ISSN: 2581 – 3633

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at: https://www.ijmacr.com

Volume – 9, Issue – 5, September – 2026, Page No.: 310 – 319

Comparison of ultrasound guided ilioinguinal nerve block with transversus abdominis plane block for post operative analgesia in paediatric elective unilateral inguinal surgeries

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How to citation this article: Dr. Kapil Rajaram Arotkar, Dr. Rajpal Singh, Dr. Ajinkya Shrikant Wazurkar, Dr. Ashish Tatobaji Nimje, “Comparison of ultrasound guided ilioinguinal nerve block with transversus abdominis plane block for post operative analgesia in paediatric elective unilateral inguinal surgeries”, IJMACR– September– 2026, Volume – 9, Issue – 5, P. No. 310 – 319.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Elective inguinal surgery is common in children and postoperative pain can delay recovery and discharge. Ultrasound-guided regional blocks are increasingly used to improve analgesia while limiting systemic analgesic exposure. This study compared ultrasound-guided ilioinguinal nerve block with ultrasound-guided transversus abdominis plane (TAP) block in children undergoing elective unilateral inguinal surgery.

Methods: This prospective, randomized, comparative study included 46 children aged 1–12 years with American Society of Anesthesiologists physical status I–II. Children were randomized equally to an ilioinguinal nerve block group or TAP block group. Both blocks were performed after induction of general anesthesia using 0.3 mL/kg of 0.25% bupivacaine. Postoperative pain was assessed with FLACC, FACES, and visual analogue scale (VAS) scores. Time to first rescue analgesia, rescue analgesic requirement over 24 hours, and intraoperative hemodynamic variables were also recorded.

Results: The groups were similar in age, weight, height, and preoperative vital signs. FLACC scores were significantly lower after ilioinguinal block at 30 minutes, 1.5 hours, and 24 hours, while the difference at 2 hours was not significant. FACES scores were also significantly lower at 30 minutes, 1.5 hours, and 2 hours. VAS scores were lower in the ilioinguinal group at all measured time points, but these differences were not statistically significant. Time to first rescue analgesia was significantly longer after ilioinguinal block (5.11 ± 0.23 hours versus 3.99 ± 0.38 hours; $p<0.0001$). The proportion requiring rescue analgesia was lower with ilioinguinal block, although the difference did not reach statistical significance.

Conclusion: In this study, ultrasound-guided ilioinguinal nerve block provided better early postoperative analgesia than TAP block in children undergoing elective unilateral inguinal surgery. It prolonged the time to first rescue analgesia and reduced pain scores without important differences in intraoperative hemodynamics. Larger multicentre studies are needed to confirm these findings.

Keywords: Children; Inguinal Surgery Ilioinguinal Nerve Block, Transversus Abdominis Plane Block, Ultrasound, Postoperative Pain, Regional Anesthesia.

Introduction

Paediatric inguinal hernia repair is a frequent surgical procedure and is commonly performed as day-care surgery. Although the operation is relatively small, children can experience significant postoperative discomfort, and effective pain relief is important for early recovery and safe discharge.[1] Inguinal hernia is particularly common in children, with a higher occurrence in boys and a greater risk among premature infants. Population-based data have also shown that a substantial number of children undergo hernia repair during the first years of life.[2] Postoperative pain in children is influenced by age, communication ability, behaviour, and the surgical experience. Good pain control is important for recovery and day-care discharge.[3]

Systemic opioids can provide effective analgesia, but adverse effects are an important concern in children. This has encouraged the use of regional anesthesia as part of multimodal postoperative pain management.[4] Regional blocks may reduce the need for systemic analgesics and are useful in ambulatory paediatric surgery. Evidence comparing caudal with non-caudal regional techniques supports the use of peripheral blocks for inguinal procedures.[5] Ultrasound-guided regional anesthesia allows better visualization of the target anatomy and is useful for peripheral blocks in children.[6] Ilioinguinal/iliohypogastric nerve block and TAP block are commonly used regional techniques for paediatric inguinal surgery.[7]

