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Evaluation of the Relationship Between Postoperative Surgical Complications and Caudal Epidural Block in Pediatric Hypospadias Surgery

Pediatrik Hipospadias Cerrahisinde Postoperatif Cerrahi Komplikasyonlar ile Kaudal Epidural Blok İlişkisinin İncelenmesi

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ABSTRACT

Objective: The use of caudal epidural block (CEB) for perioperative analgesia in hypospadias surgery has yielded conflicting results regarding its impact on postoperative complications. Our aim is to evaluate the relationship between postoperative surgical complications and the use of CEB in pediatric hypospadias surgery, specifically assessing the impact of CEB across different surgical techniques.

Methods: This retrospective study analyzed pediatric patients who underwent hypospadias surgery under general anesthesia, with or without CEB, at Gazi University between January 2017 and December 2021. Data from 174 patients, aged 7 to 143 months, were reviewed. Parameters included patient age, level of the ectopic external urethral meatus, surgical technique, postoperative complications, and anesthetic method. Statistical analyses were performed using IBM SPSS V22.0.

Results: Among the patients, 144 (82.8%) received CEB and 30 (17.2%) did not. No serious CEB-related complications were observed. Postoperative complications were recorded in 28.7% of cases. The study found no significant difference in complication rates between patients with and without CEB. The frequency of complications varied significantly with the level of the external urethral meatus. The study indicates that the choice of anesthetic method, including the use or nonuse of CEB, does not significantly affect postoperative

ÖZ

Amaç: Hipospadias cerrahisinde perioperatif analjezi amacıyla kaudal epidural blok (KEB) kullanımının, postoperatif komplikasyonlar üzerindeki etkisine ilişkin literatürde çelişkili sonuçlar bulunmaktadır. Bu çalışmanın amacı, pediatrik hipospadias cerrahisinde KEB kullanımı ile postoperatif cerrahi komplikasyonlar arasındaki ilişkiyi değerlendirmek ve farklı cerrahi tekniklerde KEB'nin etkisini incelemektir.

Yöntemler: Bu retrospektif çalışmada, Ocak 2017–Aralık 2021 tarihleri arasında Gazi Üniversitesi'nde genel anestezi altında, KEB uygulanarak veya uygulanmadan hipospadias cerrahisi geçiren pediatrik hastalar analiz edildi. Yaşları 7–143 ay arasında değişen toplam 174 hastanın verileri değerlendirildi. İncelenen parametreler; hasta yaşı, ektopik eksternal üretral meatusun seviyesi, uygulanan cerrahi teknik, postoperatif komplikasyonlar ve anestezi yöntemi idi. İstatistiksel analizler IBM SPSS V22.0 yazılımı kullanılarak yapıldı.

Bulgular: Hastaların 144'üne (%82,8) KEB uygulanırken, 30'una (%17,2) uygulanmadı. KEB'ye bağlı ciddi bir komplikasyon saptanmadı. Postoperatif komplikasyonlar olguların %28,7'sinde gözlendi. KEB uygulanan ve uygulanmayan hastalar arasında komplikasyon oranları açısından anlamlı bir fark bulunmadı. Komplikasyon sıklığının, eksternal üretral meatusun seviyesine göre anlamlı farklılık gösterdiği saptandı. Bulgular, KEB uygulanıp uygulanmamasının da dahil olduğu anestezi yönteminin, pediatrik hipospadias cerrahisi sonrası postoperatif komplikasyonları anlamlı düzeyde etkilemediğini göstermektedir. KEB

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ABSTRACT

complications following pediatric hypospadias surgery. While CEB provides effective analgesia, its association with complications is not statistically significant.

Conclusion: CEB is a beneficial analgesic technique in pediatric hypospadias surgery and is not associated with a significant increase in postoperative complications. Its use should be considered for its analgesic benefits.

Keywords: Anesthesia, caudal, epidural, conduction-blocking, hypospadias, postoperative complications

ÖZ

etkili bir analjezi sağlamakla birlikte, komplikasyonlarla istatistiksel olarak anlamlı bir ilişki göstermemiştir.

Sonuç: KEB, pediatrik hipospadias cerrahisinde yararlı bir analjezik tekniktir ve postoperatif komplikasyonlarda anlamlı bir artış ile ilişkili değildir. Analjezik faydaları göz önünde bulundurularak kullanımının değerlendirilmesi önerilir.

Anahtar Sözcükler: Anestezi, kaudal, epidural, iletim bloğu, hipospadias, postoperatif komplikasyonlar

INTRODUCTION

Hypospadias, one of the most common congenital anomalies in males, is a malformation in which the external urethral meatus is located proximally and ectopically (1). Hypospadias occurs in approximately 1 in 200–300 male births and is the second most common congenital anomaly in males, after undescended testes (2). The diagnosis of hypospadias is made by physical examination, during which chordee and preputial defects are frequently observed (3).

One of the most commonly used classifications for hypospadias was proposed by Duckett. According to this classification, hypospadias is divided into two groups: distal and proximal. Distal hypospadias is observed in 70% of cases, in which the ectopic meatus is located on the glans, corona, or distal shaft. Proximal hypospadias, seen in 30% of cases, is characterized by an ectopic meatus located on the mid-penile shaft, proximal shaft, penoscrotal region, or perineal region (4).

