ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 09 | September - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE STUDY OF PRE-PROCEDURE AND REAL TIME ULTRASOUND-GUIDED EPIDURAL ANAESTHESIA IN OBESE PATIENT.

Anaesthesiology

Dr Ravi Anand Fellowship Senior Resident, Department of Trauma and Emergency, Indira Gandhi Institute of Medical Sciences, Patna-800014.

Dr Preeti Kumari* Fellowship Senior Resident, Department of Trauma and Emergency, Indira Gandhi Institute of Medical Sciences, Patna-800014. *Corresponding Author

Dr Sanjeev Kumar Professor, Department of Critical Care Medicine, Indira Gandhi Institute of Medical Sciences, Patna-800014.

Dr Siddharth Singh Assistant Professor, Department of Critical Care Medicine, Indira Gandhi Institute of Medical Sciences, Patna-800014.

Dr Ganesh Kumar Ram Fellowship Senior Resident, Department of Trauma and Emergency, Indira Gandhi Institute of Medical Sciences, Patna-800014.

ABSTRACT

Background And Aims: Epidural anaesthesia is widely performed using a landmark-guided midline approach. The indistinct or distorted landmark is associated with obesity, previous spinal surgeries, deformities, or degenerative changes due to ageing. In the present study, we compared the efficacy of real-time ultrasound (RUS)-guided paramedian approach, and pre-procedure ultrasound (PUS) landmark-guided paramedian approach in obese patients. **Methods:** Sixty patients with body mass index (BMI) >30 kg/m2 were included in the study. The participants were randomly assigned to two groups : PUS and RUS group . The primary end point was to attain a successful placement of epidural catheter. Variables like the number of attempts, the number of passes, the time taken for identifying epidural space(s), and time taken for successful epidural catheter placement(s) were secondary end points and were recorded in both the groups. **Results:** The median number of attempts were 4 (IQR 2-4) and 2 (IQR 1-2), respectively, in the PUS and RUS group (P-value < 0.001). The median number of passes, the median time for identifying space, and the time for successful epidural catheter placement was statistically significantly less in the RUS group, than the PUS group. **Conclusion:** The time taken for the identification of the space, the number of attempts, number of passes, and the time taken for successful epidural catheter placement was more in the PUS group as compared to the RUS group.

KEYWORDS

Anaesthesia, obesity, epidural, epidural space, ultrasonography

INTRODUCTION

Popularity of regional anesthesia techniques for surgery, orthopedics, trauma surgery of a lower limb, urological surgeries obstetrics, and postoperative pain management increasing day by day. Epidural anaesthesia has multiple advantages over conventional spinal anaesthesia. Now a day Epidural anaesthesia is widely performed using a surface landmark-based "blind" technique. These surface landmarks may be absent, indistinct or distorted ageing[1]. This blind technique has several complications like patchy block, block failure and epidural haematoma. These incidences are directly associated with multiple passes and attempts while administering epidural anaesthesia.[2] Such unwanted incidences can be reduced by using Ultrasound guided epidural anaesthesia. . In the present study, we compared the efficacy of real-time ultrasound (RUS)-guided paramedian approach, and pre-procedure ultrasound (PUS) landmark-guided paramedian approach in obese patients, A pre-procedural neuraxial ultrasound technique has been used successfully to perform epidural anaesthesia. Information on the use of real-time ultrasound (RUS) guided epidural anaesthesia has, to date, been limited to case series and case reports and few prospective observational studies.[3],[4] The RUS permits more accurate estimation of the appropriate needle insertion site and trajectory. There has been no study done to compare the efficacy of RUS-guided epidural anaesthesia, and pre-procedural ultrasound (PUS) guided epidural anaesthesia. Hence, this study was aimed at evaluating the efficacy of these two modalities of epidural anaesthesia, i.e., PUS and RUS approach, in an obese patient undergoing lower abdominal, perineal and lower limb surgeries by comparing the number of attempts, number of passes, and time taken for successful lumbar puncture. The secondary variables were median time for identifying space, median time to achieve successful analgesia, and time taken for a successful lumbar puncture. Such unwanted incidences can be reduced by using Ultrasound guided epidural anaesthesia.

