

Analgesic efficacy of Ultrasound-Guided Caudal Block versus Pudendal Nerve Block in BRAKA - I Repair for Paediatric Hypospadias

Abrar Ahmed, Syed Qasim Rizvi, Muhammad Saad Sikander, Khalid Buland, Muhammad Huzaifa Shareef, Muhammad Saad Farooq

Department of Anesthesia, Combined Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To compare the efficacy of ultrasound-guided caudal versus pudendal nerve block analgesia in paediatric patients undergoing hypospadias.

Study Design: Quasi-experimental study.

Place and Duration of Study: Combined Military Hospital Rawalpindi, Pakistan from Mar to Sep 2022.

Methodology: Paediatric patients with ages ranging from 4-12 years with ASA Grade I/II planned for hypospadias repair were included. Sixty-eight patients were divided into Group-C (caudal block) and Group-P (pudendal nerve block), after randomization. Group-C patients received ultrasound-guided caudal block while pudendal nerve blockade was performed under ultrasound guidance in Group- P. Demographic variables, requirement of rescue analgesics, CHEOPS scoring at 0, 1, 2, 6 and 12 hours, and complications in the intraoperative period were recorded.

Results: Pain scores at the 6th and 12th hour were significantly reduced in Group-P compared to Group-C. Requirement of analgesia was lesser in Group P 01(2.9%) compared to 11(32.3%) in Group C with a *p*-value of 0.006. Out of 34 patients in Group-C 07(20.6%), patients encountered complications compared to Group-P, which had no complications.

Conclusion: Ultrasound-guided pudendal nerve block is superior to caudal block in providing adequate perioperative analgesia with fewer complications and decreased requirement of additional analgesic supplements.

Keywords: Analgesia, Caudal block, Children, Pudendal nerve block.

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INTRODUCTION

Paediatric surgeries pose a great challenge to surgeons due to their versatile, immature organs and structures with marked differences physiologically, anatomically and pharmacologically compared to adults.¹ The most commonly employed technique for anaesthesia in paediatric patients includes the instillation of local anaesthetic in the epidural space at the level of sacral vertebrae, also known as a caudal epidural block.² This method of providing analgesia is useful and effective for procedures that include surgery of the structures below the level of the umbilicus. The advantage of this technique over general anaesthesia is that the patient can breathe spontaneously, and such patients can be ambulated in the early post-operative post-operative period.^{3,4}

The risk of complications in neuraxial blockades led to the invention of peripheral nerve blocks, which have comparatively lower rates of complications than neuraxial blocks.⁵ The pudendal nerve originates from

the sacral ramus anterior division, giving branches to the inferior rectal region with further division into dorsal penile and perineal nerves.⁶ Blocking the nerve under vision is an effective technique with fewer complications and effective analgesia to the skin and surrounding structures innervated by the pudendal nerve. Recent advances advocate the use of a needle (nerve stimulator), which can initiate an electric stimulus and cause excitation of the nerves.^{7,8} This causes muscle contraction of the muscle that is innervated by the nerve stimulated. This modality provides an effective technique to localize the nerves and perform a regional block for perioperative analgesia and anaesthesia of the operative site.⁹

Ultrasound machines, on the other hand, can help to visualize the nerves effectively on the display screen. Installation of local anaesthetic into the vicinity of the nerves is more reliable for an effective block as compared to the traditional technique of injecting anaesthetic drugs via a landmark technique.¹⁰ This study compares the effects of ultrasound-guided caudal block versus ultrasound-guided pudendal nerve block undergoing BRAKA-I repair for hypospadias in paediatric patients.

Correspondence: Dr Abrar Ahmed, Department of Anesthesia, Combined Military Hospital, Rawalpindi Pakistan
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METHODOLOGY

The quasi-experimental study was conducted at Combined Military Hospital Rawalpindi, Pakistan from March to September 2022, after approval of the Ethical Review Committee (ERC No. 278).

Sample size was calculated using WHO sample size calculator keeping post-operative postoperative rescue analgesia required by 26% patients after the caudal block compared to 0% after the pudendal nerve block.¹¹

Inclusion Criteria: Patients of either gender, aged 4-12 years with ASA Grade I or II and planned for hypospadias repair, were included.

Exclusion Criteria: Patients with coagulation defects, neurological disorders, previous allergies to local anaesthetics, localized abscess or signs of infection at the site of block, liver disorder, psychiatric illness, congenital anatomical abnormality, were excluded.

Sixty eight patients were randomized into two groups, as Group-C (caudal block) and Group P (pudendal block) (Figure).

