International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Comparative Study of Spinal Anaesthesia Versus Caudal Anaesthesia in Paediatric Patients Undergoing Infraumbilical Surgeries

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Received: 06-10-2025
Accepted: 05-11-2025
Available online: 16-11-2025

ABSTRACT

Introduction: Regional anaesthesia techniques are now well-established in the practice of paediatric anaesthesia. Intraoperative neuraxial blockade, whether through the spinal or caudal route provides excellent analgesia with minimal physiologic alteration. This study compares caudal and spinal anaesthesia in paediatrics patients aged between 2-10 years undergoing infraumbilical surgeries in terms of haemodynamics, efficacy (sensory block characteristics), postoperative analgesia, and incidence of complications.

Materials and methods: In this study, 72 patients who fulfilled the eligibility criteria were chosen. Parents were explained about this study and written informed consent was taken. Patients were randomized into two equal groups of 36 each. Group S was given spinal anaesthesia - hyperbaric bupivacaine (0.5%) in a dose of 0.5 mg/kg was injected. Group C was given caudal block-0.5% plain bupivacaine 1ml/kg (according to the modified Armitage formula).

Results: In the spinal group, the majority (61%) of cases achieved the T8 level, whereas in the caudal group T10 level was achieved by 56%. The spinal group reached the highest sensory level significantly faster (7±1.3mins) compared to the caudal group(15±3.26mins). Haemodynamic parameters were comparable between both groups. Mean onset time, duration, and regression of sensory block as well as for motor block were higher in the caudal group than spinal group.

Conclusion - Spinal anesthesia is preferable for surgeries requiring immediate relaxation and analgesia, while caudal anesthesia is better suited for surgeries of moderately prolonged duration.

Keywords: *Caudal, spinal, infraumbilical, paediatrics surgeries.*

INTRODUCTION

Neuraxial anaesthesia is now well-established in the practice of paediatric anaesthesia. The persistent occurrence of post-operative pain in children after major surgery remains significant.[1] Neuraxial anaesthesia can enhance postoperative outcomes for high-risk children prone to respiratory complications, such as postoperative apnea and malignant hyperthermia. [2]

