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COMPARATIVE STUDY OF MANAGEMENT OF LOW BACK ACHE WITH LUMBAR EPIDURAL BLOCK, CAUDAL BLOCK, FACETAL BLOCK

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ABSTRACT

BACKGROUND: Several approaches are available to access the epidural space, namely, interlaminar, transforaminal and caudal. Despite the fact that all three techniques provide medicine into the epidural area, these methods differ significantly from one another. This study was carried out to assess the effectiveness of LEB (Lumbar Epidural Block) (interlaminar approach), CB (Caudal Block) (caudal approach), and FB (Facetal Block) (lumbar facet intrarticular injection).

MATERIALS AND METHODS: This was a prospective study involving 120 patients with LBA (Low Back Ache) for more than 6 weeks with evidence of lumbar disc herniation on MRI and failed conservative management. The patients were followed at 1st month, 2nd month, 3rd month, 6th month, one year and one and half years by VAS, ODI, SLRT and SF 36 scores.

RESULTS: The mean VAS was significantly lower in the facetal block and caudal block groups compared to the lumbar epidural block at 3 and 6 months follow-up ($p = 0.015$ and 0.001 respectively). However, there was no difference in the scores at other follow-ups. The mean ODI was significantly lower in the facetal block and caudal block groups compared to the lumbar epidural block at 2 and 6 months follow-up ($p = 0.000$ and 0.015 respectively). However, there was no difference in the scores at other follow-ups. The mean SLRT was significantly lower in the facetal block and caudal block groups compared to the lumbar epidural block at 2, 3 and 6 months of follow-up ($p = 0.000$ and 0.015 respectively). However, there was no difference in the scores at other follow-ups. There was no difference in the SF36 scores between the groups at follow-ups.

CONCLUSION: All three approaches-lumbar epidural block, caudal block, and facetal block—are effective in the management of chronic low backache, as evidenced by the reduction in the VAS, ODI, and SF 36 scores and the low incidence of complications. Although in the short term, caudal block and facetal block had better scores, on long-term follow-up, there was no difference between the three approaches.

KEYWORDS: Lumbar Epidural Block, Caudal Block, Facetal Block, Low Backache.

INTRODUCTION

LBA is a major health and socioeconomic problem in modern society. It constitutes about 37% of occupational risk factors and occupies the first rank among the disease complications caused by work. Low back discomfort can be attributed in part to degenerative disc disease; the L3-L4 and L4-L5 intervertebral levels had the largest disc degradation. Disc prolapse accounts for 5% of all low back aches. Several approaches are available to access the lumbar epidural space, namely, interlaminar, transforaminal and caudal. There are significant variations across the three methods, despite the fact that they all provide medicine to the epidural area. Because of the divergent perspectives expressed in several systematic studies and guidelines, the discussion about the effectiveness of epidural steroid injections using the different techniques in the three areas is still ongoing.[1-5] There are two methods for blocking the facet joints: lumbar medial branch block injection, which is thought to be the best for delivering the medication close to the assumed site of the pathology but only blocks the nerves and not the pathology site, and lumbar facet intraarticular injection, a target-specific modality that requires very small volume to reach the primary site of pathology.

This study was carried out to assess the effectiveness of LEB (Lumbar Epidural Block) (interlaminar approach), CB (Caudal Block) (caudal approach), and FB (Facetal Block) (lumbar facet intrarticular injection).

MATERIALS AND METHODS

This was a prospective study involving 120 patients with low back ache for more than 6 weeks with evidence of lumbar disc herniation on MRI and failed conservative management (tractions, analgesics and physiotherapy) visiting Mahavir Institute of Medical Sciences, Vikarabad, Telangana, from September 2020 to September 2022. The exclusion criteria were as follows:

1. Less than six weeks of back discomfort.
2. A person with localized neurological impairments.
3. A patient with involvement of the intervertebral discs at several levels.
4. People whose MRIs show no signs of lumbar disc herniation.
5. Lumbar canal stenosis on MRI due to osseous origin.
6. Lumbar disc degeneration symptoms on MRI that do not indicate lumbar disc herniation.
7. Other related spinal diseases present.
8. People who suffer from "cauda equina syndrome."
9. People who've had spine surgery before.

