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Original Article

Comparison of Two Different Doses of Dexmedetomidine in Lumbar Transforaminal Block for Treatment of Lumbar Radicular Pain in Tertiary Care Hospital inRawalpindi

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ABSTRACT

Objective: To compare two different doses of Dexmedetomidine in lumbar transforaminal block for treatment of lumbar radicular pain in tertiary care hospital in Rawalpindi.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of Anesthesia, Fauji Foundation Hospital, Rawalpindi Pakistan, from Oct 2022 to Oct 2023.

Methodology: A total of 60 patients, aged 30 to 60 years, experiencing lumbar radicular pain due to disc protrusion were included in this study. They were randomly divided into two equal groups. Group-A received a dose of 0.2mcg/kg Dexmedetomidine, while Group-B received 0.5mcg/kg Dexmedetomidine. Data pertaining to post-operative parameters was collected using a standardized proforma and analyzed using SPSS.

Results: Sixty patients who received lumbar transforaminal blocks to relieve lumbar radicular pain were methodically divided into two groups of thirty people each. Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) revealed no significant differences between Group-A and Group-B (p>0.05). There is no significant difference in hypotension incidence between Group-A (6.7%) and Group-B (40.0%) at baseline for blood pressures of 100/60 and higher (p=0.765). However, Group-A demonstrated a significantly lower bradycardia incidence (26.7%) compared to Group-B (36.7%) for heart rates <65 bpm (p=0.003). Also, Group-A showed lower incidence of nausea (13.3%) compared to Group-B (30.0%), but the difference was not statistically significant (p=0.160).

Conclusion: The study showed that both groups showed no significant difference in pain intensity and disability index, however, 0.2mcg/kg Dexmedetomidine exhibited a lower incidence of bradycardia and nausea, indicating a potential safety advantage over 0.5mcg/kg Dexmedetomidine. However, both groups had similar hypotension rates. These findings suggest a more favorable adverse event profile for 0.2mcg/kg Dexmedetomidine in treating the studied condition.

Keywords: Bradycardia, Dexmedetomidine, Oswestry Disability Index, Visual Analog Scale.

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INTRODUCTION

Lumbosacral radicular pain manifests as lower back discomfort radiating down to the lower limbs, often resulting from nerve root compression due to conditions like lumbar disc herniation or spinal stenosis. This compression leads to a spectrum of symptoms, including pain, altered sensation, and potential motor impairments, the intensity varying based on the degree of nerve compression. The condition can significantly impact an individual's quality of life, necessitating comprehensive evaluation and tailored treatment strategies to alleviate symptoms and enhance overall well-being.[1]

The principal way to address lumbar radicular pain involves the use of medication, physical therapy, and the application of epidural steroid injections. An effective approach for managing this type of pain is through lumbar transforaminal steroid injections.[2] Injections specifically aimed at spinal nerves, with a notable focus on nerve blocks comprising approximately 75% of spinal injections in extensive studies.[3]

Dexmedetomidine, a highly precise alpha-2 agonist, stands out for its ability to induce sedation and effectively relieve pain without compromising respiratory function. Its analgesic efficacy is attributed to its targeted influence on specific regions both within and above the spinal cord, underscoring its potential as a valuable tool in the management of spinal and lumbar pain.[4]

A range of Dexmedetomidine doses, often used alongside diverse analgesic drugs, have been explored in extensive research studies.[5,6] The potential analgesic effects of steroids encompass their ability to mitigate inflammation by suppressing proinflammatory

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cytokines and fostering anti-inflammatory cytokines, thus curtailing prostaglandin synthesis. Additionally, steroids may modulate nerve cell excitability, contributing to pain alleviation.[7,8]

The primary objective of this study was to evaluate the efficacy of varying Dexmedetomidine doses in lumbar transforaminal block for alleviating lumbar radicular pain. This research study aimed to explore the optimal dosage and potential adverse effects of Dexmedetomidine in lumbar pain.

METHODOLOGY

A Quasi-experimental study was conducted in Fauji Foundation Hospital, Rawalpindi from October 2022 to October 2023. The ethical review board of Fauji Foundation Hospital granted ethical approval (reference number 555/RC/FFH/RWP) for this project and informed consent was obtained from all participants. The sample included all the patients coming to tertiary care hospital for treatment of lumbar radicular pain in a duration of 6 months, these patients were followed up for next 6 months. Sample size was calculated using the online calculator Epitools, taking confidence interval 95%, margin of error 5%, mean and standard deviation of group one 7.7±1.1 and mean and standard deviation of group two 8.8±1.0.[2] The estimated sample size came out to be 30. To improve the validity of the data, we have used a sample of 60 total with 30 in each group.

