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Comparison Level of Lumbar Interspinous Space as Determined by Conventional Palpatory Method vs Ultrasound in Patients Who Underwent Neuraxial Anaesthesia

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ABSTRACT

Neuraxial procedures are commonly performed for therapeutic and diagnostic indications. Neuraxial procedures are typically performed via a blind surface landmark and palpation guidance. Present study was aimed to compare level of lumbar interspinous space as determined by conventional palpatory method vs ultrasound in patients who underwent neuraxial anaesthesia. Present study was single-center, prospective, observational study, conducted in adult patients between the age of 18-70 years requiring neuraxial anaesthesia with or without general anaesthesia. The lumbar spines of all subjects were scanned by the ultrasound in the sitting position. A total of 61 patients (28 females and 33 males) were enrolled in the study. Of 61 patients, the location of the puncture mark was agreed by both palpation and ultrasound methods in 27 (44.3%) patients whereas the location was disagreed in 34 (55.7%) patients. After analysis of factors leading to misidentification of interspinous level, level of agreement is high (51.52%) for males when compared to females (35.71%) (p=0.21). Moderate agreement is there for sitting position of the patient (43.18%) when compared with the lateral position (47.06%) (p = 0.78). High level of agreement is there for the neuraxial block performed by consultant(55.56%) when compared with the resident (39.53%),but did not show any significant difference (p = 0.25). In underweight (100.00%) and normal weight (56.00%) patients the percentage of agreement is high whereas acceptable agreement is there for overweight patients (36.8%) and poor agreement for obese patients (26.7%) , p = 0.89. The agreement was strong for residents if the patient was in sitting position (76.47%) compared with consultants (60.00%). However, there is not much significant difference between the groups (p = 0.41). Ultrasound imaging can make the neuraxial anaesthesia more accurate with fewer risks of complications. This can enhance the patient's overall safety, experience and satisfaction.

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Key Words
Anaesthetic techniques, regional, spinal, subarachnoid, epidural, neuraxial

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INTRODUCTION

Neuraxial procedures are commonly performed for therapeutic and diagnostic indications. These procedures are employed for surgical anaesthesia, postoperative pain control, epidural labour analgesia and chronic pain management[1,2]. Neuraxial procedures are typically performed via a blind surface landmark and palpation guidance. Unfortunately, surface landmark identification may be highly inaccurate in identifying the underlying spinal structures. The identification of interspinous space demands good knowledge of the anatomy and some skills due to its complexity. The failure in palpation of anatomical landmarks from patient factors such as obesity, abnormal spine, or previous spinal surgery results in difficult needle placement, leading to higher rate of complications[3,4]. Multiple attempts at neuraxial procedures could be associated with an increased risk of post dural puncture headache, paraesthesia and spinal hematoma.

Neuraxial ultrasonography is a recent development in neuraxial anaesthesia practice. It has been shown to be a safe and effective technique, with increasing use as an auxiliary tool to physical examination, enhancing the overall success rate of lumbar punctures, epidural catheterization and reducing the number of insertion attempts[5,6]. Present study was aimed to compare level of lumbar interspinous space as determined by conventional palpatory method vs ultrasound in patients who underwent neuraxial anaesthesia.

MATERIALS AND METHODS

Present study was single-center, prospective, observational study, conducted in department of anaesthesia, at Mazumdar Shah medical Centre, Bommasandra, Bengaluru., India. Study duration was of 6 months (December 2020 to May 2021). Study approval was obtained from institutional ethical committee.

Inclusion criteria:

- Adult patients between the age of 18-70 years requiring neuraxial anaesthesia with or without general anaesthesia, willing to participate in present study

Exclusion criteria:

- Patients in pain or discomfort who are unable to cooperate for an ultrasound scan
- Hemodynamically unstable patients in whom performing the scan can be difficult
- Patients with multiple needle puncture marks in whom it will be difficult to determine with which puncture mark the neuraxial anaesthesia was performed
- Patients who underwent previous spinal surgeries and patients with kyphoscoliosis

Study was explained to patients in local language and written consent was taken for participation and study. All eligible subjects were enrolled in the study on the day of the surgery or the first day after surgery. After informed written consent was taken, the backs of the subjects were examined to identify the puncture site of spinal or epidural needle. The lumbar spines of all subjects were scanned by the ultrasound in the sitting position. A low frequency (2-5 MHz) curvilinear ultrasound probe was used to visualize the neuraxial structures. The sacrum was identified first by placing the probe in sagittal plane at the level of posterior superior iliac spine or above the buttock crease. The sacrum is identified as a continuous convex hyper echoic line. Due to the dorsal tilt of the sacrum, the caudal portion is superficial and the cranial portion is deeper. The lumbosacral junction was then identified as the first interlaminar space between the sacrum and the L5 lamina by sliding the probe cephalad.

