CHAPTER 6

BLUNT PELVIC TRAUMA WITH POSTERIOR URETHRAL DISRUPTION

GU Tract Structure	Ch 2 Kidney	Ch 3 Ureter	Ch 4,5 Bladder	Ch 6,7,8,11 Urethra	Ch 8,9 Scrotum Testis	Ch 8,9 Spermatic Cord	Ch 8,10 Penis
No. Patients With Injury to Structure	132	36	72	83	199	14	128
% of Total GU Injuries	19.1	5.2	10.4	12.0	32.8	2.0	18.5

GU: genitourinary

INTRODUCTION

Pelvic fractures in men have an associated incidence of urethral distraction injury—usually partial or complete disruption—in roughly 4% to 14%.[1] Most of these injuries, both in civilian life and in the authors' (JNW and JWW) series of 15 urethral transection injuries associated with pelvic fractures in Vietnam War casualties, are secondary to vehicular accidents. However, blast injuries can also be encountered in the military. Most combat-incurred urethral injuries are caused by penetrating missiles (Table 6-1). Analysis of 100 cases of urethral rupture from World War II revealed that a fractured pelvis was associated with only 10% of injuries.[2] Of the 83 urethral wounds and injuries in our 692 urological injuries, 35 involved the posterior urethra and only 15 (18%) of 83 injuries were secondary to blunt pelvic forces and fractures (see Table 6-1), accounting for 2% of 692 urological injuries. Of the 252 urological war injuries reported by Salvatierra and colleagues,[3] 2% involved the membranous urethra; most of these (4 of 5) were secondary to pelvic fractures.

TABLE 6-1
DISTRIBUTION AND CAUSE OF URETHRAL WOUNDS

Location	Nature of Injury	No. Patients
Penile	Penetrating	33
Bulbus	Penetrating	13
	Blunt straddle	2
Prostato-membranous	Penetrating	20
	Blunt	15
Total Patients:		**83**

INITIAL TREATMENT (IN VIETNAM)

In general, patients with urethral transection injuries who were managed in Vietnam (by 4 different urologists at 4 different hospitals) were treated with control of retropubic pelvic bleeding, suprapubic cystostomy, pelvic drainage,

EXHIBIT 6-1
CLASSIFICATION OF URETHRAL INJURY

For decades, during the Vietnam War and currently, posterior urethral disruption injuries have been classified as to extent: *partial* or *complete* disruption. This differentiation has been useful in planning and evaluating treatment. In 1977, Calapinto and McCallum[1] devised a 3-tiered classification of urethral injury that is based primarily on the more-precise location of injury:

Type 1: urethral stretch injury,
Type 2: urethral disruption proximal to the urogenital diaphragm, and
Type 3: urethral disruption both proximal and distal to the urogenital diaphragm.

The usefulness of the 3-tiered classification of posterior urethral destruction injuries has been limited primarily to the institutional-investigative activities of major civilian trauma centers to better assess the results and sequellae of comparative treatments.

Although most urethral injuries involved the prostatomembranous urethra, the exact site of injury was not detailed in the records of our 15 patients. Therefore, for the most part, this system of classification—even if available—would not have been used during the Vietnam War.

(1) Calapinto V, McCallum RW. Injury to the male posterior urethra in fractured pelvis: A new classification. *J Urol.* 1977;118:575-580.

and reapproximation of the urethra over a stenting Foley catheter (Exhibit 6-1). Apposition of the torn, separated ends of the prostatomembranous urethra was accomplished by the use of either perineal bolster sutures or by traction on the Foley catheter.[3]

In major civilian trauma centers at the time of the Vietnam War, most cases of posterior urethral rupture associated with pelvic fracture or fractures were treated by cystostomy, evacuation of hematoma, and perivesical and urethral catheter drainage. Maximum efforts were made to guarantee approximation of the torn urethral ends: direct suture anastomosis, Vest-type suture from the vesical neck or prostate tied over a perineal bolster, and/or mild, constant catheter traction for 3 to 4 weeks.[4,5]

The initial management in Vietnam of our series of 15 patients with pelvic fractures in membranous urethral transection injuries was somewhat variable (Table 6-2):

- two patients had pelvic exploration with (*a*) the insertion of a suprapubic cystostomy tube and (*b*) drainage of the pelvic hematoma.

TABLE 6-2
INITIAL TREATMENT* OF MEMBRANOUS URETHRAL INJURIES SECONDARY TO CRUSHED PELVIS

Initial Treatment	No. Patients	
Exploration, SP Tube, Drainage Only	2	
Exploration, SP Tube, Drainage, and Urethral Catheter	13	
With Traction		6
Without Traction		7
Total Patients:	**15**	

*in Vietnam
SP: suprapubic

- 13 patients were explored surgically with (*a*) the insertion of a suprapubic cystostomy tube and (*b*) drainage of the retropubic space, and (*c*) the restoration of urethral continuity (urethral realignment) over a stenting Foley urethral catheter.
    - 6 patients had traction on the Foley catheter, usually by taping the catheter to the thigh; and
    - 7 patients had no traction; presumably on some, an attempt was made to approximate via suture the ends of the torn, distracted urethra.

