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Original Article

Study on Skin to Subarachnoid Space Depth of Pregnant and Nonpregnant Female in Cox's Bazar

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Abstract

Background: *During the procedure of sub subarachnoid block the anaesthesiologist has to face the challange of insertion of spinocain needle puncluring the skin through the tissues upto the subarachnoid space. The skin of subarachnoid space depth (SSD) varies considerably at different levels of spinal canal. It also varies from patient tyo patient at the same level as per age, sex and body mass index in pregnant and non pregnant women. To measure the skin to SSD among Non-Pregnant and pregnant women in our population. To compare and to derive a formula for predicting SSD.*

Materials and methods: *This prospective, observational study was carried out by the Department of Anesthesiology and Critical Care at Cox's Bazar Medical College Hospital from December 2021 to June 2022. Total of 224 female patients participated in this study. Non-pregnant women, and pregnant women were the two categories of patients. After doing a lumbar puncture, SSD (Subarachroid Space Depth) was measured. A method for predicting SSD was developed using statistical analysis, correlation, and study of the association between SSD and patient variables.*

Results: *The mean SSD was 5.03±0.74cm. SSD was substantially higher in the pregnant group (4.54±0.47cm) than in the female non-pregnant sample (4.32±0.45cm).*

Conclusion: *The SSD was dependent exclusively on BMI in both study groups. In our study, Craig's formula had the strongest correlation with the measured SSD.*

Key words: Lumbar puncture; Pregnant female; Subarachnoid space.

INTRODUCTION

Anesthesiologists frequently perform lumbar punctures to give spinal anesthesia. When injecting medications, proper spinal needle placement is essential. A pre-puncture estimation of skin to Subarachnoid Space Depth (SSD) may be used to guide spinal needle insertion in addition to anatomical knowledge and technical proficiency. Even after inserting the spinal needle farther than the recommended depth, if the cerebrospinal fluid cannot be obtained, it is likely offline and needs to be retrieved and redirected. Having an understanding of SSD would also help in choosing a spinal needle that is the right length. The identification of the subarachnoid space has usually been accomplished using an anatomical landmark gu.[1] Despite their value, surface anatomical landmarks are merely substitute markers. Both obese and oedematous people may have trouble palpating them. Landmark-based methods typically result in the inaccurate identification of a particular lumbar interspace because they do not account for all anatomical variations or anomalies.[2]

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Estimating the skin to Subarachnoid Space Depth (SSD) can help in spinal needle placement, resulting in a less painful or bloody lumbar puncture and reducing failed and repeated efforts that could worsen patient outcomes.[3] The SSD in a patient varies greatly at various spinal cord levels. In addition, the distance changes from patient to patient at the same vertebral level depending on the person's age, sex, and Body Mass Index (BMI).[4] According to a number of studies, BMI, body weight, height, the weight-to-height ratio and Body Surface Area (BSA) all

demonstrated statistically significant correlations with SSD.[5,6] Contrarily, these studies also showed that there is no relationship between age, gender, or ethnicity with SSD. Under spinal anesthesia, a variety of lower limb and lower abdomen procedures are carried out. Knowing in advance how deep to enter the needle to reach the subarachnoid area may help to minimize spinal anesthesia-related risks. However, for a minority of patients, such as those who are obese, elderly or have underlying structural spinal abnormalities, lumbar puncture can be difficult. The procedure is time-consuming, potentially painful, and frequently unsuccessful in these patients.[7] The chance of post-puncture headaches, neurological harm, and epidural hematoma rises with difficulty inserting the needle into the subarachnoid region. The most common causes of traumatic taps and dry taps, which are both defined as taps devoid of macroscopic blood, are improper needle placement or anterior needle advancement.[8]

There are very few research that concentrate on SSD in the Bangladeshi female population, despite the fact that many have concentrated on calculating SSD with various methodologies to enable the measurement of the skin to epidural distance for clinical practice in obstetric and pediatric population.[9,10] This study was conducted to evaluate the variation of SSD among pregnant female and non-pregnant female and to derive formulae for predicting SSD in a tertiary care hospital in Cox's Bazar.

