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NARRATIVE REVIEW

Linea Semilunaris vs. Lateral Transversus Abdominis Plane (TAP) Block after Caesarean Section: A Narrative Review

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Abstract

Cesarean section (CS) is a major obstetric surgery with a prevalence of moderate to severe postoperative pain exceeding 80% within the first 24 hours. Pain involves both somatic and visceral components, and inadequate pain management may impair early mobilization, hinder breastfeeding, increase the risk of postpartum depression, and contribute to chronic pain. The Transversus Abdominis Plane (TAP) block is an effective regional analgesia technique that can reduce somatic pain after CS and decrease opioid requirements. Two commonly used approaches are the linea semilunaris and lateral approaches; however, direct comparisons of their effectiveness in CS patients remain scarce in Indonesia. This narrative review was conducted through a literature search between 2015 and 2025 and included clinical studies evaluating pain intensity, analgesia duration, opioid requirements, and adverse effects in post-CS patients. The results show that linea semilunaris may offer broader analgesic coverage and longer duration of analgesia compared to the lateral approach in post-CS patients. Large-scale, well-designed RCTs are needed to confirm its clinical superiority and establish optimal dosing guidelines.

Keywords: Anesthesia, Local; Cesarean Section; Enhanced Recovery After Surgery; Postoperative Pain; Visual Analog Scale

Introduction

Postoperative pain remains a major concern in patients undergoing caesarean section. According to World Health Organization data, the incidence of moderate to severe pain within the first 24 hours after CS exceeds 80%. Such pain may impair early mobilization, disrupt breastfeeding, and increase the risk of chronic postoperative pain.[1]

Postoperative pain may be somatic or visceral. Somatic pain originates from abdominal wall incision, while visceral pain results from uterine manipulation and traction of surrounding tissues.[1] Pain mechanisms involve activation of peripheral nociceptors by inflammatory mediators such as prostaglandins, bradykinin, hydrogen ions, interleukin-1β, and tumor necrosis factor-α. These nociceptive impulses are transmitted through A-δ and C fibers to the dorsal horn of the spinal cord, then relayed to the thalamus and perceived in the cerebral cortex. Inadequate pain control may lead to central sensitization, increasing pain intensity and prolonging recovery.[2]

A multimodal analgesia approach has become the standard for post-CS pain management, including the TAP block. This technique aims to block pain transmission from the thoracolumbar nerve plexus (T6–L1) that innervates the abdominal wall.[3] Two commonly used approaches are the lateral and linea semilunaris approaches. The lateral approach is technically simpler and effective for infraumbilical analgesia, whereas the linea semilunaris approach provides wider dermatomal coverage, including the supraumbilical region, with a longer analgesic duration.[4]

In the context of CS, selection of the optimal TAP block technique must consider analgesic coverage, duration, opioid-sparing effects, and potential adverse events. Studies indicate that high-quality regional blocks facilitate earlier mobilization, reduce postoperative nausea and vomiting, and improve patient satisfaction.[3] Therefore, direct comparison between lateral and linea semilunaris approaches is clinically relevant, particularly in resource-limited healthcare settings.

Semilunaris versus Lateral TAP Block

TAP block is a regional analgesic technique targeting somatic nerves of the abdominal wall, particularly the anterior branches of the intercostal nerves (T6–T11), the subcostal nerve (T12), and the iliohypogastric and ilioinguinal nerves (L1). Local anesthetic is injected into the interfascial plane between the internal oblique and transversus abdominis muscles, thereby blocking nociceptive transmission from the skin, muscles, and parietal peritoneum.[5,6] This peripheral nerve conduction blockade significantly reduces nociceptive input to the spinal cord, attenuating central pain pathway activation and decreasing systemic analgesic requirements. TAP block functions as a field block rather than a classic nerve block, as it targets tissue planes traversed by sensory nerves rather than a single nerve trunk. Consequently, the extent of analgesia depends on anesthetic volume and spread within the interfascial space.[6]

