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To study efficacy of ultrasound guided paramedian technique in administering spinal anesthesia

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Abstract
Objective: Use of Ultrasound (US) to insert spinal needle for administrating Spinal Anaesthesia (SA) is the newer technique with limited literature available about its efficacy and safety. It overcomes the complication raised due to blind technique of SA. Preprocedural US image in elderly patient having technically difficult anatomy has not been studied during SA.
Methodology: Two groups received either conventional landmark guided approach SA (group C, n=37) or US guided paramedian approach (group P, n=37) for SA. Technical difficulty assessment and complication rate were recorded during the procedure.
Results: Failure rate between both groups (C and P) were (0% vs. 29.7%) respectively. Number of attempts and passes was significantly more in paramedian approach. ($p<0.001$, $p<0.01$) Alternative techniques were used in 11 patients in group P. Haemorrhagic tap was noticed in 2 patients in group C and 4 patients in group P.
Conclusion: Administrating SA in paramedian approach via US is difficult and increase complication rate. There were several instances where despite good US views of vertebral canal technical difficulty was encountered.

Keywords: spinal anaesthesia, ultrasound, Paramedian technique

1. Introduction
Any advancement to improve the safety and efficacy of spinal anaesthesia (SA) will impact millions of patients worldwide. Use of ultrasound (US) to facilitate SA is a newer challenging technique due to the presence of bony spinal canal and the depth of the target tissue. Literature revealed US improves the precision, safety and efficacy of neuraxial techniques. Number of passes and attempts of needle insertion are used as markers to assess safety and efficacy. Multiple passes and attempts of needle insertion are associated with a greater incidence of post dural-puncture headache, paraesthesia and neuraxial hematoma. To avoid these complications, use of pre- procedural US is recommended for SA in patients with difficult surface anatomic landmarks [1].

2. Material and Methods
This was a prospective, randomised controlled study performed from November 2017 to May 2018 at a tertiary level teaching hospital. After approval by institutional ethics committee and approval of clinical trial registration of India registration (CTRI/2017/11/010545), patients aged 50 years and above planned for elective surgeries under SA were included in the study. Those with contraindications to SA (allergy to local anesthetic, coagulopathy, local infection, and indeterminate neurological disease) were excluded from the study. The patients were randomized using random number generating software to undergo either conventional landmark-guided SA (group C) or preprocedural ultrasound-guided paramedian SA (group P). In both groups, SA performed by second year trainee and being supervised by experienced anaesthesiologist. Patients in both groups were then positioned sitting on a level trolley with feet resting on a foot rest. Dural puncture was performed with a 25 gauge Quincke (3.5 inch/8.9 cm) spinal needle using the midline approach in group C. The needle was advanced until loss of resistance is obtained, signifying entry into the subarachnoid space. In group P, A standard curvilinear 2-5 MHz transducer attached to US device (sonosite-M Turbo) was applied to the patient's back, lateral to midline. The US image was optimized by setting an appropriate scanning depth (6-10 cm), selecting a transducer frequency and adjusting the gain to obtain the best possible image. The sacrum was identified first and then the probe was moved cephalad in the paramedian axis with a 10-15 degree tilt toward the midline. The lumbar laminae L5 and interlaminar space between L5 and S1 was noted and the probe was positioned with its midline point directly above the selected space. The transducer was then rotated 45 degree towards the midline into an oblique paramedian sagittal view subsequent interspinous space was identified by counting the interlaminar spaces in a cranial direction. The interspinous space at which the clearest image of the anterior complex (ligamentum flavum dura complex) and posterior complex (posterior longitudinal ligament) obtained was selected. At the selected interspace, and with the probe positioned to obtain the clearest ultrasound image, a skin marker was used to mark the midpoint of the long border of the probe and the midpoints of the short borders of the probe. The medial angulations of the probe was also noted to facilitate guiding the insertion of the spinal needle, at the same horizontal level as the midpoint of the long border of

the probe, the midpoint of the line drawn between the 2 short border midpoints of the probe was used as paramedian insertion point for the spinal needle. Ultrasound gel near the selected skin puncture site was carefully removed using sterile gauge prior to needle insertion. In both groups, after 4 attempts were unsuccessful alternative method was used. The number of passes (defined as the number of forward advancements of the spinal needle in a given interspinous space, i.e., withdrawal and redirection of spinal needle without exiting the skin) and number of spinal needle insertion attempts (defined as the number of times the spinal needle was withdrawn from the skin and reinserted) were noted. Any radicular pain, paraesthesia, or blood in the spinal needle was also noted.

