Early effectiveness of endoscopic posterior urethra primary alignment

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BACKGROUND: Posterior urethra primary realignment (PUPR) after complete transection may decrease the gap between the ends of the transected urethra, tamponade the retropubic bleeding, and optimize urinary drainage without the need of suprapubic catheter facilitating concurrent pelvic orthopedic and trauma procedures. Historically, the distorted anatomy after pelvic trauma has been a major surgical challenge. The purpose of the study was to assess the relationship of the severity of the pelvic fracture to the success of endoscopic and immediate PUPR following complete posterior urethral disruption using the Young-Burgess classification system.

METHODS: A review of our Level I trauma center database for patients diagnosed with pelvic fracture and complete posterior urethral disruption from January 2005 to April 2012 was performed. Pelvic fracture severity was categorized according to the Young-Burgees classification system. Management consisted of suprapubic catheter insertion at diagnosis followed by early urethral realignment when the patient was clinically stable. Failure of realignment was defined as inability to achieve urethral continuity with Foley catheterization. Clinical follow-up consisted of radiologic, pressure studies and cystoscopic evaluation.

RESULTS: A total of 481 patients with pelvic trauma from our trauma registry were screened initially, and 18 (3.7%) were diagnosed with a complete posterior urethral disruption. A total of 15 primary realignments (83.3%) were performed all within 5 days of trauma. The success rate of early realignment was 100%. There was no correlation between the type of pelvic ring fracture and the success of PUPR. Postoperatively, 8 patients (53.3%) developed urethral strictures, 3 patients (20.0%) developed incontinence, and 7 patients (46.7%) reported erectile dysfunction after the trauma. The mean follow-up of these patients was 31.8 months.

CONCLUSION: Endoscopic PUPR may be an effective option for the treatment of complete posterior urethral disruption and enables urinary drainage to best suit the multispecialty surgical team. The success rate of achieving primary realignment did not appear to be related to the complexity and type of pelvic ring fracture. (*J Trauma Acute Care Surg*. 2013;75: 189–194. Copyright © 2013 by Lippincott Williams & Wilkins)

LEVEL OF EVIDENCE: Epidemiologic study, level III; therapeutic study, level V.

KEY WORDS: Urethral trauma; pelvic fracture; primary urethral realignment; complete posterior urethral injury.

Initial management of complete posterior urethral injury caused by pelvic fracture has remained controversial owing to technical surgical challenges to connect the urethral disrupted ends and questionable outcomes advantages.

Early realignment was first introduced by Ormond and Cothran[1] in 1934 and later reported by Wilkinson[2] in 1961 to correct the displaced prostate and to maintain continuity of the urethra. These investigators demonstrated that early realignment not only decreased the incidence of stricture/defect formation by approximately 50% but also facilitated future repair by pulling the proximal urethra into the orthotropic position while tamponading the retroperitoneal bleeding and decreasing the chance of hematoma infection.[3–6]

Initial reports of endoscopic realignment demonstrated low success rates and marginal benefit, perhaps owing to the rarity of complete posterior urethral disruption.[7,8] The correlation between the severity of pelvic trauma and success realignment has not been previously reported. Intuitively, the energy absorbed by the pelvic ring correlates with the severity of the trauma and possibly the complexity of the urethral injury. Therefore, we hypothesized that the severity of pelvic fracture may correlate to the success of primary realignment owing to possible anatomic challenging distortions that could render in difficult urethral realignment. The purpose of the study was to assess the relationship of the severity of the pelvic fracture to the success of endoscopic and immediate posterior urethral primary realignment following complete posterior urethral disruption using the Young-Burgess classification system.

PATIENTS AND METHODS

A review of 481 patients with pelvic fractures was performed in a Level I trauma registry database from January 2005 to April 2012 following approval from the institutional review board (IB#10-0931). All patients experienced blunt trauma caused by a motor vehicle accident (MVA), auto-pedestrian accident, or crush injury.

