11
Genitourinary Trauma and Emergencies

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A urologic emergency arises when a condition requires rapid diagnosis and immediate treatment. This chapter focuses on traumatic and nontraumatic genitourinary (GU) emergencies typically arising in the emergency department, outpatient clinic, or inpatient ward. The evaluation of hematuria is discussed separately in Chapter 1, and Chapter 13 provides a discussion of GU sepsis.

Trauma to the GU organs generally does not result in an immediate threat to life. However, failure to appropriately evaluate and treat these injuries may result in significant long-term patient morbidity. Recent advances in intensive care and radiologic imaging have greatly improved diagnosis and survival in serious trauma. As a member of the trauma team, it is the responsibility of the urologist to provide proper interpretation of urologic imaging and intervene surgically when necessary.

I. General principles of trauma management

Approximately 10% of all trauma involves the GU tract, but only 2% involves the GU tract exclusively. The GU system may be divided into three regions, each with its own pattern of injury. The upper tract includes the renal arteries, the kidneys, and the ureters. The lower tract consists of the bladder, the prostate, and the posterior urethra. The external portion consists of the anterior urethra, penis, scrotum, and testicles in the male. Trauma patients presenting to the emergency room may have (a) unstable vital signs requiring immediate surgical intervention, (b) penetrating trauma with stable vital signs, or (c) blunt trauma with stable vital signs.

A. History.

Attempt to obtain a detailed history of the trauma from the patient or from witnesses and emergency personnel. Loss of consciousness is a rough indicator of the force of trauma and the possible presence of head injury. In falls, the height from which the victim has fallen and the nature of the landing surface are important. In motor vehicle accidents, the speed of the vehicle, location of the victim within the automobile, and use of seat belts are important. In gunshot wounds, the type of weapon, caliber of the projectile, and distance from the victim at which the shot was fired can be used to estimate the extent of tissue damage.

B. Physical examination

is performed during the generalized trauma evaluation. Hemodynamic instability requires aggressive resuscitation and emergency surgical exploration in many cases. Physical findings of tenderness, ecchymosis, or penetrating injuries in the flank, suprapubic region,

pelvis, or external genitalia strongly suggest an underlying urologic injury. Pelvic bony instability indicates a likely pelvic fracture and should alert the trauma team to the possibility of urethral or bladder injury. Likewise, gross blood at the urethral meatus and

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superior displacement of the prostate on rectal examination are indicative of possible urethral injury.

C. Diagnostic tests

begin with routine urinalysis to look for the presence and extent of hematuria and should be performed on all patients. The urethra should be catheterized *unless urethral injury is suspected.* If blood is seen at the urethral meatus *or* a significant pelvic fracture is present, urethral injury must first be ruled out by retrograde urethrography (see below).

D. Radiologic examination

1. Plain films of the abdomen

may reveal bony fractures of the pelvis, ribs, or vertebrae. Loss of the perirenal outline, loss of the psoas shadow, or displacement of bowel gas may indicate retroperitoneal hematoma or urinoma. A “ground-glass” appearance on plain film may be caused by intraperitoneal urinary extravasation.

2. Retrograde urethrogram

is indicated whenever urethral injury is suggested by the presence of blood at the meatus, superior displacement of the prostate on digital rectal examination, pelvic fracture, or inability to pass a urethral catheter. The study may be performed easily by using either a Brodney clamp that fits onto the glans penis or a 12F Foley catheter inserted into the fossa navicularis. The balloon is inflated only enough to hold the catheter gently in place. After the patient is placed in the 30-degree oblique position, 15 mL of radiographic contrast agent is injected gently. The presence of extravasation is indicative of urethral injury. The posterior portion of the urethra above the pelvic floor is difficult to interpret on retrograde urethrography, as the external sphincter is often closed.

3. Cystography

is indicated to rule out bladder injury in all patients with blunt or penetrating trauma that manifest gross or microscopic hematuria. In patients who have penetrating trauma without hematuria, the indications for cystography depend on the nature and location of the wound. Ideally, cystography should be performed in a radiology suite with fluoroscopic capacity to obtain oblique and real-time images. Some centers have advocated computed tomographic (CT) cystogram as their study of choice. Regardless of the technique used, it is essential that the bladder be completely filled with contrast agent to demonstrate small amounts of extravasation. Extravasation from the bladder may be missed on intravenous urogram (IVU) or CT scan if the bladder is incompletely distended. Allow contrast agent to flow through the urethral catheter under gravity until the bladder is full; at least 250 mL is often

required. After the bladder is emptied, a postvoid film is vital to assess extravasation located behind the bladder.

4. CT with intravenous contrast agent

has become the “gold standard” of trauma evaluation and is our preferred study in the initial assessment of renal trauma. Scanning in the spiral (helical) mode may be done in <5 minutes and provides an excellent assessment of renal parenchymal integrity, injury to other organs in the abdomen, and the presence of hematomas or urinomas. CT can also establish the presence of both kidneys and their excretory function.

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5. IVU

is no longer recommended as the initial screening examination in patients with suspected renal injury. IVU may be useful in patients with traumatic hematuria if CT is not available. In the case of the unstable patient who is brought straight to the operating room without radiologic studies, a **“one-shot” IVU** is essential before any exploration of the kidneys to evaluate the contralateral side. After a scout film of the abdomen has been obtained, contrast agent (Renografin-60 in a dose of 1 mL/kg) is injected intravenously by hand during 3 to 5 minutes. A film is taken at 5 to 10 minutes after injection of contrast agent. Adequate visualization of the kidneys may not be obtained on IVU unless the patient has a stable systolic blood pressure above 90 mm Hg.

6. Renal arteriography

may be indicated in instances of renal vascular injury, a diagnosis suggested by nonvisualization of the kidney on CT or IVU. In selected patients, it also may be useful in identifying the source of persistent renal bleeding following trauma. If a source of bleeding is clearly identified, arteriographic embolization may be performed at the same time.

7. Ultrasonography

(US) permits noninvasive assessment of perirenal and subcapsular hematomas and is useful in following patients with renal trauma who are being managed nonsurgically.

