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Erector Spinae Plane Blocks for Circumferential Lumbar Spinal Fusion: Retrospective Cohort Study

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ABSTRACT

Background: Circumferential lumbar spine fusions are extensive procedures that involve accessing the lumbar spine from multiple approaches. These surgeries often make postoperative pain control challenging, and efforts have been made to find alternative methods of analgesia that do not rely solely on opioids. The use of erector spinae plane (ESP) blocks has been found to be effective in controlling pain while decreasing narcotic requirements in patients undergoing thoracolumbar spine surgery. The purpose of this study is to evaluate the efficacy of ESP blocks for postoperative pain control and its effect on opioid consumption in patients undergoing circumferential lumbar spinal fusion.

Methods: A retrospective review was performed on patients undergoing 1- or 2-level elective anterior lumbar interbody fusion with open posterior decompression and posterolateral fusion. An analysis was performed to determine the effect of ESP blocks on hospital length of stay (LOS), pain scores using the visual analog scale, and opioid consumption using morphine milligram equivalents.

Results: 144 patients were included in the cohort analysis, of whom 36 patients received a preoperative ESP block and 108 did not. Demographic data, comorbidities, and number of levels fused were equally distributed between groups. Patients who received an ESP block had shorter LOS (3.0 vs 4.0 days, $P = 0.005$) and lower cumulative morphine milligram equivalent in the first 48 hours after surgery (123.7 vs 141.2, $P = 0.05$). Visual analog scale scores did not significantly differ between patients group except for on postoperative day 4 and at 12-month follow-up.

Conclusions: The use of ESP blocks for patients undergoing 1- or 2-level circumferential fusion via an anterior lumbar interbody fusion with concomitant posterior open procedures was associated with decreased postoperative inpatient opioid requirements and LOS. This cohort study supports the growing body of evidence that ESP blocks are a useful adjunct for multimodal pain control.

Level of Evidence: 3

Clinical Relevance: The data and results of this study provide clinical evidence supporting the use of ESP blocks in patients undergoing circumferential lumbar spine fusion procedures.

Lumbar Spine

Keywords: erector spinae plane block, opioids, anterior lumbar interbody fusion, circumferential lumbar fusion, multimodal analgesia, opioids

INTRODUCTION

Lumbar spinal fusion surgery causes significant pain, often making postoperative pain management challenging.[1] Poorly controlled pain may lead to an increase in complications, delayed recovery, and chronic pain syndromes.[2] Opioids have been the mainstay for pain control in patients undergoing lumbar spine surgery but are associated with an increased risk of dependence and significant adverse effects.[3] In light of the current opioid epidemic, efforts have been made to use other methods of pain control as part of a multimodal analgesia (MMA) regimen.[4] These pathways were developed to decrease reliance on opioids and associated adverse effects through the addition of nonopioid medications such as nonsteroidal anti-inflammatory medications and neuromodulatory agents (eg, gabapentin).[5] Few studies have evaluated the use of novel interfascial plane blocks as part of an MMA regimen in patients undergoing lumbar spinal fusion.[6]

The erector spinae plane (ESP) block is a paraspinal interfascial plane block that has been shown to effectively provide analgesia after a multitude of surgical and interventional procedures.[2,7] It has been gaining popularity in the adult spine surgery literature for its ability to reduce postoperative opioid consumption in patients undergoing thoracolumbar spine surgery.[2,7–9] Recent studies have demonstrated that the addition

of ESP blocks to MMA treatment algorithms leads to decreased postoperative opioid consumption in patients undergoing lumbar decompression, posterior lumbar interbody fusion, and lumbar spine fracture surgery.[6,9,10] However, to our knowledge, there have not been any studies evaluating the use of ESP blocks in patients undergoing circumferential fusion.

The authors conducted a retrospective cohort study on consecutive patients undergoing elective 1- or 2-level anterior lumbar interbody fusion (ALIF) with concomitant posterior open decompression and posterolateral fusion with transpedicular fixation. Circumferential fusions tend to demand more operative resources and usually result in longer surgeries.[11] The purpose of this study was to evaluate the efficacy of preoperative ESP blocks in patients undergoing circumferential lumbar spinal fusion. Primary outcomes included hospital length of stay (LOS) and postoperative inpatient opioid consumption. Secondary outcomes included postoperative pain scores between the two patient cohorts, need for revision surgery during the follow-up period, and pain scores during follow-up. The authors hypothesized that preoperative ESP blocks would result in decreased inpatient opioid consumption, shorter LOS, and improved pain scores.