Since we are a regional Level I trauma center, patients with diagnosis of complete posterior urethral disruption may come from other institutions with a suprapubic catheter and imaging studies, or they are diagnosed at our institution by clinical and imaging evaluation. Data were collected for male patients who underwent primary endoscopic posterior urethral realignment with pelvic trauma.

Exclusion criteria included female patients, those diagnosed with incomplete urethral disruption, or those with complete urethral disruption and underwent open realignment. Data collection included patients demographics, mechanism of trauma, type of treatment, injury severity index (Injury Severity Score [ISS]), associated organ injury, and radiologic findings. Pelvic fractures were classified according the Young-Burgess classification system. Postoperative follow-up included urologic evaluation, adjunct procedures such as urethroplasty, urinary incontinence, and erectile dysfunction. Urinary continence was defined as no pads needed for urinary leakage. Erectile function was assessed by the patient's ability to have sexual intercourse with penetration without medical assistance.

Patients who present with a triad of blood at the urethral meatus, inability to urinate, and a palpably full bladder are treated with the following protocol: attempt to pass a Foley catheter in the emergency department; if unsuccessful and if the patient is in stable condition, cystoscopy or retrograde urethrogram (RUG) is performed, followed by the placement of a suprapubic tube if needed. If unstable, the patient is brought directly to the operating room for exploratory laparotomy and pelvic packing and/or pelvic angioembolization by the trauma surgeons. During the exploratory laparotomy, if the patient is in stable condition and the diagnosis of complete urethral disruption is made, the endoscopic primary realignment can be performed at the same setting, or a suprapubic catheter can be placed, and realignment can be addressed later.

The endoscopic primary realignment was performed by a single surgeon (F.K.) under general anesthesia after stabilization of other life-threatening injuries. The time of endoscopic realignment was determined by patient's clinical stability, ranging from 1 day to 5 days from the time of injury. Primary realignment consisted of obtaining urethral continuity by retrograde placement of a Super Stiff guidewire under rigid cystoscopy to the distal urethra with anterograde flexible cystoscopy via the suprapubic catheter tract dilated to 20 Fr diameter. Common surgical findings and realignment technique include (Figs. 1 and 2) the following: (1) proximal urethral stump deviation toward 12-o'clock position after complete posterior urethral disruption; (2) the use of rigid cystoscope for distal urethroscopy and flexible cystoscope for the proximal urethral stump for downward traction; (3) suprapubic tract dilatation to 20 Fr diameter with the use of an Amplatz sheath to allow access to the proximal urethra; (4) the use of fluoroscopic guidance for realignment using rotation of the axis to abstract different levels of urethral disrupted ends. This procedure must be performed with real-time fluoroscopic guidance with constant C-arm rotation maneuvering (horizontal axis ± 210 degrees) to identify the different axis and levels to join both urethral ends; (5) one may expect complete occlusion of distal urethral end if realignment is performed after the second day after injury.

Postoperative care included radiology, urinary flow studies, and cystoscopic evaluation. A pericatheter RUG was performed at 6 weeks before removing the urethral catheter. If extravasation of contrast is appreciated, the catheter is left in place until no extravasation is noted. Urinary flow study is performed after the catheter is removed by uroflowmetry and post–void residual measurement. If uroflow studies revealed a flat flow curve with a peak pressure of less than 12 mL/min similar to the average flow (typically 4–6 mL/min) and post–void residual volumes of greater than 150 mL, the diagnosis of urethral stricture must be considered, and a cystoscopic evaluation in clinic should be performed. During cystoscopy, if the strictures is observed to be less than 1 cm, urethral dilatation should be considered. If dilatation is unsuccessful, direct visualization internal urethrotomy with laser is indicated. For strictures greater than 1 cm, urethroplasty is usually recommended and performed.

Descriptive statistics were generated using Microsoft Excel. Fisher's exact tests using R version 2.11 (The R Project, Wein, Australia) were implemented to compare the success of primary realignment with the Young-Burgess severity groups. Data are reported as mean ± SE and frequency (percentage of the total).