Functional outcome evaluation, by visual analogue scale [no pain (0–4 mm), mild pain (5–44 mm), moderate pain (45–74 mm), and severe pain (75–100 mm)] and oswerthy disability index [0-20: minimal disability, 21-40: moderate disability, 41-60: severe disability, 61-80: crippling back pain, 81-100] completely disabled, before the start of treatment and later at the time of follow-up was carried out. Objective physical impairment assessment was done by SLRT (straight leg raising test): <10 degrees: 4 points; 10-30: 3 points; 30-60: 2 points; 60-80: 1 point; >80-0: 1 point.

Quality of life assessment was done by SF 36 (Short Form 36) performa across eight domains as follows:

1. Physical operation
2. Limitations on role because of physical health

3. Role restrictions brought on by emotional issues
4. Vitality/weariness
5. The state of mind
6. Social operations
7. Anguish and
8. Overall well-being

The SF-36 is a valuable tool for tracking changes in QoL (Quality of Life) over time and in response to therapy since it includes a single question that measures perceived changes in health. The SF-36 has eight scaled scores; the scores are weighted sums of the questions in each section. Scores range from 0 to 100. Lower scores mean more disability; higher scores mean less disability.

Following collection, the data were exported and statistical analysis was performed using the Statistical Analysis System (SAS Institute Inc., Cary, N.C.). The efficiency of the therapy was examined using repeated ANOVA, and treatment comparisons were made using independent sample mean comparisons.

RESULTS

Just 120 of the 148 individuals with low back pain who were included in the trial were accessible for follow-up. After analysis, the ensuing findings were found to be statistically highly significant at the two, three, and six-month marks: The groups did not significantly vary after three months, and among the blocks, FB (Facetal Block), which is again superior to CB (Caudal Block), was inferior to LEB (interlaminar approach). LEB (interlaminar approach), CB (caudal approach), and FB definitely showed good short term improvement in patients with intervertebral disc herniations and facet joint disease, respectively.

The bulk of the patients in our research (40.7%) were in the 41–50 year age range, with a mean age of 47.7 (Table 1). Of the 120 patients, 80 had been female (66.6%), and 40 had been male (33.3%).

Age Group	**Total**	**Percentage**
20-30	10	8.3%
31-40	20	16.6%
41-50	48	40%
51-60	22	18.3%
61-70	20	16.6%
Table 1: Distribution of Study Subjects According to Their Age with Low Back Ache		

Type of Blocks

In our study, among 120 cases, 63 were treated by LEB (Lumbar Epidural Block) (interlaminar approach), 21 by FB (Facetal Block) and 36 by CB (Caudal Block) (caudal approach). Table 2

Types of Blocks	**No. of Patients**	**Percentage**
lumbar epidural block (interlaminar approach)	63	52.5%
Facetal block	21	17.5%
Caudal block (caudal approach)	36	30%
TOTAL	120	
Table 2: Distribution of Study Subjects According to Types of Blocks		

VAS Scale

The patients were followed at 1st month, 2nd month, 3rd month, 6th month, one year and one and a half years, and the mean and standard deviation were calculated.

		N	Mean	Std. Deviation	P-Value
Before Blocks VAS	lumbar epidural block (interlaminar approach)	63	5.524	1.554	0.909
	Facetal block	21	5.429	1.690	
	Caudal block	36	5.611	1.420	
1 month VAS	lumbar epidural block (interlaminar approach)	63	2.317	0.820	0.752
	Facetal block	21	2.381	0.805	
	Caudal block	36	2.222	0.797	
2 months VAS	Lumbar epidural block (interlaminar approach)	63	1.778	1.142	0.021
	Facetal block	21	2.381	0.805	
	Caudal block	36	2.222	0.797	
3 months VAS	Lumbar epidural block (interlaminar approach)	63	1.746	1.164	0.015
	Facetal block	21	2.381	0.805	
	Caudal block	36	2.222	0.797	
6 months VAS	lumbar epidural block (interlaminar approach)	63	3.492	0.878	0.001
	Facetal block	21	4.000	0.000	
	Caudal block	36	3.944	0.333	
1 year VAS	Lumbar epidural block (interlaminar approach)	63	4.032	0.439	0.375
	Facetal block	21	4.095	0.436	
	Caudal block	36	3.944	0.333	
1.5 year VAS	Lumbar epidural block (interlaminar approach)	63	4.095	0.560	0.086
	Facetal block	21	4.476	0.873	
	Caudal block	36	4.167	0.737	