METHODS

This retrospective medical record review study involving human participants was in accordance with the ethical standard of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study received approval from the Human Investigation Committee (institutional review board) at our institution and did not receive any sources of funding.

Data Collection

A retrospective analysis was conducted on consecutive patients who underwent elective 1- or 2-level circumferential lumbar spine fusion through an ALIF with concomitant posterior open decompression and posterolateral fusion with transpedicular fixation at a single tertiary center from July 2018 to August 2020. All patients were operated on by 1 of 5 neurosurgeons. All surgeons contributed equally to the patient cohort in both the ESP block and control cohorts. Patients undergoing revision surgery with previous instrumentation in the thoracolumbar spine were excluded. Patients were also excluded if they were younger than 18 years or older than 90 years, had surgery for spine trauma or neoplasms, or had an allergy to any component of the local anesthetic used for the ESP block. Pain scores were assessed using the visual analog scale (VAS), and opioid consumption was calculated with morphine milligram equivalents (MME) according to a chart provided by the Center for Disease Control and Prevention.[12] Data collected included demographics, past medical history, surgical history, smoking history, previous pain management requirement, LOS, inpatient postoperative VAS scores for each postoperative day (POD) up to POD 5, cumulative inpatient opioid consumption in the first 48 hours after surgery, total inpatient opioid consumption, complications from the surgery or ESP block, and VAS scores at 2- to 4-week, 3-month, 6-month, and 1-year follow-up. For patients whose circumferential fusion was staged, the ALIF was always done initially with the open posterior portion of the fusion (second stage) being performed 2 to 3 days later. In such cases, data for postoperative pain scores and opioid consumption were collected after the second stage because for these patients, the preoperative ESP block was administered prior to the second stage (posterior approach).

ESP Block

All blocks were performed preoperatively in the holding area. After informed consent, patients are placed in sitting position. The overlying skin is prepped with chlorhexidine. An ultrasound scan (typically using a linear probe [7–12 MHz] or a curvilinear probe [2–6 MHz] for patients with increased body mass index) was used to identify the transverse process between L1 and L3 depending on the planned operative level. The skin is localized with 2 to 3 mL of 1% lidocaine. A 90-mm, 21-gauge Pajunk needle is advanced, in plane, under live ultrasonographic visualization to contact the transverse process. After negative aspiration, the injectate is deposited with periodic negative aspiration. The injectate used in our protocol was composed of 10 mL of liposomal bupivacaine and 20 mL of 0.25% bupivacaine. This was separated into 2 separate 15 mL infusions for both sides. All patients were monitored in the preoperative area for any adverse effects following block placement prior to proceeding with surgery.

Statistical Analysis

Statistical analyses were performed with IBM SPSS Statistics version 27 (IBM Corporation, Armonk, NY). We conducted 2-tailed tests, and $P \leq 0.05$ defined statistical significance. Power analysis determined a

Table 1. Summary of patient characteristics.[a]

Patient Characteristic	Erector Spinae Plane (n = 36)	Control (n = 108)	P Value
Age, y	62.5 (9.4)	62.9 (1.3)	0.840
Body mass index	29.5 (5.1)	31.5 (6.2)	0.092
Sex			
Male	19 (52.8%)	51 (47.2%)	0.564
Female	17 (47.2%)	57 (52.8%)	
Smoking	5 (13.9%)	25 (23.1%)	0.236
Diabetes	10 (27.8%)	26 (24.1%)	0.657
Rheumatoid arthritis	6 (16.7%)	1 (0.9%)	<0.001[a]
Drug abuse history	2 (5.6%)	6 (5.6%)	>0.99
Previous pain management	13 (36.1%)	54 (50.0%)	0.148
Number of levels	1.0 (1.0–2.0)	1.5 (1.0–2.0)	0.702

Note: Data presented as number (%), mean (SD), or median (interquartile range).
[a]Statistically significant ($P \leq 0.05$).

minimal sample size of 126 based on an alpha level of 0.05, a power of 0.80, and an effect size of $d = 0.55$. Variables are expressed as frequency (percentage) or median (interquartile range). Normality was assessed by Shapiro-Wilk test ($P > 0.05$). Comparisons were conducted using the Mann-Whitney U test, χ^2 test, or Fisher's exact test.