WOUND ANALYSIS

Of the 35 patients with posterior urethral trauma that we managed in Japan during the Vietnam War, 15 (43%) had had prostatomembranous transection injuries caused by blunt trauma (see Table 6-1). All of the 15 had fractures of the bony pelvis, most often of the pubic rami, with diastasis of the pubic symphysis and sacroiliac joint or joints. 13 (87%) of the 15 patients had complete urethral transection, and two had a partial urethral disruption (Table 6-3).

Ten injuries were caused by moving vehicular accidents; the etiology of 5 injuries was unknown (Table 6-4). 3 soldiers had fallen from a truck, 2 were crushed by a truck, and 2 were injured in jeep accidents. 1 was injured in a motorcycle crash, 1 by a forklift, and another by a tractor (Table 6-5).

Associated Organ Injuries

Ten (67%) of the 15 patients had 19 other organ injuries; 5 (33%) of 15 had injuries that involved the bladder (Table 6-6). Although there was only 1 intraperitoneal bladder rupture, bladder injuries were associated with more-severely injured patients. Serious hemorrhage was encountered in 2 soldiers with multiple injuries, which included

TABLE 6-3
PELVIC FRACTURES WITH TRANSECTED MEMBRANOUS URETHRA

Transection	No. Patients
Complete	13
Partial	2
Total Patients:	**15**

TABLE 6-4
PELVIC FRACTURES WITH TRANSECTED URETHRA

Etiology	No. Patients
Vehicular	10
Unknown	5
Total Patients:	**15**

TABLE 6-5
VEHICULAR CAUSES OF FRACTURED PELVIS WITH TRANSECTED URETHRA

Vehicle	No. Patients
Fall From Truck	3
Crushed By Truck	2
Jeep Accident	2
Motorcycle Accident	1
Forklift Injury	1
Tractor Injury	1
Total Patients:	**10**

TABLE 6-6
CRUSH INJURIES TO THE PELVIS WITH URETHRAL INJURY: OTHER ORGANS INJURED

Organ Injured	No. Injured Organs*	
Bladder	5	
Liver	1	
Spleen	1	
Iliac Vessels	1	
Colon	1	
Extrapelvic Bony Fractures	10	
Extremities		7
Ribs		1
Clavicle		1
Transverse process (lumbar [L-5])		1
Total Other Organs Injured:	**19**	

*Patients with other organ injuries: 10; total patients, crush injuries of the pelvis with urethral transection: 15

bladder injuries:

- multiple bladder tears, retroperitoneal perforation, liver capsular disruption, splenic laceration, and fractures of the knee, ankle, and tibia; and
- bladder laceration and rupture of the right external iliac artery and vein.

Another soldier with an extraperitoneal bladder rupture sustained a serosal tear of the colon and fractures of the ribs, humerus, and femur. Six casualties with pelvic fractures and urethral transection had a total of 10 extrapelvic bony fractures.

Complications and Treatment (in Japan)

Thirteen of 15 (87%) patients developed 27 complications (Table 6-7), which required 33 surgical procedures

TABLE 6-7
COMPLICATIONS IN JAPAN

Complication	No. Complications	No. Patients With Each Complication*
Urethral Stricture	6	6
Pelvic Retropubic Abscess	6	5
Periurethral Abscess	3	3
Obstructing Suprapubic Tube	3	3
Gram-Negative Sepsis	2	1
Vesicocutaneous Fistula	1	1
Urethrocutaneous Fistula	1	1
Urethral "False Passage"	1	1
Urethral Diverticulum	1	1
Urinary Incontinence	1	1
Fat Embolism	1	1
Total Complications:	**26**	

*Total patients: 15
Patients with complications: 13 (87%)
Patients without complications: 2

TABLE 6-8
SURGICAL PROCEDURES IN MANAGING COMPLICATIONS IN JAPAN

Surgical Procedures	Each Procedure	Number Patients*
Urethral Dilation	11	6
I&D Pelvic Abscess	6	5
Pelvic Hematoma	1	1
Suprapubic Cystostomy	5	5
Urethral Stenting	4	4
Panendoscopy	4	3
I&D Periurethral Abscess	2	2
Total Procedures:	**33**	

*Total patients having procedures: 13/15 (87%); patients with 2 or more procedures: 11/13
I&D: incision and drainage

in Japan (Table 6-8). Significant urethral strictures at the site of the urethral transection or in the penoscrotal urethra developed in 6 patients, which required 11 urethral dilations in Japan. Five patients had retropubic pelvic abscesses, which necessitated 6 open surgical drainage procedures. One patient with a large pelvic hematoma required surgical evacuation. Two patients, one with a vesicocutaneous fistula and the other with a urethrocutaneous fistula, both associated with a pelvic abscess, responded to enhanced drainage. Of the 3 patients with periurethral abscesses—all at the penoscrotal location—1 abscess drained spontaneously into the urethra with closure of the associated urethral diverticulum after Foley catheter removal, and 2 abscesses resolved following incision and drainage and catheter removal.

