

ORIGINAL PAPER

Management of complex pelvic fracture urethral injury following high-energy trauma in female patients: A case series

Adrianus Gupta Wijaya, Paksi Satyagraha, Besut Daryanto

Department of Urology, Faculty of Medicine, Universitas Brawijaya, Saiful Anwar General Hospital, Malang, East Java, Indonesia.

Summary

Introduction and objectives: Female pelvic fracture urethral injury (PFUI) with vaginal trauma following high-energy collision trauma is rare and challenging to manage, particularly in delayed presentations complicated by urinary and vaginal sequelae. This case series aims to describe the clinical presentation, management strategies, and outcomes of patients with complex PFUI associated with vaginal injury.

Materials and methods: We retrospectively reviewed the medical records of three female patients who underwent surgical treatment for pelvic fracture urethral injury (PFUI) at our hospital. Imaging findings, operative details, endoscopic findings, and clinical outcomes were collected and analyzed.

Case presentation: Three female patients were referred to our tertiary center with complex pelvic fracture urethral injury (PFUI) associated with vaginal trauma following high-energy collision trauma. Case 1 was a 6-year-old girl who had undergone suprapubic diversion for 11 months and presented with complete urethral obliteration, urethrovaginal fistula, and vesicolithiasis. Case 2 was a 9-year-old girl with a 9-month history of suprapubic diversion due to distal urethral obliteration/stenosis and extensive vaginal synechiae. Case 3 was a 19-year-old woman with long-term suprapubic diversion complicated by posterior urethral stenosis, complete vaginal synechiae, urethrovaginal fistula, and colpolithiasis.

Management was individualized: Case 1 underwent endoscopic realignment; Case 2 underwent vaginal synechiolysis and pull-through mucosal vaginoplasty; and Case 3 underwent vaginal synechiolysis with neovaginal reconstruction using a placental graft. All patients achieved spontaneous voiding with urinary continence and maintained vaginal patency during follow-up.

Conclusions: Management of female PFUI with associated vaginal injury should be individualized based on the anatomical defect and functional objectives. Staged reconstruction and long-term follow-up may be required to optimize urinary continence and vaginal function.

KEY WORDS: Female urethral injury; PFUI; Urethrovaginal fistula; Vaginal synechiae.

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INTRODUCTION

Pelvic fracture urethral injury (PFUI) typically results from high-energy blunt trauma associated with pelvic ring dis-

ruption and may occur in isolation or alongside life-threatening non-urological injuries that take priority during initial resuscitation (1). PFUI is reported in fewer than 10% of patients with pelvic fractures (2). Although PFUI is classically described in males, female PFUI represents a distinct clinical entity. Delayed diagnosis or referral can lead to complex sequelae, including urethrovaginal fistula, vaginal stenosis or synechiae, urinary incontinence, recurrent infection, and impaired sexual function.

The incidence of female urethral injury among patients with pelvic trauma is low; two reviews estimated a prevalence of 4-6%, with higher susceptibility in younger girls than in adult females (3). In pediatric and adolescent populations, high-impact blunt trauma is the predominant mechanism, and injury patterns may differ from those in adults because of differences in pelvic anatomy and tissue characteristics (4). In our setting, road traffic collisions represent the most common mechanism.

A major challenge in female PFUI is delayed presentation, particularly in resource-limited settings. Prolonged suprapubic diversion and untreated associated vaginal injury may result in chronic inflammation and scarring, urethral obliteration, vaginal synechiae, and fistulous communication, complicating definitive reconstruction. Chronic urinary stasis within the vagina, particularly in the presence of a urethrovaginal fistula and outlet obstruction, may also predispose to vaginal calculi, which are rare and may be overlooked or misdiagnosed (5).

Here, we present three delayed presentations of complex female PFUI following high-energy trauma, each associated with concomitant vaginal injury and distinct reconstructive challenges. We highlight practical decision-making and functional outcomes in a tertiary referral setting.

CASE PRESENTATION

Case 1

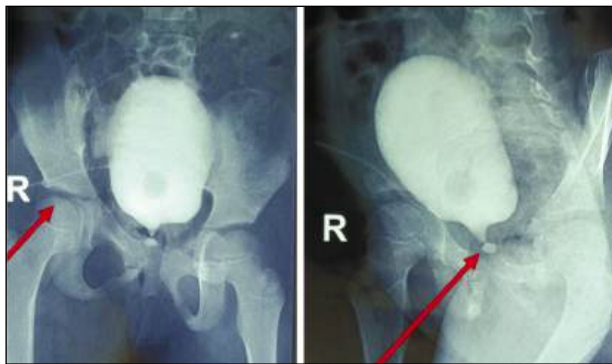
A 6-year-old girl had a suprapubic cystostomy for 11 months because of complete urethral obliteration, urethrovaginal fistula, and vesicolithiasis. The injury occurred when her perineum struck a road divider, followed by genital bleeding. Initial management at a referring hospital included suprapubic diversion and perineal repair. On examination, the patient was hemodynamically stable and

Figure 1.