8. Radionuclide studies

may be useful in the follow-up care of patients with trauma in whom hypertension develops.

II. Kidney

A. Trauma.

Located high in the retroperitoneum, the kidneys are relatively well protected by the bony rib cage, lumbar spine, and vertebral muscles. However, trauma sufficient to fracture a rib or vertebral process often is accompanied by trauma to the kidney. Renal trauma accounts for approximately 50% of all cases of GU trauma, and >50% of cases involve patients under

the age of 30. There is a male-to-female predominance of 4:1. In children aged 5 to 15, the most common cause of renal injury is bicycle riding.

1. Blunt trauma

to the abdomen, flank, or back accounts for >80% of all renal injuries. The most common causes are motor vehicle accidents, falls, sports accidents, and assaults. Rapid deceleration such as commonly occurs in motor vehicle accidents or falls may cause tears in the renal artery intimal layer or even complete avulsion. In adult patients with blunt trauma, gross hematuria, shock, and direct trauma to the flank are associated with an increased risk of sustaining major renal injury (about 25%). In children, the most common cause of blunt renal trauma is bicycle riding.

2. Penetrating trauma

is most commonly caused by knife and bullet wounds. Approximately 85% of instances of penetrating trauma involving the kidney are associated with injury to other intraabdominal organs (Table 11.1). Children are especially prone to renal injury because of the underdevelopment of the back muscles and rib cage and because the kidneys are relatively larger than in adults. In addition, the kidneys in children are not as well protected by perirenal fat and Gerota's fascia, which can act as a buffer against trauma. Renal injury

is more likely in the presence of preexisting conditions such as hydronephrosis or tumors.

Table 11.1. Intraabdominal injuries associated with penetrating renal trauma (% risk)

Liver	45
Stomach	25
Pancreas	25
Small bowel	25
Spleen	20
Right colon	20

Left colon	15
Major vessels	15

3. Classification of renal injury

a. **Grade 1** injury (**renal contusion**) is bruising of the renal parenchyma without true parenchymal disruption (Fig. 11.1). An associated **subcapsular hematoma** may be present, but the kidney is intact. Such injuries account for the majority of cases of blunt renal trauma.

Fig. 11.1. Classification of renal injury. (Classification system from Moore et al. Organ injury scaling: spleen, liver, and kidney. *J Trauma* 1989;29:1664.)

b. **Grade 2** injury involves ruptures or tears of the renal capsule and parenchyma that are **<1 cm** in length (nonexpanding **perirenal hematoma** may be present). The injury does not involve the collecting system or the medulla of the kidney (no urinary extravasation). Grade 1 and 2 injuries are classified as minor injuries and account for 85% of all renal injuries.

c. **Grade 3** injury is the same as grade 2 injury but extends **>1 cm** (no urinary extravasation).

d. **Grade 4** injury is a major laceration that extends into the collecting system and produces **extravasation of urine.** Involvement of a segmental vessel also qualifies as a grade 4 injury.

e. **Grade 5** indicates the most extensive renal injury. Severe multiple lacerations, fracture, **shattering of the kidney**, and avulsion of the renal hilum are all examples of grade 5 injury. Grade 3, 4, and 5 injuries are classified as major injuries. **Renal lacerations** account for approximately 15% of blunt renal injuries and 30% of penetrating injuries. **Renal vascular injury** includes occlusion, thrombosis, or avulsion of the renal artery, renal vein, or one of their branch vessels; it occurs in <1% of instances of blunt renal trauma but in up to 10% of instances of penetrating trauma. Renal vascular injuries are difficult to diagnose quickly enough to prevent renal loss because significant and irreversible renal injury occurs within 1 hour if significant ischemia is present.

4. Diagnosis

a. Patients who are **hemodynamically unstable** will almost always need to be explored quickly. The urologist is often called to the operating room for consultation after the patient has been explored by the general surgeons and must

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determine whether both kidneys are present and functioning. This can be accomplished with a **one-shot IVU** performed on the operating table. If there is no evidence of renal injury, no exploration is indicated. Major injuries or unilateral nonfunction noted on intraoperative IVU should be explored. If only minor injury is noted on the IVU but retroperitoneal bleeding is present, the kidney should be explored and repaired.

b. In patients who are **hemodynamically stable**, CT is the preferred initial radiologic examination (see Chapter 2).

5. Treatment

of renal injury depends heavily on the nature and severity of injury, determined by the evaluation previously described.

a. **Blunt trauma.** In general, the likelihood of significant urinary tract injury in patients with blunt trauma who are hemodynamically stable and have no hematuria is low. Patients with microscopic hematuria who are hemodynamically stable also have a low risk for significant renal injury, but they should be observed more closely if the mechanism of injury warrants it. Patients with hemodynamic instability or gross hematuria are more likely to have a significant injury and should therefore undergo a more aggressive

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radiologic assessment if time allows. These patients are monitored for signs of bleeding, such as a change in vital signs, decrease in the hematocrit, or expanding flank hematoma. Patients with fractured kidney or renal vascular injuries usually require prompt surgical intervention for repair of the kidney or urgent nephrectomy. The management of **urinary extravasation** in blunt renal injury is controversial; some authorities favor conservative treatment, and others feel that early surgical intervention is preferable. Antibiotic therapy is usually indicated, especially if the urine is infected at time of injury, and serial US can be used to monitor the resolution of the urine collection. If signs of abscess formation or sepsis appear, the urinoma should be drained surgically or percutaneously. The proponents of early surgical exploration in patients with urinary extravasation argue that it results in decreased length of hospital stay and reduced incidence of complications such as infected urinoma; however, the incidence of nephrectomy is increased in patients explored surgically.

b. **Penetrating trauma.** All patients with abdominal gunshot wounds and almost all

patients with stab wounds should undergo surgical exploration (Table 11.2). The only exception is the patient with a stab wound of the flank, no hematuria, normal CT findings, and no abnormal physical findings. This type of case can be managed nonoperatively. In other instances of penetrating trauma, abdominal exploration is required to repair associated injuries and the urologic injury itself. Surgical management of penetrating renal trauma consists of gaining control of the renal pedicle, obtaining adequate hemostasis, debriding devitalized tissue, repairing the collecting system, and providing adequate drainage. When the severity of the injury makes this treatment impossible, nephrectomy is indicated, which occurs in approximately 10% of patients with stab wounds and in 40% of those with gunshot wounds (Table 11.3).

