

ORIGINAL RESEARCH

Optimum Positioning For Obstetric Sub-Arachnoid Block: A Randomized Controlled Study

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ABSTRACT

Background: Subarachnoid block (SAB) is the preferred anaesthetic technique for Caesarean sections due to its rapid onset, safety, and minimal foetal exposure. Patient positioning is critical for successful dural puncture. This study evaluates the efficacy and comfort of a novel sitting position (knee-flexed with a 30 cm pillow under the knees) compared to the conventional sitting position (legs extended) in parturients. **Methods:** This prospective, interventional, controlled study was conducted at ESI PGIMS, Manicktala from February 2020 to April 2021, involving 122 ASA II parturients undergoing elective Caesarean section under spinal anaesthesia. Participants were randomly allocated into two groups: control (traditional positioning) and experimental (new positioning with a pillow under the knees). Lumbar interspinous distances at L3–L4 and L4–L5, posterior dura visibility, number of needle passes and attempts, and patient comfort (Likert scale) were recorded. Ultrasonography guided spinal needle placement. Statistical analyses were performed using SPSS v27.0 and JASP v0.11.1. **Results:** Demographic parameters (age, height, weight, BMI) were comparable between groups ($p > 0.05$). No statistically significant difference was found in interspinous distances, posterior dura visibility, number of needle passes, or attempts between the two groups ($p > 0.05$). Comfort during positioning was significantly higher in the experimental group ($p < 0.05$), although overall procedural comfort did not differ significantly. The new positioning did not reduce lumbar lordosis or improve needle passage success. **Conclusion:** The novel knee-flexed sitting position with a pillow under the knees provided superior positioning comfort without compromising the technical aspects of spinal anaesthesia. However, it did not significantly improve interspinous space or reduce the number of needle passes or attempts. Further studies with larger, more diverse populations are recommended to validate these findings.

Keywords: Subarachnoid block, spinal anaesthesia, patient positioning, lumbar puncture, Caesarean section, ultrasonography, interspinous distance, parturients.

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INTRODUCTION

Currently, the most prevalent major surgical procedure in the United States is Caesarean delivery, constituting over 30% of all births and nearly 1 million operations annually [1]. The global incidence of Caesarean deliveries has risen steadily. Nonetheless, there exists a significant variance ranging from 0.4% to 45.9%. [2] Maternal, obstetric, foetal, medico-legal, and social factors compromise this heterogeneity, affecting the differing rates even within individual obstetricians and institutions. [3]

The patient's positioning during a subarachnoid block significantly influences its efficacy. The typical positions for parturients undergoing subarachnoid blocks are sitting or lateral positions. [4, 5] The spinal

markers may be readily discerned in seated situations, making them preferable for fat parturients. [6] The sitting position will diminish spinal lordosis associated with pregnancy and facilitate spinal puncture. The crossed leg sitting position (CLSP) is a newly acknowledged alternate posture suggested for use during regional anaesthesia. [7]

Additional benefits of employing a sub-arachnoid block encompass the technique's simplicity, swift onset, cost efficiency, and the use of minimal medication volume and concentration, all while ensuring enough muscular relaxation during operation. The aforementioned reasons render this the preferred procedure for the majority of elective caesarean sections. The sub-arachnoid block is

characterised by less absorption of local anaesthetic into the maternal circulation, resulting in reduced foetal exposure [6, 7].

Therefore, an essential aspect that affects the outcome of lumbar dural puncture for this block is optimal patient posture. Published literature recommends putting the patient in the 'knee-chest position,' which involves hip and knee flexion, to optimise lumbar flexion, hence increasing the interspinous space between adjacent lumbar spinous processes and facilitating spinal needle insertion. The knee-chest position is impractical for the term parturient because of the gravid uterus.

Ultrasonography has been increasingly popular among anaesthesiologists in recent years. It is extensively utilised for regional blocks and central venous catheterisation. Ultrasonography for neuraxial blocks proved advantageous, particularly in identifying the appropriate needle insertion site and assessing the depth of needle penetration into the epidural area. Numerous recent studies have assessed ultrasound-guided epidural and spinal blocks in obstetric patients [8, 9]. Imaging investigations have shown that flexion of the lumbar spine and hip-knee flexion augment the lumbar inter-spinous distance [10]. Limited research has assessed the impact of different positioning techniques for parturients on the success and ease of dural puncture during spinal anaesthesia for subarachnoid block.

