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RESEARCH ARTICLE

COMPARISON OF ULTRASOUND VERSUS LANDMARK GUIDED INSERTION OF COMBINED SPINAL EPIDURAL IN TOTAL HIP REPLACEMENT/TOTAL KNEE REPLACEMENT SURGERIES

***Dr. Arul Selvan, Dr. Yashpal Singh, Dr. Singh, D.K., Dr. Sarath Kumar, Dr. Siva Kumar, R. and Dr. Mohan**

Department of Anaesthesiology, Trauma Centre, BHU, Varanasi, India

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****Corresponding author:*** **Dr. Arul Selvan**

ABSTRACT

Background: Multiple attempts and needle redirection in a single attempt while performing combined spinal epidural anaesthesia are associated with a greater incidence of postdural puncture headache, paraesthesia, and spinal hematoma. We hypothesized that the routine use of a preprocedural ultrasound-guided combined spinal epidural anaesthesia would reduce the number of attempts and needle redirection in a single attempt when compared with the conventional landmark-guided combined spinal epidural anaesthesia. ***Methods:*** Sixty consenting patients scheduled for elective total joint replacements (hip and knee) were randomized into group U (Ultrasound guided technique) and group L (Landmark technique) with 30 in each group. In group L, combined spinal epidural was done via the midline approach using clinically palpated landmarks. In group U, a preprocedural ultrasound scan was used to mark the insertion site, and combined spinal epidural anaesthesia was performed. ***Results:*** The mean number of attempt was lower in Group U (1.06±0.25) than Group L (1.26±0.89) and p-value (0.039) was found to be significant. The mean total number of needle redirection in a single attempt were found to be lower in Group U (1.16±0.53) than Group L (1.60±0.89) and the p-value (0.027) was found to be significant. The mean value of time taken for identifying landmark for Group U (126.9±9.31) was higher than Group L (25±7.08) and p-value (<0.05) was found to be significant.The mean value of time taken for the procedure was higher in Group U (634.83±48.90) than Group L (458.93±41.15) and p-value (<0.05) was found to be significant. The mean periprocedural VAS score of pain and the demographic profile were comparable in both groups. ***Conclusion:*** Routine use of combined spinal epidural anaesthesia in the orthopaedic patient population undergoing joint replacement surgery, guided by preprocedural ultrasound examination, significantly decreases the number of attempts and needle redirection needed to enter the subarachnoid and epidural space.

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INTRODUCTION

Total Hip and Knee Replacement surgeries are becoming major orthopaedic procedure in aged population. Regional anaesthesia in the form of combined spinal epidural anaesthesia is provided for these surgeries to reduce the complications associated with general anaesthesia. However multiple passes and attempts during the procedure in elderly patients due to anatomical irregularities like khyphoscoliosis, disc prolapse, rotation of spine etc. Due to these changes, there has been a current trend in use of ultrasound in regional anaesthesia practice. There is a paucity of literature that compares the landmark and ultrasound guided insertion of combined spinal and epidural anaesthesia in patients undergoing THR/TKR surgeries. Hence this study was conducted to evaluate and compare the both techniques.

METHODS

Present sample consists of 60 patients posted for Total Hip/Knee Replacement surgery in general population in a tertiary care institute from November 2017 to March 2019. This is a Prospective Randomized Comparative study. Approval was obtained from the Institutional Ethical Committee and written consent was obtained from every patient. All the patients had the neuraxial procedure done in sitting position.

Group U: Patients underwent ultrasonographic preprocedural space marking based combined spinal and epidural technique.

Group L: Patients underwent landmark based combined spinal epidural technique.

Inclusion criteria: Age of 18-80 years posted for THR/TKR.

Exclusion criteria:

- Age <18 years or >80 years.
- Any contraindication of regional anaesthesia.
- Uncontrolled Diabetes/ Hypertension.