Obstructing, small-caliber, eccentrically positioned suprapubic cystostomy tubes, which were associated with pelvic abscesses, required replacement and relocation in 3 patients. The urethral false passage was managed with combined suprapubic–urethral endoscopic-assisted urethral relocation and stenting. The patient with the fat embolism responded to nasal oxygen, intravenous Decadron (dexamethasone sodium phosphate, Merck & Co, West Point, NY), and intravenous heparin. The patient with urinary incontinence was treated with 3 weeks of Foley urethral catheter traction following his initial injury in the Republic of Vietnam (RVN).

CASE STUDIES

The following case studies demonstrate the severity of the initial injury, the frequency of associated organ injuries, and the variation in the initial treatment of these urethral disruptive injuries in RVN. The complications of the initial injury and the treatment given in Japan are reviewed.

Associated Bladder Injuries

Case 6-1

C. J., a 20-year-old soldier, sustained a severe disruption fracture of the anterior and posterior pelvis in a fall from an armed personnel carrier. At abdominal pelvic exploration, celiotomy revealed no intraperitoneal injuries, and the patient was found to have a ruptured bladder and posterior urethra, which were repaired with suprapubic cystostomy, Foley urethral catheter, and anterior extraperitoneal pelvic drainage. He was admitted to the Orthopedic Service at US Army Hospital, Camp Zama, Japan, 12 days later. Urological consultation 1 week later revealed purulent drainage around a poorly functioning laterally located suprapubic cystotomy tube. A large pelvic retroperitoneal abscess (containing *Staphylococcus* and *Proteus* organisms) was drained, and a large, midline, suprapubic, Malecot cystotomy tube was placed at surgery. A small vesicopelvic fistula, demonstrated on cystography a few days later, subsequently closed.

Three weeks later, the patient was evacuated to the continental United States (CONUS) tube-free and voiding with complete urinary control and sterile urine.

Case 6-2

W. K., a 23-year-old soldier, sustained the following injuries in a jeep accident: extensive fractures of the pelvis, right femur, right humerus, and right 4th and 5th ribs; a serosal tear of the sigmoid colon; and ruptured bladder and posterior membranous urethra. At abdominal pelvic exploration, he had repair of the colon and bladder, suprapubic cystostomy, and urethral stenting. His early postoperative course in Vietnam was complicated with fever and infiltration in his right lung. Eighteen days later, he was evacuated to the Orthopedic Service in Japan. On urological consultation, an eccentric, laterally located suprapubic catheter was partially dislodged from the bladder, which required pelvic exploration and placement in the bladder dome. A small, extravesical, pelvic abscess (containing *Pseudomonas* and α-streptococcal species) was drained. One month later, cystography revealed a normal bladder and an anterior urethral stricture, which was treated with urethral dilations.

On evacuation to CONUS, the patient was voiding with complete urinary control and with all tubes out.

Case 6-3

B. K., a 21-year-old soldier, sustained a crush injury to the pelvis when thrown from a jeep. He had comminuted fractures of the entire pubic ramus with extensive displacement and diastases of the symphysis pubis, and fractures of the sacrum and right ileum. Celiotomy, done because of a rigid abdomen, revealed an intraperitoneal bladder rupture without injury to intraabdominal organs. The bladder was repaired and drained with suprapubic cystostomy; a size 26 French (F) urethral Foley catheter was placed on traction for a complete transection of the prostatomembranous urethra, and Penrose drains were positioned into Retzius' space. Eight days later, on transfer to US Army Hospital, Camp Zama, Japan, the patient was febrile, had purulent drainage around the suprapubic tube, and anterior obstructing Penrose drains. The urine and wound drainage cultured positive for *Proteus, Herellea,* and *Klebsiella* species; the infection was treated with Garamycin (gentamicin sulfate, Schering Corp, Kenilworth, NJ). Two weeks postinjury, because of urethritis, the 26F Foley catheter was removed.

Five weeks postinjury, the patient was evacuated to CONUS, voiding with the suprapubic catheter clamped and with a mild urethral stricture having been dilated.

Case 6-4

N. T., a 19-year-old soldier, was crushed in the pelvis between 2 trucks, sustaining multiple pelvic fractures and dislocation of the right sacroiliac joint, rupture of the right external iliac artery and vein, complete transection of the prostatomembranous urethra, and laceration of the bladder. Abdominal exploration revealed no intraperitoneal injury. Pelvic exploration was done with repair of the bladder and urethra with Foley catheter and cystostomy tube placement, repair of the right external iliac artery, and ligation of the iliac vein. Severe pelvic bleeding was treated with pelvic gauze packing, and he was transfused with 47 units of whole blood.