Therefore, in this study, we want to assess the effectiveness of a novel positioning technique for the parturient during subarachnoid block in comparison to the conventional spine-flexed sitting position with legs extended on the operating table.

METHODOLOGY

The present study was a suggested interventional prospective controlled study conducted at the Department of Anaesthesiology at ESI PGIMSR, Manicktala from February 2020 to April 2021.

The study spanned 12 months, including data collection, analysis, manuscript preparation, and final submission. A total of 122 pregnant women scheduled for Caesarean section under spinal anaesthesia were enlisted, including 61 participants in both the experimental and control groups. Informed written consent was secured from all individuals prior to commencing any procedure. The inclusion criteria targeted parturients scheduled for spinal anaesthesia, whereas the exclusion criteria encompassed patients with lumbar site infections, abnormal coagulation, specific obstetric complications (such as eclampsia or antepartum haemorrhage), ASA physical status III or higher, spinal deformities, pre-existing neurological deficits, or severe foetal distress.

The experimental group utilised an innovative positioning technique that involved a 30 cm high pillow positioned beneath the knees to enhance hip and knee flexion, subsequently placing the parturient in an upright seated posture with a flexed spine on the

operation table. The control group was assigned the conventional seated position. Precautions were implemented to prevent any axial torsion or lateral spinal flexion during placement. Lumbar interspinous distances at L4/5 and L3/4 were assessed utilising static ultrasonography (USG) with a curved low-frequency transducer. Upon visibility of the posterior dura, the site was designated for dural puncture utilising a 25G Quincke spinal needle under aseptic conditions. If the dura was not visible, the individual was excluded, and spinal anaesthesia was provided via a paramedian route or general anaesthesia if required. The primary outcomes encompassed the percentage of initial dura punctures, mean needle passes necessary, total tries made, and patient comfort rated on a 1–5 Likert scale. Observer and operator biases were mitigated through random allocation via dice rolls. Information was inputted into a secure, time-stamped, tamper-resistant Google Form and stored on a remote server utilising SSL/TLS encryption. Statistical analysis was conducted with JASP version 0.11.1.

RESULT

Data were initially input into a Microsoft Excel spreadsheet and subsequently analysed using SPSS version 27.0 for statistical analysis. Continuous values were summarised by mean and standard deviation, whilst categorical variables were represented as counts and percentages. Normality was assessed using the Shapiro-Wilk test, complemented by visual evaluations of histograms and Q-Q plots, as well as computations of skewness and kurtosis. Levene's Test was employed to evaluate the homogeneity of variance. Normally distributed variables with homogenous variances were analysed using the independent samples t-test, while non-normally distributed or ordinal variables were assessed using the Mann-Whitney U test or Kolmogorov-Smirnov test. Categorical variables were examined via Chi-square or Fisher's Exact Test if applicable, with a p-value ≤ 0.05 being statistically significant. Demographic characteristics, including age, height, and weight, had a normal distribution in both groups and were comparable, with no significant differences ($p > 0.05$), as assessed by independent samples t-test. The interspinous distances at L4–L5 and L3–L4, along with the length of the posterior dura at L3–L4, had a non-normal distribution; Mann-Whitney U tests revealed no significant differences between the groups at these levels ($p > 0.05$), suggesting similar distributions. The length of the posterior dura at L4–L5 exhibited a normal distribution and was comparable between both groups ($p > 0.05$). Chi-square analysis indicated no statistically significant difference in the proportion of successful first-pass dural punctures between the groups ($p > 0.05$). The total needle passes had a non-normal distribution but were statistically equivalent according to the Mann-Whitney U test ($p > 0.05$).

Patient comfort scores, evaluated by a Likert scale, demonstrated a statistically significant disparity between groups as determined by the Mann-Whitney U test ($p < 0.05$), indicating varying distributions of comfort levels. Subsequent research employing median tests, the Kolmogorov-Smirnov test, and Moses' test revealed no significant disparity in

median comfort values, suggesting that the central tendency of comfort scores was uniform across groups. The statistical data indicate similar baseline features and procedural outcomes for the two positioning approaches, with a significant exception in the distribution (but not the median) of comfort scores.

