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Original research article

A study to compare the success rate of block and puncture frequency of ultrasound guided with traditional method for caudal epidural anaesthesia in paediatric patients aged 1-11 years

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Abstract

The use of ultrasound in regional anaesthesia is being increasingly used in adult and paediatric patients recently. Chances of bony ossification in children are less as compared to adults. Ultrasound imaging helps to delineate sacral and caudal anatomy. It also helps in guiding of caudal needle insertion and to visualize the caudal injectate. Hence ultrasound serves as an important tool in caudal epidural blocks specially in children. After obtaining the approval of ethical committee and parental written informed consent, a total of 70 children undergoing elective lower abdominal surgeries under caudal epidural anaesthesia were included in the study. After having met inclusion and exclusion criteria, patients were randomized based on computer generated randomization table into one of the two groups. Group A-Caudal block by traditional method and whoosh test. Group B-Caudal block using ultrasound. In our study, percentage of successful blocks were comparable in group A (31 of 35) and group B (35 of 35) and the difference was statistically nonsignificant (p= 0.12). In the present study motor response after block was seen in only 4 patients in group A while none in group B and hence the difference was statistically nonsignificant (p<0.122). In the present study, the first puncture success rate was higher in Group B (33 of 35 patients) as compared to Group A (10 of 35 patients) and the difference was statistically significant (p value <0.0001). Second attempt was required in 20 of 35 patients in Group A as compared to 2 of 35 patients in Group B. In group A, 5 patients required third attempt while none in Group B required more than two attempts.

Keywords: Ultrasound guided, traditional method, caudal epidural anaesthesia, paediatric patients

Introduction

Caudal anaesthesia is the most frequently used regional anaesthetic technique in paediatric patients[1].Caudal epidural anaesthesia involves the injection of local anaesthetics into the epidural space through the sacral hiatus [2]. It serves as an important tool in controlling painand also for the anaesthetic management in children undergoing surgical procedures below the umbilicus [1].

Successful caudal blockade mainly depends upon the correct placement of needle in the caudal space[3].It benefits the patient by decreasing the intraoperative use of volatile anaesthetic agents and narcotics with less postoperative nausea and vomiting [1].

In the traditional caudal epidural technique, the needle is inserted at right angle to the skin surface until the sacrococcygeal ligament is pierced with the characteristic “give away’’ or “pop”. The needle is then lowered to 20-30 degree and advanced 2-3mm further into the sacral canal [4].

The risk of inadvertent dural or vascular puncture is more in paediatric age group as sacral hiatus is small and shallow in the conventional technique. To insert the needle correctly into the sacral canal with anatomic variationswill also be difficult sometimes [4].

The use of ultrasound in regional anaesthesia is being increasingly used in adult and paediatric patients recently [1]. Chances of bony ossification in children are less as compared to adults. Ultrasound imaging helps to delineate sacral and caudal anatomy. It also helps in guiding of caudal needle insertion and to visualize the caudal injectate [5]. Hence ultrasound serves as an important tool in caudal epidural blocks specially in children [1].

In the traditional method location of caudal epidural space is difficult and the number of punctures required are also more. Ultrasound helps in identifying the caudal epidural space accurately and with less number of punctures so will be beneficial in terms of accuracy and decrease in the incidence of complications.

The earlier studies done used ultrasound either to determine the optimal angle for needle insertion during caudal block or to visualise the cranial spread after caudal injectate but direct study comparing the

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efficacy of traditional method and ultrasound guided caudal block in children are lacking.
Hence we undertook the study to compare the success rate of block, puncture frequency and associated complications of ultrasound guided with traditional method for caudal epidural anaesthesia in paediatric patients aged 1-11 years.

Methodology

Source of data

- Patients between the age group of 1-11 yrs belonging to ASA Grade I and II scheduled for elective lower abdominal surgeries under caudal epidural anaesthesia were included.

Study design

A one year randomised controlled trial.

Selection criteria

Inclusion

- ASA physical status I and II
- Age between 1 to 11 years.
- Patients undergoing elective lower abdominal surgeries.
- Parental consent.
- Duration of surgery less than 1 hour.

Exclusion

- Patients allergic to local anaesthetics.
- Patients with coagulation abnormalities.
- Patients with spinal abnormalities and neurological deficits.
- Patients with infection at the site of caudal block.

Sample size

Total sample size is 70 patients.
Caudal block using ultrasound. -35.
Caudal block by traditional method and whoosh test. -35.
Randomisation was achieved by computer generated randomisation chart.
After obtaining the approval of ethical committee and parental written informed consent, a total of 70 children undergoing elective lower abdominal surgeries under caudal epidural anaesthesia were included in the study.
After having met inclusion and exclusion criteria, patients were randomized based on computer generated randomization table into one of the two groups.

