

CHAPTER 11

ANTERIOR URETHRAL
PENETRATING AND BLUNT INJURIES

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

The incidence of urethral injuries in reports from Vietnam indicates a moderate variability. Salvatierra and colleagues¹ reported 14 urethral injuries in 252 urological war injuries for an incidence of 5.6%, whereas Selikowitz² reported 25 urethral injuries in 250 urological injuries for an incidence of approximately 10%. (Actually, Selikowitz’s incidence would be higher if he had included anterior urethral injuries as urethral injuries, but he reported these under penile injuries.) In a very small series, Busch and colleagues³ reported an incidence of 6.3%; and Umhey,⁴ 1 urethral injury in 8 patients with penile injuries. The World War II experience of Kimbrough⁵ and Culp⁶ was relatively comparable regarding the incidence of urethral injuries, being 14.4% and 16.25%, respectively, of all urological injuries.

At the US Army Hospital, Camp Zama, Japan, we authors (JNW and JWW) managed 83 patients who had received their urethral injuries in Vietnam; their injuries constituted 11.9% of the 692 urological injuries (Table 11-1). (These same 83 patients constituted 16.5% of our 503 *patients* with genitourinary tract injuries.) This num-

TABLE 11-1
GENITOURINARY SYSTEM WAR
INJURIES*

Organ	Injuries	
	No.	%
Kidney	132	19.2
Ureter	36	5.2
Bladder	72	10.4
Urethra	83	11.9
Penis	128	18.5
Scrotum–Testis	227	32.8
Spermatic Cord	14	2.0
Total Injuries:	692	100.0

*Total patients: 503; the number of patients is smaller than the number of injuries because some casualties have multiple injuries

ber of urethral injuries is the largest series reported to date. Rohner and Blanchard⁷ reported 49 urethral war injuries from 3 hospitals in Vietnam. Kimbrough⁵ had 34 patients with urethral injuries in his World War II series. The 83 urethral injuries in our series constituted 18.4% of the 452 injuries of the external genitalia that we treated in Japan

(Table 11-2). Table 11-3 outlines the location and nature of the urethral injury. In our 33 patients, all the penile urethral injuries were secondary to penetrating trauma. Likewise, the bulbourethral injuries in 13 of our 15 patients were secondary to penetrating trauma, but 2 were due to blunt straddle-type injuries. Of the 35 patients with prostatomembranous (posterior) urethral injury, 20 had injuries secondary to penetrating trauma, and 15 had injuries secondary to blunt trauma (see Chapter 6, Blunt Pelvic Trauma With Posterior Urethral Disruption). Because there are unique problems in the management of penetrating posterior prostatomembranous urethral injuries, the management of the 20 patients with these is discussed in Chapter 7, Wounds of the Posterior Urethra and Prostate.

TABLE 11-2
INJURIES OF THE GENITALIA

Injured Organ	No. Patients*	Injuries	
		No.†	%
Scrotum–Testis	139	227	50.2
Penis	128	128	28.3
Urethra			
Anterior	48	48	10.6
Posterior	35	35	7.8
Spermatic Cord	14	14	3.1
Total Injuries:		452	100.0

*Total patients: 303; some have multiple injuries

†Total injuries: 452

TABLE 11-3
DISTRIBUTION OF URETHRAL INJURIES*

Location	Nature of Injury	No. Patients
Penile	Penetrating	33
Bulbus	Penetrating	13
Bulbus	Blunt Straddle	2
Prostatomembranous	Penetrating	20
Prostatomembranous	Blunt	15
Total Patients:		83

*penetrating and blunt

ANALYSIS OF ANTERIOR URETHRAL INJURIES

The following discussion deals with the 48 patients we managed who had anterior urethral injuries, both penetrating and blunt (Figure 11-1). The agent of injury was multiple missile fragments in 33 patients, and bullets in 13; straddle injuries account for the remaining 2 (Table 11-4). Generally speaking, penetrating injuries (or wounds) caused by bullets or missiles were more severe than blunt injuries. Table 11-5 reflects the high incidence of other organ system injuries, both extragenital and otherwise. There were 33 associated penile