Group-A receiving 0.2mcg/kg Dexmedetomidine plus 0.25% bupivacaine 4ml and Group-B receiving 0.5mcg/kg Dexmedetomidine plus 0.25% bupivacaine 4ml (Figure).

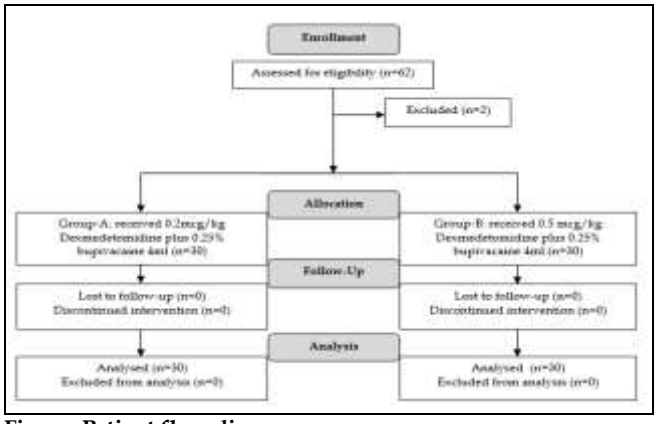

Figure: Patient flow diagram

Inclusion Criteria: Patients within age group of 30 to 60 years receiving lumbar transforaminal block for treatment of lumbar radicular pain due to disc protrusion at 2-3 segment level on MRI were included. Patients were only included if the pain was present for more than 6 months and did not resolve with conservative treatment.

Exclusion Criteria: Patients with lumbar extrusion, vertebral deformity, infections, coagulation abnormalities, history of spine surgery, spondylolisthesis, scoliosis and patients with any neurological condition or psychiatric conditions were excluded.

Data on the demographics, post-operative parameters including pain assessed by VAS and disability assessed by ODI was collected. The data pertaining to adverse effects such as hypotension and brady cardia was also collected. Data was collected at different intervals after the procedure. Means and standard deviations for quantitative data and percentages and frequencies for qualitative variables were reported, respectively.

Statistical analyses were carried out using appropriate methods using Statistical Packages for the Social Sciences (SPSS) version 23. The Shapiro Wilk test was utilized to verify the normality, and the results were presented using descriptive statistics like Mean±SD since the data was normally distributed. Qualitative variables were analyzed using the appropriate Chi square test. A significance level of <0.05 was applied to *p*-value.

RESULTS

Sixty patients (n=60) were included in the study meeting both the inclusion and exclusion criteria, sorted into two distinct groups, each consisting of thirty individuals. Mean age in Group-A was 44.77±5.08 years, with a male to female ratio of 1:29 (3.33% males, 96.67% females). In Group-B, the mean age was 51.27±13.05, with a male to female ratio of 3:27 (10% males, 90% females). Our study highlighted a greater prevalence of female patients among the cases examined. The age and gender disparities between the groups suggest potential differences in demographic characteristics.

In our research, the analysis of pain intensity using the Visual Analog Scale (VAS) revealed no significant differences between Group-A and Group-B and the changes were not statistically significant as shown in Table-I.

The Oswestry Disability Index (ODI) demonstrated no significant differences between Group-A and Group-B at various time points ($p>0.05$), as indicated in Table-II.

Additionally, there was no notable distinction in hypotension incidence between the two groups at baseline (p=0.765) and after two weeks (p=0.659), as shown in Table-III.

Table-I: Comparison of Pain among both Groups according to Visual Analogue Scale (n=60)

Visual Analogue Scale	Group-A(n=30) Frequency (%)	Group-B(n=30) Frequency (%)	*p*-value
After the procedure			
Mild	16(53.3)	10(33.3)	0.106
Moderate	13(43.3)	20(66.7)	
Severe	1(3.3)	0(0)	
After 2 weeks			
Mild	17(56.7)	9(30.0)	0.577
Moderate	10(33.3)	19(63.3)	
Severe	3(10.0)	2(6.7)	
After 4 weeks			
Mild	2(6.7)	15(50)	0.733
Moderate	16(53.3)	13(43.2)	
Severe	12(40.0)	2(6.7)	
After 1 month			
Mild	7(23.3)	4(13.3)	0.344
Moderate	16(53.3)	19(63.3)	
Severe	7(23.3)	7(23.3)	
After 3 months			
Mild	0	0	0.500
Moderate	11(36.7)	15(50.0)	
Severe	19(63.3)	15(50.0)	
After 6 months			
Mild	0	0	0.596
Moderate	9(30.0)	14(46.7)	
Severe	21(70.0)	16(53.3)	

Initially, Group-A had a significantly lower bradycardia incidence (26.7%) than Group-B (36.7%) for heart rates <65 bpm at baseline (p=0.003). However, after two weeks, there was no significant difference in bradycardia rates between the groups for heart rates <65 bpm or >65 bpm (p=0.696), as indicated in Table-IV.

