

The Use Of Assisted Pre-Procedural Ultrasonography Versus Landmark Technique in Identifying Epidural Space in Women Requesting Labor Analgesia

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ABSTRACT

Objective: To compare whether the use of ultrasonography (USG) is superior to blind landmark technique in correctly identifying epidural space in pregnant patients requesting labor analgesia through epidural catheter.

Study Design: Prospective analytical study (IRCT20230819059186N1)

Place and Duration of Study: Anesthesia Department of Combined Military Hospital, Rawalpindi Pakistan from Apr 2023 to Oct 2023

Methodology: A total of 250 patients were included in the study protocol divided into Group U (n=125) and Group L (n=125). Primary variables measured were mean number of tries for epidural insertion (taking the needle out and then re-introduction), mean number of needle re-directions (without taking out from skin), difference between actual measured needle length (AML) versus USG measured needle length (UML) and number of dural punctures between the USG and landmark Group.

Results: Mean needle attempts of 1.27 ± 0.44 in Group U versus 1.74 ± 0.60 in Group L ($p < 0.001$). Success of needle attempts was in 91 (72.8%) patients in the first and 34 (27.2%) patients in the second attempt in Group U versus 43 (34.4%) patients in the first, 71 (56.8%) in the second and 11 (8.8%) in more than two attempts in Group L ($p = 0.022$). There was a statistically significant and positive co-relation between both measured lengths with a Pearson co-efficient (r) value of 0.828

Conclusion: We conclude that USG guided epidural insertion provides better rates of success in identifying epidural space as well as less chances of complications in parturients requiring labor analgesia.

Keywords: Analgesia, Epidural, Labour, Ultrasonography USG guided epidural.

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INTRODUCTION

Pregnancy is a life-changing experience for the female both physically and mentally¹. With the advent of modern practices in obstetrics and anesthesia, pain relief during labor has now taken paramount importance in ensuring best patient care and comfort². Studies have shown that poor pain management in previous pregnancies is associated with increased mental discomfort and patient apprehension in subsequent labor trials³. It becomes important to address the pain relief needs of parturient. It is now widely established that epidural analgesia used for painless labor provides superior comfort, excellent pain relief and is not associated with increased rates of caesarian section^{4, 5} and can be safely administered and offered to patients for best results⁶. One of the most common and effective methods of labor analgesia is the use of epidural anesthesia, which

involves the injection of a local anesthetic and an opioid into the epidural space of the spine. This blocks the transmission of pain signals from the lower part of the body to the brain, while allowing the patient to remain awake and alert⁷. Epidural anesthesia has many benefits for both the mother and the baby. It can reduce the stress and discomfort of labor, improve maternal satisfaction and well-being, lower the risk of postpartum depression and anxiety, and facilitate breastfeeding and bonding⁸. It can also reduce the need for other interventions, such as oxytocin augmentation, instrumental delivery, or cesarean section. For the baby, epidural anesthesia can improve oxygenation and blood flow, reduce fetal distress, and enhance neonatal outcomes⁹. The technique in practice and vogue in the past has been the blind landmark technique for insertion of the epidural catheter after confirmation of space usually done by the hanging drop method¹⁰. With the physiological changes in pregnancy resulting in lumbar lordosis, pre-sacral edema and laxity of ligaments, the chances of failure are increased due to complexity of the procedure and

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increased chances of complications. Our study aims to use the USG method to space identification and marking and compare the success rate and chances of adverse effects (dural puncture) between both the techniques used.

METHODOLOGY

This prospective analytical study was carried out at the Department of Anesthesiology, Combined Military Hospital from 19 Apr 2023-19 Oct 2023 after approval from the ethical review board vide letter no. 429 and IRCT Trial Id No. IRCT20230819059186N1. The minimum sample size required for both Groups was done using the WHO calculator keeping the confidence interval at 95%, margin of error at 5% with the success rate of the ultrasound technique at 80%¹¹ of the population proportion in correctly identifying the epidural space. Minimum sample sizes calculated was 245. We included 250 participants in our study protocol.

Inclusion Criteria: all ASA (American society of Anesthesiologists) I and II patients between 20-35 years of age presenting in labor after achieving term.

