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Role of Non-Real Time Imaging in Improving Success of Blind Inter-Laminar Epidural Injection for Treatment of Symptomatic Prolapsed Lumbar Inter-Vertebral Disc

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ABSTRACT

Background: One of the most commonly employed methods of treatment for Lumbar disc herniation with leg pain is epidural steroid injection. Of the three routes being deployed, inter-laminar approach is preferred as needle entry can be directed more closely to the assumed site of pathology, requiring less volume than the caudal route and it is less risky compared to the trans-foraminal approach. For effective placement of the spinal needle in the epidural space, use of C-arm is a must. But, the operation theatre and C-arm is not available in most of the health centers in the developing countries especially in rural settings. Time taken to set up is another issue. To improve the success rate of needle placement in "blind method" of ILESI, we have developed a technique of using digital X-ray of lumbo-sacral spine, which is available universally nowadays, to measure the depth of the epidural space and level of the targeted inter-vertebral space. Objective: To assess the effectiveness of measurements in plain roentgenograms of lumbo-sacral spine in guiding needle placement into epidural space. **Methods:** A prospective study was taken up in the Dept. of PMR, JNIMS during the period May 2017-Feb 2018. 56 consecutive clinically diagnosed prolapsed PIVD patients were enrolled. Lengths of spinous process and skin thickness were measured using a caliper. A 22G Quincke needle was advanced to the expected depth given by digital x-ray measurement. 1 ml of Iohexol dye was injected. Position of needle was checked by C-arm x-ray. **Results:** Out of the total 56 subjects, 46 (82.1%) completed the treatment program. Needle was placed at proper depth in 36 cases by using X-ray measurement, giving success rate of 87.8%. Mean (SD) depth of epidural space from skin was found to be 3.82 (o.74) cm as measured from X-ray and actual measurement confirmed by fluoroscopy was 3.9 (0.81) cm (Pearson's correlation coefficient =0.86). **Conclusion:** Measurement of depth of epidural space using plain X-ray of LS spine improves the success rate of blind MILESI from around 50% to 87.8%. This method of non-real time imaging is cost effective in developing countries where C-arm X-ray facilities are not available.

Keywords: Lumbar inter-laminar epidural injection, Non-real time imaging, Prolapsed inter-vertebral disc.

INTRODUCTION

Low back pain with or without lower extremity pain is one of the commonest problems among chronic pain disorders with significant economic, societal and health impact both in rural and urban areas.[1-3] The most common diagnoses of low back pain with leg symptoms are Prolapsed Intervertebral Disc (PIVD), spinal stenosis, intervertebral disc degeneration without disc herniation, degenerative spondylolisthesis with stenosis, and post lumbar surgery syndrome.[4,5] Although conservative management is the first line of treatment for these conditions,[6] one of the most commonly employed methods of treatment for Lumbar disc herniation with leg pain is epidural steroid injection.[7,8] While the long-term benefit of epidural steroid is arguable, short-term benefit from weeks to months is accepted.[9]

There are three approaches for giving epidural steroid viz., inter-laminar (IL), trans-foraminal (TF), and caudal (Ce). Among these approaches IL is the most preferred approach.[7] This is so because needle entry can be directed more closely to the assumed site of pathology, requires less volume than the caudal route and is less risky compared to the trans-foraminal approach. TF is considered to be a more target-specific approach requiring the smallest volume to reach the primary site of pathology but is associated with more catastrophic complications like paraplegia due to intra-arterial injection.[10-12]

Earlier IL approaches were done without fluoroscopic guidance resulting to extra epidural placement of the

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needle sometimes, which could go unrecognized. Other disadvantages of the IL approach without fluoroscopy include erroneous placement of the needle in wrong inter-space, intravascular placement of needle, deviation of the needle to the non-dependent side, difficulty entering the epidural space, potential risk of dural puncture and post-lumbar puncture headache.[13-17]

Advocates of fluoroscopic guidance point to several studies which have shown that in as many as 30% of the lumbar epidural injections by experienced injectionists, the epidural space was misidentified.[18-20] And while using the loss of resistance (LOR) technique, loss of resistance to air in the other tissue plane before reaching the exact epidural space can be encountered in about 20-30% of cases.[21]

Hence, for effective placement of the spinal needle in the epidural space, use of C-arm is a must. The operation theatre and C-arm is not available in most of the health centers in the developing countries especially in rural settings. Even if these are available, their usage is restricted due to competing demands by other specialties. Time taken to set up is another issue. Number of cases of Inter-laminar epidural steroid injection (ILESI) performed per hour is around 5-6, thereby restricting number of cases per operating session. ILESI given by blind method is less time consuming and can be completed in less than half of time. Because of these restrictions, blind ESI is used in many centers in India. To improve the success rate of needle placement in "blind method" of ILESI, we have developed a technique of using digital X-ray of lumbo-sacral spine, which is available universally nowadays, to measure the depth of the epidural space and level of the targeted inter-vertebral space. These measurements can be used to guide needle to proper epidural site more effectively. The procedure can be performed in outpatient setting.

