

ORIGINAL ARTICLE

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A comparison of the efficacy of penile block and caudal block with bupivacaine on perioperative bleeding in circumcised children

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Abstract

The management of postoperative pain is a fundamental aspect of surgical care. To achieve the aforementioned result, a variety of blocks may be utilized. A review of the literature revealed no significant difference between penile block and caudal block in terms of pain management. The objective of this study was to compare two methods with respect to perioperative bleeding. With regard to the caudal block group, the caudal block was conducted by the anaesthetist using a 22G caudal needle, administering bupivacaine. In contrast, in the penile block group, the procedure was a dorsal penile nerve block with bupivacaine, performed by the surgeon. During the intraoperative period, hemodynamic parameters were recorded and the amount of bleeding was quantified. In the postoperative period, pain scales, recovery times and early complications were recorded, and family satisfaction was evaluated. The demographic and hemodynamic data were found to be comparable between the two groups. No statistically significant difference was identified between the groups with regard to pain scales. The analysis revealed no statistically significant difference between the two groups with regard to early complications. It was calculated that the risk of bleeding of 2.5 grams or more was approximately 188 times higher with the penile block method compared to the caudal block method ($p < 0.001$). In conclusion, the results demonstrated that intraoperative bleeding was less in patients who underwent caudal block, irrespective of age and weight.

Keywords: Caudal block, penile block, circumcision, bleeding, pediatric surgery

Introduction

Caudal block and penile block are generally used for pain control in urogenital surgeries such as circumcision and hypospadias [1-3]. Thanks to regional anesthesia, pain control is provided, crying, restlessness and agitation are reduced, and as a result, the risk of bleeding, complications and morbidity in the postoperative period is reduced [4,5].

Numerous studies indicate that there are no significant differences in postoperative pain or complications between patients receiving caudal block and those undergoing penile block [6-8]. When researching the literature, no previous studies on intraoperative bleeding in patients who underwent caudal block or penile block were found.

All neuroadnexial blocks result in sympathetic block, which leads to vasodilation and anticipated increased bleeding at the

surgical site. We aimed to investigate whether there is a variance in intraoperative bleeding among patients who underwent caudal block or penile block.

Material and Methods

This study was approved by the local ethics committee with the decision no. 21-07, dated September 11, 2023. This study was conducted in accordance with the World Medical Association Declaration of Helsinki-Ethical Principles for Medical Research Involving Human Subjects. The written consent was obtained from parents. A total of 300 children were included in the study. The present study was conducted in a clinic situated within a training and research hospital. Patients who were operated due to circumcision in our pediatric surgery clinic were prospectively examined. The study was designed as a prospective randomised study. Patients who did not undergo

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successful caudal block, as well as those who were unable to undergo the procedure, were excluded from participating in the study. Patients who had undergone circumcision and were under the age of 18 years, as well as those who did not suffer from chronic diseases or bleeding disorders, were included in

the study.
For the assignment of the patients participating in the study to the groups, a randomization scheme in accordance with the 4-way block randomization method was used using the Random Allocation Software program (Table 1).

Table 1. Descriptive statistics of the pilot study

	Caudal block				Penile block				p
	Mean	Sd	Median	Range	Mean	Sd	Median	Range	
Bleeding	1.88	0.71	2.00	2.00	3.86	1.65	3.00	6.00	<0.001
Weight	17.42	9.48	14.50	37.00	16.81	6.60	16.00	27.00	0.803
Age	3.73	2.36	3.50	8.00	3.38	1.94	3.00	7.00	0.587

In the operating room, patients were divided into two groups for penile block or caudal block using a randomized, closed-envelope method. Patients were excluded if their family refused to participate, if there was an infection or anomaly at the application site, if they had a known history of allergy, or if they had bleeding diathesis. Patients who experienced regional anesthesia failure were also excluded from the study. During the procedure, heart rate, peripheral oxygen saturation, and non-invasive blood pressure were monitored. Anesthesia was induced with 2mg/kg of propofol and maintained with 3% sevoflurane. Penile or caudal block was subsequently administered based on the assigned groups.

In the group that received the caudal block, the patient was positioned in lateral decubitus and underwent sterile staining and draping. The block was then performed utilizing a 22G caudal needle through the sacral hiatus. For the caudal block, a dosage of 1 ml/kg of 5% bupivacaine was administered. Following the block, patients were positioned supine and allowed to wait for 15 minutes before commencing the procedure.

