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A Randomized Controlled Trial Comparing Preservative-Free Intrathecal Morphine and Surgical Site Local Anesthetic Infiltration Combined with Conventional Analgesia for Post-Cesarean Section Pain Management

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P. I.: Conceptualization, methodology, data collection, analysis, drafting, and coordination. E. K.: Methodology, clinical investigation, data collection, and manuscript revision. F. I.: Investigation, data analysis, interpretation, and manuscript revision. Prof. A. A. O.: Supervision, methodology, validation, project administration and critical manuscript revision. All authors approved the final manuscript.

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ABSTRACT

Background: Effective pain control after cesarean section (CS) supports early ambulation and maternal recovery. Preservative-free intrathecal morphine provides prolonged analgesia but causes opioid-related side effects. Surgical-site local anesthetic infiltration with conventional analgesia offers an alternative.

Aim: To compare the efficacy and safety of intrathecal morphine versus surgical-site local anesthetic infiltration combined with conventional analgesia following CS.

Methods: This prospective randomized controlled trial at Kibogora Level Two Teaching Hospital, Rwanda, assessed pain using visual analog scores (VAS) at 2, 6, 12, and 24 hours. Secondary outcomes included analgesic consumption, adverse effects, ambulation, and hospital stay.

Results: Preservative-free intrathecal morphine was associated with lower mean VAS pain scores at 2, 6, and 12 hours than surgical-site local anesthetic infiltration combined with conventional analgesia (all $p < 0.001$). At 24 hours, the local-anesthetic-infiltration plus conventional analgesia group had a lower mean VAS score (4.17 ± 1.10 vs 5.46 ± 1.22 ; $p < 0.001$). The intrathecal morphine group consumed fewer additional analgesic medications within 24 hours (1.30 ± 0.58 vs 3.65 ± 0.80 ; $p < 0.001$). Nausea/vomiting and pruritus were more frequent with intrathecal morphine, while sedation and respiratory depression did not differ significantly. Total opioid MME could not be reliably compared.

Conclusion: Intrathecal morphine provided superior early analgesia but more adverse effects, while local infiltration achieved better pain control at 24 hours. Individualized analgesic selection should consider effectiveness, safety, monitoring capacity, and available resources.

Keywords: Cesarean section; Intrathecal morphine; Local anesthetic infiltration; Conventional analgesia; Postoperative pain management.

INTRODUCTION

A cesarean section (CS) is a method of childbirth involving a surgical cut made in the abdominal and uterine wall to deliver the infant (1). Its rate continues to rise globally and represents a large proportion of surgical procedures performed in obstetric practice (1). In Rwanda, cesarean delivery constitutes a significant workload in the district, underscoring the importance of effective, safe, and feasible postoperative pain management strategies (4). Poorly controlled post-cesarean pain management contributes to poor maternal-infant bonding; chronic pain, postpartum depression, and prolonged hospital stay (5).

Preservative-free intrathecal morphine administered during spinal anesthesia was widely regarded as the reference standard for post-cesarean analgesia due to its potent and prolonged analgesic effect (6). Low-dose intrathecal morphine significantly reduced postoperative pain scores and supplemental opioid requirements for up to 24 hours after surgery. However, its use was associated with dose-dependent adverse effects, including pruritus, nausea, vomiting, urinary retention, and, in rare cases, delayed respiratory depression (6,7). These adverse effects necessitated close postoperative monitoring, which was challenging in low- and middle-income country settings where staffing levels and monitoring resources were often limited.

Multimodal analgesia led to improved pain control while minimizing opioid use and related adverse effects. Surgical site local anesthetic infiltration is a simple, low-cost technique that targeted incisional pain by blocking peripheral nociceptive pathways. When combined with intravenous conventional analgesia, it allowed individualized postoperative pain control while maintaining safety limits. This approach reduced peak systemic opioid exposure and improved recovery outcomes (8).

Rwanda due to the significant rise in cesarean section rates. According to available data, the rate increased from 2. 2 percent in 2000 to roughly 15. 6 percent in 2020, with some regional teaching hospitals reporting rates between 38 and 44 percent (14). Over 93% of cesarean deliveries involved the use of anesthesia; however, the use of intrathecal morphine without preservatives remained below 1%, in part due to resource constraints (14). Limitations in postoperative monitoring may also have an impact on the safe use of intrathecal morphine in other LMICs. Frequent assessment of respiratory rate and sedation may be challenging due to a lack of nursing staff and functional monitoring equipment, such as pulse oximeters. These restrictions are especially pertinent in the first 24 hours following intrathecal opioid administration, as early detection of opioid-related side effects depends on monitoring (2,14).

Problem Statement

In many situations, postoperative pain following a cesarean section is still poorly managed, which can hinder the mother's recuperation, satisfaction, and capacity to care for the infant (15). Effective postoperative analgesia is provided by intrathecal morphine; however, proper postoperative monitoring is necessary due to its possible side effects. Hospitals with limited resources may find it challenging to regularly fulfill this requirement. As part of multimodal postoperative pain management, local anesthetic infiltration at the surgical site offers an alternative strategy when paired with traditional analgesia (13). Nevertheless, there is still little data directly contrasting this strategy with intrathecal morphine in the local context. Uncertainty about the best course of action for women undergoing cesarean sections and variations in analgesic practices may be caused by a lack of locally relevant comparative evidence. Thus, this study compared intrathecal morphine with surgical-site local anesthetic infiltration in conjunction with intravenous patient-controlled analgesia in postoperative pain management after cesarean section.

METHODOLOGY

Study Design

A prospective, quantitative, parallel-group randomized controlled trial was used for this investigation. The design was suitable for establishing causal relationships while reducing bias and for directly comparing the safety and effectiveness of two postoperative analgesic strategies.

Study Setting

The study was carried out at the tertiary-level Kibogora Level Two Teaching Hospital in Rwanda, which offers full obstetric and anesthesia services. Every year, the hospital performs a significant number of cesarean deliveries, guaranteeing a sufficient patient volume for recruitment. Because spinal anesthesia was frequently used during cesarean sections, the study interventions could be applied consistently. Safe administration and monitoring were also guaranteed by the presence of qualified anesthesia providers, organized perioperative care pathways, and well-established postoperative monitoring systems. The institution was a practical and suitable setting because of its clinical infrastructure and encouraging learning environment.

Study Population

One hundred women who had elective cesarean sections at Rwanda's Kibogora Level Two Teaching Hospital under spinal anesthesia made up the study population. Ages 18 to 45 and ASA physical status I–II were among the predetermined eligibility requirements. Every participant satisfied the predetermined requirements for eligibility. Before being enrolled, each participant gave written informed consent.

Inclusion Criteria

Women in the 18–45 age range.
ASA I–II physical status.
Spinal anesthesia for an elective cesarean section.
Written informed consent provision.

Exclusion Criteria:

Contraindication to spinal anesthesia, opioids, or local anesthetics
Chronic pain conditions or long-term opioid use
Significant medical comorbidities (ASA III or higher)

Sampling Method

Participants were randomly allocated to the two study groups using a computer-generated randomization sequence with an intended allocation ratio of 1:1. The study planned to enroll 100 participants, with approximately 50 participants allocated to each group. The final randomization resulted in 54 participants being allocated to Group A (intrathecal morphine) and 46 participants to Group B (surgical site local anesthetic infiltration combined with conventional analgesia). The observed difference in group size represents the final randomization distribution and was retained in the analysis.

Group A (Intervention Group): Standard spinal anesthesia for cesarean section includes intrathecal morphine.

Group B (Comparison Group): local anesthetic infiltration at the surgical site plus Conventional analgesia Sample Size

Calculation

The two study groups were to be distributed roughly 1:1 among the 100 participants in the planned sample. 54 individuals were assigned to Group A and 46 to Group B in the final randomized allocation. The Visual Analog Scale (VAS) was used to measure postoperative pain intensity, which served as the basis for calculating the sample size. With a statistical power of 80% and a two-sided alpha level of 0.05, assuming a clinically meaningful difference of 1.0 points in mean VAS scores between groups, roughly 64–80 participants (32–40 per group) were statistically sufficient to detect a significant difference. A total sample size of 100 participants was used to guarantee sufficient statistical power and take potential attrition or incomplete data into account.

