Original Article

Comparison of the time taken for subarachnoid block using ultrasound-guided method versus landmark technique for cesarean section – A randomized controlled study

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Abstract

Background and Aims: Spinal anesthesia is the regional technique preferred for cesarean section and is usually administered using the traditional landmark technique. Ultrasonography of the spine appears to be helpful in locating the puncture site and increasing the success rate. The primary objective of this study was to assess the use of ultrasonogram in locating the lumbar interspinous space for spinal anesthesia in laboring parturients brought for elective cesarean section.
Material and Methods: Sixty parturients scheduled to undergo elective cesarean section under spinal anesthesia were included in this prospective randomized controlled trial, after obtaining the institutional ethical clearance. In Group I, 30 patients received spinal anesthesia by landmark technique and in Group II, 30 patients underwent ultrasound-guided spinal anesthesia. The statistical analysis was done using SPSS software version 17 (SPSS Inc., Chicago, Illinois, USA) for Microsoft windows.
Results: The time taken for spinal in Group I was longer than in Group II (62 ± 18s; 41 ± 11s; $P = 0.0001$). The number of attempts of needle insertion was significantly less in Group II (group I 1.86 ± 1.04: group II 1.06 ± 0.25). However, the total preparation time ($28\ 8.30 \pm 92$ vs 804.73 ± 77; $P = 0.0001$) was more in the ultrasound-guided than in the landmark group. The patients had better satisfaction in group II.
Conclusion: Preprocedural ultrasound is a useful tool for successful lumbar puncture in parturients as it minimizes the number of attempts of needle insertion and provides better patient satisfaction.

Keywords: Cesarean section, landmark technique, LSCS, spinal anesthesia, subarachnoid block, USG

Introduction

Spinal anesthesia is the preferred regional technique for cesarean due to it's ease of administration with a high success rate and rapidity of onset of anesthesia.[1,2] Spinal anesthesia for cesarean section is usually administered using the traditional landmark technique which depends on the palpation of bony anatomical landmarks - the iliac crests and spinous processes.[3] At times, these landmarks may be difficult to identify accurately the specific intervertebral level, a problem exacerbated by altered patient anatomy, including obesity and pregnancy related changes. Failure of spinal anesthesia results in a need for supplemental analgesia or immediate conversion to general anesthesia.[4]

Ultrasonography appears to be helpful in locating the puncture site accurately. Technological advances in the field of anesthesia enabled us to use ultrasound-guided spinal

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and epidural anesthesia in patients where the landmark technique poses difficulty. Recently, we have seen many studies being published on the effectiveness of ultrasound-guided identification of subarachnoid and epidural space in pregnant women undergoing cesarean sections.[5-7] Also, recent studies on preprocedural ultrasound aided location of interspinous space have shown that it can help in locating the appropriate spinal level with more accuracy and in reducing the number of attempts of needle insertion and passes.[8,9] Although, the above studies show that the time taken to perform subarachnoid blockade is less in the ultrasound technique, their superiority over the landmark technique has not been proven yet. There is a paucity of literature that measured the total preparatory time taken for the procedure and the patient satisfaction between the landmark and the ultrasound approach, hence our study was aimed at studying these parameters.

Material and Methods

After obtaining approval from the ethical committee and with informed written consent, 64 pregnant patients of ASA II, undergoing elective lower segment cesarean section under spinal anesthesia, were included in the study. The patients were randomly allocated into two groups namely group I and group II. This was a randomized prospective study conducted over a period of six months. Randomization was done by computer-generated numbers and concealed using sealed opaque envelope method. In group I, spinal anesthesia was administered using landmark technique and in group II, ultrasound-guided spinal anesthesia was administered.

Pregnant patients of body mass index (BMI) between 25-34 kg/m^2, posted for elective cesarean section under spinal anesthesia were included in the study. Those posted for emergency cesarean section, patients with infection at the site of spinal injection, patients with bleeding disorder or coagulopathy, patients with cardiovascular disease or neurological impairment, or spinal deformity, and with known allergy to any of the drugs used were excluded from the study.