(A) & (B) Vaginal synechia due to laceration.

**Figure 2.**

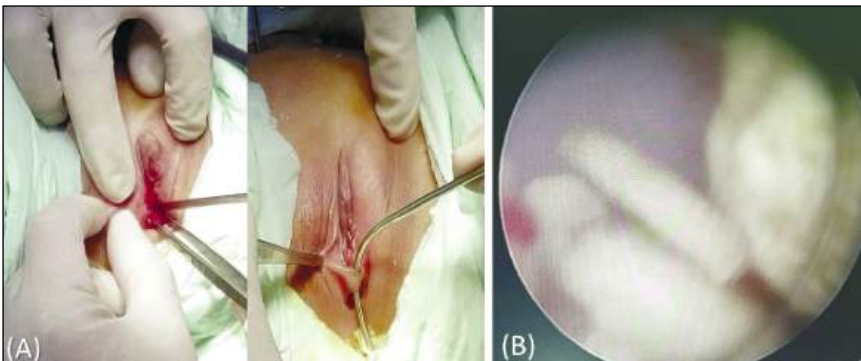
BVCUG: Bladder stone with intact bladder and fracture of inferior pubic ramus.



had vaginal synechiae (Figure 1). Bipolar voiding cystourethrography (BVCUG) demonstrated an inferior pubic ramus fracture with an intact bladder (Figure 2). At the first procedure, cystoscopy and vaginal synechiolysis were performed. Endoscopy revealed a bladder stone, a patent bladder neck, a visible urethral meatus, and complete urethral obliteration (Figure 3). The largest stone measured 0.5 cm, and percutaneous vesicolithotripsy was performed. The distal and proximal urethral segments, measured from the meatus, were approximately 1 cm and 2 cm, respectively (Figure 4).

Figure 3.

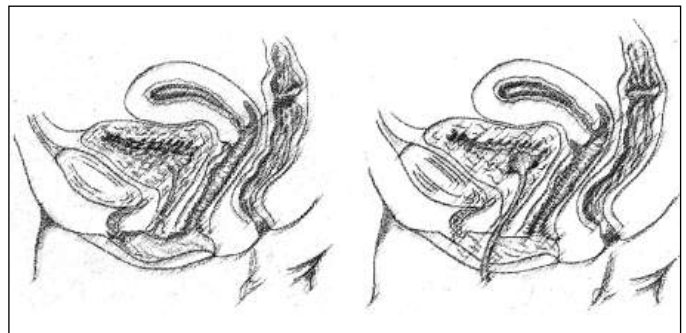
(A) Release of vaginal synechia; (B) Endoscopic Evaluation – bladder stone.



The suprapubic catheter was subsequently maintained for 9 months because of COVID-19-related constraints. The patient later reported urine leakage via the vagina. During the second procedure, endoscopic assessment demonstrated spontaneous realignment of the distal and proximal urethral segments through the fistulous tract. A urethral catheter was left in situ for 6 weeks (Figure 5). Follow-up panendoscopy showed a patent urethra without a residual fistula tract, and the bladder appeared normal. Colposcopy demonstrated a normal vaginal lumen without a fistula. After catheter removal, the patient voided spontaneously.

Figure 4. Urethra's illustration at first surgery.**Figure 5.**

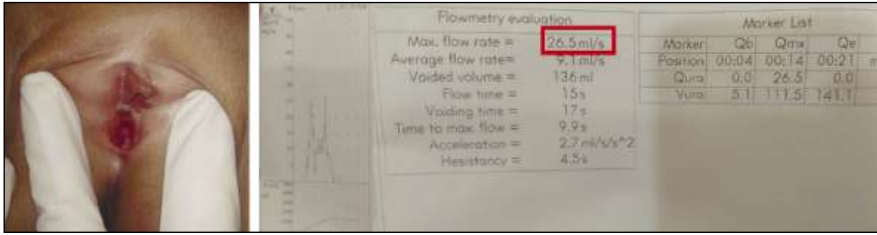
(A) Spontaneous urethral realignment; (B) Urethral Catheter in placed for 6 weeks.