Figure 1. Primary realignment was performed after concomitant pelvic stabilization by orthopedic surgery.

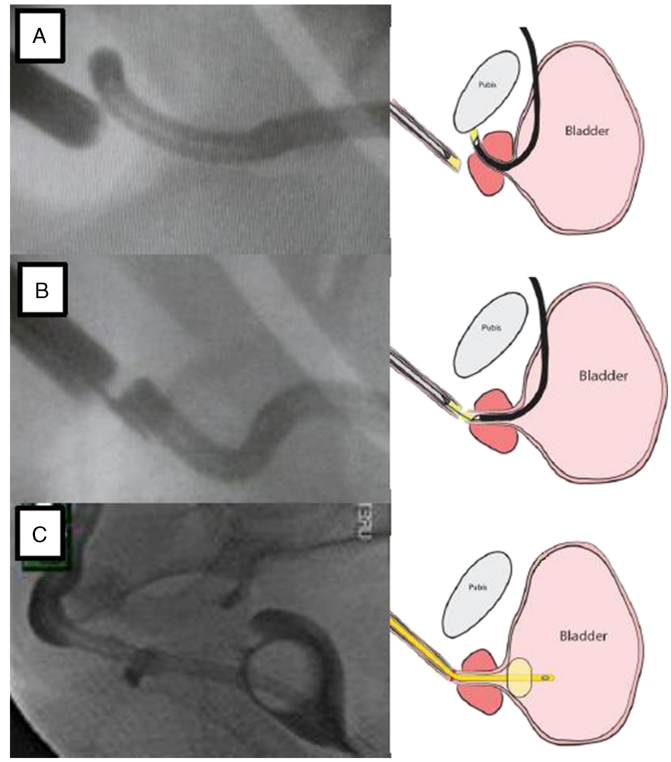

Figure 2. *A*, Passive deflection of flexible cystoscope. *B*, Proximal urethral stump downward traction and realignment of disrupted urethral ends. *C*, CUPD realignment with Foley catheter.

RESULTS

Of the 481 pelvic fractures, 18 male patients with complete posterior urethral disruption as a result of complex pelvic trauma were reviewed. Fifteen underwent endoscopic posterior urethral primary realignment and were evaluated. Three patients underwent open realignment and were excluded from the results. The mean age was 40.5 ± 4.1 years, with an ISS of 33.7 ± 5.0, and a follow-up of 31.8 ± 7.3 months. The majority of patients (60.0%) were involved in an MVA, while the remainder experienced crush injury (26.7%) or auto-pedestrian injury (13.3%) (Table 1).

The success rate of endoscopic primary realignment was 100%. Realignment was able to be performed regardless of the

TABLE 1. Demographics and Outcomes

Age, y	40.5 ± 4.4
ISS	33.7 ± 5.0
Mechanism of trauma	
MVA	9 (60.0%)
Crush	4 (26.7%)
Auto-pedestrian	2 (13.3%)
Type of pelvic fracture	
APC I	0 (0%)
APC II	4 (26.66%)
APC III	4 (26.66%)
LC I	3 (20.00%)
LC II	1 (6.66%)
LC III	3 (20.00%)
VS	0 (0%)
CPUD realignment within 48 h post-trauma	7 (46.7%)
Time to surgery, d	2.7 ± 0.9
Hemodynamic stability*	11 (73.3%)
ORT, min	78.9 ± 11.2
Success rate	15 (100.0%)
Follow-up, mo	31.8 ± 7.3

*Three hemodynamically unstable patients had pelvic packing, and one hemodynamically unstable patient had angioembolization with pelvic packing.

APC, anterior posterior compression; CPUD, complete posterior urethral disruption; LC, lateral compression; ORT, operative time; VS, vertical shear.

type of pelvic fracture. Mean time for the procedure after injury was 2.7 ± 0.9 days (1–5 days), while 7 primary realignments (46.7%) were performed within 48 hours of trauma. Realignment performed after 48 hours from injury revealed total occlusion of the distal urethral disrupted end. Initial pelvic packing due to hemodynamic instability was performed in four patients. No patient developed an intra-abdominal infection during or following treatment. Mean operating time was 78.9 ± 11.2 minutes; mean clinical follow-up was 31.8 ± 7.3 months.

