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RESEARCH

The evaluation of the caudal block performance in 0–8-year-old children using FLACC scale

0-8 yaş arası çocuklarda kaudal blok performansının FLACC ölçeği kullanılarak değerlendirilmesi

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Abstract

Purpose: The evaluation of postoperative pain in pediatrics is a true challenge. We aimed to evaluate the immediate postoperative pain management using FLACC (Face, Legs, Activity, Cry, Consolability (FLACC) Behavioral Pain Scale) scale after caudal block.

Material and Methods: The anesthesia records of children aged 0–8 years who underwent caudal block under general anesthesia prior to surgery were evaluated. The intraoperative and postoperative use of opioids were obtained, as well as, the FLACC scores.

Results: Seventy-eight children were included and evaluated in two groups according to ages of 1-24 (n=37) and 24-96 months (n=41). Intraoperative requirement for opioid was observed in 7.7% (n=6) of patients. Nine patients (11.5%) required fentanyl in the immediate postoperative period with FLACC ≥4. Only 1 patient required opioids both intraoperatively and in the immediate postoperative period, suggesting a success rate of 98.7%. The patients were observed to receive single dose opioid, despite FLACC ≥4 in the following postoperative 1st,2nd and 3rd hours. The subgroups of age were similar in terms of FLACC scores and the changes in these scores within the postoperative 3 hours. There were no urinary retention or motor block. However, paresthesia was recorded in 4 patients at age of 24-96 months, whereas, in none of the patients at age of 1-24 months. The uncomfortable numbness, which could not be described at age of 1-24 months may have caused the difference, as well as, leading to high FLACC scores without any opioid use.

Conclusion: Our study supported that anesthetists consider FLACC scale as a part of pain assessment to administer opioid, not as a sole indicator.

Keywords:. Caudal anesthesia, anesthesia and analgesia, pain scale, pain assessment.

Öz

Amaç: Pediatride ameliyat sonrası ağrının değerlendirilmesi gerçek bir zorluktur. Kaudal blok sonrası FLACC (Face, Legs, Activity, Cry, Consolability (FLACC) Behavioral Pain Scale) ölçeğini kullanarak ameliyat sonrası acil ağrı yönetimini değerlendirmeyi amaçladık.

Gereç ve Yöntem: Ameliyat öncesi genel anestezi altında kaudal blok uygulanan 0-8 yaş arası çocukların anestezi kayıtları değerlendirildi. İntraoperatif ve postoperatif opioid kullanımının yanı sıra FLACC skorları elde edildi.

Bulgular: Yetmiş sekiz çocuk çalışmaya dahil edildi ve 1-24 ay (n=37) ve 24-96 ay (n=41) yaşlarına göre iki grupta değerlendirildi. Hastaların %7.7'sinde (n=6) intraoperatif opioid gereksinimi gözlendi. FLACC ≥4 olan dokuz hastada (%11,5) hemen ameliyat sonrası dönemde fentanil gerekmiştir. Sadece 1 hasta hem intraoperatif hem de hemen postoperatif dönemde opioide ihtiyaç duymuştur ve bu da %98,7'lik bir başarı oranına işaret etmektedir. Hastaların ameliyat sonrası 1., 2. ve 3. saatlerde FLACC ≥4 olmasına rağmen tek doz opioid aldıkları görülmüştür. Yaş alt grupları FLACC skorları ve postoperatif 3 saat içinde bu skorlardaki değişiklikler açısından benzerdi. İdrar retansiyonu veya motor blok görülmedi. Ancak, 24-96 aylık 4 hastada parestezi kaydedilirken, 1-24 aylık hastaların hiçbirinde parestezi kaydedilmedi. Bu farklılığa 1-24 aylıkken tanımlanamayan rahatsız edici uyuşukluk neden olmuş olabileceği gibi, herhangi bir opioid kullanımı olmaksızın yüksek FLACC skorlarına yol açmış olabilir.

Sonuç: Çalışmamız anestezistlerin FLACC skalasını tek başına bir gösterge olarak değil, opioid uygulamak için ağrı değerlendirmesinin bir parçası olarak görmelerini desteklemektedir.

Anahtar kelimeler: Kaudal anestezi, anestezi ve analjezi, ağrı skalası, ağrı değerlendirmesi.