In group U, select a low-frequency (2-5 MHz), curved-array ultrasound probe. Adjust focus, gain and depth of about (7-10) cm on the ultrasound machine as required. Place probe in a postero-sagittal orientation 3-4 cm from the midline. Transverse process is represented by the finger-like acoustic shadows (Trident sign). Slide the probe medially toward the midline while maintaining a postero-sagittal orientation. Facet joints between superior and inferior articular processes will be seen as rounded humps. Tilt the probe toward the midline to obtain the postero-sagittal oblique view. Additional small sliding and tilting movements of the probe may be required to optimize the view of "Sawtooth" appearance of the laminae, Posterior complex (Ligamentumflavum, Epidural space and Posterior dura) and Anterior complex (Anterior dura, Posterior longitudinal ligament, vertebral body). Slide the probe caudad while maintaining a postero-sagittal oblique orientation, until the L5-S1 intervertebral space is centered on the US screen. Its location will correspond with the midpoint of the probe's long side and can be marked on the patient's skin. Slide the probe in a cephalad direction, middling each successive intervertebral space (L4-L5, L3-L4, L2-3) on the US screen and marking it on the patient's skin ("counting up" approach). The identity of the intervertebral spaces may be confirmed by identifying the T12 vertebra by its articulation with the twelveth rib and then sliding the probe in a caudad direction to visualize each successive intervertebral space ("counting down" approach).
Rotate the probe 90 degrees into a transverse orientation and slide it cephalad or caudad as required to obtain transverse interlaminar views of the interspaces. The probe may have to be tilted in a cephalad direction to optimize the view. Centre the neuraxial midline on the US screen in the transverse interlaminar view and mark the midpoint of the probe's long and short sides. The intersection of these two markings indicates the needle insertion point. Then perform the combined spinal epidural anaesthetic technique in the usual fashion in the insertion point.

In group L, with the patient in the sitting position, under strict aseptic precautions painting and draping was done. Then the patient's iliac crest was palpated to identify the Tuffier's line (imaginary line passing between two iliac crests usually crossing L3-4 space).Then the corresponding spinous process was palpated in the midline to identify the lumbar space and combined spinal epidural performed using the loss of resistance to air method. Using needle through needle method, a long spinal needle was introduced into the subarachnoid space through the epidural needle. After obtaining a free flow of cerebrospinal fluid (CSF), 15 mg of heavy Bupivacaine 0.5% was administered into the subarachnoid space and the spinal needle withdrawn. Before removing the Tuohy needle, a 16-gauge lateral eye epidural catheter was inserted 5 cm into the epidural space. The patient was then changed into the supine horizontal position till loss of sensation and motor power of lower limb is abolished. The basic demographic profile like age, sex, height, weight and co morbidities were noted. The primary outcome was the total number of attempts. The secondary outcomes were the total number of repeat needle insertion in a single attempt, time taken for identifying landmark, time taken for the whole procedure and the periprocedural VAS score of pain.

OBSERVATION AND RESULTS

Table 1. Comparison of total number of repeat needle insertion between Group U and Group L

Parameter	Group U	Group L	p value
	Mean ± SD	Mean ± SD	
No. of repeat needle insertion	1.16±0.53	1.60±0.89	0.027(significant)

Data is presented as Mean ± SD.

In Group U the mean number of repeat needle insertion was 1.16 and for Group L, it is 1.60. The P value (0.027) was statistically significant.

Table 2. Comparison of total number of attempt between Group U and Group L

Parameter	Group U	Group L	p value
	Mean ± SD	Mean ± SD	
Number of attempts	1.06±0.25	1.26±0.89	0.039(significant)

Data is presented as Mean ± SD.

The mean value of number of attempt in Group U was 1.06, whereas it was higher in Group L with a value of 1.26.In the inter group analysis, there was a statistically significant difference between the mean number of attempts with a p value of 0.039.

Table 3. Comparison of time taken for identifying landmark between Group U and Group L

Parameter	Group U	Group L	p value
	Mean ± SD	Mean ± SD	
Time for identifying landmark(sec)	126.9±9.31	25±7.08	<0.05(significant)

Data is presented as Mean ± SD.

The mean value for identifying landmark in Group U was 126.9 seconds and for Group L was 25. In the intergroup analysis, there was a statistically significant difference in the number of attempt between the two groups.

Table 4. Comparison of time taken for performing procedure between Group U and Group L

Parameter	Group U	Group L	P value
	Mean ± SD	Mean ± SD	
Time for performing Procedure(sec)	634.83±48.90	458.93±41.15	<0.05(significant)

Data is presented as Mean ± SD.

The mean time taken for performing the procedure for Group U was 634.83 seconds and for Group L was 458.93 seconds. In the inter group analysis, there was a statistically significant change in time taken for performing procedure. The mean periprocedural VAS score of pain at injection site for Group U was 2.53 and for Group L was 2.83.The difference between the two group was statistically insignificant (p=0.097).

