Clinical Research

# Incidence of urethral stricture in patients with urethral trauma: a 10-year experience in an Indonesian tertiary hospital

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**ABSTRACT**

**BACKGROUND** Urethral injuries are rarely life-threatening but can cause significant morbidity if left untreated. Until now, data on urethral trauma incidence are still limited in Indonesia. This study aimed to report the incidence of traumatic urethral stricture within 10 years of experience in treating urethral trauma.

**METHODS** This retrospective study used a total sampling method for all patients with urethral trauma who came to the emergency department and agreed to undergo radiological evaluation. Patient data were collected from January 2012 to December 2021. All patients were followed up for 3 months after trauma, and the incidence of urethral stricture was analyzed using the chi-square or Fisher's exact tests as an alternative.

**RESULTS** The overall incidence of urethral stricture was 48.4%. Of 122 patients, 82.0% had anterior urethral trauma. Grade III American Association for the Surgery of Trauma (43.4%) was the most common urethral trauma. The cause of urethral trauma was iatrogenic, pelvic fracture urethral injury (PFUI), straddle injury, and penile fracture, contributing in 64.8%, 18.0%, 16.4%, and 0.8% of the cases, respectively. Most patients (70.5%) underwent a cystostomy catheterization procedure as initial treatment. Straddle injury, PFUI, and a higher degree of urethral trauma were significantly associated with urethral stricture formation ($p<0.05$).

**CONCLUSIONS** Straddle injury, PFUI, and a higher degree of urethral trauma were significantly related to a higher incidence of urethral stricture. Most low-grade and anterior urethral traumas can resolve spontaneously.

**KEYWORDS** incidence, trauma, urethra, urethral stricture

Urinary tract trauma from non-iatrogenic causes accounts for 1.5% of all traumas and affects 1 in 45,000 individuals per year.[1] Non-iatrogenic urethral trauma is potentially much more serious than iatrogenic trauma as it requires greater force to injure the urethra from an external origin.[1,2] In addition, iatrogenic urethral trauma is typically due to improper or prolonged catheterization, instrumentation, or surgery. Silicone and small catheters are associated with lower urethral morbidity.[1]

The incidence of post-traumatic urethral stricture is approximately 9.6–36.1%.[3] Urethral stricture may lead to greater morbidity and affect the patient's quality of life.[3,4] Studies regarding the incidence of urethral stricture with previous urethral trauma episodes in Indonesia are limited. Tambah and Adi[5] analyzed the characteristics of urethral trauma among patients in tertiary hospitals in West Java, Indonesia, though the incidence of later urethral strictures was not reported. Pasaribu et al[6] reported the incidence

of traumatic urethral strictures in tertiary hospitals in Central Java, Indonesia, though the mechanism of injury was not specified. Furthermore, only a limited number of centers in Indonesia can perform urethroplasty as the mainstay of treatment for urethral strictures. Therefore, this study aimed to investigate the incidence of urethral stricture in patients with a history of urethral trauma.

## METHODS

This retrospective cohort study was conducted from January 2012 to December 2021. Patients with urethral trauma who visited the emergency department (ED) of Saiful Anwar General Hospital and agreed to undergo urethrography or bipolar voiding urethrography 3 months after the trauma were included. Patients who refused to participate in the study or did not attend the follow-up examinations were excluded from the study.

Data regarding age, degree of trauma, site of trauma, cause of trauma, and treatment were documented during the initial examination. The patients were classified based on the degree of trauma according to the American Association for the Surgery of Trauma (AAST),[2] the site of trauma (anterior or posterior urethral trauma), and the etiology of trauma (iatrogenic trauma due to urethral catheterization, pelvic fracture urethral injury [PFUI], straddle injury, or penile fracture). The patients were evaluated using urethrography or bipolar voiding urethrography after 3 months. Patients with cystostomy catheters underwent bipolar voiding cystourethrography, and patients without cystostomy catheters underwent urethrography performed by the Department of Radiology, Saiful Anwar General Hospital. The bipolar voiding cystourethrography was performed by inserting iodine water-soluble contrast through the cystostomy catheter and external urethral orifice. The urethrography was performed by only inserting contrast from the external urethral orifice.[1]

The incidence of urethral stricture according to trauma grade and etiology was compared using chi-square or Fisher's exact tests. Urethral trauma AAST grade I, iatrogenic urethral trauma, and conservative treatment were used as references to analyze the results of other categories. All statistical analyses were performed using SPSS software version 25 (IBM Corp., USA). Statistical significance was set at $p<0.05$. This study was approved by the Health Research Ethics Commission of Saiful Anwar General Hospital (No: 400/178/K.3/302/2023).