MATERIALS AND METHODS

This prospective, observational study was carried out by the Department of Anesthesiology and Critical Care at Cox's Bazar Medical College from December 2021 to June 2022 after receiving the necessary approval from the regional ethical council. A total of 224 female patients between the ages of 18 to 60 years were included in this study. Exclusion criteria for the study included patients with neurological disorders, seizure disorders, spinal anomalies, low back pain, prior spine surgery, skin infections at the site of needle puncture, sepsis, neuraxial anesthetic drug allergies, coagulation disorders, associated medical conditions that were largely contraindicated to spinal anesthesia, pregnant patients with hypertensive disorders and patients in whom the paramedian approach of spinal anesthesia had to be used. Participants' informed consent was acquired. They were further divided into two groups, GROUP F (Containing 94 non-pregnant female patients) and GROUP PF (Containing 130 parturient female patients).

Patients were positioned under aseptic conditions, with their backs fully extended. The L3 and L4 intervertebral spaces were found using the palpatory approach, utilizing the Tuffier's line as a reference. The dura was punctured through the midline route with a 25-gauge Quincke spinal needle that was 3.5 inches long. The cerebrospinal fluid started to flow easily once the spinal needle was put perpendicular to the skin and proceeded until there was barely any resistance left. The dose of intrathecal local anesthetic was chosen based on the patient's characteristics and the surgical requirement. The spinal needle was firmly held with the patient's back between the thumb and index finger after the intrathecal injection was given, marked with a sterile skin-marking pen, and then withdrew. The depth of insertion was then measured and recorded using a standard scale.

The updated formulas of Abe, Bonadio, Craig, Stocker, and Chong were individually applied to each patient in order to estimate expected SSD across the entire population. the amount determined in millimeters using Stocker's formula and converted to centimeters for comparison. The formulars are listed below:

- Abe's formula [11]: SSD (cm) =17 weight (kg)/height (cm) +1,
- Bonadio's formula [12]: SSD (cm) =0.77 cm + 2.56 × BSA (m2),
- Craig's formula [13]: SSD (cm) =0.03 cm × height (cm),
- Stocker's formula [14]: SSD (mm) =0.5 × weight (kg)+18
- Chong's modified formula [15]: SSD (cm) =10 [weight(kg)/height (cm)] +1

For statistical analysis, clean coded data was entered into Microsoft Excel and exported to SPSS version 22. Sentences, graphs, tables, frequencies, percentages, and the mean and standard deviation were all used to describe the descriptive statistical analysis. In a descriptive study, the variable frequencies were utilized to calculate the 95% Confidence Intervals (CIs). Incomplete surveys were excluded from the statistical analysis. Statistical significance in multivariable logistic regression was set at $p < 0.05$.

RESULTS

A total of 224 individuals had participated in this study, of whom 94 were non-pregnant and 130 were pregnant females. There were no adverse effects recorded during the procedures or 48 hours afterward. The mean age of the study population was 33.37 years. The mean height and weight for the study population were 158.57cm and 62.99kg respectively. Table I, displays patient characteristics and SSD in the total study population.

Table I Patient characteristics and SSD

Variables	Mean ± Std. Deviation (n=224)
Age (Years)	29.79±10.76
Height (cm)	154.82±5.99
Weight (kg)	60.99±11.78
BMI (kg/m2)	25.48±4.62
BSA (m2)	1.61±0.17
Skin to subarachnoid space depth (cm)	
Observed	5.03±0.74
Predicted-Craig	4.92±0.25
Predicted-Abe	7.35±1.24
Predicted-Bonadio	4.95±0.72
Predicted-Stocker	4.73±0.68
Predicted-Chong modified	4.76±0.63

The study populations were further divided into two groups, GROUP F (Containing 94 non-pregnant female patients) and GROUP PF (Containing 130 pregnant female patients).

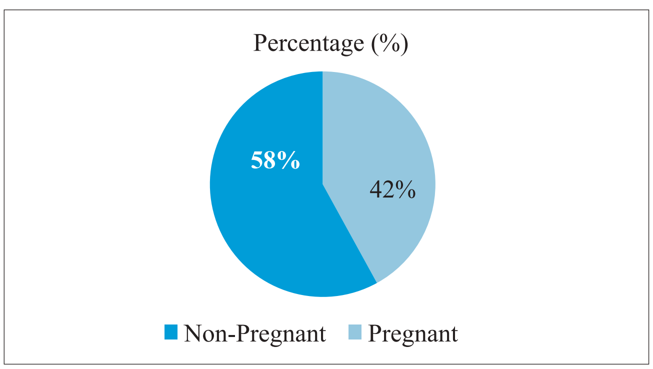

Figure 1 Two groups of study population

Tables II demonstrate, the patient characteristics and SSD for the two groups (Non-pregnant and pregnant females). When compared the non-pregnant and pregnant female groups separately, the pregnant patient's group's height, weight, BSA, actual measured SDD and calculated SSD by Abe's, Bonadio's, Stocker's, Craig's and Chong's modified formulae were all significantly higher and there were no significant differences between the two groups.

