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Original Research Article

PRE-SPINAL ASSESSMENT OF SPINE ANATOMY WITH ULTRASONOGRAPHY IN CLASSICAL SITTING V/S CROSSED LEG SITTING POSITION IN PATIENTS UNDERGOING BELOW UMBILICAL SURGERIES

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ABSTRACT

Background: Conventionally, anaesthesiologists determine the appropriate lumbar intervertebral space using palpable surface anatomical landmarks. Ultrasound examination allows visualization of key spinal anatomical structures before performing the spinal anaesthesia. Therefore, the present study is designed to compare the classical sitting position and the crossed-leg sitting position using ultrasonography to determine which position provides better anatomical visualization for spinal anaesthesia in patients undergoing surgeries below the umbilicus.
Materials and Methods: This prospective comparative study was conducted in patients of age between 18-60 years scheduled for elective below umbilical surgeries under spinal anesthesia. Patients were randomly allocated into one of the following groups of 45 each. Group 1-CSP - Patients in classical sitting position, Group2- CLSP - Patients in crossed leg sitting position. A low-frequency curved ultrasound probe was used to scan the lumbar spine longitudinally in midline and paramedian oblique plane. The following parameters were recorded in L3-L4, L4-L5, L5-S1S spaces- Interspinous space, Inter laminar space, Skin to ligamentum flavum distance.
Results: Group 2 showed a significantly larger interspinous space and interlaminar space at all lumbar levels (L3–L4, L4–L5, and L5–S1) when compared with Group 1 ($p < 0.001$). The mean skin-to-ligamentum flavum distance was also greater in Group 2 at each level with statistical significance ($p < 0.001$). A higher proportion of patients in Group 2 achieved successful spinal anesthesia on the first attempt (66.7%) compared to Group 1.
Conclusion: Pre-spinal ultrasonographic assessment revealed that patient positioning significantly influences visualization of lumbar spine anatomy. The crossed-leg sitting position demonstrated better widening of interspinous spaces and clearer anatomical landmarks compared to the classical sitting position.
Keywords: Spinal anesthesia, Ultrasonography, Lumbar spine, Classical sitting position, Crossed-leg sitting position.

INTRODUCTION

Spinal anaesthesia is a frequently employed regional anaesthetic technique for surgical procedures involving the lower abdomen, pelvis, perineum, and lower limbs. Conventionally, anaesthesiologists determine the appropriate lumbar intervertebral space using palpable surface anatomical landmarks. Although this technique is widely practiced, accurate identification of the correct spinal level may be difficult in certain patients, particularly in individuals with obesity, advanced age, or poorly palpable spinal landmarks.[1] In such situations, repeated attempts at needle insertion may be required, which can increase patient discomfort, prolong the procedure, and potentially increase the risk of complications.[2,3,4] With advances in imaging technology, ultrasonography has become increasingly useful in the practice of regional anaesthesia. Ultrasound examination allows visualization of key spinal anatomical structures such as the spinous processes, laminae, interspinous spaces, and posterior complex before performing the neuraxial block.[5,6,7,8]

Patient posture during the procedure is another important factor influencing the ease of spinal needle placement. Adequate flexion of the lumbar spine helps widen the interspinous spaces, making needle insertion easier. The conventional sitting position is commonly used during spinal anaesthesia; however, the crossed-leg sitting position may promote greater lumbar flexion and improved exposure of the lumbar intervertebral spaces.[9] Despite these potential benefits, only limited studies have evaluated and compared these two positions using ultrasonographic assessment of spinal anatomy. Therefore, the present study is designed to compare the classical sitting position and the crossed-leg sitting position using ultrasonography to determine which position provides better anatomical visualization for spinal anaesthesia in patients undergoing surgeries below the umbilicus.

MATERIALS AND METHODS

This prospective comparative study was conducted in 90 patients of age between 18-60 years scheduled for elective below umbilical surgeries under spinal anesthesia. Sample size was calculated based on previous studies comparing interspinous distance in classical versus crossed-leg sitting positions. Using mean difference of 1.3 mm, standard deviation of 1.5 mm, $\alpha = 0.05$, and power 80%, the minimum required sample size per group was 45 patients. Patients belonging to ASA 1 and ASA 2 were enrolled after obtaining institutional ethical committee clearance and informed consent. Patients not willing for the procedure, patients with history of spine surgery, patients with lumbar hernia, scoliosis and lower back pain or trauma, patients with pelvic and knee problem related to arthropathy were excluded. Patients were randomly allocated into one of the following groups of 45 each.