Uroflowmetry showed a maximum flow rate (Q_{max}) of 26.5 mL/s, with a voided volume of 136 mL and a post-void residual (PVR) of 15.3 mL (Figure 6).

Case 2

A 9-year-old girl presented with inability to void per urethra for 9 months. She had undergone suprapubic cystostomy after a road traffic collision in which her pelvis was struck by a truck, followed by genital bleeding. Initial management at a referring hospital included suprapubic diversion and attempted ure-

**Figure 6.**

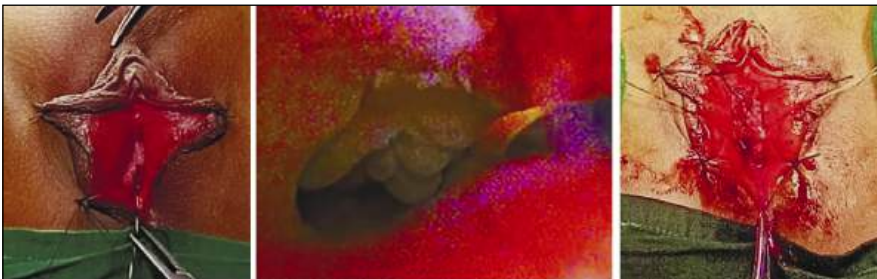
Patent urethra with uroflowmetry result post-surgery.

Figure 7.

(A) & (B) Vaginal Synechia due to laceration.

**Figure 8.**

A) & (B) Cystography and Colpography.

**Figure 9.**

Vaginoplasty with pull-through mucosa technique.

**Figure 10.**

Patent vagina, continent spontaneous micturition through urethrovaginal fistula.

Case 3

A 19-year-old woman presented with urinary retention and secondary amenorrhea. She had undergone suprapubic cystostomy after a transportation accident 18 months before admission. Previous procedures included pubic wound closure, cystostomy placement, and bilateral thigh skin grafting. On examination, she was hemodynamically stable and had vaginal synechiae (Figure 11).

BVCUG and MRI demonstrated vesicovaginal lithiasis with obliteration of the urethra. The suprapubic catheter bal-

loon was located intravesically (Figure 12). Antegrade flexible cystoscopy performed through the cystostomy tract revealed a bladder stone, normal bilateral ureteric orifices, an intact bladder neck, a proximal urethral remnant measuring approximately 1 cm, and a urethrovaginal fistula.

Percutaneous vesicolithotripsy was performed through the cystostomy tract (Figure 13). A guidewire was then advanced through the urethral remnant and visualized within the vaginal cavity. Under cystoscopic guidance, the vagina was accessed with a needle, after which a guidewire was advanced into the bladder and retrieved. Vaginal synechiolysis was performed, followed by neovaginal reconstruction using a placental graft.

A cross incision was made over the vaginal septum using a No. 11 blade, releasing approximately 30 mL of retained hematometra and hematocolpos. The vaginal canal was then identified by gentle digital dissection and further widened with a double Langenbeck retractor, followed by careful hemostasis. A sterile vaginal mold, preassembled with a condom-covered core lined with autologous placental mucosa and secured with No. 1 silk sutures, was soaked in gentamicin-normal saline solution before insertion into the neovaginal canal. The septal edges were grasped at three points with Kocher clamps and sutured to the adjacent distal vaginal mucosa using interrupted No. 1 silk sutures to maintain patency of the neovaginal opening.

A soft amnion mold was left in situ for 10 days, and scheduled vaginal dilation was continued for 2 months (Figure 14).

Figure 11.

(A) & (B) Vaginal Synechia due to laceration.



Figure 12.

BVCUG and MRI after suprapubic catheterization.