In the group that received penile block, the surgeon performed a block on the dorsal side of the penis at the 10 and 2 o'clock positions using a 22G needle, after the surgical field was sterilized

and covered. The block was administered with 1ml/kg of 5% bupivacaine. The operation commenced 15 minutes after the block was performed while the patient was in a supine position.

Demographic data and operation times were recorded. Heart rate, blood pressure, and oxygen saturation were recorded at regular intervals during the operation. At the conclusion of the procedure, inhalation anesthesia was terminated, and the patient was permitted to open their eyes. Subsequently, they were transferred to the recovery unit. In the recovery unit, patients were assessed using pain scales, specifically the OPS, M-POPS and Five Face Scale. Patients who achieved an Aldrete score of 9 were then transferred to the ward (Tables 2 and 3).

Table 2. Observer Pain Scale

Score	Observation criteria
1	Smiling, euphoric
2	Happy, playing
3	Sleeping
4	Crying, mild pain
5	Screaming, severe pain

Table 3. Modified pediatric objective pain scale

	0	1	2
Localization of pain	No pain	There is pain, unable to localize	There is pain, able to localize
Crying	Not crying	Cries but responds to attention and affection	Cries, not responding to attention and affection
Movement	None	Continues	Like fighting
Anxiety	Sleeping	Mild	Hysterical
Posture	No specific posture	Flexion of the leg and thigh	Grabbing his crotch

During the operation, the surgical sponges were weighed using a precision balance to measure the amount of bleeding. The recorded data was used to determine the extent of bleeding.

Various complications were recorded, including headache, urinary retention, bleeding, agitation, fever, nausea and vomiting,

as well as need for additional analgesics and time of first miction. The parents' satisfaction with the applied method was recorded. During the follow-up period, patients who reported a pain score greater than 4 were administered 15mg/kg of oral paracetamol.

With the hypothesis that caudal blockade results in less bleeding compared to penile blockade, which is the routinely used method, descriptive statistics obtained from the pilot study consisting of 26 caudal and 21 local method patients were used for sample size calculation for our prospective randomized controlled study. Accordingly, the sample size calculation, which would be statistically significant for a difference of approximately 20% from the mean value of 3.86 ± 1.65 calculated as the local bleeding, was calculated for a two-sided, independent groups t-test at a minimum 80% power, 5% error level, and a total of 100 ($n_1=50$ and $n_2=50$) was found (PASS 11. NCSS, LLC. Kaysville, Utah, 2011).

Statistical Analyses

In order to decide on the statistical methods to be applied, the Shapiro Wilk normality test was first applied, and nonparametric test methods were selected if the normality assumption was not met even in any of the groups. In this context, Student's t and/ or Mann-Whitney U test were applied to compare the variables obtained by measurement in two independent groups, and chi-square and Fisher's exact test were applied to examine the relationship or differences between groups in terms of categorical variables. The diagnostic performances of the variables were

determined by the Receiver Operating Curve analysis method and cut-off points were determined according to the Youden index for the variables found to be significant. In addition, other risk factors thought to increase intraoperative bleeding will be analyzed by using univariate and multiple logistic regression models. The results of demographic and group comparisons will be presented as ratio in qualitative variables and mean $\pm$ St. Dev and median (Min.-Max.) for continuous variables. IBM SPSS Statistics for Windows, Version 25.0 program will be used in the statistical analysis of the study and $p<0.05$ will be accepted as the statistical significance limit.

Results

Caudal and penile blockade groups were compared in terms of age, weight and intraoperative bleeding variables. Accordingly, the difference between the groups was found significant for all three variables ($p<0.001$). The amount of bleeding calculated as 1.51 ± 0.61 in the caudal group was found to be 4.12 ± 1.75 in the penile block group and this difference showed a statistically and also clinically significant difference. Similarly, it is shown in Table 4 that the Penile block group was significantly higher for weight and age.