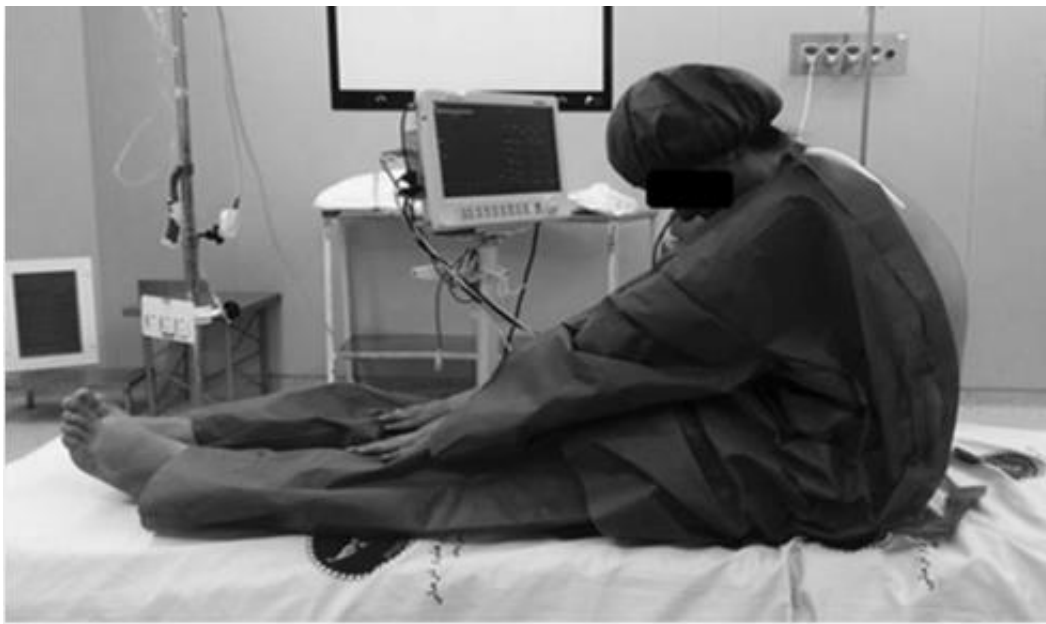


Figure 1: Spine-flexed sitting position with legs extended on the OT table



Figure 2: Spine-flexed sitting on the edge of the OT table with legs supported



Figure 3: Lateral lying down position with spine-flexed



Figure 4: A 30 cm high pillow put underneath the knees to achieve both knee and hip flexion and then the parturient made to sit up in spine-flexed position on the OT table.