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INTRODUCTION

Pediatric regional anesthesia is an effective and safe method in modern anesthesia practice to provide opioid-free management both in the intraoperative and postoperative period[1]. Caudal epidural block is the most commonly used regional anesthesia method for postoperative analgesia in children[2]. Studies have shown that acute postoperative pain can develop into chronic postoperative pain in up to 20% of children undergoing major surgery[3]. Therefore, postoperative pain should be treated aggressively. Multimodal analgesia, in which non-opioid analgesics are used effectively in combination with low-dose opioids or regional blocks, is also recommended for pediatric patients[3,4].

Pain in children can be difficult to describe and measure. Children vary according to their cognitive and emotional development, medical conditions and operations, response to treatment and pain. Therefore, the same painful stimulus or surgical procedure does not show the same response to pain or result in the same pain scores in every patient. Many valid and useful scales including verbal, pictorial and numerical scales exist for scoring pain in most children[5]. Assessing and measuring pain are crucial components of a comprehensive evaluation in pediatric patients. Pain scales and tools should be valid and reliable in clinical practice. It should adapt to the needs of the child and be easy to use[6]. Generally, the accepted standard in pain assessment is that the patient can tell his/her own pain. However, infants and children younger than 3 years of age cannot explain their pain well. Therefore, many behavioral observation scales have emerged[7]. FLACC (*Face, Legs, Activity, Cry, Consolability*) scale is one of these scoring systems[8].

In our hospital, we use caudal block for children at 0-8 years of age as complementary to intraoperative anesthetic management and postoperative analgesia. We often use opioids for postoperative pain management as 'rescue analgesic' in the immediate postoperative period and we often employ FLACC scale for decision of rescue medication. We aimed to investigate the use of rescue medication after caudal block and the parameters that have an impact in our decision making.

This study aims to contribute valuable insights into the utilization of rescue medication following caudal block in pediatric patients and to identify key parameters influencing the decision-making process in our clinical setting. We hypothesize that certain demographic, surgical, or postoperative factors may significantly impact the decision to administer rescue analgesics, shedding light on personalized approaches to pediatric postoperative pain management. By addressing these objectives, our research seeks to fill existing gaps in the literature and provide evidence-based recommendations for optimizing postoperative pain control in the pediatric population.

MATERIALS AND METHODS

Study design

Following approval from the Hacettepe University Non-Interventional Clinical Research Ethics Committee, this study was conducted using records of patients undergoing surgery under general anesthesia combined with caudal block in the Pediatric Surgery operating room of Hacettepe University Faculty of Medicine between 1 February 2020-1 August 2020. The procedures and records are done by authors themselves. Hacettepe University is one of the major pediatric surgery centers in Turkey. And all the authors are experienced and competent in pediatric regional anesthesia.

The anesthesia follow-up form in the patients' files, the preoperative anesthesia evaluation form, and the nurse follow-up forms in the recovery unit and wards were obtained. Patient demographics, type of operation, anesthetic agents used for induction and maintenance, timing of caudal block performance, type, amount and concentration of local anesthetic applied for caudal block, 3-hour follow-up and pain scores in the recovery unit (0., 1., FLACC scale pain scores at 2nd and 3rd hour), analgesics administered intraoperatively and postoperatively, and complications were evaluated.

FLACC Scale

The FLACC scale was first introduced in 1997[8]. This scale scores behavioral traits consisting of 5 categories. Reminds scoring with initials; F: *Face*, L: *Legs*, A: *Activity*, C: *Cry*, C: *Consolability*. Each category is scored between 0 and 2. The highest value is 10. Total score; 0: Calm and relaxed, 1-3: Mild discomfort, 4-6: Moderate pain, 7-10: Severe discomfort or pain, or both. This scale was mainly developed to assess pain in children between the ages

of 2 months and 7 years. It is a simple, consistent, easily documented, reliable pain scoring method that facilitates communication between clinician and nurse[6,7,9]. It is easy to apply in crowded clinics. Due to these features, it is the most commonly used pain scale in the evaluation of pain and pain management of interventional procedures today. On the other hand, according to the values found in the FLACC scale, the plan to initiate analgesic administration differs in many clinics. Some centers accept a certain score as the 'threshold value'. The administration of analgesics is recommended when the clinician has doubts about the pain behavior or if there is a possible reason for the pain.