Ten days later the patient was transferred from Vietnam to Clark US Air Force Hospital, Philippines, where the sacroiliac joint fracture was stabilized with multiple pins. The suprapubic catheter was removed 7 weeks postinjury without the benefit of a cystogram, the urethral catheter was maintained, and he was placed in a hip spica cast and evacuated from the Philippines to the Orthopedic Service at US Army Hospital, Camp Zama, Japan.

The patient had an abscesslike febrile course over the next 7 days. Urological evaluation revealed purulent pelvic suprapubic drainage; on digital examination of the suprapubic wound, a large amount of gauze—presumably from the pelvic packing that was used in Vietnam for control of the initial hemorrhage—was found and removed; and both a poorly functioning Foley catheter draining purulent material and a penoscrotal periurethral abscess were found. He had immediate incision and drainage of both the periurethral abscess and an extensive extravesical pelvic abscess (1 pint of purulent drainage cultured positive for *Escherichia coli*), and suprapubic cystostomy was performed. Cystourethrography 3 weeks later revealed an intact bladder and normal urethra.

The patient was evacuated to CONUS for prolonged rehabilitation for his orthopedic injuries.

Comment on Cases 6-1 Through 6-4

Intraperitoneal injuries should be excluded (via celiotomy) in *all* patients with (*a*) extensive crush injury to the pelvis and bladder, (*b*) posterior urethral disruption (especially when associated with clinical signs of a surgical abdomen or intraperitoneal injury), and (*c*) intraperitoneal bladder perforations. Liberal, unobstructive, retropubic, perivesical drainage with well-positioned and -controlled cystostomy tube drainage should be routine in all of these injuries (see Chapter 4, Wounds of the Bladder; Chapter 5, Pelvic Fractures and Crush Injuries of the Bladder; and Chapter 7, Wounds of the Posterior Urethra and Prostate). Cystourethrography should be routine, to define bladder and urethral integrity and urethral strictures prior to suprapubic and Foley catheter removal. Urethral catheter–induced periurethritis, periurethral abscess, and early stricture formation were not uncommon (see Chapter 7 and Chapter 12, Nontraumatic Urological Conditions).

Urethral Disruption Treated by Suprapubic Cystostomy, Pelvic Drainage, and Urethral Catheter Traction

Case 6-5

D. H., a 23-year-old soldier, had a crush injury to the pelvis resulting in a complete fracture of the lower pubic rami and diastases of the symphysis pubis. On pelvic exploration, a large hematoma was evacuated, the urethral rupture identified, urethral continuity was established with a 24F Foley catheter placed on traction, and suprapubic cystostomy

was performed. Nine days postinjury, the patient was evacuated to Japan. Three weeks after the accident, the Foley catheter was removed; a subsequent voiding cystourethrogram demonstrated several proximal bulbus urethral false passages. Under anesthesia, using suprapubic and urethral endoscopy, normal urethral continuity was established with a 16F urethral catheter. The suprapubic tube was maintained.

The patient was evacuated to CONUS with the Foley and suprapubic catheters indwelling.

Comment on Case 6-5

Postsurgical evaluation of the status of the urethral and bladder injury must be accomplished with cystourethrography. Urethral false passages can be avoided by gentle, limited attempts at urethral catheterization and stenting. Prompt suprapubic cystostomy only is indicated in instances of difficult urethral catheterization and stenting.

Case 6-6

D. M., a 19-year-old soldier, sustained a comminuted fracture of the left anterior pelvis, complete avulsion of the prostatomembranous urethra, and contusion of the left lung when pinned beneath a large, earth-moving tractor. At abdominal pelvic exploration, no intraperitoneal injuries were identified, the complete transection of the prostatomembranous urethra was treated with a stenting 18F Foley catheter placed on traction, a suprapubic cystostomy was done, and extrapelvic drainage was established. He received 8 units of whole blood.

The patient was evacuated to Japan 18 days after the injury and was placed on a Stryker frame. Three and a half weeks after he was injured, a voiding cystourethrogram via the suprapubic catheter revealed left vesicorenal reflux; a wide-open patulous bladder neck; and an elongated, open, patulous posterior urethra without stricture or extravasation.

After the suprapubic tube was removed, the patient voided but was partially incontinent when evacuated to CONUS.

Comment on Case 6-6

Vesicorenal reflux was not uncommonly demonstrated in patients requiring long-term suprapubic cystostomy, urethral catheterization, or both, presumably secondary to chronic bacterial cystitis (see Chapter 12, Nontraumatic Urological Conditions). Urinary incontinence seen in patients with posterior urethral transection injuries treated with catheter traction has been attributed to pressure damage to the vesical outlet, resulting in an incompetent internal urinary sphincter in the presence of existing external sphincteric damage.