Data Collection Tools

The Visual Analog Scale (VAS), a validated 10-cm scale ranging from 0 (no pain) to 10 (worst imaginable pain), was used to measure postoperative pain. From patient medication administration charts, the total amount of opioids consumed during the first 24 hours following surgery was calculated in milligrams of intravenous morphine equivalents. Adverse effects associated with opioids were operationally documented and prospectively monitored. We measured time to first ambulation (hours from surgical completion to first mobilization) and length of hospital stay (days from surgery to discharge) using nursing documentation records.

Validity and Reliability

The validity of the outcome measurement was ensured by using standardized scale metrics (Ramsay Sedation Score and VAS). Strict randomization protocols, allocation concealment, standardized outcome evaluations, and careful postoperative monitoring to reduce bias and missing data all contributed to maintaining methodological rigor.

Data Collection

Pain scores were recorded at 2, 6, 12, and 24 hours following surgery, both at rest and during movement where applicable. Opioid-related adverse effects were prospectively monitored within 24 hours postoperatively, operationally defined as: Nausea and vomiting requiring antiemetic therapy, Pruritus requiring treatment, Sedation (defined using Ramsay Sedation Score ≥ 3), Respiratory depression (respiratory rate < 8 breaths/min or oxygen saturation $< 90\%$). A binary outcome (present/absent) was used to record the incidence of each negative effect. Nursing records were used to record the time to first ambulation and the duration of hospital stay. An intention-to-treat strategy was used. Reasons for missing data were recorded; complete case analysis was carried out if the percentage was less than 5%, and multiple imputation was taken into consideration if it was more than that.

Statistical analysis

SPSS software was used for data analysis. $P < 0.05$ was the threshold for statistical significance, and all tests were two-tailed. Means and standard deviations for continuous variables and frequencies and percentages for categorical variables were used to summarize baseline clinical and demographic characteristics. Repeated-measures analysis of variance (ANOVA) was used to analyze postoperative pain scores measured by VAS at 2, 6, 12, and 24 hours in order to evaluate differences between groups over time. Between-group comparisons at individual time points were performed using independent samples t-tests. The prespecified analysis planned comparison of total opioid consumption within 24 hours; however, this comparison was not performed because opioid-consumption data were incomplete and inconsistently documented. A separate exploratory analysis of the number of additional analgesic medications administered within 24 hours was performed using the Mann-Whitney U test. The incidence of opioid-related adverse effects was analyzed using chi-square tests. Multivariable linear regression was prespecified for continuous outcomes, and multivariable logistic regression was prespecified for categorical outcomes to adjust for potential confounders, including age, duration of surgery, parity, and indication for cesarean section; however, these regression analyses were not performed because valid final regression results were not available. An intention-to-treat approach was applied.

Ethical Considerations

The study was initially approved by the Kibogora Level Two Teaching Hospital Research Ethics Committee (77/HK/02.2026) and prospectively registered with Pan African Clinical Trials Registry (PACTR) (PACTR202604681329855); finally, Ethically approved from The Operating Room Global Institutional Review Board (TORG-IRB; approval reference TORG-RF-2025-003). All participants gave written informed consent, and confidentiality was maintained through anonymized coding. Only routine, hospital-approved analgesic protocols were used, with continuous monitoring and naloxone available. The authors declare no conflicts of interest.

RESULTS

Participant Characteristics and Analysis Population

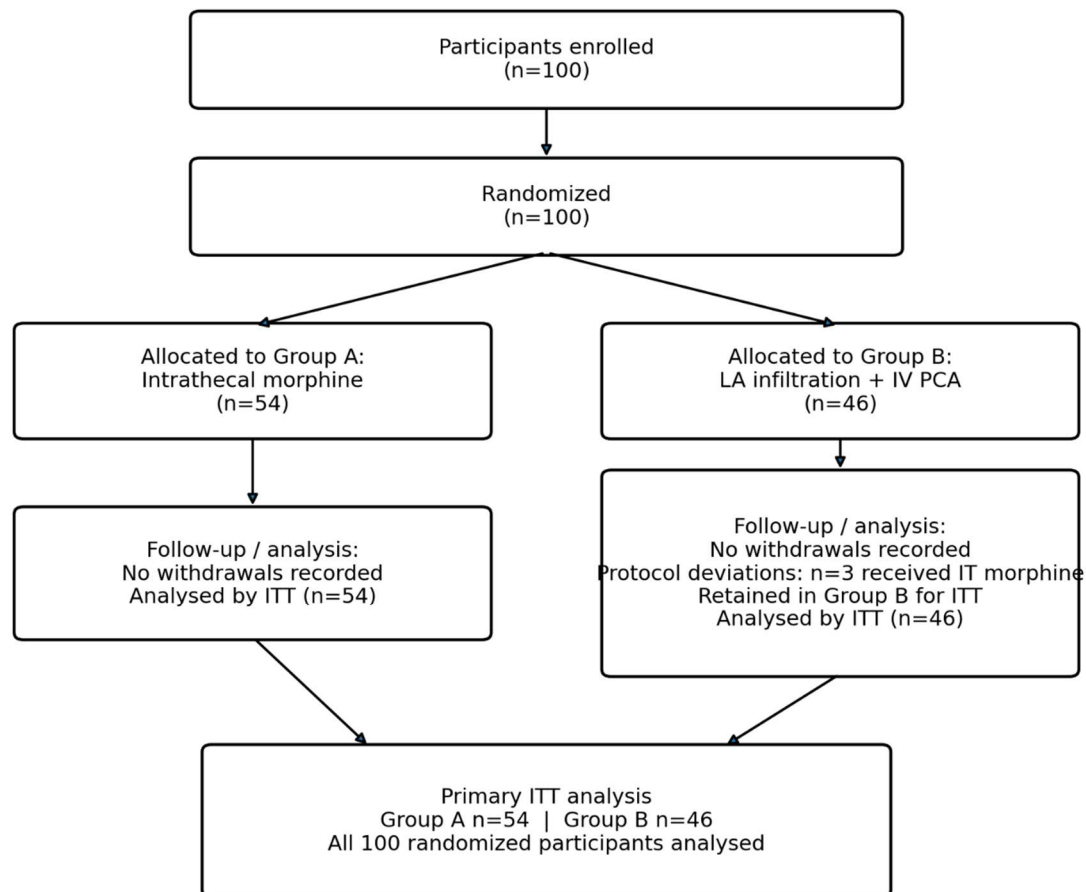
A total of 100 participants were enrolled and included in the primary intention-to-treat analysis. The final randomized-group records comprised 54 participants in Group A, which received intrathecal morphine, and 46 participants in Group B, which was assigned to surgical-site local anaesthetic infiltration combined with conventional analgesia. No participant was recorded as withdrawn.

Table 1 Baseline Characteristics of Participants by Analgesic Group

Characteristic	Group A: Intrathecal morphine (n=54)	Group B: LA infiltration+CA (n=46)	p-value
Age, years; mean $\pm$ SD	31.80 $\pm$ 6.44	30.65 $\pm$ 5.82	0.354
Weight, kg; mean $\pm$ SD	65.83 $\pm$ 7.95	72.13 $\pm$ 11.05	0.002
Parity, n (%)	Primigravida:4(7.4%) Multigravida:50(92.6%)	Primigravida:6(13.0%) Multigravida:40(87.0%)	0.547
Duration of surgery, hours; mean $\pm$ SD*	0.95 $\pm$ 0.48	0.78 $\pm$ 0.22	0.020
Indication for cesarean section, n (%)	Previous uterine scar: 38(70.4%) Cephalopelvic disproportion:5(9.3%) Fetal malpresentation: 5(9.3%) Fetal distress:3 (5.6%) Failed induction:2 (3.7%) Recent laparotomy:1 (1.9%)	Previous uterine scar:31(67.4%) Cephalopelvic disproportion:5(10.9%) Fetal malpresentation: 4(8.7%) Fetal distress: 3 (6.5%) Failed induction:1 (2.2%) Preeclampsia: 1 (2.2%) Twin pregnancy:1 (2.2%)	0.831
ASA II, n (%)	54 (100%)	46 (100%)	—

Age was comparable between groups. Group B had a higher mean body weight than Group A (72.13 $\pm$ 11.05 kg vs 65.83 $\pm$ 7.95 kg; $p=0.002$). Mean duration of surgery was also longer in Group A (0.95 $\pm$ 0.48 hours vs 0.78 $\pm$ 0.22 hours; $p=0.020$).

