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An Evaluation of Depth of Epidural Space by Ultrasound in Thoracic Epidural via Paramedian Approach

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Abstract

The insertion of the epidural catheter at the thoracic spine is technically more difficult and can cause neurological complications. The ultrasound prepuncture knowledge of the distance from the skin to the extradural space and a preview of the spinal anatomy may facilitate the procedure. Hence the aim of our study was to evaluate the accuracy of ultrasound in prediction of the depth for thoracic epidural insertion using paramedian approach. *Aims and Objectives*: To compare the depth of thoracic epidural space as measured by US compared to the actual depth of space by loss of resistance. *Material Method:* Thirty four patients, age ≥ 20 years undergoing any major surgery, requiring thoracic epidural for intraoperative and postoperative pain relief belonging to ASA 1-4 status were selected. The approval of research ethical committee of the institution was obtained. The written informed consent of patients were taken after explaining the procedure and the aim of the study in detail. The thoracic spine of these patients were scanned preoperatively with ultrasound in sitting position. The probe was placed vertically in the paramedian plane and the skin epidural depth was noted. After infiltrating the skin with 3 ml of 2% lignocaine, puncture was done. The actual depth of the space by loss of resistance was noted.The analysis of the data was done using paired 't test', pearson correlation co-efficient and Bland- Altman analysis. *Result:* Both techniques differ in their measurements. *Conclusion:* Pre-puncture ultrasonography does not provide accurate assessment of depth of thoracic epidural space.

Keywords: Depth; Epidural Space; Paramedian Approach; Thoracic; Ultrasound Guided.

Introduction

The indications for the use of thoracic epidural anaesthesia have increased in the last decade [1]. But the improvement in the technique, particularly in identification of epidural space is not up to the mark. The palpation of anatomical landmarks and loss of resistance technique still remains the standard procedure to locate epidural space [2].

The lumbar epidural anaesthesia puncture is generally performed below Lumbar vertebrae 2/3 i.e. below conus medullaris whereas thoracic epidural catheters are inserted in close proximity to the spinal cord [1]. Hence the insertion of the epidural catheter at the thoracic spine is technically more difficult and can cause neurological complications [3].

Ultrasound imaging of the spine has recently been proposed to facilitate identification of epidural space. The prepuncture knowledge of the distance from the skin to the extradural space and a preview of the spinal anatomy may facilitate the procedure [1].

Hence, the aim of our study was to evaluate the accuracy of ultrasound in prediction of the depth for thoracic epidural insertion using paramedian approach.

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Aims and Objectives

To compare the depth of thoracic epidural space as measured by US compared to the actual depth of space by loss of resistance.

Material and Method

A single group observational – prospective cohort study was done on 34 patients, age ≥ 20 years undergoing any major surgery, requiring thoracic epidural for intraoperative and postoperative pain relief belonging to ASA 1-4 status. Patients with coagulopathy, skin infection over the back and any neurological illness were excluded from the study. The approval of research ethical committee of the institution was obtained. The written informed consent of patients were taken after explaining the procedure and the aim of the study in detail. The range of body mass index of the patients was 25.11 ± 3.80 Kg/m^2.

Procedure

The thoracic spine of these patients were scanned preoperatively with ultrasound, the curvilinear probe (frequency 3-5 Hz) in sitting position. The probe was placed vertically in the paramedian plane to visualize the articular processes and then directed medially. The probe position was then adjusted to visualize the ligamentum flavum and duramater as 2 parallel echogenic lines at a deeper level. The distance of the ligamentum flavum from the skin was measured using the built-in calipers in the US machine i.e. the skin epidural depth was noted. Also the probe position was marked on the skin with a permanent marking pen both vertically and horizontally. The angle of the probe to the skin was noted visually.

After preparing the skin with povidone iodine the epidural catheter placement was done under full aseptic precautions, without further US guidance. After infiltrating the skin with 3 ml of 2% lignocaine, puncture was done at the intersection of the vertical and horizontal lines and the needle will be angled in the direction noted earlier. The actual depth of the space by loss of resistance was noted.