Table 11.2. Indications for renal exploration

Absolute	Relative
Pulsatile or expanding retroperitoneal mass	Major renal injury
Hemodynamic instability from renal bleeding	Urinary extravasation
Renal vascular injury in solitary kidney	Laparotomy for associated injury
	Nonviable renal tissue needing debridement

Table 11.3. Results of renal exploration

Surgery	Blunt Trauma (%)	Stab Wound (%)	Gunshot Wound (%)

Debridement and repair	35	60	40
Partial nephrectomy	15	15	20
Nephrectomy	10	7.5	15
Vascular repair	10	7.5	10
Pelvic repair	15	0	0
Exploration only	15	10	15

Source: Modified from McAninch JW. *World J Urol* 1999;17:65.

6. Complications of renal injury

include delayed bleeding, hypertension, formation of arteriovenous fistulas, hydronephrosis, and loss of renal parenchyma. Delayed bleeding may occur during the first month after injury. Persistent hematuria may be an indication of a traumatic arteriovenous

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fistula and should prompt arteriography. The patient's blood pressure should be monitored carefully during the first 6 months after injury. If hypertension develops, CT or renal US should be performed at the end of that period.

B. Renal vascular emergencies

1. Renal arterial emboli

constitute 2% of arterial emboli. The main renal arteries are most frequently involved by systemic emboli from the left atrium in association with atrial fibrillation, artificial heart valves, the vegetations of endocarditis, or a mural thrombus from a myocardial infarct. Iatrogenic emboli are being increasingly seen because of the widespread use of invasive vascular procedures. The intrarenal arteries are end arteries, so their occlusion leads to a

wedge-shaped infarction of the renal parenchyma. These infarcts may be unilateral or bilateral, although they are more common on the left. Clinically, a spectrum ranges from no symptoms in a large number of patients to acute flank pain that may radiate to the groin, nausea, vomiting, and fever when infarction occurs. This picture closely mimics that of a ureteral calculus. Microscopic or gross hematuria is found in 50% of cases. This may be accompanied by proteinuria, leukocytosis, and epithelial cells in the urine. Renal infarction causes a characteristic sharp rise in the serum glutamic–oxaloacetic transaminase level, followed by a prolonged elevation of lactate dehydrogenase.

a. The **diagnosis** is suspected when CT with contrast agent fails to visualize all or part of the kidney. Although visualization may be poor or delayed with ureteral stone, *some* nephrogram is usually seen. The presence of a cardiac or vascular lesion lends credence to the diagnosis. A dynamic technetium scan demonstrating nonperfusion of the kidney and selective renal arteriography are required to confirm the diagnosis.

b. The **treatment** of choice is systemic anticoagulation (heparin). Intraarterial fibrinolytic agents (streptokinase), if instituted promptly within 4 to 6 hours, can lead to a significant recovery of renal function. The underlying cardiac disease usually precludes surgical embolectomy in these

high-risk patients. Late-onset hypertension, a sequela of renal ischemia, and activation of the renin–angiotensin system may require nephrectomy.

2. Renal vein thrombosis.

Rare in adults, it is frequently unilateral and usually associated with membranous glomerulonephritis and nephrotic syndrome, invasion of the renal veins and vena cava by tumor, or retroperitoneal disease. In infants and children, it is more commonly bilateral and associated with severe dehydration resulting from diarrhea or vomiting. In its clinical presentation, renal vein thrombosis closely mimics acute pyelonephritis and ureteral calculus. The patient presents with severe flank pain, hematuria, and fever. Signs of sepsis and shock are variable. A large, tender, smooth mass is usually felt in the flank, which represents the passively congested kidney.

a. **Diagnosis.** Gross or microscopic hematuria caused by focal renal infarction is invariably found. Thrombocytopenia is also a consistent finding in the acute setting, and its absence should make one suspect the renal vein thrombosis to be in the resolving stage. Proteinuria is more common in the adult type of thrombosis, where it may be massive. Rising blood urea nitrogen and creatinine are found quite frequently, even in unilateral thrombosis. CT scan shows a large kidney with delayed or absent enhancement of the parenchyma. US usually shows an enlarged hypoechoic kidney with a renal vein or vena caval thrombus. CT and magnetic resonance imaging are sensitive, but selective renal venography remains the definitive test.

b. **Treatment.** This depends on the age of the patient. In infants and children with bilateral renal vein thrombosis, the prognosis is dismal; prompt rehydration, antibiotics for infection, and correction of electrolyte imbalance form the mainstay of treatment. In adults, early heparinization and selective intravenous fibrinolysis (streptokinase or urokinase) have yielded promising results. Surgical thrombectomy is reserved for caval thrombosis. Following renal vein thrombosis, renal function usually recovers completely. In a small subset of patients, nonfunction, renal hypertension, or chronic renal infection may necessitate delayed nephrectomy.

III. Ureter

A. Trauma

to the ureter is almost always penetrating trauma. Blunt trauma to the ureter is extremely rare and usually involves disruption of the ureteropelvic junction following rapid deceleration, a mechanism seen most commonly in children. The most common cause of ureteral trauma is iatrogenic injury during pelvic surgery, in particular abdominal hysterectomy; however, ureteral injury has occurred in a wide variety of intraabdominal, pelvic, and retroperitoneal surgical procedures. Ureteroscopy is an increasingly important cause of ureteral perforation or avulsion. The second most common cause of ureteral injury is gunshot wound, most commonly from low-velocity weapons. All portions of the ureter are at equal risk for penetrating trauma from gunshot wounds. Stab wounds involving the ureter are rare.