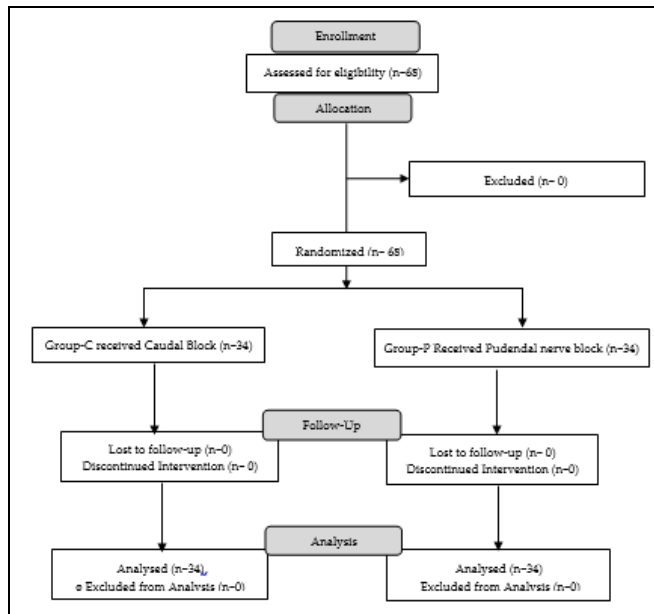


Figure: Patient Flow Diagram (n=68)

All participants were assessed before the procedure; the procedure was explained to the attendants based on history, examination and laboratory investigations. After obtaining written informed consent, fitness for the procedure was provided per the institutional protocol. Patients were admitted to the paediatric ward before surgery for monitoring and preparation. Nil per oral strategy for

08 hours before surgery was adopted, and patients were shifted to the operation theatre on the day of surgery. Intravenous hydration was done via a 20 G cannula placed on the upper limb under aseptic measures while monitors, including a non-invasive blood pressure cuff, pulse oximetry probe, three leads electrocardiography and a temperature probe, were attached for continuous monitoring intraoperatively.

After premedication, induction was done with an injection of Propofol @ 2mg/kg, followed by confirmation of ventilation. The airway was secured using a Laryngeal mask airway of an appropriate size depending on the weight of the patient. Maintenance of anaesthesia was done using Isoflurane @ 1-2 minimum alveolar concentration and a 50% mixture of air with oxygen.

After confirmation of airway control, patients from Group C were placed in the left lateral position. Under aseptic measures using a linear probe in nerve mode, the probe was placed in the posterior superior iliac spine line to visualize the sacral hiatus. After rotation of the probe to 90 degrees and placing it in a longitudinal direction, sacral cornu, and sacrococcygeal ligaments were identified. A block needle of 22 size 50mm long was used while the probe was in a longitudinal direction. The in-plane technique was adopted, and the needle was passed through the sacrococcygeal membrane; after ensuring the absence of free flow of blood or cerebrospinal fluid, 0.2mg/kg of bupivacaine 0.25% was administered, visualizing the flow of drug in the desired caudal epidural region.

After confirmation of a secure airway, Group-P patients were kept supine with their legs abducted and the soles of their feet touching each other. Using nerve mode under aseptic measures, the linear probe of the ultrasound machine was placed in such a way that the long axis of the probe was along a horizontal line that connected the anus with the ischial tuberosity. The ultrasound screen identified the rectum and the ischial tuberosity as hyperechoic areas. The ischiorectal fossa was identified as the area medial to the ischial tuberosity and lateral to the rectum. The pudendal artery was identified using the colour mode of the ultrasound. A block needle of 22g with a length of 50mm out of plane approach was adopted. Block needle was advanced under vision at a 15-degree angle into the ischiorectal fossa, and after confirmation of negative aspiration, 0.25% bupivacaine @ 0.2ml/kg was instilled into the region. The spread of the local anaesthetic in the ischiorectal fossa was a reliable

indicator of the correct administration of the local anaesthetic. The same procedure was done for the other side to block the pudendal nerves bilaterally.

Patients were observed for 15 minutes before the commencement of the surgical procedure in groups till the effect of the local anaesthetic. Monitoring was done throughout the intraoperative period, and an increase in the heart rate or the blood pressure of greater than 20% of the baseline values was the indicator of failure of the block. Rescue analgesia with intravenous paracetamol @ 15mg/kg was given if required.

Patients were extubated and shifted to post-anesthesia care units at the end of the surgical procedure. Monitoring was continued throughout the perioperative period. Postoperatively, the patient's pain assessment was done using the Children's Hospital of Eastern Ontario Pain Scale (CHEOPS). It ranges from a scale of 4-13, and a score greater than 7 indicates significant pain for which rescue analgesia was provided. This criterion includes crying, expressions of the face, verbal responses, posture and movement of the body and patients touching or pointing to the affected region.^{9,10}

Recorded variables in the post-operative period included the requirement of rescue analgesics and CHEOPS scoring at 0, 1, 2, 6, and 12 hours. Complications like bleeding, urinary retention, nausea, vomiting, etc., were recorded in both groups. Data was analysed using a Statistical Package for Social Sciences (SPSS) version 23. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test and Independent sample t-test were applied to explore the inferential statistics. The *p*-value of ≤0.05 was set as the cut-off value for significance.