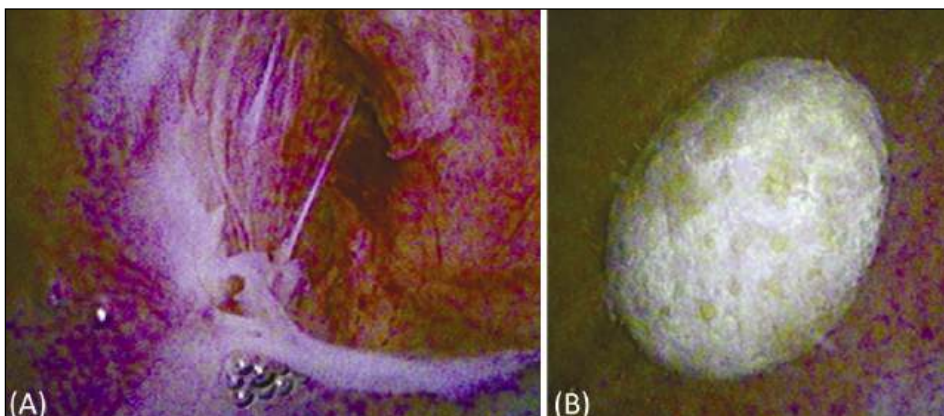
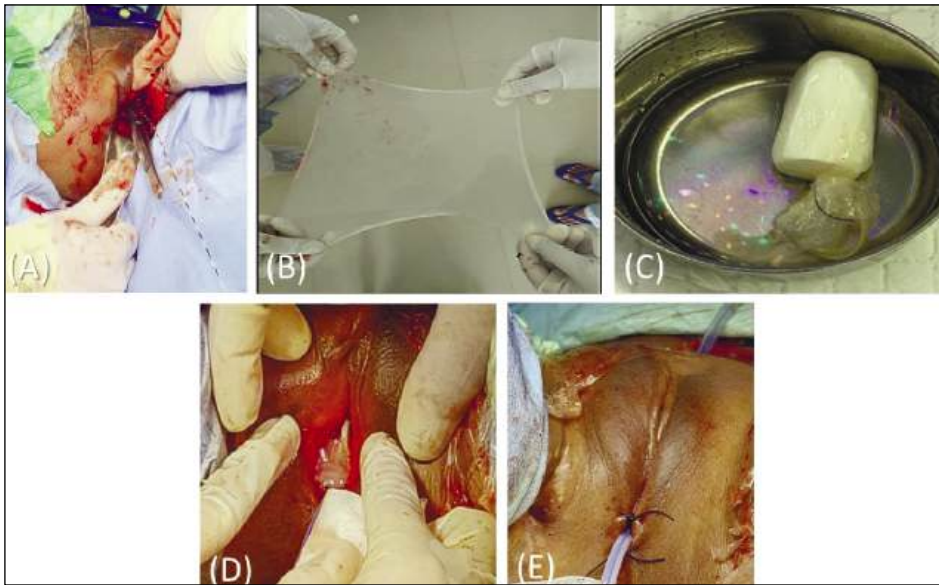
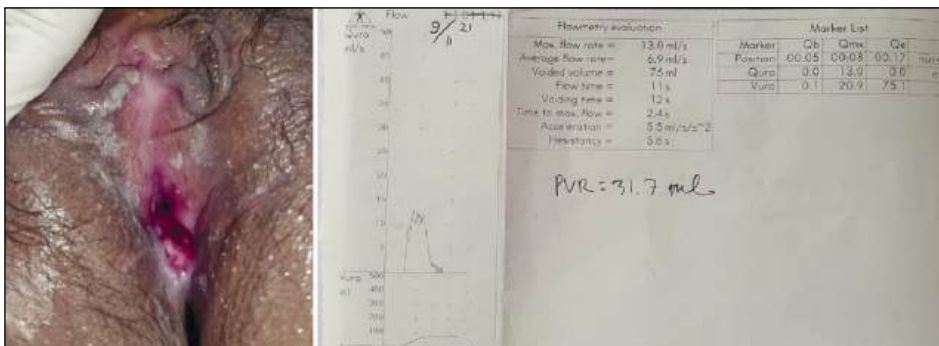


Figure 13.

(A) Urethrovaginal fistula (B) Vaginal Stone.

**Figure 14.**

(A) Release of vaginal synechia;
(B) (C) (D) Neovagination with
placenta soft moulding;
(E) Urethral catheterization
through wire.

**Figure 15.**

Patent vaginal lumen, continent
spontaneous micturition.

At follow-up, the vaginal lumen remained patent. The patient voided spontaneously and remained continent. Uroflowmetry showed a $Q_{\max}$ of 22.5 mL/s, with a voided volume of 108 mL and a PVR of 13.7 mL (Figure 15).

Discussion

Female PFUI is uncommon. A contemporary series reported one urethral injury among 2,102 females with pelvic fractures (0.05%), compared with an incidence of 2% in males (6). In contrast to male PFUI – which typically involves the posterior urethra – female urethral injury is less frequent, likely because the short, relatively mobile urethra is positioned posteriorly and partially protected by the pubic arch, and because severe pelvic ring disruption may be less common in females in some cohorts (7). In pediatric trauma, urethral injury similarly accounts for a small proportion of traumatic genitourinary injuries and most commonly occurs in association with pelvic fractures following blunt trauma (4). Pelvic fracture-related trauma may result in a spectrum of female urethral injuries, ranging from contusion to partial or complete urethral disruption, including longitudinal urethral tears. These injuries frequently involve the vagina and may occasionally extend to the rectum (8). All patients in this series had combined urethral and vaginal injury followed by synechia formation, consistent with previous observations that proximal urethral injuries may

be complete and are associated with vaginal lacerations in up to 75% of cases (5).