- **Group A:** Caudal block by traditional method and whoosh test.
- **Group B:** Caudal block using ultrasound.

A thorough pre-anaesthetic evaluation was done. Detailed medical and personal history was obtained. A detailed physical examination was done. Patients were advised fasting for 6 hours. Routine investigations such as Hb, platelet count were carried out.
In the preoperative holding area, all patients were premedicated with inj glycopyrrolate 0.01mg/kg and inj. ketamine 5mg/kg IM.
Inside the operation theatre, standard non-invasive monitors were attached and baseline HR, BP, SpO2 were recorded. Anaesthesia was induced with sevoflurane 2-4% in oxygen via facemask and peripheral venous access was taken.
Under strict aseptic precaution the following procedure was carried out:
Group A: The patient was put in left lateral position. Sacral cornua and hiatus was palpated. The skin over sacrococcygeal ligament was punctured using 22 gauge hypodermic needle. The needle was inserted at 45-60 degree angle to skin surface and advanced until a pop (piercing sacrococcygeal ligament) was felt. The needle was then lowered to 20-30 degree angle to the skin and advanced 2-3 mm further into the sacral canal. A stethoscope was placed over lower lumbar spine and 2-3 ml of air was injected (whoosh test) which confirmed caudal epidural space. After negative aspiration for blood and CSF, 1 ml/kg of 0.25% bupivacaine was injected and then the patient was turned supine.
Group B: The patient was put in left lateral position. In the transverse plane, sacral hiatus was first scanned at sacral cornua using a portable sonosite ultrasound machine and a linear array transducer (13-6MHz) with a sterile sheath. The depth and gain settings were adjusted to obtain optimal image quality. Any abnormalities of sacrum and sacral hiatus were noted. In the longitudinal plane, the ultrasound image of hiatus was positioned in the middle of ultrasound screen. A 22 gauge needle was inserted at 45-60 degree angle to skin surface in an in-plane technique. Once the needle was visualized in the caudal space on the ultrasound imaging, 1 ml/kg of 0.25% bupivacaine was injected. It was confirmed by

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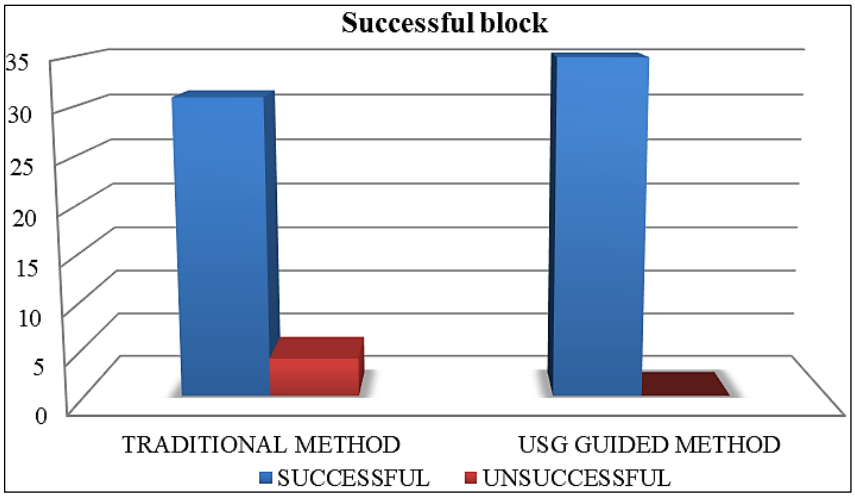
localized turbulence or dilatation of hiatus on ultrasound imaging. The patient was then turned supine. After performing the block in both groups sevoflurane was switched off and sedation was maintained with inj. midazolam 0.05mg/kg and inj fentanyl 1microgram/kg along with O_2 by face mask.
Motor movements were tested by pinprick method 10 min after LA injection and then skin incision was performed.

Results

Table 1: Successful block (Also refer Graph 4)

	Successful	Unsuccessful	Total
Traditional method	31	4	35
USG guided method	35	0	35
Total	66	4	70

p value by Chi-square test with Yate's correction is 0.1224 (ns)