Table 4. Comparison of groups in terms of variables

	Caudal blockade		Penil blockade		p
	Mean $\pm$ St.Dev.	Median (Min.-Max.)	Mean $\pm$ St.Dev.	Median (Min.-Max.)	
Intraoperative bleeding	1.51 $\pm$ 0.61	1 (1-2)	4.12 $\pm$ 1.75	4 (3-5)	<0.001
Weight	17.74 $\pm$ 7.83	16 (12-22)	22.03 $\pm$ 9.1	21 (16-26)	<0.001
Age	4.42 $\pm$ 2.71	4 (2-7)	5.83 $\pm$ 2.71	6 (4-8)	<0.001

For these group comparisons, a box-plot graph was prepared in Figure 1 and nonparametric test was used for the weights that were observed to have deviating values.

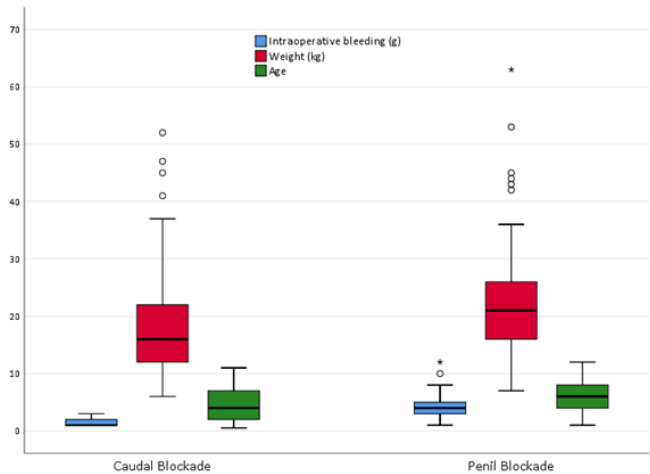


Figure 1. Box-plot for variables

Since weight and age variables were also found to be different between the groups, the diagnostic performances of these 3

variables were determined by Reciever Operating Characteristic (ROC) analysis and in order to interpret the results of the multiple logistic model more clearly, it was deemed appropriate to include these variables in the multiple model in categorical form by using appropriate cut-off points (Figure 2).

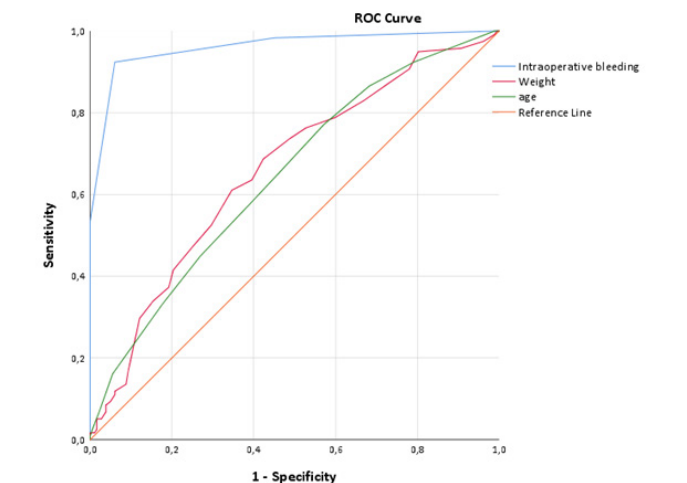


Figure 2. ROC curves for 3 dependent variables

When Table 5 is analyzed, all three variables were found to be significant in terms of diagnostic performance. Intraoperative bleeding variable had the strongest diagnostic performance in terms of area under the curve (0.961 ± 0.012 and $p<0.001$). Cut-off points for all three variables were determined according to the Youden index and are given in Table 6 with the corresponding

sensitivity and selectivity points.

The variables categorized according to the cut-off points specified in Table 6 were first subjected to univariate and then multiple logistic regression analysis and the results are summarized in Table 6.

Table 5. Area under curve and other statistics for ROC curve

Test result variable(s)	Area	Std. error	P	95% Confidence interval	
				Lower bound	Upper bound
Intraoperative bleeding	0.961	0.012	<0.001	0.938	0.984
Weight	0.659	0.032	<0.001	0.596	0.722
Age	0.644	0.032	<0.001	0.581	0.707

Table 6. Cut-off points for variables with sensitivities- specificities and Youdens

	Value cut-off	Sensitivity	Specificity	Youden
Intraoperative bleeding	2.500	0.924	0.940	0.863
Weight	19.500	0.610	0.654	0.264
Age	3.500	0.771	0.429	0.200

In Table 7, all univariate variables of bleeding, age and weight were found to be statistically significant. Penile block increases the risk of bleeding approximately 188 times more than caudal block ($p<0.001$). Age over 3.5 years increases this risk 2.5-fold and weight increases the same risk approximately 3-fold.