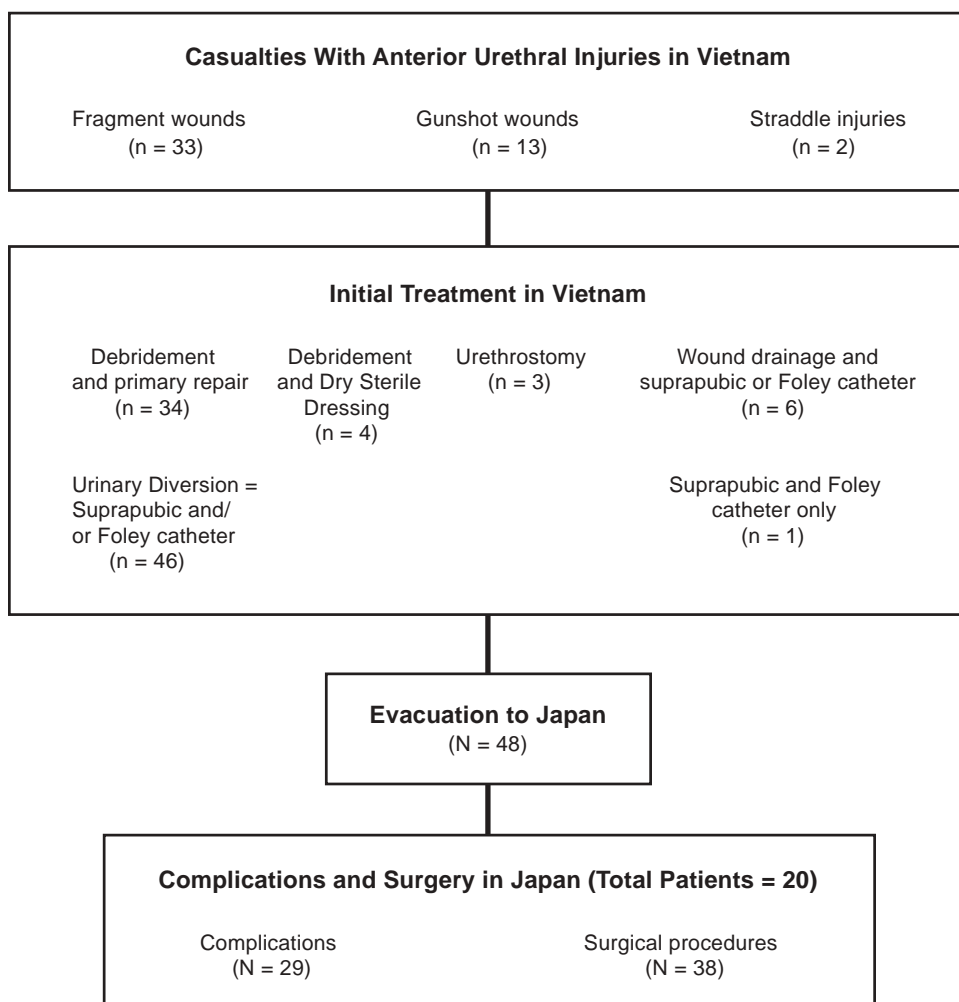


Fig. 11-1. Description and disposition of casualties with anterior urethral injuries in Vietnam.

TABLE 11-4
CAUSES OF ANTERIOR
URETHRAL INJURIES

Agent of Injury	No. Patients
Multiple Missile Fragments	33
Gunshot	13
Straddle	2
Total Patients:	48

TABLE 11-5
ANTERIOR URETHRAL INJURIES*

General Data	No. Patients
Associated Penile Wound	33
Urethral Injury Only	15
Associated Scrotal–Testis Injury	27
Associated Major Organ System Injury	45

*Total patients in this population: 48; the total number of patients with each injury is larger than the total patient population because some casualties have multiple injuries

wounds, with 15 of the urethral injuries not involving a significant soft-tissue penile injury. Of 48 patients, 27 had associated scrotal–testicular injury, and 45 of the 48 patients had other associated major organ system injuries, of which soft-tissue and bony wounds of the lower extremities were the most common. Wounds of the rectum, buttocks and perineum, and abdomen and bowel were frequently experienced in patients with anterior urethral injuries. When we reflect on the nature of these types of injuries—primarily from multiple fragments emanating from below and traveling upward—it is not surprising that lower-extremity wounds and wounds of the buttocks, rectum, and perineum were encountered. These associated wounds were not only multiple but often severe, requiring immediate resuscitative measures. Rohner and Blanchard⁷ reported their experience in managing 49 patients with urethral injuries over an 11-month period (July 1968–May 1969) at the 24th and 93rd Evacuation Hospitals and the 74th Field Hospital in Vietnam. Of their 49 patients with urethral injuries, those of 40 were caused by penetrating trauma, for the most part (multiple fragments from various explosive devices, most often mines, grenades, and rocket grenades). All of their patients with urethral injuries had wounds involving other body parts. Regarding the distribution of their 49 urethral injuries, 28 involved the anterior urethra with 24 of these 28 involving the penile urethra and 4 the bulbus urethra. They had 12 penetrating injuries of the prostatic membranous urethra and 9 blunt injuries of the prostatic membranous urethra.

DIAGNOSIS

In diagnosing these urethral injuries, most often the wound of the urethra was suggested by the nature of the injuries. Wounds of the scrotum, perineum, and penis were highly suspect for associated urethral injuries. In extensive penile wounds, a urethral disruption or other injury was often obvious. A patient with a bloody urethral discharge or bloody urine—either after catheterization or in voiding—was suspected of having a urethral injury. An inability to pass a catheter or an inability to void suggested a urethral injury. Any patient who had incurred blunt trauma and who subsequently had either tissue disruption or ecchymosis and swelling of either the perineum or the penile soft tissues was suspected of urethral injuries.

Some treating physicians stated that retrograde urethrography was performed in all patients suspected of urethral injury, and voiding cystourethrography was performed in those in whom passage of a catheter revealed bloody urine. Other treating physicians relied less frequently on urethrography and more on physical findings and exploration (preferably performed under anesthesia). Most often these patients had other, more-severe, associated injuries, and accordingly, examination under anesthesia generally awaited repair of these other injuries and resuscitation of the patient. Explorations of the soft-tissue penile wounds with a Foley catheter in place, a van Buren sound, or a Kelley clamp placed in the distal urethra were helpful in finding these wounds. We found no reports of the use of endoscopy in establishing urethral injuries in Vietnam. We also had no reports of missed urethral injuries.

Initial Treatment in Vietnam

In their initial treatment reports, all authors stress the importance of primary repair of the urethral injury with simultaneous diversion of urine preferably by the suprapubic route or via perineal urethrostomy. Rohner and Blanchard⁷ and Selikowitz² stressed the importance of avoiding long-term indwelling Foley catheters. From these reports, the majority of anterior urethral injuries were managed by debridement and primary repair of the urethral defects and proximal urinary diversion. These primary repairs varied from local excision of a small defect with approximation of the urethra to circumferential excision of more-extensive lesions and mobilization of the urethra with nontension anastomosis. Blumberg⁸ reported 8 anterior urethral injuries that were treated with debridement, local excision, and urethral reanastomosis after the technique of Hamilton-Russell.⁹ This technique was employed to avoid subsequent urethral stricture formation. It was relatively successful in Blumberg's hands. However, we managed no patients in Japan who were primarily treated by this method.