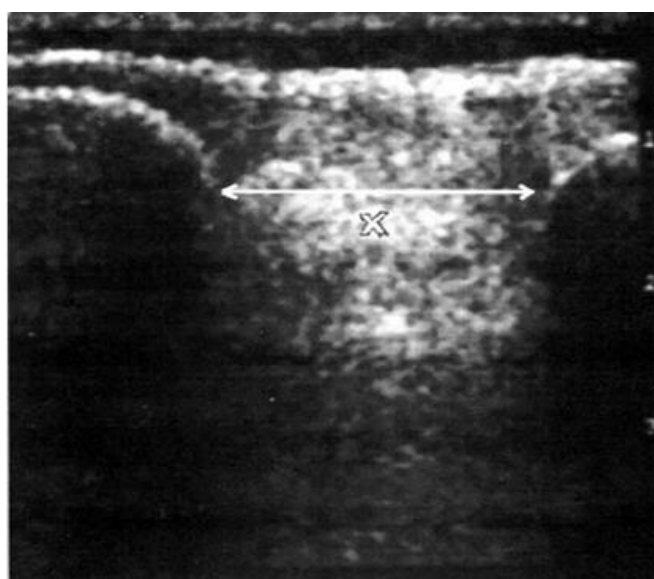
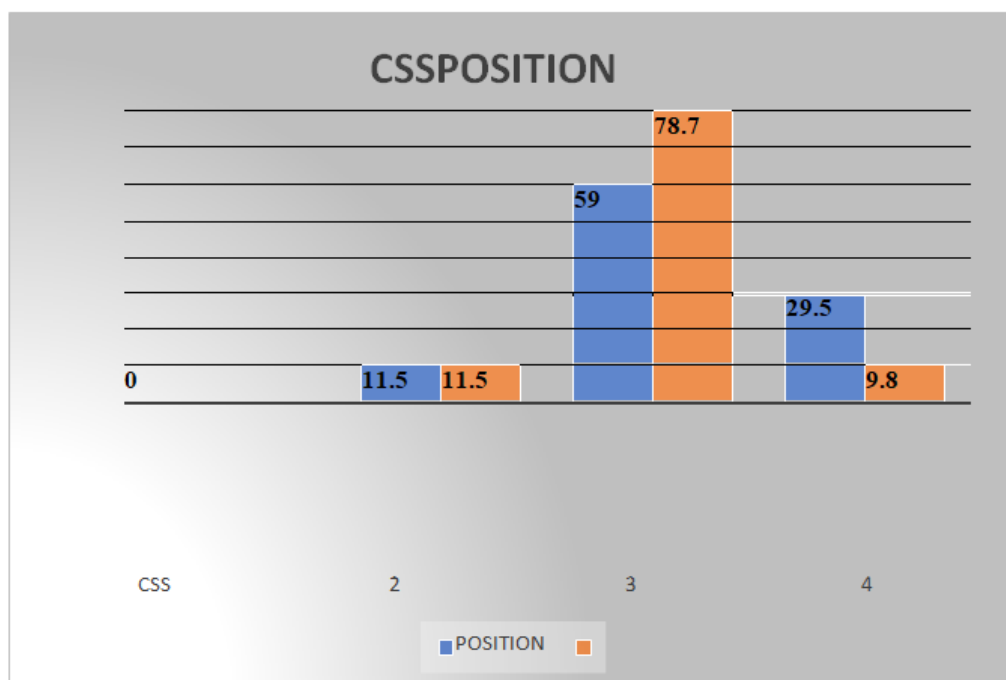
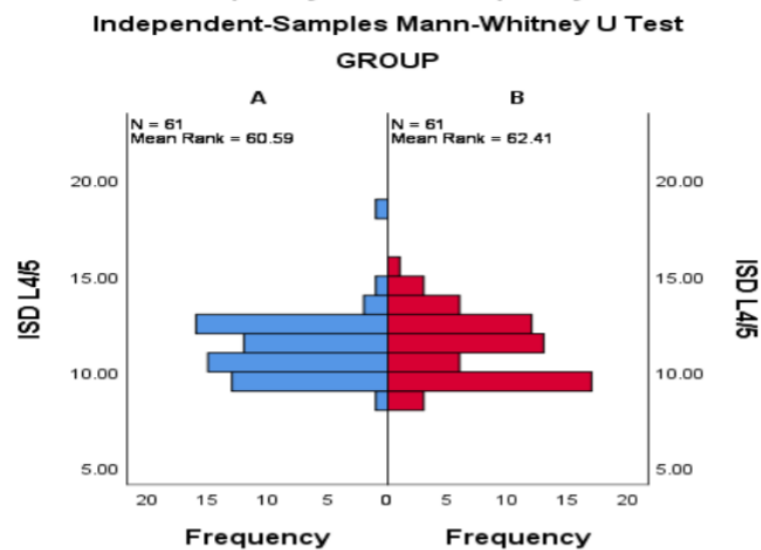
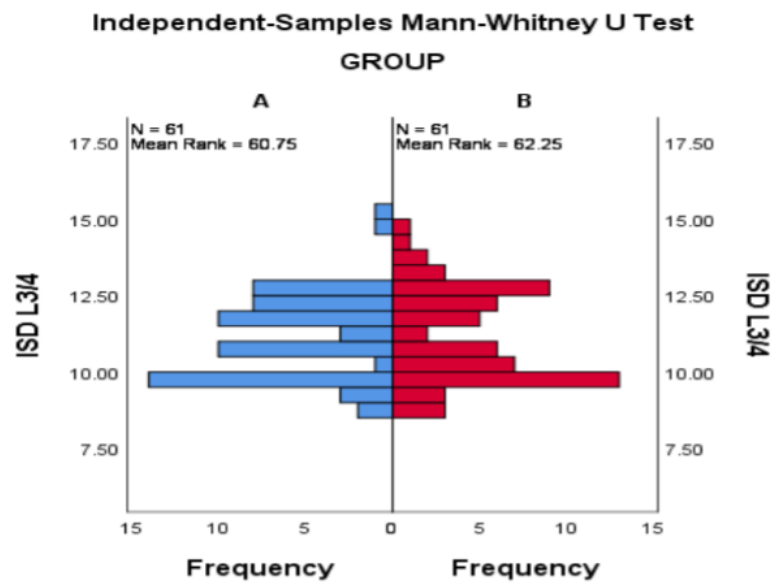


Figure 5: Interspinous distance measured by USG



DISCUSSION

Spinal anaesthesia in obstetric patients for caesarean sections is a judicious anaesthetic approach that has been employed for numerous years [11]. Spinal anaesthesia is a landmark-based method, and the primary predictor of difficulties in executing a subarachnoid block is the accurate identification of anatomical landmarks. Factors influencing the success rate of treatments include age, sex, BMI, structural deformities, and posture [12]. The positioning of patients during a subarachnoid block is crucial for achieving a successful dural puncture.

