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Comparison Between Caudal and Combined Caudal with Spinal Anesthesia in Paediatric Bilateral Inguinal Hernia Surgery

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ABSTRACT

Objective: To compare the analgesic efficacy and adverse effect profile of using caudal anaesthesia versus caudal combined with spinal anaesthesia for paediatric patients undergoing bilateral inguinal hernia surgery.

Study Design: Prospective longitudinal study.

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

Methodology: Eighty paediatric patients between ages 5-10 years requiring bilateral inguinal hernia repair were included in the study. The Caudal Group received 0.25% Bupivacaine per the Armitage regime at a 1 ml/kg volume to reach an effective sensory level of T10. The Combined Group received spinal anaesthesia at a dose of 0.3 mg/kg for >15 kg patients and 0.4 mg/kg for 5-15 kg patients in the L4-L5 epidural space for an effective spinal level of T10. Once the spinal was administered, the same caudal dose as per the caudal Group's Armitage regime.

Results: The total duration of block and subsequent reversal to the S1 level was 326.2±12.6 minutes in the Caudal Group versus 441.22±31.8 minutes in the Combined Group (p<0.001). The mean time for the first dose of analgesia for pain was required after 5.27±0.24 hours in the caudal versus 7.03±0.20 hours in the Combined Group.

Conclusion: We conclude that the combined caudal spinal approach offers better and superior pain control, resulting in less IV analgesic requirement and less hospital stay, offering a good alternative to general anaesthesia in paediatric surgeries.

Key Words: Analgesia, Bilateral inguinal hernia, Caudal anaesthesia, Caudal combined with spinal anaesthesia.

How to Cite This Article: *Hashmi SRA, Shah SQA, Tariq W, Sarfaraz A, bhalli HAH, Khan TA. Comparison Between Caudal and Combined Caudal with Spinal Anesthesia in Paediatric Bilateral Inguinal Hernia Surgery. Pak Armed Forces Med J 2023; 73(6): 1786-1789. DOI: https://doi.org/10.51253/pafmj.v73i6.10168*

INTRODUCTION

Paediatric inguinal hernias account for one of the most common surgical presentations in the early age group. With an estimated incidence of 0.8-5% at birth,[1] they require early surgical correction for the defect before puberty.[2] The incidence has a strong predilection towards boys, with the incidence as much as four times that in girls, with bilateral inguinal hernias twice as common in girls than in boys.[3,4]

The anaesthetic choices vary among anaesthetists and can range from general anaesthesia to spinal anaesthesia and caudal with general anesthesia.[5] The commonest method employed is general anaesthesia. However, the post-operative period requires good analgesic control and a good duration of analgesia.[6] Intravenous pain relief in the paediatric population generally requires good observation since opioids, if given for adequate pain relief, may result in respiratory depression in this age group. This requires more care and observation in the paediatric wards and high-dependency units, resulting in prolonged hospital time and stay.[7]

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Received: 31 Mar 2023; revision received: 18 Jul 2023; accepted: 25 Jul 2023

Caudal anaesthesia for pre and post-operative analgesia remains the commonest choice at centres employing the regional approach for the surgical procedure with a total analgesia time lasting 4-8 hours.[8] However, pain episodes post-surgery for bilateral inguinal hernia can last up to 24 hours in children after the procedure.[9] This results in the inadvertent use of intravenous analgesics, which can be reduced if the effect of analgesia can be prolonged by adopting other modalities. Spinal anaesthesia in the paediatric age group has been in practice in international institutes for the past few years, resulting in effective analgesia and excellent per-operative results.[10]

However, the practice of spinal anaesthesia in children in our setups has been scarce at best, with limited literature on our demographic population. The combination of spinal with caudal has also been a topic of interest, especially in the paediatric Group, but studies have been limited. Our study aims to compare the analgesic efficacy and adverse effect profile of using caudal anaesthesia versus caudal combined with spinal anaesthesia for paediatric patients undergoing bilateral inguinal hernia surgery.

