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Original Research Article

Comparison of Real-Time Ultrasound-Guided Spinal Anaesthesia Vs Pre-Procedural Ultrasound-Guided Spinal Anaesthesia in Geriatric Patients Undergoing Infra Umbilical Surgeries

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Abstract

Background: Age-related degenerative changes of the lumbar spine, including narrowing of interspinous spaces and ligament calcification, increase the technical difficulty of neuraxial block placement in geriatric patients. Ultrasound guidance has been used to improve the success of spinal anaesthesia either by pre-procedural ultrasound (PUS) assisted landmark identification or real-time ultrasound (RUS) guided needle insertion. However, comparative evidence between these two techniques in elderly patients is limited. This study aimed to compare the efficacy of real-time ultrasound-guided spinal anaesthesia with pre-procedural ultrasound- guided spinal anaesthesia in geriatric patients undergoing infra-umbilical surgeries.

Material and Methods: In this prospective randomized study, 50 patients aged ≥60 years with American Society of Anaesthesiologists (ASA) physical status I–III undergoing infra-umbilical surgeries under spinal anaesthesia were randomized into two groups of 25 each to receive spinal anaesthesia using either the PUS or RUS technique via a paramedian approach. Primary outcomes measured were the number of attempts and needle passes required for successful subarachnoid block. Secondary outcomes included time taken for identification of subarachnoid space, procedure time, and total time for successful lumbar puncture. Statistical analysis was performed using independent sample t-test and Chi-square test.

Results: First-attempt success rate was higher in the PUS group (64%) compared to the RUS group (48%) without statistical significance (p=0.561). First-pass success was also greater in the PUS group (48%) than in the RUS group (28%) (p=0.209). The mean time for identification of the subarachnoid space was significantly longer in the PUS group (74.76±21.37 s) compared to the RUS group (63.72±17.94 s) ($p<0.05$). Procedure time was significantly longer in the RUS group (56.56±24.62 s) compared to the PUS group (32.94±14.47 s) ($p<0.0001$). Total time for successful lumbar puncture was comparable between the groups (p=0.149).

Conclusions: The total duration taken for successful lumbar puncture remains the same irrespective of the ultrasound technique used, with pre procedural ultrasound taking longer time for identification of the subarachnoid space and real time ultrasound taking longer time from skin prick to cerebrospinal fluid backflow.

Keywords: Geriatrics; Spinal Anaesthesia; Subarachnoid Space; Ultrasonography; Treatment Outcome.

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Introduction

Spinal anaesthesia since its inception in 1898 by August Bier has been performed by an anatomical landmark guided method. The rates of post dural puncture headache, paresthesia and spinal haematoma are also correlated with the number of passes or attempts during administration of spinal.[1] The landmark approach is helpful, it does not consider anatomical variations such as difficult palpable landmarks, degenerative changes, lumbar scoliosis and kyphosis. One possible solution is to use ultrasound to map the intervertebral space and identify the needle insertion and angulation. While the pre procedural ultrasound (PUS) has been used to identify the suitable intervertebral space for spinal and epidural and give an idea on needle angulation it still remains a blind technique during the

procedure. Real time ultrasound (RUS) guided spinal allows visualization of the interlaminar space, ligaments, needle insertion and trajectory.[2] Information on the use of real-time ultrasound (RUS) guided spinal anaesthesia in elderly to date, has been limited to case series and case reports and few prospective observational studies.[3,4]

Hence, this study aimed at evaluating these two modalities of PUS and RUS approach, in geriatric patients undergoing infraumbilical surgeries and compare the variables of number of attempts, number of passes, time for identifying sub arachnoid space, procedure time and time taken for a successful lumbar puncture.

Material and Methods

The study was approved by the institutional ethics committee (IEC approval number: SSMC/MED/IEC−148/OCTOBER−2025) and registered in clinical trials registry of India at https://ctri.nic.in (CTRI/2025/12/099636). Informed written consent was taken from all the patients. Ultrasound procedures were done by anaesthesiologists with adequate training. Fifty patients aged sixty years and above, ASA 1 to 3 undergoing infraumbilical surgeries under spinal anaesthesia were included in this study. The patients excluded were those who had contraindications to spinal anaesthesia and refusing to give informed consent for the procedure.