Exclusion Criteria: Patients with history of back pain, surgeries of the spine, on-going medical treatment for backache, patients unwilling to be included in the study, patients with coagulation disorders or on anti-coagulants and BMI greater than 35 kg/m².

The study method included all patients as per the inclusion criteria furnished. The patients were divided into the ultrasonography Group (Group U) (n=125) and the landmark Group (Group L) (n=125). Patients in both Groups received 500 ml normal saline as pre-load fluid in the recovery room and injection Ondansetron 4 mg an anti-emetic. All the patients were thoroughly counseled regarding the procedure.

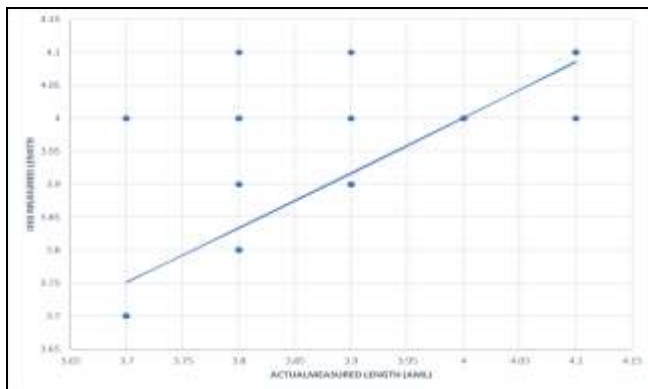


Figure: Correlation between USG Measured Length and Actual Needle Length (n=125)

Patients in Group L followed the standard blind landmark technique¹² for insertion of the epidural catheter in the L4-L5 space under strict aseptic measures in the procedure room in the sitting position. In case of dural puncture, the space above was then identified and epidural was inserted. Patients in Group U were also prepped in the recovery room under aseptic measures for the USG procedure. A standard curvy-linear probe was placed and the parasagittal view of the L5-S1 space was identified and L4-L5 space was identified by counting upwards. After correct placement and confirmation of the space, the probe was then rotated, and the transverse view was obtained. Epidural space was then identified between the ligamentum flavum and dural space. Using machine built-in measuring calipers, the depth of the space was measured and noted for each case. A vertical line was then drawn, and horizontal lines later joined at the exact level of space identification, and this was the point for needle insertion subsequently. Touhy needle was then insertion in the USG and was advanced till 0.5 mm less than the measured depth using the machine previously. Loss of resistance technique was then used to pierce the space and further confirmed by hanging drop method for re-confirmation. The length of needle at this point of insertion was then measured using a ruler. This was the actual measured needle length (AML) and was compared with the USG measured length (UML) later.

Primary variables measured were mean number of tries for epidural insertion (taking the needle out and then re-introduction), mean number of needle re-directions (without taking out from skin), difference between AML and UML and number of dural punctures between both Groups. Demographic data were statistically described in terms of mean and SD, frequencies, and percentages where appropriate. Independent samples t-test was used to compare mean values of outcome variables and demographic data between both Groups. Chi-square test was used to compare data frequencies. Pearson co-relation coefficient was used to establish a linear co-relation between measured and actual depth of epidural space in the USG Group. A *p* value of <0.05 was considered statistically significant. All statistical calculations were performed using Statistical Package for Social Sciences 26.0

RESULTS

A total of 250 patients were included in the study protocol divided into Group U (n=125) and Group L

(n=125). Mean age of patients in Group U was 27.82 ± 2.45 years versus 28.18 ± 2.43 in Group L ($p=0.076$). Mean weight was 74.62 ± 4.04 kg in Group U versus 74.82 ± 3.90 kg in Group L ($p=0.435$) (Table-I).

