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Original article

Evaluation of Analgesic Effect of Bupivacaine Injection into Both Angles of the Rectus Sheath Incision after an Elective Caesarean Section

Ali M. Al Gazzar, Ahmed S. Abdelazim, Ahmed S. Soliman, Gehad S. Attia

Abstract:

Background: Pain management after a caesarean section (CS) remains a significant clinical challenge, and alternative strategies for analgesia are continually being explored This study aimed to determine the efficacy of injecting the local anesthetic, Bupivacaine, bilaterally into the rectus sheath incision angles to block the ilioinguinal and ilio-hypogastric nerves, with the aim of reducing postoperative pain in patients undergoing CS under general anesthesia. **Methods:** A total of 150 female patients scheduled for elective Caesarean section were enrolled in this study. Patients were randomly assigned to one of two groups: Group A received Bupivacaine injections, while Group B received saline injections into the rectus sheath incision angles. Pain assessments, medication usage, and patient satisfaction were evaluated as primary outcome measures. **Results:** The study revealed that patients in Group A, receiving Bupivacaine injections, experienced significantly lower pain scores at various time intervals, shorter time to the first analgesic request, and a reduced need for meperidine compared to Group B. Additionally, patients in Group A reported higher satisfaction with pain management. **Conclusion:** Injection of Bupivacaine into both angles of the rectus sheath incision during Caesarean section effectively reduces postoperative pain and improves patient satisfaction.

Keywords: Bupivacaine; Caesarean Section; Ilioinguinal Nerve; Ilio-hypogastric Nerve; Postoperative Pain Management.

Obstetrics and Gynecology Department, Faculty of Medicine Benha University, Egypt.

Corresponding to:
Dr. Gehad S. Attia.
Obstetrics and Gynecology Department, Faculty of Medicine Benha University, Egypt.
Email: gehadsamir794@gmail.com

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Introduction

Caesarean delivery rates are rising, and postoperative pain, which can be severe and last for 48 to 72 hours, is a major concern for women [1, 2]. This pain can lead to delayed ambulation, prolonged hospitalization, atelectasis, vascular thrombosis, and patient dissatisfaction, with inadequate pain relief and satisfaction in many cases [3].

Cesarean section patients have specific needs for safe and effective pain relief that does not hinder their ability to care for their newborns, with no adverse effects on breastfeeding [4]. The pain has somatic and visceral components, with a significant portion arising from the abdominal wall incision [5].

Somatic pain at the incision site is carried by the ilioinguinal and ilio-hypogastric nerves [6], which are at risk of injury due to their superficial course during the Pfannenstiel incision [7].

The ilioinguinal and ilio-hypogastric (IIIH) block is a valuable part of multimodal analgesic strategies for postoperative pain, including in caesarean deliveries [8]. Ultrasound-guided IIIH blocks have shown post-operative analgesic benefits, reducing opioid use, pain, and nausea after caesarean deliveries [9, 10].

Opioid analgesic drugs, while predictable in their pain relief properties, often come with side effects like dizziness, respiratory depression, and nausea. They require frequent IV or IM injections, and often fail to provide sufficient analgesia [11].

Local anesthetics, on the other hand, offer opioid-free pain relief and are increasingly used for surgical pain due to their effectiveness and lack of opioid-related adverse effects. Infiltrating local anesthesia during caesarean delivery can reduce postoperative narcotic requirements, particularly for superficial pain components [10].

Bupivacaine, an amide local anesthetic, is more potent and longer-lasting than other options [12].

Although research in this area is expanding, there is no universally accepted 'gold standard' for post-caesarean pain management. Many methods rely on opioids supplemented with non-opioid analgesics, nerve blocks, or other techniques [13].

The purpose of this study was to determine the efficacy of injection of local anesthetic "Bupivacaine" in both angles of the rectus sheath incision aiming to block ilioinguinal and ilio-hypogastric nerves bilaterally to reduce postoperative pain after caesarean section in patients receiving general anesthesia.