Management of female urethral injury differs from that in males because it must account for distinct anatomical and functional considerations. Female urethral trauma is almost invariably accompanied by vaginal wall laceration (7). All our cases had concomitant vaginal injury. Case 3 represented the most severe presentation and was complicated by secondary amenorrhea, vaginal calculus formation, urinary retention, and extensive vaginal synechia. The primary treatment objectives in female PFUI are restoration of safe spontaneous voiding, preservation of urinary continence, and maintenance or restoration of vaginal patency, while minimizing repeated interventions and optimizing future sexual function (7). Achieving these goals often requires individualized strategies based on the location and extent of urethral loss, bladder neck competence, concomitant vaginal injury, and timing of presentation.

In Case 1, endoscopic realignment with prolonged catheterization resulted in urethral patency and continence. Although primary realignment in urethral trauma has variable success rates, favorable outcomes may be achieved in selected patients when adequate alignment can be established and maintained. Catheterization for approximately 6 weeks is commonly used for complete disruptions.

Cases 2 and 3 had extensive distal urethral loss with urethrovaginal communication and severe vaginal scarring. In such scenarios, restoring vaginal patency becomes cen-

tral to both function and quality of life. Both patients achieved spontaneous voiding and continence. This observation aligns with the concept that continence in females depends on a composite mechanism – including bladder neck competence, urethral length, mucosal coaptation, the sphincter complex, and pelvic support – rather than urethral patency alone (7).

Post-traumatic synechiae represent a challenging late complication. Dhaiban et al. described labial synechiae as an inflammatory consequence leading to fusion of the labia minora; management ranges from conservative measures to operative separation (9). In this series, all patients required operative management of vaginal synechiae: Case 1 underwent simple separation, Case 2 required pull-through mucosal vaginoplasty, and Case 3 required neovaginal reconstruction using a placental graft with temporary molding and a structured dilation program to reduce re-adhesion.

Vaginal calculi are rare and may be overlooked in delayed PFUI. Wei D reported that primary vaginal calculi can arise from inorganic salt deposition and infection in the setting of urinary stasis, with predisposing factors including congenital anomalies, trauma, urethrovaginal fistula, ectopic ureter, and vaginal outlet obstruction (10). These mechanisms were relevant in our cohort, underscoring the importance of thorough endoscopic and vaginal evaluation when chronic diversion and urinary leakage are present. This case series is limited by its small sample size, retrospective descriptive design, and heterogeneity in injury patterns and prior management. Nevertheless, it illustrates a spectrum of delayed and complex female PFUI presentations with significant vaginal sequelae in a referral setting where delayed presentation may influence both reconstructive options and outcomes.

DECLARATIONS

Ethical approval and consent for participate: This retrospective case series was conducted in accordance with institutional policies and the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of Dr. Saiful Anwar General Hospital, Malang, Indonesia (Ref No: 070/146/120/1027/2023). Written informed consent for publication of clinical details and images was obtained from the patients' legal guardians for Cases 1 and 2 and directly from the patient for Case 3. All patient data were anonymized prior to analysis and publication.

Availability of data and material: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: AGW contributed to study conception and design, data collection, data analysis, and manuscript drafting; PS contributed to clinical data analysis and critical revision of the manuscript; BD contributed to study supervision and critical revision of the manuscript. All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

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CONCLUSIONS

Delayed female PFUI with concomitant vaginal injury requires individualized management based on anatomical findings, clinical symptoms, and patient-centered functional goals. Long-term follow-up is essential, and staged reconstruction may be required – particularly in patients who are sexually active or those with severe vaginal scarring – to optimize urinary continence and vaginal function. Given the rarity of female PFUI, multicenter registries and collaborative studies are needed to strengthen the evidence base and inform consensus on the optimal timing and selection of reconstructive techniques in both pediatric and adult populations.

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Correspondence

Adrianus Gupta Wijaya (Corresponding Author)
guptawijaya@gmail.com

Department of Urology, Faculty of Medicine, Universitas Brawijaya, Saiful Anwar General Hospital, Malang, East Java, Indonesia
Jl. Jaks Agung Suprpto No.2, Klojen, Kec. Klojen, Kota Malang, Jawa Timur 65112, Indonesia

Paksi Satyagraha

Besut Daryanto

Department of Urology, Faculty of Medicine, Universitas Brawijaya, Saiful Anwar General Hospital, Malang, East Java, Indonesia