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Efficacy of Errector Spinae Block on Peri-Operative Opioid Consumption in Spine

Nayyab Mujahid[1], Asiya Taqi[2]

[1,2]Doctors Hospital and Medical Centre, Lahore, Pakistan

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Correspondence to: Nayyab Mujahid, Doctors Hospital and Medical Centre, Lahore, Pakistan.
Email: nayyabmujahid5@gmail.com

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ABSTRACT

Background: Spine surgery often involves moderate to severe pain that can be difficult to manage effectively postoperatively. Poor pain control may result in delayed mobilization and higher complications postoperatively. Regional techniques for anesthesia, such as erector spinae block, may play a role in achieving low opioid dosages and improved pain control. **Objective:** To determine the efficacy of erector spinae block in reducing perioperative opioid consumption and postoperative pain in patients undergoing spine surgery. **Study Design:** Randomized controlled trial. **Duration and Place of Study:** This study was conducted from February 2025 to May 2025 in the Orthopedic and Neurosurgery operation theatres under the Department of Anesthesia at Doctors Hospital, Lahore. **Methodology:** A total of 60 patients aged 18 to 60 years undergoing elective lumbar spine surgery were included and randomly divided into two groups with 30 patients in each group. Postoperative pain was assessed using numerical pain scale at 2, 6, 12 and 24 hours at rest and during movement. Total opioid consumption within 24 hours was recorded. Data were analyzed using independent sample t test. **Results:** The mean opioid consumption within 24 hours was significantly lower in the erector spinae block group (12.39 ± 9.86 mg) compared to the control group (30.44 ± 12.23 mg) with $p < 0.001$. Postoperative pain scores at rest and during movement were also significantly lower in the erector spinae block group at all measured time points, with all p values < 0.001. **Conclusion:** Erector spinae block is an effective technique for reducing perioperative opioid consumption and postoperative pain in spine surgery patients.

INTRODUCTION

Spinal surgery-induced pain in the postoperative period can be moderate to severe in intensity and has long been a challenging condition, both for patients as well as surgical staff.[1] Spine surgeries involve extensive muscle dissections, bone manipulation, as well as irritation of neural structures, all of which, combined together, contribute substantially to both nociceptive as well as inflammatory types of pain experienced in the postoperative period.[2] Failure to manage pain postoperatively can lead to delayed ambulation, reduced respiratory mechanisms, increased hospital stay, as well as increased susceptibility to complications like thromboembolic events as well as chronic pain.[3] Patient satisfaction as well as functional outcomes can be affected by acute postoperative pain. For these reasons, managing pain post-spine surgery has been recognized as an important part of comprehensive care in the postoperative period, as it has been challenging because of its intensity as well as complexity.[4]

Opioid usage during spinal surgery is notable due to the widespread application of opioids for pain relief purposes.[5] Opioids have often been shown to be useful for pain control, especially severe pain associated with procedures. However, their overuse has been associated with several adverse effects, which include nausea, vomiting, somnolence, respiratory depression, ileus, urinary retention, as well as an increased relative risk of opioid addiction.[6] Opioid usage during procedures may also be influential in affecting opioid requirements and pain scores in the postoperative period due to the associated effects of opioid overuse, particularly during major spinal procedures.[7] It has therefore been emphasized in recent advances in anesthesia that opioid-sparing and multimodal analgesia strategies be adopted to limit opioid usage without hindering pain relief efforts.[8]

The erector spinae block represents a relatively newly developed regional anesthesia technique that gained interest for pain control during spine surgery.[9] It involves the injection of local anaesthetics into the plane deep to the erector spinae muscle at the level of the transverse processes, followed by distribution to the dorsal and ventral rami of the spinal nerves.[10] This regional anaesthetic technique is simple to apply, possesses an excellent safety profile, and offers both somatic and visceral analgesiae over several dermatomes.[11] Efficacy

studies suggest that this regional anaesthetic technique, the erector spinae block, significantly decreases the use of opioids during the recovery period and pain scores during spine surgery.[12]

A randomized study in lumbar spine surgery reported that patients receiving a single 40 ml injection of 0.25% bupivacaine for erector spinae plane block required significantly less post-operative morphine compared to the control group (1.4±1.5 mg vs 7.2±2.0 mg, P<0.001). Pain scores were also significantly lower in the ESP block group immediately after surgery (P=0.002) and at 6 hours post operatively (P=0.040).[13]

Data on postoperative pain control and the use of opioids in spinal surgery is sparse in Lahore. Most of the existing literature is carried out in developed nations, and results cannot be completely extrapolated to our population of patients and operating environment in Lahore. In Lahore, the usage of opioids is still a commonly practiced mode of analgesia, and complications related to opioids are commonly seen in postoperative patients. It is therefore critical to evaluate the role of erector spinae block in the existing environment of a teaching institution in Lahore such that the role of this mode of block as a feasible and effective alternative in the reduction of postoperative pain as well as the usage of opioids can be established.