Once the L5-S1 interlaminar space is identified, further spaces are identified by sliding the probe cephalad. The space at which the puncture site is located was noted down. Additionally it was recorded if the procedure was done by a resident trainee or a consultant, the subject's Body Mass Index and gender, type of neuraxial anaesthetic technique (spinal, epidural, combined spinal epidural). Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. $p<0.5$ was considered as statistically significant. The strength of the agreement between palpation method and postoperative ultrasound assessment of lumbar interspinous space were analyzed using kappa statistics. The agreement is considered good for kappa

Table 1: General characteristics

Variables	Unit	Count (n=61)	Percent
Sex	Females	28	45.90
	Males	33	54.10
Age	Mean±SD	45.52 ± 1.73	-
Weight	Mean±SD	67.74 ± 11.91	-
Height	Mean±SD	160.20 ± 9.07	-
BMI	Mean±SD	26.59 ± 5.41	-
BMI	Under weight	2	3.3
	Normal weight	25	41.0
	Over weight	19	31.1
	Obese	15	24.6
ASA Classification	I	21	34.43
	II	35	57.38
	III	5	8.20
Type of neuraxial block	CSE	2	3.28
	Epidural	3	4.92
	SAB	56	91.80

Table 2: Level of agreement between palpation method and ultrasound method

Variable	Frequency	Percent	
Agreement		27	44.3
Disagreement		34	55.7
Total	61	100.0	

Table 3: Consistent versus inconsistent results of Inter-spinous level

Variable	Unit	Agreement	Disagreement	p-value
Gender	Females	10 (35.71)	18 (64.29)	0.21
	Males	17 (51.52)	16 (48.48)	
Position of patient	Lateral	8 (47.06)	9(52.94)	0.78
	Sitting	19 (43.18)	25 (56.82)	
Neuraxial block performed by	Consultant	10 (55.56)	8(44.44)	0.25
	Resident	17(39.53)	26(60.47)	
BMI	Underweight	2(100.0)	0(0.00)	0.89
	Normal weight	14(56.0)	11(44.0)	
	Overweight	7(36.8)	12(63.1)	
	Obese	4(26.7)	11(73.3)	

Table 4: Interspinous level noted in anaesthesia chart vs Interspinous level noted by ultrasound Crosstabulation

			Inter-spinous level noted by ultrasound				
			L1-L2	L2-L3	L3-L4	L4-L5	Total
Interspinous level noted in anaesthesia chart	L1-L2	Count	3	0 0	0	3	
		Expected Count	.6	1.5	.9	.0	3.0
	L2-L3	Count	5	8 0	0	13	
		Expected Count	2.6	6.4	3.8	.2	13.0
	L3-L4	Count	4	22 16	1	43	
		Expected Count	8.5	21.1	12.7	.7	43.0
	L4-L5	Count	0	0 2	0	2	
		Expected Count	.4	1.0	.6	.0	2.0
Total	Count	12	30	18 1	61		
	Expected Count	12.0	30.0	18.0	1.0	61.0	

Table 5: Symmetric Measures

	Value	Asymp. Std. Errora	Approx. Tb	Approx. Sig.
Measure of Agreement Kappa	.177	.074	2.469	.014

Table 6(a-b): Cross tabulation: Agreement between Neuraxial block performed by consultant and resident with Position of patient

	Lateral (n = 8)	Sitting (19)	
Consultant (n=10)	4 (40 %)	6 (60 %)	0.41
Resident (n=17)	4 (23.53 %)	13 (76.47 %)	
Consultant (n=8)	1 (12.5 %)	6 (60 %)	0.40
Resident (n=26)	8 (30.77 %)	18 (69.23 %)	

values > 0.80, moderate for kappa values between 0.60 and 0.80 and poor for kappa values <0.60.