1. Diagnosis

a. **Iatrogenic injury.** Any patient in whom flank pain, fever, and paralytic ileus develop during the first 10 days following intraabdominal or pelvic surgery should be suspected of having ureteral injury. In female patients, a ureterovaginal fistula may develop after ligation of the ureter during hysterectomy. IVU or CT will demonstrate delayed excretion, hydronephrosis, and sometimes extravasation of contrast material.

b. **External penetrating injury.** Hematuria is present in approximately 80% of patients with penetrating injury of the ureter. Thus, the absence of hematuria does not rule out penetrating ureteral injury. The diagnosis is usually apparent on IVU. In patients with ureteral transection from penetrating trauma, there is little time for a urinary collection to develop, and the IVU may demonstrate no abnormality except for extravasation at the point of injury. In approximately 10% of patients, IVU findings will be completely normal. The injury can be well delineated with a retrograde pyelogram. To avoid the risk of contaminating the retroperitoneum, however, this study should be performed immediately before surgical exploration.

2. Treatment

depends on whether the injury is recognized immediately or after some period of delay.

a. **Immediate recognition.** Injuries diagnosed within a few days should generally be treated with surgical exploration. Sepsis, abscess formation, and other injuries or medical problems may delay surgical exploration. Debridement and primary anastomosis should be performed whenever possible. Injuries involving the lower third of the ureter can generally be managed by reimplantation into the bladder, with or without the use of a bladder flap or psoas hitch. An internal stent should be provided until healing is complete (usually 3 to 4 weeks). At that time, the stent can be removed via cystoscopy.

b. **Delayed recognition.** In instances of delayed recognition, the presence of infection usually prevents primary reconstruction; urinary diversion by percutaneous nephrostomy and drainage of any urinary collection are the initial steps. Reconstructive surgery is undertaken after the hydronephrosis and infection have resolved.

3. Complications of ureteral injury

include ureteral stricture, retroperitoneal fibrosis, pyelonephritis, and ureterocutaneous fistula.

B. Ureteral calculi

may cause semiemergent situations regarding management of ureteral obstruction and pain. These are discussed in Chapter 14.

IV. Bladder

A. Trauma.

The bladder normally is protected from injury by the bony pelvis; however, the bladder and/or the urethra are frequently injured when the pelvis is fractured. Severe blunt trauma to the lower abdomen may result in bladder rupture if the bladder is filled at the time of trauma. Penetrating trauma to the bladder may occur by the same mechanisms as to the ureter (see preceding discussion).

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1. Classification

a. **Contusion** involves injury to the bladder wall, resulting in hematuria and perivesical hematoma with no extravasation of urine demonstrated.

b. **Extraperitoneal rupture.** In this injury, the lateral wall or floor of the bladder is

ruptured, leading to extravasation of urine into the pelvis and retroperitoneum. This type of injury accounts for approximately 50% of all bladder ruptures and is almost always associated with pelvic fracture. Conversely, approximately 15% of patients with pelvic fracture have bladder rupture.

c. **Intraperitoneal rupture** usually involves bladder rupture at the dome, leading to intraperitoneal extravasation of urine. This type of injury is almost always caused by blunt trauma to the lower abdomen and is often seen in intoxicated patients who fall with a full bladder or are involved in a motor vehicle accident.

d. **Spontaneous rupture.** Rarely, the bladder ruptures without external trauma, usually indicating underlying pathology such as bladder tumor.

2. Diagnosis.

Acute bladder trauma rarely produces specific symptoms or signs. Extraperitoneal rupture is characterized by the presence of contrast agent outside the bladder in the pelvis and paracolic areas. The bladder may assume a “teardrop” appearance during compression by a pelvic hematoma. Intraperitoneal rupture is characterized by the presence of contrast agent in the peritoneal cavity, outlining loops of small bowel. A small number of patients may have both kinds of injury. Even if bladder trauma is demonstrated by cystography, all trauma patients with hematuria should undergo IVU.

3. Treatment

in almost all patients with bladder trauma involves exploration, debridement, surgical repair, drainage of the perivesical space, and diversion of urine, usually by a suprapubic catheter. Following repair, a low-pressure cystogram should be obtained to assess the integrity of the bladder before the catheter is removed.

a. **Extraperitoneal rupture.** Many patients may be successfully treated by **urethral catheter** drainage alone, provided that (a) only a minor degree of extraperitoneal extravasation is present, (b) there is no evidence of infected urine, and (c) the patient is carefully monitored for the development of clot retention and infected pelvic hematoma. However, all patients with significant extraperitoneal extravasation should undergo exploration. Extraperitoneal rupture of the bladder from blunt trauma usually is repaired transvesically.

b. **Intraperitoneal rupture** requires a transperitoneal approach to rule out associated injuries and to permit removal of extravasated urine from the peritoneal cavity. With penetrating trauma, concomitant injury to the rectum, iliac vessels, or ureters should be ruled out during surgical exploration.

4. Complications of bladder injury

include cystitis, sepsis, pelvic collection, nephrogenic adenoma, and vesicovaginal fistula.

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B. Urinary retention

1. Diagnosis.

The most common causes are prostatic enlargement or cancer, prostatitis or abscess, prostatic infarction, urethral stricture, blood clots, medications, and neuropathic and psychogenic conditions. The history should include the voiding pattern before retention, past urologic surgery, and medications with anticholinergic side effects, especially common cold remedies containing nasal decongestants and antihistaminic compounds. The physical examination should focus on the suprapubic area to determine whether a distended bladder can be palpated or percussed. In most cases, pressure on the bladder during the examination will produce discomfort or pain. With long-standing chronic retention, the patient feels no discomfort from pressure on the distended bladder. A rectal examination should be performed to determine the size of the prostate and possible presence of prostatic abscess.

2. Treatment.

Placement of a Foley catheter, if possible, is the treatment of choice. In many cases, this can be made difficult by the presence of urethral stricture, prostate enlargement, or prostate cancer. The basic aspects of urethral catheterization are discussed in Chapter 5. **Percutaneous suprapubic cystotomy** should be performed in cases ofimpassable urethral stricture or prostatic obstruction. *The bladder must be full to perform this safely.* The presence of prior surgical scars in the suprapubic area is a contraindication to blind cystotomy since bowel may be adherent in the space of Retzius. It is much safer in such cases to use US guidance to avoid bowel injury. If in doubt about the bladder location, use a long spinal needle to aspirate urine from the bladder and determine its location. Mark the depth on the spinal needle, and make a mental note of it. Infiltrate local anesthetic (1% or 2% lidocaine) at a spot one finger-breadth above the symphysis pubis. Many different varieties of trocar catheters sets are available (Fig. 11.2). Insert the trocar through a small incision made with a no. 11 knife blade through the skin and the anterior rectus fascia. Keep in the midline, stay perpendicular to the skin, and make a short, quick stab into the bladder. Balloon catheters are the best means of securing the catheter in the bladder. Secure the catheter with a stitch to the skin.