METHODOLOGY

This randomized controlled trial was carried out from 8 February 2025 to 8 May 2025 in the Orthopedic and Neurosurgery operation theatres under the Department of Anesthesia at Doctors Hospital Lahore. Approval was obtained from the Institutional Review Board prior to initiation of the study (Dated 3 May, 2024), and permission was granted to collect data from eligible patients. A total sample size of 60 patients was calculated by using a 5% level of significance and 95% power of test, based on difference in total opioid requirement at 24 hours between two comparison groups,[13] with 30 patients allocated in each group. Patients were enrolled through non-probability consecutive sampling technique until the required sample size was completed. Adult patients aged between 18 and 60 years of both genders classified as ASA I or ASA II and scheduled for elective open lumbar spine surgery under general anesthesia were included. Patients were excluded if they had bleeding disorders, infection at the site of block, prior chronic opioid use, allergy to local anesthetics or opioids, emergency spine procedures or neurological or cognitive impairment interfering with pain assessment. Written informed consent was obtained from all participants before data collection. Demographic characteristics including age, gender and body mass index were recorded on a structured proforma. Pre-operative evaluation included detailed medical history and complete general and systemic examination along with local examination of the proposed block area. Baseline investigations such as complete blood count, liver function tests, renal function tests, serum electrolytes, random blood sugar and coagulation profile were performed. Patients older than 40 years or having comorbid conditions also underwent electrocardiography and chest radiography. All patients were counseled preoperatively regarding the pain assessment tool.

On the day of surgery, patients were shifted to the operating theatre, intravenous access was secured and standard general anesthesia was administered with endotracheal intubation. Type of spine surgery was documented. Patients were randomly assigned into two groups using lottery method. Patients in Group A received bilateral ultrasound-guided erector spinae plane block after induction of general anesthesia whereas Group B did not receive any regional block. Intraoperative monitoring included electrocardiography, heart rate, blood pressure and oxygen saturation. Duration of surgery was recorded. Approximately 15 minutes prior to completion of surgery, intravenous ondansetron 8 mg was administered. Neuromuscular blockade was reversed at the end of surgery using neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg. After adequate recovery patients were extubated and transferred to the post-anesthesia care unit where they were monitored for 2 hours. Postoperative monitoring started when patients were fully conscious and responsive. All patients received intravenous provas 1 g three times daily for 2 days. Rescue analgesia in the form of intravenous nalbuphine 0.1 mg/kg was administered when pain score exceeded 3 and time to first rescue analgesic was documented. Episodes of nausea and vomiting were treated with intravenous ondansetron 8 mg. Patients were followed for 24 hours postoperatively. Total peri-operative opioid consumption was calculated as cumulative nalbuphine dose in milligrams administered within 24 hours after surgery. Postoperative pain intensity was measured at 2, 6, 12 and 24 hours using a numerical pain scale ranging from 0 to 10 where higher values indicated more severe pain. Sedation was considered present when patients showed reduced responsiveness requiring stimulation.

Data were entered and analyzed using SPSS version 26. Quantitative variables were expressed as mean and standard deviation. Qualitative variables were presented as frequencies and percentages. Comparison between groups was performed using independent sample t test. A p value less than 0.05 was considered statistically significant.

RESULTS

In ESP block group, the mean age of patients was 47.67 ± 8.03 years while in control group it was 44.30 ± 10.60 years. The body mass index was found to be 28.49 ± 2.12 kg/m^2 in ESP block group and 28.55 ± 2.17 kg/m^2 in control group, showing no significant difference between groups. The duration of surgery were also similar, with ESP block group having mean duration of 174.93 ± 30.94 minutes and control group having 175.73 ± 29.36 minutes. Regarding gender distribution, males were predominant in both groups where 21 patients (70.0%) was male in ESP block group and 22 patients (73.3%) was male in control group. Female patients were 9 (30.0%) in ESP block group and 8 (26.7%) in control group. When ASA classification was analyzed, majority of patients belonged to ASA class II in ESP block group with 22 patients (73.3%) while 8 patients (26.7%) were classified as ASA class I. In control group, 18 patients (60.0%) was ASA class II and 12 patients (40.0%) was ASA class I (as shown in Table 1).