Fifty patients were randomized into 2 groups of 25 each by a computer-generated random sequence table. The allocation was concealed and opened only by the anaesthesiologist performing the procedure. Preoperatively, 18G Intravenous line secured for the patient and they were started on 5 to 10 ml/kg ringer lactate solution. Patient shifted to the operative room, with table in neutral position and patient in left lateral decubitus position standard ASA monitors attached to monitor pulse rate, blood pressure, oxygen saturation and ECG. Oxygen was administered at 5L/min by Hudson mask. A curvilinear ultrasound transducer (2−5 MHz) was used in both groups.

PUS group: ultrasound was used to identify the L3-L4, L4-L5 interspinous space with the best image of the posterior complex (ligamentum flavum dura complex - LFD) and the anterior complex (posterior longitudinal ligament - PLL) in the parasagittal oblique (PSO) view. At the selected interspace, the probe was positioned to obtain a clear ultrasound image. A skin marker used to mark the mid-point along the long border of the probe, and the mid-points along the short borders of the probe. The intersecting point of the 2 lines was used as a paramedian insertion point of the spinal needle and angulation of probe as the angulation of the spinal needle. Spinal anaesthesia was administered with 25G quincke needle with 0.5% hyperbaric bupivacaine.

RUS group: The lumbar area was disinfected with betadine, the ultrasound probe covered with gel and covered with sterile protective sheath. The betadine acted as a coupling agent between the sterile ultrasound sheath and skin. The sacrum is identified in parasagittal view using ultrasound and with cephalad movement the interspinous space of L3-L4 or L4-L5 located in the PSO view of 250 towards midline. Under real time USG guidance, the posterior and anterior complex identified as the subarachnoid space lies between them. Betadine wiped off at the injection site and local infiltration of 2% lignocaine was administered. 25 G quincke needle introduced and the needle trajectory visualized as it breached into the subarachnoid space.

Patient's vitals parameters were continuously monitored. Hypotension defined as systolic blood pressure fall of greater than 20% from baseline, intravenous Inj Ephedrine 3mg/ Inj Mephenteramine 6mg will be given. Bradycardia defined as heart rate less than 50 bpm, was treated with intravenous Atropine 1 mg.

The primary parameters compared were the number of attempts (defined as number of times the spinal needle was withdrawn from the skin and reinserted) and number of passes (defined as the number of forwarding advancements of the spinal needle in a given interspinous space). The secondary parameters were the time taken for identifying sub arachnoid space, procedure time and time taken for successful lumbar puncture.

Time for identifying sub arachnoid space:

PUS group: the time from when the probe was placed on the skin until the skin marking was complete

RUS group: the time from when the probe was placed on the skin until the anterior and posterior complex was identified.

Procedure time: recorded from the needle insertion into the skin until observation of the outflow of CSF

Time taken for a successful lumbar puncture (LP): defined as the sum of the identifying time and procedure time.

If there was failure to identify the anterior and posterior complex from L2 to L5, the anaesthesiologist chose to perform traditional landmark technique. Unsuccessful spinal anaesthesia including inadequate level of block, pain intraoperatively or in instances of unexpected prolongation of surgery general anaesthesia was to be administered.

Sample size was estimated based on the study by Ravi et al based on the number of attempts to successful spinal anaesthesia. The sample size was estimated to be 25 with alpha of 0.05, a power of 0.8, a confidence level of 95% and taking into account a 10% drop out. Thus a total of 50 subjects were randomized into 2 groups of 25 each by a computer generated randomised sequence.

The collected data were entered in the Microsoft Excel 2016 and analysed with IBM SPSS Statistics for Windows, Version 29.0.(Armonk, NY: IBM Corp).To describe the data, descriptive statistics, frequency analysis, percentage analysis were used for categorical variables and the mean & standard deviation were used for continuous variables.

The normality of the data was verified with Shapiro Wilk test. To find the significant difference between the bivariate samples in independent groups the independent sample t-test was used. To find the significance in qualitative categorical data Chi-Square test was used. In both the above statistical tools the probability value 0.05 is considered as significant level.

Results

Total of 50 patients were included in the study. The data was normally distributed and were comparable in terms of age, sex and ASA grading. The first attempt success rate was 64% in PUS compared to 48% in RUS. The number of attempts of 2 and more were greater in RUS group, yet this was not statistically significant (P value 0.561). When comparing the number of passes, the first pass success rate was 48% in PUS and 28% in RUS with number of passes more than 2 being higher in RUS group. This was still not statistically significant (P value 0.209).