Standard fasting protocols were followed in all the patients. Intravenous cannulation was established and oral premedication with tab. ranitidine 150 mg and tab. metoclopramide 10 mg were given two hours prior to the procedure. Patients were then shifted to the operating room in the left lateral position. Inside the operation theatre, standard monitoring in the form of non-invasive blood pressure, electrocardiogram, and pulse oximetry was instituted and the baseline parameters were recorded.

In our study, two different anesthesiologists were involved in group II: the first anesthesiologist marked the L3 – L4

interspinous space and the point of entry of the spinal needle using the ultrasound device. The second anesthesiologist performed the spinal anesthesia in the marked target point without any prior information of the interspinous space. This was done to reduce the observer error. Anesthesiologists with a minimum experience of having identified posterior cord structures under ultrasonogram in >50 cases, including difficult spines such as in scoliosis, performed the ultrasound of the lumbar spine in all patients, and the one with the experience of administering spinal block for more than two years performed the spinal anesthesia.

In group I, with patients in sitting posture, under aseptic precautions, spinal anesthesia was administered in L3 – L4 interspinous space with 25G Quincke Babcock spinal needle (Becton, Dickinson and Company, Franklin Lakes, New Jersey, 07417-1880, USA) using the standard landmark technique. The time taken from the beginning of palpation of iliac crest and until the identification of interspinous space was noted. Then the procedural time – the time taken from insertion of the needle and until the free flow of CSF was obtained. The preparatory time was the total time taken by the anesthetist from palpation of iliac crest until the successful spinal. The number of attempts and passes were noted. The depth of the spinal needle from the skin to the subarachnoid space was measured after the needle was taken out. Here, the needle was firmly held in one hand by the anesthesiologist; with the other hand thumb and index finger, the point of marking was pinched on the needle at the skin level and marked using a sterile marker and a sterile ruler.

In group II, with the patient in the sitting posture, under aseptic precautions, the L3- L4 interspinous space was identified by ultrasound technique and marked. A curvilinear probe (3–6 MHz) of portable ultrasound machine (Sonosite M Turbo™) was used for the pre-procedural ultrasound. For reasons of sterility, the transducer surface of the ultrasound probe was first wiped with a sterile gauze soaked in disinfectant, by an assistant wearing sterile gloves. The assistant placed the ultrasound gel on the transducer surface of the probe and handed the probe to the anesthesiologist, who on receiving the probe, wrapped it with a sterile surgical glove with the ultrasound gel inside, thus the outer surface was now sterile and could be used on the prepared part of spine for identification. The probe cord was usually wiped with a sterile gauze and covered by a separate sterile disposable surgical drape to its entire length. This assured sterility of the probe end, and the entire cord. A parasagittal oblique view of the spine was first obtained, and then the L3–L4 intervertebral space was identified by moving up from the sacrum below [Figure 1]. After identifying the L3–L4 space, the best image of the anterior complex (anterior dura mater, posterior longitudinal

ligament, and body of corresponding vertebra) and posterior complex (ligamentum flavum and posterior dura mater) was obtained. At this selected L3–L4 intervertebral space, the probe position was changed to transverse view and brought to the midline [Figure 2] and a sterile surgical skin marker was used to mark the midpoint of the long and short borders of the probe in the midline. The point of intersection between the two perpendicular lines was identified as the point of entry [Figure 3]. Then spinal anesthesia was given in a similar manner as in group I, in the midline, at the marked target point of entry, with 25G Quincke's needle. Again, the procedural time (time from which the anesthesiologist starts inserting the needle to the time of free flow of cerebrospinal fluid was obtained), the number of attempts and passes were noted. The preparatory time was the total time taken, from when the anesthetist placed the USG probe to identify the interspinous space and until the end of the successful spinal.

The distance from the skin to the subarachnoid space was measured by measuring the distance from the skin to the ventral border posterior complex on the ultrasound. In all patients, strict aseptic precautions were maintained throughout the procedure. The dosage of local anesthetic was kept standard between the groups as 10mg of 0.5% hyperbaric bupivacaine with 60 mcg of buprenorphine. In both the groups, the primary outcome was the procedural time. The secondary outcomes were the number of attempts, number of passes without exiting the skin, number of redirections, total preparatory time, conversion rate to general anesthesia and the patient satisfaction. At the end of the surgery, patients were queried for satisfaction and made to mark intraoperative anesthetic satisfaction on a four-point Likert scale (1 – Not satisfactory, 2 – Satisfactory, 3 – Good, 4 – Optimal) based on the number of needle pricks, pain at the site of injection, intraoperative analgesia and sedation.

