Evaluation of urethral traumas in children: A retrospective analysis

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Abstract

Objective: The leading cause of child mortality is trauma. Urethral injuries, although rare and with low mortality rates, pose a challenging treatment process. In this study, we conducted a retrospective evaluation of cases from two centers with anterior, posterior urethral, and bladder neck injuries associated with trauma. Our aim was to discuss the obtained results in conjunction with the existing literature.

Materials and Methods: A total of 14 cases with urethral and bladder neck injuries resulting from trauma were retrospectively analyzed. These cases were selected from the period between 2010 and 2015 in the first clinic, and between 2017 and 2022 in the second clinic. Parameters such as age, gender, mechanism of injury, location of urethral injury, presence of additional injuries, surgical interventions performed, and treatment outcomes were retrospectively evaluated.

Results: The average age was 10.2±2.9 years (Range: 4-13 years). Motor vehicle accidents were documented in nine cases, fall down from higher places were in two cases, bicycle accidents in three cases, and injury due to clean intermittent catheterization in one case. Based on the identified localization of urethral injuries, seven cases involved bladder neck injuries, six cases had posterior urethral injuries, and one case had an anterior urethral injury. All patients were observed from their first admission to full recovery.

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. It is crucial to meticulously plan personalized treatment strategies to ensure voluntary and satisfactory voiding with appropriate calibration.

1. Introduction

Traumatic injury to the pediatric urethra is a relatively uncommon occurrence in children, but it can potentially have serious consequences [1]. These injuries typically result from straddle injuries, which happen when the perineum is struck by an external object with force, causing significant trauma to the urethra. Both boys and girls can experience such injuries. In girls, however, urethral injuries are rare due to the short and mobile nature of the urethra, as well as its protected location behind the pubic bone. When injuries do occur in girls, they are often associated with pelvic fractures and can involve lacerations of the anterior vaginal wall due to the close proximity of these two structures [2].

Pediatric urethral trauma poses a significant challenge for 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. However, there have been successful outcomes reported in the repair of anterior and posterior traumatic pediatric urethral injuries [3, 4].
Posterior urethra injuries are frequently associated with pelvic fractures, including the prostate and membranous segments. Studies investigating pediatric urethral trauma frequently include patients with pelvic fractures resulting from blunt trauma to determine the incidence of pediatric urethral injuries. While pelvic fractures are common, the occurrence of posterior urethral injury following such fractures is relatively uncommon, with reported frequencies ranging from 0.47–4.2% [5, 6]. Considering the low incidence of pediatric pelvic fractures, estimated at 2.4–4.6%, it is evident that pediatric posterior urethral trauma is extremely rare [7].

In contrast to posterior urethral injuries, pediatric anterior urethral injuries, involving the penile and bulbar segments, are less common. The bulbar urethra is the most frequently affected region in anterior urethral trauma. Injury to the bulbar urethra occurs when anterior-directed forces are applied to the perineum, causing compression against the 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 0.6–10% [4, 5, 7, 8].

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 the pediatric population. Our study included a cohort of patients treated for a total of ten years in a first-level university hospital with experience in urogenital trauma and a second-level hospital with a high patient density. To evaluate our results, we performed a comprehensive analysis of our urogenital trauma database.

2. Methods

2.1. Study design and study population

This multi-center, retrospective study was conducted at the Department of Urology of Van Yüzüncüyl University Hospital between January 2010 and December 2015 and Department of Urology and Pediatric Surgery of Gebze Yüzüyl Hospital between January 2017 and December 2022. Before the study, a written informed consent was obtained from the parents and/or legal guardians of the patients.

2.2. Statistical analysis

Statistical analysis was performed using the SPSS for Windows version 21.0 software (IBM Corporetaion, Armonk, NY, USA). Continuous data were presented in mean ± standard deviation (SD), while categorical data were presented in number and frequency.

3. Results

The average age was 10.2±2.9 years (Range: 4-13 years). Motor vehicle accidents were documented in nine cases (64 %), fall down from higher places were in two cases (14 %), bicycle accidents were in three cases (21 %), and injury during clean intermittent catheterization was in one case (7 %). Based on the
identified localization of urethral injuries, seven cases (50 %) involved bladder neck injuries, six cases (42 %) had posterior urethral injuries, and one case (7 %) had an anterior urethral injury. The ages, etiological factors, and accompanying pathologies of the cases with urethral trauma are summarized in Table 1. Three of the patients with urethral injury had isolated pelvis fractures, while a total of five (35%) patients had pelvic fractures with other additional pathologies. Two patients had femur fractures and one patient had tibia fractures. Liver laceration was detected in two patients, spleen laceration in one patient, hematoma in the renal parenchyma in one patient, and contusion in the renal capsule in one patient. All but three of the patients had additional pathology (78%). All patients were observed from their first admission to full recovery. Patients who treated at a second center were excluded from the this study. Except for one patient, all others underwent suprapubic catheter insertion as the first approach. Four patients required multiple surgeries due to persistent complaints.