Additionally, at baseline and after two weeks, Group-A exhibited a non-significantly lower nausea incidence than Group-B. Top of Form.

DISCUSSION

In our research, pain intensity (VAS) and functional impairment (ODI) didn't significantly differ between Group-A receiving 0.2 mcg/kg of Dexmedetomidine and Group-B receiving 0.5 mcg/kg of Dexmedetomidine at various post-treatment points (p>0.05). Both groups experienced a transition from mild to moderate/severe pain and improved functional disability (ODI range of 21-60) throughout the follow-up period. Furthermore, hypotension, bradycardia rates, and nausea incidence were comparable between the groups initially and at the two-week mark. Opioid-related side effects can affect the quality of postoperative recovery. Employing multimodal analgesia is a prevalent strategy to address pain and minimize postoperative adverse effects. Dexmedetomidine (DEX), an α2 receptor agonist, proves effective in easing postoperative pain and reducing instances of postoperative nausea.[9] In contrast to our study, a study on unilateral inguinal hernioplasty, incorporating 0.5 mcg/kg of Dexmedetomidine as a supplement to 0.25% bupivacaine in a transversus abdominis plane block seems to offer heightened post-operative pain relief in contrast to using a 0.25 mcg/kg dose. This suggests a potential enhancement in analgesic effectiveness and patient comfort.[10]

Table-II: Comparison among Groups according to Oswestry Disability Index (ODI) (n=60)

Oswestry Disability Index	Group-A(n=30) Frequency (%)	Group-B(n=30) Frequency (%)	*p*-value
After the Procedure			
0-20	3(10.0)	0	0.347
21-40	8(26.7)	12(40.0)	
41-60	12(40.0)	11(36.7)	
61-80	7(23.3)	7(23.3)	
81-100	0	0	
After 2 weeks			
0-20	2(6.7)	0	0.126
21-40	10(33.3)	16(53.3)	
41-60	13(43.3)	13(43.3)	
61-80	5(16.7)	13(3.3)	
81-100	0	0	
After 4 weeks			
0-20	1(3.3)	0	0.354
21-40	9(30)	15(50)	
41-60	15(50)	13(43.3)	
61-80	5(16.7)	2(6.7)	
81-100	0	0	
After 1 month			
0-20	4(13.3)	0	0.471
21-40	8(26.7)	14(46.7)	
41-60	12(40.0)	13(43.3)	
61-80	6(20.0)	3(10.0)	
81-100	0	0	
After 3 months			
0-20	1(3.3)	1(3.3)	0.585
21-40	10(33.3)	12(40.0)	
41-60	14(46.7)	14(46.7)	
61-80	4(13.3)	3(10.0)	
81-100	1(3.3)	0	
After 6 months			
0-20	1(3.3)	1(3.3)	0.573
21-40	9(30.0)	11(36.7)	
41-60	13(43.3)	15(50.0)	
61-80	6(20.0)	3(10.0)	
81-100	1(3.3)	0	

A study by Jia *et al.*, showed that administering different doses of Dexmedetomidine (0.2, 0.3, and 0.4μg·kg−1) resulted in a significant reduction in heart rate across all groups (p<0.05), while still maintaining heart rates within normal clinical levels. We observed no hypotensive events after administration of different doses of Dexmedetomidine.[11]

Table-III: Comparison of Hypotension between Group-A and Group-B (n=60)

Hypotension	Group-A(n=30) Frequency (%)	Group-B(n=30) Frequency (%)	*p*-value
Baseline			
Blood pressure <100/60 mmHg	2(6.7)	12(40.0)	0.765
Blood pressure >100/60 mmHg	28(93.3)	18(60.0)	
After 2 weeks			
Blood pressure <100/60 mmHg	28(93.3)	30(100.0)	0.659
Blood pressure >100/60 mmHg	2(6.7)	0	

Table-IV: Comparison of Bradycardia and Nausea among Study Groups (n=60)