Statistical analysis

Sample size was calculated for the primary outcome which is the time taken for the spinal anesthesia, based on the previous study by Dhanger et al. which showed that the average time taken for spinal anesthesia for an experienced anesthesiologist would be 51.80 ± 12.28s (mean $\pm$ standard deviation) in the landmark group and 31.90 ± 6.30s in the ultrasound group. Taking a power of 90% and alpha error of 0.05, a minimum sample of 20 patients was calculated in each group. A total of 30 patients were included in each group to compensate for the possible dropouts from the study. The statistical analysis was done using SPSS software version 17 (SPSS Inc., Chicago, Illinois, USA) for Microsoft windows. Descriptive statistics were presented as numbers and percentages. The data were expressed as mean and standard deviation. Independent sample student *t*-test/Mann–Whitney test was used to compare
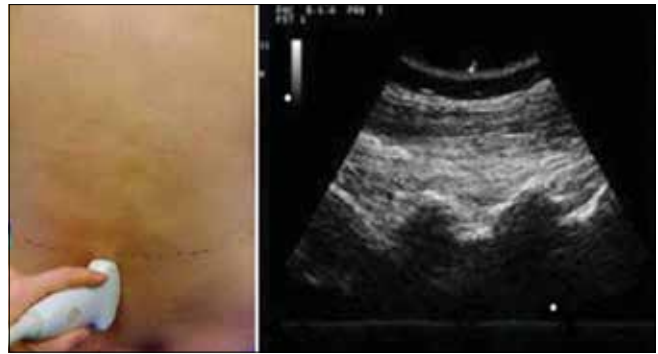
Figure 1: Direction of placement of USG probe - Paramedian sagittal view; Showing classical "saw tooth" appearance representing lamina & interlaminar space

Figure 2: Transverse interspinous view at L3-4 showing "Flying bat appearance" and the Depth of the posterior cord structures from the skin

Figure 3: Intersection of two lines at L3 -L4 Interspinous space determines the point of entry of the needle

continuous variables between two groups. A Chi-squared test was used for the comparison of the two attributes. A $p < 0.05$ was considered statistically significant.

Results

All sixty pregnant patients posted for cesarean section under spinal anesthesia were randomly allocated into two groups of 30 each. Four participants from a total of 64 patients recruited were excluded from the study as they expressed unwillingness to participate and opted for GA. There were no significant statistical differences in the demographic profile between the study groups. The age, height and weight were comparable between the two study groups [Table 1].

The procedural time in group II was lesser than in group I which was statistically significant (p = 0.0001) [Table 2].

The difference in the number of attempts in group I and in the group II was found to be statistically significant (p = 0.0001). The participants in the group II required lesser number of attempts for successful spinal, compared to those in the group I. The number of passes in group I was also significantly higher than in group II. Both the number of re-attempts for the needle insertion in same interspinous space and in the different interspinous space among the two groups were significantly different.

The total preparation time in group II was significantly longer than in group I (p = 0.0001). None of the patients in either of the groups required conversion to general anesthesia.

The patients in the group II demonstrated better satisfaction score than those in the group I (p = 0.0001). The difference in the distance from the skin till subarachnoid space between group I and group II remained statistically insignificant (p = 0.72).

Discussion

The procedure for the successful spinal showed >30% reduction in time using the ultrasound-guided technique when compared to the landmark technique. However, the total preparatory time was almost 2.8 times longer in the USG group than the landmark group.

In a study by Dhanger *et al.*,[10] the time taken for the successful lumbar puncture was lesser in the preprocedural

ultrasound group than in the traditional landmark group. In the present study, we found a similar decrease in the time taken for subarachnoid block in the ultrasound group than the landmark group. Another study by Sahin *et al.*,[6] that compared preinsertion ultrasound for spinal anesthesia in cesarean section among the obese and lean patients, concluded that the time taken for spinal procedure was shorter in the pre-procedural ultrasound group than the landmark technique.