Caudal epidural block (CEB) is a commonly used regional anesthetic and analgesic technique that can provide perioperative and postoperative analgesia. It can be useful in pediatric patients undergoing sub-umbilical procedures, including inguinal hernia repair, hypospadias surgery, and lower extremity procedures. CEB can be used alone or serve as a supplement to general anesthesia for these procedures (5). Complications associated with CEB include headache, systemic toxicity from local anesthetics, transient neurological symptoms, cauda equina syndrome, and wound pain (6).

In hypospadias surgery, postoperative complication rates range from 5–10% for distal hypospadias to 15–90% for proximal hypospadias. The most common complications include fistula, meatal stenosis, dehiscence of the wound or glans, persistent chordee, and diverticulum (7).

Conflicting results regarding the effect of CEB on postoperative complications in hypospadias cases have been reported (8,9). In our study, we aimed to contribute to the literature by reporting data from our center and to evaluate separately the effects of different surgical techniques.

MATERIALS AND METHODS

After approval was obtained from the Clinical Research Ethics Committee of Gazi University, patients who underwent surgery for hypospadias between January 2017 and November 2021 were retrospectively evaluated. A total of 174 ASA I patients who underwent hypospadias surgery and received general anesthesia, with either CEB or penile block (PB), were included in the study. The patients were followed for a minimum of 6 months.

Patient data were reviewed to determine patients' ages, hypospadias levels, anesthesia methods, hypospadias repair types, and complications. Levels of hypospadias were classified as proximal, midpenile, subcoronal, coronal, or glanular in each patient. Anesthesia methods were divided into two groups: CEB and PB; both groups underwent general anesthesia.

According to our clinic's standard operating procedure, CEBs are performed by an experienced anesthesiologist in no more than two attempts. If CEB cannot be performed within the first two attempts, it is performed under USG guidance. PBs are performed by surgeons. For CEB, 0.8 mL/kg of 0.20% bupivacaine is administered, with a maximum total volume of 20 mL.

Surgery was performed using meatotomy, meatal advancement and glanuloplasty incorporated (MAGPI), tubularized incised plate urethroplasty (TIPU), the Mathieu procedure, skin-flap methods, and graft methods. It was evaluated whether postoperative complications such as recurrence, fistula, and urethral stricture were related to CEB.

Statistical Analysis

SPSS Version 22.0 for Windows (IBM Corp., Armonk, NY) was used for statistical analysis. Chi-square and Fisher's exact tests were used to compare categorical variables between patients who received CEB and PB, and between patients with and without complications. Chi-square and Fisher's exact tests were used to compare the presence or absence of complications between patients who received CEB and those who received PB.

RESULTS

Data from 174 patients were analyzed. Patient ages ranged from 7 to 143 months (mean ± standard deviation, 4.70 ± 2.61 years). The Ectopic external urethral meatus was glandular in 52 patients (29.9%), coronal in 55 (31.6%), subcoronal in 33 (19.0%), midpenile in 12 (6.9%), and penoscrotal in 22 (12.6%). The mean age of the 30 patients who received PB was 6.17 ± 2.87, whereas the mean age of the 144 patients who received CEB was 4.40 ± 2.46; this difference was statistically significant ($p < 0.01$). Patients were evaluated for postoperative surgical complications, including recurrence, fistula, and urethral stricture. Complications occurred in 7 of the 30 patients who received PB and in 43 patients who received CEB, with no statistically significant difference between the two groups ($p = 0.472$). When evaluating the relationship between CEB and PB and the frequency of complications across surgical techniques, no statistically significant differences were found for any individual

technique. The MAGPI procedure, one of the most frequently performed techniques, was associated with complications, including recurrence (n = 1), fistula (n = 2), and urethral stricture (n = 2), in 11.62% of the 43 patients who received CEB. No complications occurred in the 11 patients who received PB; the difference was not statistically significant (p = 0.571) (Table 1).

Ethical approval was obtained from the Gazi University Clinical Research Ethics Committee (decision number: 219, dated: 27.12.2021).

DISCUSSION

Our study found no significant association between anesthetic method (with or without CEB) and postoperative complications in pediatric hypospadias surgery. According to our literature review, a prospective study published in September 2011 was the first to suggest that CEB causes vasodilation and venous pooling, leading to increased bleeding and penile edema in the surgical field, increased tension in sutures, and impaired wound healing, thereby increasing urethral fistula formation (10). Later, Zaidi et al. (11) reported that, in a randomly selected group of operated hypospadias patients at their center, the use of CEB was not significantly associated with fistula development. In the next study, Kreysing and Höhne (12), who evaluated all hypospadias patients over a five-year period, reported that CEB was not statistically associated with fistula development (12). However, a subsequent study by Kim and colleagues reported that the use of CEB in hypospadias surgeries performed with the TIPU technique significantly increased the frequency of postoperative complications (13). Saavedra-Belaunde et al. (14), who examined the effect of CEB on complications in distal hypospadias surgery, similarly reported that it increased the frequency of postoperative complications over a five-year period. In the same year, Braga et al. (15) and colleagues reported that CEB did not alter the frequency of complications in patients undergoing the TIPU technique, whereas Taicher and colleagues reported that CEB increased postoperative complications thirteenfold. They further stated that its application should be carefully evaluated until further research is conducted, which may increase ethical dilemmas for clinicians (8).