Pain assessment in children is challenging because age and communication ability affect the reliability of a pain score. Different age-appropriate pain assessment tools are therefore used.[8] Understanding the abdominal wall anatomy is important for both blocks, including the relationship between the abdominal wall muscles and the nerves supplying the region.[9] Ultrasound-guided abdominal wall blocks are useful in paediatric regional anesthesia because they allow visualization of the abdominal wall muscle layers and the needle.[10] Ultrasound is particularly useful in children because it permits direct visualization of the relevant structures during block placement.[11]

The TAP block was described as an abdominal field block and later developed into an ultrasound-guided technique for abdominal wall analgesia.[12]

Anatomical studies have clarified the course of the thoracolumbar nerves and their contribution to the innervation of the anterior abdominal wall. [13] Clinical studies have demonstrated the analgesic value of TAP block after abdominal surgery.[14] Ultrasound-guided TAP block has been described as a practical technique in infants, children, and adolescents.[15]

Ilioinguinal nerve block has been used in children undergoing inguinal surgery and has been compared with caudal block for intraoperative and postoperative analgesia. [16] Both techniques therefore have a reasonable clinical basis, but the literature comparing them directly in children has been limited and results have not always been consistent. The present study was undertaken to compare ultrasound-guided ilioinguinal nerve block with ultrasound-guided TAP block for postoperative analgesia after elective unilateral inguinal surgery.

Aim and Objectives

The aim was to compare ultrasound-guided ilioinguinal nerve block with ultrasound-guided TAP block for postoperative analgesia in children undergoing elective unilateral inguinal surgery.

The primary objective was to compare postoperative pain using FLACC, FACES, and VAS scores. Secondary objectives were to compare intraoperative hemodynamic variables, time to first rescue analgesia, and total rescue analgesic requirement during the first 24 hours.

Materials and Methods

This prospective, interventional, randomized comparative study was conducted in the Department of Anaesthesiology and Intensive Care at Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi. The study period was 18 months, from October 2019 to March 2021. Institutional ethical approval was obtained before starting the study, and written informed consent was obtained from the parents or guardians.

A total of 46 children aged 1–12 years were included. All participants were American Society of Anesthesiologists physical status I–II and were scheduled for elective unilateral inguinal surgery. Children with known allergy to local anesthetic drugs were excluded.

Participants were allocated by computerized randomization into two equal groups. The ilioinguinal group included 23 children and the TAP group included 23 children. Consecutive eligible children were recruited until the required sample size was reached.

The sample size was based on a previous comparison of time to first rescue analgesia between ultrasound-guided ilioinguinal/iliohypogastric block and TAP block. With 80% power and a two-sided significance level of 5%, 23 participants were required in each group.

Children underwent routine pre-anaesthetic assessment and standard fasting according to paediatric guidelines. Baseline heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, and oxygen saturation were recorded.

General anesthesia was induced according to routine paediatric practice. After induction, ultrasound-guided regional block was performed under aseptic precautions. In both groups, 0.3 mL/kg of 0.25% bupivacaine was used.

For the ilioinguinal block, the ultrasound probe was placed near the anterior superior iliac spine to identify the three abdominal wall muscle layers. A 22-gauge needle was introduced using an in-plane technique and the local anesthetic was deposited at the interface between the internal oblique and transversus abdominis muscles after appropriate visualization.

For the TAP block, the probe was positioned between the anterior superior iliac spine and costal margin around the midaxillary region. The external oblique, internal oblique, and transversus abdominis muscles were identified, and the needle was advanced under direct ultrasound visualization. Local anesthetic was injected between the internal oblique and transversus abdominis muscles.

Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, and oxygen saturation were monitored at five-minute intervals for up to 50 minutes. Postoperative pain was assessed at predefined time points using FLACC, FACES, and VAS scales according to the child's age and ability to communicate.

FLACC scores range from 0 to 10 and assess facial expression, leg movement, activity, crying, and consolability. FACES is a child-friendly self-report scale, while VAS records pain on a 10-cm continuum from no pain to the worst pain.