The number of attempts for the spinal needle insertion was lesser in the USG group than in the landmark group. A previous study had concluded that the success rate of first attempt of needle insertion in ultrasound group was 92% compared to only 44% in the conventional landmark technique in obese patients undergoing cesarean section under spinal anesthesia.[11] Similar results were obtained in the present study (93% in USG; and 33% landmark group). In their study, Lim *et al.*[12] also found a higher success rate of first attempt needle insertion in the ultrasound group. On the other hand, Srinivasan *et al.*[13] in their study comparing the pre-procedural ultrasound-guided paramedian approach, with that of landmark midline approach for spinal anesthesia in total joint replacement procedures, concluded that the number of attempts were not significantly dfferent among the two groups. This nonsignificance could have been due to the anesthetists with the same experience performing both the neuraxial scanning and the spinal anesthesia.

The number of passes were 50% less in the USG group than in the landmark technique group. This correlates well with the results observed in a randomized trial conducted by Creaney *et al.*[5]. The number of reattempts in different interspinous space was three times more in the landmark technique when compared to the USG technique. This is also in concurrence with the study of Dhanger *et al.*[10].

Our study showed that the total preparation time in the USG group was longer than the landmark group. Although USG

Table 1: Demographic profile

	Group I (*n*=30)	Group II (*n*=30)	*P*
Age (yrs) (Mean+SD)	26.1±3.4	27.5±4.0	0.1124
Weight (kgs) (Mean+SD)	73.0±5.6	74.1±6.9	0.5506
Height (cms) (Mean+SD)	156.2±6.2	154.2±7.3	0.2331

Table 2: Comparison of time taken for spinal, number of attempts, number of reattempts in the same and different space, number of passes, total preparation time and patient's satisfaction score between group I and II

Variables	Group I (*n*=30)	Group II (*n*=30)	*P*
Procedural time (Time taken for spinal in sec)	62.24±18.10	41.27±11.33	0.0001
Number of Attempts	1.86±1.04	1.07±0.25	0.0001
Number of Re Attempts in same space	1.00±0.90	0.27±0.45	0.0002
Number of Re Attempts in different space	0.46±0.73	0.17±0.37	0.0493
Number of Passes	0.93±1.01	0.40±0.56	0.0079
Distance of Dura from skin (cms)	4.07±0.81	4.13±0.47	0.7269
Total preparation time (secs)	288.30±92.20	804.73±77.36	0.0001
Patient satisfaction score	2.73±1.17	4.00±0.10	0.0001

guided marking of interspinous space reduces the time for the lumbar puncture, it is also time consuming to locate the exact interspinous space and requires expertise.

The distance from the skin to the posterior complex (ligamentum flavum, posterior duramater) between the USG estimated depth and needle depth, remained insignificant within the same group and between the two groups. In a pilot study, comparing the depth from the skin until the ligamentum flavum marked on the spinal needle with that from USG, Gnaho *et al.*[14] proved no significant differences in the depth among their two groups.

None of the patients in both groups required conversion to general anesthesia. Two patients in group I needed supplemental sedation. Major reasons for dis-satisfaction cited by patients in our study were the number of attempts of needle pricks, being more than three. The patients in the USG group demonstrated better satisfaction score than those in the landmark group. We determined that more than three attempts for the lumbar puncture was in direct corelation to patient dissatisfaction. The previous study by Rhee *et al.*[15] concluded that one of the main intraoperative reasons for the dissatisfaction for spinal anesthesia was needle insertion with more than three attempts.

One of the limitations of our study was related to blinding. As there were markings on the spine in the ultrasound group, blinding was difficult between patients and observers.

Conclusion

Preprocedural ultrasound is a useful tool for successful lumbar puncture in parturients as it reduces the procedure time, number of attempts, passes in spinal anesthesia and provides better patient satisfaction as compared to conventional landmark technique.

Conflicts of Interest
There are no conflicts of interest.

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