INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"COMPARISON OF ULTRASOUND GUIDED TECHNIQUE AND LOSS OF RESISTANCE TECHNIQUE USED FOR COMBINED SPINAL AND EPIDURAL CATHETER ANAESTHESIA-A PROSPECTIVE RANDOMISED STUDY"

Anaesthesiology

Siddhi Sawant* Senior Registrar, Department of Anaesthesiology and Critical Care, Seth G S Medical College & KEM Hospital, Mumbai. *Corresponding Author

Devika Jadhav Consultant, Sub-District Hospital Gandhinglaj.

Rajendra Patel Professor, Department of Anaesthesiology and Critical Care, Seth G S Medical College & KEM Hospital, Mumbai.

ABSTRACT

Background- An access to epidural space is based on the anatomical landmark with 'loss of resistance' technique. Currently, Ultrasound (USG) is a unique tool used to access the epidural space. **Method-** We compared the insertion of combined spinal epidural needle via midline and paramedian approach with USG guided technique and loss of resistance (LOR) technique in the lumbar interspace in 180 individuals undergoing surgery below umbilicus. **Results-** UVS was >18 in 70 individuals. In 62 individuals from USG guided group, epidural space was reached in first attempt as compared to 46 from LOR technique group. The mean vertical and oblique distances from skin to lamina, ligamentum flavum, posterior dura were 2.66cms, 3.24cms, 3.62cms and 3.52cms, 4.42cms, 4.84cms respectively. Median time taken for epidural needle insertion in USG guided group was 40 seconds and LOR technique group was 41 seconds. Mean time taken for epidural catheter insertion in USG guided and LOR technique was 10.91 and 12.36 seconds. Mean depth of epidural space in USG guided and LOR technique group was 4.46 and 4.43 cms. The Lins concordance correlation coefficient between USG measured vertical depth and actual depth by needle mark in midline approach was 0.320(P<0.0001) and between USG measured oblique depth and actual depth by needle mark in paramedian approach was 0.0810(p<0.0001). **Conclusion-** Paramedian USG guided technique was revealed to be superior than paramedian LOR technique for epidural access. Also, USG can be used to evaluate the depth of epidural space accurately.

KEYWORDS

Epidural, Ultrasound, loss of resistance

INTRODUCTION-

Epidural anaesthesia or analgesia is widely used method to provide intraoperative anaesthesia as well as postoperative analgesia. Identification of epidural space is the utmost important part of the technique as it determines the success or failure of epidural block [1,2]. 'Loss of resistance' (LOR) technique, though a gold standard technique to identify the epidural space is also a blind technique. This may lead to incorrect identification of the epidural space especially those with anatomical variations, obese [1,2]. Ultrasonography is a recently introduced tool in the field of regional anaesthesia which has shown favourable results for epidural space identification. A pre puncture scan improves the success rate of accessing the epidural space on the first attempt, reduces the number of puncture attempts, or the need to puncture multiple interspaces [3, 4, 5]

Therefore, the aim of our study was to find whether USG guided technique is superior to LOR technique for combined spinal epidural anaesthesia in patients undergoing infraumbilical surgeries.

METHODOLOGY-

After Institutional Ethics Committee approval and written informed consent, 180 ASA I–II patients, for infraumbilical surgery were enrolled for study. Standard ASA monitors and IV access were secured before patients were positioned in the lateral position with hip and knees slightly flexed.

USG guided group-

MIDLINE APPROACH

The preview US scan was performed by a single investigator and the procedure was performed by two investigators. A longitudinal (sagittal) paramedian scan of the lumbar spine was performed to locate the L1/L2, L2/L3, L3/L4, L4/L5 or L5/S1 lumbar interspace and as a part of the scout scan (pre-intervention scan). The transducer was finally positioned over the best intervertebral space, and the position of transducer was marked on patient's back using a skin marking pen. The local anaesthetic (lidocaine 2%, 2–3 ml) was infiltrated into the skin and underlying tissue between desired spinous process in the midline and probe was kept at the marked site on the skin. The Tuohy's needle was inserted in the midline with the oblique paramedian view with a tilt of the US transducer to visualize the best view for midline approach from the interlaminar space (L1/L2, L2/L3, L3/L4, L4/L5 or L5/S1) and neuraxial structures on the US image. This target interlaminar space was always maintained in the centre of the US image. The Tuohy's needle was gradually advanced to the intervertebral space, under real-time US guidance, until the tip was engaged in the ligamentum flavum. This was confirmed by testing for resistance to injection of air using the standard LOR syringe included in the epidural kit and 3-4cc saline through Tuohy's needle and observing the changes in epidural space with colour doppler.