Rescue analgesia was given when clinically indicated. The time from completion of the block to the first rescue analgesic dose and the total rescue analgesic requirement during 24 hours were recorded.

Categorical variables were summarized as number and percentage. Quantitative variables were summarized using mean with standard deviation and, where appropriate, median with interquartile range. Normality was assessed using the Kolmogorov–Smirnov test. Chi-square or Fisher exact tests were used for categorical variables, while independent t-test or Mann–Whitney testing was used for quantitative variables as appropriate. A p value below 0.05 was considered statistically significant. Statistical analysis was performed using SPSS version 21.0.

Results

Forty-six children were included in the final analysis, with 23 in each group. The two groups were well matched at baseline. Mean age was 6.65 ± 3.47 years in the ilioinguinal group and 6.70 ± 2.98 years in the TAP group (p=0.964). Mean weight was 20.50 ± 7.98 kg and 20.43 ± 7.82 kg, respectively (p=0.978), while mean height was 115.74 ± 21.02 cm and 117.04 ± 18.01 cm (p=0.822).(Table 1)

Preoperative heart rate, blood pressure, mean arterial pressure, respiratory rate, and oxygen saturation were comparable between the groups. No clinically important difference in baseline hemodynamic status was observed.

Postoperative FLACC scores favored the ilioinguinal group. At 30 minutes, the mean FLACC score was 1.12 ± 0.83 compared with 2.50 ± 1.22 in the TAP group (p=0.028). At 1.5 hours, scores were 1.75 ± 0.71 and 3.17 ± 0.75, respectively (p=0.004). At 2 hours, the difference was not statistically significant (3.50 ± 1.31 versus 4.33 ± 0.82; p=0.197). At 24 hours, the FLACC score remained lower in the ilioinguinal group (4.00 ± 1.69 versus 5.83 ± 0.98; p=0.026).(Table 2)

FACES scores showed a similar pattern. At 30 minutes, mean scores were 1.56 ± 0.73 in the ilioinguinal group and 2.55 ± 0.93 in the TAP group (p=0.018). At 1.5 hours they were 1.89 ± 1.05 and 3.09 ± 1.04 (p=0.020), and at 2 hours they were 2.44 ± 0.88 and 3.45 ± 0.93 (p=0.024). At 24 hours the difference was not significant (4.11 ± 1.62 versus 4.91 ± 1.38; p=0.248). (Table 2)

VAS scores were numerically lower in the ilioinguinal group at every assessed time point. At 30 minutes, the scores were 1.50 ± 1.52 versus 2.83 ± 0.98 (p=0.101); at 1.5 hours, 2.33 ± 1.37 versus 3.50 ± 1.05 (p=0.128); at 2 hours, 2.67 ± 1.21 versus 3.83 ± 0.75 (p=0.073); and at 24 hours, 3.67 ± 1.21 versus 4.50 ± 1.22 (p=0.263). (Table 2)

The time to first rescue analgesia was significantly longer after ilioinguinal block. Among children who required rescue medication, the mean time was 5.11 ± 0.23 hours in the ilioinguinal group compared with 3.99 ± 0.38 hours in the TAP group (p<0.0001). (Table 3)

During the first 24 hours, 7 children (30.43%) in the ilioinguinal group and 13 children (56.52%) in the TAP group required rescue analgesia. This difference did not reach statistical significance (p=0.074). The mean number of rescue doses was also comparable, at 1.81 ± 0.81 and 1.72 ± 0.82, respectively (p=0.800). (Table 3)

Table 1: Baseline demographic characteristics of the study groups.

Variable	Ilioinguinal (n=23)	TAP (n=23)	p value
Age, years	6.65 ± 3.47	6.70 ± 2.98	0.964
Weight, kg	20.50 ± 7.98	20.43 ± 7.82	0.978
Height, cm	115.74 ± 21.02	117.04 ± 18.01	0.822

Table 2: Postoperative pain scores in the two study groups.