The analysis of the data was done using paired 't test', pearson correlation co-efficient and Bland-Altman analysis.

Results

The depth of epidural found via ultrasound and loss of resistance is statistically significant indicating that both techniques differ in their measurements (Table 1). Pearson correlation (Fig. 1) and Bland

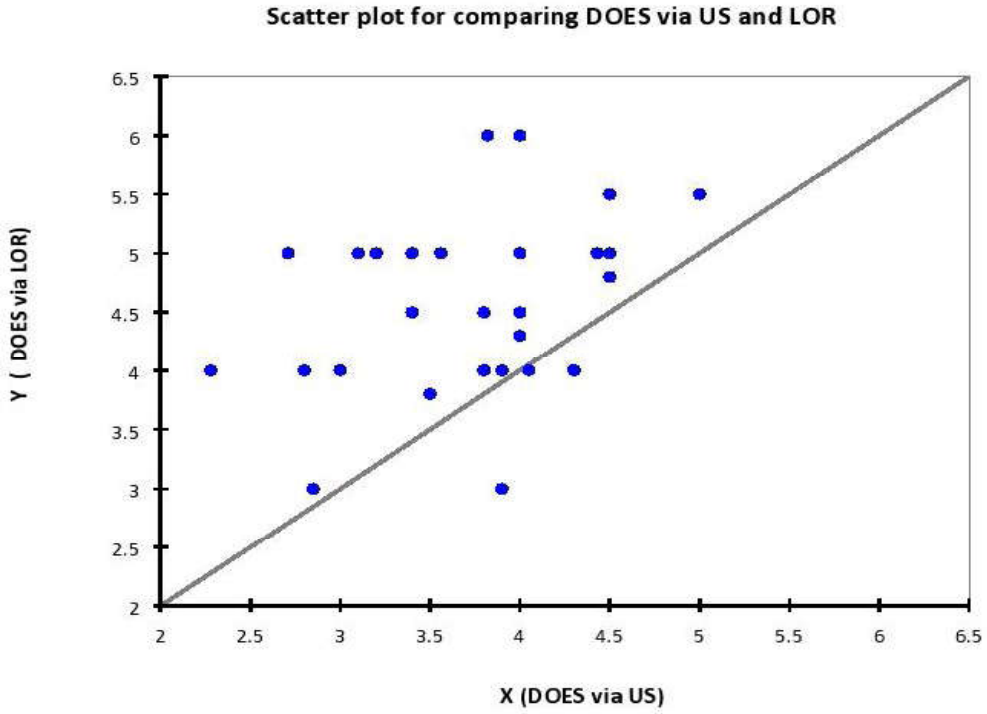

Fig. 1: Scatter plot for comparision of depth of epidural space (Does) via US and via LOR showing pearson corrclation cocfficient 0.133 and confidence interval (95%) was [-0.215, 0.451]