Paramedian Approach

The local anaesthetic (lidocaine 2%, 2–3 ml) was infiltrated to skin and underlying tissue, 1-2cm lateral to the spinal process. With the desirable lumbar interspaces in paramedian oblique view, the Tuohy's needle was inserted in the long axis (in-plane) of US transducer from the caudal end with its tip directed towards the interlaminar space that had the best visibility of the neuraxial structures on the US image. The angle of needle insertion was optimized while the needle was still in the erector spinae muscle. The needle was gradually advanced to the interlaminar space, under real-time US guidance, until the tip was engaged in the ligamentum flavum. This was also confirmed by testing for 'resistance to injection of air through the needle using the standard LOR syringe included in the epidural kit.

Loss of resistance (LOR) group-

The confirmation of the intervertebral space was based on anatomical landmarks. The line drawn through the highest point of iliac crest (tuffier's line) crosses either the body of L4 or the L4-L5 space. The spinous process was palpated with the thumb of the non-dominant hand.

Midline Approach

Local anaesthetic (lidocaine 2%, 2–3 ml) was infiltrated to skin and underlying tissue between two desired spinous processes. The Tuohy's needle was gradually advanced into the intervertebral space until the tip was engaged in ligamentum flavum. Epidural space was confirmed by testing resistance to injection of air through the Tuohy needle using the standard LOR syringe included in the epidural kit and 1-2cc of saline.

Paramedian Approach

Local anaesthetic (lidocaine 2%, 2–3 ml) was infiltrated to the skin and underlying tissue 1-2cm lateral to the spinous process. The Tuohy needle was gradually advanced into the interlaminar space until the tip was engaged in ligamentum flavum. Epidural space was confirmed by testing resistance to injection of air through the Tuohy needle using the standard LOR syringe included in the epidural kit and 1-2cc of saline.

In all approaches after confirming the correct placement of needle in epidural space a 27 G pencil point spinal needle was inserted through the Tuohy needle (needle-through-needle technique) to perform the dural puncture. Once a free flow of cerebrospinal fluid (CSF) was ascertained, the spinal needle locked into place and heavy bupivacaine 0.5%, 3-4cc was injected. The spinal needle was removed and an epidural catheter was immediately inserted into the epidural space through the Tuohy needle and depth of needle and marking of the catheter on skin was noted in all groups. The catheter was secured to the back.

Patients were then placed in supine position. The level of anaesthesia was monitored at 0 minute and every 5 minutes till 30 min and thereafter every 15min.Hemodynamic parameters were also monitored.

RESULTS-

In our study, we included 180 subjects amongst ASA I-II category. Forty -five USG guided group and 45 LOR technique group underwent midline approach of epidural insertion and 45 USG guided group and 45 LOR technique group underwent paramedian approach of epidural insertion. USG guided group had 59 males and 31 females with mean age of 46.24 years (SD16.572), mean BMI of 19.89 kg/m^2. LOR technique group had 66 males and 24 females with mean age of 50.61 years (SD16.685) and mean BMI of 20.54 kg/m^2. L2-3 was the most commonly used interspace in USG guided group and L1-2 was the most commonly used interspace in LOR technique group.

USG guided visibility of neuraxial structures at lumbar interspace were scored by the investigator who performed the scan. A four-point numerical scale (0= not visible, 1= hardly visible, 2=well visible, 3=very well visible; maximum possible score of 27) was used to assess the USV. UVS was considered good if the total UVS was >18, average if score was 9-18 and poor if score was <9 [5, 6].