Sixty percent of these patients had concomitant bladder injuries with the complete posterior urethral disruption (Table 2). Six patients (40.0%) also had associated organ injuries requiring exploratory laparotomy and trauma surgery involvement.

After the urethra healed and the Foley catheter was removed, eight patients (53.3%) developed urethral stricture requiring intervention. Two patients (APC II, LC I) successfully underwent urethral dilation, and four patients (APC II, APC II, LC I, LC III) underwent direct visualization internal urethrotomy. Two patients classified with APC III trauma underwent urethroplasty. Interestingly, none of patients treated with urethroplasty required inferior pubectomy, corporal splitting, or crural rerouting during urethroplasty since the primary realignment prevented a longer scaring gap between the disrupted urethral ends.

Urinary incontinence occurred in three complete posterior urethral disruption patients (20.0%) with concurrent APC pelvic fracture injury, one patient with APC II and two patients with APC III. One APC III patient had a concomitant bladder neck injury that required artificial external sphincter placement. The other three patients with APC III pelvic ring fracture did not develop urinary incontinence (follow-up of 32 months).

Seven patients (46.7%) reported erectile dysfunction post-trauma. There was no correlation between the pelvic ring fracture type and development of erectile dysfunction ($p = 0.85$). Furthermore, there was no difference between pelvic ring fracture severity and the need for a secondary procedure after realignment ($p = 0.58$). Impotent patients were initially managed with 5-phosfodiesterase inhibitors but with poor results.

DISCUSSION

The treatment of patients with combined pelvic fractures and urethral injuries requires coordination between orthopedics, urology, and general surgery.[9] Abdominal organ injury occurs in 50% of patients with pelvic and urologic injury.[10] The incidence of injury to the male urethra associated with pelvic fractures ranges from 1.4% to 11%.[11,12] Straddle fracture combined with diastasis of the sacroiliac joint increases the risk of urethral injury.[13] Basta et al.[14] demonstrated that for every 1-mm increase in the pubic symphyseal diastasis or displacement of the inferomedial pubic bone fracture fragments, the risk of urethral injury increases by 10%.

A standard of care for the management of complete posterior urethral trauma after pelvic injury has yet to be established. The diagnosis of urethral injury and its types in the emergency department setting depends on the availability of urologists and endoscopic equipment as well as promptness to obtain RUGs. When the patient is not hemodynamically stable, generally the diagnosis is made in the operating room during exploratory laparotomy. The objectives of the treatment for disrupted urethra are the reestablishment of urethral continuity and urinary drainage with minimal risk of complications such as urinary incontinence, impotence, and stricture formation.[15] Presently, patients may undergo primary realignment or delayed urethroplasty, depending on the trauma center.[16] Webster et al.[17] demonstrated that primary realignment had lower rates of strictures and additional procedures compared with suprapubic catheter placement followed by delayed urethroplasty. Mouraviev and Santucci[13] further demonstrated that early urethral realignment may provide better outcomes compared with delayed open urethroplasty. However, the early attempts of urethral realignment were performed without the benefit of advanced endoscopic technology and involved the retrograde catheterization of the injured urethra through a cystostomy with varying levels of paravesical dissection. Contemporary flexible endoscopic scopes with fluoroscopic guidance allow primary urethral primary realignment to be performed safely and efficiently. Our technique of simultaneous anterograde and retrograde urethroscopy can be used to place urethral catheters with a reduced risk of iatrogenic injury to the periurethral tissues.[18]

TABLE 2. Organ-Related Injury

Organ Injury	n (%)
Bladder	9 (60.0)
Brain injury	2 (13.3)
Pulmonary contusion	1 (6.7)
Sigmoid colon	1 (6.7)
Thoracic aorta injury	1 (6.7)