METHOD

After approval from ethical committee of Gouri Devi Institute of Medical Sciences and Hospital, Durgapur (April 2020 to September 2020), 60 patients were selected for the study. Written informed consent was obtained from all enrolled patients. All the procedures were done by anaesthesiologists with adequate training in ultrasound. The inclusion criteria included patient aged between 20 and 75 years, American Society of Anesthesiologists (ASA) grade II or III, obese with body mass index (BMI) >30 kg/m2 scheduled for the elective lower abdominal, perineal and lower limb surgeries under epidural anaesthesia, were included in the study. The exclusion criteria included contraindications to neuraxial blocks, pregnant patients and the patient refusal for epidural anaesthesia. Patients were monitored with oxygen saturation, blood pressure (systolic, diastolic, mean arterial pressure) and electrocardiogram. Basal values were recorded. Intravenous line was secured. The patient was positioned sitting over operation table with keeping their legs straight and an assistant holding the patient to aid positioning. The skin was cleaned with 5% povodine iodine followed by wiped with 70 % propyl alcohol. Under strict aseptic condition, local infiltration of 2% lignocaine was done. The epidural anaesthesia was carried out at L3-L4/L4-L5 level by Tuohi's needle. About 3-4 mL of plain bupivacaine 0.125% was injected through epidural catheter in both the groups as test dose followed by 20 ml 0.125% bupivacaine after 5 minute of test dose.The study was a single-blinded randomised controlled study. Group-1 (PUS group) received pre-procedural paramedian epidural anaesthesia. Group-2 (RUS group) participants received real-time USG guided paramedian epidural anaesthesia.

A Mindray USG machine (Model-UMT 150) of Shenzhen Mindray Bio-medical Electronics Co. of China was used with the 2 -5 MHz curvilinear probe and sterility maintained with the application of a transparent sheet.

In the PUS group, ultrasound (US) was used to identify the L3-L4, L4-L5 interspinous space with the best image of the anterior complex (ligamentum flavum dura complex- LFD) and the posterior complex (posterior longitudinal ligament- PLL) being in the parasagittal oblique (PSO) view. At these selected interspaces, the probe was positioned to obtain a clear ultrasound image, after which, a skin marker was used to mark the mid-point along the long border of the probe, and the mid-points along the short borders of the probe . At the same horizontal level as the mid-point of the long border of the probe, the mid-point of the line drawn between the two short border mid-

points of the probe was used as a paramedian insertion point. Epidural needle was then inserted based on these landmarks. The epidural space was confirmed by loss of resistance technique to either air or saline.

In the RUS group, the L3- L4, L4-L5 interspinous space was identified by using the real time images in PSO view, and the needle was visualised breaching into the epidural space. The sacrum was the first structure to be identified, after which the probe was advanced cephalad with an angle of 20° tilted towards the midline. Then, the lumbar lamina was identified along with a target space between L3-L4 and L5-S1. The probe was then further rotated 25° towards the midline to achieve a classical oblique parasagittal approach. The biggest advantage of this view is that not only is one able to visualise the lamina, inter-vertebral space and the posterior longitudinal ligament complex, but the ergonomic advantage of handling the needle and the probe together is also provided. The needle was gradually advanced into the interlaminar space, until the tip breached the ligamentum flavum. At this point, the classical giveaway feeling was also observed [Figure 1]

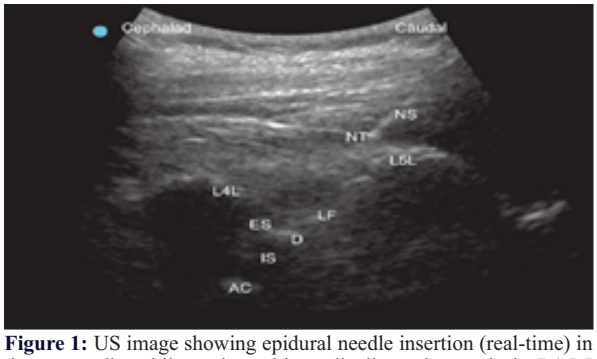

Figure 1: US image showing epidural needle insertion (real-time) in the paramedian oblique view with needle directed towards the L4-L5 inter-laminar space. NS: needle shaft, NT: needle tip, L4L: L4 Lamina, L5L: L5 lamina: LF: ligamentum flavum, ES: epidural space; D: Dura, IS: intrathecal space, AC: anterior complex

The vital parameters of patient were monitored throughout the procedure. Patients were asked for the feeling of nausea, dizziness, and assessed for pruritus and observed for vomiting. Hypotension and bradycardia were treated as per institutional protocol.

The primary variables which were compared between the two groups included the number of attempts (defined as the number of times the epidural needle was withdrawn from the skin and reinserted), number of passes (defined as the number of forwarding advancements of the epidural needle in a given interspinous space), and the time taken for successful epidural space identification. The secondary variables were median time for identifying space, median time to achieve successful analgesia and median time taken for a successful epidural catheter placement.