Patients and methods

This randomized controlled study was conducted at the Obstetrics and Gynecology Department of Benha Teaching Hospital and involved 150 female patients who were scheduled for elective caesarean section (C.S.) from January 2023 to October 2023. Prior to their participation, all patients provided informed written consent after receiving an explanation of the study's objectives and were assigned a unique secret code number.

Sample size:

Sample size determination followed the method proposed by a previous study [14], which uses the formula: n = Z^2P(1-P) / D^2. Where: n = sample size, Z = Z statistic for a level of confidence, P = expected prevalence from previous literature, D = precision. For this study, considering a 95% confidence interval with Z = 1.96, an expected prevalence (P) of 54%, and a precision (d) of 10% (0.1) as per [15], the minimum required sample size was determined to be 150.

Inclusion criteria were female patients between the ages of 20 to 40 years, with a confirmed booking for elective lower segment caesarean section (LSCS), a

singleton pregnancy, and a body weight ranging from 50 kg to 100 kg.

Exclusion criteria were patients requiring emergency cesarean section, those with a history of bleeding tendency, individuals falling outside the weight range of <50 kg or >100 kg, patients unable to comprehend the numeric rating scale (NRS) or utilize patient-controlled analgesia (PCA), individuals with hypersensitivity to local anesthetic, and those afflicted with medical disorders such as preeclamptic toxemia, hepatic disease, hemostatic disorders, cardiovascular, pulmonary, renal, neurological, metabolic, or infectious diseases, as well as patients who declined to participate in the trial.

Randomization and blinding:

Randomization in this study was executed by allocating patients to the three groups through the utilization of a computer-generated random number list. The randomization list was concealed and accessed using sequentially numbered, opaque, sealed envelopes (SNOSE) immediately prior to the intervention. Furthermore, a blinding protocol was implemented to ensure both the patients and the personnel responsible for evaluating postoperative pain were kept unaware of the patients' group assignments. All patients were randomly assigned to one of two groups, with Group A (n=75) designated as the study group and Group B (n=75) assigned as the control group.

Methods

All studied cases were subjected to the following:

Detailed history-taking encompassed a comprehensive assessment of personal, menstrual, obstetric, present, past, and family histories, with a particular focus on obstetric details such as parity, gravidity, number of previous cesarean sections, gestational age, medical disorders, and chronic diseases. A full clinical examination was conducted to evaluate general health parameters, body mass index, and blood pressure before and after the operation.

Obstetric abdominal examinations were performed to assess the fundal level, fetal presentation, estimated fetal weight, amount of liquor, and any scars from previous operations. Additionally, laboratory investigations, including complete blood count, coagulation profile, liver and renal function tests, were carried out prior to the cesarean section. Ultrasound was utilized to confirm gestational age, detect fetal presentation, and rule out major congenital malformations or placenta previa.

The nerve block procedure followed a series of steps: all cesarean deliveries were performed via Pfannenstiel incisions under general anesthesia. During the cesarean section and prior to the closure of the rectus sheath, the following injections were administered: Group A (n=75) received a 10 ml injection of 0.5% Bupivacaine in each angle of the rectus sheath incision, using a fan-like pattern with a needle passed under vision to exclude vascular injury. This procedure was repeated on the contralateral angle of the rectus sheath incision. Group B (n=75) received a 10 ml injection of 0.9% saline in each angle of the rectus sheath incision, following the same procedure as Group A. Following the closure of the anterior abdominal wall, the abdominal wound was covered with a pressure dressing, and patients received fentanyl citrate (100 mcg intravenous) as an opioid analgesic during surgery after umbilical cord clamping.

Postoperatively, all patients received diclofenac potassium (75 mg intramuscular) every 12 hours for pain management, with the option for patients to receive meperidine (50 mg intramuscular) on demand. Pain assessments were conducted at various time points post-surgery, both during rest and ambulation, using a standard 10 cm VAS. Additionally, adverse effects of medications and other outcome parameters, including nausea, vomiting,

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and itching, were recorded. Clinically significant postoperative nausea and vomiting were addressed by administering metoclopramide (10 mg intravenous). Patient satisfaction with pain management was assessed through interviews conducted 48 hours post-surgery on a scale ranging from 0 (very unsatisfied) to 10 (highly satisfied).