We performed a prospective open-label trial with random assignment of participants into one of two groups (new technique as seen in figure 4 or conventional technique as illustrated in figure 1).

This study involved measuring lumbar interspinous lengths at the L3/L4 and L4/L5 levels utilising static ultrasound imaging immediately upon patient placement, with particular emphasis on visualising the posterior dura by midline static ultrasound guidance. The quantity of needle passes, encompassing redirections and efforts (characterised by alterations in lumbar space), necessary for a successful dural puncture via the midline interspinous route was systematically documented. Furthermore, patient comfort throughout the dural puncture and the entire treatment was evaluated using a standardised comfort score. The study presented an innovative positioning technique wherein the parturient was sat on the operating table with the lumbar spine flexed and the knees elevated in flexion by a 30 cm pillow positioned beneath them (Figure 4). The new position was subsequently compared to the conventional sitting posture—lumbar flexed with extended knees (Figure 1)—regarding the number of needle passes necessary and the comfort level reported by the subjects.

The research involved 122 ASA II parturients slated for Caesarean section at ESI PGIMSR, with subjects randomly assigned to control and experimental groups. Demographic information such as age, height, weight, and BMI were documented for each subject. The average age was 28.18 years in the control group and 27.33 years in the experimental group, while the average height was 154.79 cm (control) and 153.69 cm (experimental), and the average weight was 60.92 kg (control) and 60.75 kg (experimental). Given the comparability of weight and height, the BMI values were similarly analogous, and altogether, there was no statistically significant difference between the groups for age, height, weight, BMI, or ASA categorisation.

The interspinous distance at both L4-5 and L3-4 did not exhibit a substantial increase in our new location. The length of the posterior dura was consistent in both positions. The frequency of needle redirection did not markedly diminish at the new position. The total attempts necessary for a successful block were not significantly reduced in the new position. The comfort level in the positioning was found to be more in cases.

A study by Palanisamy A et al. (2011) [13] concluded that the utilisation of general anaesthesia for caesarean delivery is minimal and decreasing. These results may indicate the initial and growing application of neuraxial methods, especially in parturients with concurrent comorbidities. A notable decrease in trainee exposure to obstetric general anaesthesia has been noted. In our study, the majority of parturients exhibited no contraindications for spinal anaesthesia. Only a small number were subject to the exclusion criteria associated with the aforementioned study [13]. The interspinous distance was determined following the placement of the parturients utilising ultrasound guidance. Ultrasound guidance has facilitated clear visualisation of the postural dura and the interspinous region in both groups, as examined by Gayathri et al., [14] Dhangar et al., [15] and Creaney et al. [16]

A research by Ruzman et al. indicates that the accurate identification and penetration of the subarachnoid space are critical to the success or failure of the procedure. Repeated attempts and challenging access to the subarachnoid space pose significant risks [17]. Ultrasonography was employed to enhance the identification of lumbar spaces, and the posterior dura was visible in all parturients from both groups. This may explain the absence of unsuccessful subarachnoid blocks or paramedian procedures, which aligns with the aforementioned findings.

However, we also discovered that no particular location offered a relative advantage in terms of enhanced dura visibility or increased interspinous distance. The interspinous distance at L4-5 and L3-4 for both patients and control groups exhibited no significant difference. Therefore, we can ascertain that the new posture offers no advantage over the traditionally utilised position. The reason may be that the altered position has not reduced the lumbar lordosis. The total number of passes (i.e., needle redirections necessary) and total tries for both spaces are compared across the two groups, revealing no significant statistical difference. Several research examine various adjusted sitting positions for this aim. Tashayod and Tamadon et al. [18] characterised the extended knee position in their study, asserting that it is "more effective in conditions of lumbar lordosis" and that "spinal puncture appears to be easier."