Table 3: Descriptive Statistics of VAS in IVDP and Facet Joint Disease

The statistical analysis of the changes observed at each visit showed that the mean VAS was significantly lower in the facetal block and caudal block groups compared to the lumbar epidural block at 3 and 6 months follow-up (p = 0.015 and 0.001, respectively). However, there was no difference in the scores at other follow-ups. Table 3

ODI Index

The patients were followed at 1st month, 2nd month, 3rd month, 6th month, one year and one and a half years, and the mean and standard deviation were calculated.

		N	Mean	Std. Deviation	P-Value
Before Blocks ODI	lumbar epidural Block (interlaminar approach)	63	32.762	5.899	0.155
	Facetal block	21	31.286	4.173	
	Caudal block	36	34.333	6.520	
1 month ODI	lumbar epidural block (interlaminar approach)	63	32.825	5.575	0.142
	Facetal block	21	31.286	4.173	
	Caudal block	36	34.333	6.520	
2 months ODI	lumbar epidural block (interlaminar approach)	63	22.302	5.890	0.000
	Facetal block	21	24.952	4.466	
	Caudal block	36	26.889	5.115	
3 months ODI	lumbar epidural block (interlaminar approach)	63	24.063	5.379	0.035
	Facetal block	21	24.952	4.466	
	Caudal block	36	26.889	5.115	
6 months ODI	lumbar epidural block (interlaminar approach)	63	23.603	5.738	0.015
	Facetal block	21	24.952	4.466	
	Caudal block	36	26.889	5.115	
1 year ODI	lumbar epidural block (interlaminar approach)	63	25.508	4.310	0.228
	Facetal block	21	24.952	4.466	
	Caudal block	36	26.889	5.115	
1.5 year ODI	lumbar epidural block (interlaminar approach)	63	31.603	3.549	0.617
	Facetal block	21	31.667	2.817	
	Caudal block	36	32.222	2.231	

Table 4: Descriptive Statistics of ODI in IVDP and Facet Joint Disease

The mean ODI was significantly lower in the facetal block and caudal block groups compared to the lumbar epidural block at 2 and 6-month follow-up (p = 0.000 and 0.015, respectively). However, there was no difference in the scores at other follow-ups. Table 4

SLRT

The patients were followed at 1st month, 2nd month, 3rd month, 6th month, one year and one and a half years, and the mean and standard deviation were calculated.

		N	Mean	Std. Deviation	P-Value
Before Block SLRT	lumbar epidural block (interlaminar approach)	63	31.603	3.549	0.617
	Facetal block	21	31.667	2.817	
	Caudal block	36	32.222	2.231	
1 Month SLRT	lumbar epidural block (interlaminar approach)	63	3.143	0.353	0.714
	Facetal block	21	3.190	0.402	
	Caudal block	36	3.111	0.319	
2 Month SLRT	lumbar epidural block (interlaminar approach)	63	3.444	0.501	0.001
	Facetal block	21	3.190	0.402	
	Caudal block	36	3.111	0.319	
3 Months SLRT	lumbar epidural block (interlaminar approach)	63	3.429	0.499	0.002
	Facetal block	21	3.190	0.402	
	Caudal block	36	3.111	0.319	
6 Months SLRT	lumbar epidural block (interlaminar approach)	63	2.429	0.499	0.002
	Facetal block	21	2.190	0.402	
	Caudal block	36	2.111	0.319	
1 Year SLRT	lumbar epidural block (interlaminar approach)	63	2.143	0.353	0.714
	Facetal block	21	2.190	0.402	
	Caudal block	36	2.111	0.319	
1.5 Years SLRT	lumbar epidural block (interlaminar approach)	63	2.143	0.353	0.714
	Facetal block	21	2.190	0.402	
	Caudal block	36	2.111	0.319	

Table 5: Descriptive Statistics of SLRT in IVDP and Facet Joint Disease

The mean SLRT was significantly lower in the facetal block and caudal block groups compared to the lumbar epidural block at 2, 3, and 6 months of follow-up (p-0.000 and 0.015, respectively). However, there was no difference in the scores at other follow-ups. Table 5

SF36 Score

The patients were followed at 1st month, 2nd month, 3rd month, 6th month, 1 year, and 1 and a half years, and the mean and standard deviation were calculated.