Salvatierra and colleagues¹ reported treating an extensive penetrating urethral injury with marked corporeal involvement by debridement and marsupialization of the severely damaged urethral remnants to adjacent skin, as is done in a first-stage Johansson urethroplasty. Salvatierra et al then suggested that a second-stage urethroplasty be accomplished at a later date. Subsequently, Rohner and Blanchard⁷ similarly managed 3 patients who had severe lacerations of the adjacent corporeal bodies and loss of 3 to 4 cm of the urethra with urethral marsupialization. One patient with avulsion of the distal end of urethra with extensive injury to the external genitalia and penis was left with a permanent perineal urethrostomy. Selikowitz² reported managing patients with minimal to moderate injury and tissue loss to the distal or bulbous urethra by a circumferential repair and closure using a tension-relaxing technique as described by Simpson-Smith.¹⁰

Table 11-6 outlines the initial treatment of urethral injuries in Vietnam. Of the 48 urethral injuries that we saw later in Japan, 34 had had attempts at primary

TABLE 11-6
INITIAL TREATMENT (IN
VIETNAM) OF URETHRAL
INJURIES

Treatment	No. Injuries
Primary Repair	34
Debridement (open dressing)	4
Urethral Marsupialization	3
Urinary Diversion:	
Suprapubic and/or Urethral Catheter	6
Suprapubic and Urethral Catheter (only missed injury)	1
Total Injuries:	48

repair, whereas debridement and open dressing were accomplished in 4 (those who had primary repair also had debridement as part of this therapy). Urethral marsupialization was accomplished in 3 patients in managing extensive urethral injuries with soft-tissue destruction. Urinary diversion with either a suprapubic or urethral catheter was accomplished in 6, and both suprapubic and urethral catheter drainage were accomplished in 1 patient (who was the only patient with a missed urethral injury that was detected by us in Japan). Records of urinary di-

version in these 48 patients are presented in Table 11-7. More than half the patients had only urethral catheters as the form of urinary diversion. Urethral catheter in addition to suprapubic cystotomy was employed in 17 patients, whereas 2 had suprapubic tubes only, and 1 patient had a perineal urethrostomy.

Slightly more than half of the 48 patients with anterior urethral injuries had either complications of the initial injury or complications of their treatment (all complications were managed in Japan). Table 11-8 shows the relation of the location of the anterior urethral injury (penile or bulbus) to the complication, and demonstrates that patients with penile urethral injuries had the higher percentage of complications. Presumably, this relates to the fact that more patients with penile urethral injuries had extensive associated soft-tissue injuries as opposed to those patients with bulbourethral injuries, whose soft-tissue injuries were less severe. Seven wounds of the glandular urethra were managed without complications with debridement and primary repair, dressings, or both. We saw no evidence of significant meatal stenosis in this group. There were some deformities of the glans but these were of no consequence.

Urethral Injuries Treated in Japan

Twenty-nine major complications of anterior urethral injuries were managed primarily in Japan (Table 11-9). When they arrived in Japan, 8 patients had significant stricture disease. Urethral marsupialization, creating an acquired "hypospadiac-like" penile shaft deformity, was performed on 7 patients. Of these, 3 had marsupialization of the urethra in Vietnam, and we just managed them

TABLE 11-7
METHODS OF URINARY DIVERSION USED IN INITIAL TREATMENT IN VIETNAM

Method Used	No. Patients
None	2
Urethral Catheter Only	26
Urethral Catheter and Suprapubic Cystotomy	17
Suprapubic Cystotomy Only	2
Perineal Urethrostomy	1
Total Patients:	48

TABLE 11-8
COMPLICATIONS OF ANTERIOR URETHRAL INJURIES

Site of Injury	Patients	
	n*/N†	%
Anterior Urethra	26/48	54
Penile urethra	20/33	67
Bulbus urethra	6/15	40

* n : patients with complications, managed in Japan

† N: total patients, all treated initially in Vietnam

TABLE 11-9
COMPLICATIONS OF ANTERIOR URETHRAL INJURIES

Complication	No. Complications
Urethral Stricture	8
Marsupialization of Urethra (Hypospadias)*	7
Sepsis and Ischemic Necrosis, Penile Urethra	5
Urethrocuteaneous Fistula	4
Inadequate Urinary Diversion	3
Urethral Diverticulum	2
Total Complications:	29
Total Patients:	26

* 3 urethral marsupializations were performed in Vietnam and are included as complications of or from initial injury

in the healing phase in Japan; 4 marsupializations were accomplished in Japan in treatment of sepsis and ischemic necrosis of their urethra with the associated soft-tissue injury. Five patients had extensive necrosis of the penile urethra that required therapy in Japan, and 3 of these subsequently had urethral marsupialization. Four urethrocuteaneous fistulae were managed in Japan: 2 of these were closed surgically; the remaining 2 closed with urinary diversion and treatment of their sepsis. Inadequate urinary diversion requiring a diversionary procedure in Japan was seen in 3 patients. Two of these had a suprapubic cystostomy and the other was treated with a perineal urethrostomy. In this group of 29 patients, 2 urethral diverticula were encountered, 1 of which was treated successfully with a diverticulectomy.