Sample

Caudal block was performed in 87 paediatric patients aged 0-8 years. The operation types were sub-umbilical surgeries such as hypospadias, undescended testis, circumcision, inguinal hernia, hydrocelectomy. Five of these patients were evaluated separately because they were in the category of long surgeries (duration of surgery >3 hours). Two patients were not included in the analysis because bilateral rectus sheath block was performed together with caudal epidural block. 1 patient was not included in the analysis because of missing data in the file. 1 patient was not included in the study because laparoscopic undescended testicular surgery was performed. A total of 78 patients were included in the statistical analysis. Anesthesia management for these surgeries is standard in all patients. Flow chart describing the eligible patients and excluded ones is given in Figure 1.

Procedure

According to the standardized protocol, all patients are premedicated with 0.5-1 mg/kg midazolam orally 30 minutes before the operation. Then, all patients receive sevoflurane in oxygen-air for anesthetic induction followed by obtaining vascular access and administration of propofol at a dose of 2 mg/kg intravenously. All patients' airway is maintained using LMA (laryngeal mask airway) and they all receive caudal block with the same regimen of bupivacaine at a dose of 2 mg/kg at a concentration of %0.25. Since caudal block was applied to the patients, fentanyl is not administered during induction. In case of a more than 20% increase in the heart rate on surgical incision, 1 mcg/kg fentanyl is administered intravenously. All patients receive 20 mg/kg intravenous paracetamol during the surgery as the first dose of paracetamol to be used postoperatively according to the analgesic protocol which combines paracetamol and ibuprofen, as well as, fentanyl as rescue medication.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics 17.0 software (IBM Corporation, Armonk, NY, USA). The Kolmogorov-Smirnov test was used to determine if the distribution of continuous numerical variables was close to normal, and whether the homogeneity of variances was assumed by the Levene test. Descriptive statistics were expressed as mean ± standard deviation for continuous numerical variables, as median (minimum-maximum) for ordinal variables, and as number of cases and (%) for categorical variables.

The significance of the difference between the groups in terms of mean values was evaluated with Student's t test. The significance of the differences in terms of ordinal variables was analyzed with the Mann Whitney U test. Categorical variables were evaluated with Continuity corrected Chi-Square or Fisher's exact probability tests. While the Friedman test was used to investigate whether there was a statistically significant difference in pain levels related to FLACC scores between the post-op follow-up times within the groups, whether the differences in the incidence of pain were significant was examined with Cochran's Q test. Unless otherwise stated, results for $p<0.05$ were considered statistically significant. However, in all possible multiple comparisons, Bonferroni Correction was made to control the Type I error.

RESULTS

Out of the eighty-seven patients identified as eligible for the study, seventy-eight patients were included in the statistical analysis. (Figure 1). The demographic data of these patients are presented in Table 1.

All patients were premedicated with 0.5-1 mg/kg midazolam orally 30 minutes before the operation. Sevoflurane in oxygen-air was used for anesthetic induction, and all patients received propofol at a dose of 2 mg/kg intravenously as vascular access was obtained, prior to LMA placement. All patients received sevoflurane in oxygen-air combination for anesthetic maintenance. None of them received fentanyl for induction. Caudal block was performed

using the same regimen of bupivacaine at a dose of 2 mg/kg at a concentration of %0.25 in all patients. The time period between the performance of the caudal block and the surgical incision was not available in the records. After the surgical incision, 7.7% (n=6) of the patients required fentanyl (Table 2), and 1 of these patients needed fentanyl in the recovery room, as well. All patients received intravenous paracetamol 20 mg/kg intraoperatively. In the recovery room, 11.5% (n=9) patients received fentanyl (Table 2). The FLACC scale scores of these patients who received fentanyl were ≥4. Urinary retention was not observed, however, 17% of the patients were with urinary catheter in the end of the surgery, hence, could not be evaluated for urinary retention. Motor block was not observed in any of our patients; however, a short-term paresthesia was described by 5.1% of them (n=4) (Table 2). There was no difference between the groups. Although it was not statistically significant, the patients who developed paresthesia was present only in the 25-94-month-old group (Table 2).