		N	Mean	Std. Deviation	P-Value
Role limitations due to emotional problems	lumbar epidural block (interlaminar approach)	63	65.778	28.476	0.031
	Facetal block	21	47.333	34.236	
	Caudal block	36	66.306	26.561	
Pain	lumbar epidural block (interlaminar approach)	63	58.024	9.927	0.011
	Facetal block	21	51.238	12.881	
	Caudal block	36	52.444	11.312	
General health	lumbar epidural block (interlaminar approach)	63	46.984	7.045	0.014
	Facetal block	21	41.905	8.437	
	Caudal block	36	47.222	6.912	

Table 6: Descriptive Statistics of SF36 in IVDP and Facet Joint Disease

There was no difference in the SF36 scores between the groups at follow-ups. Table 6.

Complications

Out of the 120 patients in the current research, 7 experienced discomfort at the injection site, 2 experienced hypotension right after, 3 suffered nerve damage, 2 experienced dural punctures with CSF leaking, and the other 5 experienced transient headaches after lumbar epidural (interlaminar), caudal block, or facetal block.

DISCUSSION

While ESI (Epidural Steroid Injection) is useful in treating pain temporarily and delaying surgery, there is little data to support its long-term benefits. The facetal, caudal, and interlaminar routes to the epidural space are the most often used ones. Examining the efficacy of ESI in treating lumbar radicular pain as determined by the VAS and ODI was the goal of this study.

Age Distribution

According to the literature, intervertebral disc prolapse occurs after the age of 35. The mean age of the patients in the current research was 47.7, with the highest number of patients falling between 41 and 50 years of age. One of the key elements in the etiology of this illness seems to be age. The age incidence in our study is similar to that of Renato Santiago Gomez.[6] The age in the present study is correlated with studies such as Wang, Jeffrey, et al.[7] where the mean age of 69 patients in their study was 44.8, and the mean age in the study conducted by Carette S et al.[8] was 39.0±9.3 and Buchner M et al.[9] was 37.5.

Sex Distribution

In our study among 120 patients, there were 40 male and 80 female patients, in contrast to studies conducted by Juyal Anil et al.[10] and William E. Ackerman et al.,[11] wherein most of the study population consisted of males.

Comparison of VAS Scores

Prior to injection, the mean VAS scores for FB, C, and IL were 5.533±1.55, 5.429±1.69, and 5.611±1.420, respectively. We found that the mean VAS ratings were lower following injection when we performed a statistical analysis comparing the scores before and after injection for various techniques. The collected data showed a high degree of significance ($p<0.01$). When statistical analysis was done by multiple comparisons between 3 approaches at 2nd, 3rd, and 4th follow-ups, the interlaminar approach was found to be superior when compared to facetal block and caudal approach. Among FB and C, FB was superior at the 2nd, 3rd, and 4th follow-ups. Similar observations were made in other studies (Candido et al.[12] , Gorbach C et al.[13] , Datta et al.[14])

Oswestry Disability Index

The mean ODI for different approaches, IL, FB, and C, prior to injection was 32.762±5.8, 31.286±4.1, and 34.333±6.2, respectively. The mean ODI scores before and after injection for various techniques were compared statistically, and the findings showed that the differences were extremely significant at the 2nd, 3rd, and 4th follow-ups ($p<0.01$). When statistical analysis was done by multiple comparisons between 3 approaches at 2nd, 3rd, and 4th follow-ups, the interlaminar approach was found to be superior to facetal and caudal approaches. Among FB and C, FB was superior at the 2nd, 3rd, and 4th follow-ups. Other studies (Laxmaiah Manchikanti et al.[5], Arden et al.[15], Buttermann et al.[16], Gorbach C et al.[13]) also made similar observations.