Thirty-eight genitourinary surgical procedures were required in Japan in managing 20 of the patients with anterior urethral injuries (Table 11-10). As noted, 8 urethral strictures required treatment. These 8 patients were initially treated with urethral dilation; 1 patient subsequently developed a total urethral occlusion, which later was treated with a distal penile urethrostomy proximal to the stricture. All 8 of these patients with urethral strictures requiring treatment had penetrating injuries: 3 of the penile urethra and 5 of the bulbus urethra. Six of these 8 had primary repair of their initial urethral injury in Vietnam and 2 had only urethral catheters placed. All 8 had indwelling Foley catheters for diversion, and in addition, 4 had suprapubic cystostomy. Two of the patients with urethral strictures had urethral fistulae also. None of these patients with urethral strictures had extensive injuries.

It appears that perhaps the strictures in these patients may be attributed in part to the use of the indwelling Foley catheter. Most of these patients with indwelling Foley catheters developed rather extensive urethritis and periurethritis with purulent drainage around the catheters, and perhaps this may have been a contributing factor. Others^{7,8,11-14} have clearly shown that the incidence of urethral strictures in urethral injury is reduced by suprapubic or proximal urinary diversion.

Ten patients required debridement of their associated soft-tissue injuries of the penile shaft and perineum, half of whom required multiple debridement along with debridement of their associated urethral injuries. (We have discussed our management of soft-tissue penile wounds, including corporal lacerations, in Chapter 10, Penile

TABLE 11-10
ANTERIOR URETHRAL INJURIES:
SURGICAL PROCEDURES IN
JAPAN

Procedure	No. Patients per Procedure
Urethral Dilation	8
Debridement	10
Multiple	5
Plastic Reconstruction, Penis	9
Skin grafts	5
Urethroplasty	5
Hypospadias	4
Urethrostomy	1
Closure Urethrocuteaneous Fistula	2
Urethral Diverticulectomy	1
Urinary Diversion	3
Suprapubic cystostomy	2
Perineal urethrostomy	1
Total Surgical Procedures:	38
Total Patients:	20

Injuries). Plastic reconstruction of the penis was required in 9 of these patients with urethral injuries. Various types of skin grafts—primarily scrotal pedicle grafts and pedicle skin grafts—were used in 5 of the patients; 1 patch skin graft was applied. Five patients required urethroplasty in Japan. One had an excision and reconstruction and secondary repair with debridement and creation of a urethrostomy because of extensive loss of soft tissue and of nearly the entire corporeal body of the penile shaft. The other 4 were treated with urethrostomy because of severe ischemic necrosis and damage to the soft tissue and urethra. As stated above, these were treated by debridement and suturing the marsupialized urethra to the skin, as in a first-stage Johanson urethroplasty. Each of these 4 patients had, in essence, an acquired penile hypospadias. Their injuries healed well and they were evacuated back to the continental United States (CONUS), where second-stage urethroplasties were accomplished.

These patients' injuries were extensive, and perhaps they should have been treated initially by this technique. Salvatierra and colleagues¹ utilized this method (urethral marsupialization) in the management of severe penetrating urethral injury in Vietnam. Subsequently, Rohner and Blanchard⁷ reported success in treating 3 patients with severe lacerations of the adjacent corporeal bodies and loss of urethral tissue with primary urethrostomy.

CASE REPORTS

Case 11-1

C. B., a 20-year-old soldier, received multiple fragment wounds to the right posterior chest, right posterior thigh, buttocks, and perineum on 15 August 1968 in the Republic of Vietnam (RVN). A retrograde urethrogram showed urinary extravasation into the perineum. A size 20 French (20F) catheter was placed into the urethra; the urethra was primarily debrided and repaired and the adjacent area drained. C. B.'s wounds of the thigh and perineum were debrided, dressed, and left open. Six days later he was evacuated to Japan, where his wounds were cleaned and treated with dressing changes. Examination of the perineum and rectum showed no evidence of abscess formation; however, there was rather extensive periurethritis when palpating the perineal area. The Foley catheter was removed 15 days postinjury, and it was noted to be snug in the urethra. The patient was unable to void, and a subsequent retrograde urethrogram showed moderate stricture formation of the distal penile urethra as well as of the bulbous urethra. These strictures were dilated initially to 18F and again 10 days later, because of persistent voiding problems, to 24F with moderate bleeding. The patient was able to void with difficulty and was evacuated to CONUS for further treatment of his healing wounds and urethral stricture.

Comment on Case 11-1

As this case illustrates, there was a high incidence of stricture formation in patients with urethral injury treated with primary repair and urethral catheterization. We believe that a major contributing factor to these strictures was the severe urethritis secondary to indwelling Foley urethral catheters.

Case 11-2

H. W., a 26-year-old soldier, had multiple fragment wounds to his scrotum and lower extremities. His injuries resulted from hostile action (IRHA) in RVN on 31 April 1970 and included multiple fractures of the right foot, lacerations of the left testis, and lacerations of the perineal urethra. Debridement of the extremity wounds and the left scrotum was accomplished along with primary repair of the urethra through a perineal approach. The bladder was drained with a urethral Foley catheter only. Six days later the patient arrived in Japan and was transfused because of anemia; he was also febrile with a bleeding purulent wound of the left scrotum. This did not respond to irrigations and subsequently an orchiectomy was performed on the left for an ischemic and necrotic testis. Twenty days after the injury, after the catheter was removed, the patient had difficulty in urination; van Buren sounds were passed with a moderate stricture noted in the perineal penoscrotal urethra. The patient subsequently developed extravasation of urine from the perineal incision; a suprapubic cystotomy was then performed to divert the urine. A voiding cystourethrogram approximately 7 weeks postinjury showed a rather massive diverticulum at the site of previous urethral fistula. There was a slight stricture of the urethra on either side of the diverticulum. Approximately 2 months postinjury, an internal urethrotomy was performed in the short stricture distal to the diverticulum, the diverticulum was excised, and the urethra was closed primarily. A 22F Foley catheter was left in as a stint. Three weeks postoperatively, the suprapubic tube was clamped, and a cystourethrogram showed a basically normal urethra without urinary extravasation.