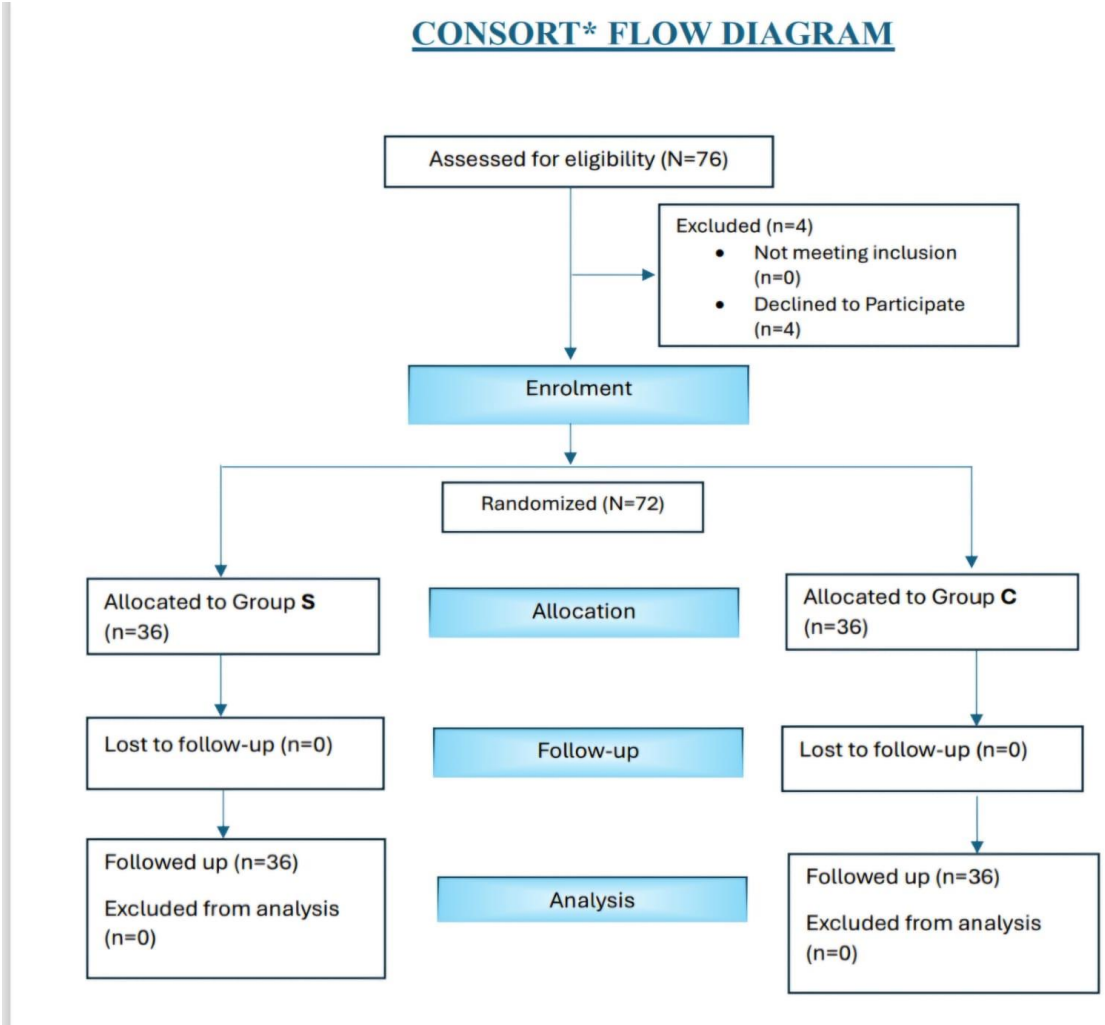
In 1899, August Bier first reported the successful use of spinal anaesthesia in an 11-year-old child undergoing surgery for a thigh tumour[3], while the first mention of caudal anaesthesia in paediatric patients appeared in Campbell's 1933 publication, followed by Leigh and Belton's work in 1951[4]. The use of spinal anaesthesia in infants and children undergoing sub-umbilical surgeries is becoming increasingly popular worldwide. [5,6] Caudal analgesia, combined with general anaesthesia, is a widely used regional technique for extended postoperative pain relief in various paediatric surgeries involving sub-umbilical sites. Although neuraxial blockade is increasingly favoured in infants and young children, uncertainties

surrounding its safety, reliability, and dependability can only be clarified through expanded adoption and research.[7] This comparative study aims to explore the effectiveness and safety of spinal versus caudal anaesthesia in paediatric patients undergoing infraumbilical surgeries.

MATERIALS AND METHODS

A Prospective randomized comparative study was conducted after the approval of the Institutional Ethics Committee with order no. 686/GMC/IEC/2022/Reg. No. 623/IEC/R-20-11-2022. In this study, 72 patients who fulfilled the eligibility criteria were chosen. Parents were explained about this study and written informed consent was taken. Patients were randomized into two equal groups of 36 each. After standard fasting times, the child was shifted to the operating room. The child was monitored for ECG, HR, non-invasive blood pressure, and SPO2%. Intravenous line access with an appropriate IV cannula was secured. All cases were pre-loaded with "lactated ringer" solution 10ml/kg. In the operating room, all the children were oxygenated with 5L O2/min with paediatric mask and received IV ketamine 0.5-1mg/kg immediately before spinal or caudal block to achieve immobility of the patient during the block. Under all aseptic precautions, Group S was given spinal anaesthesia with hyperbaric bupivacaine (0.5%) in a dose of 0.5 mg/kg was injected and Group C was given caudal block-0.5% plain bupivacaine 1ml/kg (according to modified Armitage formula).

The level of "sensory blockade", "heart rate" and "MAP" were recorded at various intervals were recorded. Pain was evaluated through the "Children and Infant Postoperative Pain Scale" (CHIPPS). Surgeons and parent satisfaction is evaluated by a 4-point Likert scale postoperatively.

