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ORIGINAL RESEARCH REGIONAL ANESTHESIA

Bilateral ultrasound guided erector spinae plane block for postoperative pain management in lumbar spine surgery

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Abstract

Background & Objective: The postoperative pain after spine surgery is almost always severe. A recently described loco-regional procedure called the erector spinae plane block (ESPB) has been claimed to be associated with positive outcomes. We evaluated the ESPB's efficacy for the relief of postoperative pain after lumbar spine surgery.

Methodology: This randomized controlled clinical investigation was conducted at the Ain Shams University Hospitals during the course of a year starting January 2021. Patients were randomly allocated to one of the two groups: Group C (the control group) patients underwent lumbar spine surgery under conventional general anesthesia (GA) in accordance with hospital policy. Group ESP was administered GA similar to the control group, but the patients received bilateral ultrasound-guided ESPB before starting lumbar spine surgery. The primary objective was total morphine consumption. Numeric rating scale (NRS) scores were measured at rest on shifting to post-anesthesia care unit (PACU) and then at 2 h, 6 h, 10 h, 14 h, 18 h and 24 h in the ward. Complications, e.g., PONV and hemodynamic parameters were recorded on shifting to PACU and then at 2 h, 6 h, 10 h, 14 h, 18 h and 24 h in the ward.

Results: Total morphine consumption was higher in the control group than the Group ESP, at the 6th, 12th, and 18th hours postoperatively, the numeric rating scale scores in Group ESP were lower compared to the control group, and ESPB significantly reduced the time to first mobilization when compared to the control group. In terms of PONV and postoperative vital signs, there was no statistically significant difference; however, the patient satisfaction was higher in Group ESP was far more satisfied than the control group overall.

Conclusion: We conclude that bilateral ultrasound guided ESPB is useful for postoperative analgesia in patients having lumbar spine operations. It lowered postoperative opioid consumption, decreased pain scores at various time intervals, and increased patient satisfaction while reducing the occurrence of PONV.

Key words: Ultrasound; Erector spinae plane block; Pain; Pain management; Spine surgery

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1. Introduction

Patients who need spine surgery frequently worry about suffering from the pain postoperatively. Many of these patients continue to suffer from chronic pain over prolonged periods, necessitating high doses of opioids and other analgesics.[1]

Reduced opioid usage following spine surgery has been achieved by the combination of several approaches e.g., spinal and epidural morphine, local infiltration, or epidural catheters.[2] After spine surgery, pain scores and morphine intake improved in a number of cases where bilateral block of the lumbar dorsal rami was done.[3]

Not many randomized controlled trials have been conducted to look at how opiate use and pain scores are affected by different nerve block techniques. Additionally, the ESPB, a novel block has lately been described as a simple and safe method for treating acute postoperative pain at the thoracic level, and thus demonstrated promising outcomes for postoperative analgesia.[4]

We evaluated the efficacy of bilateral ESPB for the relief of postoperative pain after lumbar spine surgery.

2. Methodology

A total of 44 patients participated in the current randomized controlled clinical study, at Ain Shams University Hospitals, over the course of one year beginning in January 2021. The study was approved by the Research Ethical Council of the Faculty of Medicine, Ain Shams University, and registered with the clinical trials.gov (No. NCT05247021). all participants provided written informed consent. The study included patients of ASA physical status I and II from both sexes, aged between 20 to 60 y, scheduled for lumbar spine surgeries.

The patients those who had received long-acting opioids prior to surgery, those with bleeding disorders, infections at the injection site, allergies to local anesthetics, significant cognitive impairment, diabetic neuropathy, uncontrolled hypertension or diabetes, and those with advanced cardiac, respiratory, hepatic, or renal disease, were excluded.

One skilled operator worked on the erector spinae block.

Numeric rating scale (NRS), from 0 and 10, was used to measure the intensity of pain at rest on shifting to post-anesthesia care unit (PACU) and then at 2 h, 6 h, 10 h, 14 h, 18 h and 24 h in the ward.

Study Interventions: 44 individuals who met the inclusion criteria and had one level lumbar discectomy or fixation were included in the study. A computer-generated random number table divided them into 2 equal groups, group C and Group ESP, each with 22 patients

Group C: (control group) patients received standard general anesthesia for lumbar spine surgery according to hospital protocol.

Group ESP: as in control group but they received bilateral ultrasound guided erector spinae block before the lumbar spine surgery started.