Comment on Case 11-2

Again we see stricture formation presumably secondary to urethritis from an indwelling Foley catheter. Clearly, this patient should have had initial suprapubic urinary diversion. The diverticulum formation was presumably secondary to ischemic necrosis that was caused by either inadequate initial debridement or tension on the repair of the urethral defect.

Case 11-3

T. R. was a 21-year-old soldier whose IRHA in RVN was from a gunshot wound (GSW) to the right anterior thigh, penis, and left scrotum. Initial treatment included a left orchiectomy and delayed primary closure (DPC) of the wound to the right thigh. In addition, the penile urethra was totally destroyed along with some of the adjacent soft tissue. There was no apparent damage to the corpora cavernosa. The soft tissue of the penis was debrided and treated open with a dressing; the proximal urethra was anastomosed to the penoscrotal area, creating a penoscrotal urethrostomy with drainage from a Foley catheter. The patient was evacuated to Japan 9 days postinjury. Part of his glans penis and distal penile skin were devascularized, and these were treated with wet neomycin sulfate dressings to the penis. Ten days after admission to the hospital, these areas were significantly clean to allow for a DPC of the penile skin. The glans was curetted. The skin margins were debrided, mobilized, and sutured to the remaining strip of urethra. In essence, this patient had a penile scrotal hypospadias at this point. A delayed urethroplasty was accomplished after evacuation to CONUS.

Case 11-4

R. R. was a 19-year-old soldier whose IRHA in RVN on 12 April 1969 was from a .45 caliber pistol at close range. The anterior right thigh was debrided as well as the left scrotum. He sustained a laceration of the urethra at the penoscrotal junction. The extensive

soft-tissue and urethral destruction was treated primarily with marsupialization of the urethra at this point, creating a penoscrotal urethrostomy. A suprapubic cystotomy was performed, and the urethra was stented with a 22F Foley catheter. DPC of the extremity wounds was accomplished 4 days postinjury. He was evacuated to Japan 10 days postinjury, where he was noted to have an enlarged right hemiscrotum with purulent drainage that cultured mixed Gram-negative organisms. Subsequently, a right scrotal hematoma was evacuated. The urethrostomy was calibrated easily with a 22F bougie. The patient was evacuated to CONUS with a suprapubic cystotomy in place and with the penile urethra healing without problems. He was to have repair of his hypospadiac defect at a later date.

Case 11-5

C. B. was a 21-year-old soldier whose IRHA in RVN from multiple fragment wounds occurred on 29 April 1969. He incurred severe injuries of all 4 extremities, the face, and the genitalia. The extremity wounds were debrided and the soft palate sutured, and a tracheostomy was performed. He had a right orchiectomy for a destroyed right testis. The extensive fragment wounds to the midline penis, the lacerations of the corpus cavernosa, and the extensive urethral destruction were all treated with debridement. The corpus cavernosa was closed. The damaged urethra was excised; and marsupialization of the urethra at the level of the midshaft of the penis was performed, creating a urethrostomy at this site. A suprapubic tube was placed at the time of the injury and the Foley catheter was removed 3 days postinjury. The patient received 18 units of blood. Prior to his evacuation to Japan 2 weeks postinjury, the tracheotomy tube was removed. He then had serial redebridement of the penis with neomycin sulfate dressings and surgery over a 3-week period. Subsequently, he had (1) a rotational scrotal flap for a large skin and subcutaneous defect in the ventral aspect of the penis and (2) a urethrotomy because of stenosis of the penile scrotal urethrostomy. Approximately 3 weeks later, he had release of the rotational scrotal skin flap as well as excision of a small necrotic portion of the scrotal skin graft. From that time on he had progressive healing of the penis. The patient's suprapubic tube was subsequently removed and he voided well. He had good erections at the base of the penis but the midshaft of the penis was somewhat flaccid. The patient was then evacuated to CONUS with plans for a subsequent urethroplasty.

Comment on Cases 11-3, 11-4, and 11-5

These 3 cases show the utility of both partial debridement and the creation of a marsupialized urethra and interval hypospadias in patients with extensive soft-tissue and urethral penile injuries. Clearly, the penis is amenable to debridement, redebridement, and DPC—as is practiced in other extensive soft-tissue injuries.

Case 11-6

R. C., a 21-year-old soldier, suffered a GSW to the left hip and penis. The bullet lodged in the soft tissue of the distal penis. The missile was surgically removed, the defect in the urethra cleansed, and the urethra stented with an indwelling Foley catheter. Shortly after evacuation to Japan the dressings were removed from the penis, revealing a large through-and-through wound in the subcoronal region of the penis and urethra. The entire area was carefully cleansed and debrided, and then the urethra, subcutaneous tissue, and skin were closed in a transverse fashion with absorbable suture. This was accomplished over a Foley catheter stent, which was then removed, and a suprapubic cystotomy was performed. The patient's penile urethral wound healed without complications (Figure 11-2. a,b,c,d).