Categorical data were analyzed using the chi square test. Normally distributed parametric data were analyzed using Student t test. All tests were 2-tailed. For patient characteristic variables and primary and secondary outcome variable, a 2-tailed $P < 0.05$ was considered significant and 95% CIs were reported. SPSS was used for statistical analysis.

3. Observation and Results

Demographic parameters and clinical characteristics were comparable between the groups. (Table 1) Most of patient in ASA grade I. Thirty seven patients were randomized to each group. The results for first needle attempt success rate and first needle pass success rate were (54% vs. 35%) with p value 0.001 and (16.2% in each group). Failure rate between both groups were (0% vs. 29.7%) respectively. (Table 2) Number of attempts and passes was significantly more in paramedian approach. ($p<0.001$, $p<0.01$) Alternative techniques were used in 11 patients in group P. Haemorrhagic tap was noticed in 2 patients in group C and 4 patients in group P.

Table 1: Demographic profile and baseline clinical characteristics of patients in both the group, ASA- American society of anaesthesia.

Parameter		Group C (=37)	Group P (=37)	p-value
Age in years		61.1 ±9.8	57.3 ±6.37	0.05
Male/female		27/10	22/15	
Weight (Kg)		57.0 ± 8.6	57.5 ± 8.1	0.83
ASA Status	I	34	32	
	II	3	5	

#all values expressed as mean ± SD or as expressed otherwise

Table 2: Showing technical difficulty between two groups

Parameter		Group C (=37)	Group P (=37)	p-value
Number of attempts		1.5±0.6	2.3±1.2	0.001
Number of passes		2.5± 1.07	3.2± 1.5	0.01
Number of attempts	1	20	13	
	2	15	9	
	3	2	4	
	4	0	11	
Number of Passes	1	6	6	
	2	13	5	
	3	12	11	
	4	4	3	
	5	2	12	

4. Discussion

Midline approach is most routinely used for SA, but in elderly patients (age 50 years and above which was our study population) spinal ligament are calcified and may present as difficult to get space for SA. This is reason we took elderly patient for this study.

Studies done so far shows preprocedural US imaging of the spine can clearly reduce the technically difficulty of lumbar neuraxial blockade, particularly in patients with challenging anatomy and may improve the clinical efficacy and safety but insufficient data to support routine use of US in all patients. Study suggested that greater chance of first-attempt success and consequently lesser chances of complications would be more likely in patients having easily palpable spinous processes and those who fully flexed their spine [2]. Chin and colleagues prospective cohort study results showed that despite difficult to palpate landmarks in 38% patients by preprocedural US assisted median approach the first needle attempt success rate and first needle pass success rate were 84% and 52% [3]. K. Srinivasan and colleagues prospective randomised controlled trial study compared first needle attempt success rate and first pass success rate between conventional surface landmark guided median technique (as our group C) and preprocedural US assisted paramedian approach (P group).The results for first needle attempt success rate and first needle pass success rate were (60% vs. 84%) with p value 0.0075 and (40% vs. 28%) with p value 0.21 which was statically not significant. Failure rate between both groups were (12% vs. 4%) respectively [4].

In present study there is few limitations. In our study needle insertion is not guided by US in real time, but rather by skin markings made with assistance of US. Secondarily, population studied in present study was elderly patients and they may have degenerative spinal disease present directing an US beam or needle into vertebral canal may be physically difficult or impossible. There is also an element of tissue distortion when performing the US scan particularly in elderly, who often have loose and mobile skin. Thirdly, skin marking does not indicate the caudad to cephalad angle at which the needle must be advanced in a paramedian approach. This can be estimated by a probe tilt required to produce an optimal image of interlaminar space.

5. Conclusion

The present study concluded that administrating SA in paramedian approach via US is difficult and increase complication rate. We believed it was a valuable skill to acquire. There were several instances where despite good US views of vertebral canal technical difficulty was encountered. Hence, further research into the learning curve associated with US assisted central neuraxial blockade to be explored.

6. References

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