Figure 1 CONSORT Participant Flow Diagram



Primary findings

The present study demonstrated a time-dependent difference in postoperative pain intensity between the two analgesic strategies. Participants who received preservative-free intrathecal morphine had lower mean VAS pain scores at 2, 6, and 12 hours after cesarean delivery compared with those who received surgical-site local anesthetic infiltration combined with conventional analgesia. The mean VAS scores in the intrathecal morphine group were 0.93, 1.59, and 2.69 at 2, 6, and 12 hours, respectively, compared with 2.57, 4.52, and 6.37 in the local anesthetic infiltration plus IV PCA group. These findings indicate that intrathecal morphine provided more effective analgesia during the early postoperative period.

6. Primary Outcome — VAS Pain at Rest

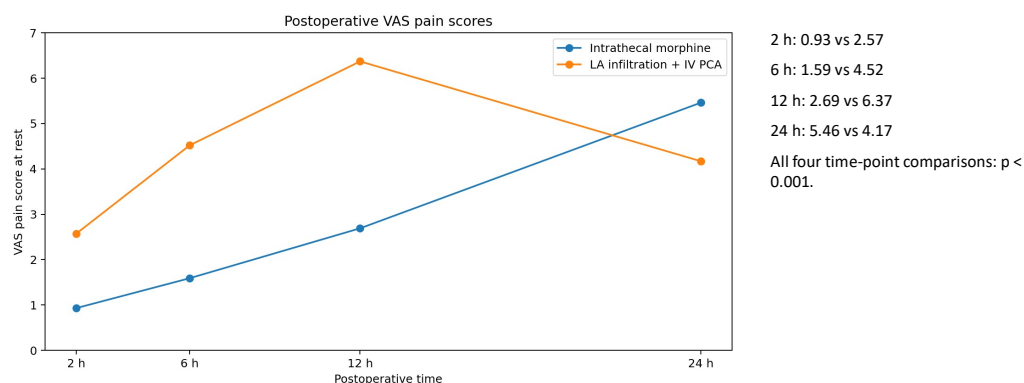


Figure 2 Mean Postoperative VAS Pain Scores at 2, 6, 12, and 24 Hours by Analgesic Group**Protocol Deviations**

Three participants randomized to the surgical-site local anesthetic infiltration plus conventional analgesia (Group B) received intrathecal morphine during their perioperative management. These cases were considered protocol deviations because intrathecal morphine was not the analgesic strategy assigned to Group B. Importantly, the participants were retained in their original randomized group (Group B) for the primary intention-to-treat analysis. The primary analysis was conducted according to the intention-to-treat principle, whereby all participants were analyzed according to their original randomized allocation, irrespective of protocol deviations or the intervention actually received. Thus, the three participants randomized to Group B who received intrathecal morphine were retained in Group B for the primary analysis.

Table 2 Documented Protocol Deviations Among Participants Randomized to Group B

Participant	Original allocation	Specific documented reason
26	Group B	G9P8 patient scheduled for C/S + bilateral tubal ligation with adhesions associated with a previous cesarean scar. Because of the anticipated prolonged and technically complex procedure, intrathecal morphine was used as part of clinical anesthesia management to provide a more extensive and prolonged spinal analgesic effect rather than according to the research analgesia protocol.
50	Group B	Scheduled case that developed bleeding on the morning of surgery, with suspected placenta previa and concern for placenta accreta and possible hysterectomy. Because a prolonged surgical and anesthetic procedure was anticipated, intrathecal morphine was administered for clinical anesthesia management rather than according to the randomized research analgesic strategy.
82	Group B	The patient provided research consent and was randomized to Group B. On the operating table, intrathecal morphine was administered instead of the planned local anesthetic infiltration based on the clinical team's judgment regarding anticipated postoperative pain and the prolonged/technically complex procedure

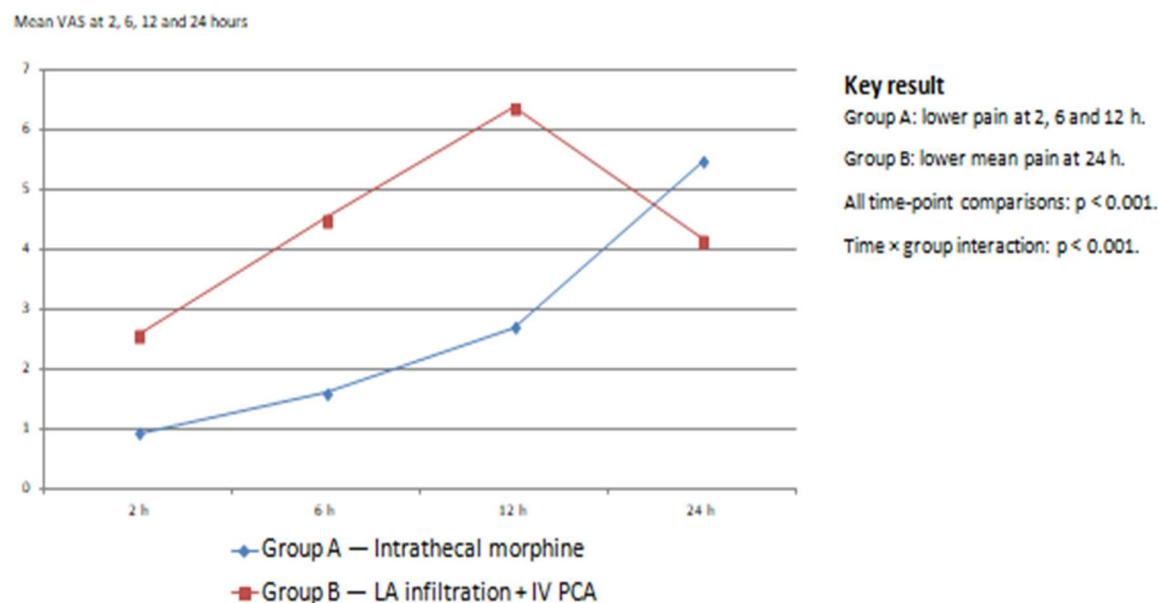
Postoperative Pain Scores

Postoperative pain scores differed significantly between the two groups at all assessment time points ($p < 0.001$). Group A (intrathecal morphine) had significantly lower mean VAS pain scores than Group B (local anesthetic infiltration plus CA) at 2 hours (0.93 ± 0.64 vs. 2.57 ± 0.89), 6 hours (1.59 ± 0.88 vs. 4.52 ± 0.94), and 12 hours (2.69 ± 1.13 vs. 6.37 ± 1.14). At 24 hours, however, the direction of the between-group difference was reversed, with Group B demonstrating a lower mean VAS pain score than Group A (4.17 ± 1.10 vs. 5.46 ± 1.22 ; $p < 0.001$). The overall mean VAS across the four postoperative assessment points was approximately 2.67 in Group A and 4.41 in Group B ($p < 0.001$). The significant treatment-by-time interaction indicates that the difference in postoperative pain between the two analgesic strategies varied significantly across the postoperative period.

