Original Article

A prospective observational study of skin to subarachnoid space depth in pregnant females undergoing cesarean section at a district hospital in Nepal

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ABSTRACT

BACKGROUND

Correct placement of the spinal needle is crucial for spinal anesthesia. Due to physiological changes associated with pregnancy like weight gain and changes in the curvature of spine, performing spinal anesthesia may be difficult leading to multiple attempts, inadvertent nerve injuries and patient discomfort. So a pre-procedural estimation of the skin to subarachnoid space depth may be beneficial. This study aims to estimate the skin to subarachnoid space depth by using Ultrasound in pregnant females undergoing cesarean section under spinal anesthesia.

METHODS

This was a prospective, observational study conducted at a district hospital of Nepal in parturients undergoing cesarean section under spinal anesthesia. A pre-procedural ultrasound of lumbo-sacral spine was done by using 2-5 Hz curvilinear probe and skin to subarachnoid space depth (SSD) was measured at the level of L3-L4 using inbuilt calipers after which subarachnoid block was performed under all aseptic precautions.

RESULTS

Total patients included in the study were 50 pregnant females with mean age being 24.5 (± 8.56). The ultrasound estimated SSD was found to be 4.24 ± 0.48 cm.

CONCLUSIONS

Ultrasound estimated SSD in the study population was found to be 4.24 ± 0.48 cm which is almost same as the inserted length of spinal needle. So, use of ultrasound can be very helpful in performing subarachnoid block.

KEY WORDS

Pregnancy, Skin to subarachnoid space depth, spinal needle, subarachnoid block, ultrasound

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BACKGROUND

Spinal anesthesia, one of the commonly used techniques of regional anesthesia involves injection of local anesthetic agent into the subarachnoid space to block the spinal nerve roots running through it.1,2 As landmark is used as the method for identification of proper site of insertion of the needle to get the free flow of CSF before giving the local anesthetic agent, it may be associated with multiple attempts increasing patient discomfort which is more likely in patients with obesity, old age and spine deformity.2,3 Failure rates ranging from 3.1% to 9.1% to as high as 17% have been reported in previous studies. 4,5,6 So, an estimation of skin to subarachnoid space depth (SSD) prior to lumbar puncture may be helpful in selection of appropriate length of spinal needle to be inserted and thereby reducing the risk of traumatic or bloody lumbar puncture and unsuccessful and repeated attempts.7

Being a landmark guided procedure, spinal anesthesia has been known to be difficult to perform in patients with obesity or spinal deformities due to which various modifications 8,9 have been described to reduce the morbidity related to repeated attempts and needle passes. Ultrasound has been one of the recent advances known to reduce the morbidity associated with spinal anesthesia particularly in difficult patients and is commonly used as a preoperative assessment tool predicting the feasibility of neuraxial blockade in such patients.8

Various studies have been done in Indian and Western population to predict the skin to subarachnoid space depth (SSD) and evaluate the correlation between the pre-procedure SSD and the length of needle to be inserted.10,11,12 One study done by Sagar et al1 highlighted the correlation between the skin to subarachnoid space depth and the length of spinal needle to be inserted but this study excluded the parturient females. Therefore, this study aims to estimate the skin to subarachnoid space depth by using Ultrasound in pregnant females scheduled for cesarean section under spinal anesthesia and compare it with the inserted length of spinal needle.

METHODS

This prospective observational study was performed at one of the district hospital of Nepal after getting ethical clearance from NHRC and informed written consent in 50 consecutive ASA II pregnant females scheduled for elective cesarean section surgeries under subarachnoid block. The exclusion criteria were spinal deformity, obesity, bleeding diathesis, history of spine surgery and multiple attempts. Using a prefromed proforma demographic details of the patients who consented for the study were recorded. One day prior to the study, pre-anesthetic evaluation was done and the ultrasound of lumbar spine was performed using a Sonosite curved 2-5Hz array probe by a qualified anesthesiologist. After getting the desired view by careful manipulation of the probe (Figure 1), the distance from skin to subarachnoid space depth was measured by using the inbuilt caliper and this measurement was recorded. On the day of surgery, intravenous access was secured and preloading was done. After attaching the monitors and recording the baseline vitals, the same anesthesiologist who performed the ultrasound performed the subarachnoid block under all aseptic precaution with a 25G Quincke spinal needle. After free flow of CSF, the length of needle outside the skin was measured and this was subtracted from the standard length of the spinal needle which gave the length of spinal needle inserted. Both the lengths were recorded in the proforma.