Objective:

The objective of the present study were (i) To study the effectiveness of measurements in plain roentgenograms of lumbo-sacral spine in guiding the needle placement into epidural space in performing blind MILESI for conservative treatment of prolapsed lumbar intervertebral disc and (ii) To find out medium term response of patients with lumbar PIVD using this method of ESI.

MATERIALS AND METHODS

After getting approval of the Institutional Ethics Committee, JNIMS, a prospective study was done in the Dept. of Physical Medicine and Rehabilitation (PMR) May 2017- Feb 2018. A total of 56 patients aged 18-80 yrs clinically diagnosed as PIVD cases were recruited for the study. Patients having severe uncontrolled diabetes, hypertension, myocardial infarction, stroke, malignancy, mental disorders or having infection at lower back or not willing to participate were excluded.

A digital X-ray of LS spine lateral view was taken for measuring the depth of epidural space. Length of spinous process was measured using a caliper. Actual measurement by caliper was converted to centimeter by using calibration bar in x-ray plate and distance between spinous process and skin was also measured in similar fashion (Fig. 1). Antero-posterior film was used to determine the desired inter-vertebral disc level. Level was determined in relation to iliac crest.

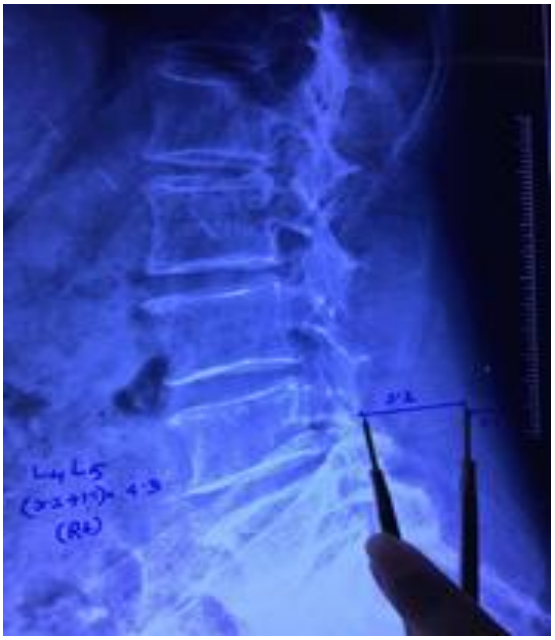

Figure 1: Measuring length of spinous process with calipers

Patient was then, positioned in lateral position with affected side placed downwards; with bent hips and knees. Under proper aseptic precautions a 22G Quincke spinal needle was introduced at mid inter-spinous space at the level indicated in AP view of LS spine X-ray. Needle was advanced to a depth which is 3 mm short of predetermined depth fixed by an artery forceps clamped on to the spinal needle. Patient was asked to cough to see that no spinal fluid came out. If spinal fluid flash-back occurred, procedure was considered as failure. From this point onwards, needle was advanced cautiously with simultaneous pushing plunger of 2 ml glass syringe attached to needle. If sudden LOR on pushing the plunger of glass syringe occurred, it was possible that tip of needle was in epidural space. This was checked by injecting 1 ml of non-ionic radio-opaque dye (Iohexol). If tip of needle was in the epidural space, epidurogram with proper dye spread would be visible in the C-arm x-ray [Figure 2]. If no blob of dye could be seen which signified that when the tip of needle was in the fat overlying ligamentum flavum, then also the procedure was considered as failure.

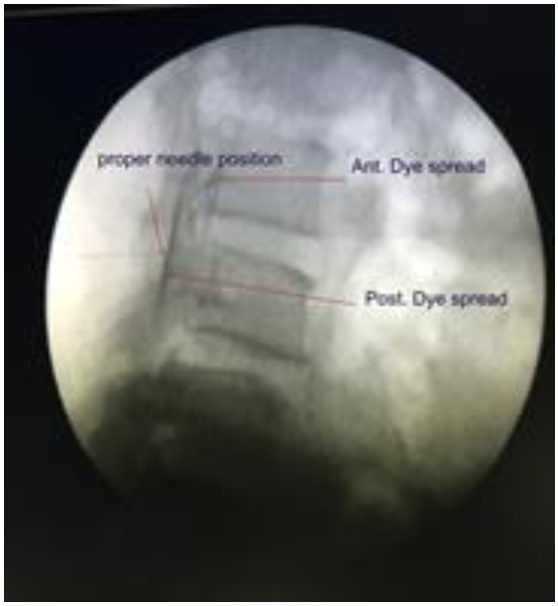

Figure 2: Epidurogram showing needle tip in epidural space

In some cases, sudden LOR did not happen at predetermined depth. In such cases needle tip was further advanced to a depth, which was not more than 1 mm of pre-determined depth. If LOR occurred, certainty of epidural space was checked by injecting radio-opaque dye and taking x-ray as described before. If epidurogram was visible, position of needle tip in epidural space was confirmed. Otherwise procedure was considered failure.