RESULTS

A total of 61 patients (28 females and 33 males) were enrolled in the study. Mean age was 45.52±1.73 years, weight of the patients was 67.74±11 whereas mean height was recorded as 160.20±9.07. BMI was calculated and most of the patients are of normal weight (41 %). More number of patients were in ASA II classification (57.38%) followed by ASA I (34.43%) and ASA III (8.20%). Types of neuraxial block included more subarachnoid blocks (SAB) (91.80%) followed by Epidural (4.02) and Combined spinal epidural (CSE)(3.28%).

Of 61 patients, the location of the puncture mark was agreed by both palpation and ultrasound methods in 27 (44.3%) patients whereas the location was disagreed in 34 (55.7%) patients. Majority of the patients had the neuraxial procedure performed in the sitting position (72.13%) and only 27.87% patients had the procedure done in lateral position. More number of neuraxial blocks were performed by the residents (70.49%) and few were performed by consultants (29.51%). After analysis of factors leading to misidentification of interspinous level, level of agreement is high (51.52%) for males when compared to females (35.71%) (p = 0.21). Moderate agreement is there for sitting position of the patient (43.18%) when compared with the lateral position (47.06%) (p = 0.78). High level of agreement is there for the neuraxial block performed by consultant (55.56%) when compared with the resident (39.53%), but did not show any significant difference (p = 0.25). In underweight (100.00%) and normal weight (56.00%) patients the percentage of agreement is high whereas acceptable agreement is there for overweight patients (36.8%) and poor agreement for obese patients (26.7%), p = 0.89. Cross tabulation was performed to see the location of the puncture mark documented, interspinous level noted using the anaesthetist chart by palpation method and by ultrasound. Location of needle puncture mark in 3 patients was at L1- L2 located by Ultrasound method and by palpation method, in 8 patients the location was at L2-L3 by Ultrasound method and by palpation method, in 16 patients the location was at L3- L4 by Ultrasound method and by palpation method and in 0 patients the location was at L4- L5 by Ultrasound method and by palpation method.

Kappa statistics revealed that the expected level of agreement was 0.177 which indicates that there exists a poor agreement between palpation and ultrasound methods of identification of a puncture mark and showed statistically significant difference between both the methods. In lateral position there is (40.00%)

agreement if the consultant is performing neuraxial block when compared with residents making neuraxial block in lateral position (23.53%). The agreement was strong for residents if the patient was in sitting position (76.47%) compared with consultants (60.00%). However, there is not much significant difference between the groups (p = 0.41).

DISCUSSIONS

Ultrasound helps in the visualization of spinal anatomy which can provide the anaesthetist valuable information regarding the midline of the spine, the vertebral level and also the depth of the posterior complex. The ultrasonography can add up on the information provided by the palpation and make the process more accurate and reliable. Doing a preprocedural ultrasound examination can also help determining the angle of needle insertion with the estimated depth of spinal structures. This can significantly improve patient comfort and safety with lesser numbers of failed and traumatic procedure. A guideline by the National Institute for Health and Excellence[9] on ultrasound guided epidural catheterization mentioned that ultrasound might be helpful in achieving correct epidural placement, but the evidence was limited.

Perlas *et al*.[10] did a systemic review and meta-analysis of ultrasound assisted lumbar neuraxial ultrasound for spinal and epidural anaesthesia where they concluded that preprocedural ultrasound imaging provides accurate measurement of the depth of the epidural or intra-thecal space improving efficacy of neuraxial anaesthesia, improving the localization of midline and lumbar inter-spaces. They also said that there is good evidence to support the role of neuraxial ultrasound in improving the precision and efficacy of the neuraxial blocks. We have also determined in our study that ultrasound helps to correctly identify the lumbar inter-spaces and midline. Whitty *et al*.[9] compared the interspinous level used for administering obstetric neuraxial anaesthesia in 121 patients as documented in the anaesthesia chart using palpation with the level estimated by ultrasound. They found that the vertebral level documented by the anaesthesiologist was in agreement with the level assessed by ultrasound in 67 of 121(55%) patients. In 39 (32 %) women the ultrasound estimated the mark to be at least one space higher than noted. They concluded there was poor agreement between palpation and ultrasound estimation of a specific lumbar inter-space. In our study, out of 61 patients the location of puncture mark was agreed by both palpation and ultrasound in 27 patients (44.3%) whereas the location was disagreed in 34 patients (55.7%). Hence our study also produced similar results where we concluded that we often choose a lumbar interspinous level one to two spaces higher than the one we intended to. Thus using an ultrasound before the procedure can add to our accuracy.