Table II Characteristics of the two study groups

Variables	Non-pregnant group (n=94)	Pregnant group (n=130)	p-value
Age (Years)	35.77±13.51	25.47±4.87	0.002**
Height (cm)	154.10±6.16	155.34±5.88	0.005**
Weight (kg)	56.03±10.57	64.57±11.34	0.013
BMI (kg/m2)	23.57±4.14	26.86±4.47	0.009
BSA (m2)	1.54±0.16	1.66±0.16	0.015
Skin to subarachnoid space depth,observed and predicted			
Observed	4.32±0.45	4.54±0.47	0.001**
Predicted-Craig	4.16±0.70	4.60±0.79	0.021
Predicted-Abe	4.23±0.21	4.15±0.29	0.003**
Predicted-Bonadio	5.46±1.71	5.73±1.73	0.020
Predicted-Stocker	4.54±1.20	4.67±0.65	0.003**
Predicted-Chong modified	4.30±1.15	4.21±1.23	0.015

SSD is influenced by age, weight, height, BMI, and BSA, which were all identified as confounders using a multivariate regression analysis [Table III]. In both the non-pregnant group and the pregnant group, SDD showed significant associations with BMI, weight, and BSA.

Table III Multivariate regression analysis to determine covariates that influence SSD

Group	Non-pregnant group		Pregnant group	
	Regression coefficient	p-value	Regression coefficient	p-value
Constant	13.8		0.080	
Height	-0.022	0.110	-0.002	0.752
BSA	-0.017	0.877	1.75	0.049
BMI	-0.026	0.553	0.05	0.14

Table IV shows the formulas created by our study to predict SSD in the general population and in the two study groups

Table IV Formula derived from our study

Group	Formula
Overall population	2.1 + (0.009 × height) + (0.03 × weight) + (0.02 ×BMI) + (0.15× BSA)
Non-pregnant female	3.8+0.02 × weight 0.02 × BSA 0.17 × BMI
Pregnant female	0.08+ (1.75 × BSA) + (0.05 × BMI) (0.002 × height)

DISCUSSION

In order to minimize difficulties during the treatment, the current study concentrated on quantifying the distance between the skin and the subarachnoid space and predicted its model with an emphasis on the ideal depth of spinal needles to be implanted on patients' lumbers.In our entire study sample, the mean SSD was 5.03±0.74cm. SSD was substantially higher in the pregnant group (4.54±0.47cm) than in the female non-pregnant sample (4.32±0.45cm).

Both pregnant women and the general population showed favorable correlations between SSD and Body Mass Index (BMI). In comparison to the population of the West, the SSD in our subjects is shorter. While the mean SSD in our population is 5.01±0.73cm, Basgul et al. reported that it was 5.40 ± 0.66cm. Bassiakou et al. found SSD in parturients to be 6.5 ± 1.2 cm which is 1.98 cm longer than that observed in our parturient.[11,12] When compared the adult non-pregnant and adult pregnant female patients separately, the SSD was noticeably longer in the adult pregnant patient.

In this study, formulas for determining SSD in the general adult population, including pregnant women and non-pregnant women, were developed using height, weight, BMI, and BSA. Other out-of-date equations were based on pediatric population studies, such those by Bonadio et al., Craig et al., Stocker and Bonsu, and Chong et al.[13-16] But utilizing computed tomography scans on adult patients, Abe et al. devised a method for predicting SSD from lumbar puncture depth.[17]

The Craig et al. formula, which was tested on our sutdy population, came the closest and is only 0.15 cm longer than the actual observed distance.[14] It is renowned for being uncomplicated, easy to remember and use height as the sole variable. The results of this investigation, which corroborate those of Bassiakou et al. who also noted a connection between SSD, BMI and body weight in all patients, demonstrate that BMI has a significant impact on SSD in both the general population and two groups.[12]

CONCLUSION

SSD in pregnant women was much higher than in non-pregnant women. Only BMI had any bearing on SSD in either research group.

DISCLOSURE

All the authors declared no competing interest.

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