

Evaluation of urethral traumas in children: A retrospective analysis

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Traumatic injury to the pediatric urethra is a relatively uncommon occurrence in children, but it can potentially have severe consequences.^[1] Trauma poses a significant challenge for pediatric surgeons or pediatric urologists due to its rarity. The management of pediatric urethral trauma has traditionally followed treatment algorithms designed for adult cases, given the limited available data specific to pediatric patients.^[2-4]

Urethral injuries typically result from straddle injuries, which happen when the perineum is struck by an external object with force, causing significant trauma to the anterior urethra. While pelvic fractures are common with posterior urethral injuries, the occurrence of posterior urethral injury following such fractures is relatively uncommon, with reported frequencies ranging from 0.47 to 4.2%.^[5-7] In contrast to posterior urethral injuries, pediatric anterior urethral injuries involving the penile and bulbar segments are less common.^[8] The bulbar urethra is the most frequently affected region in anterior urethral trauma.^[9] Injury to the bulbar urethra occurs when anterior-directed forces are applied to the perineum, causing compression against the

Abstract

Objectives: This study aimed to evaluate posttraumatic urethral injuries treated at two centers and evaluate the findings in light of the existing literature.

Patients and methods: The records of 14 male patients (mean age: 10.2 ± 2.9 years; range, 4 to 13 years) who underwent treatment for urethral trauma between 2010 and 2015 at the first clinic and between 2017 and 2022 at the second clinic were retrospectively analyzed. Variables including age, sex, etiology of trauma, location of urethral injury, presence of associated injuries, surgical interventions performed, and treatment outcomes were systematically assessed.

Results: Motor vehicle accidents emerged as the most frequent cause of injury with eight (57.1%) patients. Urethral injuries were observed in seven patients at the bladder neck, six at the posterior urethra, and one at the anterior urethra. Two patients sustained complete injuries, whereas partial injuries were identified in the remaining 12 cases. All patients initially received either a cystofix catheter or a urethral catheter. Two patients underwent open urethroplasty, while internal urethrotomy was performed in 10 patients. Two patients experienced spontaneous recovery without the need for surgical intervention. The patients achieved complete recovery from their initial presentation.

Conclusion: Although open repair of urethral injuries may offer a lower risk of recurrence, delayed internal urethrotomy, which is a less invasive approach, should be considered the primary treatment choice in children.

Keywords: Child, cystofix catheter, trauma, urethral injury, urethrotomy.

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symphysis pubis, commonly known as “straddle injury.” Additionally, pubic rami fractures resulting from blunt pelvic trauma can also lead to bulbar urethral injury. The reported incidence of bulbar urethral injuries secondary to straddle injuries ranges from 0.6 to 10%.^[8-10]

Considering the rarity of pediatric urethral injuries, we aimed to present our experience with the initial and definitive surgical repair of traumatic anterior and posterior urethral injuries in a pediatric population.

PATIENTS AND METHODS

This multicenter retrospective study was conducted at the Department of Urology of the İnönü University Faculty of Medicine between January 2010 and December 2015 and Department of Urology and Pediatric Surgery of the Gebze Yüzyıl Hospital between January 2017 and December 2022. The study included 14 male patients (mean age: 10.2 ± 2.9 years; range, 4 to 13 years) patients. The first center was a first-level university hospital with experience in urogenital trauma, and the second center assessed was a second-level hospital with a high patient density. A comprehensive analysis of the urogenital trauma database was performed to evaluate the results.

The internal urethrotomy procedure was conducted with a Sachse Urethrotome (Karl Storz SE & Co. KG., Tuttlingen, Germany) by making cuts that radiated outward through the stricture, targeting the 12 o'clock positions within the urethra.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 21.0 software (IBM Corp., Armonk, NY, USA). Continuous data were presented as mean \pm standard deviation (SD), while categorical data were presented as number and frequency.

RESULTS

Motor vehicle accidents were documented in eight (57.1%) cases, two (14.3 %) cases were due to a fall, bicycle accidents were in three (21.4%) cases, and injury during clean intermittent catheterization was in one (7.1%) case. Based on the identified localization of urethral injuries, seven (50%) cases involved bladder neck injuries, six (42.9%) cases had posterior urethral injuries, and one (7.1%) case had an anterior urethral injury. The age, etiological factors, and accompanying pathologies of the patients with urethral trauma are summarized in Table 1.

Eleven (78.6%) of the patients had additional pathology. Eight (57.1%) patients had a pelvic fracture. Three (21.4%) patients had isolated pelvis fractures, and five (35.7%) patients had pelvic fractures. Femur fractures (n=2), tibia fracture (n=1), liver laceration (n=2), spleen laceration (n=1), hematoma in the renal parenchyma (n=1), and contusion in the renal capsule (n=1) were also present among these eight patients with fractures.