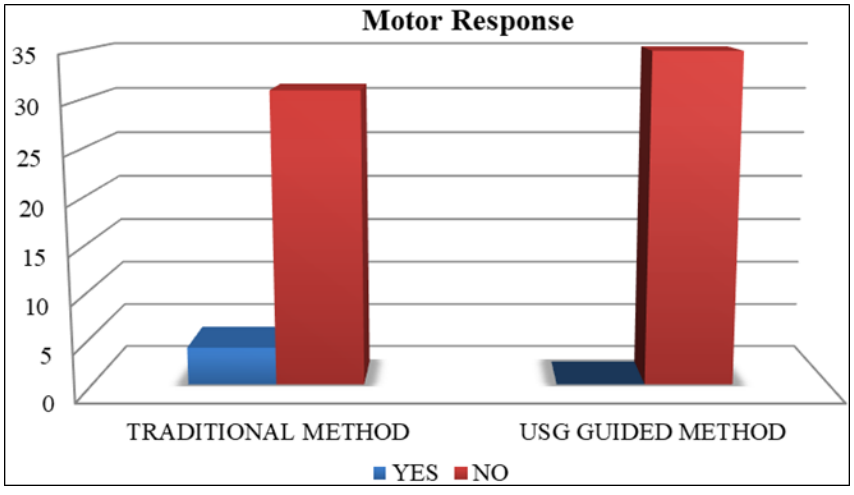
Graph 1: Successful block

In our study, percentage of successful blocks were comparable in group A (31 of 35) and group B (35 of 35) and the difference was statistically nonsignificant (p= 0.12).

Table 2: Motor response after block

	Yes	No	Total
Traditional method	4	31	35
USG guided method	0	35	35
Total	66	4	70

p value by Chi-square test with Yate's corection is 0.1224 (ns)



Graph 2: Motor response after block

In the present study motor response after block was seen in only 4 patients in group A while none in

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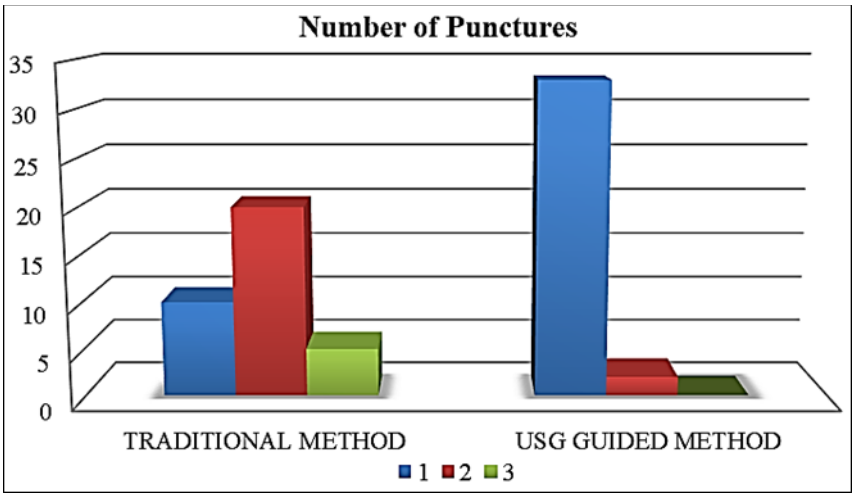
group B and hence the difference was statistically nonsignificant (p<0.122).

Table 3: Number of puncture attempts (Also refer graphs 7)

	1	2	3	Total
Traditional method	10	20	5	35
USG guided method	33	2	0	35
Total	43	22	5	70

p value by Chi-square test is <0.0001 (hs)



Graph 3: Number of Punctures

In the present study, the first puncture success rate was higher in Group B (33 of 35 patients) as compared to Group A (10 of 35 patients) and the difference was statistically significant (p value <0.0001). Second attempt was required in 20 of 35 patients in Group A as compared to 2 of 35 patients in Group B. In group A, 5 patients required third attempt while none in Group B required more than two attempts.

Discussion

A total of 70 children undergoing infraumbilical surgeries under caudal epidural anaesthesia were randomly allocated into two groups using a computer-generated randomization chart:

- **Group A:** Received Caudal block by traditional method and whoosh test (n=35).
- **Group B:** Received Caudal block using ultrasound (n=35).

In our study we found no statistically significant difference between group A and group B with regards to mean age (33.49±22.61 and 37.71±23.63 months respectively; p = 0.44), mean weight (11.31±3.97 and 11.74±3.48 kgs respectively; p = 0.63).

In our study puncture frequency was defined as number of attempts made to identify caudal epidural space. The first puncture success rate was higher in Group B (33 of 35 patients) as compared to Group A (10 of 35 patients) and the difference was statistically significant (p value <0.0001). Second attempt was required in 20 of 35 patients in Group A as compared to 2 of 35 patients in Group B. In group A, 5 patients required third attempt while none in Group B required more than two attempts. Higher first success rate is reflective of effectiveness of the approach or technique. In this case it reflects the usefulness of USG in locating the landmark accurately. Thus, it is obvious that use of USG guidance led to higher success rate in the Group B.

