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Original Article

Comparison of Lumbar Erector Spinae Plane (ESP) Block versus Fentanyl for Post-Operative Pain Control in Minimally Invasive Lumbar Disc Surgery

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ABSTRACT

Objective: To measure efficacy of Erector Spinae Plane (ESP) block compared to intravenous Fentanyl for reduction of post-operative pain after Minimally Invasive Lumbar Disc Surgery.

Study Design: Quasi-Experimental Study

Place and Duration of Study: Operation Theatre, Combined Military Hospital (CMH) Quetta, Pakistan from July-Dec 2023.

Methodology: After ethical approval, sixty patients were divided into two groups. Group-FEN and Group-ESP. In Group-ESP, thirty patients were given Erector Spinae Plane (ESP) block and in Group-FEN thirty patients were given intravenous Fentanyl for post-operative analgesia. Primary outcome of our study was the mean duration to first rescue analgesia and secondary outcome was pain intensity at time of first rescue analgesia.

Results: Time to receive first analgesia was considerably shorter in Group-FEN that is 2.37 ± 0.69 hours compared to 13.07±4.22 hours in Group-ESP with a *p*-value of <0.001. Similarly, the pain intensity was mild in 2(6.7%) patients, moderate in 19(63.3%) patients and severe in 9(30.0%) patients in Group-FEN. The pain intensity at first analgesic request was moderate in 17(56.7%) patients and severe in 13(43.3%) patients in Group-ESP.

Conclusion: The Erector Spinae Plane (ESP) Block provides better quality and duration of post-operative analgesia than Fentanyl for patients undergoing minimally invasive Lumbar disc surgery.

Keywords: Erector spinae plane (ESP) block, Fentanyl, Lumbar disc surgery, Minimally invasive lumbar disc surgery (MIS-LDS), Lumbago and Pain

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INTRODUCTION

Low back pain or lumbago has become a prevalent morbidity and major cause of disability in modern world with an expected 766 million cases in year 2020.[1] About 5–10% of occurrences of low back discomfort are caused by prolapsed or herniated lumbar discs, and the local statistics show that two and three percent of Pakistanis also have prolapsed lumbar discs. According to a careful estimate by Khan *et al,* Pakistan carried out about 10,000 lumbar disc operations in 2018.[2]

Historically, considerable muscle dissection and a big back incision have been required during disc prolapse surgery which resulted in significant discomfort and a protracted recovery period. Major improvements in surgical techniques for disc prolapse have occurred recently, making surgery a more practical choice for many patients. Compared to open surgery, minimally invasive lumbar disc surgery (MIS-LDS) is a more recent surgical method that requires fewer incisions, less dissection of muscle, and less pain. Results from MIS-LDS operations have also been demonstrated to be equivalent to those from open surgery. Microdiscectomy, endoscopic discectomy, and percutaneous discectomy are a few of the most popular MIS-LDS operations. MIS-LDS operations carry some risks, similar to any surgery, with the possibility of severe pain following the procedure.[3] Opioids used to be the cornerstone of post-lumbar disc surgical pain management but they are also known to cause a lot of negative side effects, such as addiction, overdose, nausea, vomiting, constipation, and respiratory depression.[4]

Consequently, Surgeons and Pain Specialists have switched to alternative medications like Ketamine, Acetaminophen, and NSAIDs. These medications do, however, also have adverse effects. Regional anesthesia techniques such as Transversus Abdominis Plane block, Epidural anesthesia, Erector Spinae, Quadratus Lamborum and Paravertebral blocks have also been used for post-operative pain in microdiscectomy with variable success rate.[5] ESP

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block is a relatively newer and more effective technique in comparison to other peripheral nerve blocks, such as transversus abdominis plane (TAP), quadratus lumborum (QL), and even epidural.[5] Some studies have elucidated that analgesic effect of ESP lowers post-operative opioid usage in thoracic and anterior abdominal wall surgeries.[6] Few recent studies have established that ESP block can be a substitute for Fentanyl in the management of post-operative pain following lumbar disc surgery or it can be an ally to multimodal analgesia.[7] However, more investigation is required to directly compare the ESP block and Fentanyl in terms of results and to offer a fresh viewpoint on the matter, particularly to investigate the possibility to perform this surgery entirely opioid-free. The rationale of our study was to compare efficacy of ESP block to Fentanyl for reducing post-operative pain. The results of this study will allow us to formulate post-operative pain management strategy after lumbar Minimally Invasive Lumbar Disc Surgery (MI-LDS).

