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Original Research Article

Ultrasound guided technique versus landmark technique for caudal epidural block in children: A randomized controlled study

Samakshi Singh Dhadwal^{1,*}, Anjali Bhure¹, Sumita Bhargava¹¹Dept. of Anaesthesiology, NKP Salve Institute of Medical Sciences & Research Centre, Lata Mangeshkar Hospital, Nagpur, Maharashtra, India

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ABSTRACT

Aims and Objectives: The aim of this study was to compare the two modalities of performing caudal block – ultrasonography guidance and conventional landmark technique in terms of time taken to perform the block, number of attempts to perform the block, block success at first puncture, haemodynamic changes and complications.

Settings and Design: The study was conducted in Department of Anaesthesiology, NKP Salve Institute of Medical Sciences and Research Centre and Lata Mangeshkar Hospital, Nagpur. It was a prospective randomized single blinded study.

Materials and Methods: This study was conducted in 62 grade ASA I and II patients of both sexes between age group of 2 - 8 years posted for elective surgeries below the level of umbilicus. Patients were randomized into 2 groups: Group C (Conventional technique) (n = 31) and group U (Ultrasound technique) (n=31). Caudal solution was prepared as Inj 0.2% Ropivacaine with Inj Fentanyl 2 mcg/kg with dosage according to Armitage formula, and was administered to both groups.

Measurements: The block performing time, the block success rate, the number of needle puncture, the success at first puncture and the complications were recorded.

Statistical Analysis: The analysis was 2 tailed and significance level was set at 0.05.

Results: The mean block performance in group C was 39.3 ± 10.9 seconds while that of the Group U was 52.2 ± 11.4 seconds ($P = 0.001$). The time taken for identification of the caudal epidural space in Group C was 15.74 ± 8.05 seconds while that of the Group U was 24.26 ± 8.89 seconds ($p = 0.0002$). There was no significant difference noted in the number of attempts taken for the block in between both the groups. C group had a success rate of 61.29% in the first attempt while U group has a success rate of 90.32%. ($p = 0.008$). C group had a success rate of 83.87% while U group has a success rate of 100%. ($p = 0.008$). The only complication seen in the study was subcutaneous bulging which was seen significantly more in patients of C group compared to U group. Subcutaneous bulging was seen in 8 patients of C group and in 2 patients of U group.

Conclusions: Despite the limitations in central neuraxial anesthesia we recommend the use of ultrasound since it reduces the complications and increases the success rate of first puncture in paediatric caudal injection.

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1. Introduction

Surgery is associated with painful stimulus which leads to stress response.¹ Several methods have been employed in paediatric pain relief with different degrees of success.

* Corresponding author.

E-mail address: samakshisingh92@gmail.com (S. S. Dhadwal).

Amongst them, paediatric regional anaesthesia is one of the most valuable and safe tools to treat perioperative and post-operative pain and is an essential part of modern anaesthetic practice. Caudal block is one of the most preferred regional anesthesia methods in pediatric population.² Ultrasound guided technique offers a number of advantages for nerve blockade over conventional landmark technique for caudal epidural block. Studies report varying success rates with the use of ultrasound for caudal blocks in paediatric anaesthesia.³ However, it is not freely available in our country which makes conventional landmark technique more popular. Hence we performed an observational study to compare the two techniques.

2. Materials and Methods

The study was conducted in the department of anesthesiology of a tertiary care academic hospital in central India over a period of 2 years. We included a total of 62 children, ASA I-II, aged between 2 and 8 years, who were scheduled for elective surgery below the level of umbilicus. The ethical committee approval was obtained. The children were selected preoperatively at the time of preanaesthetic assessment, procedure was explained to the guardian and written consent was obtained.

Block performing time was defined as the period from the identification of the sacral hiatus to completion of local anaesthetic administration. Time required to identify sacral hiatus in the ultrasound group was defined as, the time taken starting from placement of USG probe over the skin overlying the sacral hiatus to visualization of the sacral hiatus on the screen. In the conventional method group, time taken for identification of the sacral hiatus was defined as time taken to locate the sacral hiatus by palpation.