Table-I Demographic Characteristics of Study Participants (n=250)

Variables	U Group (n=125)	L Group (n=125)	p-value
Mean Age (Years)	27.82 ± 2.45	28.18 ± 2.43	0.076
Mean Weight (Kg)	74.62 ± 4.04	74.82 ± 3.90	0.435

Analysis of the primary variables revealed mean needle attempts of 1.27 ± 0.44 in Group U versus 1.74 ± 0.60 in Group L ($p<0.001$). Success of needle attempts was in 91(72.8%) patients in the first and 34(27.2%) patients in the second attempt in Group U versus 43(34.4%) patients in the first, 71(56.8%) in the second and 11(8.8%) in more than two attempts in Group L ($p=0.022$). Similarly, mean number of attempts at needle pass were 1.08 ± 0.27 in Group U versus 1.55 ± 0.49 in Group L ($p<0.001$). Success at first attempt for needle pass was seen in 115(92%) patients in Group U versus 56(44.8%) patients in Group L ($p=0.003$). The incidence of accidental dural puncture was not seen in any patient in Group U but was seen in 06(4.8%) patients in Group L (Table-II).

Table-II: Comparison of Primary Variables between Both Groups (n=250)

Variables	U Group (n=125)	L Group (n=125)	p value
Mean Number Of Needle Attempts	1.27 ± 0.44	1.74 ± 0.60	<0.001
Success In Identifying Epidural Space			
First Attempt	91(72.8%)	43(34.4%)	0.022
Second Attempt	34(27.2%)	71(56.8%)	
More Than 2 Attempts	00(0%)	11(8.8%)	
Mean Number Of Needle Passes	1.08 ± 0.27	1.55 ± 0.49	<0.001
Success At First Attempt For Needle Pass	115(92%)	56(44.8%)	0.003
Inadvertent Dural Punctures	00(0%)	06(4.8%)	-

In comparison between the USG measured length (UML) of the epidural space versus the actual measured needle length (AML), the mean length measured by USG was 3.86 ± 0.12 versus actual measured length once inserting the needle in the USG Group was 3.89 ± 0.12 . There was a statistically significant and positive co-relation between both measured lengths with a Pearson co-efficient (r) value of 0.828 (Figure).

DISCUSSION

The study was carried out at our demographic setup in parturients scheduled for trial of labor and requesting labor analgesia. Central neuraxial blockade

is now the mainstay and gold standard in alleviation of pain in the obstetric Group¹³. Spinal, epidural, and combined spinal-epidural techniques are now being used as both as providing anesthesia as well as analgesia in these patients¹⁴. The ordeal of pregnancy already has profound physical and mental effects on the mother and provision of a pain-free experience during childbirth provides the mother with mental satisfaction, decreases depression, and allows the mother and baby to bond and interact more effectively¹⁵. This results in better post-operative results with less complications and increased satisfaction on part of the new mother^{8,16}.

The modality of ultrasonography has revolutionized the practice and interventions done in anesthesia and is the mainstay of effective pain management¹⁷. Very few centers in our demographic area are using ultrasonography effectively and we wanted this study to make a benchmark in the routine use of the modality in providing patients with the best techniques at hand for successfully passing an epidural with minimal complications. Our study concluded that ultrasonography is superior to blind landmark technique in both the number of needle pricks as well as achieving the desired result in minimum needle passes required. Our results were similar to studies carried out in the past^{18,19}. The mean difference in the measured space by ultrasound and during actual procedure was 0.15 cm which can be attributed to the probe compression for the edema seen during pregnancy in these patients.

When talking about the adverse effect profile, the chances of accidental dural puncture were not seen in any patient of the ultrasound Group. This provides a breakthrough in decreasing post-operative complications especially post-dural puncture headache which causes considerable morbidity in patients. One pre-requisite that is required for effectively achieving these favorable results is the availability of trained and experienced staff for the ultrasound procedure. We employed anesthetists and pain specialists with a minimum 5-year experience with regional blocks. Studies have showed that untrained and inexperienced residents or even consultants when employed for ultrasound guided procedure, the results were not different than performing the procedure using blind landmark technique.¹⁹ The study recommends the use of USG guided technique as a superior modality in epidural insertion of parturients requiring labor analgesia.

CONCLUSION

We conclude that USG guided epidural insertion provides better rates of success in identifying epidural space as well as less chances of complications in parturients requiring labor analgesia.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SAAS & MRI: Data acquisition, data analysis, critical review, approval of the final version to be published.

RASK & GS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AYZ & SAQ: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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