As a result of the multiple model established with these 3

variables, which were found to be significant in the univariate analysis, it was observed that the weight and age variables lost their significance in the presence of intraoperative bleeding. In this way, as a result of the multiple model adjusted for age and weight; it was calculated that the risk of bleeding of 2.5 grams or more was approximately 188 times higher with the penile block method compared to the caudal block method ($p<0.001$).

Table 7. Univariate and multiple logistic regression model results

Penile blockade	Univariate results		Multiple Log. Regr. results	
	OR (95% C.I)	P	OR (95% C.I)	P
Bleeding (>2.5)	188.27 (75.54-469.18)	<0.001	188.27 (75.54-469.18)	<0.001
Age (>3.5)	2.50 (1.50-4.25)	<0.001	-	
Weight (>19.5)	2.95 (1.83-4.77)	<0.001	-	

Discussion

This study aimed to determine if there is a difference in intraoperative bleeding between caudal block and penile block for circumcision, a common childhood procedure. The findings of this study indicate that the caudal block is a highly effective procedure for reducing bleeding during surgical interventions when compared with the penile block ($p<0.001$). There was no statistically significant difference in pain rating scales. This is consistent with the literature. Bupivacaine was preferred as a local anesthetic to avoid motor block in patients. The mobilization times were approximately equal for both groups. Both methods provided effective analgesia, resulting in a comfortable process for all patients. Parental satisfaction was high for both methods.

Effective postoperative pain management is crucial as children experience pain to the same extent as adults [9]. Various methods have been attempted to manage postoperative pain, including topical local applications and parenteral opioid use. However, these methods have not provided sufficient analgesia [10]. Regional anesthesia is often utilized for postoperative pain management. The majority of pediatric surgical procedures are performed in the inguinoscrotal area. Penile block and caudal block are both commonly used for inguinoscrotal region operations. However, there is no clear evidence to suggest that one method is superior to the other in terms of pain control. Our study found no significant difference in pain between the two methods. Therefore, the choice of method should be based on the surgeon's preference and experience. It is important to note that

the goal of both methods is to increase surgical comfort.

In their study, Vater et al. found that caudal block provided 6-8 hours of analgesia, while penile block provided 6 hours of analgesia when using Bupivacaine [11]. Weksler found no significant difference in postoperative pain between caudal block and penile block using Bupivacaine [1]. Margetts reported that both methods were effective, but the caudal block remained effective for a longer duration [12]. We also found no significant difference in postoperative pain between caudal block and penile block using Bupivacaine.

When comparing the use of levobupivacaine, ropivacaine, and bupivacaine for caudal block, no significant difference was found in terms of pain control among the three agents [13]. Studies have shown that bupivacaine may produce more motor block than other agents when used for caudal block [14]. In this study, only one patient experienced motor block lasting for one hour.

Complications, such as delayed initial urination, nausea and vomiting, and motor block, may occur after a caudal block [11]. In their study, Demiraran et al. [15] did not find any significant difference in terms of side effects. Conversely, Gaunlett et al. [16] reported a lower complication rate with penile block. Our study found that complications were higher in the caudal block group, but no statistically significant difference was observed.

In view of the growing body of homogeneous and large-population studies on this subject which are being added to the existing literature, it is reasonable to conclude that the question in the minds of clinicians will be answered. The exclusion of urological cases other than circumcision is the biggest limitation of the study.

Conclusion

The results of this study demonstrate that the caudal block is an efficacious technique for reducing bleeding during surgical procedures when compared to the penile block ($p < 0.001$). This will enhance visual acuity during surgical procedures and mitigate other complications associated with surgery. In conclusion, caudal block, which is one of the two most commonly used methods for postoperative pain control in children, has been demonstrated to result in a statistically significant reduction in perioperative bleeding. It is hypothesised that the incidence of perioperative bleeding was reduced in the caudal block group due to a reduction in perioperative pain. Although this study was conducted on patients who underwent circumcision, we believe that the findings will be beneficial in operations such as hypospadias, where bleeding control is of greater importance.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

Ethical approval was granted by the Clinical Research Ethics Committee of Aksaray University Faculty of Medicine (105-SBKA EK).

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