METHODOLOGY

After getting approval of the hospital's committee of ethics (vide IERB number CMH QTA-IB/088) the Quasi-Experimental study with was carried in the Operation Theatre of Combined Military Hospital Quetta, Pakistan from Jul-Dec 2023. WHO sample size calculator was used to calculate sample size keeping level of significance 5%, power of test 90%, The expected mean pain score with Fentanyl to be of 6 and expected mean pain score with Erector Spinae Plane Block to be 28. The sample was calculated to be 24 and we rounded it off to 30. Keeping this as reference, 80 patients were initially recruited; after applying the inclusion criteria, 60 patients were included in the study. The patients were randomly divided into 2 groups with 30 in each group marked as Group-ESP and Group-FEN. Sampling technique employed was non-probability, consecutive sampling. Until the time of surgery, the anaesthesiologist and participants were both unaware of the randomization sequence. The group formation is shown in Figure.

Inclusion Criteria: ASA I or ASA II patients of either gender with a BMI of less than 30 kg/m2 planned for elective minimally invasive lumbar disc surgery with duration not more than 90 minutes were included in the study.

Exclusion Criteria: Patients with uncontrolled diabetes, hypertension, ischemic heart disease , COPD, drug allergies, addictions, neurological deficits, lactating or pregnant females, blood dyscrasias and psychiatric problems were excluded from the study.

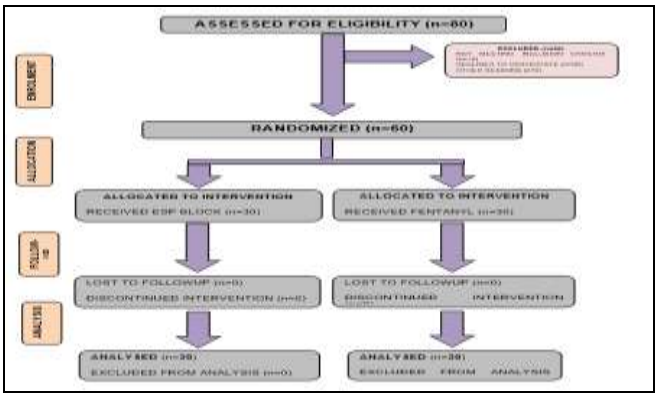

Figure: Phases of The Study

The written consent of every patient undergoing elective lumbar disc surgery was obtained. All participants were evaluated in pre-anesthesia assessment clinics. Based on the medical history, physical examination, and laboratory findings, anesthesiologists determined the anesthesia fitness and patients fulfilling the pre-anesthetic assessment were booked for elective surgery. On night before surgery, all participants were given 3 mg of Bromazepam and were kept nil per oral (nothing by mouth) for 12 hours before surgery. This was a double-blind study with the anesthetist in the OT receiving a sealed envelope with the instructions for the infusion or the method to perform block for the respective group. Findings were written on a proforma by a resident anesthetist in the OT unaware of the drug or the study protocol.

On the day of the procedure, they were outfitted with non-invasive monitoring equipment, such as temperature probes, electrocardiograms, pulse oximeters, and non-invasive blood pressure monitors, to track baseline hemodynamic parameters. Before the procedure began, an 18-gauge intravenous catheter was inserted into the upper limb to deliver crystalloids. A properly fitting mask was used to preoxygenate the participants at a rate of 10 L/min of Oxygen. Following preoxygenation, each subject received a 2-milligram/kg Propofol induction dose, and ventilation was maintained. After three minutes of bag-mask ventilation and the administration of Atracurium (0.5 mg/kg), adequate ventilation was verified. After that, patient was intubated with a 7.5 mm internal diameter endotracheal tube and

Isoflurane (1.2-2 MAC) and Atracurium (0.1 mg/kg) were used to maintain anesthesia. For Group-ESP, an experienced anesthesiologist used ultrasound guidance to perform an ESP plane block after the patient was placed in the prone position. At the level of the surgical incision, a 22-gauge block needle was placed into the ESP plane, and 20 mL of 0.25% Bupivacaine was injected. After induction, Group-FEN received a loading dose of 50 micrograms of Fentanyl, and until the end of the procedure, an infusion of 4 mcg/kg/min was administered[9].