Table 1: Ultrasound visibility score (UVS)

GROUP	UVS	
	>18	9-18
USG GUIDED	70	20
USG GUIDED MIDLINE	36	9
USG GUIDED PARAMEDIAN	34	11

The distances from the skin, ligamentum flavum and posterior dura on the USG were greater in oblique view compared to vertical view. The epidural space was successfully identified in first attempt in 62 (57.4%) USG guided group and 46 (42.6%) LOR technique group. [Table 2]. Amongst them, 33 (58.9%) underwent USG guided median approach and 29 (55.8%) underwent USG guided paramedian approach; 23 (41.1%) patients underwent LOR midline approach and 23 (44.2%) LOR paramedian approach.

Table 2: Comparison among USG guided and LOR guided for number of attempts

NO OF ATTEMPTS			TOTAL
	USG GUIDED	LOR GUIDED	
1	62(57.4%)	46(42.6%)	108(100%)
2	22(43.1%)	29(56.9%)	51(100%)
3	6(40%)	9(60%)	15(100%)
CROSS OVER			
4	0	3(100%)	3(100%)
5	0	3(100%)	3(100%)
TOTAL	90(50%)	90(50%)	180(100%)

The median time taken for insertion of epidural needle in USG guided group was 40 seconds (interquartile range30-73) and that for LOR technique group was 41seconds (interquartile range 36-45) (P=0.0747). For USG guided midline group, it was 35 seconds whereas for LOR technique midline group it was 41 seconds (P=0.071). For USG guided paramedian group it was 48 seconds whereas for LOR technique paramedian group it was 41 seconds (P=0.044).

The mean time for insertion of epidural catheter in USG guided technique was 10.91 seconds (SD 2.6) for LOR technique was 12.36 seconds (SD 2.76) (P=0.000). For USG guided midline group was 10.61 seconds (SD 2.37) for LOR technique midline group was 12.60 seconds (SD 2.72) (P=0.000). For USG guided paramedian group was 11.2 seconds (SD 2.80) for LOR technique paramedian group was 12.61 seconds (SD 2.81) (P=0.128).

The mean depth of epidural space by needle mark in USG guided group was 4.46cms (SD 0.99) whereas in LOR technique group was 4.43cms (SD 0.78) (P=0.836). The mean length of placement of epidural catheter in USG guided group was 8.94cms (SD 1.13) and in LOR technique group was found to be 9.33cms (SD 0.88) (P=0.010). The Lins concordance correlation coefficient between USG measured vertical depth and actual depth by needle mark in midline USG guided approach was 0.320(P<0.0001) and between USG measured oblique depth and actual depth by needle mark in paramedian USG guided approach was 0.0810(p<0.0001).

DISCUSSION-

In our study, both the study groups USG guided and LOR technique group were comparable with respect to the age, sex distribution, sample size and ASA grading. Mean BMI in the USG guided and LOR technique group was 19.89 kg/m^2 (SD 3.955) and 20.54 kg/m^2 (SD 3.13) (P=0.221) respectively. L2-3 was the most commonly used interspace in USG guided group and L1-2 in LOR technique group. We included the lumbar epidural spaces as done by Karmakar et al [6] whereas H.Willschke et al included more thoracic intervertebral spaces and less lumbar spaces. The neuraxial structures were identified by USG and were scored for their visibility as UVS. In our study, we were able to delineate the neuraxial structures relevant for neuraxial block. The mean UVS was 20.77 and was judged as good in majority of our patients (70) which was higher than that seen by Karmakar et al [6]. Visibility of neuraxial structures can be difficult in obese patients as excess fat may attenuate the transmission of ultrasound waves that travels a greater distance through soft tissue [7,8] The mean BMI in our study was 19.89 kg/m2. Therefore, the above results may not be applicable in obese patients.

The mean vertical and oblique distances were measured from skin to lamina, ligamentum flavum and posterior dura to estimate the depth of needle insertion to the epidural space as there is good correlation between ultrasound measured depth and needle measured depth to epidural space [9]. It was found that the oblique distances were greater than vertical distances. The oblique distance may predict the needle insertion depth during paramedian epidural access. However, the mean vertical and oblique distances measured from skin to lamina, ligamentum flavum and posterior dura were lesser when compared with Karmakar et al [6] which could be because of the fact that these studies were done in Caucasian population and our study involved Indian population.