METHODOLOGY

The prospective longitudinal study was carried out at the Department of Anaesthesiology, Combined Military Hospital, Rawalpindi Pakistan, from March to August 2022, after approval from the Ethical Review Board (letter no. 237). Sample size was calculated using the WHO calculator, keeping the population proportion of paediatric inguinal hernia requiring surgery at 5%.[1] The method of sampling was non-probability consecutive sampling.

Inclusion Criteria: All ASA-I pediatric patients aged 5-10 years presenting in the Paediatric Surgery Department for scheduled bilateral inguinal hernia repair were included.

Exclusion Criteria: Patients unwilling for spinal anaesthesia, patients with allergy to Bupivacaine, patients with deranged coagulation profile as a contraindication to spinal or caudal administration, patients with major heart or respiratory disease and patients non-compliant with the procedure were excluded.

The study method included all patients as per the inclusion criteria furnished. The patients were divided into the Caudal Group (n=40) and the Combined Group (caudal and spinal combined) (n=40) using random number tables (Figure). Once the patients were divided into the two groups, both groups received 200 ml of normal saline in the patient holding bay 15 minutes before being shifted to the operating room.

Standard monitoring, including non-invasive blood pressure, heart rate, capnography and ECG, was attached to participants in both groups. Both groups received a sedative dose of ketamine at 0.3 mg/kg for compliance with the procedure. The Caudal Group received 0.25% Bupivacaine as per the Armitage regime at a 1ml/kg volume to reach an effective sensory level of T10. The combined Group received spinal anaesthesia at a dose of 0.3mg/kg for >15 kg patients and 0.4mg/kg for 5-15 kg patients in the L4-L5 epidural space for an effective spinal level of T10. Once the spinal was administered, the patient received the same dose of caudal as per the Armitage regime of the caudal Group. Bradycardia was defined as a heart rate of <80 beats per minute11 and hypotension as MAP <50 mm Hg12 and was treated with 1 mg Ephedrine and 200 mcg of Glycopyrrolate where needed.

Sensory blockade till the T10 dermatome level was confirmed by loss of sensation to cold ethyl chloride spray and pinprick in the mid-line bilaterally below the umbilicus. Once a successful block was achieved, the surgery was then continued. Block regression was again checked similarly once sensations were returned to the S1 level. Post-operatively, all patients received IV Paracetamol at 10 mg/kg in the pediatric care unit (PCU) once the pain intensity on the standard FLACC pain scale was four or above.[13]

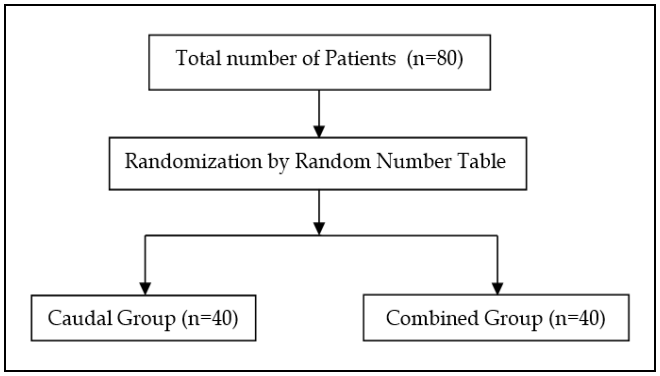

Figure: Patient Flow Diagram (n=80)

All statistical calculations were performed using Statistical Package for the Social Sciences 26.0. Demographic data were statistically described in terms of mean and SD, frequencies, and percentages when appropriate. The t-test was used to compare statistically significant differences between groups. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 80 patients were studied, divided into the caudal Group (n=40) and the combined Group (n=40). The mean age of patients was 6.67±1.49 years in the Caudal Group versus 6.67±1.42 years in the Combined Group. The mean weight between both groups was 18.0±2.54kg in the caudal versus 17.10±1.87 in the Combined Group.