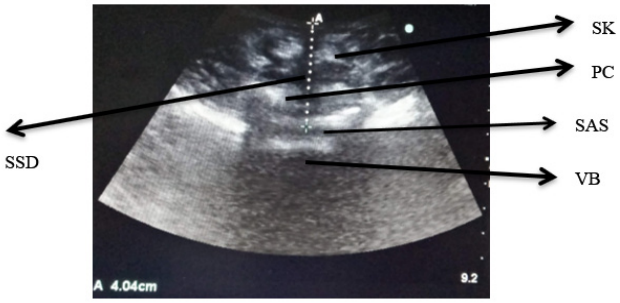

Figure 1. Measurement of Ultrasound-estimated SSD (SSD: Skin to subarachnoid space depth; SK: skin; PC: posterior complex; VB: vertebral body; SAS: subarachnoid space)

STATISTICAL ANALYSIS

Collected data were entered in and analyzed using statistical software IBM-SPSS (Statistical Package for Social Sciences) version 20.0. Analyzed data were presented as mean ± standard deviation for continuous variables and as numbers and percentages for categorical variables. Student's t-test was applied for continuous variables like age, weight, BMI and distance from skin to subarachnoid space using inserted length of needle and by using ultrasound. Paired t-test was used to measure the difference between ultrasound estimated SSD and the inserted length of needle. Analyzed data was presented in the form of tables, graphs and charts. The P-value of less than 0.05 was considered significant.

RESULTS

A total of fifty pregnant females who were scheduled for caesarean sections under spinal anaesthesia were enrolled in the study.The mean age of the study population was 24.50 ± 8.56 years. Similarly, mean BMI was 26.61 ± 4.91 kg/m2. The demographic details of the study population were presented in tabulated form (Table 1).

Table 1: Demographic data of the patients

Patient characteristics	(Mean ± SD) (N=50)
Age (yrs.)	24.50 ± 8.56
Weight (kg)	58.30 ± 9.94
Height (cm)	148.14 ± 9.86
BMI (kg/m2)	26.61 ± 4.91

The mean ultrasound estimated SSD was found to be 4.24 ± 0.48 cm (95% CI, 4.4126 to 4.0813).

Table 2: Ultrasound estimated SSD

SSD (N=50)	Mean ± SD	P-value
Female (N=50)	4.24 ± 0.48 cm	

The inserted length of spinal needle was measured which was found to 4.23 ± 0.46 cm (95% CI, 4.4007 to 4.0882).

Table 3: Inserted length of spinal needle

SSD (N=50)	Mean ± SD	P-value
Female (N=50)	4.23 ± 0.49 cm	

The two measured values were statistically analyzed and the difference between them was not found to be statistically significant (95% CI 0.04897 to -0.04397, p=0.914).

Table 4: Ultrasound estimated SSD and inserted length of spinal needle

	Ultrasound estimated SSD (cm) (Mean ± SD)	Inserted length of spinal needle (cm) (Mean ± SD)	P-value
SSD in overall population	4.24 ± 0.49	4.23 ± 0.46	0.914*