No significant difference was observed for the time required for epidural needle insertion between USG guided group and LOR technique group or USG guided midline and LOR technique midline or USG guided midline and paramedian group or LOR technique midline and paramedian group. But, USG guided paramedian approach takes significantly more time as compared to LOR guided paramedian approach which could be because of the fact that USG guided paramedian approach requires certain angulation of the probe for location of the needle during real time imaging. Any movement of the probe which disturbs this angulation can cause a delay during insertion of epidural needle by paramedian approach. The time taken for epidural catheter insertion in USG guided group was significantly less as compared to LOR technique group. Also, mean length of epidural catheter placement in USG guided group was less as compared to LOR technique group This could be contributed to the fact that insertion of the catheter is under vision in USG guided group but blind in the LOR technique group.

Thus, a preview USG scan can be used to accurately predict the depth of epidural needle insertion which can help us to reduce the number of needle punctures as well as prevent dural taps [6]. USG guided technique can reduce the number of times the needle touches the bone as compared to the LOR technique and also USG guided paramedian technique was better than USG guided midline technique in this aspect. There were no conversions to general anaesthesia. No additional anaesthesia was required except the two in USG guided group and successful completion of block was achieved in all individuals. No dural punctures, bloody taps, dry taps or puncture site haemorrhages were seen.

CONCLUSION-

The number of attempts required to localise the epidural space by USG guided technique were lesser than those required by LOR technique. The time taken to insert the epidural needle was longer in the paramedian USG guided technique than paramedian LOR technique but equivocal in other groups. Though the time taken to guide the epidural catheter was lesser in USG guided group than in LOR technique group, there was significant correlation between the USG measured depth of epidural space and depth by needle mark. Hence USG can be used to as an important tool for accessing the epidural space.

REFERENCES-

1. Broadbent, C. R., Maxwell, W. B., Ferrie, R., Wilson, D. J., Gawne.Cain, M., & Russell, R. (2000). Ability of anaesthetists to identify a marked lumbar interspace. *Anaesthesia*, *55*(11), 1122-1126.
2. Reynolds Jr, A. F., Roberts, A. P., Pollay, M., & Stratemeier, P. H. (1985). Quantitative anatomy of the thoracolumbar epidural space. *Neurosurgery*, *17*(6), 905-907.
3. Grau, T., Leipold, R. W., Conradi, R., Martin, E., & Motsch, J. (2001). Ultrasound imaging facilitates localization of the epidural space during combined spinal and epidural anesthesia. *Regional anesthesia and pain medicine*, *26*(1), 64.
4. Grau, T., Leipold, R. W., Conradi, R., Martin, E., & Motsch, J. (2002). Efficacy of ultrasound imaging in obstetric epidural anesthesia. *Journal of clinical anesthesia*, *14*(3), 169-175.
5. Grau, T., Leipold, R. W., Fatehi, S., Martin, E., & Motsch, J. (2004). Real-time ultrasonic observation of combined spinal–epidural anaesthesia. *European journal of anaesthesiology*, *21*(1), 25-31.
6. Karmakar, M. K., Li, X., Ho, A. H., Kwok, W. H., & Chui, P. T. (2009). Real-time ultrasound-guided paramedian epidural access: evaluation of a novel in-plane technique. *British journal of anaesthesia*, *102*(6), 845-854.
7. Grau, T., Bartusseck, E., Conradi, R., Martin, E., & Motsch, J. (2003). Ultrasound imaging improves learning curves in obstetric epidural anesthesia: a preliminary study. *Canadian Journal of Anesthesia*, *50*(10), 1047.
8. Chin, K. J., Karmakar, M. K., Peng, P., & Warner, D. S. (2011). Ultrasonography of the adult thoracic and lumbar spine for central neuraxial blockade. *The Journal of the American Society of Anesthesiologists*, *114*(6), 1459-1485.
9. Currie, J. M. (1984). Measurement of the depth to the extradural space using ultrasound. *BJA: British Journal of Anaesthesia*, *56*(4), 345-347.