Pain scale/time	Ilioinguinal	TAP	p value
FLACC – 30 min	1.12 ± 0.83	2.50 ± 1.22	0.028
FLACC – 1.5 h	1.75 ± 0.71	3.17 ± 0.75	0.004
FLACC – 2 h	3.50 ± 1.31	4.33 ± 0.82	0.197
FLACC – 24 h	4.00 ± 1.69	5.83 ± 0.98	0.026
FACES – 30 min	1.56 ± 0.73	2.55 ± 0.93	0.018
FACES – 1.5 h	1.89 ± 1.05	3.09 ± 1.04	0.020
FACES – 2 h	2.44 ± 0.88	3.45 ± 0.93	0.024
FACES – 24 h	4.11 ± 1.62	4.91 ± 1.38	0.248
VAS – 30 min	1.50 ± 1.52	2.83 ± 0.98	0.101
VAS – 1.5 h	2.33 ± 1.37	3.50 ± 1.05	0.128
VAS – 2 h	2.67 ± 1.21	3.83 ± 0.75	0.073
VAS – 24 h	3.67 ± 1.21	4.50 ± 1.22	0.263

Table 3: Rescue analgesia outcomes.

Outcome	Ilioinguinal	TAP	p value
Time to first rescue analgesia (h)	5.11 ± 0.23	3.99 ± 0.38	<0.0001
Children requiring rescue analgesia, n (%)	7 (30.43)	13 (56.52)	0.074
Mean number of rescue doses	1.81 ± 0.81	1.72 ± 0.82	0.800

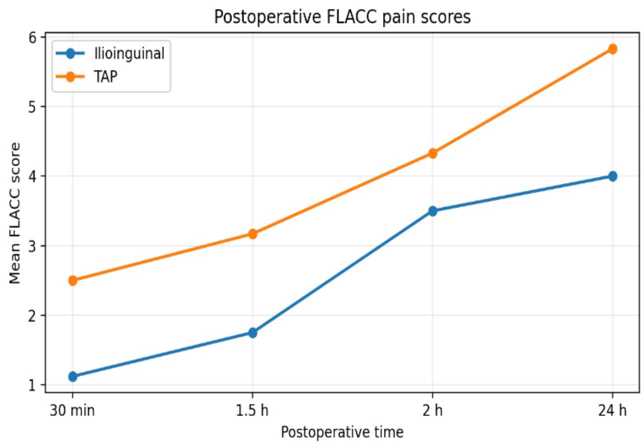

Figure 1: Postoperative FLACC pain scores at the assessed time points.

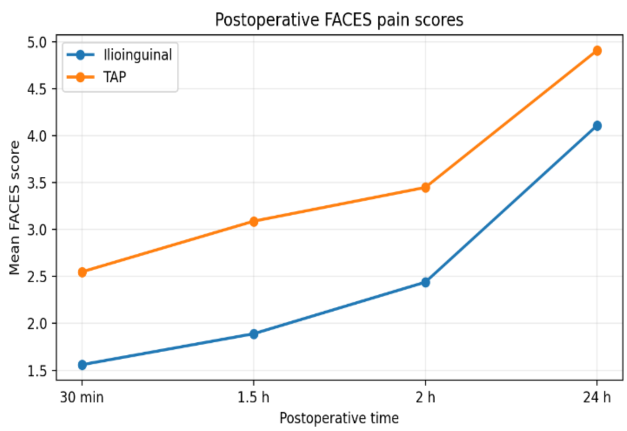

Figure 2: Postoperative FACES pain scores at the assessed time points.

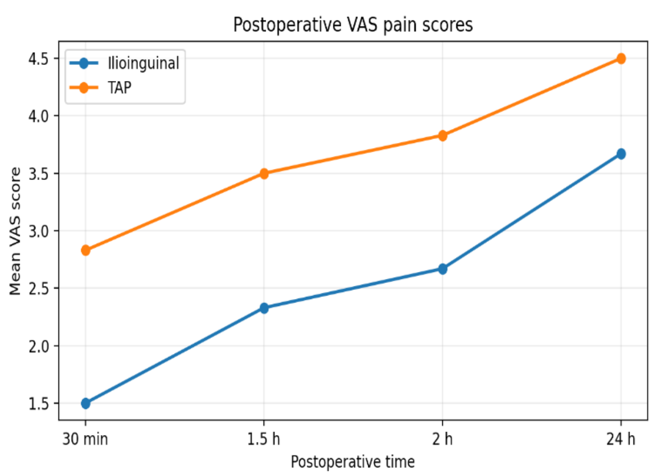

Figure 3: Postoperative VAS scores at the assessed time points.

