ORIGINAL ARTICLE

The evaluation of upper leg traction in lateral position for pediatric caudal block

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ABSTRACT

Purpose: A well-functioning caudal block is an excellent adjunct to general anesthesia, but misplaced injection results in poor analgesia as well as possibility of serious morbidity. Therefore, the purpose of this study was to evaluate the effectiveness of leg traction on success rate of caudal block in lateral position in children. **Methods:** Two hundred children, age 2 months to 6 years, ASA I and II, who underwent lower abdominal surgeries were randomized in prospective controlled clinical trial study in two groups. After induction of General anesthesia, the caudal block was performed in the lateral position with upper leg traction (L-T-) or with the standard position (S-P) (leg flexed 90°). Hemodynamic changes, movement of lower extremity in response to surgical stimulus were evaluated. **Results:** There was no significant difference in caudal block's success rate between two groups at first attempt ($P=0.25$). In group (S-P) the procedure was successful in 60% of cases at first attempt, 25% at second,10% at third attempt and 5% failure of caudal block, whereas in the first group it was 75%, 20%, 1% and 4% of cases respectively. There were no significant differences in heart rate and blood pressure changes between two groups ($P>0.05$). **Conclusion:** The success rate of pediatric caudal block in upper leg traction did not differ from that of the standard position.

Key words: *Caudal block, lateral position, leg traction, pediatric*

INTRODUCTION

Caudal epidural blockade (CEB) is a widely used technique for perioperative pain management in children.[1] A well-functioning caudal block is an excellent adjunct to general anesthesia, but misplaced injection results in poor analgesia as well as possibility of serious morbidity.[2-4] In clinical studies, the success rate of CEB has been reported to be about 70-80% in adults.[5]

One of the important key factors of successful CEB may be a clear understanding of the normal anatomy of the sacral hiatus and the surrounding structures.[6-8]

The enhancement effect of the lateral position on the onset, maximum spread, and duration of caudal anesthesia in adult have been demonstrated.[9] Other studies showed effects of head tilt on the success rate of lumbar puncture in children undergoing spinal anesthesia and distribution of contrast medium in the epidural space after epidural puncture, respectively.[10,11] Some studies showed that changing position and fully flexing the leg influenced the location of the spinal cord and cauda equina in the subarachnoid space, especially at the lumbar level.[12,13]

There are no studies looking at the effect of leg traction on success rate of caudal block in children. We designed this prospective controlled, randomized study to assess the efficacy of leg traction in the lateral position on the success rate of the caudal block at the first attempt in children.

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METHODS

After obtaining the approval of the ethics committee and written parental informed consent, 200 children ASA physical status I and II, aged 2 months to 6 years scheduled for lower abdominal surgeries referred to children's hospital of Tabriz university of medical sciences, were randomized in prospective controlled clinical trial study using Ran List software. Children were excluded if they had any contraindication to caudal anesthesia; severe coagulation disorders, severe infection, hydrocephaly, true allergy to local anesthesia, uncorrected hypovolemia and abnormal superficial landmarks at the sacral level.

All children had intravenous access line before arriving at operating room. Patients were randomly allocated into two groups. Children (>10 kg) were premedicated with midazolam (0.02 mg/kg) intravenously before arriving at operating room.

All children were monitored by pulse oximetry, electrocardiogram, and noninvasive blood pressure cuff. After induction with lidocaine 1.5 mg/kg and propofol (2.5–3 mg/kg), an appropriate sized LMA was inserted. For maintenance of anesthesia isoflurane 1.5-2 % in a 50% N_2O – 50% O_2 was administered during spontaneous breathing.

After induction of general anesthesia, caudal block was performed in the first group (Leg_ Traction;L-T) in lateral position with upper leg traction (lower leg less flexed, 120° flexion of hip, and upper leg tracted frontward) [Figure 1], and in the second group (Standard Position; S-P) in standard lateral position (legs flexed 90°). We evaluated success rate of block at the first, second and third attempt.

Bupivacaine (0.25%) 1 ml/kg was used for caudal block. Caudal puncture was performed under aseptic precautions, usually with a pediatric caudal needle number 25 (Epican paed caudal B BRAUN). After sterile preparation and drape, place the needle into the skin in the midline at a 45° angle to the skin aiming cephalad. Loss of resistance, aspiration for blood and cerebrospinal fluid and electrocardiographic monitoring during injection were parts of the overall techniques for all caudal blocks. Systolic blood pressure, diastolic blood pressure, and heart rate were monitored every 5 minutes during surgery and in the recovery room. Surgery was performed 15 minutes after block. All the caudal blocks were done by the same attending anesthetist who had experience of more than ten years in pediatric anesthesia. All the lower abdominal surgeries were done by the same surgeon without significant difference in during of surgeries. Intraoperative changes in vital signs or lower extremity movement response to surgical stimulus were considered when deciding whether a caudal block was successful.