## RESULTS

Of 132 patients with urethral trauma who visited the ED, 122 were included in this study. Ten patients were lost to follow-up (n = 8) or did not return for a repeat radiological evaluation (n = 2). The mean age of the patients was 47.99 years (range: 13–85 years). Most patients were classified as having AAST grade III urethral trauma. More than half of the patients had trauma to the anterior urethra. Most patients had iatrogenic urethral trauma due to improper urethral catheterization. The initial management strategy was conservative in 21 patients and urinary diversion in the

**Table 1.** Demographic characteristics of urethral trauma cases

| Characteristics | n (%) (N = 122) |
|---|---|
| Age (years), mean (SD) | 47.99 (19.6) |
| Degree of trauma | |
| AAST grade I | 26 (21.3) |
| AAST grade II | 9 (7.4) |
| AAST grade III | 53 (43.4) |
| AAST grade IV | 31 (25.4) |
| AAST grade V | 3 (2.5) |
| Location of trauma | |
| Anterior urethra | 100 (82.0) |
| Posterior urethra | 22 (18.0) |
| Etiology | |
| Iatrogenic | 79 (64.8) |
| PFUI | 22 (18.0) |
| Straddle injury | 20 (16.4) |
| Penile fracture | 1 (0.8) |
| Initial treatment | |
| Cystostomy catheterization | 86 (70.5) |
| Conservative | 21 (17.2) |
| Transurethral catheterization | 12 (9.8) |
| PER | 3 (2.5) |
| Incidence of stricture | |
| No stricture | 63 (51.6) |
| Stricture | 59 (48.4) |

AAST=American Association for the Surgery of Trauma; PER=primary endoscopic realignment; PFUI=pelvic fracture urethral injury; SD=standard deviation

**Table 2.** Urethral trauma degree with the underlying etiology

| Degree of trauma | Etiology, n (%) | | | | Site of trauma, n (%) | |
|---|---|---|---|---|---|---|
| | Iatrogenic | PFUI | Straddle injury | Penile fracture | Anterior urethra | Posterior urethra |
| AAST grade I | 24 (92) | 0 (0) | 2 (8) | 0 (0) | 26 (100) | 0 (0) |
| AAST grade II | 7 (78) | 0 (0) | 2 (22) | 0 (0) | 9 (100) | 0 (0) |
| AAST grade III | 37 (70) | 5 (9) | 11 (21) | 0 (0) | 50 (94) | 3 (6) |
| AAST grade IV | 11 (35) | 15 (48) | 5 (16) | 0 (0) | 14 (45) | 17 (55) |
| AAST grade V | 0 (0) | 2 (67) | 0 (0) | 1 (33) | 1 (33) | 2 (67) |

AAST=American Association for the Surgery of Trauma; PFUI=pelvic fracture urethral injury

**Table 3.** Relationship between urethral stricture formation and the degree and etiology of urethral trauma

| Variables | Incidence of urethral stricture, n (%) | | OR (95% CI) | *p* |
|---|---|---|---|---|
| | Stricture | No stricture | | |
| Degree of trauma* | | | | |
| AAST grade I | 0 (0) | 26 (100) | - | - |
| AAST grade II | 0 (0) | 9 (100) | - | 0.473 |
| AAST grade III | 26 (49) | 27 (51) | - | **<0.001** |
| AAST grade IV | 30 (97) | 1 (3) | - | **<0.001** |
| AAST grade V | 3 (100) | 0 (0) | - | **<0.001** |
| Etiology of trauma† | | | | |
| Iatrogenic | 22 (28) | 57 (72) | - | - |
| PFUI | 22 (100) | 0 (0) | - | **<0.001** |
| Straddle injury | 14 (70) | 6 (30) | 2.4 (1.21–4.76) | **0.001** |
| Penile fracture | 1 (100) | 0 (0) | - | 0.287 |

AAST=American Association for the Surgery of Trauma; CI=confidence interval; PFUI=pelvic fracture urethral injury; OR=odds ratio
*AAST grade I was used as reference to compare with other categories; †iatrogenic was used as reference to compare with other categories

remaining patients. All strictures were managed using urethroplasty (Table 1).