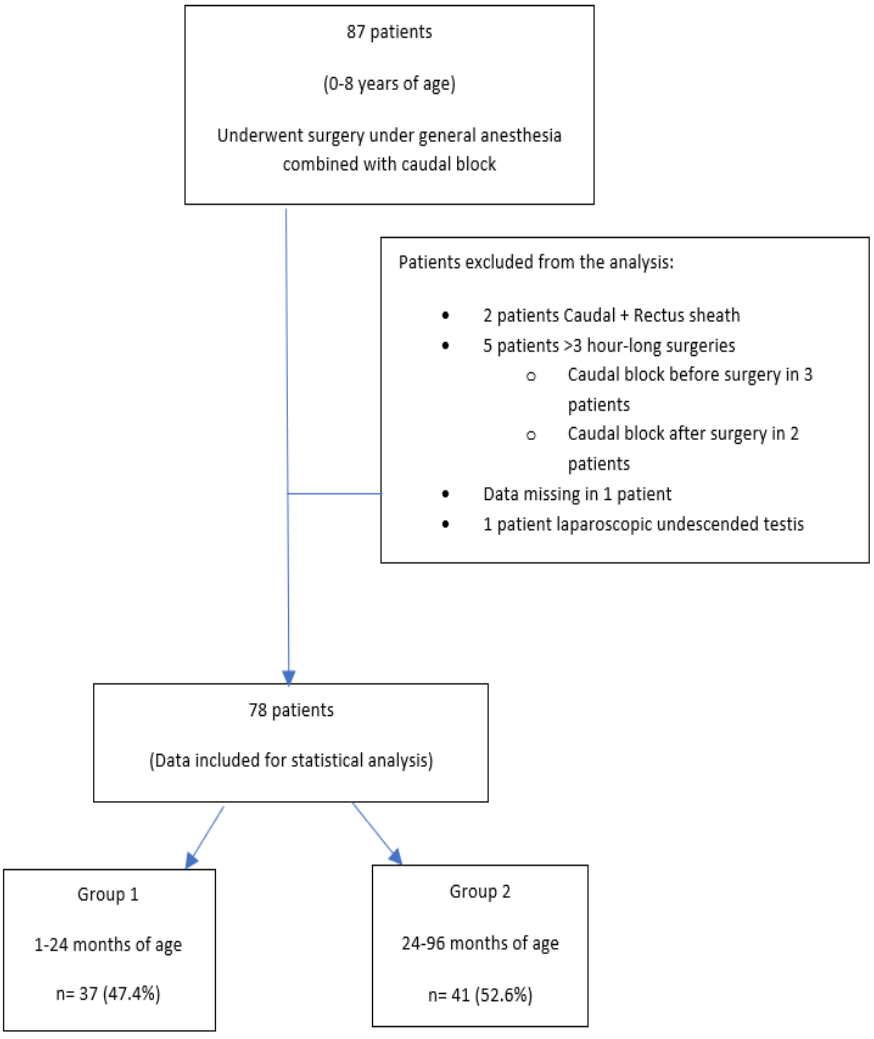

Figure 1. Flow chart describing the eligible patients, excluded ones and the ones included in the analysis.

Table 1. Demographic data of the patients.

Variable	**Patients (n = 78)**		
Age (month)	36.0 ± 29.2		
Age groups			
1-24 months	37 (47.4%)		
25-96 months	41 (52.6%)		
Gender			
Female	7 (9.0%)		
Male	71 (91.0%)		
Body weight (kg)	14.1±6.0		
Groups according to age			
	1-24 months (n=37)	25-96 months (n=41)	
Gender			**0.048 †**
Female (n (%))	6 (16.2)	1 (2.4)	
Male (n (%))	31 (83.8)	40 (97.6%)	
Body weight (kg)	9.6 ± 3.7	18.1 ± 4.6	**<0.001 ‡**

Table 2. The fentanyl requirement of the patients after surgical incision and in the recovery room. Urinary retention and motor block after caudal block.

Variable	**1-24 months (n=37)**	**25-96 months (n=41)**	**p -value**
Fentanyl requirement during surgical incision			>0.999†
-	34 (91.9%)	38 (92.7%)	
+	3 (8.1%)	3 (7.3%)	
Fentanyl requirement in the recovery room			0.159†
-	35 (94.6%)	34 (82.9%)	
+	2 (5.4%)	7 (17.1%)	
Urinary retention			0.757
-	30 (81.1%)	31 (75.6%)	
Urinary catheter in place	7 (18.9%)	10 (24.4%)	
Motor block/Paresthesia			0.117†
-	37 (100.0%)	37 (90.2%)	
Paresthesia	0 (0.0%)	4 (9.8%)	

† Fisher's exact probability test, ‡ Student's t test, ¶ Chi-square test with continuity correction.