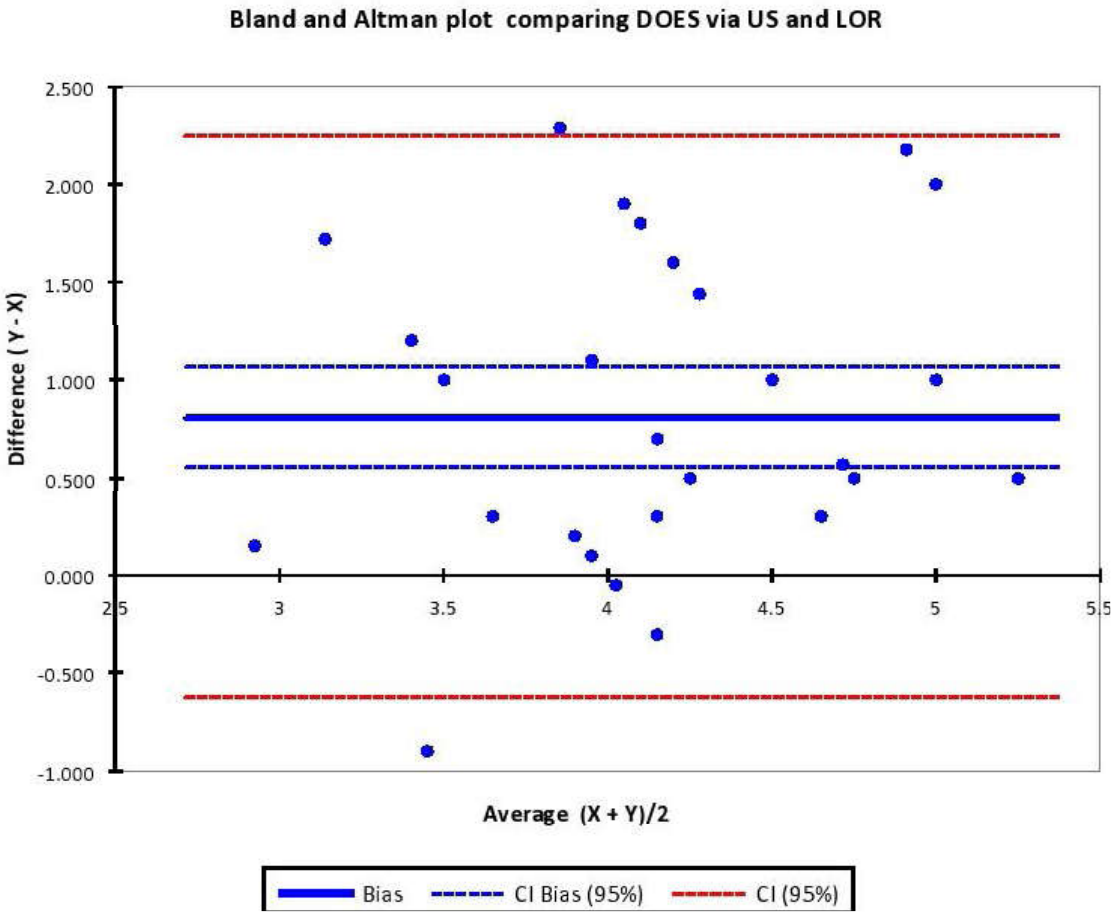

Fig. 2: Bland-Altman analysis for comparision of depth of epidural space (DOES) via Ultrasound (US) and via Loss of resistance (LOR) showing, Bias-0.812, Standard error-0.733 and CI Bias (95%)-[0.556cm, 1.068]

Table 1: Comparision of Depth of epidural space (DOES) via Ultrasound (US) and via Loss Of resistance (LOR)

	Does via US		Does via LOR
No. of Patients	34		34
Mean of Depth	3.803 cm		4.615 cm
S.D.	0.624 cm		0.705 cm
t (critical value)		2.035	
t (Observed value)		6.455	
P value		0.02	
Significance		Highly significant	

Altman analysis also showed poor correlation between the two techniques of measurement (Fig. 2).

Discussion

In the present study we found that the depth of epidural space measured by loss of resistance was consistently significantly higher than that measured by ultrasound. Mean depth of epidural space with ultrasound was 3.80±0.62 cm while with loss of resistance was 4.61±0.70 cm, which showed a statistically significant difference ($p < 0.02$) (Table 1). Other methods of comparison such as a Pearson correlation coefficient showed r of 0.133 and bias of 0.812 cm with 95% limits from–0.625 to 2.25 cm (Fig 2). Bland Altman analysis also showed poor correlation between the two techniques of measurement (Fig 2).

Whereas Rosaulian et al in their study found a good correlation (r = 0.65) but wide 95% of limit of agreement from -7.47 to 13.9 mm between ultrasound and loss of resistance measurements in

paramedian approach for thoracic epidural [4]. Salman et al also in their study found good co-relation (r=0.75) but wide range 95% limit of agreement from - 0.8 to 2.2 cm [5].