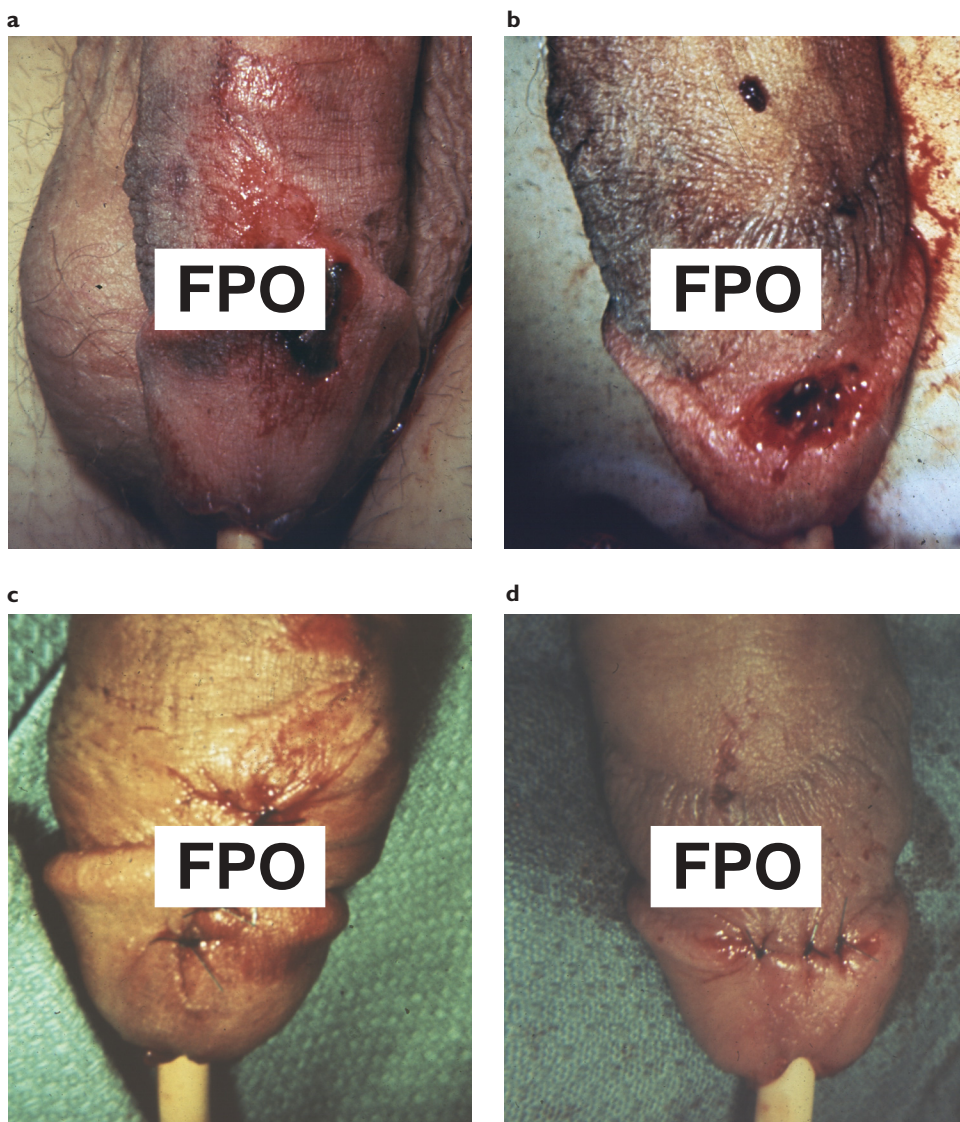


Fig. 11-2. Case 11-6. A bullet perforated the distal penile urethra in Vietnam; the wound was debrided and repaired in Japan. Dorsal and ventral views of the wound are shown before (**a** and **b**) and after (**c** and **d**) the wound was debrided and repaired in Japan.

Comment on Case 11-6

This case demonstrates the utility of delayed primary repair of contaminating penile urethral injuries.

Case 11-7

C. G., a 19-year-old soldier, received a direct hit in the external genitalia from an AK-47 and suffered an extensive penile urethral injury. The distal penile urethra and associated soft-tissue structures were described as being shattered, as was a portion

of the left testicle. The initial therapy that C. G. received consisted of rather heroic attempts at meticulous reconstruction of the extensively damaged penile skin, urethra, glans, and corpora over a Foley catheter. The left testicle was debrided and drained; the scrotal incision was then closed. When C. G. arrived in Japan 3 days later, examination under anesthesia revealed extensive cellulitis, edema, subcutaneous hemorrhage, and purulent discharge from the tissue of the penis and left hemiscrotum. The penis was completely covered by skin, sutured under tension, and subcutaneous drains emanated from defects of the distal skin. The drains and sutures were removed, the penile wounds and left scrotum evacuated, and obvious gangrenous tissue removed prior to dressing with nitrofurazone gauze [Furacin Soluble Dressing, Roberts Pharmaceutical Corp, Eatontown, NJ]. A suprapubic cystostomy was performed. He subsequently underwent 6 dressing changes with limited debridement (gangrenous tissue only removed) over the next 3 weeks. There was almost complete sloughing of the penile urethra. Three and one half weeks after admission to the hospital, plastic revision of the pendulous penis was performed by covering a large skin defect on the ventral penis by sliding available penile skin. Almost the entire distal penile urethra was lost in the ischemic process and was redebrided. The distal viable urethra was sutured to the penile skin, creating a midpenile hypospadias. There was no attempt to perform a urethroplasty at this stage, and C. G. was evacuated 2 months postinjury with a proximal penile hypospadias; he was to have a urethroplasty later. This patient's problems were clearly compounded by the initial attempt to primarily repair his soft-tissue penile and urethral injuries.