The patients (n=9) who received fentanyl in the recovery room, had FLACC score ≥4 on arrival to the recovery room (Table 3). The scores were ≥4 in 6 patients at the 1st hour, in 2 patients at the 2nd hour and in 1 patient at the 3rd hour. However, it was observed that no additional dose of fentanyl was administered to these patients (Table 3). The groups were similar in terms of the FLACC scores and the changes in scores in time were similar, as well. The FLACC scores of the patients who received fentanyl in the recovery room at the 1st, 2nd and 3rd hour postoperatively were higher than the ones who did not receive ($p<0.001$) (Table 3). It was observed that all of our patients in the group 24-96-month of age, had a score of 0 or <4, except for 1, after the 1st hour postoperatively (Table 3).

Table 3. Postoperative 0, 1st, 2nd and 3rd hour FLACC Scores and the number of patients for scores.

	Number of Patients							
FLACC scores	**Postoperative 0 hour**		**Postoperative 1st hour**		**Postoperative 2nd hour**		**Postoperative 3rd hour**	
0	66		64		69		65	
	1-24 mo	25-96 mo	1-24 mo	25-96 mo	1-24 mo	25-96 mo	1-24 mo	25-96 mo
	34	32	30	34	33	36	30	35
<4	3		6		7		10	
	1-24 mo	25-96 mo	1-24 mo	25-96 mo	1-24 mo	25-96 mo	1-24 mo	25-96 mo
	1	2	4	2	2	5	5	5
≥4	9		8		2		3	
	1-24 mo	25-96 mo	1-24 mo	25-96 mo	1-24 mo	25-96 mo	1-24 mo	25-96 mo
	2	7	3	5	2	0	2	1

DISCUSSION

In our study, caudal block performed by 2 mg/kg bupivacaine at a concentration of 0.25% provided an early postoperative FLACC scale score of <4 in 88.5% of patients at age of 0-8 years old. The patients who received fentanyl in the recovery room had higher FLACC scores, however, fentanyl was administered only once despite ongoing high scores of FLACC scale revealing that this score was not the only parameter used for postoperative pain management.

The Pediatric Regional Anesthesia Network (PRAN) study, the largest data analysis to date on neuraxial blocks in the pediatric age group, reported that the most common adverse event related to the caudal block was the failure of the block[2]. In our study, it was observed that there was 1 patient who needed fentanyl both intraoperatively and in the recovery room, suggesting that the block may have been inadequate, and the failure rate was evaluated as 1.3%.

Bupivacaine, levobupivacaine and ropivacaine, which are frequently used for caudal block were found to provide similar onset times for the analgesic effect of the block which were 8 minutes, 8 minutes and 7 minutes, respectively[10,11]. It was also reported that longer-duration of analgesia was provided with bupivacaine, while the incidence of motor block was higher with bupivacaine, as well[12]. In our study, all patients received standard dose and concentration (2mg/kg, 0.25%) of bupivacaine, and 7.7% of patients needed intraoperative fentanyl. Due to the retrospective nature of our study, there is no definite data on the time period between caudal block performance and the surgical incision. Considering that only 1 of our patients needed fentanyl immediately after surgical incision, but didn't need fentanyl in the recovery room, it was thought that there was a delay related to the onset of action of the block rather than failure of the block. However, due to the retrospective design of our study, it is not possible to give precise information about the onset time of the effect. In a study using a similar concentration of bupivacaine in comparison with levobupivacaine for caudal block, the success rate was reported as 94% and 91%, respectively; while the postoperative analgesic efficacy was reported as 98% and 97.5% in terms of patient satisfaction, respectively[4]. In our study, it was observed that only 1 patient needed fentanyl in both the intraoperative and early postoperative periods, and therefore the success rate was evaluated as 98.7%, which is higher than this study. The analgesic effect was assessed using FLACC scale, and the scores were available from the records, however, no data on the level of patient satisfaction could be obtained. On the other hand, we observed that only standard doses and concentrations of bupivacaine were used without addition of any adjuvant agents, therefore, drug comparison or differences that may develop depending on dose or concentration could not be evaluated.