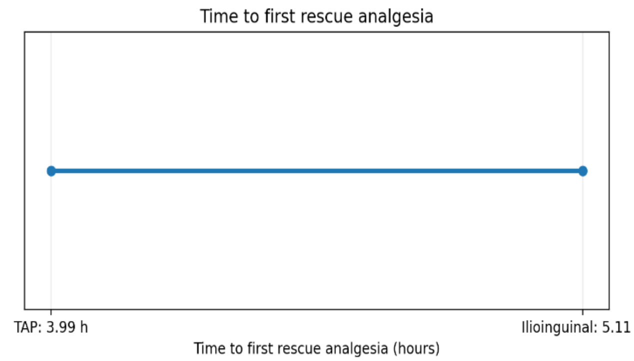

Figure 4: Time to first rescue analgesia in the two study groups

Discussion

The present study found that ultrasound-guided ilioinguinal nerve block provided better postoperative pain control than TAP block in children undergoing elective unilateral inguinal surgery. The main advantages were lower FLACC and FACES scores at several early postoperative time points and a clearly longer interval before the first rescue analgesic was required. One reason for the difference may be the more focused coverage provided by the ilioinguinal approach for surgery in the groin. The block is directed toward nerves that are closely related to the sensory supply of the operative area, whereas TAP block produces a broader fascial plane block. The practical value of a regional technique depends on whether the local anesthetic reaches the nerves responsible for pain from the incision. Previous paediatric work has supported the use of ultrasound-guided abdominal wall blocks. Early experience with TAP block demonstrated that it can provide useful analgesia in children after lower abdominal procedures.[17]

The present findings are consistent with the randomized comparison by Mohamed and Kamal, in which ultrasound-guided ilioinguinal/iliohypogastric block provided better postoperative analgesia than TAP block in children.[18] Earlier paediatric work has also supported the usefulness of TAP block for abdominal wall analgesia. Other studies have not shown a clear difference between these blocks. This suggests that patient age, surgical approach, block technique, local anesthetic volume, operator experience, and the timing of pain assessment may influence the observed results.

The present study showed significant differences in FLACC scores at 30 minutes, 1.5 hours, and 24 hours. The difference at 2 hours was not significant. This pattern indicates that the benefit was most noticeable during the early recovery period, when surgical pain is usually more prominent. FACES scores showed significant differences during the first 2 hours but not at 24 hours. This is clinically understandable because the effect of a single-shot peripheral block is expected to become less important as the surgical pain decreases and the local anesthetic effect wears off.

VAS scores were consistently lower in the ilioinguinal group, but none of the differences reached statistical significance. One important reason is the small number of children for whom VAS could be used in the study. Therefore, the VAS results should be interpreted cautiously rather than taken as evidence that the two techniques are identical.

The longer time to first rescue analgesia is an important practical finding. Children receiving ilioinguinal block required rescue medication at a mean of about 5.1 hours, compared with about 4.0 hours after TAP block. A longer pain-free period can make recovery more comfortable and may reduce the need for repeated early analgesic administration.

Although fewer children in the ilioinguinal group required rescue analgesia during 24 hours, the difference was not statistically significant. The mean number of rescue doses was also similar. Therefore, the study supports a benefit in delaying the first rescue dose but does not establish a significant reduction in total analgesic consumption over 24 hours.

The hemodynamic findings were reassuring. Heart rate, blood pressure, mean arterial pressure, respiratory rate, and oxygen saturation remained comparable between the two groups during the intraoperative period. This is important because both techniques are performed in children under general anesthesia, and the choice of block should not add clinically important cardiovascular or respiratory instability when performed appropriately.