Outcomes measured included pain assessments during rest and ambulation using VAS at various time intervals, the time to first meperidine request, total meperidine dosage, incision length, surgery duration, ambulation time, hospital stay, and any side effects resulting from the administered drugs, such as nausea and vomiting.

Ethical committee Approval code: Ms.16-3-2023

Statistical analysis

Statistical analysis was done by SPSS v27 (IBM©, Armonk, NY, USA). Shapiro-Wilks test and histograms were used to evaluate the normality of the distribution of data. Quantitative parametric data were presented as mean and standard deviation (SD) and were analyzed by unpaired student t-test. Quantitative non-parametric data were presented as the median and interquartile range (IQR) and were analyzed by Mann Whitney-test. Qualitative variables were presented as frequency and percentage (%) and analyzed using the Chi-square test. A two-tailed P value < 0.05 was considered statistically significant.

Results

In this study, 170 patients were assessed for eligibility, 14 patients did not meet the criteria and 6 patients refused to participate in the study. The remaining 150 patients were divided into 2 groups (75 patients in each). All patients were followed-up and analyzed statistically, Figure (1).

There was no significant difference between the two groups as regard age, residence, weight, height, and BMI. There was no significant difference between the two groups as regard SBP, DBP, and temperature. There was no significant difference between the two groups as regard gestational age. There was no significant difference between the two groups as regard gravidity. There was no significant difference between the two groups as regard parity, Table (1).

There was no significant difference between the two groups as regard hemoglobin, white blood cells, platelets, creatinine, and urea, Table (2).

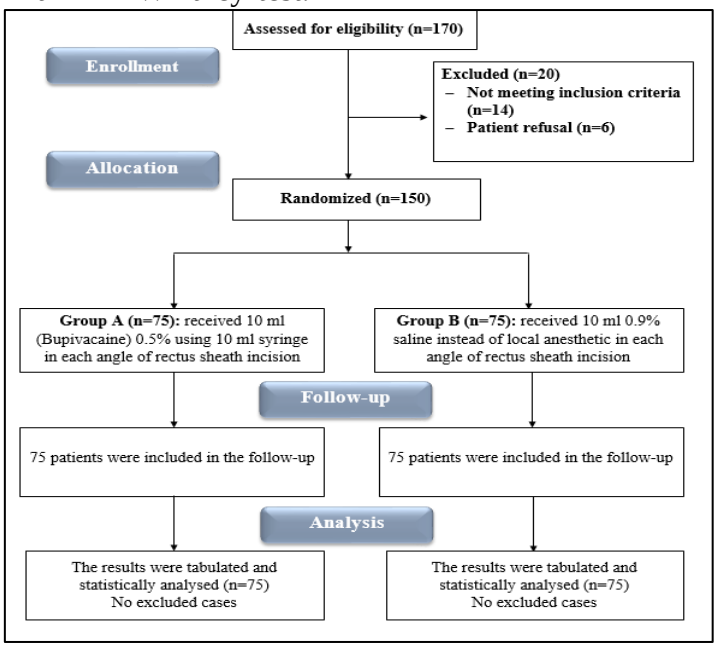

Figure 1: CONSORT flowchart of the studied patients

Table 1: Demographic data, vital signs, gestational age, gravidity and Parity of the studied groups.