A study undertaken by Zhang YF, Wang LZ, Chang XY, Xiao XH (2013) to compare caudal block by sacral hiatus injection under ultrasound guidance with traditional sacral canal injection in 140 patients undergoing inguinal hernia repair. The first puncture success rate was higher in ultrasound group (Group H) than in traditional sacral canal group (Group C) i.e. 92.8% vs 60% respectively. Hence the findings of our study are similar to their study [4].

In another study done by Zhonghua YX, Liu JZ, Wu XQ, Li R (2012) comparing ultrasound imaging and classic method of surface landmarks and whoosh test in 102 ASA I-II paediatric patients undergoing urologic or perineal surgery under caudal epidural anaesthesia, the number of puncture attempts was 1.10±0.30 vs 1.56±0.63. Success rate at the first puncture attempt was 90.4% vs 66% in ultrasound group and classic method of surface landmarks and whoosh test respectively. Again, findings of our study confirm these findings of Zhonghua *et al.* [6].

Raghunathan, Schwartz D, Connelly NR in 2008 conducted retrospective observational study of caudal epidural injections on 83 pediatric patients (0-11 years) to determine the accuracy of caudal needle

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placement by swoosh test and ultrasonography. Eighty out of 83 patients (96.4%) had a successful caudal block as seen by minimal or no perioperative narcotic use, no response to surgical stimulation, presence of the motor blockade and patient comfortness in the PACU. 'Swoosh' test was compared with transverse 2D imaging and color flow Doppler as a confirmatory test for caudal injections. Ultrasound was significantly superior to 'swoosh' for sensitivity (96.3% vs 57.5%), negative predictive (40% vs 5.6 value) % and likelihood ratio (2.89 vs 1.73). As this study used swoosh test instead of whoosh test the success rate of block is slightly different from our study [5].

In our study, complications like bloody puncture, dural puncture, subcutaneous bulging were also assessed. However, none of these complications were noted in either group.

In a study conducted by Zhang YF, Wang LZ, Chang XY, Xiao XH (2013) the incidence of bloody puncture was 18.6% in sacral canal group (group C) and 5.7% in ultrasound group (group H) (p<0.05). Subcutaneous bulging occurred in six patients (7.1%) in Group C but none in Group H (p<0.05). This finding again showed the effectiveness of ultrasound in reducing the incidence of complications associated with caudal epidural block [4].

Hence ultrasound can be used as an adjuvant tool in performing caudal epidural block as it provides real-time images in guiding the needle into the caudal epidural space with fewer complications and lesser number of punctures and with almost 100% success rate as compared to traditional method of caudal block and whoosh test.

Conclusion

Our study showed that ultrasound guided caudal epidural block is a safe and reliable alternate to traditional technique as it provides real-time images in guiding the needle into the caudal epidural space and helps in visualizing the injectate. The most notable finding of our study was regarding the number of punctures needed to identify the caudal epidural space. The first puncture success rate was higher in ultrasound group as compared to traditional method of caudal block and whoosh test.

However, the overall success rate was similar in both groups. None of the complications like bloody puncture, dural puncture, subcutaneous bulging were noted in either group.

Ultrasound guidance being noninvasive, safe and providing real time images of sacral anatomy and caudal epidural space with high level of resolution, it can be used as an adjuvant tool in performing caudal epidural block in children undergoing elective lower abdominal surgeries.

References

1. Isabella, Michael Logan, Chandra, Santhanam S. Ultrasound guided central blocks in infants, children and adoloscents. Anaesthesiology news special edition; c2011 Oct. P. 29-36.
2. Carl PC, Tang SF, Hsu TC, Tsai WC, Liu HP, Chen MJ, *et al*. Ultrasound guidance in caudal epidural needle placement. Anaesthesiology. 2004;101;181-184.
3. Park JH, Koo BN, Kim YJ, Cho JE, Kim WO, Kil KH. Determination of the optimal angle for needle insertion during caudal block in children using ultrasound imaging, Paediatric anaesthesia journal; c2006. p. 946-949.
4. Wang LZ, Zhang YF, Chang XY, Xiao XH. A randomised comparison of caudal block by sacral hiatus injection under ultrasound guidance with traditional sacral canal injection in children, Jiaxing China. Paediatric anaesthesia journal. 2013;23:395-400.
5. Raghunathan KL, Schwartz D, Connelly NR. Determining the accuracy of caudal needle placement in children; a comparison of the whoosh test and ultrasonography. Paediatric anaesthesia journal. 2008;18:606-612.
6. Miller RD. Miller's Anesthesia 8th ed., Philadelphia: Elsevier Saunders; c2015.