Broadbent *et al*.[11] did a study about anesthetist's ability to determine the lumbar interspace correctly. They compared the lumbar interspinous level marked by the anaesthesiologist with the one determined using magnetic resonance imaging. The results showed that the lumbar interspinous level was one space higher than assumed in 51% of the patients. In only 29 % of the patients the determined vertebral space was correct. Accuracy was not affected by the patient position (sitting or lateral), although it came down with obesity (p< 0.0001). The level of agreement between the two techniques when determining the lumbar interspinous space is higher for males (51.52 %) when compared to females (35.71%), p = 0.21. There is a moderate degree of agreement in the two patient positions used for neuraxial block, sitting (43.18) and lateral (47.06) with p = 0.78. In the neuraxial anaesthesia procedures performed by the consultant the level of agreement was higher (55.56%) compared to when it was done by a resident (39.53%). This shows that with experience the capability to correctly estimate the lumbar inter-spaces increases.

The level of agreement between the lumbar inter-spaces noted by the anaesthetist and as determined by the ultrasound is higher in patients who are underweight or normal weight. As the BMI increases the level of agreement drops because obesity makes it difficult to correctly determine the lumbar anatomy by surface palpation. We did not come across any complications of neuraxial anaesthesia during the period of our study like transient or permanent neurological injury, postdural puncture headache, diplopia, tinnitus, hematoma or infections. Neuraxial blocks are very safe procedures when performed correctly with very low rate of complications. Limitations of the study were, results were not verified with fluoroscopy which is the gold standard to determine the exact lumbar inter-space as it is out of scope of this study. The study design required to identify the sacrum first and then counting the spinal level up from spinal. The abnormal anatomy such as fusion or narrowed inter-spaces could result in misinterpretation of the results.

CONCLUSION

Ultrasound imaging can make the neuraxial anaesthesia more accurate with fewer risks of complications. Ultrasound examination before the neuraxial procedure can supplement the information

received from palpatory method and help in determining the midline, the optimal lumbar inter-space level, the optimal insertion point, the best angle for needle insertion along with the estimated depth of the epidural or intra-thecal space. This can enhance the patient's overall safety, experience and satisfaction.

REFERENCES

1. Barash, G., Paul, 2013. Clinical Anaesthesia. 7th Edn., Lippincott Williams Wilkins, Philadelphia
2. Morgan, M.,S.G. and E. Mikhail, 2006. Clinical Anaesthesiology. 1st Edn., McGraw Hill Medical, New York
3. Lumley, J.S.P., 2019. Bailey and Love's Essential Clinical Anatomy. 1st Edn., Abrahams, Richard Tunstall, ISBN-13: 9781315100722
4. Miller, D. and Ronald, 2010. Miller's Anaesthesia. 7th ed Edn., Churchill Livingston, Philadelphia
5. Whitty, R., M. Moore and A. Macarthur, 2008. Identification of the lumbar interspinous spaces: Palpation versus ultrasound. Anesthesia. Analg., 106: 538-540.
6. Lee, A.J., J.S. Ranasinghe, J.M. Chehade, K. Arheart, B.S. Saltzman, D.H. Penning and D.J. Birnbach, 2011. Ultrasound assessment of the vertebral level of the intercristal line in pregnancy. Anesthesia. Analg., 113: 559-564.
7. Furness, G., M.P. Reilly and S. Kuchi, 2002. An evaluation of ultrasound imaging for identificationof lumbar intervertebral level. Anaesth., 57: 277-280.
8. Ansari, T., A. Yousef, A.E. Gamassy and M. Fayez, 2014. Ultrasound-guided spinal anaesthesia in obstetrics: Is there an advantage over the landmark technique in patients with easily palpable spines? Int. J. Obst. Anesth., 23: 213-216.
9. NICE., 2008. National institute of health and clinical excellence.
10. Perlas, A., L.E. Chaparro and K.J. Chin, 2016. Lumbar neuraxial ultrasound for spinal and epidural anesthesia. Reg. Anesth. Pain. Med., 41: 251-260.
11. Broadbent, C.R., W.B. Maxwell, R. Ferrie, D.J. Wilson, M. Gawne-Cain and R. Russell, 2000. Ability of anaesthetists to identify a marked lumbar interspace. Anaesth., 55: 1122-1126.