Fig. 11.2. Percutaneous suprapubic cystostomy catheter consisting of a balloon retention catheter and trocar stylet.

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V. Urethra

A. Difficult catheterization.

The difficult urethral catheterization is a common clinical problem. A frequent cause is spasm of the external sphincter, followed by urethral stricture and then bladder neck contracture. Prostatic enlargement rarely prevents the passage of a catheter, as the prostate lobes are easily pushed aside by the catheter, especially one with a 22F diameter. If the patient is known or suspected to have urethral stricture, retrograde urethrography should be carried out to assess the urethra (see Chapter 2). If this shows a clearly impassable stricture, percutaneous suprapubic cystotomy should be performed for temporary relief of urinary retention. If no stricture is evident, a coude catheter should be tried—a maneuver that is often successful in negotiating a prominent bladder neck. The coude catheter should be oriented with the tip pointing anteriorly during passage.

1. Flexible cystoscopy

is the safest maneuver if initial attempts to pass a catheter are unsuccessful. This allows direct visualization of the urethral lumen. If a stricture is seen and a lumen through the stricture is visible, a guide wire can usually be passed through the cystoscope into the bladder. Dilators can be passed over the guide wire. After the stricture is dilated, place a well-lubricated Councill catheter over the guide wire into the bladder. After irrigating the catheter to be certain it is in the bladder, inflate the catheter balloon (to at least 15 mL) and withdraw the guide wire.

2. Filiforms and followers

may be used if no flexible cystoscope is available. Filiforms are narrow, solid catheters with various configurations at the tip (see Chapter 5). They are sometimes successful in bypassing urethral strictures and false passages. With adequate lubrication, the filiform is passed gently until it meets resistance in the urethra. The first filiform is left in place, and another one is passed adjacent to it. If it fails to pass, a third or fourth one can be passed. By trying each filiform in turn, one hopes that one of them will enter the urethral lumen and pass into the bladder. If this happens, the other filiforms should be removed, and a small 8 or 10F follower should be screwed on. The follower then follows the filiform into the bladder, where it curls upon itself. After passing the first follower, it is withdrawn to the meatus and unscrewed from the filiform, and the next size follower is screwed on and passed into the bladder. This process is repeated until the stricture or urethra is adequately dilated. A Councill catheter with screw-tip stylet can be screwed onto the filiform and passed into the bladder.

B. Periurethral abscess.

Periurethral abscess usually results from spontaneous rupture of a urethral abscess caused by urethral stricture. The purulent collection may present in the perineum as a warm, tender, erythematous, sometimes fluctuant mass. If the abscess has drained spontaneously, purulent material can be expressed. Diagnosis consists of retrograde urethrography to demonstrate patency of the urethra and any fistulous connection between the urethra and abscess cavity. The purulent drainage should be examined for acid-fast bacilli and cultured. Treatment consists of surgical incision and drainage

with diversion of the urine by Foley catheter or, preferably, by percutaneous cystostomy. Urethral injuries in male patients are usually divided into those involving the anterior portion (penile and bulbous urethra) and those involving the posterior portion (membranous and prostatic urethra).

C. Urethral trauma

1. Anterior urethral injury

occurs most often as a result of blunt trauma suffered during straddle-type falls in which the urethra is crushed against the pubic bones. If the urethra remains intact, the injury is a urethral contusion, whereas the presence of extravasation implies urethral laceration.

2. Posterior urethral injuries

are usually associated with **pelvic fractures.** Most severe pelvic fractures are associated with motor vehicle accidents, especially a pedestrian being struck by a vehicle. The incidence of urethral injury in pelvic fracture cases is 5% to 10% in males and 1% to 5% in females. The risk of urethral injury associated with a traumatic pelvic fracture is also dependent on the type of fracture. The more severe the fracture of the pelvis, the higher risk of urethral injury exists. Owing to the major force necessary to fracture the pelvis, the prostate is displaced upward and the urethra may be stretched, partially ruptured, or completely ruptured at the bulbomembranous junction. Disruption of the periprostatic venous plexus as well as bleeding from the bony fragments often result in a large pelvic hematoma. **Classification of posterior urethral injuries** in males consists of type I (stretch injury with intact urethra, type II (partial tear but some continuity remains), and type III (complete tear with no evidence of continuity) (Fig. 11.3). Type I is rare. Type II constitutes about 25% of injuries, and Type III constitutes about 75%. In women, partial rupture at the anterior position is the most common urethral injury associated with pelvic fracture.

Fig. 11.3. Classification of posterior urethral injuries.

3. Diagnosis

a. **Anterior urethral injuries.** The patient gives a history of trauma to the perineum followed by perineal pain and inability to void. Almost always, a bloody urethral discharge is present. The bulbous urethra is extremely vascular, and both blood and urine will extravasate if the urethra is lacerated. This injury results in a characteristic ecchymosis, in which the pattern depends on the fascial planes of the genitalia and perineum. If Buck's fascia is not ruptured, the ecchymosis is limited to the penis. If Buck's fascia is ruptured, the extent of the ecchymosis is limited by Colles' fascia in the perineum and by Scarpa's fascia in the abdomen. This injury results in a

"butterfly" ecchymosis in the perineum with possible extension along the anterior abdominal wall up to the clavicles.

b. **Posterior urethral injuries**

1. **Symptoms.** The patient presents with suspected pelvic fracture and inability to void. Most patients have bloody urethral discharge. Inability to void may, of course, be caused by pain or hypovolemia. With partial rupture, voiding may be normal, but the urine is usually bloody. Although blood at the meatus or gross hematuria is the most reliable indicator of urethral injury, the amount of

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urethral bleeding correlates poorly with the severity of injury. In women, urethral injury should be suspected when pelvic fracture, vaginal bleeding, and inability to void are present. Labial edema after pelvic trauma may represent urinary extravasation.