Table 1
Patient Demographics in Both Groups

Variables	ESP Block Group n=30 Mean ± SD	Control Group n=30 Mean ± SD
Age (years)	47.67 ± 8.03	44.30 ± 10.60
BMI (kg/m^2)	28.49 ± 2.12	28.55 ± 2.17
Duration of Surgery (minutes)	174.93 ± 30.94	175.73 ± 29.36
Gender	**n (%)**	**n (%)**
Male	21 (70.0%)	22 (73.3%)
Female	9 (30.0%)	8 (26.7%)
ASA Classification		
I	8 (26.7%)	12 (40.0%)
II	22 (73.3%)	18 (60.0%)

The total analgesic consumption in 24 hours postoperatively showed significant difference between the groups (as shown in Table-II). Patients in ESP block group consumed significantly less nalbuphine with mean consumption of 12.39 ± 9.86 mg compared to control group where mean consumption was 30.44 ± 12.23 mg. This difference was statistically highly significant with t-value of -6.293 and p-value of <0.001 (as shown in Table 2).

Table 2
Comparison of Total Analgesic Consumption in Both Groups

	ESP Block Group n=30	Control Group n=30	t	P value
Total Analgesic Consumption in 24 hours (Injection Nalbuphine in mg)	12.39±9.86	30.44±12.23	-6.293	<0.001

The postoperative pain scores assessed by Visual Analog Scale demonstrated significant differences between both groups at all time points (as shown in Table 3). For VAS scores at rest, at 2 hours postoperatively, ESP block group had mean score of 3.23 ± 0.77 while control group showed significantly higher score of 5.77 ± 0.77 with p-value <0.001. At 6 hours, VAS at rest was 2.27 ± 0.98 in ESP block group compared to 4.67 ± 1.06 in control group (p<0.001). The pain scores continued to decrease over time where at 12 hours, ESP block group had VAS score of 1.63 ± 1.03 versus 3.97 ± 1.13 in control group (p<0.001), and at 24 hours, the scores were 1.13 ± 0.90 in ESP block group and 3.43 ± 1.19 in control group (p<0.001). When pain was assessed during movement, the scores were consistently higher than at rest but ESP block group still maintained significantly lower pain scores. At 2 hours, VAS at movement was 5.07 ± 0.78 in ESP block group and 7.47 ± 0.82 in control group (p<0.001). At 6 hours postoperatively, mean VAS score during movement were 3.90 ± 0.99 in ESP block group versus 6.40 ± 0.97 in control group (p<0.001). At 12 hours, the scores was 3.07 ± 0.98 in ESP block group compared to 5.57 ± 1.17 in control group (p<0.001), and at 24 hours, VAS during movement showed 2.40 ± 1.00 in ESP block group and 4.83 ± 1.23 in control group (p<0.001). All differences in pain scores between the two groups were statistically highly significant (as shown in Table 3).

Table 3
Comparison of Visual Analog Scale Scores in Both Groups

Postoperative pain score	ESP Block Group n=30	Control Group n=30	P value
VAS at Rest - 2 hours	3.23 ± 0.77	5.77 ± 0.77	<0.001
VAS at Rest - 6 hours	2.27 ± 0.98	4.67 ± 1.06	<0.001
VAS at Rest - 12 hours	1.63 ± 1.03	3.97 ± 1.13	<0.001
VAS at Rest - 24 hours	1.13 ± 0.90	3.43 ± 1.19	<0.001
VAS at Movement - 2 hours	5.07 ± 0.78	7.47 ± 0.82	<0.001
VAS at Movement - 6 hours	3.90 ± 0.99	6.40 ± 0.97	<0.001
VAS at Movement - 12 hours	3.07 ± 0.98	5.57 ± 1.17	<0.001
VAS at Movement - 24 hours	2.40 ± 1.00	4.83 ± 1.23	<0.001

DISCUSSION

Total analgesic intake in the first 24 hours after surgery was significantly decreased in the erector spinae plane block group (12.39 ± 9.86 mg) when compared to the control group (30.44 ± 12.23 mg), and p < 0.001. The decrease in opioid intake can be ascribed to the effective dorsal and ventral ramus block of spinal nerves due to the deposition of local anesthetic in the fascial plane between the erector spinae muscles and the transverse processes. The ESP block provides prolonged analgesic effects by ensuring a wide craniocaudal spread of the local anesthetic agent, thus resulting in the inhibition of dermatomal segments. Moreover, extensive neural blockade results in the decreased transmission of nociceptive impulses from the surgical site, thus resulting in low opioid intake in the postoperative period.

The Visual Analog Scale scores, both at rest and during movement, were significantly lower in the erector spinae plane (ESP) block group at all times (2, 6, 12, and 24 hours), with all p-values < 0.001. At 2 hours postoperative, VAS at rest was 3.23 ± 0.77 in the ESP block group compared to 5.77 ± 0.77 in the control group, and VAS during movement was 5.07 ± 0.78 in the former compared to 7.47 ± 0.82 in the latter. The superior analgesic effect of ESP block can thus be attributed to the persistent blockade of nociceptive pathways at the level of the nerve roots and dorsal root ganglion. Local anesthetics block the sodium channels of nerve fibers, thus preventing the production and transmission of action potentials responsible for conduction of pain impulses. In this context, the fascial plane provides a mechanism for the local anesthetic agent to remain in intimate contact with the neural structures, thus providing prolonged action of analgesia. The steady decline in VAS scores in the ESP block group within the 24-hour period suggests good analgesic action throughout the early postoperative phase, when the intensity of pain would normally be maximal after spine surgery.