PFUI was the most common type of grade IV urethral trauma. In contrast, iatrogenic and straddle injury mechanisms were the most common causes of grade III trauma. AAST grades I, II, and III urethral trauma primarily involved the anterior urethra. In contrast, most patients with grade IV and V urethral trauma had posterior urethra trauma (Table 2). Strictures were identified in 37% and 100% of patients with anterior and posterior trauma, respectively.

PFUI and iatrogenic etiology were associated with the two highest incidences of stricture. PFUI and straddle injury were associated with a significantly higher rate of urethral stricture development than iatrogenic urethral trauma. Grades I and II urethral trauma were not associated with the formation of urethral strictures. However, patients with grades III, IV, and V urethral trauma had a significantly higher rate of urethral stricture development than those with grade I urethral trauma (Table 3). Furthermore, patients with urethral trauma of AAST grade IV had a significantly higher risk of developing urethral strictures than those with AAST grade III urethral trauma (odds ratio = 15.7, 95% confidence interval = 2.25–25.56, $p<0.001$).

Most patients in this study underwent cystostomy catheterization, though patients with low-grade urethral trauma (AAST grades I and II) were treated conservatively. Most patients with PFUI underwent cystostomy catheterization (Table 4). The patients treated with cystostomy catheterization and primary endoscopic realignment (PER) had a significantly higher rate of urethral stricture development than those treated conservatively (Table 5). There was no significant difference between the cystostomy catheter and PER ($p = 0.548$) for urethral stricture development.

## DISCUSSION

In this study, a significant proportion of urethral trauma was due to urethral catheterization, which is consistent with the results of a previous study conducted in West Java, Indonesia, that reported a high incidence of urethral catheterization associated with urethral trauma (44%) over a 5-year period.[5]

Urethral trauma may affect both men and women; however, men are nearly 10 times more prone to urethral injury than women.[5,7] The incidence of urethral injury among females with pelvic fractures is <6%,[7]

**Table 4.** Treatment for urethral trauma

| Variables | Treatment, n (%) | | | |
|---|---|---|---|---|
| | Conservative | Transurethral catheterization | Cystostomy catheterization | PER |
| Degree of urethral trauma | | | | |
| AAST grade I | 12 (46) | 7 (27) | 7 (27) | 0 (0) |
| AAST grade II | 4 (44) | 3 (33) | 2 (22) | 0 (0) |
| AAST grade III | 5 (9) | 2 (4) | 45 (85) | 1 (2) |
| AAST grade IV | 0 (0) | 0 (0) | 29 (94) | 2 (6) |
| AAST grade V | 0 (0) | 0 (0) | 3 (100) | 0 (0) |
| Etiology of trauma | | | | |
| Iatrogenic | 14 (18) | 9 (11) | 55 (67) | 1 (1) |
| PFUI | 0 (0) | 0 (0) | 20 (91) | 2 (9) |
| Straddle injury | 2 (10) | 4 (20) | 14 (70) | 0 (0) |
| Penile fracture | 0 (0) | 0 (0) | 1 (100) | 0 (0) |

AAST=Association for the Surgery of Trauma; PER=primary endoscopic realignment; PFUI=pelvic fracture urethral injury

**Table 5.** Relationship between urethral stricture formation and urethral trauma treatment

| Treatment of urethral trauma* | Incidence of urethral stricture, n (%) | | *p* |
|---|---|---|---|
| | Stricture | No stricture | |
| Conservative | 0 (0) | 21 (100) | - |
| Transurethral catheterization | 0 (0) | 12 (100) | **0.364** |
| Cystostomy catheterization | 56 (65) | 30 (35) | **<0.001** |
| PER | 3 (100) | 0 (0) | **<0.001** |

PER=primary endoscopic realignment
*Conservative was used as reference to compare with other categories

which is attributed to their comparatively shorter and more mobile urethra. A multicenter, prospective, descriptive cross-sectional study reported urethral trauma secondary to urethral catheters in 66 males and no females.[7] In the current study, only one female patient had urethral trauma due to PFUI.