Once position of needle in the epidural space was confirmed, negative suction was applied to see if blood or fluid was aspirated. Then 2 ml of methyl prednisolone acetate was injected into the epidural space. Steroid was injected without local anesthetics and volume enhancing fluid. Patient was soon turned to prone position to help ventral spread of the injectate. This position was maintained for a few minutes and patient was monitored for hypotension, hypoventilation and headache. Afterwards, patient was allowed to assume erect position and walk to post-operative room.

Depth measured by using digital X-ray in cm and length of spinal needle from epidural space to skin as confirmed by C-arm X –ray fluoroscopy in centimeters were primary outcome measures. To ascertain clinical response, some outcome measures like pain by VAS, degree of straight leg rising test (SLRT) positivity, restriction of forward flexion of spine expressed as inches and claudication distance (CD) in meters were noted. Functional assessment by Oswestry Disability Index (ODI) was also used as tool.

All the patients were followed up and re-assessed after one week of injection and also at 3 months.

RESULTS

Out of 56 subjects recruited for the study, only 46 (82.14%) patients comprising of 19 males (41.3%) and 27 females (58.7%) completed epidural injection treatment program. Their age range was 22-80 with the mean (SD) being 51.36 (14.9) Majority of the patients belonged to age group 40-59. There were 20 (43.4%) right-sided, 18 (39.1%) left-sided and 8 (17.4%) both-sided sciatica cases. The mean (SD) duration of disease was 9.46 (10.7) weeks.

Out of 46 the cases subjected to MILESI, records of depth measurement were missing in five cases. Thus, the result of success of spinal needle in epidural steroid was assessed using these 41 cases.

Needle were placed at proper depth in 36 cases by using X-ray measurement; giving success rate of 87.8%. The depth of epidural space from skin (mean 3.82+/-0.74 cm) as measured from X-ray (mean 3.82; SD 0.74) and actual measurement confirmed by fluoroscopy (mean 3.96; SD 0.81 cm) were compared using Pearson's correlation coefficient which gave a value of 0.86. Comparison of mean depths as measured by X-ray and C-arm fluoroscopy by paired t test was done. Test result, however, showed variance between two 'means' with p value = 0.01. [Table 1]

Table 1: Comparison between mean depths as measured by using X-Ray and C-Arm

Measurement method	Mean depth in cm (SD)	Value of "t"	P value	Pearson's correlation coefficient
C-arm	3.96 (0.81)	2.68	0.01	0.83
X-ray	3.82 (0.74)			

Out of 46 patients who were subjected to ILESI, five were lost to follow-up and only 41 (89.1%) patients were available for second follow-up. These were assessed for improvement by using clinical parameters: Pain by VAS by 50%, increase in degree of SLRT by at least 10 degree, increase in forward flexion of spine by decrease in distance of tip of finger from floor in inches, increase in claudication distance by 50% and decrease in ODI by 50%. In all parameters, there were statistically significant differences between initial and final values [Table 2].

Table 2: Changes in clinical parameters at last follow-up

Parameter	Baseline mean (SD)	Mean at follow-up (SD)	p-value (t-test)
Pain (VAS numbers)	7.25 (1.5)	2.53 (1.79)	0.0001
SLRT (degrees)	59.89 (29.39)	81.83 (20.73)	0.0001
Forward flexion (in)	7.95 (12.73)	2.32 (17.63)	0.0001
Claudication distance (m)	70.05 (148.97)	385.86 (169.46)	0.0001
ODI (%)	57.84 (19.39)	18.17 (17.63)	0.0001

By using this assessment method, out of 41 patients, 36 of them (87.8%) got improved.

DISCUSSION

Although there was 87.8% success in placing spinal needle in epidural space by using non-real time imaging in the form of X-ray of LS spine as described above, when means of measures of depth by X-ray and actual depth by using C-arm fluoroscopy were compared the 'means' were found to be different. This was due to the fact that the thickness of skin and subcutaneous layer was difficult to measure in persons whose body mass index was above 30. This led to erroneous estimate of depth.

MILESI is considered not site-specific; and its effectiveness was considered inferior to that of either lateral inter-laminar ESI or transforaminal ESI.[22] However, if injection was placed at appropriate level and position of patient is kept lateral with affected side down, drug will gravitate down to the site of inflammation. The issue of ventral spread of drug is important in lateral ILESI. In our study, it was found that by prone positioning of patient immediately after injection, ventral spread was present in significant number of cases. Out of five cases of failure, CSF flash-back occurred in 3 cases; which were due to overestimation of depth using X-ray. There were two failures due to underestimation of depth of needle. This was corrected after detection in fluoroscopy.

One of the limitations of this study was short follow-up period. For similar studies, minimum follow-up should be 6 months. Also, number of cases studied was small.

CONCLUSION

Measurement of depth of epidural space by using plain X-ray of lumbo-sacral spine improves the success rate of blind ILESI from less than 50% to nearly 90%. This method of non-real time imaging is successful in placing spinal needle in epidural space in 87.8% of cases. And this procedure will be cost-effective in developing countries where C-arm X-ray facilities are not available.

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