Two main TAP block approaches are used: the semilunaris and lateral approaches, which differ in anatomical targets, dermatomal coverage, and analgesia duration. The semilunaris approach, also known as the paramedian umbilical TAP, follows the linea semilunaris at the junction of the rectus sheath with the internal oblique and transversus abdominis muscles. Injection at this site produces a combined effect of medial TAP and rectus sheath block, potentially covering dermatomes T7–T12. In contrast, the lateral TAP block is performed at the mid-axillary line and primarily covers dermatomes T10–T12, without significant cranial spread.[4,7]

TAP block typically uses 20-30 mL of local anesthetic per side and provides approximately 12 hours of analgesia.[7,8] Adjuvants such as dexmedetomidine, lipophilic opioids, or magnesium sulfate may further prolong analgesia through synergistic mechanisms. Dexmedetomidine acts on presynaptic α-2 adrenergic receptors, reducing norepinephrine release and decreasing postsynaptic neuronal excitability in the dorsal horn. This mechanism not only enhances analgesia but also attenuates sympathetic responses and promotes hemodynamic stability.[4]

Clinically, the linea semilunaris TAP block demonstrates a longer duration of analgesia, with a delayed requirement for rescue analgesics (>6–8 hours) and lower VAS scores in the early postoperative period. In comparison, the lateral TAP block

has an average effective duration of approximately 4–6 hours and is associated with higher opioid requirements. The advantages of broader coverage and longer analgesic duration with the linea semilunaris approach are offset by greater technical complexity and the need for more advanced ultrasonographic skills. Conversely, the lateral approach is simpler, quicker to perform, and more suitable for resource-limited settings. These fundamental differences are important when selecting a TAP block technique for caesarean section, as they influence pain control, opioid consumption, early mobilization, and implementation of obstetric Enhanced Recovery After Surgery (ERAS) protocols.[9]

Postoperative Pain Scores

A single-arm study in laparotomy patients demonstrated that the semilunaris TAP block significantly reduced VAS scores at multiple postoperative time points.[8] Median VAS scores were 2 (IQR: 1–2) at 4 hours and increased to 4 (IQR: 4–5) at 10 hours postoperatively. The broader analgesic distribution—extending below the xiphoid process, above the pubic symphysis, and laterally from the midclavicular line—likely contributed to lower early pain scores due to the combined rectus sheath and TAP block effects.[4,7]

A study also reported higher Numeric Analog Scale (NAS) scores in the lateral TAP group compared with the posterior TAP group at 6 hours (2.94 ± 0.51 vs 2.65 ± 0.62; p=0.03), 12 hours (4.63 ± 0.75 vs 3.15 ± 0.67; p<0.001), and 24 hours (4.02 ± 0.85 vs 3.47 ± 0.76; p=0.004) postoperatively. This study indicates shorter analgesia duration and reduced efficacy of the lateral approach.[8]

Time to First Rescue Analgesia

Analgesia duration was assessed by the time to first patient-controlled analgesia (PCA) demand. Xu et al. reported that the semilunaris TAP block provided rapid and effective analgesia with moderate duration, attributable to extensive interfascial spread and combined block effects, while maintaining a favorable safety profile due to lower total anesthetic doses.[7]

A study observed that patients receiving lateral TAP blocks required rescue analgesia at a mean of 6.73 hours postoperatively, compared with 13.3 hours in the posterior TAP group. Although direct comparisons with semilunaris TAP in CS remain limited, the wider analgesic area suggests a potentially longer effective duration for the semilunaris approach.[8]

Postoperative Opioid Consumption

Total intravenous opioid consumption within 24–48 hours postoperatively is an important indicator of TAP block efficacy. A study demonstrated that semilunaris TAP blocks significantly reduced postoperative analgesic requirements following open abdominal surgery.[4,7]