Table 3 Comparison of Postoperative VAS Pain Scores Between Analgesic Groups at Different Time Points

Time	Group A mean $\pm$ SD	Group B mean $\pm$ SD	p-value
2 hours	0.93 $\pm$ 0.64	2.57 $\pm$ 0.89	<0.001
6 hours	1.59 $\pm$ 0.88	4.52 $\pm$ 0.94	<0.001
12 hours	2.69 $\pm$ 1.13	6.37 $\pm$ 1.14	<0.001
24 hours	5.46 $\pm$ 1.22	4.17 $\pm$ 1.10	<0.001

Figure 3 Mean Postoperative VAS Pain Scores Over Time by Analgesic Group



Twenty-Four-Hour Opioid Consumption

Opioid consumption 24 hours after surgery was a secondary outcome in the study protocol. However, not all participants had complete opioid consumption data. For some participant IDs in Group A (intrathecal morphine, $n=54$), opioid consumption data was lacking. The study opioid used in this group was intrathecal morphine; no other opioids were regularly given. As a result, it was not possible to determine the full 24-hour opioid consumption for every member of Group A using the records that were available. Additional opioid doses were recorded in both milligrams (mg) and micrograms (mcg) in Group B (local anesthetic infiltration plus conventional analgesia, $n=46$). However, a valid between-group comparison of total 24-hour opioid consumption could not be carried out because comparable and complete opioid-consumption information was not available for all participants in Group A.

Four participants had documented rescue opioid administration within 24 hours with 1 (1.9%) participants in Group A and 3 (6.5%) participants in Group B. The remaining participants had no documented opioid administration though they all received analgesia for pain management within 24 hours. However, participants with incomplete opioid documentation were not classified as opioid-free, and missing values were not converted to zero or estimated.

Due to the incomplete and inconsistent documentation of the available opioid records, the planned comparison of total 24-hour opioid consumption could not be completed in a reliable manner. As a result, the final dataset did not provide a definitive answer to this goal.

Exploratory Analysis of Additional Analgesic Consumption Within the First 24 Hours

As an exploratory analysis, the number of additional analgesics consumed within the first 24 hours after surgery was assessed separately from the planned 24-hour opioid-consumption outcome. The analysis used the variable

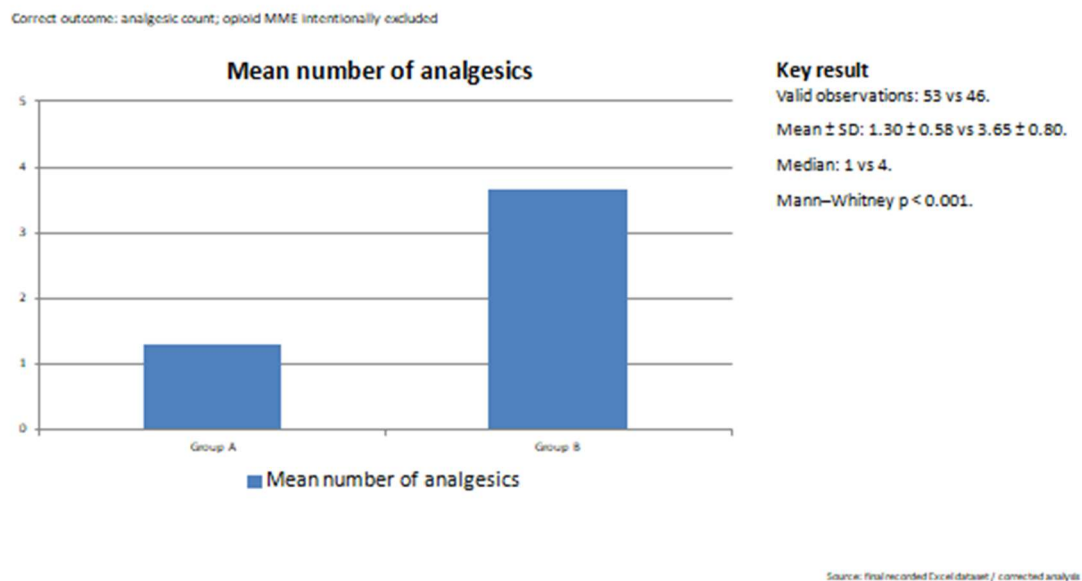
Number_of_analgesics_consumed_in_24hrs from the completed dataset. Analgesic use was determined from the documented medications administered and was not converted into or interpreted as total opioid consumption. Complete analgesic-use data were available for all 100 participants, comprising 54 participants in Group A and 46 in Group B. Group A had a significantly lower number of additional analgesics consumed within the first 24 hours compared with Group B. The mean number of analgesics consumed was 1.30 ± 0.58 in Group A compared with 3.65 ± 0.80 in Group B (Mann–Whitney $U = 61.5$, $p < 0.001$). The median number of analgesics consumed was 1 in Group A and 4 in Group B.

Among valid observations, 75.5% of participants in Group A consumed exactly one additional analgesic, whereas 84.8% of participants in Group B consumed between three and five analgesics. The documented medications included NSAIDs like diclofenac, paracetamol, and tramadol, pethidine 25mg as an opioid and small doses of fentanyl. The exploratory analysis demonstrated that participants receiving intrathecal morphine consumed fewer additional analgesic medications during the first 24 hours. This variable represents the number of medications administered and should not be interpreted as a measure of total opioid dose or morphine-equivalent consumption.

Table 4 Exploratory Analysis of Additional Analgesic Consumption Within the First 24 Hours

Measure	Group A	Group B	p-value
Valid participants	54	46	—
Mean $\pm$ SD	1.30 ± 0.58	3.65 ± 0.80	<0.001
Median	1	4	—
Mann–Whitney U	61.5	—	<0.001

Figure 4 Mean Number of Additional Analgesics Consumed Within the First 24 Hours



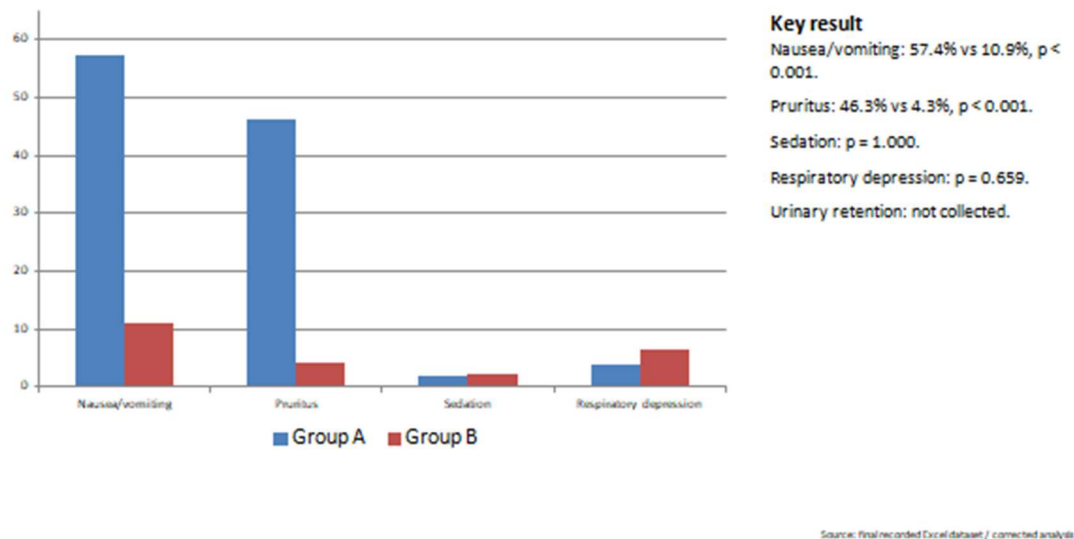
Opioid-Related Adverse Effects

The present study found a significantly higher occurrence of nausea/vomiting and pruritus among participants receiving intrathecal morphine. These findings support the importance of appropriate postoperative monitoring when intrathecal morphine is used, while also demonstrating that clinically important respiratory depression was infrequent in this study.