This study utilised Fisher et al. [19] as a foundation, comparing 205 patients in a traditional sitting position with legs supported on a tool beside the operating table (knees flexed at 90 degrees) as depicted in figure 2, to 201 patients in the hamstring stretch position (HSP) concerning the frequency of needle-bone contact during epidural labour analgesia. The quantity of needle-bone interactions was determined to be identical in both groups. Fisher et al. also confirmed that the incidence of needle-bone contact was reduced in individuals whose lower limbs were positioned on the table. Our investigation revealed a statistically negligible difference in bone connections between the

two groups. This discrepancy may be attributed to the utilisation of bigger epidural needles in the obstetric population examined by Fisher et al. in contrast to the smaller spinal needles employed in our investigation. Several research have examined and contrasted various positions to enhance the efficacy of central neuraxial blockade. Soltani Mohammadi et al. [20] reported that the induction of spinal anaesthesia was expedited in patients in squatting position on the operating table. This position achieved maximum knee flexion, hip adduction, and forward bending, proving more successful in diminishing lumbar lordosis. Given the difficulty of achieving a squatting position with a gravid uterus, we hypothesised that a 30 cm pillow would facilitate a knee flexion of 45 degrees, thereby reducing lordosis and needle-bone contact during the initiation of spinal anaesthesia, without causing issues for the parturient, as full leg extension may induce. Contrary to the aforementioned study, our research did not reveal any significant variation regarding the number of needle passes (i.e., needle-bone interactions) and the total attempts. Research has demonstrated that hip and knee flexion reduce lumbar lordosis, hence increasing interspinous distance, which enhances both the success rate and ease of needle insertion; however, this finding was not corroborated by our investigation.

In research conducted by Afolayan JM et al. [21] One hundred appropriate senior patients, aged 65 to 80 years, scheduled for open prostatectomy, were prospectively randomised into two groups, LS and LT. Patients in the LS group underwent spinal anaesthesia induction in a seated posture with their legs positioned on a stool, whereas patients in the LT group had their spinal anaesthesia induced in a seated position with their legs remaining on the operating table. The principal objective was accurate needle positioning. The number of tries, needle redirections, and patient comfort were assessed to compare outcomes between the two groups. Our data demonstrated equivalence between the usual hamstring stretch position (control) and the new posture (with a 30 cm pillow beneath the knees) with the number of passes and attempts necessary for a successful subarachnoid block.

The comfort level in the new position was much greater than in the traditional position of the parturient. The majority of the parturient reported comfort with a pillow placed beneath their knees. Only a small number of parturient women who were slightly overweight had discomfort due to their gravid uterus. The comfort experienced throughout the entire treatment was not markedly different between the two groups.

CONCLUSION

Overall, the study found no statistically significant difference between the traditional positioning method (knees extended) and the new method (knee flexion with a 30 cm pillow beneath the knees) in terms of

interspinous distance at L3–L4 and L4–L5, posterior dura visibility, posterior dura length, first-pass success of dural puncture, total number of needle passes, and total attempts. However, the new position demonstrated a higher comfort score during patient positioning, while overall procedural comfort remained statistically comparable between both groups. We recommend further research involving a larger sample size, including parturients across a broader range of ages and BMI categories. The study's limitations include the absence of blinding due to visible differences in positioning, potential variability in operator efficiency, and the subjectivity of measurements such as interspinous distance and comfort scores. Additionally, as the participants had normal BMI, the findings may not be generalizable to morbidly obese patients.