		Group A (n=75)	Group B (n=75)	P value
Age (years)	Mean ± SD Range	30.1 ± 5.79 20 - 40	28.6 ± 5.56 20 - 39	0.103
Residence	Rural Urban	49 (65.33%) 26 (34.67%)	41 (54.67%) 34 (45.33%)	0.182
Weight (Kg)	Mean ± SD Range	73.7 ± 12.82 51 - 95	73.7 ± 13.41 52 - 95	0.990
Height (m)	Mean ± SD Range	1.6 ± 0.05 1.55 - 1.7	1.6 ± 0.05 1.55 - 1.7	0.608
BMI (Kg/m^2)	Mean ± SD Range	27.8 ± 5 18.65 - 36.92	27.9 ± 5.08 18.78 - 35.94	0.881
Vital signs				
SBP (mmHg)	Mean ± SD Range	123.1 ± 12.84 100 - 140	121.5 ± 10.74 100 - 140	0.409
DBP (mmHg)	Mean ± SD Range	74 ± 9.59 60 - 90	76.3 ± 9.97 60 - 90	0.158
Temperature (°C)	Mean ± SD Range	37 ± 0.28 36.5 - 37.4	36.9 ± 0.3 36.5 - 37.4	0.257
Gestational age (Weeks)	Mean ± SD Range	39.1 ± 1.39 37 - 41	38.7 ± 1.49 37 - 41	0.064
Gravidity	Mean ± SD Range	2.1 ± 0.79 1 - 3	2.1 ± 0.81 1 - 3	0.612
Parity	Nullipara Multipara	34 (45.33%) 41 (54.67%)	40 (53.33%) 35 (46.67%)	0.327

BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure.

Table 2: Blood analysis of the studied groups.

		Group A (n=75)	Group B (n=75)	P value
Hb (g/dl)	Mean ± SD Range	11.2 ± 1.31 9 - 13.5	11.1 ± 1.31 9 - 13.5	0.714
WBCs (10^9/L)	Mean ± SD Range	8.4 ± 2.24 4.8 - 12.5	8.1 ± 2.04 4.9 - 12.5	0.399
Platelets (10^9/L)	Mean ± SD Range	281.4 ± 43.58 202 - 349	274.7 ± 45.94 201 - 350	0.360
Creatinine (mg/dL)	Mean ± SD Range	0.7 ± 0.16 0.5 - 0.9	0.7 ± 0.14 0.5 - 0.9	0.871
Urea (mg/dl)	Mean ± SD Range	12.8 ± 4.21 5 - 20	12.9 ± 4.46 5 - 20	0.851

There was no significant difference between the two groups as regard surgery time. There was no significant difference between the two groups as regard incision length. Time interval before first ambulation was significantly longer in group B compared to group A (P<0.001), Table (3).

Regarding VAS measurements between the studied groups on the right side at rest, Group B had significantly higher VAS score at 2h, 4h, 6h, 8h, and 12h compared to group A (P<0.001), while VAS score was insignificantly different between the two groups at 30 min, 24h and 36h, Figure 2 A)

Regarding VAS measurements between the studied groups on the left side at rest, Group B had significantly higher VAS score at 2h, 4h, and 6h, compared to group A (P<0.001), while VAS score was insignificantly different between the two groups at 30 min, 8h, 12h, 24h and 36h. Figure (2 B).

Regarding VAS measurements between the studied groups on the right side after ambulation, Group B had significantly higher VAS score at 2h, 4h, 6h, 8h, and

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12h, compared to group A (P<0.001), while VAS score was insignificantly different between the two groups at 30 min, 24h and 36h., Figure (2 C).

Regarding VAS measurements between the studied groups on the left side after ambulation, Group B had significantly higher VAS score at 2h, 4h, and 6h, compared to group A (P<0.001), while VAS score was insignificantly different between the two groups at 30 min, 8h, 12h, 24h and 36h., Figure (2 D).

Time to first analgesic request was significantly longer in group A compared to group B (P<0.001). Number of patients who required total dose of meperidine was significantly higher in group B compared to group A (P<0.001). Group B had significantly longer hospital stay duration compared to group A (P<0.001), Table (4).

Regarding incidence of PONV, incidence of grade 0 and grade 1 were significantly higher in group A compared to group B, while incidence of grade 3 was significantly lower in group A compared to group B (P<0.003). Group A had significantly more satisfied patients (satisfied, very satisfied) compared to group B (P<0.001), Table (5) and Figure (3).

Table 3: Surgery time, Incision length (cm), and time interval before first ambulation (Hours) of the studied groups.

		Group A (n=75)	Group B (n=75)	P value
Surgery time (min)	Mean ± SD Range	48.9 ± 3.46 43 - 55	48.5 ± 3.78 42 - 54	0.529
Incision length (cm)	Mean ± SD Range	11.5 ± 1.11 10 - 13	11.7 ± 1.21 10 - 13	0.293
Time interval before first ambulation (Hours)	Mean ± SD Range	2.7 ± 0.85 2 - 4	8.3 ± 2.89 4 - 13	**<0.001***

Table 4: Time to first analgesic request, total dose of meperidine and hospital stay duration of the studied groups.