The first puncture success rate was defined as reaching the sacral canal or sacral hiatus with a single-needle orientation on the first puncture without any withdrawal from the skin.⁴

The block success was evaluated according to the intra-operative hemodynamic parameters. Defined as absence of increase in heart rate, systolic blood pressure and respiratory rates more than 20% of the basal levels following surgical incision. In case of a unsuccessful block, Inj Paracetamol 15mg/ kg iv was administered as rescue analgesia.

The subjects were allocated to two treatment groups using computer generated statistical software, RALLOC version 7 by Minitab corporation. Group allocation was shared with the anaesthetist who performed the block in a sealed opaque envelope. The research fellow evaluating the caudal block was blinded to group allocation. The block performance time was noted down by a colleague assisting the anaesthetist performing the block, the data was then handed over to the blinded observer without revealing the technique group. A blinded observer collected the data.

Caudal block was performed in Group C by conventional palpatory method. The sacral cornua and the sacral hiatus were palpated. Under all aseptic precautions, a 22-gauge needle was inserted into the skin at a 60–75 degree angle until the sacrococcygeal membrane was passed with a “pop”. Then, the angle of the needle was reduced to 25–30 degrees and inserted further for 2–3 mm, entering into the sacral canal. Only after aspiration and confirming the absence of any blood or cerebrospinal fluid (CSF), local anaesthetic was injected, doing frequent aspirations. In case if the needle touching the bone, CSF or blood aspiration or subcutaneous tissue swelling, the angle of the needle was changed and the intervention was repeated.

In USG group (Group U) after sterilization of the region, sacral cornua and hiatus were visualized in transverse plane using low frequency linear probe. The probe was then rotated to 90 degrees to the longitudinal plane and sacrococcygeal ligament and caudal canal were visualised. Using in-plane technique a 20-22 gauge needle was inserted through skin over lying sacrococcygeal ligament. The needle tip was continuously visualised in real-time till the tip entered sacral canal. After confirming the absence of any blood or CSF on aspiration, local anaesthetic was injected. The surgical incision was made 10 min after administering caudal block in both groups.

All conventional and ultrasound-guided caudal blocks were performed by the same experienced anaesthesiologist. Block performing time, number of needle punctures, success at first puncture, hemodynamics and procedural complications were noted. Systolic & diastolic blood pressure, mean arterial pressure, heart rate, respiratory rate and oxygen saturation of the patients was recorded every 5 min for 30 minutes after that every 10 mins till the end of the surgery.

Data was entered in MS Excel, coded and analysed in statistical software RALLOC version 7 by Minitab corporation. The qualitative variables were expressed in terms of percentages and the difference between two proportions was tested by fisher's exact or chi square test. The quantitative variables were expressed either in terms of mean and standard deviation or categorised and expressed in terms of percentages. The difference between the two means was tested using student t test. All the analysis was 2 tailed and significance level was set at 0.05.

3. Observation and Results

There was no significant difference in between both the groups with respect to the demographic parameters such as age, weight, height and ASA grading. But the time taken was significantly higher in ultrasound group (52.2 ± 11.4 sec) as compared to landmark technique (39.3 ± 10.9 sec). However, the success on first attempt was higher in ultrasound group (U group) (90.32%) as compared to landmark technique group (C group) (61.29%). The success

rate of the block was 100% in U group as compared to a success rate of 83.87% in the C group which was significant. (Table 1)

The hemodynamic changes in the form of heart rate, respiratory rate, mean blood pressure, systolic and diastolic blood pressure, and oxygen saturation were recorded from the first minute of the removal of the needle to every 5 min up to 30 minutes and then every 10 minutes till the end of the surgery, and showed no significant differences in between the two groups.

Subcutaneous bulging was seen significantly more in patients of C group (25.81%) compared to U group (6.45%). There was no vascular puncture or dura puncture seen in either group.