The first meta-analysis on this subject reported no significant relationship between CEB and postoperative complications. However, two meta-analyses published approximately six months later reported that CEB increased the frequency of postoperative surgical complications (16-18).

While studies continued to report conflicting findings regarding whether CEB increases postoperative surgical complications of hypospadias, Ngoo et al. (19), in 2020, highlighted a different point by showing that PB significantly increased the need for postoperative revision surgery. Following this publication, Braga et al. (20) drew attention to the issue by publishing an article that discussed the dilemmas and attributed the existing contradictions to methodological issues such as selection bias, confounding, sample size, reliability, and generalizability.

Since then, five retrospective studies, one randomized controlled trial, and three meta-analyses have all reported that CEB has no effect on complications of hypospadias surgery (9,21-28). In a recent meta-analysis published in 2024, which included 3,201 patients and 10 studies involving 33 surgeons, the importance of study design, sample size, and power analysis was particularly emphasized, in addition to reporting the study's results, thereby addressing previous conflicting publications (28).

Table 1. Ages and complications based on surgical techniques with caudal epidural block or penile block

	Complication	Total (n = 174)	Caudal block (n = 144)	Penile block (n = 30)	p-value
Age (years)		4.70 ± 2.61	4.40 ± 2.46	6.17 ± 2.87	0.002[a]
Meatotomi	+	0	0	0	-
(n = 17)	-	17	13	4	
MAGPI	+	5	5	0	0.571[b]
(n = 54)	-	49	38	11	
TIPU	+	24	19	5	1.000[b]
(n = 53)	-	29	24	5	
Mathiue	+	10	9	1	1.000[b]
(n = 36)	-	26	23	3	
Onlay island flap	+	2	2	0	-
(n = 7)	-	5	5	0	
Dorsal inlay greft	+	6	5	1	1.000[b]
(n = 7)	-	1	1	0	

A Mann-Whitney U test was used for statistical analysis.
Fisher's exact test was used for statistical analysis.
MAGPI: Meatal advancement and glanuloplasty incorporated, TIPU: Tubularized incised plate urethroplasty.

Several authors have proposed that CEB may increase postoperative complications through vasodilation induced by decreased sympathetic activity, leading to venous pooling in penile tissues. This hemodynamic alteration has been suggested to promote intraoperative penile edema, increased bleeding within the surgical field, and subsequent tension on suture lines, mechanisms that are thought to impair tissue healing and to predispose patients to fistula formation or dehiscence, as initially described by Kundra et al. (10) and later supported by Kim et al. (13) and Saavedra-Belaunde et al. (14)and their colleagues. However, numerous subsequent retrospective studies, randomized trials, and meta-analyses have not confirmed a consistent association between CEB and impaired wound healing, calling into question the clinical relevance of this proposed physiological pathway (9,21–28). In line with these recent findings, the absence of a significant difference in complication rates in our study suggests that venous pooling is unlikely to be a predominant mechanism underlying postoperative complications.

Study Limitations

This study has several limitations that should be acknowledged. First, its retrospective design inherently carries a risk of selection bias and limits the ability to control for potential confounding factors. The relatively small sample size, particularly in the PB group, reduces the statistical power and restricts the generalizability of the findings. Finally, the single-center institutional nature of the data may not reflect practices or outcomes in other settings, reducing external validity.

Prospective, multicenter studies with larger sample sizes and detailed stratification based on hypospadias severity, surgical technique, and patient-specific factors are necessary to provide more definitive evidence on the impact of different regional anesthesia techniques on outcomes of hypospadias surgery.

CONCLUSION

Hypospadias surgery is one of the most challenging areas in pediatric urology because of the high prevalence of hypospadias, relatively high complication rates, and more than three hundred surgical techniques described in the literature. The application of CEB, a frequently used technique in this field, has often been investigated for its impact on surgical outcomes, resulting in conflicting findings in the literature. In our study, the lack of a significant difference in surgical complications associated with CEB suggests that its use, considering the associated risks, is not a contraindication to surgery in these patients. Considering its analgesic effectiveness, we believe CEB to be beneficial in pediatric hypospadias surgery.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Gazi University Clinical Research Ethics Committee (decision number: 219, dated: 27.12.2021).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: C.K., G.A., R.K., Z.T., K.S., B.I., Concept: R.K., Z.T., K.S., B.I., Design: R.K., Z.T., K.S., B.I., Data Collection or Processing: C.K., G.A., G.G.K., Analysis or Interpretation: C.K., G.A., G.G.K., Literature Search: C.K., G.A., R.K., Z.T., K.S., B.I., Writing: C.K., G.A., G.G.K., R.K., Z.T., K.S., B.I.

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