Table 5 Comparison of Opioid-Related Adverse Effects Between the Two Analgesic Groups

Adverse effect	Group A n/N (%)	Group B n/N (%)	p-value
Nausea/vomiting	31/54 (57.4%)	5/46 (10.9%)	<0.001
Pruritus	25/54 (46.3%)	2/46 (4.3%)	<0.001
Sedation	1/54 (1.9%)	1/46 (2.2%)	1.000
Respiratory depression	2/54 (3.7%)	3/46 (6.5%)	0.659

Figure 5 Comparison of Opioid-Related Adverse Effects Between the Two Analgesic Groups

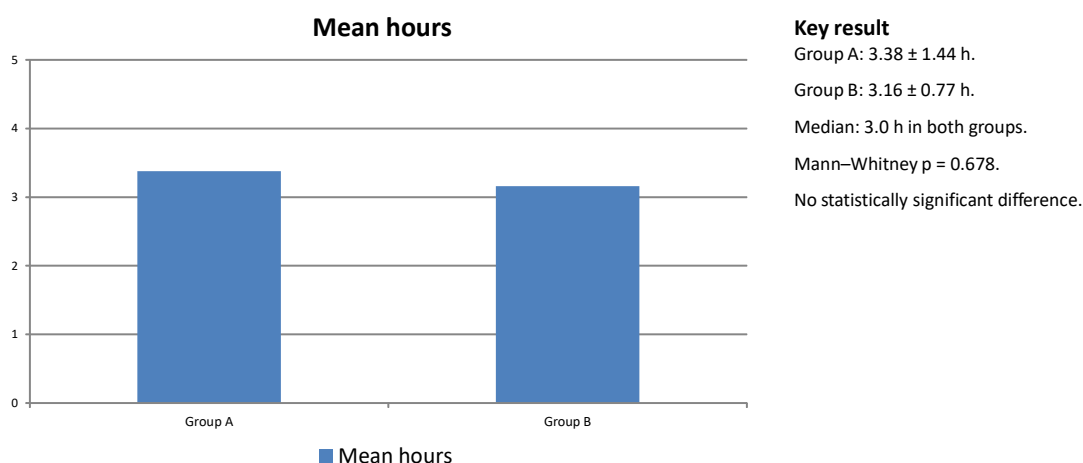


Time to First Ambulation

Using the exact dataset variable Hours from end of surgery to first ambulation, Group A had a mean time to ambulation of 3.38 ± 1.44 hours, compared with 3.16 ± 0.77 hours in Group B. The difference was not statistically significant (Mann–Whitney $p=0.678$). Both groups had a median ambulation time of 3.0 hours

Figure — Time to first ambulation (Objective 4)

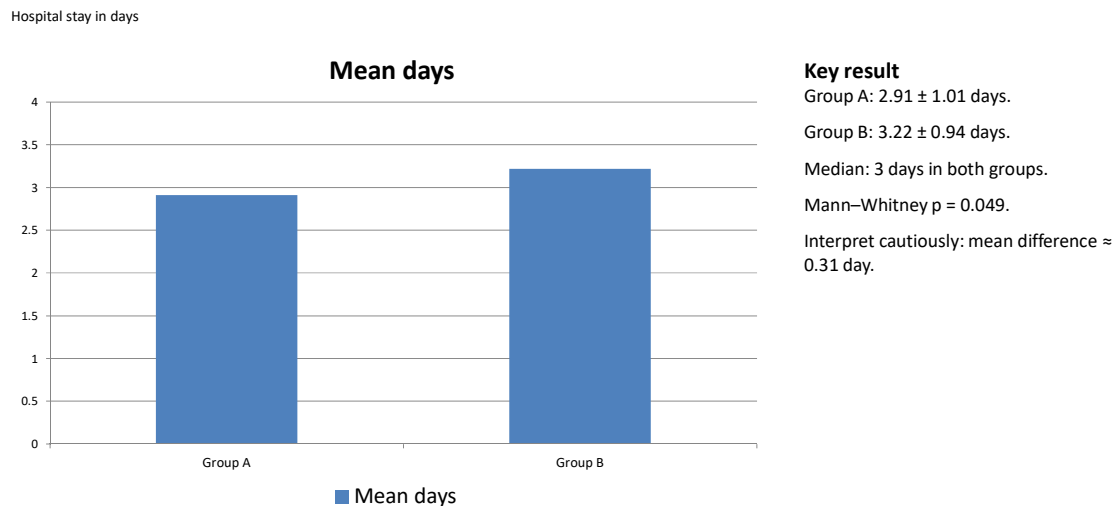
Hours from end of surgery to first ambulation — exact Excel field



Length of Hospital Stay

The mean length of hospital stay was 2.91 ± 1.01 days in Group A and 3.22 ± 0.94 days in Group B. The Mann–Whitney U test demonstrated statistically significant difference between the groups ($U = 973$, $p = 0.049$). However, the median length of hospital stay was 3 days in both groups, and the absolute difference in mean length of stay was only 0.31 day. The difference reached the prespecified threshold for statistical significance ($p=0.049$), although the absolute difference was small (0.31 day) and its clinical significance is uncertain.

Figure 7 Comparison of Mean Length of Hospital Stay Between the Two Analgesic Groups



Source: final recorded Excel dataset / corrected analysis

Summary of Findings by Objective

Table 6 Summary of Findings According to Study Objectives

Objective	Main finding
1. Pain scores	Group A had lower pain scores at 2, 6, and 12 hours; Group B had a lower mean score at 24 hours; all $p < 0.001$.
2. Total opioid consumption within 24 hours	Could not be reliably compared between groups because opioid-consumption data were incomplete and inconsistently documented.
3. Adverse effects	Nausea/vomiting and pruritus were significantly more frequent with intrathecal morphine.
4. Ambulation	No significant difference in time to first ambulation, $p=0.678$.
5. Hospital stay	Group A had a slightly shorter distribution of hospital stay, $p=0.049$, but both medians were three days.
Exploratory analysis	Group A received fewer additional analgesic medications within 24 hours than Group B (mean 1.30 vs 3.65; $p < 0.001$). This should not be interpreted as total opioid consumption

Table 7 Summary of Study Outcomes by Analgesic Group

Objective	Intrathecal morphine group	LA infiltration + CA group	Statistical result	Interpretation
Pain at 2 h	0.93 ± 0.64	2.57 ± 0.89	$p < 0.001$	Morphine clearly better

Objective	Intrathecal morphine group	LA infiltration + CA group	Statistical result	Interpretation
Pain at 6 h	1.59 ± 0.88	4.52 ± 0.94	p < 0.001	Morphine clearly better
Pain at 12 h	2.69 ± 1.13	6.37 ± 1.14	p < 0.001	Morphine clearly better
Pain at 24 h	5.46 ± 1.22	4.17 ± 1.10	p < 0.001	LA + PCA better at 24 h
Total opioid consumption within 24 h	Not reliably estimable	Not reliably estimable	Not compared	Prespecified outcome could not be reliably analysed because of incomplete opioid-consumption data
Nausea and vomiting	31/54 (57.4%)	5/46 (10.9%)	p < 0.001	More common with morphine
Pruritus	25/54 (46.3%)	2/46 (4.3%)	p < 0.001	More common with morphine
Sedation	1/54 (1.9%)	1/46 (2.2%)	p = 1.000	No difference
Respiratory depression	2/54 (3.7%)	3/46 (6.5%)	p = 0.659	No significant difference
4.First ambulation	3.38 ± 1.44 h	3.16 ± 0.77 h	p = 0.678	No significant difference
Hospital stay	2.91 ± 1.01 days	3.22 ± 0.94 days	p = 0.049	Small difference favoring morphine

DISCUSSION

To manage postoperative pain after cesarean section, this randomized controlled trial compared preservative-free intrathecal morphine (Group A) with surgical-site local anesthetic infiltration combined with conventional analgesia (Group B). Intrathecal morphine significantly improved early postoperative analgesia, with lower mean VAS pain scores at 2, 6, and 12 hours after surgery, according to the study's main findings. At 24 hours, Group B showed a noticeably lower mean VAS pain score, indicating that this analgesic benefit was not sustained. Overall, rather than always showing a consistent superiority of one strategy, these results suggest that the relative efficacy of the two analgesic strategies varied throughout the postoperative period.