Table 1: Comparative age, height, weight, ASA grading, success on 1st attempt, time taken to perform block, rate of successful block in two groups

Parameter	Group C	Group U	p value
Age (yr)	4.64+1.56	5.06+1.89	NS
Height (cm)	109.06+9.67	111.32+13.23	NS
Weight (kg)	17+3.34	17.97+3.91	NS
ASA grading	29/2	30/1	NS
Time taken (sec)	39.3	52.2	0.0001
Success at first attempt (%)	61.29	90.32	0.008
Success rate of block (%)	83.87	100	0.008

NS- not significant

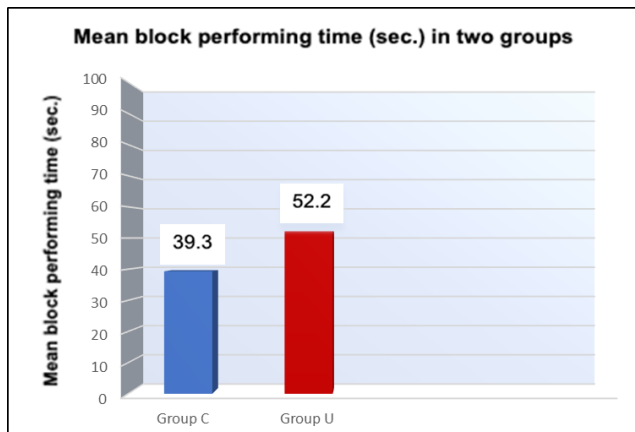


Fig. 1: Mean block performing time (sec.) in tow groups

4. Discussion

Reliability of landmark technique for caudal block in infants and children has been questioned by many.⁵ Equiangular triangle, used for the identification of sacral hiatus, has been called a myth in children.⁶ However not many studies have been done on comparison of landmark technique and

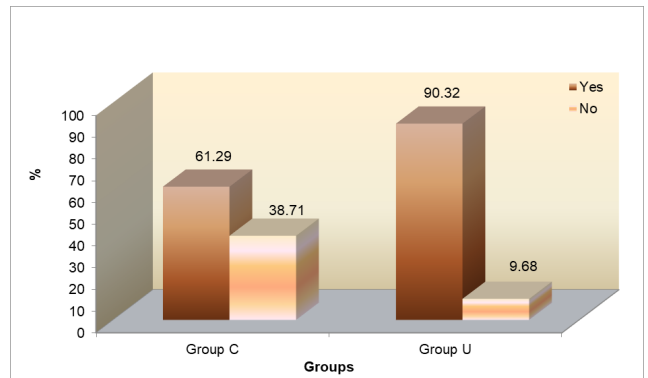


Fig. 2: Group-wise distribution of subjects according to success at first attempt

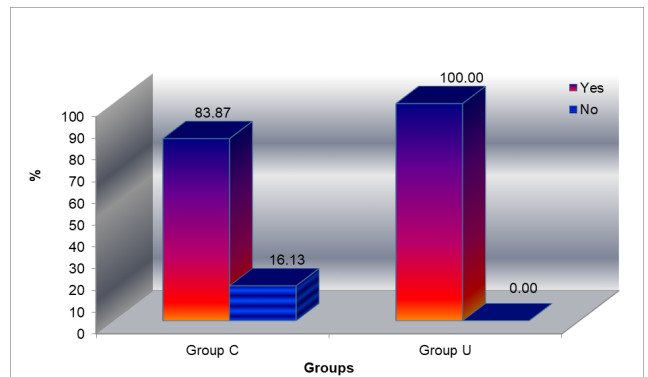


Fig. 3: Group-wise distribution of subjects according to success rate of block

ultrasound guided caudal injection in children.

There was significant difference noted in the block performance time in between the two groups. The mean block performance time for Group C was 39.3 ± 10.9 seconds while that of the Group U was 52.2 ± 11.4 seconds (P = 0.001). Similar pattern was observed in most of the other studies as well, which indicates a comparatively longer timeframe required for USG guided procedures.