The mean time to effective sensory block at the T10 dermatome level for surgery was achieved at 18.2±1.8 minutes in the Caudal Group, whereas the mean time was 3.38±0.10 minutes in the Combined Group. The total duration of block and subsequent reversal till the S1 level was 326.2±12.6 minutes in the caudal versus 441.22±31.8 minutes in the combined Group (p<0.001). The mean time for the first dose of analgesia for pain was required after 5.27±0.24 hours in the caudal versus 7.03±0.20 hours in the combined Group. Subsequently, the total dose of analgesia required in the 24 hours post-surgery was 190.0±45.5 mg in the Caudal versus 95.0±43.5 mg in the Combined Group (p<0.001). The mean Paediatric Unit Care (PCU) stay was 24.2±1.8 hours in the caudal versus 17.2±1.34 hours in the combined Group (p<0.001) (Table-I).

Table-I: Comparison of Block Onset, Block Regression and Rescue Analgesia (n=80)

Variables	Caudal Group (n=40)	Combined Group (n=40)	*p*-value
Sensory Block			
Mean Time For Effective Sensory Block (T10) (minutes)	18.2±1.8	3.38±0.10	<0.001
Mean Time For Sensory Block Regression (S1) (minutes)	326.2±12.6	441.22±31.8	<0.001
Mean Time To First Dose Rescue Analgesia (hours)	5.27±0.24	7.03±0.20	<0.001
Mean Volume Of Analgesia Given In Pcu (mg/24 hr)	190.0±45.5	95.0±43.5	<0.001
Mean Paediatric Unit Care Stay (Hours)	24.2±1.8	17.2±1.34	<0.001

When comparing the adverse effect profile between both groups, the incidence of hypotension was highest in the combined Group with 10 (25%) patients compared to 05 (12.5%) in the Caudal Group. There was no incidence of respiratory depression seen in the Caudal Group but was seen in 01 (2.5%) patients in the Combined Group (Table-II).

Table-II: Frequency of Side Effects between Both Groups (n=80)

Side Effects	Caudal Group (n=40)	Combined Group (n=40)
Hypotension	05(12.5%)	10(25%)
Nausea	02(5.0%)	03(7.5%)
Shivering	04(10.0%)	08(20.0%)
Respiratory Depression	00(0%)	01(2.5%)

DISCUSSION

The study was carried out at a tertiary care setup receiving the major bulk and burden of paediatric surgical cases nationwide. This study aimed to propose better anaesthetic techniques in the paediatric age group while avoiding the adverse cognitive effects of general anaesthesia in the younger age demographic, as evidenced by a study by Rosenblatt *et al*. 14 and L Wu *et al*.[15] These recent studies concluded that general anaesthesia has both short- and long-term cognitive impairment effects in children and should be best avoided and only to be used in very critical or lifesaving surgeries. So, the avenue of new modalities for surgeries where general anaesthesia can be best avoided is now being increasingly used in the developed world.

Our study revealed a significant decrease in the sensory block onset time, considering the early onset and excellent depth provided by the spinal route. The onset time was decreased by almost one-third of the time required by the caudal alone to achieve the same effect. This was in line with a study by Jayanthi *et al*.[16] which had similar results. When talking about the total duration of the block, the time between both groups was significantly different, with an average difference of two hours between both groups. This is the reason that the first dose of analgesia was also required later in the combined Group in line with a study carried out by Hala *et al*.[17] resulting in less total requirement of IV analgesia in the next 24 hours, resulting requiring less stay in PCU and early discharge resulting in early bed availability and less resource burden.[18]

When comparing the adverse effect profile, hypotension was seen in around one-fourth of the patients in the combined Group. However, it can be adequately managed with good fluid pre-load and vasopressor support readily available at all centres. The incidence of respiratory depression was seen in only one patient in the combined Group, who was responsive to oxygen therapy via face mask with no major complications. Even though caudal blocks are usually associated with local or allergic adverse effects,[19] they were not seen in any patients in our study.

LIMITATION OF STUDY

The technique and experience in paediatric spinal approach is less in our setups, which requires training and expertise.

CONCLUSION

We conclude that the combined caudal spinal approach offers better and superior pain control, resulting in less IV analgesic requirement and less hospital stay, offering a good alternative to general anaesthesia in paediatric surgeries.

Conflict of Interest: None.

Authors' Contribution

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

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

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

HAHB & TAK: 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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