The dose, volume and concentration of the local anesthetic drug used for caudal block have been shown to be determinative in terms of postoperative motor block[4,13-15]. Although motor block was not observed in our study, paresthesia was observed and it was higher in the group of patients aged between 25-96 months, despite statistical insignificance. Although we cannot provide data on whether this situation is related to the dose, concentration or volume of the drug, in fact, a similar situation may

have developed in the 0-24-month-old group. Considering the incapability of defining the discomfort and numbness at this age group high FLACC scores with the lack of any defined paresthesia may have developed. However, the relationship between paresthesia and the dose, concentration and volume of the drug in the 24-96-month-old patients can be addressed in prospective studies conducted with large patient groups.

Opioid administration is often recommended when the FLACC score is >7; however, in our study, it was observed that a score of >4 was sufficient for fentanyl administration[16,17]. As all patients received 20 mg/kg intravenous paracetamol, the first dose of paracetamol to be given in the postoperative period was given intraoperatively, hence the rescue medication in this early period became fentanyl when FLACC score >4, similar to the pain management in the study by Tao et al., in which the efficiency of caudal block in laparoscopic surgery was evaluated in pediatric patients[18]. On the other hand, in our study, after the first dose of fentanyl administration in the recovery room of 3 patients, it was observed that no additional dose of fentanyl was administered, although the FLACC score was >4 at the following 2nd and 3rd hours. This situation supported the information about the use of the FLACC scale, suggesting that the anesthetist did not use the FLACC scale alone, but also evaluated the general condition of the child in his decision to administer analgesics[19].

In the *APRICOT (Anaesthesia PRactice in Children Observational Trial)*, it was reported that caudal block was mostly applied at <3 years of age, and no neurological damage or local anesthetic toxicity was reported[20]. Similarly, no such complications were encountered in our study, as well. Ultrasound guidance is recommended as a viable technique to further reduce complications in caudal block application, where the risk of developing complications is generally low[21]. However, as reported in the APRICOT study, caudal block was most commonly applied by using the landmark technique applied by palpation (97.4%); however, it has been reported that ultrasonography is not preferred in terms of both infection and complications related to application[22-24]. In our study, landmark technique with palpation was used, not ultrasound guidance. The use of ultrasound in caudal block application is recommended especially in the presence of anatomical variations, which actually requires experience in ultrasonographic view of normal anatomy[25]. Therefore, it should be kept in mind that it may be important to become familiar with the anatomical image by using ultrasound guidance as much as possible in caudal block application.

In the early postoperative period, a FLACC score of <4 can be achieved at a success rate of 98.4% in patients aged between 0-8 years, undergoing surgery with caudal block performed by 2 mg/kg bupivacaine at a concentration of 0.25% without any adjuvant agent. Although the FLACC scale is an easy-to-use assessment method with proven validity in children, our study has also supported the data regarding its use as a component of pain assessment not as a sole measure.

Our retrospective analysis of caudal block performance in 0-8-year-old children using the FLACC scale for immediate postoperative pain management demonstrated a high success rate of 98.7%. The majority of patients achieved a FLACC score of less than 4 in the early postoperative period, indicating effective analgesia. The study also highlighted the practicality of the FLACC scale as a valuable tool for pain assessment in pediatric patients undergoing caudal block. However, our findings suggested that anesthetists did not solely rely on FLACC scores but also considered the overall clinical condition of the child when deciding to administer rescue analgesics. Despite the success of the caudal block, we observed that opioid administration was minimal, and additional doses were not commonly required in the immediate postoperative period.

While our study contributes valuable insights into the use of caudal block and the FLACC scale in pediatric patients, there are certain limitations that should be acknowledged. The retrospective design of the study introduces inherent biases and limits our ability to establish causal relationships. The absence of data on the precise onset time of caudal block effect and the lack of information on long-term outcomes, including patient satisfaction, are additional limitations. Future prospective studies with larger sample sizes and more comprehensive data collection may further refine our understanding of pediatric regional anesthesia and postoperative pain management.

The FLACC scale remains a valuable tool for pain assessment, but its use should be complemented by a holistic evaluation of the patient's clinical status.

Further research is warranted to explore optimal dosages, concentrations, and potential adjuvants for caudal block in various pediatric age groups, ultimately contributing to the refinement of postoperative pain management strategies for this vulnerable population.

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