Ultrasound guidance is particularly useful in paediatric regional anesthesia because it permits visualization of the relevant anatomy during block placement.[19] Knowledge of the abdominal wall and inguinal region is important when performing procedures involving the groin.[20] Imaging studies have described the anatomy and pathology of the inguinal canal and its surrounding structures.[21]

The current study adds useful information because there is relatively limited Indian literature directly comparing ultrasound-guided ilioinguinal block and TAP block in children undergoing unilateral inguinal surgery. The study population was clearly defined, randomization was used, and the two groups were comparable at baseline.

An important strength is that pain was assessed using more than one method. FLACC provided a behavioural measure, while FACES and VAS allowed assessment in children who could communicate their pain. Using several tools reduces dependence on a single pain scale. Another strength is the assessment of clinically meaningful outcomes. Time to first rescue analgesia is easy to understand and has direct relevance to postoperative comfort. Total rescue analgesic use and hemodynamic variables also provide information about the overall performance and safety of the blocks. However, the study has limitations. It was a single-centre study with only 46 participants, so the findings should not be generalized to all paediatric populations. The procedures could not be blinded to the operator, which may introduce performance bias. Long-term follow-up was not performed. The study therefore cannot comment on persistent postoperative pain or other outcomes beyond the immediate postoperative period.

The local anesthetic dose and block technique were standardized, but the success of ultrasound-guided blocks still depends on the experience of the anesthesiologist. This is particularly relevant in children because small differences in anatomy and needle position can affect the spread of local anesthetic.

Pain after inguinal surgery is usually short lived, but good early analgesia remains important because children may have difficulty expressing pain and may become distressed. Adequate pain control can improve recovery and make the day-care experience easier for both the child and family.

Earlier anatomical work has described the functional anatomy of the groin and its relevance to inguinal surgery.[22] Anatomical descriptions of the inguinal canal and abdominal wall help explain the technical basis of inguinal procedures.[23] Further anatomical literatures has refined understanding of the groin region relevant to inguinal hernia repair. [24]

The present findings should therefore be viewed as supportive rather than definitive. The numerical improvement in pain scores, particularly with FLACC and FACES, together with the significant prolongation of the first rescue analgesic interval, suggests that ilioinguinal block may be a useful first-choice regional technique for selected children undergoing unilateral inguinal surgery.

The remaining uncertainty relates mainly to whether this early benefit translates into lower total analgesic consumption and better functional recovery. Larger trials with standardized rescue analgesia, blinded outcome assessment, and longer follow-up are required.

Anatomical and surgical references provide background for understanding the groin region, but they should not be interpreted as evidence that one analgesic technique is superior to another.[25] Surgical anatomy literature supports careful understanding of the groin region when performing procedures in this area. [26] The anatomy of the inguinal region provides the basis for understanding the role of targeted ilioinguinal blockade in unilateral groin surgery.

In an adult randomized trial of open inguinal hernia repair, Faiz et al. also reported lower pain scores with ultrasound-guided ilioinguinal/iliohypogastric block than with TAP block, although opioid requirements were similar.[27] The epidemiology of paediatric inguinal hernia also supports the clinical importance of effective analgesia and uncomplicated recovery after repair.[28]

Conclusion

In children undergoing elective unilateral inguinal surgery, ultrasound-guided ilioinguinal nerve block provided better postoperative analgesia than ultrasound-guided TAP block in this randomized comparative study. Ilioinguinal block produced lower FLACC and FACES scores at several postoperative time points and significantly prolonged the time to first rescue analgesia. VAS scores were also lower, although the differences were not statistically significant. The two techniques had comparable intraoperative hemodynamic profiles, and total rescue analgesic use over 24 hours did not differ significantly. Larger multicentre studies are required to confirm the findings and to determine whether the early analgesic advantage leads to meaningful improvements in recovery and overall analgesic consumption.

Declarations

Ethics approval and consent: Institutional ethical approval was obtained before commencement of the study, and written informed consent was obtained from parents or guardians.

Confidentiality: Patient privacy and confidentiality were maintained during the study.

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