Comment on Case 11-7

This patient's wounds would have been better managed by initial debridement and covering of dressings without attempt at meticulous reconstruction. If the extent of the initial urethral injury was apparent, this wound clearly should have been treated with marsupialization. This case also illustrates that open dressing and marsupialization of the urethra are viable alternatives when the extent of the original injury is not apparent and the surgeon is trying to avoid being overly aggressive at initial debridement. Suprapubic cystostomy should have been performed as part of this patient's initial therapy. For further information on this topic, see Chapter 10, Penile Injuries, particularly Case 10-9 and its illustrations.

Case 11-8

D. C., a 24-year-old soldier, incurred a severe blast injury of the anterior thigh and groins bilaterally and massive wounds of the genitalia when an oxygen tank, which he was filling, exploded at the Atsugi Naval Station in Japan. The bottle exploded at 1,500 lb pressure, and large metal fragments caused extensive wounds (injury not received in hostile action, a nonbattle injury). The patient was brought to the emergency room, US Army Hospital, Camp Zama, Japan, and was rapidly taken to the operating room, where lacerations of the left superficial femoral artery were repaired. The anterior thigh wounds were debrided; the loss of tissue there was extensive. The intrascrotal contents were carefully examined, and the totally destroyed left testis was surgically removed. The 80%-destroyed right testis was debrided, and the tunica albuginea and scrotum were closed. The distal two thirds of the penile urethra was severely damaged. The injury involved the urethra, corpus spongiosum, and a small portion of the corpus cavernosa on the right. The penis was carefully debrided, and the remaining bulbous urethra at

approximately the mid-penile shaft was marsupialized and sutured to the skin as a penile urethrostomy. After debridement, the penile skin and the scrotum were closed. Suprapubic cystostomy was placed and the Foley catheter was removed 2 days postinjury. The patient had secondary closure of the wounds of the thigh and subsequently was evacuated to CONUS with the penile hypospadias to be repaired at a appropriate interval (Figure 11-3. a,b,c,d).

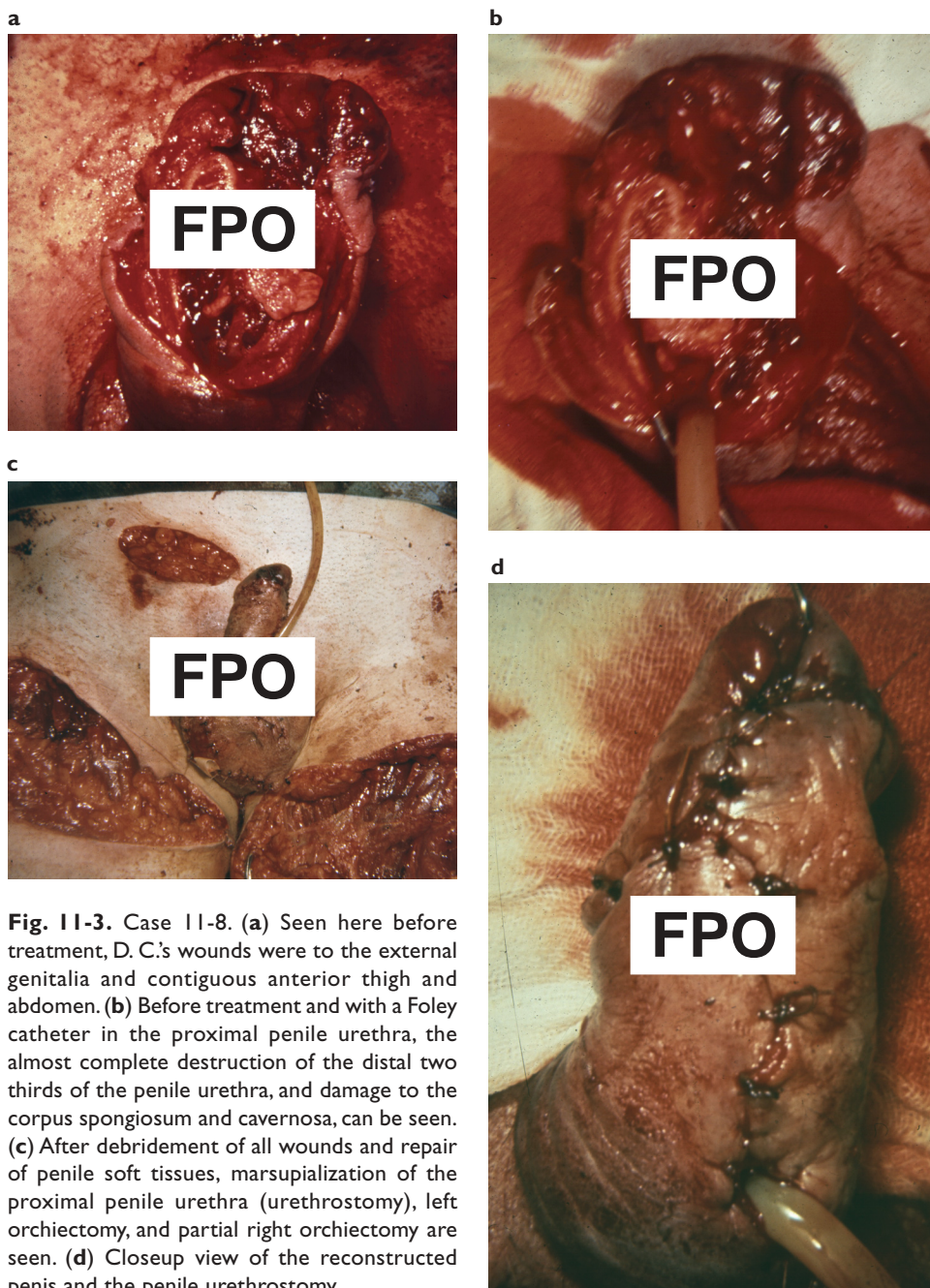


Fig. 11-3. Case 11-8. (a) Seen here before treatment, D. C.'s wounds were to the external genitalia and contiguous anterior thigh and abdomen. (b) Before treatment and with a Foley catheter in the proximal penile urethra, the almost complete destruction of the distal two thirds of the penile urethra, and damage to the corpus spongiosum and cavernosa, can be seen. (c) After debridement of all wounds and repair of penile soft tissues, marsupialization of the proximal penile urethra (urethrostomy), left orchiectomy, and partial right orchiectomy are seen. (d) Closeup view of the reconstructed penis and the penile urethrostomy.