Table-I: Intensity of Pain Quantified by Numeric Rating Scale (NRS) score

Intensity of pain	Numeric Rating Scale (NRS) score
Mild	NRS 0-3
Moderate	NRS 4-6
Severe	NRS 7-10

Following the completion of the surgical procedure, all infusions were stopped, and an injection of 2.5 mg of Neostigmine and 0.5 mg of Glycopyrrolate was given to counteract the muscle relaxant's effects. Patients were extubated once participants demonstrated sufficient muscle power by following spoken instructions or moving their bodies purposefully. After being monitored, the patients were moved to the post-anesthesia care unit (PACU). A Numeric Rating Scale (NRS)10 score was used to quantify pain as shown in Table-II.

Table-II: Comparison of Patient Characteristics among Study Groups (n=60)

Variable(s)		Group-ESP (n = 30) Mean ± SD	Group-FEN (n = 30) Mean ± SD	*p*-value
Age (years)		49.07 ± 6.16	52.97 ± 5.39	0.178
Height (cm)		163.97 ±7.73	162.97 ± 7.27	0.880
Weight (Kg)		71.63 ± 9.45	70.77 ± 8.00	0.802
BMI in (Kg/m2)		26.78 ± 4.12	26.77 ± 3.70	0.632
		Frequency (%)	**Frequency (%)**	
Gender	Male	12(40.0 %)	10(33.3 %)	0.592
	Female	18(60.0%)	20(66.7%)	
Co-morbid	Diabetes mellitus	7(23.3%)	8(26.7%)	0.224
	Hypertension	12(40.0%)	6(20.0%)	
	None	11(36.7%)	16(53.3%)	
ASA class	ASA I	11(36.7 %)	16(53.3 %)	0.194
	ASA II	19(63.3 %)	14(46.7 %)	

The NRS was recorded at time of first analgesic drug administration request .Primary outcome of our study was the mean duration to first rescue analgesia and secondary outcomes was pain intensity at time of first rescue analgesia.

Statistical Package for the Social Sciences was the statistical software used to analyze data. We employed a t-test to analyze the primary outcome which was mean duration to first rescue analgesia between the two groups. A Chi square test was used to compare the pain intensity at time of first rescue analgesia. A *p*-value of ≤0.05 will be considered statistically significant.

Table–III: Comparison of Duration of Surgery, Analgesia and Pain score (n=60)

Variable(s)		Group-ESP (n = 30) Mean ± S.D	Group- FEN (n = 30) Mean ± S.D	*p* value
Duration of Surgery (Minutes)		81.97 ± 7.35	79.23 ± 8.54	0.639
Time to First analgesia (Hours)		13.07 ± 4.22	2.37 ± 0.69	<0.001
Pain intensity at first rescue analgesia	Mild	2(6.7%)	0(0.0 %)	0.242
	Moderate	19(63.3%)	17(56.7%)	
	Severe	9(30.0%)	13(43.3%)	

RESULTS

A total of 60 participants were included in the trial which were divided into Group-ESP (n=30) and Group-FEN (n=30) respectively with 22(36.6%) males and 38(63.3%) females. Mean age in Group-ESP was 49.07±6.16 years versus 52.97±5.39 years in Group-FEN. Distribution based on BMI revealed a mean value of 26.78±4.12 Kg/m2 versus 26.77±3.70 Kg/m2 in ESP and Fentanyl groups respectively. ASA I patients in Group-ESP were 11(36.7 %) as compared to 16(53.3 %) while ASA II patients were 19(63.3 %) and 14(46.7 %) in Group-ESP and Group-FEN. 7(23.3%) patients in Group-ESP had diabetes mellitus, 12 (40.0%) had hypertension and 11(36.7%) had no known co-morbid. 8(26.7%) patients in Fentanyl group had diabetes mellitus, 6(20%) had hypertension and 16(53.3%) had no co-morbid which was analogous in both groups with *p* value of 0.224. Patient characteristics are shown in Table-I.