All patients were assessed before surgery, and were fasted for eight hours. In the operating room, a 20−18G intravenous line was set up, and pantoprazole 40 mg and ondansetron 4 mg were administered IV. Lactated Ringer solution was infused at a rate of 10 ml/kg, and the patient received midazolam 0.5 mg increments for sedation. Patients' perioperative vital signs, including for pulse oximetry (SpO2), non-invasive blood pressure, heart rate, and five-lead electrocardiogram (ECG) were recorded.

Group ESP patients received ESPB. skilled personnel in the field of ultrasound guided regional anesthesia carried out the blocks before general anesthesia was induced. The patient was placed in the prone position; according to the patient's BMI, a high-frequency linear probe or a curved array probe was positioned in longitudinal alignment, 2−3 cm lateral to the vertebral column. The erector spinae muscle, the psoas muscle, and the transverse processes of the vertebrae at the level of surgery were recognized. Using an in-plane method, a 5- or 8-cm 22 G ultrasound needle was introduced from cephalad to caudal direction until contact with the tip of the transverse process was achieved. Bupivacaine 0.25% 20 ml was administered behind the erector spinae muscle after a small retraction of the needle. On the opposite side, the same step was repeated.

Both groups had standardized general anesthetic induction procedures utilizing propofol 2− 3 mg/kg, fentanyl 1 µg/kg, and atracurium 0.5 mg/kg. Following tracheal intubation, sevoflurane anesthesia was used. Atracurium 0.1 mg/kg increments were given if necessary. Inj. fentanyl 0.5 µg/kg was given after one hour of general anesthetic induction. Patients were given acetaminophen 1g IV and 0.5 mg/kg IV of ketorolac following surgery, were extubated in the operating room and kept under observation in the PACU for an hour.

Acetaminophen 1g IV was administered routinely every 6 h in the ward to alleviate postoperative pain for the first 24 h.

Rescue doses of intravenous morphine were administered to patients as a bolus of 5 mg at any time when NRS became more than 4 in both groups. Patients were evaluated for pain score by NRS.

Table 1: Comparison between groups as regard demographic data.

Demographic data	Group C (n = 22)	Group ESP (n = 22)	T/X^2	P-value
Age (y)	42.5 ± 8.4	43.8 ± 8	0.5[t]	0.61
BMI	25.3 ± 2.3	24.8 ± 1.9	0.79 [t]	0.44
Duration of surgery (min)	118.3 ± 20.5	122.6 ± 23.7	0.64 [t]	0.52
ASA ½ (number of patients)	14/8	13/9	0.1[x2]	0.76

Data expressed as mean ± SD, or number of patients as appropriate; T = student t test; X^2 = chi square

Patients were observed and recorded for nausea, vomiting, pruritis and urine retention. In the event of PONV, 4 mg of ondansetron diluted in 10 ml of normal saline 0.9% was administered IV over 10 min. In the case of pruritis, 45.5 mg of pheniramine hydrogen maleate was administered IM. In case of urine retention, urinary catheter was inserted.

The postoperative 24-hour morphine consumption was the primary outcome indicator. The end point was 24 h after surgery, and the secondary outcome measurements included the time to first mobilization to a chair, patient satisfaction, and the hemodynamic parameters.

Statistical analysis

A sample size of 22 patients in each group, assuming a postoperative morphine intake effect size of 0.9 across the 2 study groups, was sufficient to identify such an effect, if true at 0.05 alpha error and 0.90 power of the test.

The Statistical Package for Social Science (SPSS) version 22.0 was used to analyze the data. Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and data were expressed as frequency and percentage. Results with $P < 0.05$ were deemed significant.

Tests used for analysis were; when comparing two means, the independent-samples t-test of significance was used. To compare proportions between two qualitative factors, Chi-square (X2) test of significance was implemented. For two-group comparisons in non-parametric data, the Mann Whitney U test was implemented. The allowable margin of error was set at 5%, while the confidence interval was set at 95%. $P \geq 0.05$ was deemed significant.

3. Results

In terms of age, BMI, operation time, and ASA, the groups were equivalent, and there was no statistically significant differences between the groups ($P > 0.05$) (Table 1).

The control group consumed considerably more narcotic (morphine) postoperatively than the Group ESP (Table 2).

Table 2: Comparative consumption of postoperative morphine between groups

Morphine consumption	Group C (n = 22)	Group ESP (n = 22)	X2	p-value
0 mg	9	20	12.6	0.0018
5 mg	9	2		
10 mg	4	0		

Data expressed as number of patients as appropriate, X2 = chi square

The numerical rating score (NRS) used to quantify postoperative pain was compared between the two groups. Up to 18 h after surgery, the control group's NRS had a higher significant value than the Group ESP, but there was no difference beyond that until the first 24 h of the research (Table 3).