Case 6-7

D. T., a 20-year-old private first class, suffered a crush injury to the pelvis with fractures and dislocations of the symphysis pubis, transection of the membranous urethra, and fracture of the right clavicle. At suprapubic exploration, urethral continuity was established with Foley urethral catheter stenting and catheter traction, suprapubic tube placement, and drainage of the space of Retzius. Twelve days, later the patient was evacuated to Japan. Three weeks postinjury he became febrile; this condition was found to be secondary to a penoscrotal periurethral abscess and diverticulum, which spontaneously drained intraurethrally after the Foley catheter was removed. A subsequent voiding cystourethrogram revealed resolution of the urethral diverticulum and a distal bulbus urethral stricture, which was easily dilated.

On evacuation to CONUS, the patient was tube-free and voiding without problems.

Comment on Case 6-7

Periurethral abscess formation was not uncommon. The abscess formed generally at the penoscrotal urethra, and was secondary to pressure necrosis from a large-caliber or poorly positioned urethral catheter or one placed on traction (see Chapter 12, Nontraumatic Urological Conditions). Urethral diverticula and stricture are frequent sequelae of this complication.

Case 6-8

T. F., a 20-year-old soldier, was thrown from a truck and suffered a complete fracture of the pubic rami and rupture of the prostatomembranous urethra. He had suprapubic realignment of the urethral disruption over a 20F Foley catheter with a 30-cc balloon, placed on traction; suprapubic cystostomy; and anterior pelvic drainage. He was evacuated to Japan 1 week after the injury. Two weeks postinjury, because of urethritis, the urethral catheter was replaced with a 16F Foley catheter maintained on mild traction. The Foley catheter was removed 3 weeks after the injury; cystourethrography was normal, and the patient voided without difficulty after the suprapubic catheter was clamped.

The patient was evacuated to CONUS without urological complications.

Comment on Case 6-8

Urethritis secondary to large-caliber Foley catheters was often seen; it responded to replacement with smaller catheters. Generally, in uncomplicated cases, urethral catheter removal was attempted at approximately 3 weeks postinjury in patients managed in Japan.

Preoperative Diagnosis by Retrograde Urethrography

Case 6-9

In a jeep accident, J. O., a 21-year-old soldier, sustained a crush injury to the pelvis with fractures of the symphysis pubis. Retrograde urethrography, done because of urethral bleeding, revealed complete transection of the prostatomembranous urethra. At pelvic exploration, a suprapubic cystostomy, Foley urethral stenting, and anterior pelvic Penrose drainage were established.

On evacuation to Japan 11 days later, the obstructing Penrose drains were replaced with sump-suction drainage for urinary extravasation, and the poorly functioning suprapubic tube was changed. Urine and suprapubic drainage cultured positive for *Proteus, Aerobacter*, and *Pseudomonas* species; the infection was treated with Coly-Mycin (colystimethate sodium; Parke-Davis, Morris Plains, NJ). Three weeks postinjury, cystourethrography revealed an intact bladder; subsequent urethral dilation was performed for an irregular defect in the urethra at the site of injury.

The patient was evacuated to CONUS for further convalescence; he was voiding with control and without obstruction.

Comment on Case 6-9

When conditions permit (ie, stable patient with limited injury; available equipment and expertise), retrograde urethrography is indicated for posttraumatic urethral bleeding. It usually defines the extent of urethral disruption and the direction

of further management. The judgment of the adequacy of suprapubic and pelvic drainage is empirical in these injuries; the drainage is necessary to minimize the complications of urethral extravasation and sepsis.

Case 6-10

R. B., a 21-year-old soldier, sustained a crush injury to the pelvis with fractures of the left pubic ramus and left sacrum. Retrograde urethrography, done because of urethral bleeding, showed massive extravasation from a complete posterior membranous urethral rupture. At suprapubic exploration, the operator was unable to reestablish continuity of the transected prostatomembranous urethra; a suprapubic cystostomy was done and the retropubic space drained. The patient was evacuated to Japan 1 week later, and polymicrobial, Gram-negative bladder and wound infections were treated with antibiotics. Urethral continuity was established over a stenting urethral catheter at suprapubic pelvic exploration. Subsequently, he developed 2 episodes of Gram-negative sepsis: first, after the urethral surgery and second, after Foley catheter removal. He responded to antibacterial therapy, after which a voiding cystourethrogram was normal; subsequently, the patient voided with complete control.

A suprapubic tube was removed and evacuation to CONUS was accomplished.

Comment on Case 6-10

Retrograde urethrography was definitive in diagnosing the extent of the initial urethral injury. Several situations warrant initial suprapubic cystostomy only in the patient with crushed pelvic urethral transection injuries: hemodynamically unstable patients, multiple severe other organ injury, massive pelvic hematoma or bleeding, difficulty in establishing posterior urethral catheter (realignment) stenting, and operator inexperience with such injuries. Delayed urethral reconstruction (realignment) can be accomplished up to several days later, under more-ideal conditions.