When urethral trauma was suspected in patients whose general condition was hemodynamically stable in the emergency department, radiological diagnosis was made by ultrasonography, computed tomography (CT), and retrograde urethrography. A Cystofix®

TABLE 1			
Age, etiological factors, and accompanying pathologies of the patients with urethral trauma			
Patient no	Age (year)	Trauma of urethral part	Other system pathology
1.	4	Bladder neck	Femur fracture + pelvis fracture
2.	12	Bladder neck	Renal contusion
3.	10	Bladder neck	Lung contusion + pelvic fracture
4.	8	Bladder neck	Femur fracture
5.	9	Posterior urethra	Laceration of spleen + Grade 1 renal hematoma
6.	13	Bladder neck	No
7.	10	Posterior urethra	No
8.	10	Anterior urethra	Pelvic fracture
9.	13	Bladder neck	Pelvic fracture
10.	10	Posterior urethra	Pelvic fracture + spleen and liver laceration
11.	13	Posterior urethra	Tibia fracture
12.	8	Bladder neck	Pelvic fracture
13.	8	Posterior urethra	Liver laceration
14.	16	Posterior urethra	No

TABLE 2						
The type of urethral trauma and treatment methods						
Injury type	Complete	n	%	Incomplete	n	%
Treatment	Delayed open urethroplasty	2	14.2	Delayed internal urethrotomy	11	78.5
				Spontaneous recovery	1	7.1
Total		2	14.2		12	85.7

catheter (Cystofix; Braun, Melsungen, Germany) was inserted into all patients affected by trauma except for one. The penile catheter was inserted into that patient with incomplete and mild urethral injury in the posterior urethra.

A Cystofix® catheter was placed as the first intervention in all seven patients with bladder neck injuries. After patients were followed for a certain period (1-3 months), internal urethrotomy was performed in five patients, and open urethroplasty was performed in one patient. One patient spontaneously recovered with only the catheter.

After initial treatment with a Cystofix® catheter in six patients with posterior urethra injuries, internal urethrotomy was performed in five of these patients. One patient underwent open urethroplasty three months later. Considering that the patient with anterior urethra injury later underwent internal urethrotomy, internal urethrotomy was performed in a total of 11 patients.

Thus, internal urethrotomy was performed in 11 (78.5%) of all 14 patients who were under observation with a Cystofix® and urethral catheter, at the earliest in the first week and at the latest in the third month. Of the 11 patients who underwent internal urethrotomy, repeat internal urethrotomy was performed in four (36.3%) patients whose symptoms continued. The number of repeated internal urethrotomies ranged from a minimum of two to a maximum of six. No additional procedure was performed in seven (63.6%) patients who underwent internal urethrotomy.

All patients recovered smoothly, exhibiting continence and well-calibrated urine output upon completion of their treatment durations. No mortality associated with the procedure-related trauma was observed.

In two (14.2%) patients, the urethral injury was found to be the complete type, while in the

remaining 12 (85.8%) patients, the injury was partial. Except for one patient who had a urethral catheter inserted for monitoring, the remaining 13 (92.8%) patients underwent initial intervention with a Cystofix® catheter insertion. The urethral injury in the patient with a urethral catheter was of a mild nature. However, three months later, this patient developed urethral stricture and underwent internal urethrotomy. Among the two patients with complete urethral injuries, open urethroplasty was performed three months after Cystofix® catheter insertion. None of the patients who underwent open urethroplasty experienced recurrence, whereas in four (36.3%) out of 11 patients who underwent internal urethrotomy, repeat internal urethrotomy was performed. Internal urethrotomy was performed in one patient within the first week, while delayed internal urethrotomy was performed in all other patients (90.1%). The type of urethral trauma and treatment methods are presented in Table 2.