		Group A (n=75)	Group B (n=75)	P value
Time to first analgesic request (Hours)	Mean ± SD Range	8.7 ± 1.96 6 - 12	5 ± 2.05 2 - 8	**<0.001***
Total dose of meperidine	Yes No	24 (32%) 51 (68%)	52 (69.33%) 23 (30.67%)	**<0.001***
Hospital stays (Hours)	Mean ± SD Range	20 ± 2.54 16 - 24	36.1 ± 6.91 24 - 48	**<0.001***

Table 5: PONV and satisfaction of the studied groups.

		Group A (n=75)	Group B (n=75)	P value
PONV	**0**	13 (17.33%)	8 (10.67%)	**0.003***
	1	62 (82.67%)	57 (76%)	
	3	0 (0%)	10 (13.33%)	
Satisfaction	**Very unsatisfied**	4 (5.33%)	19 (25.33%)	**<0.001***
	Unsatisfied	12 (16%)	22 (29.33%)	
	Neutral	13 (17.33%)	20 (26.67%)	
	Satisfied	30 (40%)	11 (14.67%)	
	Very satisfied	16 (21.33%)	3 (4%)	

PONV: Postoperative nausea and vomiting

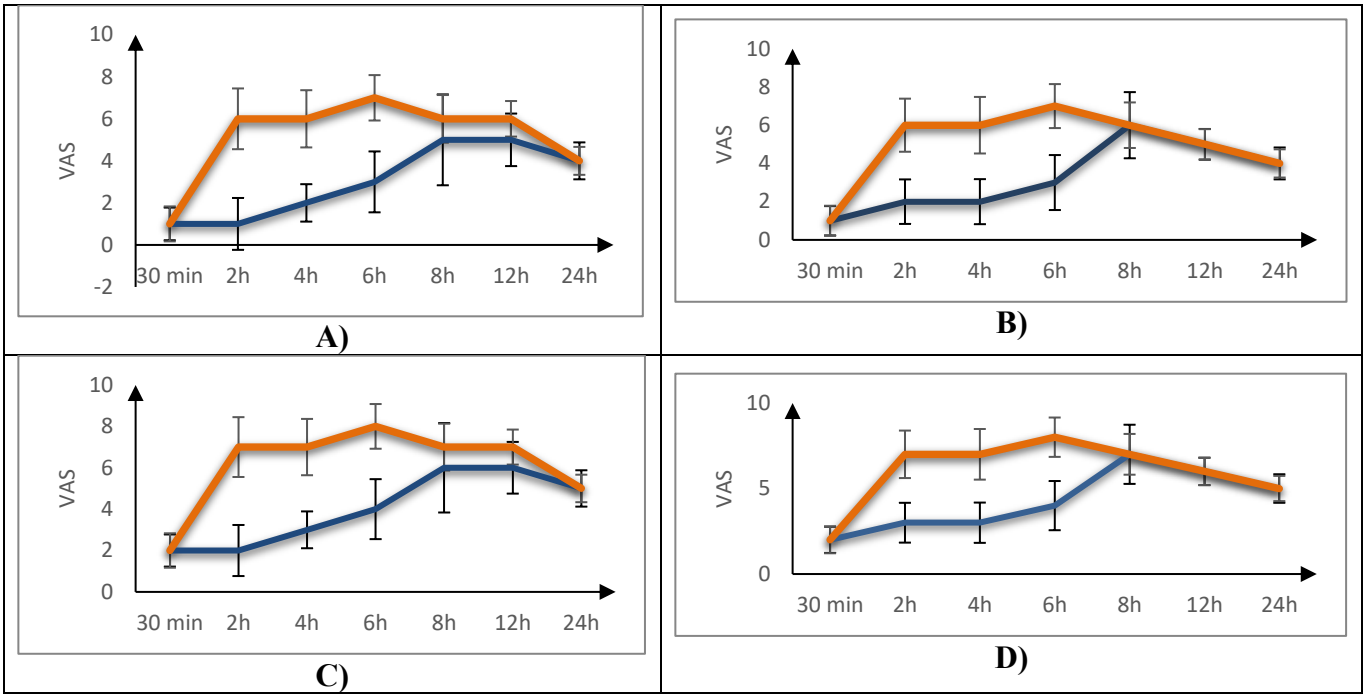

Figure 2: A) VAS measurements of the right side of the studied groups at rest. B) VAS measurements of the left side of the studied groups at rest. C) VAS measurements of the right side of the studied groups after ambulation. D) VAS measurements of the left side of the studied groups after ambulation

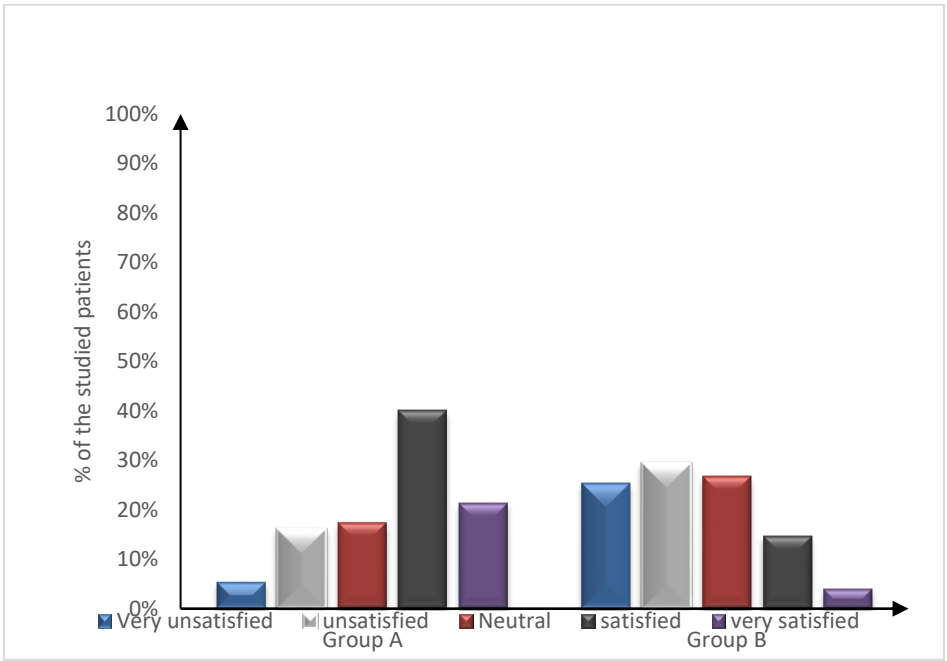

Figure 3: Satisfaction of the studied groups

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Discussion

In the present study, time interval before first ambulation was significantly longer in group B compared to group A (P<0.001).

In agreement with our results, a study found that me to first ambulation was shorter in the bupivacaine group (P< 0.01) [16].