RESULTS

A total of 144 patients met criteria and were included in the analysis. Of these, 36 patients had undergone preoperative ESP block. Patient demographics and procedural details are presented in Table 1. The standardized differences between the cohorts were similar when comparing patient age, sex, body mass index, social history, previous use of pain management, comorbidities such as diabetes, and number of levels fused in surgery. The ESP group consumed significantly less total inpatient MME on POD 0 to POD 2 and POD 0 to POD 5 than the control group. When calculating total MME for the first 48 hours after surgery (POD 0 through POD 2), there were significant differences in total MME (Table 2), with the median POD 0 to POD 2 total opioid consumption being significantly less in patients who received an ESP than those who did not (123.7 vs 141.2 MME; $P = 0.050$). A similar trend was found in the total inpatient opioid consumption (POD 0–5), with the ESP group having a lower median total opioid consumption than the control group (149.8 vs 188.3 MME; $P = 0.020$). The ESP group had a significantly shorter LOS (3.0 vs 4.0 days; $P < .005$). There were no significantly different VAS scores other than on POD 4 ($P = 0.009$) and the 1-year follow-up ($P = 0.050$; Table 3). There were no complications from the ESP blocks administered in the study's cohort.

DISCUSSION

The ESP block, first described in 2016 by Forero et al, is a paraspinal interfascial plane block targeting the ventral and dorsal rami of spinal nerves.[13] Since then, it has been shown to be an effective method of reducing postoperative opioid consumption and providing effective postoperative analgesia in patients undergoing thoracolumbar spinal surgery.[2,7–9] Early studies where bilateral ESP blocks were performed in lumbar decompressions showed significant improvements in postoperative pain control and enhanced recovery.[2] A retrospective study by Ueshima et al found lower postoperative pain scores and decreased fentanyl requirement in patients receiving an ESP block prior to undergoing lumbar spinal surgery. They did not find increased complications with the administration of an ESP block.[8] To our knowledge, there have been 4 randomized controlled trials investigating bilateral ESP blocks in lumbar spinal surgery,[7,9,10,14] but none of these involved a uniform cohort of patients undergoing a circumferential lumbar fusion. Also, the different randomized controlled trials differed in the site of local

Table 2. Summary of total postoperative day opioid consumption.[a]

Outcome Measure	Erector Spinae Plane (n = 36)	Control (n = 108)	P Value
Total MME POD 0 to 2	123.7 (69.2–143.9)	141.2 (75.8–185.5)	0.050[a]
Total MME POD 0 to 5	149.8 (80.0–241.1)	188.3 (121.3–330.2)	0.020[a]
Length of stay, d	3.0 (2.0–4.0)	4.0 (3.0–6.0)	0.005[a]

Abbreviations: MME, morphine milligram equivalents; POD, postoperative day.
Note: Data presented as median (interquartile range).
[a]Statistically significant ($P \leq 0.05$)

Table 3. Summary of VAS scores.[a]

Pain VAS	Follow-up		ESP (n = 36)	Control (n = 108)	P Value
	ESP	Control			
POD 0	36 (100%)	106 (98.1%)	7.0 (6.0–8.0)	8.0 (6.0–9.0)	0.349
POD 1	35 (97.2%)	105 (97.2%)	8.0 (6.0–9.0)	8.0 (6.0–9.0)	0.862
POD 2	30 (83.3%)	97 (89.8%)	7.0 (4.7–8.2)	7.0 (5.0–8.0)	0.911
POD 3	23 (63.8%)	78 (72.2%)	7.0 (3.0–8.0)	7.0 (6.0–8.2)	0.227
POD 4	13 (36.1%)	59 (54.6%)	5.0 (3.5–7.5)	8.0 (7.0–9.0)	0.009[a]
POD 5	4 (11.1%)	42 (38.8%)	7.0 (1.5–9.5)	7.0 (5.0–8.0)	0.955
Weeks 2 to 4	34 (94.4%)	89 (82.4%)	4.0 (2.0–6.0)	5.0 (2.0–7.0)	0.703
Months 2 to 3	33 (91.6%)	80 (74.0%)	2.0 (0.0–5.0)	4.0 (1.0–6.0)	0.075
Month 6	22 (61.1%)	63 (58.3%)	3.0 (0.0–5.5)	4.0 (0.0–6.0)	0.218
1 Year	13 (36.1%)	44 (40.7%)	3.0 (0.0–5.5)	5.0 (2.0–7.0)	0.050[a]

Abbreviations: ESP, erector spinae plane; POD, postoperative day; VAS, visual analog scale.
Note: Data presented as number (%) and median (interquartile range).
[a]Statistically significant ($P \leq 0.05$).