The mean time for identifying SAB in PUS group was 74.76±21.37 seconds and RUS group was 63.72±17.94 seconds which was statistically significant (P<0.05). The procedure time in the PUS group was 32.94±14.47 seconds and RUS group was 56.56±24.62 seconds which was statistically significant (P < 0.0005). The total time taken for successful LP in the PUS group was 107.7±30.14 seconds and RUS group was 120.28±30.58 seconds which was comparable and showed no statistical significance (P value 0.149).

Table 1: Patient Demographics

	PUS group	RUS group	P Value
Age	71.12±6.66 years	72.48±6.83	0.479
Sex			
Male	12 (48%)	17 (68%)	0.152
Female	13 (52%)	8 (32%)	
ASA			
I	7 (28%)	5 (20%)	0.801
II	11 (44%)	12 (48%)	
III	7 (28%)	8 (32%)	

Table 2: Parameter comparison in each group

Parameter	PUS group	RUS group	P value
Number of attempts n (%)			
1st attempt success	16 (64%)	12 (48%)	>0.05
≤2	23 (92%)	21 (84%)	>0.05
≥3	2 (8%)	4 (16%)	>0.05
Number of passes			
1st pass success n (%)	12 (48%)	7 (28%)	>0.05
≤2	19 (76%)	13 (26%)	>0.05
≥3	6 (24%)	12 (48%)	>0.05
Time for identifying space (s)	84.76±21.37	63.72±17.94	<0.05
Procedure time (s)	32.94±14.47	56.56±24.62	<0.0001
Time taken for successful LP (s)	107.7±30.14	120.28±30.58	>0.05