The superior early analgesic effect observed with intrathecal morphine is explained with evidence from previous obstetric anesthesia studies. Intrathecal morphine is well established as an effective neuraxial component of multimodal analgesia following cesarean delivery because it provides prolonged spinal analgesia while reducing the need for additional systemic analgesic medication (2,4,5,6,10,13). Sultan et al. demonstrated that intrathecal morphine improves postoperative analgesia following cesarean delivery and can reduce the requirement for additional systemic opioids (2). Similarly, Roofthoof and Van de Velde described intrathecal morphine as an effective approach for providing sustained post-cesarean analgesia, while emphasizing the need to balance analgesic efficacy against opioid-related adverse effects (10). The current findings therefore support the established role of intrathecal morphine as an important component of multimodal analgesia after cesarean delivery although it is associated with opioid-related adverse effects and requires adequately trained staff and appropriate monitoring.

In the present study, the mean VAS pain scores in Group A were 0.93 ± 0.64 at 2 hours, 1.59 ± 0.88 at 6 hours, and 2.69 ± 1.13 at 12 hours, compared with 2.57 ± 0.89 , 4.52 ± 0.94 , and 6.37 ± 1.14 , respectively, in Group B. The progressively lower pain scores observed in the intrathecal morphine group during the first 12 hours are also consistent with the pharmacological characteristics of neuraxial morphine. Intrathecal administration allows morphine to act directly within the spinal cord, producing prolonged analgesia and reducing the need for systemic opioid administration. Sultan et al. further demonstrated that the dose of intrathecal morphine influences postoperative analgesic outcomes, although higher doses must be balanced against the risk of opioid-related adverse effects (8). Consequently, the

relatively low pain scores observed in the intrathecal morphine group during the early postoperative period are clinically plausible and consistent with previous research. All between-group differences were statistically significant ($p < 0.001$). These results demonstrate a substantial early analgesic advantage associated with intrathecal morphine. The findings are compatible with the broader evidence supporting neuraxial morphine as an important component of multimodal post-cesarean analgesia (2,4,5,9,13). The dose-dependent analgesic effects of intrathecal morphine reported by Sultan et al. also provide a pharmacological basis for its effectiveness during the early postoperative period (8).

An important finding was the reversal of the between-group pain-score difference at 24 hours. At this time point, Group B had a lower mean VAS score than Group A (4.17 ± 1.10 vs. 5.46 ± 1.22 ; $p < 0.001$). This finding should be interpreted in the context of the different analgesic strategies used in the two groups. Group B received local anesthetic infiltration together with IV PCA and other documented analgesic medications, providing continued multimodal analgesic support during the postoperative period. Local anesthetic wound infiltration has been shown to have a role in post-cesarean analgesia, particularly when incorporated into multimodal analgesic regimens (7,9,12). Therefore, the lower 24-hour pain score in Group B should not be interpreted as evidence that local anesthetic infiltration alone is superior to intrathecal morphine. Rather, it indicates that the relative analgesic effect of the two complete treatment strategies changed over time. This finding further supports the importance of assessing postoperative pain at multiple clinically relevant time points rather than relying on a single postoperative measurement.

The findings are also in agreement with recommendations emphasizing the use of neuraxial opioids as part of multimodal post-cesarean analgesia. The Society for Obstetric Anesthesia and Perinatology consensus statement recognizes neuraxial morphine as an effective strategy for post-cesarean pain control while emphasizing appropriate monitoring and multimodal analgesic therapy (13). Carvalho and Butwick similarly identify neuraxial morphine as an important component of post-cesarean analgesia, particularly when combined with non-opioid analgesics and other opioid-sparing approaches (5,6). Bollag et al. also emphasize the importance of individualized, multimodal strategies to achieve adequate analgesia while minimizing opioid-related adverse effects (4).

However, an important finding in the present study was the reversal of the pain-score pattern at 24 hours supporting Carvalho and Butwick similarly identify neuraxial morphine as an important component of post-cesarean analgesia, particularly when combined with non-opioid analgesics and other opioid-sparing approaches (5,6). as this reversal was showing need of other non-opioid analgesics and other opioid-sparing approaches. At this time point, the local anesthetic infiltration plus CA group had a lower mean VAS score than the intrathecal morphine group (4.17 versus 5.46) as there was continued analgesic administration that may have contributed to the lower pain score observed in Group B at 24 hours. This indicates that the relative analgesic benefit of the two strategies varied across the postoperative period. Therefore, the present results should not be interpreted as demonstrating that intrathecal morphine was universally superior throughout the entire 24-hour period. Rather, intrathecal morphine demonstrated a stronger analgesic effect during the early postoperative period, whereas the comparator strategy was associated with a lower mean pain score at 24 hours.

This late difference may partly be explained by the continued availability of conventional in the comparator group. The intervention being evaluated was not local anesthetic infiltration alone but rather local anesthetic infiltration combined with conventional analgesia. Thus, the analgesic effect observed at 24 hours represents the combined contribution of these interventions. Previous literature supports the role of multimodal analgesia in improving post-cesarean pain control and reducing reliance on systemic opioids (9). Siwicki et al. also reported favorable postoperative pain outcomes with the implementation of a multimodal pain-control protocol following cesarean delivery (3).

The present findings should also be considered in relation to evidence concerning local anesthetic wound infiltration. Adesope et al. reported that local anesthetic wound infiltration can provide postoperative analgesic benefits following cesarean section, particularly as part of a multimodal analgesic regimen (7). Similarly, Abdallah et al. demonstrated that wound infiltration is a relevant regional analgesic technique for post-cesarean pain management, although its

comparative effectiveness depends on the overall analgesic regimen in which it is used (12). Therefore, while it shouldn't be solely attributed to local infiltration, the lower 24-hour VAS score seen in the local anesthetic infiltration plus conventional group is consistent with prior research supporting multimodal approaches.

Importantly, the results of the present study demonstrate why postoperative pain should be assessed at multiple time points rather than at a single endpoint. The two pain trajectories crossed during the 24-hour follow-up period. Intrathecal morphine was associated with substantially better pain control at 2, 6, and 12 hours, while the local anesthetic infiltration plus conventional group had a lower mean pain score at 24 hours. This temporal variation is clinically relevant because adequate post-cesarean analgesia should provide effective pain relief throughout the postoperative recovery period and facilitate maternal recovery, mobilization, and participation in newborn care (4,5,13).

The findings are particularly relevant in the Rwandan context. Habimana Sibomana et al. reported concerns regarding the quality of post-cesarean pain management in a referral hospital in Kigali, highlighting the continuing importance of optimizing postoperative analgesic practices in Rwanda (11). In this context, the present study provides locally generated evidence that intrathecal morphine can provide effective early postoperative analgesia, while multimodal strategies incorporating local anesthetic infiltration and IV PCA may contribute to pain control later in the postoperative period especially in LMICs.

Additional evidence of the distinctions between the two treatment approaches came from the exploratory analysis of additional analgesic use. Group A consumed an average of 1.30 ± 0.58 additional analgesics during the first 24 hours, while Group B consumed an average of 3.65 ± 0.80 , with median values of 1 and 4. The difference was statistically significant ($p < 0.001$, Mann-Whitney $U = 61.5$). Among valid observations, 75.5% of participants in Group A consumed exactly one additional analgesic, whereas 84.8% of participants in Group B consumed between three and five additional analgesic medications. The documented medications included diclofenac, tramadol, pethidine, paracetamol, and small doses of fentanyl that sometimes given intraoperatively as documented in data set. These findings suggest that participants receiving intrathecal morphine required fewer additional analgesic medications during the first 24 hours. This observation is consistent with previous evidence demonstrating the opioid-sparing and analgesic benefits of intrathecal morphine as part of multimodal post-cesarean analgesia (2,9,10). However, this variable should not be used as a direct indicator of opioid consumption because it represented the quantity of analgesic drugs rather than opioid dosage or morphine-equivalent consumption.