Not only the feasibility of the procedure but also the morbidity has to be considered. Although Asci et al.[19] found no significant difference in impotence and incontinence rates in 38 patients undergoing early surgical realignment when compared with delayed treatment; they noted that the early realignment group had a lower rate of stricture requiring urethroplasty. Similarly, Hadjizacharia et al.[20] demonstrated that primary realignment significantly reduced time to spontaneous voiding, risk of urethral stricture, need for urethroplasty, and long-term suprapubic urinary diversion. However, Leddy et al.[21] showed that 78.9% of the patients treated with primary realignment after pelvic trauma needed an adjunctive procedure such as internal urethrotomy or urethroplasty. Conversely, Koraitim[22] in their evaluation of 871 patients after urethral injury had similar low incidence rates of incontinence after early realignment versus suprapubic cystostomy alone (5% vs. 4%), indicating that this complication is probably related more to the original trauma than to either initial management options. Investigators have proposed that the injury of the distal urinary sphincter or denervation of the striated sphincter may cause urinary incontinence and damage of the neurovascular bundles may result in impotence.[23,24] We demonstrated the intimate relationship between the male external urethral sphincter complex and the posterior urethra, corroborating with the findings of Koraitim et al. that the injury has a direct impact on the urethral sphincter complex and may cause urinary incontinence.[22,25]

Our report has several limitations, such as a retrospective study and relatively small sample size. However, this the first study to examine the relationship between the type of pelvic ring fracture and feasibility of early posterior urethral primary realignment. Moreover, we observed that the proximal urethral stump deviated upwards toward 12-o'clock position in all complete posterior urethral disruption patients displacing both disrupted urethral ends to different horizontal axes, requiring the surgeon's ability to radiologically evaluate all planes (horizontal, vertical, and variable angles) with the C-arm to realign the urethral ends. Since we did not surgically explore these patients with an open approach, we can only hypothesize that the pelvic, periprostatic, and periurethral ligaments as well as soft tissue may be responsible for these findings. Our study has focused only on complete posterior urethral disruption unlike other studies that included complete and partial injuries and other sites of urethral injury. We demonstrated that these objectives can be achieved by endoscopic primary realignment in complete posterior urethral disruptions. Total success of realignment was obtained in 15 patients with complete posterior urethral disruption, independent of the type of pelvic fracture. Although the association between pelvic fractures and genitourinary injuries is well known, there is a paucity of data correlating the pelvic ring fracture and urologic trauma including complete posterior urethral disruption. Our retreatment rate (53.3%) is slightly lower than the literature[21] with only 2 cases requiring major reconstructive procedures (urethroplasty). Interestingly, these patients were classified with more severe trauma (APC III). There could be a correlation between more complex pelvic trauma and the need for major reconstructive surgery after primary realignment. Owing to the small sample size in our study, we could not find statistical significance.

CONCLUSION

Endoscopic posterior urethral realignment may be an effective technique for the acute repair of complete posterior urethral disruption without the need of long-term suprapubic catheters for urinary drainage. The success rate of achieving realignment of completely disrupted posterior urethra is high owing to better understanding of anatomic distortions after pelvic trauma, and it did not appear to be related to the severity and type of pelvic ring injury. Long-term complications after primary realignment, that is, urinary incontinence, urethral strictures, and erectile dysfunction, are difficult to predict but may be intimately related to the mechanism of injury and severity of the pelvic fracture.

AUTHORSHIP

F.K. contributed in the concept design, data analysis, writing, editing. A.P. contributed in the orthopedic data collection and analysis as well as writing. W.R.M. contributed in the trauma data collection and analysis as well as writing. D.S. contributed in the data analysis, writing, and editing. R.M.M.D.C. contributed in the trauma data collection and analysis. C.J. contributed in the trauma data collection and analysis. E.E.M. contributed in the data analysis, writing, and editing. P.F.S. contributed in the orthopedic data analysis, writing, and editing.

DISCLOSURE

The authors declare no conflicts of interest.

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