* Paired t-test

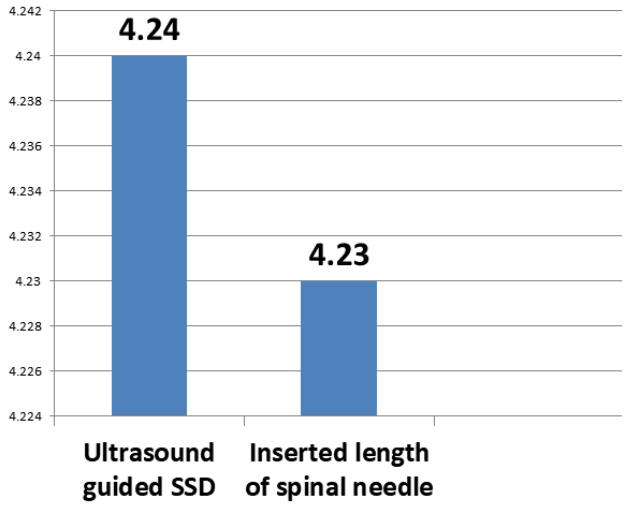

Figure 2. Ultrasound estimated SSD and inserted length of spinal needle

DISCUSSION

Correct identification of the bony landmark is very crucial for a successful subrachnoid block and Tuffier's line is used as an anatomical landmark which is believed to pass through the L4 vertebral body. 13-16

Despite the widespread use of ultrasound for various procedures17 like central line placement, peripheral nerve block, etc. use of ultrasound for spinal anesthesia has been confined only to patients with difficult identification of the intervertebral spaces due to obesity, spinal deformity or previous spinal surgeries. Pregnancy with the various physiological changes like increase in the subcutaneous fat and the changes in the curvature of spine may pose technical difficulties and lead to multiple punctures, unsuccessful attempts leading to increased patient discomfort.18 The use of ultrasound have been shown to improve rate of block success, improved the quality of anesthesia and has led to better patient satisfaction.19 An estimation of skin to subarachnoid space depth (SSD) prior to lumbar puncture will help in selection of appropriate length of spinal needle and further reduce the risk of traumatic or bloody puncture and decrease unsuccessful and repeated attempts. So, pre-puncture estimation of the SSD may be a good guide for accurate spinal needle placement.

Multiple studies done in the Western population have shown the efficacy of ultrasound in accurate estimation of skin to epidural space depth 20-21. One of the studies done in Nepalese population for the use of ultrasound for pre-procedural estimation of skin to subarachnoid space depth by Sagar et al1 excluded the parturient females. So, this study with the estimation of skin to subarachnoid space depth and correlation with inserted length of spinal needle, gives an idea about the SSD in parturient females.

In this study, the mean SSD in pregnant females based on the length of spinal needle inserted was found to be 4.23 ± 0.46 cm (95% CI, 4.4007 to 4.0882). Madhu KP22 found the SSD based on the length of spinal needle inserted to be 6.24±0.5650 cm. Similarly, Hazarika et al11 reported SSD to be 5.54 ± 0.64 cm. The finding of this study was less as compared to the above studies and this might be because of the anthropometric differences among the study populations. Similar findings were seen in studies done by Prakash et al10 (4.73 ± 0.73 cm). However, studies highlighting the ultrasound estimated SSD in parturient females are lacking.

Based on the findings of this study, there was no statistically significant difference between the two measured values (95% CI 0.04897 to -0.04397, p=0.914) which highlights the efficacy of ultrasound in performing subarachnoid block with success. Similar positive correlation between the two measured values have been documented in studies in Western population by Gnaho et al12 (r=0.982, p<0.05) and

Ferre et al25 (r=0.803, p=0.000). Furthermore Tyagi et al23, and Suttagati et al24 found the ultrasound estimated SSD to be significantly correlated with length of spinal needle inserted. However these studies have not differentiated the correlation among pregnant and non-pregnant females.

Small sample size, consideration of the midline approach only and use of the visual impression of needle being perpendicular to the skin without considering the angle of insertion are some of the limitations of the study.

CONCLUSION

The use of pre-procedural ultrasound in estimation of skin to subarachnoid space depth in parturient females can correctly predict the length of spinal needle to be inserted to get free flow of CSF thereby reducing the chances of multiple attempts, inadvertent nerve injuries and improve block success.

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