The primary outcome measure was caudal block success rate, defined as successful caudal puncture achieved at first attempt without redirection of the needle, stable hemodynamic signs during surgery. Correct placement of the needle was confirmed by loss of resistance and not intradermal injection. We defined unsuccessful caudal punctures as follows: if the needle had to be withdrawn and redirected, if the injection caused intradermal infiltration. Absent of caudal block despite caudal anesthetic administration was defined as failure of technique. Evaluation of success rate of block during surgery and recovery room has been done by an anesthetist who was blinded to the technique of caudal block. Changes in vital signs during recovery room were considered as success rate of block.

Figure 1: Picture of leg traction technique

Sample size and statistical analysis

We assumed the power study based on our previous experience. Assuming that our overall success rate of caudal puncture in the first attempt was 65%: a 20% increase in the success rate (from 65% to 78%) was of clinical relevance: α=0.05 and power=90%.The sample size were assumed 220 cases with regard these criteria. Demographic data were expressed as Means±SD and N (%). Mean of quantitative variables were compared using one way ANOVA, ratios between groups were compared using chi-square test or Fishers Exact test and changes during surgery were compared by repeated measurement of ANOVA test. Statistical analyses performed using SPSS.15/$_{win}$ software. Differences were considered statistically significant at the $P<0.05$ level.

RESULTS

200 children were included in the study, Data from 200 children were therefore analyzed: 100 in group 1(leg traction) and 100 in group 2 (standard position) [Figures 1 and 2]. There was no significant difference between two groups with respect to gender, mean age and mean weight [Table 1]. There were no differences in duration of surgery (16.90±2.46 min in group 1 vs 15.90±2.17 min in group 2, P=0.18) and duration of general anesthesia(32.1±2.88 min in group 1 vs 31.34±2.67 min in group 2, $P=0.17$).

In group (S-P) the procedure was successful in 60% of cases at first attempt, 25% at second attempt, and 10% at third attempt, whereas in first group (L-T) it was successful in 75%, 20%, 1% of cases respectively. The difference in success rate between two groups at first attempt was non-significant (*P*=0.25) [Table 2].

Systolic and diastolic blood pressure decreased during operation but the difference between two groups were not significant (*P*=0.17, *P*=0.11, [Figure 3]).

Heart rate changes between two groups were not significant (*P*=0.18, [Figure 4]).

Four patients in group L-T (4%), five patients (5%) in group S-P received intravenous fentanyl for pain relief during surgery, which were assumed as failure of block in two groups. There was no difference between two groups in failure of caudal block (*P*>0.5).

DISCUSSION

Sacral hiatus is shaped by incomplete midline fusion of the posterior element of the distal portion of the fifth or fourth sacral vertebra. The landmarks for sacral hiatus are the sacral cornua, the posterior superior iliac spines, and the coccyx.[6-8] Identification of the anatomic landmarks, loss of resistance on piercing the sacrococcygeal membrane, ease of inserting a needle or leading a catheter into the caudal canal, negative aspiration – containing solution, are the clinical guides used for successful caudal block placement.[12] On the other hand, several previous studies have suggested that epidural anesthesia may be affected by flexion and extension of the spine. One of the studies demonstrated that dorsal epidural pressure increased with extension and decreased with flexion at the lumbar level.[13] In another study, neck flexion and extension were found to strongly affect the distribution of contrast medium in the epidural space at the high thoracic level.[11]

Table 1: Demographic data

	Group 1 (upper leg traction)	Group 2 (standard lateral position)	*P* value
Sex			0.77
Male (%)	43 (43)	46 (46)	
Female (%)	57 (57)	54 (54)	
Age (years)	1.96±0.90	2.30±1.97	0.11
Weight (Kg)	11.73±2.40	12.49±4.04	0.10

Table 2: Block success rate

	1st attempt	2nd attempt	3rd attempt
Group 1 (leg traction)	75%	20%	1%
Group 2 (standard position)	60%	25%	10%
P value	0.25	0.13	<0.001