Additionally, a study found significant difference between 3 groups regarding time interval before first ambulation where the meantime interval for first ambulation was 8.4 hours in group A (the longest), 3hours in group B (the shortest) and 8 hours in group C [17].

Regarding VAS measurements, a study found that post-operative pain scores at rest were statistically significant higher in the control group than those in both wound infiltration groups from 4th h and onwards (P < 0.0001) [18].

In contrast, a study noted that there were no differences in patient-generated resting pain scores between the two groups [16]. Using lower concentration of bupivacaine (0.25%) and relatively small sample size compared to ours could confer a reasonable justification for this difference.

Also, a study reported that there is no significant difference in the threshold of VAS in the two series [19].

Parallel to our study, a study described the surgical rectus sheath block for post-operative pain relief following major gynaecological surgery. Local anaesthetic (20 ml 0.25% bupivacaine bilaterally) is administered under direct vision to the rectus sheath space at the time of closure of the anterior abdominal wall. They conducted a retrospective case note review of 98 consecutive patients undergoing major gynaecological surgery for benign or malignant disease who received either standard subcutaneous infiltration of the wound with local anaesthetic (LA, n=51) or the surgical rectus sheath block (n=47) for post-operative pain relief. On waking in recovery, patients who received the surgical rectus sheath block had significantly lower pain scores than those who received standard subcutaneous infiltration of the wound (p < 0.001) [20].