A meta-analysis reported higher meperidine consumption in lateral TAP block patients compared with posterior TAP blocks within the first 24 hours.[9] Although not a direct comparison with semilunaris TAP, these findings suggest that lateral TAP blocks may require greater opioid supplementation due to limited coverage.[9] Another meta-analysis also confirmed that TAP blocks, particularly using 0.375% ropivacaine, significantly reduce opioid consumption during the first 24 hours postoperatively.[10]

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Table 1. Literature Comparison

No.	Writer (Year)	Title	Objective	Study Design	Intervention	Result	Study Strength	Study Limitation
1.	Faiz et al. (2017)	Comparison of ultrasound-guided posterior transversus abdominis plane block and lateral transversus abdominis plane block for postoperative pain management in patients undergoing cesarean section: A randomized double-blind clinical trial study.	To compare the effectiveness of posterior versus lateral transversus abdominis plane (TAP) blocks for postoperative pain management in patients undergoing caesarean section.	RCT, double-blind	Posterior TAP block versus lateral TAP block using bupivacaine.	Pain scores were higher in the lateral TAP block group at 6, 12, and 24 hours postoperatively compared with the posterior technique; the mean time to first request for rescue analgesia was 6.73 hours in the lateral TAP group versus 13.3 hours in the posterior group; and meperidine consumption within the first 24 hours was higher in the lateral TAP group (41.8 mg) than in the posterior group (29.2 mg).	A double-blind randomized controlled trial comparing two TAP block techniques; with an adequate sample size; and clearly measured outcomes including pain scores, analgesia duration, and opioid consumption.	Included only a caesarean section population; did not evaluate long-term outcomes; and the results cannot be generalized to all type of abdominal surgery.
2.	Xu et al. (2023)	Effectiveness and safety of new umbilical paramedian semilunaris approach for transverse abdominis plane block: a prospective, single-arm, observational, evaluation study	To evaluate the effectiveness and safety of the linea semilunaris approach to the transversus abdominis plane (TAP) block in open abdominal surgery.	Prospective, observational, single-arm study	Linea semilunaris TAP block using ropivacaine.	The median VAS score at 4 hours postoperatively was 2 (IQR: 1–2), increasing to 4 (IQR: 4–5) at 10 hours; analgesic distribution was broad (3.46 cm below the xiphoid process, 1.74 cm above the pubic symphysis, and 2.02–2.19 cm lateral to the midclavicular line); the duration of analgesia was moderate, with a delayed time to first analgesic request compared with the lateral TAP block; and opioid consumption was significantly reduced (specific values not reported).	A prospective study with detailed documentation of analgesic distribution; an innovative technique (linea semilunaris) that has not been extensively evaluated previously; and measured VAS scores and opioid consumption.	There was no control group; the single-arm design limited direct comparisons; and the duration of analgesia follow-up was restricted to the early postoperative period.

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3.	Sun et al. (2017)	Postoperative Analgesia by a Transversus Abdominis Plane Block Using Different Concentrations of Ropivacaine for Abdominal Surgery: A Meta-Analysis	To analyze the effects of TAP block using different concentrations of ropivacaine on postoperative analgesia after abdominal surgery.	Meta-analysis	TAP Block with ropivacaine 0,25–0,5%	The TAP block, particularly with 0.375% ropivacaine, significantly reduces pain scores and opioid consumption within the first 24 hours postoperatively.	A meta-analysis including a large number of studies and patients; comparing different concentrations of ropivacaine; and providing standardized analyses of pain outcomes and opioid consumption.	The quality of the included studies varied; heterogeneity was high; and most studies had short follow-up periods.
4.	Uppal et al. (2019)	Transversus Abdominis Plane (TAP) and Rectus Sheath Blocks: A Technical Description and Evidence Review.	To describe TAP block and rectus sheath block techniques and review the evidence for their effectiveness.	Narrative Review	TAP block using various approaches (lateral, posterior, subcostal, and linea semilunaris).	Evidence indicates that TAP approaches providing wider coverage (e.g., linea semilunaris and posterior approaches) offer better pain control and reduce opioid requirements compared with the lateral approach, particularly for extensive incisions.	A comprehensive narrative review that discusses TAP and rectus sheath block techniques in detail and compares different approaches and their analgesic coverage.	Did not perform quantitative analysis; some evidence was derived from small or non-RCT studies; and there was potential publication bias.