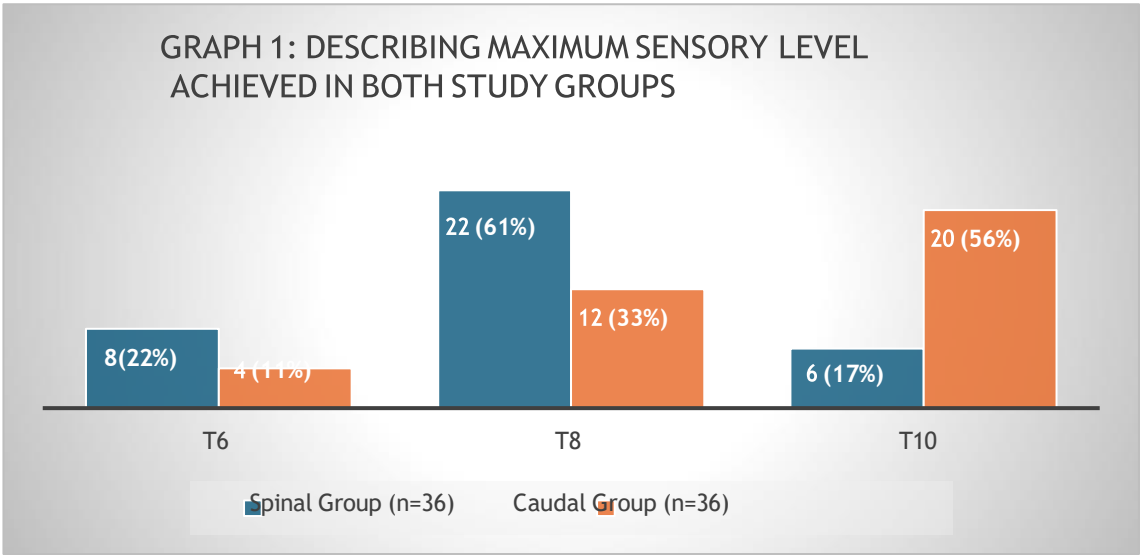


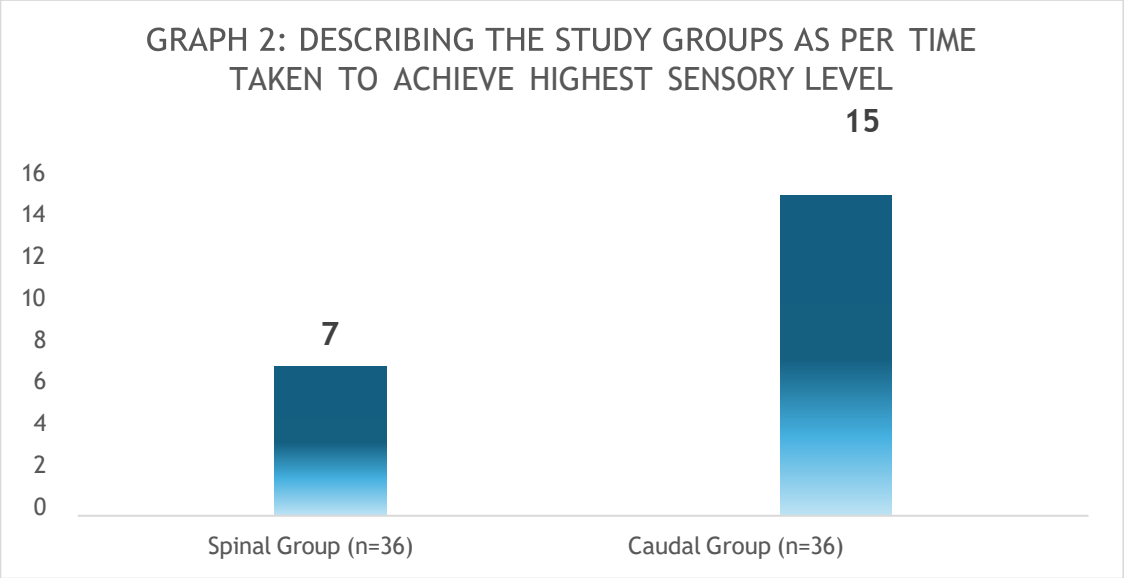
CONSOLIDATED STANDARDS OF REPORTING TRIALS

RESULTS

The demographic profile (age, sex, weight, and height) of our patients showed comparable characteristics in both groups, with no statistically significant differences ($p > 0.05$). Our study reveals significant differences in the maximum sensory levels achieved by the Spinal Group and Caudal Group. The Spinal Group showed a significantly higher proportion of patients achieving sensory blockade at T8 (61.1% vs. 33.3%, $p < 0.05$). Conversely, the Caudal Group had a significantly higher proportion at T10 (55.6% vs. 16.7%, $p < 0.05$). T6 level was achieved slightly higher by spinal group compared to

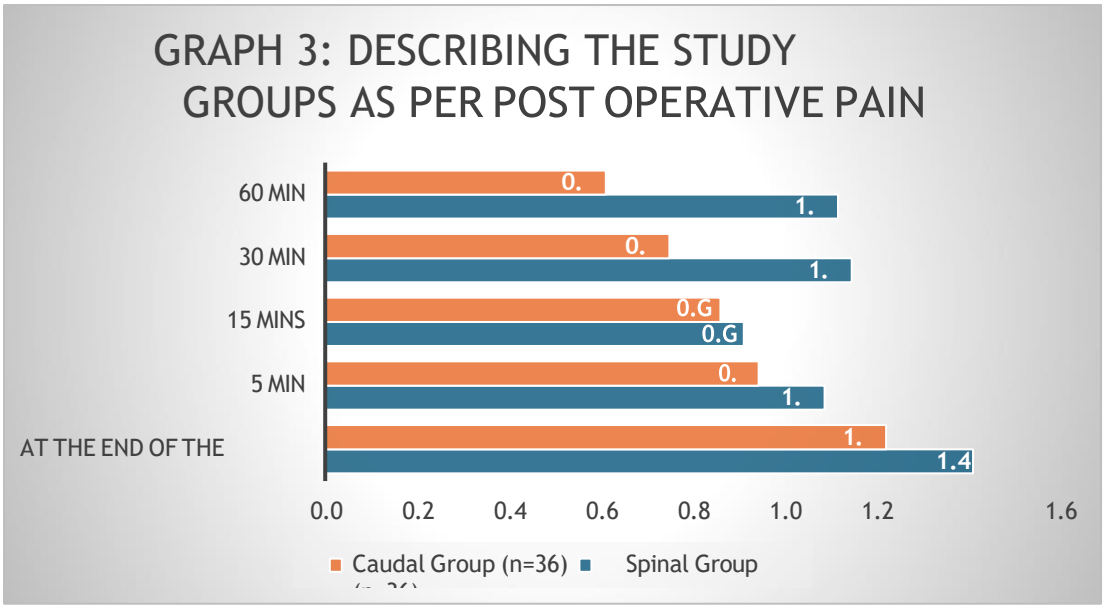
caudal group (22.2% vs. 11.1%, P>0.05) as showed in graph 1. These findings indicate spinal administration is more effective for higher sensory blockade, while caudal administration excels at lower levels.





Our study, compared the time required to achieve the highest sensory level between the Spinal Group and the Caudal Group, revealing a statistically significant difference. The Spinal Group attained the highest sensory level significantly faster (7.0±1.3 mins), compared to the Caudal Group, (15.0±3.26 mins) with p value <0.05 as showed in graph 2.

The study findings, detailed in Graph 3, compared CHIPPS scores between the spinal and caudal groups, revealing significant differences at several time points. At the end of surgery, the spinal group had an average CHIPPS score of 1.41, and the caudal group had 1.22, with a non-significant p-value of >0.05. Similarly, at 5 and 15 minutes after the end of the surgery, the differences were also not statistically significant with a p-value of >0.05. However, at 30 and 60 minutes, the spinal group had CHIPPS scores of 1.15 and 1.12, respectively, compared to CHIPPS scores of 0.75 and 0.61 in the caudal group, with significant p-values of <0.05, respectively. This shows significant increase in duration of postoperative analgesia in the caudal group compared to spinal group.