Moreover in similar studies done at lumbar level Grau et al concluded that the depth of epidural space measured was 53.1±7.5 mm via ultrasound as compared to 51.2±9.2 mm by loss of resistance technique. Both showed good correlation (r 0.80) with 95% limit of agreement from 5 to 7 mm [6]. Balki et al also in their study at lumbar level found good correlation (r 0.85) with Ultrasound measured depth as they got epidural depth by ultrasound as 6.3±0.8 cm and depth by loss of resistance as 6.6±1cm with 95% limit of agreement from - 0.7 to 1.3 cm [7].

There may be Several Possible Reasons for this Difference

- We infiltrated the skin with local anesthetic drugs forming a bleb at puncture site after doing prepuncture US examination, which may have increased the depth of epidural space by few milimeteres. So we got epidural space at increased depth via loss of resistance than ultrasound measured depth.
- Transverse approach was used in studies done at lumbar level while we used paramedian approach at thoracic vertebral level. The approaches to the lumbar epidural space with the ultrasound probe as well as the epidural needle are more easily reproducible, since the path is confined by the lumbar spines above and below. This is not so when the paramedian sagittal approach is used, since there are no bony landmarks circumscribing the approach to the thoracic epidural space.
- The position of the patient may not have been exactly identical during the ultrasound examination and the actual epidural needle insertion.
- The technique was limited by the fact that needle insertion was not guided by ultrasound in real time but rather by skin markings made with the assistance of ultrasound. At present most ultrasound transducers do not have markings to indicate their midline nor do they provide precision regarding the origin of beam emanation. Therefore an inherent degree of inaccuracy may have existed while marking a needle insertion point.

Thus while comparing two techniques of measurment, limit of agreement is more important than correlation coefficient. The wide range of 95% limit, reduces the usefulness of pre-puncture ultrasound for clinical decision making while inserting epidurals. Thus though a rough guide is provided, the loss of resistance method has to be used to identify the epidural space.

Conclusion

Pre-puncture ultrasonography may be helpful in patients with anatomical abnormalities of spine, since imaging the epidural space may guide the operator regarding point of insertion as well as the direction to take but does not provide accurate assessment of depth of thoracic epidural space. Hence further studies need to be done either by using real time ultrasonography or by resolving limitations.

References

1. Grau T, Leipold R, Delorme S, Martin E, Motsch J. Ultrasound imaging of the thoracic epidural space. Reg Anesth Pain Med. 2002;27(2):200–206.
2. Arzola C, Davies S, Rofaeel A, Carvalho JCA. Ultrasound using the transverse approach to the lumbar spine provides reliable landmarks for labor epidurals. Anesth Analg. 2007;104(5):1188–1192.
3. Kao MC, Tsai SK, Chang WK, Liu HT, Hsieh YC, Hu JS, et al . Prediction of the distance from skin to epidural space for lower thoracic epidural catheter insertion by computed tomography. British Journal of Anaesthesia. 2004;92(2):271-273.
4. Rasoulian A, Lohser J, Najafi M, Rafii-Tari H, Tran D, Kamani AA. Utility of prepuncture ultrasound for localization of the thoracic epidural space. Can J Anaesth. 2011;58(9):815-823.
5. Salman A, Arzola C, Tharmaratnam U, Balki M. Ultrasound imaging of the thoracic spine in paramedian sagittal oblique plane: the correlation between estimated and actual depth to the epidural space. Reg Anesth Pain Med. 2011;36(6):542-547.
6. Grau T, Leipold R, Conradi R, Martin E, Motsch J. Efficacy of ultrasound imaging in obstetric epidural anesthesia. J. Clin. Anesthesia. 2002;14:170-175.
7. Balki M, Lee Y, Halpern S, Carvalho JCA. Ultrasound imaging of the lumbar spine in the transverse plane: the correlation between estimated and actual depth to the epidural space in obese parturients. Anesth Analg. 2009;108:1876–1881.