This study evaluated the variables, and/or their mean of values, and determined whether they are statistically significant in order to "predict" the efficacy of two modalities of epidural anaesthesia in obese patients. A null hypothesis of no change in both the modalities of epidural anaesthesia was assumed. Based on the pilot study, a difference of 20% in the primary outcome of the two groups was hypothesised. Using this, a power calculation was done which showed a sample size of 30 in each group with an alpha of 0.05, beta of 0.3, a power of 0.8 and a confidence level of 95% giving a study population of 75. Computer-generated random number sequence was used for Randomisation.The participants of study was blind.The number of attempts, number of passes, time taken for identifying epidural space (s), and time taken for a successful epidural catheter placement (sec) were considered as the outcome variable. The Mann Whitney U test and the Chi-square test were used to evaluate statistical significance. *P* value < 0.05 was considered statistically significant. Statistical analysis was performed by using SAS statistical software version 9.4 (SAS Institute, Cary, NC).

RESULT

A total of 60 subjects were included in the final analysis . Both the groups were comparable for age, height , weight and BMI.

Table 1: Showed A Demographic Characteristic's Of Two Groups Of Study Subjects:

Parameter	Group 1 (PUS group) (n=25)	Group2 (RUS group) (n=25)	Mean
Age	61.23±3.43	61.01 ±3.01	0.643
Height (cm)	154.30±3.84	158.54±2.60	0.052
Weight (kg)	68.34±11.70	69.56±11.12	0.020
BMI	34.42 ±4.20	36.15 ±3.81	0.200

BMI= Body Mass Index

Table 2: Comparison Of Various Parameters In PSU And RUS Gropup :

Parameter	Group I (PUS) Median (IQR)	SD	Group II (RUS) Median (IQR)	SD	P value
Number of attempts	4 (2,5)	2.96	2(1,2)	1.48	<0.001
Number of passes	7.50 (4,10)	6.29	4 (3, 5)	2.96	<0.001
Time taken to identify the space (s)	128.35 (90.20,159.67)	78.03	88.19 (55.05, 123.95)	48.28	<<0.001
Time taken to successful placement of epidural catheter (s)	446.31 (286.34,580.23)	218.56	360.32 (281.46,428.31)	205.89	0.0,048
Success rate	28(93.3%)		29(96.6%)		0.644
Converted to GA	2(6.6%)		1(3.3%)		0.763
Successful Epidural Space					
On 1st needle Insertion	9(30%)		18(60%)		0.004
On 1st needle pass	3(10%)		12(40%)		0.004
On up to 5th needle pass	9(30%)		24(80%)		0.004
On up to 7th needle pass	18(60%)		29 (96.6%)		0.004

PUS: Pre-procedural ultrasound-guided spinal; RUS-Real-time ultrasound-guided spinal; SD: Standard deviation; IQR: Inter-quartile range; BMI: Body mass index;GA: general anaesthesia.

Among the patients in the PUS group, the median number of attempts was 4 (IQR 2-5), and it was 2 (IQR 1-2) in the RUS group, this was statistically significant (*P*-value <0.001). The median number of passes in the PUS group was 7.50 (IQR 4-10), and it was 4 (IQR 3-4) in patients with RUS epidural anaesthesia, which was statistically significant (*P*-value < 0.001). The median time for identifying epidural space, the median time to achieve successful placement of epidural catheter in epidural space (s), was statistically significantly less in the RUS group in comparison to the PUS group. A successful needle puncture was achieved during the first needle insertion in twice the number of patients in RUS group (60%), in comparison to the PUS group (30%).

DISCUSSION

The identification of the epidural space has traditionally been achieved by an anatomical landmark- guided approach. Surface anatomical landmarks are useful, however, they may be difficult to palpate in obese patients. They also do not take into account all the anatomical variations or abnormalities, and frequently lead to incorrect identification of a given lumbar interspace.[5] Multiple attempts at needle placement may cause patient discomfort/anxiet, higher incidence of epidural haematoma, post-dural puncture headache, and trauma to neural structures.[5] Ultrasound guided block is a relatively recent development in the field of regional anaesthesia. A "pre-procedural" ultrasound examination of the spine accurately delineates the underlying relevant anatomy, thus, aiding in successful insertion of a epidural needle. Real-time US image accusation of the epidural needle appears to be a better alternative as it excludes all the blind spots which occur during the needle insertion in "pre-procedural US-

assisted blocks".