The planned comparison of total opioid consumption within the first 24 hours could not be reliably completed because the opioid-consumption variable was incomplete according to dataset. In Group A, intrathecal morphine constituted the study opioid and additional opioid administration was not routinely documented in a manner that allowed complete determination of total 24-hour opioid exposure for all participants. In Group B, additional opioid doses were documented, but the recorded doses were expressed using different units, including milligrams and micrograms. As a result, a valid between-group comparison of total 24-hour opioid consumption was not possible due to the lack of a sufficiently complete and standardized basis in the available data. Therefore, missing opioid values were not estimated or converted to zero; instead, they were kept as missing. This limitation is important because it means that the original opioid-consumption objective cannot be considered adequately answered by the present dataset. The exploratory analysis of the number of additional analgesics was consequently reported separately and should not be presented as a substitute for the planned opioid-consumption outcome.

With respect to safety, nausea/vomiting and pruritus were significantly more frequent in Group A. Nausea/vomiting occurred in 31/54 (57.4%) participants in Group A compared with 5/46 (10.9%) in Group B ($p < 0.001$), while pruritus occurred in 25/54 (46.3%) and 2/46 (4.3%), respectively ($p < 0.001$). At least one of the four recorded adverse effects occurred in 43 (79.6%) participants in Group A compared with 9 (19.6%) in Group B ($p < 0.001$). These findings are consistent with the recognized adverse-effect profile of neuraxial morphine, particularly pruritus and nausea/vomiting (2,8,10,13). And as described by Sultan et al. (2021), Roofthoof and Van de Velde (2018), and the Society for Obstetric Anesthesia and Perinatology consensus statement (Bollag et al., 2023). Thus, although intrathecal

morphine demonstrated superior early analgesic efficacy, this benefit was accompanied by a greater burden of these opioid-related adverse effects that need adequate staffs and monitoring equipment.

Sedation and respiratory depression, on the other hand, were rare and showed little variation between the groups. 1/54 (1.9 percent) of participants in Group A and 1/46 (2.2 percent) in Group B experienced sedation ($p = 1.000$), whereas 2/54 (3.7 percent) and 3/46 (6.5 percent), respectively, experienced respiratory depression ($p = 0.659$). Regarding the frequency of severe respiratory adverse effects noted in this study, these results are comforting. Nevertheless, the relatively small number of participants and the low frequency of these outcomes limit the ability of the study to detect meaningful differences in rare, serious complications. Therefore, these findings should not be interpreted as demonstrating that the two strategies have equivalent safety profiles for rare adverse events. Appropriate postoperative monitoring remains important when neuraxial opioids are administered, as emphasized in recommendations for post-cesarean analgesia (10,13).

The time to first ambulation did not differ statistically significantly between the two groups ($p = 0.678$). Thus, the final analysis does not support the earlier hypothesis that one analgesic strategy led to earlier ambulation. This result suggests that although there was a significant variation in early pain scores and the need for additional analgesics, there was no statistically significant difference in postoperative mobilization in this study. Beyond pain management, several factors affect ambulation following cesarean delivery, including postoperative recuperation, obstetric factors, nursing practices, and institutional care pathways.

A statistically significant difference was observed in length of hospital stay, with a mean stay of 2.91 ± 1.01 days in Group A compared with 3.22 ± 0.94 days in Group B (Mann-Whitney $U = 973$, $p = 0.049$). However, both groups had a median hospital stay of 3 days, and the absolute difference in mean stay was only 0.31 day. Consequently, although the statistical analysis identified a difference between the groups, the magnitude of this difference was small, and its clinical relevance is uncertain. Hospital discharge following cesarean delivery is influenced by factors beyond postoperative analgesia, and the present finding should therefore not be interpreted as evidence of a clinically important reduction in hospitalization associated with intrathecal morphine.

The baseline characteristics showed that the two groups were comparable with respect to age and ASA classification, although a significant difference in body weight was observed. Mean body weight was 65.83 ± 7.95 kg in Group A and 72.13 ± 11.05 kg in Group B ($p = 0.001$), while mean age did not differ significantly (31.80 ± 6.44 vs. 30.65 ± 5.82 years; $p = 0.357$). The imbalance in body weight should therefore be acknowledged when interpreting the findings, particularly because patient characteristics may influence postoperative analgesic requirements and pain perception. Participants who were randomly assigned to Group B had three documented protocol deviations. Instead of the prescribed local anesthetic infiltration plus conventional approach, these patients received intrathecal morphine as part of perioperative clinical management. According to the initial randomized allocation, these deviations were kept in the Group B analysis under the intention-to-treat principle, maintaining the treatment-assignment foundation of the randomized comparison. However, the deviations raise the possibility of treatment contamination and should be taken into account when analyzing the results.

Overall, the findings indicate that preservative-free intrathecal morphine provided significantly better early postoperative pain control and was associated with substantially fewer additional analgesic medications during the first 24 hours, but this benefit was accompanied by significantly greater frequencies of nausea/vomiting and pruritus. The local anesthetic infiltration plus conventional analgesia group showed a lower mean pain score at 24 hours, but the analgesic benefit was not sustained after the first 12 postoperative hours. The time to first ambulation did not differ significantly, but the statistically significant difference in hospital stay was negligible in absolute terms. These results show that intrathecal morphine is an effective part of multimodal post-cesarean analgesia (2,4,5,6,9,10,13) and that local anesthetic infiltration and multimodal analgesic strategies may play a role (7,9,12).

Importantly, the study does not provide a valid comparison of total 24-hour opioid consumption because of incomplete and inconsistently recorded opioid data. Therefore, the principal conclusion should focus on the

demonstrated superior early analgesic effect of intrathecal morphine and its lower requirement for additional analgesic medications, together with its higher frequency of nausea/vomiting and pruritus. The findings support a balanced, multimodal approach to post-cesarean pain management in which the choice of analgesic strategy considers both the magnitude and duration of analgesia and the associated adverse-effect profile. In resource-limited settings, such considerations are particularly relevant because the feasibility of postoperative monitoring, availability of medications, and local institutional protocols may influence the selection of an appropriate analgesic strategy (11,14).

CLINICAL IMPLICATIONS

If proper monitoring and treatment of opioid-related side effects are available, intrathecal morphine can be helpful when strong early analgesia and fewer supplemental analgesic requirements are priorities. When minimizing the negative effects of neuraxial opioids is a top concern, local anesthetic infiltration in conjunction with traditional analgesia is a reasonable substitute. The decision should be made on an individual basis based on the complexity of the procedure, the patient's characteristics, the staff and monitoring resources that are available, and clinical judgment.

STRENGTHS

By using a prospective, parallel-group randomized controlled design, selection bias was reduced and the internal validity of between-group comparisons was reinforced. To enable consistent, temporally resolved comparisons across groups, pain was assessed using a standardized assessment tool at predetermined postoperative intervals (2, 6, 12, and 24 hours). To minimize bias from post-randomization exclusions and maintain the integrity of randomization, the primary analysis adhered to the intention-to-treat principle. A separate exploratory analysis of documented additional analgesic use was carried out to contextualize, rather than mask, the incompleteness in the 24-hour opioid-consumption data. The precise end-of-surgery-to-first-ambulation interval was used to measure functional recovery for Objective 4, offering a precise and clinically meaningful outcome measure as opposed to a categorical approximation. Each of the three protocol deviations that took place was separately recorded, enabling a transparent evaluation of their possible impact on the results. Finally, this study fills a long-standing gap in the literature by producing context-specific evidence from a setting with limited resources and provides results that are directly applicable to similar clinical settings.

LIMITATIONS

Additionally, there are several limitations with this study that should be taken into account when interpreting the results. The results may not be as applicable to other clinical settings or populations due to the single-center design. Due to the impossibility of complete blinding, assessment or performance bias may have been introduced. Furthermore, there was an imbalance in group size as the final randomized-group counts were 54 and 46 instead of the planned 50/50 distribution. Intrathecal morphine was administered to three participants in Group B for documented clinical reasons, which deviated from the established protocol. Due to incomplete and inconsistent documentation of opioid consumption, it was not possible to reliably compare the predetermined 24-hour opioid-consumption outcome between groups. Lastly, the study's ability to make firm conclusions about these safety endpoints was limited by the infrequent occurrence of rare outcomes like respiratory depression.