Research Gap

Although TAP block has been extensively investigated in various abdominal procedures, direct scientific evidence comparing the linea semilunaris and lateral approaches specifically in the context of CS remains limited. Most of the existing literature compares a single TAP block technique with a control group or contrasts TAP blocks with other regional analgesia techniques, such as the quadratus lumborum block or epidural analgesia.[9,10] Consequently, specific data delineating the relative advantages of the linea semilunaris versus lateral approach for caesarean delivery are still scarce.

Several findings suggest that the linea semilunaris approach may provide broader dermatomal coverage and longer analgesic duration; however, this argument is largely supported by non–head-to-head studies, single-arm study designs, or investigations conducted in non-CS populations evaluating the umbilical paramedian semilunaris approach in open abdominal surgery. Meanwhile, available studies in CS populations have primarily compared posterior versus lateral TAP approaches rather than linea semilunaris versus lateral techniques. This indicates that current evidence suggesting the superiority of the linea semilunaris approach over the lateral approach in CS patients remains inferential, derived from anatomical extrapolation, physiological rationale, and cross-population data that have not been directly tested.[4,5]

Furthermore, existing studies demonstrate substantial heterogeneity in study design, inclusion criteria, and outcome measures. Variations in dosing (20–30 mL versus 15–20 mL per side), type and concentration of local anesthetics (0.25% bupivacaine versus 0.375% ropivacaine), timing of block administration (preoperative before incision versus postoperative before wound closure), and inconsistent use of ultrasound guidance may all influence study outcomes and complicate meta-analyses in drawing robust conclusions.[9–11]

In other words, well-designed randomized controlled trials with standardized dosing and techniques, homogeneous populations (elective and emergency caesarean sections), and comprehensive outcomes encompassing pain, functional recovery, safety, and cost are still required. Only through such studies can scientific evidence provide a strong foundation for clinical practice recommendations specific to the obstetric population.

Conclusion

TAP block is an effective regional analgesia technique for reducing postoperative pain after caesarean section, and the linea semilunaris approach offers both theoretical and practical advantages over the lateral approach through a wider distribution of local anesthetic. Available data suggest that the linea semilunaris approach tends to provide better pain control in the early postoperative period, prolong pain-free duration, and reduce opioid requirements, which collectively contribute to faster recovery and a lower risk of opioid-related adverse effects.

However, direct head-to-head evidence comparing the linea semilunaris and lateral approaches in caesarean section patients remains very limited. The advantages reported to date are largely derived from anatomical extrapolation and findings from studies conducted in non-caesarean populations or using non-comparative study designs, and therefore cannot be regarded as definitive clinical superiority. Consequently, large-scale randomized

controlled trials with standardized protocols—particularly regarding dosing, ultrasound technique, local anesthetic volume, and both short- and long-term pain outcomes—are needed to establish the effectiveness and safety of the linea semilunaris approach in the obstetric population. Until such evidence is available, this technique should be considered a promising yet still investigational approach rather than a definitive standard of care.

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Conflict of Interest

The author(s) report no conflict of interest.

Data Availability Statement

No new data were generated or analysed in this study.

Author's Contributions

Conseptualization: LROR, PK. Methodology: LROR. Literature search: LROR. Data curation: LROR. Writing – original draft: LROR. Writing – review & editing: PK. Supervision: PK. All authors have read and approved the final version of the manuscript.

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