Comparision of SLRT with Different Studies

Mohammad Taghi Mortazavi et al.[17] conducted a double-blind randomized clinical trial among 40 patients on SLRT before and after the treatment and showed significant results with the steroid group. In the present study, when compared with the baseline values, the results were significant after the ESI at the 3-month follow-up.The mean SLRT was significantly lower in the facetal block and caudal block groups compared to the lumbar epidural block at 2, 3, and 6 months follow-up ($p = 0.000$ and 0.015, respectively). However, there was no difference in the scores at other follow-ups. Mohammad Taghi Mortazavi et al.[17] also made similar observations.

Short Form 36 Score

The SF-36 scores range from 0 to 100, with a higher score indicating less severe symptoms. In our study, only 3 components were selected from the SF36 score: role-limited due to emotional problems,

the bodily pain score, and general health, at 6-month follow-up. The p-value for the interlaminar approach was 0.031, for facetal approach, 0.00, with the bodily pain score being higher, and for the caudal approach, 0.014. Radcliff K et al.[18] conducted a study among 452 patients. The SF36 score was used to assess the quality of life of the patients. His follow-up period was for a 4-year baseline SF36, which showed a bodily pain score of 32.7 (19.2), a physical functioning score of 33.8 (22.8), and a physical component summary score of 29.4 (8.4). At the 1-year follow-up, a bodily pain score of 13.4 (1.7), a physical functioning score of 9.6 (1.6), and a physical component summary score of 4 (0.7).

Comparison of Various Complications with Different Studies

Out of the 120 individuals in our trial, 5 had discomfort at the injection site, 6 experienced a brief headache, and 2 experienced hypotension.

Manchikanti et al.[19] conducted a prospective cohort study. Out of 1450 injections, there were 11 cases with dural puncture, 11 with profuse bleeding at the injection site, 1 with transient headache, and 4 with nerve root irritation. In a retrospective cohort study conducted by Bartynski et al.[20] out of 276 patients, only 1 had a dural puncture. In a study conducted by Candido et al.[21] out of 106 patients, 26 had injection site pain and 18 had transient head aches after injection. In a study conducted by Evasa et al.[22] out of 120 patients, 15 developed pain at the injection site. Manchikanti et al.[19] conducted a RCT of 120 patients, nine of whom developed nerve injuries with the TF approach. In a study conducted by V.G. Murakibhavi et al.[23] out of 50 patients, 9 had transient head aches, and 12 had hypotension following a caudal epidural steroid.

CONCLUSION

All three approaches-lumbar epidural block, caudal block, and facetal block—are effective in the management of chronic low backache, as evidenced by the reduction in the VAS, ODI, and SF 36 scores and the low incidence of complications. Although in the short term, caudal block and facetal block had better scores, on long-term follow-up, there was no difference between the three approaches.

REFERENCES

1. Manchikanti L, Abdi S, Atluri S, Benyamin RM, Boswell MV, Buenaventura RM, et al. An update of comprehensive evidence-based guidelines for interventional techniques in chronic spinal pain. Part II: guidance and recommendations. Pain Physician 2013;16(2 Suppl):S49-283.
2. Manchikanti L, Nampiaparampil DE, Manchikanti KN, Falco FJE, Singh V, Benyamin RM, et al. Comparison of the efficacy of saline, local anesthetics, and steroids in epidural and facet joint injections for the management of spinal pain: A systematic review of randomized controlled trials. Surg Neurol Int 2015;6(Suppl 4):S194-235.
3. Manchikanti L, Kaye AD, Manchikanti K, Boswell M, Pampati V, Hirsch J. Efficacy of epidural injections in the treatment of lumbar central spinal stenosis: a systematic review. Anesth Pain Med 2015;5(1).
4. Manchikanti L, Benyamin RM, Falco FJE, Kaye AD, Hirsch JA. Do Epidural injections provide short- and long-term relief for lumbar disc herniation? A systematic review. Clin Orthop Relat Res 2015;473(6):1940–56.
5. Manchikanti L, Nampiaparampil DE, Candido KD, Bakshi S, Grider JS, Falco FJE, et al. Do cervical epidural injections provide long-term relief in neck and upper extremity pain? A systematic review. Pain Physician 2015;18(1):39–60.
6. Baptista JF, Gomez RS, Paulo DN, Carraretto AR, Brocco MC, Silva JJ. Epidural anesthesia with ropivacaine with or without clonidine and postoperative pain in hemorrhoidectomies. Acta Cirurgica Brasileira 2014;29(3):201-8.
7. Wang JC, Lin E, Brodke DS, Youssef JA. Epidural injections for the treatment of symptomatic lumbar herniated discs. Journal of Spinal Disorders & Techniques 2002;15(4):269-72.