Time to receive first analgesic was earlier in Group-FEN. It was 2.37 ± 0.69 hours which was significantly shorter to 13.07±4.22 hours as compared to Group-ESP with a *p*-value of <0.001 as shown in Table-II. The pain intensity was mild in 2(6.7 %) patients, moderate in 19(63.3%) patients and severe in 9(30.0%) patients in Group-FEN. The pain intensity at first analgesic request was moderate in 17(56.7%) patients and severe in 13(43.3%) patients in group ESP.

DISCUSSION

The findings of our study show that the Erector Spinae Plane (ESP) Block provides better quality and

duration of post-operative analgesia than Fentanyl for patients undergoing minimally invasive Lumbar disc surgery. This study highlighted the role of Erector Spinae Plane (ESP) Block as sole entity for management of postoperative pain in Minimally Invasive Lumbar Disc surgeries. Undoubtedly there are clear benefits to both approaches, so it's important to consider their relative advantages and disadvantages. Although opioids are very versatile and have a quick onset, they also come with a risk of addiction, tolerance, and side effects[11]. To choose the best pain management strategy, a detailed evaluation of the patient's needs and a thorough comprehension of both modalities is necessary.

In lumbar surgeries, nerve blocks have become a viable substitute for opioids in the management of postoperative pain. They provide efficient pain relief, lower the need for opioids, and have a good safety record.[12,13] When compared to systemic opioids, nerve blocks have been shown in numerous studies to be more effective in reducing pain intensity, opioid consumption, and length of hospital stay.[14] Additionally, there is a notable opioid-sparing effect of nerve blocks, which minimizes the need for opioids and lowers the likelihood of side effects[15]. Nerve blocks are displacing systemic opioids as the primary treatment for post-operative pain following lumbar disc surgery due to their effectiveness and safety profile.[16-17]

According to a meta-analysis of various randomized controlled trials of over 4,000 patients, Schnabel A *et al.*, found that nerve blocks were more effective than opioids at lowering pain intensity and raising patient satisfaction. Furthermore, nerve blocks were linked to a reduced need for opioids and a shorter duration of postoperative pain[18].

A study by Khor. et al. found that patients who had nerve blocks used about 50% less opioids overall than those who just received opioids[19]. This effect of sparing opioids is especially helpful in lowering the likelihood of opioid-related side effects, such as tolerance, addiction, and overdose risk.

Continuous femoral nerve block (CFNB) was linked to significantly lower opioid consumption and pain scores in patients undergoing lumbar fusion surgery when compared to systemic opioids, according to a study by Zhang *et al*[20]. Additionally, patients in the CFNB group reported being happier with their pain management and having a shorter hospital stay.

Peripheral nerve blocks (PNBs) were linked to significantly lower opioid consumption and pain scores in patients undergoing lumbar decompression surgery when compared to the opioid group, according to a ground-breaking study by Liang *et al*[21]. As the understanding of nerve block techniques continues to advance, their role in managing post-operative lumbar pain is likely to expand, offering patients a safer and more effective approach to pain relief.

For the safe and efficient management of postoperative pain following lumbar surgeries, nerve blocks provide an option to opioids. Nerve blocks are a useful tool for lowering pain and opioid use, which improves patient outcomes and lowers medical expenses.

Our study's findings demonstrate that ESP block is a more dependable and efficient method of delivering post-operative analgesia and lowering the need for opioid usage.

CONCLUSION

We conclude that Erector Spinae Plane (ESP) Block provides better quality and duration of post-operative analgesia than Fentanyl for patients undergoing minimally invasive Lumbar disc surgery.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

US & JZ: Data acquisition, data analysis, critical review, approval of the final version to be published.

MSS & KM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AR & KB: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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