Our study demonstrated that the time taken to identify the epidural space was significantly lesser in the RUS (88.19 s) group, in comparison to the pre-procedural group (128.35 s). Yasser *et al.*[14] reported that the the epidural space localization in Accuro Ultrasound real time group is 79.34 second and APAD Ultrasound real time group is 63.04 second respectively, This difference in time may be due to the fact that the procedure in our study was performed only by conventional ultrasound were as in Yasser study they used hand held advance ultrasound device.

The number of successful epidural space identification during the first needle insertion was double (60%) in the RUS group in comparison to the PUS group (30%). This was also statistically significant. In the real-time group, the success rate was similar to that of other studies on real-time imaging.[3],[6] However, no study has compared the RUS with the PUS. Chong *et al.*[3] reported the first successful attempts at a rate of almost 87% higher than our study. Conray *et al.*[2] have reported it at 47%. But their study was on spinal anaesthesia. This was comparable with the studies of Brinkmann and colleagues[6] at 39%. The significant difference between our study and other studies was that all the other studies were done on patients with varying weight, whereas our study only included patients who had BMI above 30. The rate of successful epidural space identification during the first needle insertion among the pre-procedural group was similar as in other studies.[7],[8],[9] This is an important finding since multiple attempts at needle placement are directly related to incidences of epidural haematoma, post-dural puncture headaches, and trauma to neural structures. Further, the number of needle passes required were also statistically less in the RUS group in comparison to the PUS group. Multiple attempts would have significantly contributed to patient discomfort and the time taken to identify the dural space. The number of passes mentioned in the other studies varies due to many reasons. First, the patient population was different. Mean age and BMI in our study was 61 years and 34.42 kg/m^2, respectively, versus 63-68 years and 28.5-30.5 kg/m^2 in the referenced studies (Chin *et al.*, Srinivasan *et al.*, and Abdelhamid e*t al.*) Second, in the study by Chong *et al*.,[3] the number of passes were self-reported, whereas in our study, it was recorded by an independent observer. This is important because it has been shown that the number of self-reported passes is always lower than the actual number of passes.[7] Third, the age of our population group was, on average, 61 years and epidural anaesthesia has been shown to be more difficult in older populations compared to the general adult population.[8] Fourth, we used a paramedian approach to the neuraxis. In the presence of interspinous ligament calcification, and an inability to achieve adequate flexion (both of which are common in the elderly), this paramedian approach might be valuable.[9] It has also been shown that both the length and width of the lumbar spinous process increases significantly with ageing, which further narrows the interspinous space available for a midline approach.[9],[10] The interlaminar space is least affected by the changes attributable to ageing, and offers a potential window for epidural anaesthesia.[11]

The technical difficulty of the neuraxial blockade is measured using two main parameters: the number of needle manipulations required for success, and the time taken to perform the block. Of the two, the first is more important because multiple needle insertions are an independent predictor of complications, such as inadvertent dural puncture, vascular puncture and paraesthesia.[1] Elicitation of paraesthesia is a significant risk factor for persistent neurological deficit after epidural anaesthesia.[9]

The success rates for achieving epidural anaesthesia in both groups were similar (RUS 96.6%, PUS 93.3%). However, in 96.6% of the patients in the RUS group, successful epidural space identification was achieved within seven needle passes, while this was achieved in only 60% of the patients in the PUS group. The success rates in the PUS group in our study are comparable to other studies.[4],[6],[9],[12] Regarding the time taken for successful epidural catheter placement between the groups, the real-time US-guided method took significantly (*P*-value = 0.048) less time (360.32 s), compared to the pre-procedural US method (446.31 s). We did not find any study comparing or mentioning this. The statistical difference may be due to the early injection of the drug in the RUS group, since the dural breach was achieved earlier in that group.

Some studies aimed at finding ways to improve the real-time ultrasound guided epidural anesthesia by improving the technique itself and making it possible to be performed by one operator only. One example of these trials is published by Denis Tran, and concluded that a real-time aim-and-insert ultrasound- guided epidural needle insertion can be performed by a single operator .but described Several limitations, mostly related to the needle guide geometry and the ease of detecting the end point (the epidural space) [15].

The number of qualified doctors who can perform the epidural anesthesia using ultrasound was limited and this was considered as a limitation in this study.

CONCLUSIONS

Real-time ultrasonography can be a useful adjunct to safe epidural anaesthesia. It facilitates the performance of epidural anaesthesia in patient population with difficult anatomic landmarks, like obese patients. The RUS method of needle insertion needed a significantly lesser number of attempts, a lesser number of passes, less time taken for identifying the epidural space and less time taken for successful epidural catheter placement as compared to the PUS method for successful epidural anaesthesia.

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