Group 1-CSP - Patients in classical sitting position (legs extended, the forearms held on laps and hands on the knees)

Group2- CLSP - Patients in crossed leg sitting position (legs crossed, the forearms on the laps, the hands are positioned on knees)

Patients will be taken on the operation table and standard ASA monitors will be connected. Preoperative heart rate and systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, oxygen saturation, electrocardiogram are recorded. Intravenous line will be secured and appropriate intravenous fluid is started. Group CSP patients are made to sit with legs extended, the forearms held on laps and hands on the knees. In Group CLSP, the patients' legs are crossed, the forearms on the laps, the hands are positioned on knees.

All the examinations are done by experienced anaesthesiologist. All sonographic examinations are done using USG machine GELogic C-5 after applying hydrophilic ultrasound transmission gel. A curved array transducer will be initially placed longitudinally over the spine in the midline to get a median sagittal spinous process view. The crescent shaped hyperechoic reflections of the spinous processes and the Inter spinous space (ISS) is identified. The transducer will be moved caudally to visualize the sacrum, and a gap seen between the sacrum and the spinous process of the L5 vertebra is L5–S1 ISS. The L4–L5 and L3–L4 ISSs will be located by counting upwards while moving the transducer in a cranial direction. Inter spinous space will be measured as the distance between the lower border of the upper spinous process and the upper border of the lower spinous process and is measured in the median sagittal interspinous view.

The transducer will be then placed in the paramedian sagittal oblique plane to visualize the L5–S1, L4–L5 and L3–L4 spaces. The L5–S1, L4–L5 and L3–L4 Inter laminar spaces will be located by counting upwards after identifying the sacrum. The interlaminar space (ILS) will be measured from the upper lamina's lower border to the lower lamina's upper border. Skin to Ligamentum Flavum(S-LF) distance will be measured from the skin to the outer border of the LF–dura mater unit. All the measurements will be taken with the aid of a built-in calliper. The following parameters were recorded in L3-L4, L4-L5, L5-S1S spaces- Interspinous space, Inter laminar space, Skin to ligamentum flavum distance.

After the anatomical measurement calculations using ultra sonography, under strict aseptic precautions lumbar spinous process and interspinous spaces will be palpated and identified in CSP and CLSP respectively. Then spinal anaesthesia is performed using the 0.5% hyperbaric bupivacaine administrated through 25G Quincke Babcock Spinal needle and patient made to lie. Level and onset of the neuraxial blockade is assessed by temperature change which is detected by wetted alcohol sponge, and the level of sensory loss by ability to detect sensation of pinpricks and motor block by the Modified Bromage scale. Patients were monitored for haemodynamic stability throughout the surgery. Single attempt for successful spinal needle placement, number and block failure is assessed between two groups.

Statistical analysis was performed using Software: SPSS version 23.0 (IBM). Continuous variables were compared using independent t-test. Categorical variables were compared using Chi-square. Significance Level: $p < 0.05$ considered statistically significant.

RESULTS

In the present study, both groups were comparable with respect to demographic characteristics. The mean age in Group 1 was 37.91 ± 14.26 years compared with 38.68 ± 12.94 years in Group 2, and the difference was not statistically significant. Similarly, there were no significant differences between the two groups with regard to sex distribution, ASA physical status, body weight, height and BMI. Baseline hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and oxygen saturation were also comparable between the two groups.

The comparison of interspinous space (ISS) measurements showed a highly statistically significant difference at the L3–L4 and L4–L5 levels and L5-S1 Level ($p < 0.001$). The mean ISS values were higher in CLSP group at all 3 levels, indicating a clear increase in space as shown in table 1. The analysis of interlaminar space (ILS) measurements demonstrated a statistically significant difference at all three lumbar levels assessed ($p < 0.001$). At L3–L4, L4–L5, and L4–S1, the mean ILS values were consistently higher in the CLSP group, indicating better widening of the interlaminar space under that condition as shown in table 2.

Table 1: Comparison of inter spinous space

ISS (in cm)	GROUP 1, n=45 Mean (SD)	GROUP 2, n=45 Mean (SD)	P VALUE
L3-L4	0.952(0.093)	1.372(0.061)	<0.001
L4-L5	0.946(0.077)	1.350(0.053)	<0.001
L5-S1	0.888(0.097)	1.403(0.44)	<0.001

Table 2: Comarision of Inter Laminar Space

ILS in cm	GROUP 1, n=45 Mean (SD)	GROUP 2, n=45 Mean (SD)	P value
L3-L4	1.042(0.028)	1.235(0.068)	<0.001
L4-L5	1.076(0.029)	1.263(0.163)	<0.001
L5-S1	1.056(0.053)	1.253(0.058)	<0.001

The comparison of skin-to-ligamentum flavum (SLF) distance showed a statistically significant difference at the L3–L4 and L4–L5 levels ($p < 0.001$) as shown in table 3, indicating a definite change between the two conditions at these segments. The mean SLF distance was slightly higher in the second measurement group at both levels, suggesting a mild increase in depth. At the L5–S1 level, although the p value was 0.001 (statistically significant), the very large standard deviation indicates high variability in measurements. Overall, positional influence was more consistent and reliable at the upper lumbar levels compared to L5–S1.