L.-Z. Wang et al observed a swifter execution of block with the use of ultrasonography, which was mainly due to fewer complications encountered during the procedure.⁷ Ahiskalioglu A et al. and Karaca et al demonstrated that the duration of procedure was similar between the two groups.^{4,8} Erbüyünet al, Riaz et al, Nanjundaswamy et al observed a longer block performing time in group U compared to group C.^{3,9,10} This finding was similar to our study. The increased time taken with USG block may be successfully cut short with more practice. (Table 2)

Studies performed by A. Ahiskalioglu et al, Erbüyün et al, Riaz et al, L.-Z. Wang et al and Karaca et al recorded a higher first puncture success in ultrasound-guided group similar to our study which recorded a first puncture success rate of 90.32% in the ultrasound group compared to 61.29%

Table 2: Showing comparative mean block performing time in different studies

Study	Mean Block Performing Time (in seconds)	
	Ultrasound guided	Conventional
L.-Z. Wang et al	145 ± 23	164 ± 31
Erbüyünet al	41.6 ± 32.6	26.1 ± 15.6
A. Ahiskalioglu et al	109.9 ± 49.7	103.1 ± 45.1
Karaca et al	9.72 ± 3.25	9.87 ± 3.23
Riaz et al	110.8 ± 16.1	63.6 ± 13.1
Nanjundaswamy et al	462.6	356.4
Present Study	52.2 ± 11.4	39.3 ± 10.9

in palpatory group.^{4,7–10}

In the study of Li-Zhong Wang et al.⁷ a higher first puncture success was observed with the use of ultrasonography (92.8%) compared to the conventional method (60%) which was mainly due to fewer bloody punctures and subcutaneous bulging i.e. lower number of complications. Another reason for the higher first puncture success rate was that bone contact usually necessitated repeating the puncture in Group C; however, it just necessitated a slight withdrawal of the needle in Group U. They concluded that higher first puncture success rate means that the use of ultrasonography can decrease the incidence of puncture-related complications.

Study of Liu JZ, et al.¹¹ also showed results similar to our study. They performed their study on 102 patients, with 52 patients in ultrasound group and 50 in control or traditional technique group. They concluded that success in first attempt and success of block were better in ultrasound group.

In consistency with the results of other studies, our study also showed a higher success rate of block (100%) in the patients who were given block by USG guided technique, in comparison to those given with conventional technique (83.3%).

Table 3: Showing comparison in different studies with respect to the block success

Study	Successful block (n, %)	
	Ultrasound guided	Conventional
A. Ahiskalioglu et al	66 (97%)	62 (93%)
Karaca et al	128 (96.2%)	126 (94.7%)
Riaz et al	(90%)	(67.5%)
Nanjundaswamy et al	(92.1%)	(81.8%)
Present Study	31 (100%)	26 (83.8%)

When comparing complications occurring in the groups of conventional sacral canal injection and USG guided

sacral hiatus injection, akin to results of all other studies, our study also found a much lower complication rate in ultrasound guided technique.

5. Limitations

The incidence of complications may not be correctly determined in groups with small sample size, as was the limitation in our study.

As a single performer executed all the procedures the results may not be applicable to all providers.

Further studies are warranted with other local anaesthetics in varying concentrations, doses, or additives, with ultrasound guided technique in other surgical procedures.

6. Conclusion

Ultrasound visualization can confirm inaccurate placement of needle tip and local anesthetic and prevent technical failure. Ultrasonography has a slight advantage over landmark technique in terms of a greater number of successful blocks, lesser complications and more haemodynamic stability.

Ultrasound visualization, a simple noninvasive technique, should be used routinely in the placement of caudal epidural in infants and children.

7. Source of Funding

None.

8. Conflict of Interest

The authors declare no conflict of interest.

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Author biography

Samakshi Singh Dhadwal, Junior Resident

Anjali Bhure, Professor and Head

Sumita Bhargava, Associate Professor

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