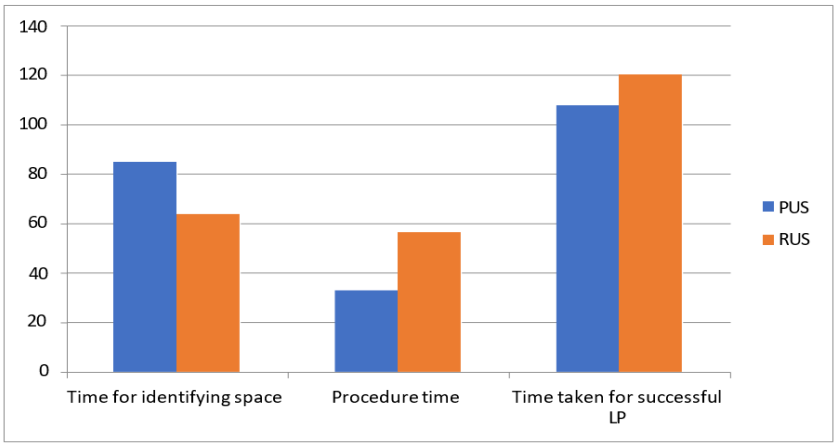

Figure 1: Time duration of parameters

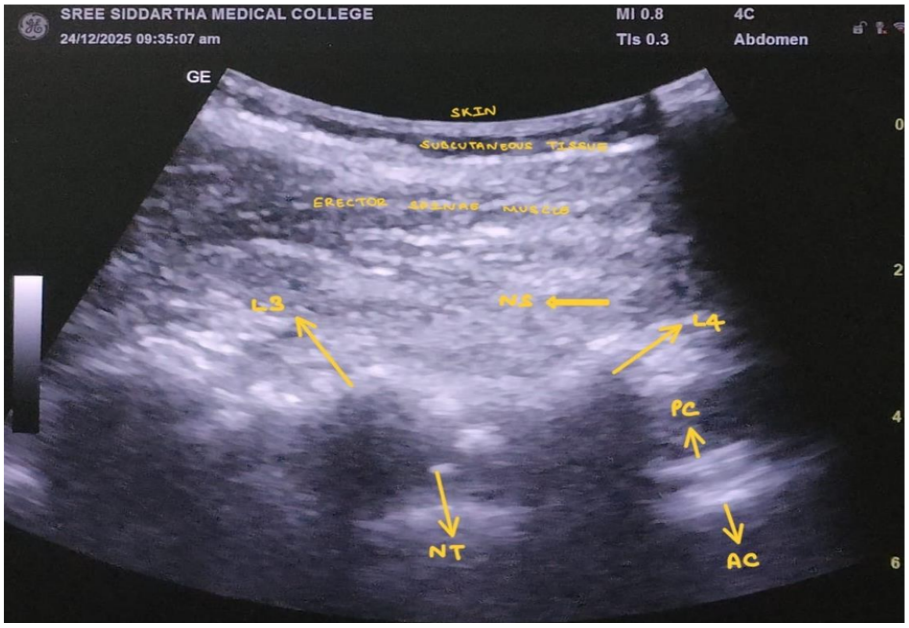

Figure 2: Ultrasound Image of RUS

AC: Anterior complex, L3: Lamina L3 vertebrae, L4: Lamina L4 vertebrae, NS: Needle shaft, NT: Needle tip, PC: Posterior complex

Discussion:

Ultrasound has grown as a technique that can help with lumbar neuraxial blocks, including pre procedural ultrasound assistance (PUS) and real-time ultrasound guidance (RUS). The PUS technique has advantages as it provides accurate anatomical information.[5−7] Compared to the landmark guided technique, pre procedural ultrasound guided spinal has shown higher first attempt success and reduced number of passes in the elderly. The drawback being the significant longer duration of the procedure.[8]

This study indicated that in the elderly, the RUS technique had a slightly lower first attempt success and first passes success compared to the PUS group though this difference was not statistically significant. The time taken to identify the subarachnoid space was longer in the PUS group, but the procedure time was significantly longer in the RUS group. These two variables were statistically significant. The total time for the entire procedure to successfully obtain CSF backflow in the spinal needle was comparable in both the groups.

Luying Chen et al had similar observations where they had statistically significant lower first attempt success and first pass success in RUS in elderly with hip fractures. The duration for identification, procedure time and total time to successful LP were also much higher in the RUS group. Challenges in patient position attributable to fracture of hip could lead to relatively suboptimal ultrasound image quality causing increase in total duration of procedure.[9] Niazi et al conducted a feasibility study on 20 patients undergoing joint arthroplasty under spinal anaesthesia using real time ultrasound guided technique. They found a 70% success rate, first skin puncture in 71% patients and 57% single needle pass. The mean total duration was 16.4 minutes and 11.1 minutes in the in plane and out of plane technique respectively.

Their implication being real-time ultrasound feasible but complex. They performed only real time ultrasound guided technique and did not compare it to the pre procedural ultrasound assisted technique.[10]

Our first attempt success rate was 48% in the RUS group which was comparable to Conroy et al [11] at 47% and Brinkmann et al [12] at 39%. Repeated attempts of entry of the spinal needle are associated with increasing incidence of complications such as haematomas, post dural puncture headaches and neural tissue injury. The approach chosen in both the groups is a paramedian approach, as the calcifications of the interspinous ligament along with narrow interspinous space makes the midline approach more challenging.[13,14] The paramedian approach is more successful as the interlaminar space is less affected with ageing.[15]

Ravi PR et al compared similar parameters in RUS and PUS in obese patients and found higher first attempts (60%) compared to our study (48%) but their total duration of procedure was much higher at 264s compared to 120s in our study.

The longer time for identifying subarachnoid space in PUS can be attributed to identification and marking of the landmarks without obtaining optimal image. The longer procedure time in RUS may be due to the need for optimal imaging and maintaining needle to beam alignment of the ultrasound probe. This increased the total time taken for successful LP.

The posterior complex is referred by collective visualisation of ligamentum flavum, epidural space, and the posterior dura is seen as hyperechoic linear line. The anterior dura mater, posterior longitudinal ligament and posterior vertebral body form the anterior complex which is also seen as a hyperechoic line. The distance between these two complexes could estimate the difficulty of subarachnoid block. The larger width has shown to have lower number of attempts and passes.

The limitations of the study are that the anaesthesiologist performing the procedure cannot be blinded due to the nature of the study.

The population in study has relatively suboptimal ultrasound image quality. The anatomical surface landmarks were not palpated in either group and hence a direct comparison to landmark guided techniques cannot be made. The width of the posterior to anterior complex was not assessed to estimate the difficulty of the procedure in each patient.