DISCUSSION

Posterior urethral transection injuries from blunt trauma, most often from vehicular causes, are uncommon but are associated with 4% to 14% of patients with pelvic fractures. In our series of 692 RVN urological war injuries that we managed in Japan, only 15 of 83 (18%) urethral injuries were posterior urethral disruptions from blunt pelvic crush fractures. These accounted for only 2% of all the genitourinary tract injuries in our series.

Associated Injuries

Two thirds of these 15 patients had 1 or more injuries to other organs (see Table 6-6). The more-severe injuries and bleeding occurred in the casualties with injuries to the iliac vessels, liver, spleen, colon, or extremity bones—who also represented the 4 of 5 patients with bladder injuries. Data from civilian trauma centers reveal that bladder rupture happens in 10% to 17% of patients with urethral disruption from pelvic fractures,[6] often making the nonoperative diagnosis of associated bladder injury difficult because of the inability to place a catheter to perform cystography. In such instances, the diagnosis should be made at surgical exploration and open inspection of the bladder.

Diagnosis of Urethral Injury

Posterior urethral injury must be suspected in all patients with crush injuries of the pelvis. Such urethral injuries rarely occur in the absence of pelvic fractures—usually "butterfly fractures" or "straddle fractures" involving the superior or inferior pubic rami with movement of this segment of bone, and with a shearing force applied to the urethra. This may result in *partial* or *complete* urethral disruption, especially when associated with diastasis of the sacroiliac joint. Separation of the symphysis pubis and distraction of fractured bone can result in retropubic hemorrhage and compression or direct injury to the urethra.

Patients with urethral disruptive injury may present with 1 or more classic findings: inability to void, a palpable distended bladder, and blood at the urethral meatus; the latter may be absent in about 50% of patients.[6] Perineal ecchymosis or swelling from extravasated blood and urine may be a late finding of urethral disruption.[7] Frequently, urological consultation is not obtained until after unsuccessful attempts at urethral catheterization. Because of possible urethral damage, extension of urethral injury, or creation of 1 or more urethral false passages, urethral catheterization is discouraged and should be limited to experienced urologists.

Retrograde urethrography is the preferred nonsurgical technique to diagnose urethral disruptive injuries in the stable, nonemergent casualty. This can be accomplished by partially inflating the balloon of a small-caliber (14F–16F) Foley catheter in the distal urethra and incremental, gentle, injection (in 10- to 15-mL increments) of a sterile 30% intravenous iodine contrast agent, preferably under fluoroscopy, until there is adequate definition of the site and extent of the urethral injury. In *partial* urethral transection, there is extravasation of contrast at the site of injury, and some of the contrast agent often enters the bladder (Figure 6-1). Complete urethral transection, on the other hand, will show periurethral-pelvic extravasation of contrast at the site of urethral injury only (Figure 6-2). However, accurate diagnosis from urethrography only can be difficult, as there may be no convincing difference on urethrography between partial or complete disruptions.[5]

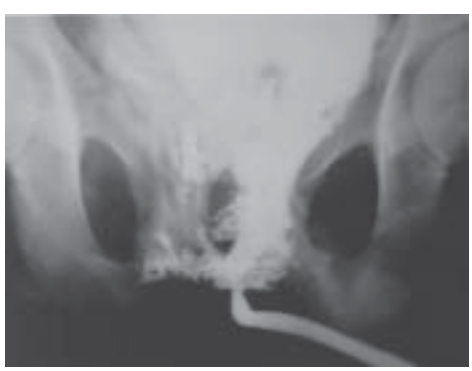

Fig. 6-1. Retrograde urethrogram showing extravasation of contrast medium in a patient with an incomplete posterior urethral transection injury secondary to a fractured pelvis.

Fig. 6-2. Fractured pelvis with complete membranous urethral transection, demonstrated by retrograde urography.

In Vietnam, preoperative retrograde urethrography was done in only 3 of the 15 patients that were evacuated to Japan, but the procedure defined complete urethral disruption in all 3. The diagnosis in the 12 remaining patients was made at pelvic exploration because of the lack of urological expertise or appropriate equipment, the inability to pass a catheter, or the obvious need for surgical exploration.

Initial Management (in Vietnam)

In Vietnam, following their general resuscitation, all patients were managed with an overall plan of early primary realignment or repair of their urethral disruptive injury:

- immediate pelvic and bladder exploration;
- hemostasis and evacuation of pelvic hematoma;
- open cystotomy is done for primary repair of bladder rupture(s), and suprapubic cystostomy is done in all;
- urethral catheter stenting;
- reapproximation of severed urethral ends: direct suture anastomosis, traction suture, or catheter traction;
- celiotomy for intraperitoneal bladder rupture or evidence of intraabdominal injury; and
- extravesical retropubic pelvic drainage.

