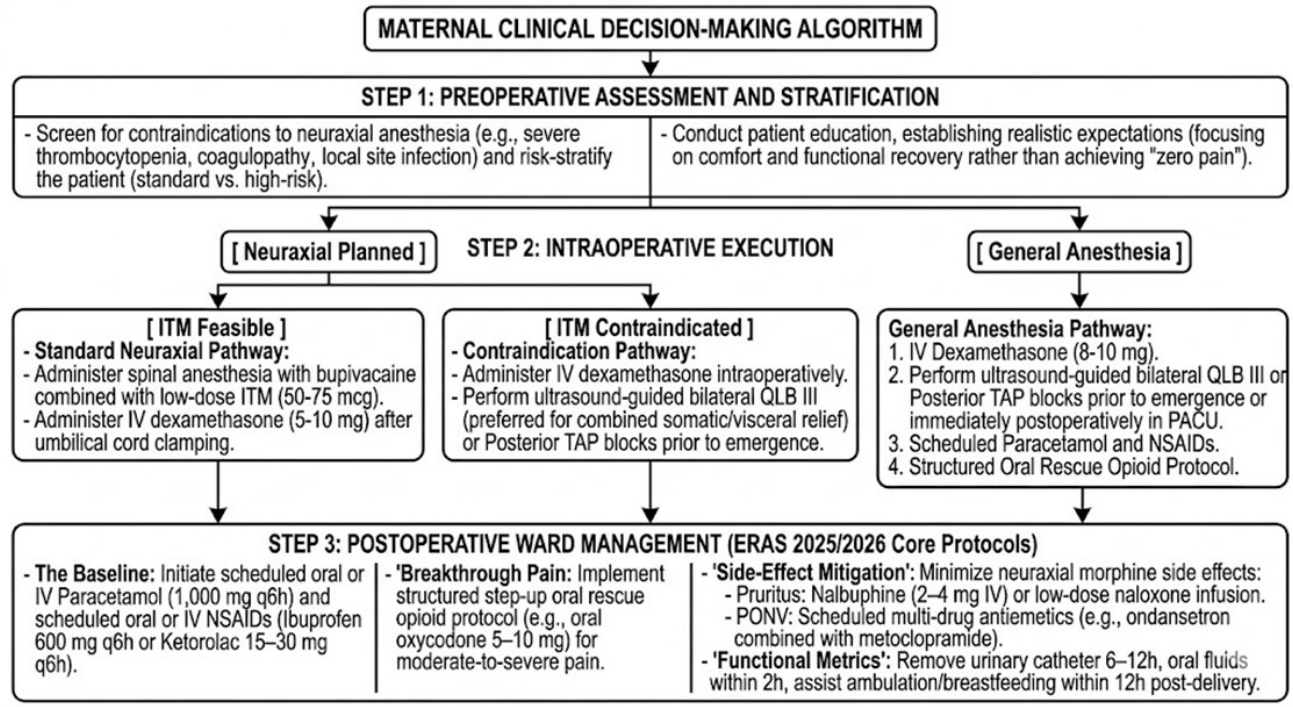

Fig. 4. Proposed perioperative decision pathway for post-cesarean analgesia. This three-step perioperative roadmap synthesizes evidence-based recommendations. Algorithmic pathways, particularly those combining central neuraxial opioids with bilateral fascial plane blocks, should be evaluated on an individual patient basis according to institutional expertise and clinical context. The recommendation for QLB III as an alternative to ITM applies only to non-coagulopathic contraindications; severe coagulopathy remains an absolute contraindication for deep fascial blocks. NSAID, nonsteroidal anti-inflammatory drug; ITM, intrathecal morphine; QLB, quadratus lumborum block; TAP, transversus abdominis plane block; PACU, post-anesthesia care unit.

cols may limit the use of regional anesthesia. To address this, institutions must adopt standardized landmark-guided regional techniques; using tactile feedback and the tactile "double-pop" landmark technique, clinicians can safely perform classical landmark-guided Petit-TAP blocks or surgical WIs, creating an effective somatic baseline without imaging technology.

Beyond just technical equipment, implementation of effective real-world protocols faces significant operational and staffing challenges. Nurses may need to substantially adjust their protocols for low-dose neuraxial opioids, as current guidelines often require detailed monitoring for 24 hours, placing additional demands on personnel and increasing the risk of alarm fatigue [27]. To comply with the the ERAS Society 2025 Update (2026) [38], hospitals can decrease monitoring frequency for low-risk patients by performing assessments every 2 hours for the first 12 hours, followed by assessments every 4 hours. This approach may facilitate maternal rest and alleviate staffing shortages among nurses and anesthesia providers that can limit the performance of bilateral blocks in busy obstetric units. This strain is worsened by high supply chain costs for specialized equipment, such as echogenic needles, sterile block packs, and long-acting anesthetics, which can challenge limited budgets. High-volume bilateral blocks, such as bilateral QLB or TAP, also raise concerns about LAST, especially when combined with WI or epidural top-ups [23]. To prevent this, clinicians should calculate safe dose limits based on patient weight, use ultrasound guidance with incremental injections and aspiration when appropriate [28], and ensure that 20% lipid emulsion is readily available for emergency treatment. Additionally, given restrictive insurance reimbursement and inconsistent billing codes for postoperative regional blocks, hospital leaders should align clinical protocols with available resources, develop cross-trained staff pools, and identify cost-effective regional anesthesia techniques. These comprehensive strategies are essential for safely integrating evidence-based multimodal pain management into routine clinical practice [14].

5.2 Future Directions

Future advances in post-cesarean pain management focus on long-acting regional techniques and enhanced pharmacological systems. Liposomal bupivacaine [41], when used in fascial plane blocks such as TAP or QLB, releases local anesthetic over 72 hours, potentially eliminating the need for indwelling catheters or neuraxial morphine, thereby simplifying postoperative care. Additionally, artificial intelligence and predictive analytics, using machine learning applied to electronic health record data, including preoperative anxiety, genetic markers, and surgical details, may enable more accurate prediction of postoperative pain. This could facilitate personalized, preemptive analgesia strategies, potentially improving patient outcomes and streamlining recovery [1,7].

6. Conclusions and Actionable Guidance

Post-cesarean pain management relies on a scheduled, nonopioid multimodal foundation (paracetamol, NSAIDs, and IV dexamethasone) combined with low-dose neuraxial morphine (50–100 µg) as the primary baseline reference standard. Regional fascial plane blocks (TAP, QLB, and TFP) serve as valuable secondary alternatives when neuraxial opioids are omitted or contraindicated, providing targeted relief of incisional somatic pain. Clinicians implementing multimodal pathways should follow four core practices: maintain scheduled administration of nonopioid analgesics, utilize risk-stratified monitoring protocols for neuraxial morphine, calculate weight-based local anesthetic dose limits while accounting for cumulative exposure across multiple administration sites, and implement protocolized, tiered rescue regimens for postoperative adverse effects.

Author Contributions

JB was solely responsible for the conceptualization of this review, comprehensive literature searching and screening, evidence synthesis, data visualization (creation of algorithms and tables), and the drafting, editing, and final critical revision of the manuscript. As the sole author, JB has participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflicts of Interest

The author declares no conflicts of interest.

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