DISCUSSION

The general treatment approach for penile urethral injuries suggests conservative management, such as a suprapubic catheter or penile catheterization for mild to moderate cases.^[11,12] Mild to moderate cases can be successfully treated with a suprapubic catheter or penile catheterization, but the treatment process becomes challenging in posterior urethral and bladder neck injuries. Although the literature reports cases of urethral injuries in girls, this study did not evaluate urethral injuries in female children. When examining the literature, it is predominantly reported that urethral injuries are much more common in male children. This is attributed to the significantly shorter length of the urethra in girls.^[13]

In our study, with the exception of one patient, 92% of the total 14 patients presented with blunt trauma as the predominant injury type. Additionally, no cases of penetrating or firearm injuries were

included. During the placement of clean intermittent catheterization for neurogenic bladder management, one patient encountered urethral injury. This patient had an uncomplicated recovery following catheterization. The most common cause of injury in our study was traffic accidents (motor and bicycle; 78.5%), followed by falls from a height (14%). Our results were compatible with the literature in terms of the mechanism of trauma.^[11,13]

Urethral injuries are infrequent occurrences primarily observed in males following blunt trauma. Indicative signs of urethral injury consist of blood presence at the meatus accompanied by perineal and penile hematoma or the inability to urinate. Rectal examination is imperative in male patients to assess the position and fixation of the prostate, which may experience displacement from the pelvic region. Urethral lesions can be classified as either anterior (involving the bulbar and penile regions) or posterior (involving the prostatic or membranous areas) injuries.^[14] The initial CT scans might reveal mild perirenal stranding or hematoma, along with retroperitoneal fluid of low density surrounding the genitourinary tract, thereby raising suspicion of ureteral injuries. Employing intravenous contrast-enhanced CT with a delayed excretory phase can enhance the diagnostic accuracy of CT scans. In cases of pediatric urethral trauma, a retrograde urethrogram is the recommended diagnostic method. Due to concurrent injuries, the majority of children with urethral trauma are hemodynamically unstable, necessitating the initial step of urinary drainage through a suprapubic catheter. A transurethral catheter should be employed solely if there is a history of posttraumatic voiding and the absence of clinical indications of urethral rupture. The initial management of anterior urethral injuries involves conservative measures, utilizing a transurethral catheter to prevent urethral bleeding or painful urination.^[15]

In the surgical treatment of urethral injuries, three different approaches are considered: early (within two days), delayed (2 to 14 days), and late (after three months).^[16] Anterior urethral trauma is classified as partial or complete disruption, while posterior urethral trauma is further categorized into four groups: distraction injury, partial disruption, complete disruption, and complex injuries involving the bladder neck or rectum.^[17] This classification of injuries is important in determining appropriate

treatment options. Complete rupture is more common in children compared to adults (69% vs. 42%) and carries a higher risk of strictures.^[18] In adults, urethral damage rarely extends beyond the membranous urethra due to prostatic support, while in children, the small prostate does not stabilize the posterior urethra.^[19] Proximal displacement of the prostate and extension of the tear towards the bladder neck are observed. The incidence of combined urethral and bladder injuries in children is 20%, which is twice as high as in adults. In this study, we reported a lower rate of complete urethral injury compared to the literature (14.2%). The rate of partial urethral injury was higher in our study. In addition, no recurrence was observed in patients who underwent open repair, although it was complete.

Surgical treatment principles for urethral injuries and strictures in children are similar to those in adults. The difference in children lies in the localization of the bladder and prostate and the narrowness of the pelvis.^[20,21] The narrow pelvis makes transperineal urethroplasty more challenging in children compared to adults.^[22,23] The management of posterior urethral injuries remains controversial, with options including immediate primary reanastomosis or suprapubic drainage followed by delayed repair. The goal of delayed urethral repair is to restore adequate urethral caliber and minimize long-term complications, such as stricture formation, urinary incontinence, or erectile dysfunction. A recently published review suggests deferred restoration of urethral continuity in children with posterior urethral distraction defects due to a pelvic fracture, utilizing tension-free spatulated anastomosis during bulboprostatic repair.^[24]

In our study, we did not observe long-term complications related to urethral trauma treatment. Repeated surgery was performed in four patients due to urethral stricture. After clinical observation, these patients recovered completely.

Recommendations regarding the selection of early or delayed treatment continue to determine the treatment approach according to the patient. Delayed treatment planning is recommended for all pediatric patients whose general condition is good and hemodynamically stable.^[25]

In conclusion, urethral injuries in childhood are considered rare traumas that often lack sufficient expertise in a single center. While most mild anterior and posterior urethral injuries in children

can be managed with urethral catheterization, advanced strictures may necessitate frequent dilation and anastomotic resection.^[26] It is crucial to meticulously plan personalized treatment strategies to ensure voluntary and satisfactory voiding with appropriate calibration. Based on the findings, although open repair of urethral injuries may offer a lower risk of recurrence, delayed internal urethrotomy, which is a less invasive approach, should be considered the primary treatment choice in children.

Ethics Committee Approval: The study protocol was approved by the Medipol University Faculty of Medicine, Non-Interventional Clinical Research Ethics Committee (date: 17.07.2023, no: E-10840098-772.02-4211). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from the parents and/or legal guardians of the patients.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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