CONCLUSION

After a cesarean section, preservative-free intrathecal morphine offered better early postoperative analgesia and was linked to significantly lower analgesic use in the first 24 postoperative hours. The main drawback was a markedly increased frequency of pruritus and nausea/vomiting. Respiratory depression and sedation were rare and did not differ much. Combining local anesthetic infiltration with traditional analgesia offered a successful substitute, especially when reducing the negative effects of neuraxial opioids is a top concern. The time to first ambulation was not significantly improved, and although the hospital-stay difference was marginally statistically significant, it was still quite small.

Overall, the findings support a balanced and individualized approach to post-cesarean analgesia rather than universal replacement of one strategy by the other.

RECOMMENDATIONS

These findings allow for several recommendations. While local anesthetic infiltration combined with conventional analgesia should be considered when reduction of nausea, vomiting, and pruritus or avoidance of neuraxial opioids is a clinical priority, intrathecal morphine may be considered when strong early analgesia is prioritized and appropriate monitoring resources are available. While maintaining the original randomized allocation for the primary intention-to-treat analysis, any deviation from the randomized analgesic protocol should be recorded with the patient-specific clinical rationale. Hospitals may use multimodal analgesic protocols, such as local anesthetic infiltration combined with conventional analgesia, as a post-cesarean pain management option in resource-constrained settings, especially when monitoring resources for neuraxial opioids are limited. The selection of multimodal analgesic strategies should take institutional protocols, monitoring capacity, and local resources into consideration. Standardized multimodal analgesia pathways should be included in clinical training programs and institutional guidelines to maximize patient safety and maternal recovery. Lastly, to further assess patient satisfaction, breastfeeding outcomes, functional recovery, cost-effectiveness, and rare, serious adverse events, as well as to confirm the generalizability and health-economic implications of these findings, larger multicenter randomized controlled trials across various district and regional hospitals in low- and middle-income countries are advised.

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AUTHORS' CONTRIBUTIONS

Pacifique Ishimwe: Conceptualization, methodology, investigation, data collection, analysis, original draft, and project administration.

Eric Kwizera: Methodology, investigation, clinical research support, data collection, interpretation, and manuscript review and editing.

Fidele Ishimwe: Investigation, data curation, formal analysis, interpretation, and manuscript review and editing.

Prof. Adebisola Adenike Owokole: Supervision, methodology, manuscript review and editing, and critical intellectual revision.

CONFLICT OF INTERESTS

The authors declare no conflicts of interest relevant to the content of this manuscript.

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DATA AVAILABILITY

The data generated and analyzed during this study are not publicly available due to ethical, confidentiality, and privacy considerations. The data may be available from the corresponding authors upon reasonable request and subject to the approval of the relevant institutional and ethical authorities.

ETHICAL APPROVAL

Kibogora Level Two Teaching Hospital Research Ethics Committee approved this study with 77/HK/02.2026 as reference and ethically approved by the Institutional Review Board of The Operating Room Global (TORG-IRB; approval reference TORG-RF-2025-003). The study was prospectively registered with PACTR (PACTR202604681329855). Written informed consent was obtained from all study participants before enrollment in the study. All study procedures were conducted in accordance with the approved research protocol and applicable ethical requirements.

USE OF ARTIFICIAL INTELLIGENCE

During the preparation of this manuscript, the authors used Google Gemini solely to assist with restructuring, formatting and improving the clarity and language of the manuscript. Gemini was not used to generate, collect, analyze, or interpret the study data, statistical results, or scientific conclusions. All data, analyses, interpretations, and conclusions are based on the authors' original research. The authors reviewed and edited the AI-assisted text and take full responsibility for the accuracy, integrity, originality, and final content of the manuscript.

REFERENCES

1. Thomaidi S, Sarantaki A, Tzitziridou Chatzopoulou M, Orovou E, Jotautis V, Papoutsis D. The rising global cesarean section rates and their impact on maternal and child health: a scoping review. *J Clin Med*. 2025;14(22):8102. DOI: 10.3390/jcm14228102.
2. Sultan P, Sharawi N, Blake L, Habib AS, Brookfield KF, Carvalho B. Impact of enhanced recovery after cesarean delivery on maternal outcomes: a systematic review and meta-analysis. *Anaesth Crit Care Pain Med*. 2021;40(5):100935. DOI: 10.1016/j.accpm.2021.100935.
3. Siwicki A, Adams RM, Cabasa K, Madan S, Ouillette H. Postpartum pain management for women undergoing cesarean sections using a multimodal pain control protocol: a retrospective study. *BMC Pregnancy Childbirth*. 2025;25(1):1318. DOI: 10.1186/s12884-025-07607-y.
4. Bollag L, Richebe P, Siaulys M, Ortner CM, Gofeld M, Landau R. Effect of transversus abdominis plane block with and without clonidine on post-cesarean delivery wound hyperalgesia and pain. *Reg Anesth Pain Med*. 2012;37(5):508–514. DOI: 10.1097/AAP.0b013e318259ce35. PMID: 22683707.
5. Neall G, Bampoe S, Sultan P. Analgesia for Caesarean section. *BJA Educ*. 2022;22(5):197–203. DOI: 10.1016/j.bjae.2021.12.008.
6. Carvalho B, Butwick AJ. Postcesarean delivery analgesia. *Best Pract Res Clin Anaesthesiol*. 2017;31(1):69–79. DOI: 10.1016/j.bpa.2017.01.003.
7. Adesope O, Ituk U, Habib AS. Local anaesthetic wound infiltration for postcaesarean section analgesia: a systematic review and meta-analysis. *Eur J Anaesthesiol*. 2016;33(10):731–742. DOI: 10.1097/EJA.0000000000000462.
8. Sultan P, Halpern SH, Pushpanathan E, Patel S, Carvalho B. The effect of intrathecal morphine dose on outcomes after elective cesarean delivery: a meta-analysis. *Anesth Analg*. 2016;123(1):154–164. DOI: 10.1213/ANE.0000000000001255.
9. Sultan P, Halpern SH, Pushpanathan E, Patel S, Carvalho B. The effect of intrathecal morphine dose on outcomes after elective cesarean delivery: a meta-analysis. *Anesth Analg*. 2016;123(1):154–164. DOI: 10.1213/ANE.0000000000001255.
10. Roofthoof E, Joshi GP, Rawal N, Van de Velde M; PROSPECT Working Group. PROSPECT guideline for elective caesarean section: updated systematic review and procedure-specific postoperative pain management recommendations. *Anaesthesia*. 2021;76(5):665–680. DOI: 10.1111/anae.15339.
11. Habimana Sibomana E, Tuyishime E, Nizeyimana F, Mukwesi C, Tuyishime JD, Dylan BM, Twagirumugabe T. Quality of post-cesarean section pain management at referral hospital in Kigali Rwanda: a cross-sectional study. *Rwanda J Med Health Sci*. 2024;7(2):372–378. DOI: 10.4314/rjmhs.v7i2.22.
12. Riemma G, Schiattarella A, Cianci S, La Verde M, Morlando M, Sisti G, Esposito I, Della Corte L, Sansone P, De Franciscis P. Transversus abdominis plane block versus wound infiltration for post-cesarean section analgesia:

a systematic review and meta-analysis of randomized controlled trials. *Int J Gynaecol Obstet.* 2021;153(3):383–392. DOI: 10.1002/ijgo.13563.

13. Bollag L, Lim G, Sultan P, et al. Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean. *Anesth Analg.* 2021;132(5):1362–1377. DOI: 10.1213/ANE.0000000000005257.
14. Chetty S, Paruk F, Kamerman P. Low-dose intrathecal morphine versus intrathecal fentanyl for post-caesarean analgesia in a resource-constrained setting: a pragmatic, randomised trial. *BMC Anesthesiol.* 2026;26. DOI: 10.1186/s12871-026-04034-0.
15. World Health Organization. WHO recommendations on maternal and newborn care for a positive postnatal experience. 2022. Available from: <https://www.who.int/publications/i/item/9789240045989>.

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