Bradycardia	Group-A(n=30) Frequency (%)	Group-B(n=30) Frequency (%)	*p*-value
Baseline			
Heart Rate <65bpm	8(26.7)	11(36.7)	0.954
Heart Rate >65bpm	22(73.3)	19(63.3)	
After 2 weeks			
Heart Rate <65 bpm	2(6.7)	2(6.7)	0.696
Heart Rate >65 bpm	28(93.3)	28(93.3)	
Nausea	**Group-A(n=30) Frequency (%)**	**Group-B(n=30) Frequency (%)**	***p*-value**
Baseline			
Negative	26(86.7)	21(70.0)	0.160
Positive	4(13.3)	19(30.0	
After 2 weeks			
Negative	29(96.7)	27(90.0)	0.474
positive	1(3.3)	3(10.0)	

**bpm: beats per min*

In a study exploring the impact of varying Dexmedetomidine (DEX) doses on stress response (SR) and postoperative cognitive function (POCF) in elderly patients undergoing spine surgery, there were no significant differences in confusion, somnolence, nausea, and vomiting (p>0.05). However, a notable distinction was observed in the total incidence of postoperative adverse reactions among the three groups (p<0.05). The group receiving 1.0 µg/kg/h DEX, showed significantly lower total postoperative adverse reactions compared to the groups receiving 0.5 µg/kg/h DEX and equal saline volume.[12]

Observation of disability index, in a study showing comparison of Caudal Block and Dexmedetomidine Infusion in Pediatric Patients Undergoing Hypospadias Repair Surgery, regarding movement limitation after surgery, there were noticeable differences in movement among groups. Thirty minutes and one hour after the operation, the caudal and Dexmedetomidine groups were quite similar in terms of movements.[13]

In contrast to our findings, regarding VAS, a study by Guo *et al.,* showed that the group given a combination of ultrasound-guided ESPB with ropivacaine and Dexmedetomidine (group RD2) experienced less pain as shown by their lower pain scores compared to the groups that received ultrasound-guided ESPB with only ropivacaine (group R) and ultrasound-guided ESPB with ropivacaine plus a lower Dexmedetomidine dose (group RD1). This initial difference was statistically significant (p<0.05), indicating that the pain relief was more effective in group RD2 right after the surgery. However, as time progressed (at 4 hours, 8 hours, 48 hours, and 72 hours post-surgery), the differences in pain scores among the three groups were not significant (p>0.05). This suggests that the initial advantage of lower pain scores in group RD2 diminished over time, and by these later time points, all three groups had similar levels of pain, indicating that the effect of the Dexmedetomidine dose in group RD2 may have subsided or equalized with the other groups in terms of pain relief.[14]

Similar to our findings, in another research adding Dexmedetomidine to Bupivacaine in Ultrasound-guided Thoracic Paravertebral Block for Pain Management after Upper Abdominal Surgery, the pain scores, measured using the Numeric Rating Scale (NRS), the BD group (bupivacaine 2.5 mg/mL 20 mL plus Dexmedetomidine 100 µg) consistently had significantly lower pain scores (NRS) than the B group (bupivacaine 20 mL alone) over time (p=0.003). Additionally, sedation scores in the BD group were notably lower than the B group at the 6th and 48th hours, indicating less sedation in the BD group during these periods.[15]

Various studies on Dexmedetomidine in combination with other drugs have reported its efficacy in post operative analgesia.[16-18] This study has few limitations that need to be considered when interpreting its results. Firstly, the relatively small sample size of 60 patients may limit the generalizability of the findings to a larger and more diverse population. Secondly, the study's one-year duration may not capture long-term outcomes or potential delayed side effects of the treatment, and it may be important to evaluate the sustained efficacy and safety of different Dexmedetomidine doses over a longer period. Lastly, the absence of a placebo group in the study design makes it challenging to distinguish the true treatment effects from potential placebo effects, which is an important consideration in assessing the efficacy of Dexmedetomidine in lumbar transforaminal block for the treatment of lumbar radicular pain. These limitations underscore the need for further research with larger, more diverse cohorts

and longer follow-up periods to provide a more comprehensive understanding of the treatment's effects and safety profile.

CONCLUSION

This study focused on comparing the effectiveness of two different doses of Dexmedetomidine (0.2mcg/kg Dexmedetomidine vs 0.5mcg/kg Dexmedetomidine) in lumbar transforaminal block for treating lumbar pain. Both doses of Dexmedetomidine demonstrated negligible disparities in pain intensity and disability index measurements. However, patients receiving a lower Dexmedetomidine dose, exhibited significantly reduced incidences of nausea and bradycardia as side effects, without impacting hypotension. The findings provide valuable insights into determining the optimal Dexmedetomidine dosage and understanding potential adverse effects crucial for enhancing lumbar pain management strategies.

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Authors' Contribution

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

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

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

MN & KU: 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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