Table 3: Comparison between groups as regard NRS scores

NRS	Group C (n = 22)	Group ESP (n = 22)	Z	P-value
PACU	4 (4-5) /3-6	2 (1−2) /1−5	5	< 0.001
2 h	3(2−3) /2−4	1 (1−1) /1−2	5.4	< 0.001
6 h	3 (2−4) /1−4	1 (1−1) /1−2	5.3	< 0.001
10 h	2.5 (2−3) /1−4	1 (1−2) /1−3	4.5	< 0.001
14 h	2.5 (2−3) /1−4	1 (1−1) /1−2	4.7	< 0.001
18 h	2 (1−3) /1−4	1 (1−2) /1−2	3.2	0.0011
24 h	2 (1−3) /1−4	2 (1−2) /1−3	0.93	0.35

Data expressed as median (IQR) /range, Z = Mann−Whitney test

Table 4: Comparison between groups as regard Postoperative 1st mobilization to chair

Parameter	Group C (n = 22)	Group ESP (n = 22)	t-test	P-value
1st mobilization to chair (min)	275.45 ± 51.2	204.55 ± 36.42	5.3	> 0.001

Data expressed as mean ± SD, T = student t test, ESP = erector spinae block, C = control group

Table 5: Comparative MABP between the groups

MABP	Group C (n = 22)	Group ESP (n = 22)	t-test	P
PACU	80.8 ± 2.7	79.3 ± 2.4	1.9	0.063
2 h	79.5 ± 2.6	78.5 ± 1.9	1.3	0.202
6 h	78.3 ± 2.2	78.0 ± 1.6	.39	0.697
10 h	79.2 ± 2.6	79.5 ± 1.4	0.37	0.717
14 h	79.5 ± 2.6	79.2 ± 1.9	0.53	0.600
18 h	80.2 ± 1.8	80.3 ± 1.9	0.24	0.808
24 h	80.7 ± 3.1	81.0 ± 1.8	0.41	0.682

Data expressed as mean ± SD, T = student t test

Table 6: Comparative HR between the groups

HR	Group C (n = 22)	Group ESP (n = 22)	t-test	P-value
At PACU	80.3 ± 1.6	80.0 ± 1.4	0.6	0.548
2 h	78.9 ± 2.2	78.3 ± 1.4	0.99	0.330
6 h	77.7 ± 2.7	77.0 ± 2.1	0.92	0.361
10 h	77.5 ± 3.4	77.5 ± 1.5	0.0	1.000
14 h	79.4 ± 2.5	78.4 ± 1.3	1.7	0.101
18 h	79.8 ± 2.3	78.9 ± 1.4	1.6	0.116
24 h	80.3 ± 2.0	80.1 ± 2.1	0.37	0.717

Data expressed as mean ± SD, T = student t test

Table 7: Comparison between groups as regard PONV and patient satisfaction:

Parameter	Group C (n = 22)	Group ESP (n = 22)	X2	P-value
PONV	5 (22.7%)	2 (9.1%)	1.5	0.216
Patient satisfaction				
0 = Poor	2 (9.09)	0 (0)		
1 = Pleasant	17 (77.27)	4 (18.18)	20.5	< 0.001
2 = Excellent	3 (13.63)	18 (81.82)		

Data expressed as number of patients (%) as appropriate, X2 = Chi square

The first mobilization to a chair following surgery was compared between the two groups. There was a statistical difference between them, with the control group's value being greater (Table 4).

The postoperative hemodynamic parameters, including mean arterial blood pressure and heart rate, were compared. Over the course of the trial, there was no statistically significant difference between the two groups (Table 5 & 6).

There was no significant difference between the two groups regarding the frequency of postoperative nausea and vomiting (PONV); with Group C values being higher. In the first 24 h postoperatively, no patient had pruritus or urinary retention. The patient satisfaction level was higher in the Group ESP, the difference being significant (Table 7).

4. Discussion

All of the 44 patients, who met the inclusion criteria for our study, underwent lumbar discectomy or fixation at one level. A computer-generated random numbers table divided them into 2 equal groups, Group C and Group ESP, with 22 patients in each. While Group C (control group) patients underwent lumbar spine surgery under regular general anesthesia in accordance with hospital practice, the Group ESP patients received bilateral ultrasound-guided ESPB before the procedure began under standard general anesthesia.