Comment on Case 11-8

The management of this case demonstrates several important principles in the initial treatment of massive injury to the anterior urethra and soft tissues of the penis and scrotal contents:

- suprapubic cystostomy;
- careful, conservative debridement of the urethra, corpus spongiosum, and penile skin;
- urethral penile marsupialization and urethrostomy, creating a temporary hypospadias;
- attempts at conservation of a solitary testis; and
- debridement and DPC of thigh wounds.

Delayed urethral reconstruction should be accomplished in CONUS.

DISCUSSION AND CONCLUSIONS

Anterior urethral injuries constituted between 10% and 15% of all war injuries to the genitourinary tract that were managed in Vietnam and Japan. Nearly all of these patients had severe, multiple wounds to other organ systems, which were generally more life-threatening. Consequently, we urologists in Japan and other surgeons in Vietnam often had to restrict our diagnostic studies to avoid interfering with resuscitation measures and other priority injuries. For the most part, the diagnosis of urethral injuries in these patients was triggered by the nature and the location of the wounds. Surgeons should maintain a high index of suspicion in patients who have

- injuries to the external genitalia,
- retained fragments in the pelvis (detected by X-ray examination), or
- severe wounds on the buttocks, thighs, or perineum.

Blood at the urethral meatus is an indication of a urethral injury, and patients with this sign were usually diagnosed by exploration of the soft-tissue injuries of the genitalia or perineum over a catheter. The successful passage of a catheter did not rule out a urethral injury, and many patients were diagnosed by exploration of their external wounds after a catheter had been passed. All patients with wounds in these regions should have debridement and inspection in an attempt to identify a urethral injury. Urethrography and endoscopy were uncommonly performed. Physical manipulation and probing were accomplished under anesthesia. Utilizing these techniques most urethral injuries were diagnosed. We managed only 1 patient whose urethral injury had been missed in Vietnam.

The management of urethral war injuries relates to the extent and the location of the injury and to the associated soft-tissue injuries. This chapter deals only with anterior urethral injuries and their management, and the problems seen with these injuries are different from the ones seen with posterior urethral injuries. In Viet-

nam, the limited, localized, frequently low-velocity, anterior urethral wounds were universally managed by debridement and primary repair after mobilization of the urethra. Blumberg⁸ reported the repair of such injuries utilizing the principle of Hamilton-Russell urethroplasty.⁹ We did not manage any patients who had been treated with the Russell urethroplasty, but Blumberg⁸ reported good success and no strictures with this technique.

The management of the associated soft-tissue wounds of the penis and corporeal bodies is discussed in Chapter 10, Penile Wounds. Clearly, massive high-velocity wounds with extensive soft-tissue and urethral destruction are better managed with urethral marsupialization (urethrostomy) in addition to extensive debridement with delayed skin grafting and urethroplasty. We managed 7 patients so treated, 3 primarily treated in Vietnam and 4 primarily treated in Japan. These patients all had extensive high-velocity injuries with large tissue and urethral defects. Three of the 4 patients on whom we operated in Japan, and on whom we created hypospadias with urethral marsupialization, were initially treated in Vietnam with attempts at meticulous reconstruction of extensive injuries. These patients all developed significant sepsis and ischemic necrosis with urethral slough. Their wounds should have been treated initially with marsupialization.

The high incidence of stricture disease and periurethritis with sepsis in patients with indwelling urethral catheters was distressing and supports proximal urinary diversion with either suprapubic tubes or perineal urethrostomy. All 8 of the patients with urethral stricture disease had indwelling Foley catheters, and 6 of the 8 had had primary repair of their urethral injuries. Without exception, these patients had extensive urethritis and periurethritis on presentation to our hospitals in Japan (primarily the US Army Hospital, Camp Zama). In his World War II experience, Robinson et al¹⁵ reported a high incidence of abscess with fistula formation in patients with urethral injuries who were treated with primary repair and urethral catheters. In his civilian experience, Del Villar¹¹ reported a high incidence of urethral stricture disease in patients with urethral injuries who were treated with primary repair and urethral catheters. Blumberg⁸ reported no strictures in patients who were treated with perineal urethrostomy after primary repair of the urethral wound, and Pontes and Pierce et al,¹⁶ in their civilian experience, reported no strictures in 14 patients who had proximal suprapubic diversion only for their anterior urethral GSWs. *Our experience, along with that of others, strongly supports proximal urinary diversion in all patients who have penetrating anterior urethral injuries.*

Currently, most experts recommend primary surgical repair of low-velocity urethral GSWs. The treatment of partial urethral disruptions by catheter realignment alone following low-velocity GSWs is associated with a much-higher incidence of stricture than treatment by primary repair.¹⁷ Initial overzealous debridement of the corpus spongiosum after trauma can occur, as tissue that is merely bruised can mimic tissue that is necrotic.^{17,18} Suprapubic urinary diversion and delayed urethral reconstruction are recommended after high-velocity GSWs to the anterior urethra with delayed reconstruction.¹⁹

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