DISCUSSION

In our study, the age of the patient and gender in both groups did not pose restrictions for technique administration. There is ongoing debate regarding whether pain can be evaluated subjectively by patients or objectively by a trained observer. However, assessing pain in infants and children is particularly problematic because crying may arise from factors such as hunger, thirst, or anxiety unrelated to pain. In our study, the Spinal Group showed a significantly higher percentage of patients reaching the maximum sensory level at T8 (61%) compared to the Caudal Group (33%), whereas, a significantly higher proportion of patients achieved the T10 level (56%) in the Caudal Group compared to the Spinal Group (17%). T6 level was achieved slightly higher by the spinal group compared to the caudal group (22.2% vs. 11.1%, P>0.05), indicating that spinal administration may achieve higher sensory blockade levels up to T8 and T6 more effectively, while caudal administration may consistently extend its effectiveness to lower levels such as T10. Similar findings were reported by **Kaushal et al.**[8] who achieved a mean sensory level of T10 following caudal anaesthesia using isobaric bupivacaine (1ml/kg). **Parthasarathy et al.** [9] conducted a study on spinal anaesthesia in paediatric patients (7.68 ± 2.49) years, achieving a similar highest sensory level between T6 and T10 with a mean of 8.5.

The Spinal Group reached the highest sensory level significantly faster (7 ± 1.3) mins, compared to the Caudal Group (15.0 ± 3.26) mins. This notable reduction in time suggests that spinal anaesthesia could be crucial for surgeries requiring a rapid onset of anaesthesia. **Mahdy et al.**[10] reported similar findings, noting a longer onset of sensory blockade in the caudal group (9.5 ± 1.6) minutes compared to the spinal group (3.1 ± 0.9) minutes. Additionally, the duration of sensory blockade was more in the caudal group (119 ± 10.8) mins than in the spinal group (91.8 ± 13) mins. These results are similar to the findings of **Pandya et al.**[11] and **Ebrahim et al.**[12]

The CHIPPS ratings differed significantly at various postoperative periods between the spinal and caudal groups. At the end of the surgery, the spinal group had higher CHIPPS scores due to motor blockade causing anxiety in children. CHIPPS scores in the spinal group remained high at 30- and 60-minutes post-surgery because of sensory regression of spinal anaesthesia. In contrast, the caudal group's CHIPPS scores decreased over time (1.2 at surgery end, 0.9 at 5 minutes, 0.82 at 15 minutes, 0.7 at 30 minutes, and 0.6 at 60 minutes), indicating better postoperative analgesia. **Shailendra et al.**[13] observed similar results, with sensory block regression at (82.54 ± 18.65) mins in the spinal group and (138.42 ± 22.42) min in the caudal group. **Mahdy et al.**[10] also noted that caudal epidural provided longer postoperative analgesia and reduced analgesic consumption. **Cigdem Bozkurt et al.**[14] found that spinal anaesthesia led to more extensive sensory and motor blocks, but the caudal block offered better postoperative pain control.

In our study, Surgeon and Parent satisfaction levels among spinal and caudal surgeons did not differ significantly. Most surgeons and parents reported good satisfaction in both groups.

CONCLUSION

In our study, we conclude that both caudal and spinal techniques are simple, safe, and effective in paediatric patients. The Group S showed a more proportion of patients reaching T6 sensory blockade (22%) compared to the Caudal Group (11%). Hemodynamic parameters were similar between both groups. The caudal block took longer to achieve the highest sensory level than the spinal block. Caudal epidural provided longer postoperative analgesia with a decreased CHIPPS score compared to spinal anaesthesia, making it preferable for surgeries of moderately prolonged duration. In the spinal group,

patients needed early rescue analgesia after surgery and had an increased CHIPPS score due to early sensory regression compared to the caudal group. Hence, caudal anaesthesia is better in terms of postoperative analgesia, a decrease in postoperative rescue analgesia, early ambulation, and respiratory complications. Both techniques are viable alternatives to general anaesthesia for infraumbilical paediatric surgeries below the T10 level.

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