Table 1. Ages, etiological factors, and accompanying pathologies of the cases with urethral trauma are summarized.
<table>
<thead>
<tr>
<th>Patient No:</th>
<th>Age</th>
<th>Trauma of urethral part</th>
<th>Other system pathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>4</td>
<td>Bladder Neck</td>
<td>Femur fracture+pelvis fracture</td>
</tr>
<tr>
<td>2.</td>
<td>12</td>
<td>Bladder Neck</td>
<td>Renal contusion</td>
</tr>
<tr>
<td>3.</td>
<td>10</td>
<td>Bladder Neck</td>
<td>Lung contusion + pelvic fracture</td>
</tr>
<tr>
<td>4.</td>
<td>8</td>
<td>Bladder Neck</td>
<td>Femur fracture</td>
</tr>
<tr>
<td>5.</td>
<td>9</td>
<td>Posterior Urethra</td>
<td>Laseration of Spleen + Grade 1 renal hematom</td>
</tr>
<tr>
<td>6.</td>
<td>13</td>
<td>Bladder Neck</td>
<td>No</td>
</tr>
<tr>
<td>7.</td>
<td>10</td>
<td>Posterior Urethra</td>
<td>No</td>
</tr>
<tr>
<td>8.</td>
<td>10</td>
<td>Anterior Urethra</td>
<td>Pelvic fracture</td>
</tr>
<tr>
<td>9.</td>
<td>13</td>
<td>Bladder Neck</td>
<td>Pelvic fracture</td>
</tr>
<tr>
<td>10.</td>
<td>10</td>
<td>Posterior Urethra</td>
<td>Pelvic fracture + Spleen and Liver laceration</td>
</tr>
<tr>
<td>11.</td>
<td>13</td>
<td>Posterior Urethra</td>
<td>Tibia fracture</td>
</tr>
<tr>
<td>12.</td>
<td>8</td>
<td>Bladder Neck</td>
<td>Pelvic fracture</td>
</tr>
</tbody>
</table>
When urethral trauma was suspected in patients whose general condition was hemodynamically stable in the emergency department, radiological diagnosis was made by ultrasonography (US), computed tomography (CT), and then retrograde urethrography. Cystostix catheter was inserted into all patients affected by trauma, except one. The penile catheter was inserted into that patient with incomplete and mild urethral injury in the posterior urethra.

Internal urethrotomy was performed in nine (57%) patients who were under observation with a cystostix catheter, at the earliest in the first week and at the latest in the third month. Spontaneous recovery was observed in two (14%) patients and no additional surgical procedure was required. Two patients (14%) underwent open urethroplasty three months later. In all of the patients who underwent urethroplasty, the level of injury was close to the bladder neck.

Repeating internal urethrotomies were performed on four patients who continued to experience symptoms following the initial procedure. The number of repeat internal urethrotomies ranged from a minimum of two to a maximum of six. 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.

4. Discussion

The mortality and morbidity of trauma in pediatric patients are higher compared to the adult [9]. There are several reasons. One of the leading causes of injury is the relatively larger head size, which results in insufficient protection of the liver, spleen, and kidneys due to the small and flexible ribs. Similarly, due to the small size of the pelvis, the bladder and urethra can be easily injured as an intra-abdominal organ. More than 80% of abdominal injuries occur due to blunt trauma and most of them can be treated conservatively [9, 10].

Ureteral injuries are a relatively rare occurrence in pediatric abdominal trauma, accounting for less than 1% of cases, mainly due to the small size, mobility, and protected location of the ureter. These injuries often coexist with injuries to other organs. While penetrating wounds are the most common cause of ureteral injuries, significant damage to the ureter can also result from blunt trauma, particularly in cases of high-energy deceleration trauma involving overextension of the pediatric spine. The general treatment approach for penile urethral injuries also suggests a conservative management [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 literature reports cases of urethral injuries in girls, our study did not observe 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, a remarkable 92% of the total 14 patients presented with blunt trauma as the predominant injury type. Also, in our study did not include any cases of penetrating or firearm injuries. During the placement of clean intermittent catheterization (CIC) for neurogenic bladder management, one patient encountered urethral injury. This patient had an uncomplicated recovery following the catheterization. In blunt abdominal trauma, if there is no major vascular injury, the average mortality rate is 15% or less [14]. Mortality is higher in these traumas compared to penetrating injuries as they may also involve central nervous system, chest, and bone injuries [13]. In children, injuries most commonly occur as a result of traffic accidents (57%) and falls (36%). Other causes of injury include sports-related incidents (5%) and animal injuries (2%), with boys being more prone to injuries compared to girls [13]. The most common cause of injury in our study was motor vehicle accidents (71%), followed by bicycle accidents (21%), and falls from a height (14%).

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. Initial computed tomography (CT) scans might reveal mild perirenal stranding or hematoma, along with retroperitoneal fluid of low density surrounding the genitourinary tract, thereby raising suspicions 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 post-traumatic 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].

While the performed urethrography accurately shows the location of the injury, it often cannot distinguish between a partial or complete injury. Partial injuries are generally classified as complete injuries. In the surgical treatment of urethral injuries, three different approaches are considered: early (within two days), delayed (2–14 days), and late (after 3 months). Urethral traumas are classified as anterior or posterior urethral trauma depending on the location of the injury [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% versus 42%) and carries a higher risk of strictures [18]. While in adults, urethral damage rarely extends beyond the membranous urethra due to prostatic support, in children, the small prostate does not stabilize the posterior urethra [19]. Displacement of the prostate proximally 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.

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 re-anastomosis 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 defect due to a pelvic fracture, utilizing tension-free spatulated anastomosis during bulbo-prostatic repair [24].

5. Conclusions

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. It is crucial to meticulously plan personalized treatment strategies to ensure voluntary and satisfactory voiding with appropriate calibration.

Declarations

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Ethics approval and consent to participate: This study protocol was approved by İstanbul Medipol University, Faculty of Medicine, Non-Interventional Clinical Research Ethics Committee (Date: June 2023, No: E-10840098-772.02-3633). Before the study, a written informed consent was obtained from the parents and/or legal guardians of the patients.
This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

**Consent for publication:** Not Applicable.

**Competing interests:** The authors declare that there is no conflict of interest.

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