anesthetic administration during the ESP block (T10 vs L3), but all resulted in patient satisfaction and reduction in postoperative opioid requirement. Yu et al evaluated the analgesic efficacy of ESP blocks in patients undergoing posterior lumbar fusion for fracture.[14] In their study, the local anesthetic for the ESP block was injected at the level of the fractured lumbar vertebra. They found the group of patients who received the preoperative ESP had better postoperative analgesia, decreased opioid consumption, and decreased incidence of postoperative nausea and vomiting.[14] Our review of the literature revealed one case report where bilateral ESP blocks at T4 were used on a posterior thoracic (T2–T8) decompression and fusion where the patient did not require any opioids during their postoperative hospital stay.[15] Alternative techniques for regional anesthesia in lumbar spinal surgery described in the literature include thoracolumbar interfascial plane block[16] and transversus abdominis plane block.[17] Both were shown to be efficacious as pain management strategies following lumbar spine surgery.

A recent systematic review from Liang et al demonstrated that ESP blocks decreased intra- and postoperative opioid consumption and decreased postoperative pain scores.[18] However, there is not sufficient evidence to demonstrate accelerated postoperative recovery. Our results demonstrated similar findings in terms of decreased postoperative opioid consumption but also found a decreased LOS, suggesting that patients may recover faster with the ESP block. Postoperative pain scores did not vary between the 2 cohorts, which is contrary to the results from previous studies.[9,10,18] This suggests that based on our results, the ESP block provided analgesia that was comparable, but not superior, to traditional regimen relying mostly on opioids for pain control. However, this may be due to the small sample size of our study and thus difficulty finding a statistically significant difference in a small change of VAS pain scores. The retrospective nature of this study limits the interpretation of these findings. Additionally, at our institution, the inpatient VAS pain score recorded in patients' medical records is obtained by the nursing staff every 4 to 8 hours depending on the individual surgeon's postoperative orders. However, the VAS pain score during follow-up is assessed by either the surgeon or a midlevel provider. We found that patients who had received the ESP block reported lower VAS scores during follow-up, particularly at 1 year after surgery. We are unable to provide any specific rationale for these findings.

There are several limitations to this study. As mentioned previously, the retrospective nature of the data collection places this study at increased risk for selection bias. Although patients could not be randomized, the authors attempted to ameliorate this risk by including consecutive elective patients during a specified time frame with strict inclusion and exclusion criteria. Second, the number of patients lost to follow-up after 3 months places the results for VAS scores during 6-month and 1-year follow-up at increased risk for attrition bias. The largest limitation of this study is its small sample size. However, the difference in required MME between the 2 cohorts resulted in statistically significant differences in narcotic requirements for each POD and cumulative for the first 72 hours postoperatively (POD 0–2), which comprises the period that most patients undergoing these procedures are admitted at our institution. Additionally, our multiregression analysis found ESP blocks to be a predictor for decreased narcotic requirement, which we found to be one of the strengths of our study. Lastly, the decision to use a preoperative ESP blocks was left at the discretion of the treating surgeon and anesthesiologist.

Despite these limitations, the 2 groups were similar in characteristics and number of levels fused. The findings of this study could be applied to a similar cohort of patients undergoing elective 1- or 2-level circumferential fusions requiring open posterior decompression. The specificity of the patient population is 1 unique factor that has not been evaluated in previous similar studies. Another unique aspect of this study is that it included opioid consumption past the first 24 or 48 hours postoperatively, which is unusual for previous studies on ESP blocks in similar patient cohorts,[18] and many of these patients may remain admitted after this time frame. In accordance with the hypothesis, preoperative ESP blocks were found to reduce postoperative opioid consumption and hospital LOS in patients undergoing elective 1- or 2-level circumferential fusion. Despite this finding, patients who received the ESP block did not report better postoperative pain control, as demonstrated by statistically similar VAS scores during each inpatient POD.

CONCLUSION

The use of ESP blocks for patients undergoing 1- or 2-level circumferential lumbar fusion may result in decreased inpatient postoperative narcotic requirements. Spine surgeons and anesthesiologists should consider this useful adjunct for multimodal pain control postoperatively. The growing body of evidence for ESP blocks in lumbar spinal surgery, including the results from this study, supports its use in this patient population. Future studies with prospective designs and larger sample sizes may further elucidate the benefit of this intervention in patients undergoing lumbar spine fusion procedures. Additionally, studies evaluating the cost-effectiveness of such interventions should take into account shorter hospital LOS and decreased opioid consumption.

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Institutional Review Board: This retrospective chart review study involving human participants was in accordance with the ethical standard of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The Human Investigation Committee (IRB) of the University of Tennessee Health Science Center (#20-039) approved this study. Informed consent was waived.

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