We chose to use ESPB before the surgery in order to obtain a clearer sonographic anatomical image before endangering the integrity of the tissue following surgery.

Age, ASA, BMI, and the length of the surgery, were comparable between groups in the current study, and there was no

statistically significant difference between two groups. The ESPB reduced the usage of morphine in the first 24 h following surgery and there was a statistically significant difference between the two groups. Ueshima et al. had a sample size of 41 patients, 18 of whom received ESPB along with general anesthesia while the remaining 23 underwent general anesthesia alone. They noted that, in the first 24 h following surgery, the Group ESPB received significantly less narcotic (fentanyl) administration than the other group.5 Another study by Breebaart and his colleagues claimed that in 80 patients who underwent lumbar operations and were split between receiving ESPB and a sham block, ESPB showed signs of lowering the amount of morphine consumed in the 24 h after surgery (block injecting normal saline).6

Duan et al. proved in a meta-analysis, which included five studies and over 340 participants, that patients who had ESPB, had considerably lower overall opioid usage in the first 48 h following surgery than those who received a placebo or no block. Additionally, individuals who received ESPB had a longer demand time and needed substantially less rescue analgesia.7 Some other authors came to similar conclusion.8,9

In our study, postoperative NRS scores were statistical difference between the groups till 18 h then there was no statistical difference between them at 24 h. Ueshima and his colleagues came to the same conclusion.5 The time to first rescue analgesia was evaluated in seven investigations, and Oh et al. discovered that the block's duration ranged from 2.8 to 14.2 h.10

The volume and kind of local anesthetic employed in each study also had an impact on the block's duration. However, according to Singh and her coworkers,11 bilateral US guided ESB delivered analgesia that lasted on average for 6 to 8 h. By the eighth hour, NRS scores in the majority of patients' ranged from 8 to 9, necessitating the use of extra (rescue) analgesics.

In our study, first mobilization to chair was equivalent between the two groups. Zhang et al.12 stated that ESPB significantly decreased the time to first mobilization compared to the control group, which is consistent with our study. This could be attributed to ESPB's analgesic effect, which diminished paraspinal muscular tension and provided analgesia in the operative area. However, Asar et al.8 stated that the mobilization periods did not differ statistically significantly. Additionally, they believed that due to a variety of factors, including how the hospital operated, they were unable to accurately assess the postoperative mobilization period or the duration until departure from the hospital.

Regarding postoperative hemodynamics, in our study we noticed that elevated blood pressure and heart rate occurred less frequent in Group ESPB than the control group, but the difference was not statistical significant over the 24 h. Daccache et al.13 also noted that hemodynamic variables are of low sensitivity and specificity and are viewed as poor predictors of antinociception administration.

Although the intervention group's mean heart rate and MABP were revealed to be significantly lower than those of the control group, Ghamry et al. noted that these hemodynamic parameters were only evaluated intraoperatively and there was no postoperative recording.14

There was no discernible difference between the two groups when it came to PONV, although we did find that the Group ESP had a lower incidence of PONV than the control group, and there was no difference at all with regard to itching or urine retention. Moreover, no significant side effects associated with the medication or the operation itself were noted in our study. It was in line to the study by Duan et al., who found that ESPB offered patients the benefit of a decreased incidence of PONV but with no discernible difference between them and the other control group, leading to a shorter length of hospital stay.7 Additionally, PONV was discovered by Smith et al. to be the most prevalent and undesirable adverse effect of opioids that may lengthen hospital stays.15

In the present study, we discovered that patients in the Group ESP had considerably greater satisfaction ratings than those in the control group. Seok and his colleagues noted in their meta-analysis patient satisfaction levels, in three studies with 176 patients and were standardized to a 0–10 scale, and reported that ESPB revealed a greater patient satisfaction score.

5. Conclusion

Based on the results of this study, we conclude that bilateral ultrasound guided erector spinae plane block is useful for postoperative analgesia in patients having lumbar spine operations. It lowered postoperative opioid consumption, decreased pain scores at various time intervals, and increased patient satisfaction while reducing the occurrence of PONV.

6. Availability of data

All data generated in this study are available from the corresponding author on rational demand.

7. Competing interests

Authors declare no conflict of interest.

8. Funding

No internal or external funding was involved in this study.

9. Authors' contribution

AAH: Conduction of the study work.

GAZ: Manuscript editing

ANS, AGS: Literature search

RAS: Statistical analysis and review

10. References

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