A previous study reported that the incidence of urethral trauma secondary to urinary catheter insertion was between 6% and 32% of all urethral injuries.[8] The European Association of Urology reported that the incidence of urethral injury during transurethral catheterization was 13.4/1,000 catheters inserted in male patients.[2] Trauma secondary to urethral catheterization arises most frequently from inadvertent intraurethral inflation of the catheter anchoring balloon or false passage creation. However, catheter-related trauma can be prevented via several measures. A guide wire or a smaller urinary catheter size after failed catheterization can help prevent urethral injury.[8,9] Suprapubic puncture can also be performed by trained non-urology doctors or nurses, especially in an institution with limited resources.[8] A lack of knowledge in urethral catheterization is a risk factor for urethral injury. A targeted training program regarding urethral catheterization for nursing staff effectively reduced iatrogenic urethral injuries in previous studies.[8,9] Despite being frequent, most iatrogenic urethral injuries often include small superficial mucosal rips that resolve without any surgical intervention and are associated with a fair prognosis.[8]

The injury site also plays an important role in determining the proper management, as each side of the urethra has unique anatomical features. In the anterior urethra, the epithelium is located directly within the spongy vascular erectile tissue of the corpus spongiosum. This tissue is tightly constrained by Buck's fascia, which is fixed to the underside of the corpora cavernosa.[10] Posterior urethral injuries are typically located at the bulbomembranous junction.[10,11]

The posterior urethra is more fixed than the anterior segment. The membranous urethra is unattached to any fixed structure; it is the only segment of the male urethra that is not surrounded by any other structure, making the posterior urethra more prone to injury from direct trauma or to tears due to pelvic ring injuries.[10] If the epithelium is breached, the urethra is immediately exposed to extravasated urine, which may lead to necrotic tissue formation.[12] In this study, patients with posterior urethral trauma had a significantly higher rate of developing urethral strictures than those with anterior urethral trauma.

AAST grading is based on the urethrogram obtained during the initial presentation of urethral trauma. Later, strictures are developed in 31–69% of patients with complete disruption of the urethra (AAST grades IV and V).[13] In the current study, 34 patients with total urethral rupture developed urethral strictures. In contrast, no urethral strictures were detected in patients with AAST grades I and II on urethrography 3 months after the presentation. Furthermore, in this study, most patients with urethral trauma did not develop urethral strictures, especially those with low-grade, catheter-induced, or anterior urethral traumas. Therefore, further interventions for urethral trauma after primary urinary diversion should be performed within 3 months of the initial trauma.

In this study, transurethral catheterization was recommended as an option for initial urinary diversion, as urethral injury may resolve spontaneously without any further treatment. However, cystostomy catheterization is recommended for high-grade urethral trauma to prevent further urethral injury. Three patients who developed urethral strictures after evaluation underwent PER. PER was not routinely performed due to its low free stricture rate and lack of evidence, which may lead to easier urethroplasty.[12,13]

Currently, the standard recommendation is to surgically place a suprapubic cystotomy tube in patients with urethral disruption.[2] Early endoscopic or non-endoscopic Foley catheter insertion attempts are possible. In the event of failure, a suprapubic tube should be inserted, as delayed urethroplasty may be required.[12] In the current study, patients treated conservatively with transurethral catheterization did not develop urethral stricture. In contrast, patients treated with cystostomy had a higher rate of urethral stricture development as those patients tended to have high-grade urethral trauma. Currently, delayed urethroplasty remains the mainstay of treatment for urethral strictures.

In conclusion, data regarding the incidence of urethral trauma in Indonesia are limited. A large multicenter study is needed to further improve urological reconstruction services. A higher degree of urethral trauma was associated with a higher incidence of urethral stricture. Most low-grade and anterior urethral traumas resolved spontaneously without any treatment within 3 months of trauma.

**Conflict of Interest**
The authors affirm no conflict of interest in this study.

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