RESULTS

The total number of patients included in our study was 68. In Group-C, the mean age of the patients was 6.78±2.12 years, and the mean age in Group-P was 7.06±2.39 years. The mean time to complete surgery in both groups was 53.63±6.34 minutes (Table-I).

Table-I: Age, Weight and Time of Surgery in Study Groups (n=68)

Variables	Group-C (n = 34) Mean±S.D	Group-P (n = 34) Mean±S.D	<i>p</i> -value
Age in years	6.78±2.12	7.06±2.4	0.612
Weight in kgs	20.6±4.5	22.35±5.2	0.141
Time of surgery in minutes	52.82±6.3	54.44±6.3	0.296

CHEOPS scoring was done to assess pain at 30mins, 1, 2, 6 and 12 hours. Pain scores at the 6th and 12th hour were significantly reduced in Group-P compared to Group-C, as shown in Table-II.

Table-II: CHEOPS Scoring at Intervals in Study Groups (n=68)

Cheops Intervals	Group-C (n=34) Mean±S.D	Group-P (n = 34) Mean±S.D	<i>p</i> -value
30mins	4.24±0.43	4.12±0.32	0.209
01 hour	4.06±0.24	4.03±0.17	0.562
02 hours	4.12±0.33	4.06±0.24	0.400
06 hours	4.29±0.46	4.03±0.17	0.003
12 hours	7.0±2.0	4.32±0.54	0.000

The requirement for analgesia was lesser in Group-P 01(2.9%) compared to 11(32.3%) in Group-C, with a *p*-value of 0.006. Out of 34 patients in Group-C 07(20.6%), patients encountered complications compared to Group-P, which had no complications. Table-III shows the requirement for analgesia and the number of complications in both groups.

Table-III: Requirement of Analgesia and Complications in Study Groups (n=68)

Variables	Group-C (n=34)	Group-P (n=34)	<i>p</i> -value
Analgesia	Yes 07(20.6%)	00	0.005
	No 27(79.4%)	34(100%)	
Complications	Yes 11(32.3%)	01(2.9%)	0.006
	No 23(67.6%)	33(97.15%)	

DISCUSSION

The quasi-experimental study was conducted in paediatric patients to compare the effectiveness of analgesia during BRAKA-I repair of hypospadias. Commonly employed caudal epidural block under ultrasound guidance was compared with pudendal nerve block under ultrasound guidance. Both techniques were effective in providing analgesia during the intraoperative period. However, results revealed that analgesia after pudendal nerve block prevailed for a longer time with lesser requirement of rescue analgesic medications as compared to the conventional caudal epidural technique. The incidence of complications was higher during the caudal epidural as compared to the pudendal nerve block. None of the patients encountered a life-threatening complication during the course. However, several studies reveal that the incidence of local anaesthetic toxicity is higher during caudal blocks and penile nerve blocks, revealing greater safety under

ultrasound guidance during pudendal nerve blocks.^{11,12}

The efficacy and superiority of ultrasound-guided pudendal nerve block have been evident in several studies.¹³ The usual technique of caudal epidural employed is a landmark technique in which there is a high possibility of block failure and complications like local anaesthetic systemic toxicity, and total spinal or high spinal anaesthesia, which can increase the morbidity and mortality in pediatric patients.^{14,15} A study revealed an increased success rate in the first attempt when ultrasound was used as a modality for caudal epidural analgesia compared to a landmark technique. Needle visualization and the spread of local anaesthetic areas were visualized and confirmed in 82% and 97.5% of the patients with ultrasound as opposed to a landmark technique where visual confirmation cannot be done.¹⁶

Similar to the results of our study, when pudendal nerve block was compared to the caudal epidural, the postoperative hospital stay was reduced in paediatric patients who underwent pudendal nerve block with a mean value of 96minutes as compared to caudal epidural blockade where the mean time to discharge from the hospital was 128minutes.¹⁷ A new modality of using a nerve stimulator for pudendal nerve block was also studied in comparison to ultrasound-guided pudendal nerve block, and the results revealed that both the techniques provided comparable and adequate analgesia in paediatric patients who underwent hypospadias surgery.¹⁸

Several modalities are in practice and under research to effectively provide pain relief and decrease the risk of mortality and morbidity in this age group due to their versatile nature and poor compensatory mechanism in response to complications. However, none of the techniques to date are considered gold standard.^{19,20} Our study proves that pudendal nerve block is more effective and reliable in terms of providing prolonged analgesia with fewer complications and decreasing the requirement for additional analgesics.

CONCLUSION

The ultrasound-guided pudendal nerve block is superior to the caudal block in terms of providing adequate perioperative analgesia with a lesser rate of complications and decreased requirement of additional analgesic supplements.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AA & SQR: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

MSS & KB: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MHS & MSF: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Analgesic efficacy of Ultrasound-Guided

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