8. Carette S, Leclaire R, Marcoux S, Morin F, Blaise GA, St.-Pierre A, et al. Epidural corticosteroid injections for sciatica due to herniated nucleus pulposus. New England Journal of Medicine 1997;336(23):1634-40.
9. Buchner M, Zeifang F, Brocai DR, Schiltenwolf M. Epidural corticosteroid injection in the conservative management of sciatica. Clin Orthop Relat Res 2000;375:149-56.
10. Juyal A, Juyal R, Chauhan VD, Chopra G, Maheshwari R. Epidural Steroid Injection in Lumbar Disc Herniation. Indian Med Gaz 2013;147 (3):107-10.
11. Ackerman III WE, Ahmad M. The efficacy of lumbar epidural steroid injections in patients with lumbar disc herniations. Anesth Analg 2007;104(5):1217-22.
12. Candido KD, Raghavendra MS, Chinthagada M, Badiee S, Trepashko DW. A prospective evaluation of iodinated contrast flow patterns with fluoroscopically guided lumbar epidural steroid injections: the lateral parasagittal interlaminar epidural approach versus the transforaminal epidural approach. Anesth Analg 2008;106(2):638-44.
13. Gorbach C, Schmid MR, Elfering A, Hodler J, Boos N. Therapeutic efficacy of facet joint blocks. Am J Roentgenol 2006;186(5):1228-33.
14. Datta R, Upadhyay KK. A randomized clinical trial of three different steroid agents for treatment of low backache through the caudal route. Medical Journal Armed Forces India 2011;67(1):25-33.
15. Arden NK, Price C, Reading IW, Stubbing J, Hazelgrove J, Dunne C, et al. A multicentre randomized controlled trial of epidural corticosteroid injections for sciatica: the WEST study. Rheumatology 2005;44(11):1399-406.
16. Buttermann GR. Treatment of lumbar disc herniation: epidural steroid injection compared with discectomy. J Bone Joint Surg Am 2004;86(4):670-9.
17. Mortazavi MT, Abedini N, Lotfinia I, Afkhamzadeh A, Delpisheh A, Janmardi R, et al. Effects of epidural injection of glucocorticoid and its combination with bupivacaine in palliating chronic low back pain due to discopathy. Life Science Journal 2013;10(1).
18. Radcliff K, Kepler C, Hilibrand A, Rihn J, Zhao W, Lurie J, et al. Epidural steroid injections are associated with less improvement in patients with lumbar spinal stenosis: a subgroup analysis of the Spine Patient Outcomes Research Trial. Spine 2013;38(4):279-91.
19. Manchikanti L, Malla Y, Wargo BW, Cash KA, Pampati V, Fellows B. A prospective evaluation of complications of 10,000 fluoroscopically directed epidural injections. Pain Physician 2012;15(2):131-40.
20. Bartynski WS, Jennings RB, Rothfus WE, Agarwal V. Immediate pain response to interlaminar lumbar epidural steroid administration: response characteristics and effects of anesthetic concentration. American Journal of Neuroradiology 2013;34(1):239-46.
21. Candido KD, Rana MV, Sauer R, Chupatanakul L, Tharian A, Vasic V, et al. Concordant pressure paresthesia during interlaminar lumbar epidural steroid injections correlates with pain relief in patients with unilateral radicular pain. Pain Physician 2012;16(5):497-511.
22. Evansa I, Logina I, Vanags I, Borgeat A. Ultrasound versus fluoroscopic-guided epidural steroid injections in patients with degenerative spinal diseases: a randomised study. European Journal of Anaesthesiology (EJA) 2015;32(4):262-8.
23. Murakibhavi VG, Khemka AG. Caudal epidural steroid injection: a randomized controlled trial. Evidence-Based Spine-Care Journal 2011;2(04):19-26.