2. **Physical examination** may reveal malrotation of the hemipelvis or shortening of a leg without long bone fracture. Abdominal examination may reveal suprapubic fullness or dullness due to a pelvic hematoma. In contrast to anterior urethral injuries, posterior urethral injuries in men are not characterized by perineal ecchymosis. There may be hematoma or swelling in the perianal area if the pelvic hematoma enters the ischiorectal fossa. Rectal examination is mandatory to determine the presence of rectal injury. The finding of a boggy, indistinct mass on digital rectal examination is often assumed to indicate that the prostate has been displaced upward. This can be misleading because of obliteration of perirectal planes by the pelvic hematoma. Diagnosis of a "high-riding" prostate is difficult by physical examination and is best appreciated by CT scan or other x-ray study. The gland is still not far from its normal position. Displacement of the prostate may indicate complete transection of the posterior urethra. In women, vaginal examination should be performed using a clear plastic speculum to look for any vaginal laceration or tear.

3. **Radiologic studies.** Regardless of the presence or absence of bloody urethral discharge, retrograde urethrography (Chapter 2) should be the initial study in all male patients with pelvic fracture (Fig. 11.4). Retrograde urethrography is usually performed with the patient in the 45-degree oblique position and the penis stretched perpendicular to the femur. However, in trauma patients, it may not be feasible to situate the patient obliquely, and urethrography may need to be performed with the patient supine and the penis stretched to one side. Retrograde urethrography is quite accurate in diagnosing the presence and type of urethral disruption. Extravasation of contrast medium with no contrast agent visible in the bladder and proximal urethra is diagnostic of complete urethral disruption (although lack of proximal filling may be due to external sphincter spasm). Extravasation with partial filling of the proximal urethra and bladder is diagnostic of partial disruption. Lack of extravasation with displacement of the prostate upward is diagnostic of stretch injury to the

posterior urethra. In women, urethrography is less reliable than endoscopy as a means of diagnosing urethral injury.

Fig. 11.4. Evaluation of the patient with pelvic fracture and suspected urethral injury.

4. **Instrumentation** of the urethra may convert a partial urethral tear into a complete transection and may introduce infection into the pelvic hematoma. This is especially true if a Foley-type catheter is used and the balloon is distended at the site of the rupture. Catheterization should not be attempted until after a negative retrograde urethrogram is obtained.

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4. Treatment

a. **Anterior urethral contusion** may be treated nonoperatively. If the patient is able to void without significant hematuria, no treatment is needed. If there is significant bleeding, urethral catheterization for several days is usually sufficient.

b. **Anterior urethral laceration** is best treated by diverting the urine by suprapubic cystotomy (open or percutaneous). In the absence of significant extravasation, conservative treatment will result in spontaneous healing in most cases, although surgical repair may be considered in the acute setting or if warranted by the clinical situation. In patients in whom a urethral stricture develops, this complication can almost always be treated in a delayed fashion successfully by endoscopic means. In the presence of perineal or scrotal hematoma, drainage of the extravasated urine and blood may be indicated in addition to suprapubic drainage.

c. **Posterior urethral injury in the male.** Stretch injury (type I) and incomplete urethral tears (type II) are best treated by stenting with a urethral catheter. The case with complete rupture remains a difficult problem because the patient is at varying risk of urethral stricture, urinary incontinence, and erectile dysfunction (ED) (Table 11.4).

Table 11.4. Complication rate (%) according to treatment of urethral injury

Complication	Suprapubic Cystotomy	Primary Realignment	Primary Repair

Stricture	95	50	50
Incontinence	5	5	20
Erectile dysfunction	20	35	55

Source: Modified from Koraitim MM. *J Urol* 1999;161:1433–1441.

1. Historically, **primary anastomosis** at the time of injury was the earliest treatment modality attempted in posterior urethral rupture. Exploration of the injury site may release the pelvic hematoma, resulting in significant blood loss and making repair difficult. Dissection in the area of the prostatic apex increases the risk of injuring the neurovascular bundles and producing ED. Some have advocated initial management with suprapubic cystotomy and attempting primary repair at 7 to 10 days after injury. This modality results in a stricture rate of about 50% but the highest rate of ED.
2. **Primary realignment** involves opposing the torn ends of the urethra over a catheter with concomitant suprapubic cystostomy. Various techniques have been used to manipulate the catheter across the urethral gap during repair, including catheter placement under direct vision and sound-to-sound techniques. The urethral catheter is left indwelling for 6 to 8 weeks. Follow-up

studies may be obtained through the suprapubic tube. The major disadvantage of primary realignment is the increased risk of ED.

3. **Suprapubic diversion with delayed repair** carries the lowest risk of ED but the highest risk of stricture (Table 11.4). Because stricture is considered to have less of an impact on quality of life than ED, most practitioners favor this approach. With this method, no attempt is made to explore or manipulate the urethra at the time of injury. The urine is diverted with a suprapubic tube introduced through a small suprapubic incision or by trocar. This modality accepts the inevitability of stricture formation following complete urethral rupture, which can be repaired electively. If the injury is overstaged and is actually a partial tear, spontaneous voiding through the urethra may be noted

1 to 2 weeks after injury.

4. **Endourologic techniques** may allow primary alignment without the risk of surgical exploration of the disrupted urethra. A flexible cystoscope is passed through the suprapubic tract to visualize and enter the vesical neck. A guide wire or 4F ureteral catheter is passed antegrade through the cystoscope; it is hoped that the urethral gap can be bridged and the wire or catheter will exit through the meatus. An indwelling catheter can be passed into the bladder over the guide wire. Endoscopic alignment may be performed anytime during the first 2 weeks after injury. Although encouraging, experience with these techniques is still limited.

d. **Urethral injury in the female.** The level of injury (proximal or distal) has major implications for treatment. **Rupture of the distal urethra** is not associated with increased risk of incontinence. Thus, transvaginal surgery to reconstruct the external meatus is recommended. Because **proximal urethral injury** in the female has major implications for continence, diversion and delayed repair as performed in the male patient are not advised. The patient should undergo immediate retropubic exploration with realignment of the urethra and end-to-end anastomosis over a stenting urethral catheter. Any vaginal laceration should be repaired to reduce the risk of urethrovaginal fistula.