DISCUSSION

In our study, the mean total number of needle redirection in a single attempt were found to be lower in Group U (1.16±0.53) than Group L (1.60±0.89) and the p-value (0.027) was found to be significant. This may be due to the fact that due to proper imaging and marking of the lumbar spaces and depth of

epidural space under direct visualisation of ultrasound compared to blind landmark technique. Consistent with our findings, in a study done by Karthikeyan *et al.* it has been shown that the total number of passes were more during landmark guided combined spinal and epidural than ultrasound guided technique. They concluded that the use of a preprocedural ultrasound-guided paramedian spinal technique resulted in a >50% reduction in the number of passes required for success compared with a conventional landmark-based midline approach in patients undergoing total hip or total knee arthroplasty. The number of passes was greater in his study compared with our study might be because of their paramedian technique and different demographic profile. In our study, the mean number of attempt was lower in Group U (1.06±0.25) than Group L (1.26±0.89) and p-value (0.039) was found to be significant. It may be due to better quality of images scanned by ultrasound and direct marking of space causing less number of attempts than blind landmark guided method. Similar to our study, Cristian Arzola *et al.* concluded that the anatomical landmarks were evaluated as good by palpation in only 81% of the patients, the puncture site as determined by Ultrasound was successful in 91.8% of the cases. We suggest that US may be helpful in reducing the number of attempts during epidural insertion compared with the conventional palpatory technique. Similarly Karthikeyan *et al*. also found out that the total number of attempts taken to perform spinal anaesthesia was more in case of landmark based palpatory technique than ultrasound guided technique. The mean value of landmark group was found to be 1.98±1.66 and that of ultrasound was 1.28±0.7. But this is in contrary to study done by Ansari *et al,* which showed no significant difference in the number of attempts. This could be due to the difference in the study population as they included only easily palpable spine patients.

The mean value of time taken for identifying landmark for Group U (126.9±9.31) was higher than Group L (25±7.08) and p-value (<0.05) was found to be significant. It can be explained by the fact that for better imaging and marking of lumbar spaces by using ultrasound takes more time as compared to landmark technique where it is done by just palpating the space. These findings were consistent with study done by Sangeeta Danger et al. They found out that the time for identification of interspinous space was significantly more in Ultrasound group (56.70±13.08secs) than landmark group (47.10±10.45secs). This may be due to difficulty in identifying a satisfactory acoustic window in ultrasound technique and more vertebral structures to be identified in various views to mark the space. The mean value of time taken for the procedure was higher in Group U (634.83±48.90) than Group L (458.93±41.15) and p-value (<0.05) was found to be significant. Similar to our study, Ansari *et al.* conclude that the use of ultrasound does not reduce the procedure time. This may be due to the fact that the time taken for identifying landmark takes more time because of various anatomical structures to be identified and our study population mainly involves old age patients with hip or knee arthritis in whom the positioning is difficult. This is in contrary to the study done by Sangeeta Danger *et al,* Karthikeyan *et al*, in which they showed decrease in time taken by ultrasound guided procedure. This may be due to the fact that they studied only on young obstetric population and performed only spinal anaesthesia as compared to combined spinal and epidural in our study. In our study, the mean periprocedural VAS score of pain in both groups were comparable. It may be due to the infiltration of local anaesthetics in the procedure site before the procedure. Sometimes during the attempt of CSE, due to the multiple attempts and passes, we experienced a lot of side effects right from periprocedural discomfort by pain, blood in the spinal needle, paraesthesia and radicular pain. Although we experienced difficulty in performing the procedure in some cases, but no case was converted into general anaesthesia in our study. There were many limitations in our study. There was no complete blinding in this study. We did not standardise the spinal procedure protocol, such as needle size used or provider experience level, as the procedure was performed by trainee anaesthetist. There is always a chance of misinterpretation of images scanned by the ultrasound like confusing an artefact with an anatomical structure or failure to scan a proper image of the ligamentumflavum due to anatomical obstruction.

Conclusion

The mean number of attempts and needle redirection in a single attempt were more in case of landmark group than ultrasound group. Hence we conclude that ultrasound guided marking of interspinous space is effective in decreasing number of redirection and attempts in combined spinal and epidural anaesthesia in patients undergoing THR/TKR. Although more time is required for identifying landmark in case of ultrasound guided technique, the imaging time gets better once we expertise the imaging technique. We suggest that more studies are needed in future to confirm this relationship.

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