REFERENCES

1. Kochanek KD, Kirmeyer SE, Martin JA, Strobino DM, Guyer B. Annual summary of vital statistics: 2009. *Pediatrics*. 2012 Feb;129(2):338–48.
2. Gibbons L, Belizan JM, Lauer JA, Betran AP, Meriandi M, Althabe F. Inequities in the use of cesarean section deliveries in the world. *Am J Obstet Gynecol*. 2012 Apr;206(4):331.e1-331.e19.
3. Uchibori C. [Impression of the 1975 General Meeting of the Japan Nursing Association. Fulfilment and some disappointment]. *Hokenfu Zasshi*. 1975 Jun;31(6):334–6.
4. Ramayyan Achary A, Puthenveetil N, Rajan S, Kumar L. A comparison of time to achieve T5 blockade in lateral versus sitting position during elective cesarean section under spinal anesthesia: A randomized control trial. *J Obstet Anaesth Crit Care* 2020;10:21-5.
5. Tan ED, Gunaydin B. Comparison of maternal and neonatal effects of combined spinal epidural anaesthesia in either the sitting or lateral position during elective cesarean section. *Turk J Anaesth Reanim* 2014;42:23-32.
6. Xu Z, Yao X, Zhang Y, Chen X, Zhou X, Shen F, et al. Efficacy of different positions for neuraxial anesthesia in caesarean section: A meta-analysis. *Int J ClinExp Med* 2016;9:20255-67.
7. Kharge ND, Mali A, Gujjar P. Comparison of haemodynamic effects of lateral and sitting positions during induction of spinal anaesthesia for elective caesarean section. *Int J Res Med Sci* 2017;5:851-6.
8. Sandoval M, Shestak W, Stürmann K, Hsu C. Optimal patient position for lumbar puncture, measured by ultrasonography. *Emerg Radiol*. 2004 Feb;10(4):179–81.
9. Nomura JT, Leech SJ, Shenbagamurthi S, Sierzenski PR, O'Connor RE, Bollinger M, et al. A randomized controlled trial of ultrasound-assisted lumbar puncture. *J Ultrasound Med Off J Am Inst Ultrasound Med*. 2007 Oct;26(10):1341–8.
10. Locks G, de Almeida M, Pereira A. Use of the Ultrasound to Determine the Level of Lumbar Puncture in Pregnant Women. *Brazilian Journal of Anesthesiology*. 2010;60(1):13-19.
11. Chestnut DH, Wong CA, Lawrence C. *Obstetric Anaesthesia*. 5th ed. Published by Elsevier 2014. p. 867
12. Hegde SV, Shivashankar A, Nalini KB, Turai A. Optimal patient positioning for spinal anesthesia using

- a visual aid in cesarean section patients: A randomized control trial. *Journal of Anaesthesiology Clinical Pharmacology*. 2024 Jul 1;40(3):445-50.
13. Palanisamy A, Mitani AA, Tsen LC. General anesthesia for cesarean delivery at a tertiary care hospital from 2000 to 2005: a retrospective analysis and 10-year update. *Int J Obstet Anesth*. 2011 Jan;20(1):10–6.
 14. Gayathri B, Swetha Ramani CK, Urkavalan K, Pushparani A, Rajendran A. Comparison of the time taken for subarachnoid block using ultrasound-guided method versus landmark technique for cesarean section - A randomized controlled study. *J Anaesthesiol Clin Pharmacol*. 2021 Jun;37(2):205–9.
 15. Dhanger S, Vinayagam S, Vaidhyanathan B, Rajesh IJ, Tripathy DK. Comparison of landmark versus pre-procedural ultrasonography-assisted midline approach for identification of subarachnoid space in elective caesarean section: A randomised controlled trial. *Indian J Anaesth*. 2018 Apr;62(4):280–4.
 16. Creaney M, Mullane D, Casby C, Tan T. Ultrasound to identify the lumbar space in women with impalpable bony landmarks presenting for elective caesarean delivery under spinal anaesthesia: a randomised trial. *Int J Obstet Anesth*. 2016 Dec;28:12–6.
 17. Ružman T, Gulam D, Haršanji Drenjančević I, Venžera-Azenić D, Ružman N, Burazin J. Factors associated with difficult neuraxial blockade. *Local Reg Anesth*. 2014;7:47–52.
 18. Tashayod ME, Tamadon S. Spinal block in sitting position without moving the legs. *Middle East J Anaesthesiol*. 1980 Oct;5(8):529–33.
 19. Fisher KS, Arnholt AT, Douglas ME, Vandiver SL, Nguyen DH. A randomized trial of the traditional sitting position versus the hamstring stretch position for labor epidural needle placement. *Anesth Analg*. 2009 Aug;109(2):532–4.
 20. Soltani Mohammadi S, Hassani M, Marashi SM. Comparing the squatting position and traditional sitting position for ease of spinal needle placement: a randomized clinical trial. *Anesth Pain Med*. 2014 Apr 5;4(2):e13969. Doi: 10.5812/aapm.13969. PMID: 24790901; PMCID: PMC3989545.
 21. Afolayan JM, Areo PO, Adegun PT, Ogundipe KO, Filani AB. Comparison of ease of induction of spinal anaesthesia in sitting with legs parallel on the table versus traditional sitting position. *Anesth Analog* 2009;109:532-4.