The total analgesic consumption in 24 hours was significantly lower in ESP block group (12.39 ± 9.86 mg) compared to control group (30.44 ± 12.23 mg) with p<0.001, which is comparable to findings reported by Wahdan *et al.* [14] who demonstrated 54% reduction in perioperative morphine consumption (14.0 ± 1.7 mg vs 30.8 ± 2.0 mg, p<0.001) and Bellantonio *et al.* [15] who showed 57% reduction in 48-hour PCA morphine (8.5 mg vs 20 mg, p<0.0001) after lumbar spine surgery. Similarly, Huda *et al.* [16] reported 40% reduction in 24-hour morphine consumption (12.6 ± 7.6 mg vs 21.1 ± 12.0 mg, p=0.01) when dexmedetomidine was added to ESPB. The

mechanism behind this substantial opioid-sparing effect is attributed to comprehensive blockade of dorsal and ventral rami of spinal nerves which effectively interrupts nociceptive transmission from surgical site, thereby reducing dependence on systemic opioids for pain management. The meta-analysis by Liang *et al.* [17] involving 696 patients across 12 RCTs confirmed that ESPB reduced 24-hour morphine equivalent by -18.7 mg (95% CI -28.0 to -9.4, p<0.0001), which further validates the opioid-sparing benefits observed in present study.

The VAS scores in present study was significantly lower in ESP block group at all time points both at rest and during movement with p<0.001. At 2 hours postoperatively, VAS at rest was 3.23 ± 0.77 in ESP block group versus 5.77 ± 0.77 in control group, and at 24 hours it was 1.13 ± 0.90 versus 3.43 ± 1.19 respectively. These findings are in agreement with Wahdan *et al.* [14] who reported lower NRS pain scores at every measurement up to 12 hours (maximum difference 3 vs 5, p<0.001) and Bellantonio *et al.* [15] who demonstrated lower NRS pain at rest from 2 hours (0 vs 5) to 36 hours (2 vs 4) with all p≤0.004. Similarly, Chen *et al.* [18] found recovery-room pain scores of 4.7 ± 2.7 vs 6.7 ± 1.9 (p<0.01) and POD-1 pain of 2.3 ± 0.6 vs 2.8 ± 0.8 (p<0.01) in ESPB group compared to controls. The consistent pain reduction across these studies can be explained by prolonged analgesic effect provided by local anesthetic deposited in fascial plane which creates extensive craniocaudal spread covering multiple dermatomal levels. However, Huda *et al.* [19] in their meta-analysis of hip surgery patients found that pain scores was significantly lower only up to 9 hours but not at 12 or 24 hours, which differ from present study where pain reduction was sustained throughout 24 hours. This difference might be attributed to different surgical site and tissue trauma involved in spine surgery compared to hip surgery, as spine procedures typically involve more extensive muscle dissection and bone manipulation which generates more prolonged nociceptive stimuli requiring sustained neural blockade.[20]

Interestingly, Składzień *et al.* [21] compared bilateral ESPB with quadratus lumborum block for laparoscopic radical prostatectomy and found no significant difference in 24-hour oxycodone consumption (22.4 ± 9.7 mg vs 26.5 ± 10.0 mg, p=0.115) or pain scores between the two blocks, indicating that both fascial plane blocks provide equivalent analgesia. However, absence of control group in their study limits interpretation of overall opioid-sparing effect. In contrast, present study included proper control group receiving standard analgesia without regional block, which allow clear demonstration of ESPB benefits over conventional pain management alone.

There exist several limitations in the current study. The first one is its single-centered nature, as the study was carried out in one single center. This can limit its generalizability to different healthcare and surgical setups. The second is its relative smallness, comprising only 30 participants in each group, thus possibly limiting its statistical power in the detection of smaller differences. The third is the nature of the study, which only measured pain and drug use for the first 24 hours postoperatively. Thus, its benefits after this duration cannot be ascertained.

CONCLUSION

Conclusion of the current study is that the erector spinae plane block is an effective method in reducing the opioid demand and postoperative pain in spine surgery. There were significantly lower demands for analgesics within the first 24 postoperative hours in the ESP group compared to the control group. Additionally, the pain scores at rest and during activity were lower in the ESP group at all times.

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Ethical Approval: This study was approved by the Ethical Committees. All the research activities were carried out by following the committees rule and the Helsinki Declaration.

Patients' Consent: Written consent was taken from all patient before including them in the study. Patients were informed that their personal data will remain confidential and they were free to withdraw at any time.

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