CONTEMPORARY MANAGEMENT

Since the Vietnam War, a commonly used decision-making sequence of diagnostic and therapeutic interventions for hemodynamically stable patients with pelvic fracture and suspected urethral rupture with or without bladder injury is recommended[8]:

- Do retrograde urography for blood at the urethral meatus or if a catheter cannot be passed.
- If no extravasation is evident, then pass a urethral catheter.
- Surgical intervention is necessary with the findings of urethral rupture with extravasation.

If the patient is unstable, usually with polytrauma, suprapubic cystostomy *only* is performed.[9,10] Otherwise, any bladder ruptures are repaired at open cystostomy, and after suprapubic cystostomy, if the patient's associated injuries are not severe, urethral realignment can be attempted. Initially, a 16F silicone-coated urethral catheter is passed and often can be digitally guided into the bladder. Today, multiple other techniques have been devised for successful urethral stenting, depending on the availability of equipment, urological expertise, and the patient's condition.[8] In no case is traction used after catheter placement, as urinary incontinence may result.[5,11]

EXHIBIT 6-2
URETHRAL AND SUPRAPUBIC CATHETERS

A 16 French (F) silicone-coated Foley catheter should be used to stent the urethra[1] and taped to the outside of the lower abdomen in the cephalad direction. This technique will help avoid pressure necrosis of the penoscrotal urethra and minimize the possibility of periurethral abscess and urethral stricture (see Chapter 7, Wounds of the Posterior Urethra and Prostate). The urethral catheter should remain in place for 3 to 6 weeks, depending on the severity of injury, and only be removed after urethrography demonstrates an intact urethra.

A large-caliber (26F–32F) Malecot suprapubic cystostomy tube should be placed in the anterior bladder dome and preferably brought out in the midline well cephalad to the pubic symphysis (see Chapter 7, Wounds of the Posterior Urethra and Prostate). The suprapubic tube should remain until the urethral and bladder integrity are defined and any urethral stricture has resolved.

(1) Patterson DE, Barrett DM, Myers RP, et al. Primary realignment of posterior urethral injuries. *J Urol*. 1983;129:513–516.

Today, orthopedic surgeons tend increasingly to perform early bony reduction and fixation in patients with pelvic fractures to reduce bleeding and enhance early healing and ambulation. Urethral realignment can be attempted at such surgery after suprapubic cystostomy. Suprapubic cystostomy, by itself, is *only* placed in the hemodynamically unstable patient or when urethral realignment cannot be accomplished.[9] Most urologists in major trauma centers recommend urethral realignment within 72 hours to reduce the extent of urethral stricture formation[12]; however, successful urethral realignment and stenting have been performed as long as 19 days after initial injury and suprapubic cystostomy.[8] "Punch" suprapubic cystostomy is used only for the unstable patient not scheduled for open surgery.[8] Techniques used for control of pelvic bleeding are thoroughly discussed in Chapter 7, Wounds of the Posterior Urethra and Prostate. The proper choice, placement, and management of urethral and suprapubic tubes is vital to enhance healing and to minimize complications in these disruptive posterior urethral injuries (Exhibit 6-2).

COMPLICATIONS

The multiple complications that developed in 13 (87%) of 15 patients and their treatment are outlined in the section on wound analysis above in this chapter (see Tables 6-7 and 6-8). There was no significant difference in the incidence of complications in patients with *complete* versus *incomplete* urethral transection; nor was there a significant difference between urethral transection injuries treated with suprapubic cystostomy only and in patients treated with suprapubic tube drainage with and without catheter traction (see Table 6-2).

Fig. 6-3. Retrograde urethrogram demonstrating an early, short stricture (between the arrows) at the prostatomembranous urethra, which resulted from posterior urethral trauma.

Six patients (of this group of 13) developed urethral strictures; they were treated with 11 urethral dilations before they were evacuated to CONUS (Figure 6-3). Some strictures were mild and soft and responded to early dilations, whereas others were dense and more severe. Patients with persistent strictures were evacuated with their suprapubic tubes in place. The incidence of delayed or persistent strictures that required surgical intervention and reconstruction (urethroplasty) in this group is unknown, because of the lack of long-term follow-up. However, the high incidence of urethral stricture in this group is not surprising. The incidence of significant urethral stricture following partial or complete blunt urethral disruption injuries from civilian trauma centers varies from 50% to 65%.[11,13] Further, patients with complete urethral disruption managed only by suprapubic cystostomy *always* developed extensive urethral stricture with the need for a major urethroplasty.[14]

One third of patients arrived in Japan with pelvic abscesses of varying sizes and complexity. These were associated with obstructing anterior pelvic drains and urinary fistulae in 2 patients, and a pelvic hematoma in 1. All these patients required perivesical retropubic exploration and drainage of the abscesses, hematoma, and urinary extravasation; and improved sump drainage. This high incidence of infection is attributed to (*a*) inadequate pelvic wound drainage and (*b*) poor monitoring and management of the drains and tubes. Inadequate surveillance of patients with tubes and drains in the evacuation chain was a persistent problem.