VI. Penile trauma and emergencies

A. Trauma to the penis

may occur from gunshot wounds, stab wounds, machinery accidents, animal attacks, and self-mutilation. Penetrating injury to the penis is managed by debridement, hemostasis, and repair of the injured tissue along with systemic antibiotic therapy. Machinery accidents may result in partial or total avulsion of the genital skin. Such injuries require careful debridement and skin grafting. Urethral continuity may need to be assessed by retrograde urethrography.

B. Spontaneous penile fracture

may occur during intercourse and result in rupture of the tunica albuginea of the corpora. Penile fracture typically occurs in young men (average age 30 years). The clinical signs and symptoms of penile fracture consist of sudden onset of sharp pain, swelling, ecchymosis,

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bloody urethral discharge, deviation of the penis away from the side of the injury, and spontaneous loss of erection during sexual intercourse. Penile fracture can occur anywhere on the shaft or at the base of the penis. Delayed presentation of penile fracture may mimic Peyronie's disease. Injury to the urethra may occur concomitantly and should be ruled out with a retrograde urethrogram. Sexual trauma may concomitantly produce rupture of the urethra or rupture of the testicles or suspensory ligaments of the penis. Injuries to the penile ligaments may present with abnormal angulation, deviation, or dislocation or as an

unstable erect penis. Most cases of penile fracture will require surgical exploration of the injury to debride devitalized tissue, evacuate hematoma, and close the defect in the tunica albuginea. We advocate a penoscrotal incision with eversion of the corporal bodies to gain access to the injury site.

C. Penile vascular injuries.

Sexual trauma to the superficial dorsal vein of the penis may result in thrombosis of the vein and present as painful erections, ecchymosis, and palpable thrombosed veins on the dorsal surface of the penis. Rupture of the deep dorsal vein of the penis may mimic fracture of the penis. **Traumatic lymphangitis** after intercourse may present as nodular, firm, circumferential swelling of the coronal sulcus. Patients with coagulopathy of any etiology are more prone to vascular injuries of the penis. **Frenular artery laceration** may occur during intercourse. For patients with tears in the frenular artery, the artery should be surgically ligated, and, if indicated, a circumcision should be performed.

D. Phimosis

is the inability to retract the foreskin of the penis. Chronic low-grade infection eventually leads to loss of elasticity and scarring of the foreskin. The patient usually complains of erythema, itching, or pain on intercourse. Most commonly, there is a mild associated infection (balanoposthitis), which should be treated with a broad-spectrum antibiotic such as tetracycline (250 mg four times daily by mouth). The phimosis is then treated electively by dorsal slit or circumcision. Rarely, the patient presents with tight phimosis and severe balanitis. Under these circumstances, semiemergent dorsal slit is indicated to promote drainage. Once the infection is controlled, elective circumcision can be performed. Very rarely, tight phimosis may present as a cause of urinary obstruction.

E. Paraphimosis

is a condition in which the foreskin becomes trapped in a retracted position behind the glans. Most commonly, this occurs in a patient with preexisting phimosis. With time, the entrapped foreskin becomes edematous, and the glans itself becomes engorged. Rarely, vascular insufficiency of the glans can occur. Treatment consists of firm compression of the glans to decrease edema and continuous traction on the foreskin, combined with counterpressure on the glans. Field block of the penis with 1% lidocaine (Xylocaine) is sometimes helpful. When this treatment is unsuccessful, incision of the constricting ring under local anesthesia should be performed. Once the inflammation and edema have subsided (3 to 4 days), elective circumcision is indicated.

F. Priapism

is characterized by persistent erection unrelated to sexual activity. It is discussed in Chapter 21.

VII. Scrotum

A. Trauma

to the scrotum is relatively rare. The peak incidence occurs in the 10- to 30-year age range. Embarrassment associated with the injury or its mechanism often results in delayed presentation. Physical examination should assess corporal integrity and look for blood at the meatus that may indicate urethral injury. Retrograde urethrography is warranted in suspected urethral injury. Color Doppler US imaging of the testes should be performed to assess integrity of the blood supply and the tunical coverings of the testes.

1. Antibiotic therapy

is indicated in injuries acquired in the field (e.g., farm, hunting, military related) and must be treated with clindamycin (900 mg IV/IM q8h) and penicillin (nafcillin 1 to 2 g IV q4h) to cover *Clostridium perfringens* and tetanus. Treatment of animal bites should cover *Streptococcus* sp and *Pasteurella multocida.* The antibiotic of choice is amoxicillin/clavulanate (500 to 875 mg PO bid).

2. Surgical therapy

a. **Scrotal avulsion** is managed by debridement and primary closure with absorbable sutures. The vascularity and elasticity of the scrotum allow closure of relatively large defects. Complete scrotal loss requires skin grafting.

b. **Blunt trauma** to the scrotum often involves testis injury as well. Dislocation of the testis can occur in blunt trauma and should be approached inguinally to obtain control of the spermatic cord. Testis tumors may present as scrotal hemorrhage after minor trauma.

c. **Penetrating trauma.** Low-velocity bullets and stab wounds to the scrotum require surgical exploration to determine testis viability. High-velocity missiles imply a higher risk of subsequent vascular thrombosis and tissue loss. Skin should be extensively debrided and drains used. With late necrosis, further debridement and wound care will be necessary.