Conclusion:

Real time ultrasound guided spinal anaesthesia helps in patients with known difficult spinal anatomy and age-related changes which can otherwise be challenging by traditional blind methods. The total duration taken for successful lumbar puncture remains the same irrespective of the ultrasound technique used, with pre procedural ultrasound taking longer time for identification of the subarachnoid space and real time ultrasound taking longer time from skin prick to cerebrospinal fluid backflow. I strongly recommend pre procedural ultrasound for spinal anaesthesia in the geriatric population.

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References

1. Chin KJ, Ramlogan R, Arzola C, Singh M, Chan V. The utility of ultrasound imaging in predicting ease of performance of spinal anaesthesia in an orthopedic patient population. Reg Anesth Pain Med 2013;38:34-8.
2. Qu B, Chen L, Zhang Y, Jiang M, Wu C, Ma W, et al. Landmark-guided versus modified ultrasound-assisted Paramedian techniques in combined spinal-epidural anesthesia for elderly patients with hip fractures: a randomized controlled trial. BMC anesthesiology. 2020;20(1):248–248.
3. Conroy PH LC, McCartney CJ, McHardy PG. Real-time ultrasound-guided spinal anaesthesia: A prospective observational study of a new approach. Anesthesiol Res Pract 2013;2013:525818. doi: 10.1155/2013/525818.
4. Chong SE, Mohd Nikman A, Saedah A, Wan Mohd Nazaruddin WH, Kueh YC, Lim JA, et al. Real-time ultrasound paramedian spinal anaesthesia: Evaluation of the efficacy and the success rate of single needle pass. Br J Anaesth 2017;118:799-801.
5. Chin KJ, Perlas A, Chan V, Brown-Shreves D, Koshkin A, Vaishnav V. Ultrasound imaging facilitates spinal anaesthesia in adults with difficult surface anatomic landmarks. Anesthesiology. 2011;115:94–101.
6. Chin KJ, Perlas A, Singh M, et al. An ultrasound-assisted approach facilitates spinal anesthesia for total joint arthroplasty. Can J Anaesth. 2009;56:643–650.
7. Chin KJ, Karmakar MK, Peng P. Ultrasonography of the adult thoracic and lumbar spine for central neuraxial blockade. Anesthesiology. 2011;114:1459–1485.
8. Chen L, Huang J, Zhang Y, Qu B, Wu X, Ma W, Li Y. Real-time ultrasound–guided versus ultrasound-assisted spinal anesthesia in elderly patients with hip fractures: a randomized

controlled trial. Anesthesia & Analgesia. 2022 Feb 1;134(2):400-9.
9. Niazi AU, Chin KJ, Jin R, Chan VW. Real-time ultrasound-guided spinal anesthesia using the SonixGPS ultrasound guidance system: a feasibility study. Acta Anaesthesiol Scand. 2014;58(7):875-81.
10. Chong SE, Mohd Nikman A, Saedah A, Wan Mohd Nazaruddin WH, Kueh YC, Lim JA, et al. Real-time ultrasound paramedian spinal anaesthesia: Evaluation of the efficacy and the success rate of single needle pass. Br J Anaesth 2017;118:799-801.
11. Brinkmann S, Tang R, Sawka A, Vaghadia H. Single-operator real-time ultrasound-guided spinal injection using SonixGPS: A case series. Can J Anaesth 2013;60:896-901.
12. Srinivasan KK, Leo AM, Iohom G, Loughnane F, Lee PJ. Pre-procedure ultrasound-guided paramedian spinal anaesthesia at L5-S1: Is this better than landmark-guided midline approach? A randomised controlled trial. Indian J Anaesth 2018;62:53-60.
13. Khemka R, Rastogi S, Desai N, Chakraborty A, Sinha S. Comparison od ultrasound imaging in transverse median and parasagital oblique planes for thoracic epidurals: A pilot study. Indian J Anaesth 2016;60:377-81.
14. Lin GX, Suen TK, Quillo-Olvera J, Akbary K, Hur JW, Kim E, Park EJ, Kim JS. Dimensions of the spinous process and interspinous space: a morphometric study. Surgical and Radiologic Anatomy. 2018 Dec;40(12):1383-90.
15. Liu Y, Qian W, Ke XJ, Mei W. Real-time ultrasound-guided spinal anesthesia using a new paramedian transverse approach. Curr Med Sci. 2018;38:910–913.