Table 3: Comarision of skin to Ligamemtum Flavum Distance

ILS in cm	GROUP 1, n=45 Mean (SD)	GROUP 2, n=45 Mean (SD)	P value
L3-L4	3.87(0.15)	3.96(0.09)	<0.001
L4-L5	3.92(0.14)	4.08(0.08)	<0.001
L5-S1	3.95(0.13)	4.20(0.05)	<0.001

Table 4 shows a significantly higher first-attempt success rate in the crossed-leg sitting position (66.7%) compared with the classical sitting position (33.3%), with a statistically significant difference between the two groups ($p = 0.006$). Table 5 shows that although the frequency of block failure was lower in Group 2 compared to Group 1, the difference between the groups was not statistically significant ($p = 0.266$).

Table 4: Comparision of successful procedure in first attempt

SUCCESSFUL PROCEDURE IN FIRST ATTEMPT	Frequency (%) n=45	Frequency (%) n=45	P Value
Group 1	15(33.3%)	29(64.4%)	0.006
Group 2	30(66.7%)	16(35.6%)	

Table 5: Comparition of block failure

BLOCK FAILURE	Frequency (%) n=45	Frequency (%) n=45	P Value
Group 1	6(13.3%)	39(86.7%)	0.266
Group 2	2(4.4%)	43(95.6%)	

DISCUSSION

The present study was done to compare the anatomical characteristics of the lumbar spine using ultrasonography in the classical sitting position (CSP) and crossed leg sitting position (CLSP) in patients undergoing below-umbilical surgeries. Our findings show that the two study groups were demographically comparable, thereby minimizing the influence of confounding variables on the outcome measures. Comparable baseline characteristics indicate observed differences in spinal anatomical measurements or procedural outcomes are more likely attributable to the difference in patient positioning rather than demographic factors. Several studies have demonstrated that ultrasound assisted neuraxial techniques improve first-attempt success and reduce the number of needle pricks when compared with conventional landmark-based techniques.[10]

The observed increase in interspinous distance in the crossed-leg sitting position can be explained by biomechanical changes in the lumbar spine. Crossing the legs tends to tilt the pelvis posteriorly and reduce lumbar lordosis, thereby promoting lumbar flexion. Increased flexion of the lumbar spine separates the adjacent spinous processes and enlarges the interspinous gap, which may facilitate easier needle insertion during spinal anesthesia. Another important parameter assessed in the present study was the interlaminar space. The study demonstrated a statistically significant increase in the interlaminar space measurements in the crossed leg sitting position. A wider interlaminar space provides a larger anatomical window for needle passage and reduces the likelihood of needle contact with bone. The SLF distance was slightly greater in the crossed-leg sitting position compared with the classical sitting position at all lumbar levels, and the difference was statistically significant. Although the increase in depth was relatively small, it may reflect changes in spinal curvature and soft tissue distribution associated with the crossed-leg posture.

A clinically important outcome evaluated in the present study was the success of spinal anaesthesia on the first attempt. The improved success rate observed in the crossed-leg sitting position may be attributed to the increased interspinous and interlaminar spaces demonstrated in the ultrasonographic measurements. A larger anatomical window allows easier needle passage and reduces the need for repeated attempts or needle redirections. Reduced needle attempts are beneficial not only for procedural efficiency and also for patient comfort and safety. Block failure was also evaluated in this study. The relatively lower incidence of block failure in Group CLSP may be attributed to better positioning and improved identification of the intervertebral space, which facilitates easier needle placement and enhances the success rate of spinal anesthesia.

Several authors have highlighted that optimization of patient positioning combined with ultrasound guidance can significantly improve the ease of spinal needle placement and reduce procedure-related complications.[11,12] Furthermore, several studies have highlighted that combining optimal patient positioning with ultrasound guidance may enhance procedural success and minimize complications during neuraxial anesthesia.[13]

Overall, the present study demonstrates that the crossed-leg sitting position provides superior widening of the interspinous and interlaminar spaces compared with the classical sitting position. These anatomical advantages were associated with a higher first-attempt success rate of spinal anesthesia. The use of pre-procedural ultrasonography further enhances visualization of spinal anatomy and may contribute to safer and more efficient neuraxial block performance.

CONCLUSION

Pre-spinal ultrasonographic assessment revealed that patient positioning significantly influences visualization of lumbar spine anatomy. The crossed-leg sitting position demonstrated better widening of interspinous spaces and clearer anatomical landmarks compared to the classical sitting position. Incorporating ultrasonography before spinal anesthesia can enhance precision and potentially reduce multiple needle attempts. The crossed-leg sitting posture may serve as a simple, practical modification to improve procedural success, particularly in patients with difficult spinal anatomy.

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