B. Fournier's gangrene.

Described in 1883 by Jean-Alfred Fournier, a French venereologist, Fournier's gangrene is the sudden onset of fulminant gangrene of the external genitalia and perineum in an apparently healthy person. A form of necrotizing fasciitis, it usually begins in the scrotum or penis and may spread along fascial planes (beneath Scarpa's fascia) to the perineum and abdominal wall up to the axillas. Originally, the term “Fournier's gangrene” meant idiopathic gangrene of the genitalia; in modern usage, it has been applied to nonidiopathic cases of genital gangrene as well. A source can now be identified in 80% of cases (Table 11.5). It is common for patients to have predisposing systemic conditions such as alcoholism (50%) or diabetes (33%) (Table 11.6). The common denominator seems to be a depressed immune state, as both diabetes and alcoholism are known to impair the immune

system.

Table 11.5. Etiology of Fournier's gangrene

Colorectal source (30%)
Perianal gland infection
Ischiorectal abscess
Colonic diverticulitis
Appendicitis

Urogenital source (50%)
Bulbourethral gland infection
Periurethral abscess
Urethral stricture
Urinary tract infection

Skin source (20%)
Hidradenitis suppuritiva
Scrotal ulcer or lesion
Scrotal trauma

Table 11.6. Comorbidity associated with Fournier's gangrene

Diabetes mellitus
Morbid obesity
Cirrhosis of the liver
Malignancies
Drug and/or alcohol abuse
Malnutrition
HIV infection
Chronic steroid use

1. Diagnosis.

Fournier's gangrene presents suddenly with marked swelling and erythema of the genitalia,

fever, chills, and malaise. There may be a prodrome lasting 2 to 5 days. The mean duration of symptoms is 5 days. Physical examination is the cornerstone of diagnosis. Blistering of the scrotal or penile

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skin overlying a cellulitic area with yellow–brown fluid is pathognomonic of underlying necrotizing fasciitis. Crepitus may be elicited at this stage, and a feculent odor caused by anaerobes is usually present. If untreated, gangrenous sloughing soon ensues. The testes and spermatic cord are almost always spared.

a. **Radiology.** Plain film imaging may show moderate to large amounts of soft tissue gas or foreign bodies. US is sensitive for gas, but the need for pressure on the skin to perform the examination is a drawback. CT is very sensitive for gas in tissue and fluid collections. If a urethral source is suspected from a history of stricture or urethral instrumentation, a retrograde urethrogram is indicated.

b. **Physical examination.** Fever and tachycardia may be present. The skin may be erythematous, edematous, cyanotic, blistered, or frankly gangrenous. A feculent odor is quite characteristic secondary to infection with anaerobic bacteria. Crepitus may be present, but its absence does not exclude the presence of tissue gas. A thorough genital and perianal examination is required to detect potential

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portals of entry. If the rectal examination suggests a bowel source, proctoscopy should be performed.

c. **Microbiology.** Cultures reveal polymicrobial flora with gram-negative rods (*Escherichia coli, Pseudomonas* sp, and *Klebsiella* sp), gram-positive cocci (β-hemolytic streptococci, *Staphylococcus aureus*, and *Enterococcus*), and anaerobes (*Bacteroides fragilis, C. perfringens*).

2. Treatment.

The basic tenets of management include the following:

a. **Radical debridement** of all necrotic and gangrenous tissue must be performed emergently. The testicles are often spared from necrosis. The exposed testicles may be placed in a subcutaneous pocket in the thigh to protect them. If a testicle is involved, orchiectomy should be performed.

b. Blisters and abscess cavities not included in the initial debridement are **incised and drained.**

c. **Intravenous broad-spectrum antibiotics** designed to cover both aerobic and anaerobic organisms are administered, followed by more specific therapy once the results of culture are obtained. We use a regimen of 12 g of piperacillin/1.5 g of tazobactam IV for 7 to 10 days in divided doses of 3.375 g q6h, 80 mg of gentamicin IV q8h, and 600 to 1,200 mg/day divided q6–8h of clindamycin IV/IM. As an

alternative to clindamycin, 500 mg of metronidazole IV can be given every 8 hours.

d. **Supportive measures**

1. **Hyperbaric oxygen therapy** in patients with extensive anaerobic infection has been tried with mixed results.

2. **Cystostomy or colostomy** may be required for temporary diversion in patients with periurethral or perirectal suppuration.

3. **Systemic corticosteroids** have been found to be useful in isolated cases unresponsive to standard measures.

4. **Wound care** following debridement involves application of wet-to-dry saline dressings for local debridement.

5. **Delayed split-thickness skin grafting** of denuded genitals is sometimes required. In most cases, remaining scrotal skin can be mobilized to cover the testicles.

6. **Prognosis.** Despite extensive therapeutic measures, the overall mortality approaches 30%, which stresses the need for prompt diagnosis and early treatment of this condition. Common postoperative complications include prolonged sepsis, coagulopathy, and pulmonary insufficiency.

VIII. Testis trauma and emergencies

A. Trauma.

Injuries to the testes typically occur in young men, usually aged 15 to 40 years. Blunt trauma accounts for about 85% of cases. The most common cause of blunt trauma is sports injuries, followed by kicks to the groin. Less common etiologies of blunt testicular trauma include motor vehicle accidents, falls, and straddle injuries. The most common cause of penetrating testicular injuries is a gunshot wound. Severe blunt trauma to

the testis may result in testicular rupture. The testis may also rupture spontaneously or with minimal trauma if underlying pathology, especially carcinoma, is present. Following rupture of the tunica albuginea, there is considerable bleeding into the space around the testis, resulting in a hematoma.

1. Diagnosis.

The patient usually presents with a fairly clear history of blunt trauma to the scrotum often associated with nausea and vomiting. For penetrating injuries, determine the entrance and exit sites of the projectile. Carefully examine the contralateral side, the perineum, the rectum, and the femoral vessels. On physical examination, there is a tender, swollen scrotal mass that does not transilluminate. Scrotal or perineal ecchymosis may be present. US should be performed to delineate the injury.

2. Treatment

depends on the degree of trauma and extent of the hematoma. When there is little or no trauma, an underlying carcinoma should be suspected, and the patient should undergo testis exploration by the inguinal approach. Patients with severe trauma and bleeding should undergo scrotal exploration and repair of the testis, if possible. Shattered testis is best treated with orchiectomy. Patients in whom there is a clear history of trauma but minimal hematoma formation may be treated conservatively with analgesics, elevation, and ice packs applied to the scrotum.

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