Also, a study found out the effect of local anaesthetic (bupivacaine) wound infiltration before skin wound closure on postoperative use of opioids after elective lower segment caesarean section. The study enrolled a total number of 30 patients, 15 in each group. The data of group A (placebo group) who received normal saline and group B (bupivacaine group). Group A patients showed higher pain intensity on visual analogue score, both clinically and statistically, in comparison with group B patients at the end of 30 minutes, 2 hours, 4 hours, 6 hours and 24 hours [21].

Furthermore, a study showed that regarding post-operative pain at movement, there was statistically significant increase in VAS in the control group versus others at 2, 4, 12, 24 h post-operatively (P < 0.0001). However, patients received magnesium plus bupivacaine wound infiltration showed a significant decrease in post-operative pain scores than who received bupivacaine from 4th h and onward (P value were 0.0782, <0.0001, 0.0054, 0.0001, respectively) [18].

In the current study, time to first analgesic request was significantly longer in group A compared to group B (P<0.001).

Compatible to our findings, a study proved that the time interval for first analgesic request was compared between the three groups and there was a significant difference as group A is longer than the B and C groups. The longest time interval was in group A and the shortest time interval was in group B [17].

This was agreed with a study documented that surgical incision infiltration with ropivacaine 7.5 mg/mL significantly prolongs by 2 hours and 26 minutes the pain-free interval after Caesarean section

and decreases the rescue analgesic demand by 30% [19].

Another study for evaluation of local infiltration with bupivacaine for pain management after partial bilateral salpingectomy showed that application of bupivacaine is effective in reducing the need for analgesics one hour after surgery and reduces the use of opioids [22].

This was agreed with a study showed that preemptive analgesia with 20m1 of 0.5% Bupivacaine infiltrated before closure of the skin decreased postoperative analgesia request with Pethidine in patients who underwent elective LSCS by Pfannenstiel incision [21].

In the present study, number of patients who required total dose of meperidine was significantly higher in group B compared to group A (P<0.001).

A study showed that overall opioid consumption was significantly more in group S (control groups) compared to group B (treatment group-a.001) [23] .

Our results displayed that group B had significantly longer hospital stay duration compared to group A (P<0.001).

The average duration of hospital stay was 5.52 ± 0.87 days in the subcutaneous group and 5.32 ± 0.69 days in the preperitoneal group, (P = 0.37) [24].

Regarding incidence of PONV, comparable to our findings, a study concluded that the overall incidence of nausea was greater in controls (1 1 of 35) than for those given bupivacaine (3 of 35) (p=O.O46). The peak incidence of nausea was seen between 4 and 12 hours with 20% (control groups=S) compared to 5.7% (treatment group= B) complaining of this symptom (P=0.054) [23].

Our study recorded that group A had significantly more satisfied patients (satisfied, very satisfied) compared to group B (P<0.001).

Our results are in the same line with a study concluded that patient's satisfaction with the analgesia provided within the first 24 hours postoperative as excellent and good was significantly higher in bupivacaine group than in controls [16].

Additionally, a study reported that bupivacaine group also reported improved satisfaction with their pain relief over 24 hours after surgery and better patient's satisfaction [25].

Conclusion

In conclusion, our study showed the efficacy of Bupivacaine injection into both angles of the rectus sheath incision for pain management following elective caesarean sections. It effectively reduced postoperative pain, leading to a delayed requirement for analgesics and shorter hospital stays. However, a slightly increased risk of postoperative nausea and vomiting associated with this approach was observed. Overall, Bupivacaine administration demonstrates promise as an integral component of pain management strategies for caesarean section patients, with potential benefits for both pain relief and patient satisfaction.

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Author contribution

Authors contributed equally in the study**.**

Conflicts of interest

No conflicts of interest

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