Eccentrically placed, small-caliber, obstructing, poorly stabilized suprapubic cystostomy tubes were major problems and contributed to the pelvic sepsis and urinary extravasation. Three patients with complications needed pelvic exploration, redrainage, and replacement of suprapubic tubes. Penoscrotal periurethral abscess required incision and drainage in 2 patients. Recommended techniques for suprapubic cystostomy and urethral catheterization, and care to prevent these complications, are reviewed above in this chapter.

The overall incidence of urinary incontinence in posterior urethral distraction injuries is 2% to 4%.[8] Urinary incontinence in these injuries is attributed to injury to the internal "involuntary" sphincter at the bladder neck, as most of these patients have incurred injury to the external (striated) sphincter in the prostatomembranous urethra at their initial injury. Postoperative urethral catheter traction is thought to injure the internal sphincteric bladder neck continence mechanism and result in incontinence in these patients.[15] Accordingly, urethral catheter traction is to be avoided in treating these injuries.

Impotence has an incidence of 13% to 30% in patients with pelvic fracture and urethral distraction injury treated with early catheter placement (without

pelvic-suprapubic exploration).[8] These patients presumably had less-severe urethral disruption. Impotence was much higher (48%–72%) in a group of patients who ultimately required open repair and likely had more-severe, complete urethral distraction.[16,17] Secondary damage to the penile parasympathetic nerves[18] and arterial insufficiency[19,20] are believed to account for impotence in these injuries. The anejaculation that occurs in 15% of patients with these injuries is attributed to damage to the parasympathetic nerves or vesicle neck scarring.[11] The incidence of impotence and anejaculation in this group of 15 patients with pelvic fractures and urethral disruptive injuries is presumed to be high and to reflect the cited figures associated with more-severe injuries.

SUMMMARY

Posterior urethral disruptions, associated with 4% to 14% of pelvic fractures, are most often caused by vehicular trauma in both military and civilian populations. These injuries are uncommon and occurred in only 15 (2%) of 692 of the RVN urological war injuries that we managed in Japan. Two thirds (10 of 15) of these patients had other organ injuries; 4 of the 5 bladder injuries were associated with more-severe injuries and bleeding.

The diagnosis of posterior urethral injury is suspected in all patients with crush injuries of the pelvis. Retrograde urethrography should be accomplished in the stable, nonemergent, traumatized patient with any of these signs: the inability to void, a palpable distended bladder, blood at the urethral meatus, and inability to pass a urethral catheter. Urethral catheterization, prior to retrograde urography, in inexperienced hands is contraindicated. Only 3 of 15 patients had preoperative retrograde urography, the diagnosis in 12 patients was made at pelvic exploration.

In general, initial treatment in Vietnam included pelvic exploration in all, control of bleeding, celiotomy for suspected intraperitoneal injury, suprapubic cystostomy, bladder repair, urethral stenting and attempts at approximation of the severed urethral ends including catheter traction in 6, and pelvic drainage. Current recommendations for management of these injuries include retrograde urography in all, with passage of a urethral catheter if urography shows no extravasation. Surgical intervention is reserved for findings of urethral rupture with bladder repair if needed, and suprapubic cystostomy; and nonincisional techniques are used for urethral catheter realignment in the stable (anesthetized) patient. Catheter traction and direct attempt at suture apposition of the torn urethral ends is contraindicated. Suprapubic cystostomy only is indicated

- in hemodynamically unstable patients,
- in patients with multiple severe other organ injuries,
- in patients with massive pelvic hematomas or bleeding,
- when posterior urethral catheter stenting is difficult, and
- in situations of operator inexperience.

Urethral realignment can be delayed several days under more-ideal conditions.

The 27 complications that developed in 13 (87%) of 15 of our patients required 33 surgical procedures in Japan. Urethral stricture was the most common complication, which is not unexpected: incidence of significant urethral stricture in such injuries from civilian trauma centers is 50% to 65%. The relative frequency of pelvic abscesses is attributed to (1) the inability of anterior Penrose drains to adequately drain the pelvis and (2) poor surveillance and management of drains in the postoperative evacuation. Small, eccentrically located, obstructing, suprapubic catheters associated with infection was a major problem, requiring reoperation and enhanced drainage. Current recommended techniques of suprapubic cystostomy include (1) placing a large (26F–32F) Malecot suprapubic cystostomy tube in the anterior bladder dome and (2) bringing it out midline and above the pubic symphysis. The use of properly positioned and appropriately sized silicone urethral catheters will minimize the frequency of periurethral abscesses.

The incidence of late urethral stricture in these battlefield injuries is expected to approximate the civilian experience. We have no data on the frequency of impotence in our group of patients, but from civilian data the incidence of impotence was 50% or greater in patients with more-complete urethral distraction injuries that required urethroplasty.

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