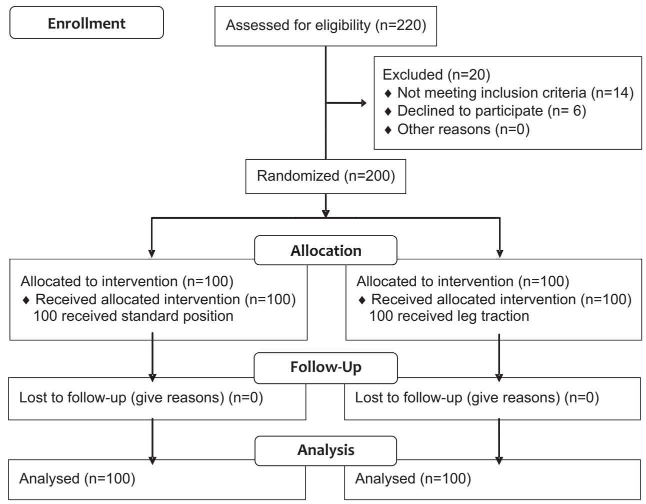

Figure 2: Trial profile

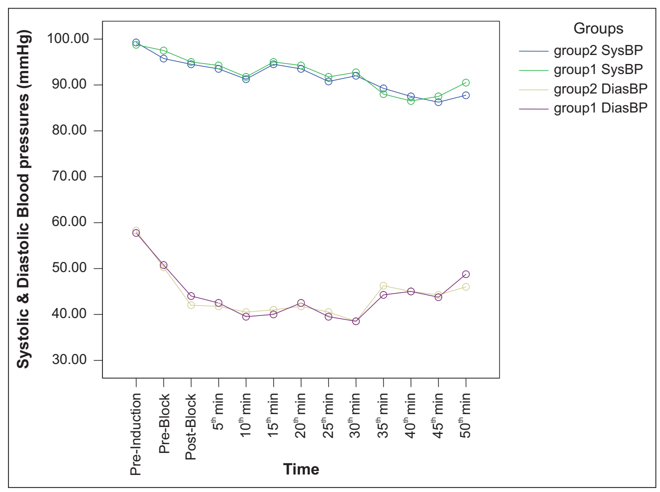

Figure 3: Variation in systolic (SBP) and diastolic (DBP) blood pressures in the both study groups by the time

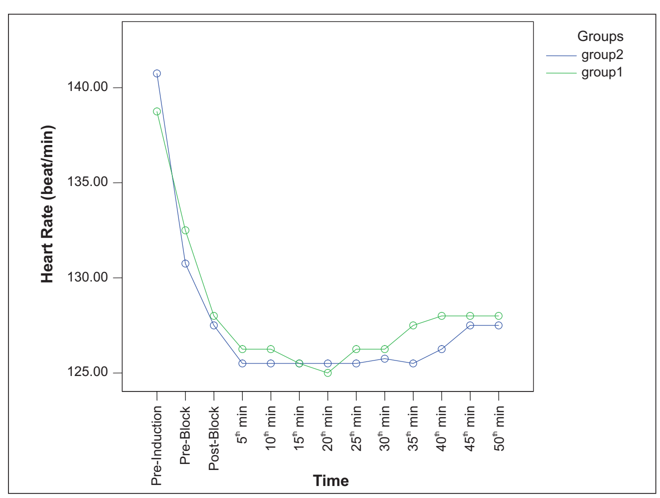

Figure 4: Variation in heart rate (HR) in both study groups by the time

This is the first controlled study that evaluates the influence of upper leg traction on the success rate of caudal block in children undergoing subumbilical abdominal surgeries. Results of this study showed that caudal success rate was higher in children in the lateral position with leg traction than in the standard position, but there was not significant difference between two groups. There are few studies on the effect of position on success rate of lumbar puncture in regional anesthesia of children. Apiliogullari *et al.* found that 45° head-up position in lateral position increased success rate of spinal anesthesia in infants.[10] Furthermore, Dalens and Hasnaoui reported that the success rate of single-shot caudal block via the sacral hiatus was relatively high, up to 90%, in children, but multiple puncture rates also reached as high as 25%. Therefore, repeated caudal punctures even after identification of sacral hiatus can occur.[14] The depth of caudal space is variably narrow.[15,16] Therefore, accurate identification of the hiatus and appropriate needle insertion angle is necessary to success in puncture through the hiatus.[15-17] In the present study, we thought that upper leg traction could help to identify and widen the hiatus space, to facilitate the insertion and to increase overall success rate of hiatus puncture. However, Raghunathan *et al*. found that ultrasonography was superior to the swoosh test as an objective confirmatory technique during caudal block placement in children.[12] This shows that ultrasonography can help identification and increasing of successful caudal puncture rate. Nonetheless, unavailability of sonography is a limitation of our study. We recommend our technique of upper leg traction be applied to caudal puncturing where no ultrasonography devices are available. There are no controlled and randomized studies on the influence of upper leg traction on the success rate of caudal block. To the best our knowledge, the present study is the first investigation to evaluate the effect of upper leg traction on success rate of caudal block in children.

Our study was limited by several factors. First, ultrasonography modality was not available. Ultrasound imaging can help to clarify the anatomy of injection site, and increase the success rate of caudal block. Second, the drug distribution following the caudal block was not determined. Therefore, the results may be influenced by the anesthesiologist's experience in pediatric anesthesia.

In conclusion it seems that the success rate of pediatric caudal block in upper leg traction did not differ from that of the standard position. Further studies using ultrasound imaging in this regard are needed.

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