CHAPTER 31
Urogenital and Perineal Trauma

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Introduction

Trauma is a leading cause of death in children in developed countries.[1,2] In Africa, as in many developing countries where malnutrition and infectious diseases are leading causes of death in children, trauma may not be encountered as often by the surgeon. As developing countries improve the general health care of children with better nutrition and control of infectious disease vectors, however, trauma is becoming a leading cause of death in children in Africa. This is largely due to the rise of high-speed motor vehicle travel and increasing traffic congestion along poorly developed transportation routes. Most areas lack emergency response systems with trained personnel, adequate emergency transport vehicles, and avenues for medical evacuation to higher echelons of care, which are critical to the survival and decreased morbidity. Dilapidated vehicles traveling on these roads often add to the burden of trauma in these regions.[3] Many of these young trauma victims arrive to the surgeon a long time after injury, so the surgeon operating in developing countries must be prepared to quickly and accurately evaluate and manage these youngsters in order to save lives and decrease morbidity from urinary tract injuries.[4]

The urogenital tract is involved in up to 12% of children with abdominal and pelvic trauma.[1] The same mechanisms causing injury to the urinary and genital systems also frequently involve the perineum and challenge the surgeon who is attempting to evaluate the extent of injury. After conducting the primary survey and instituting resuscitative measures, the surgeon will need to employ diagnostic imaging studies to evaluate and identify the urological injuries that can be managed nonoperatively. Advances in radiological imaging have led to a greatly decreased number of unwarranted exploratory operations because some of these patients can be managed nonoperatively.[5] In settings with limited facilities, the use of a simple protocol in children with blunt abdominal trauma could lead to a reduction in laparotomy and mortality rates.[3]

Aetiology and Mechanism of Injury

Injury to the urogenital tract results from either blunt or penetrating trauma. Blunt trauma accounts for more than 98% of injuries to the urogenital tract, and penetrating trauma occurs in less than 2%.[1,2] There are many different mechanisms of injury to the urinary tract; in Africa, the majority of these injuries occur as a result of motor vehicular accidents. Most accidents occur on poorly maintained roads with minimal emergency response capability.[3] The aetiology of urogenital trauma can be divided into blunt and penetrating causes and regions of involvement (renal, ureteral, bladder, urethral, genital, and gonadal).

Blunt

Blunt injuries in Africa commonly are caused by motor vehicle and traffic accidents, falls from heights, and direct blows to the abdomen or perineum from child abuse, sports injuries, and straddle accidents.

Penetrating

Penetrating injuries in Africa are commonly due to gunshots, stab wounds from a knife or other sharp object, machete hacking, or foreign body insertion into the urethra. Medical procedure–related penetrating injuries include catheter trauma (i.e., urethral disruption from balloon inflation inside the urethra or creation of a false passage), penile surgery (especially circumcision), and surgeries of the retroperitoneum, pelvis, and anorectal area (e.g., posterior sagittal anorectoplasty).

With increasing violence in many parts of urban Africa, urogenital tract trauma from high-velocity gunshot wounds and use of sharp objects in children are likely to increase. The ability to provide early and rapid treatment to victims in war-torn regions may be severely limited due to the remote locations and transportation difficulties. Domestic violence also must be remembered as a significant cause of paediatric trauma, which may be from sexual abuse (usually penetrating injury) or use of blunt force.

Evaluation

To avoid serious long-term complications, significant urogenital tract injuries in children must be appropriately and promptly managed. Improper or inadequate treatment may have a long-term disabling effect on these children and condemn a child to lifelong urological disability. The initial approach to the child with any urogenital tract injury is identifying life-threatening conditions and applying the ABCDE's of resuscitation. These include identification and control of any airway obstruction, breathing problems, control of the circulatory system, management of other life-threatening (usually neurological) disabilities, and control of potentially lethal environmental threats (exposure). Once these priorities are addressed, then the assessment and subsequent management of the urogenital tract injuries follows.

History

A detailed history after resuscitation includes the description of the accident scene and mechanism of injury. One should strongly suspect urogenital tract involvement in any sudden deceleration accident with anuria, penetrating flank injury, urethral bleeding, or gross haematuria. In penetrating injuries, the type and calibre of the missile or weapon must be determined. It should be noted that, due to the kinetic properties of high-velocity injuries, one must suspect a much more extensive injury than appears on the surface.

The paediatric patient's medical history must also be known. Certain congenital or acquired conditions of the urinary tract are predisposed to injury. Congenital hydronephrosis from pelvi-ureteric or uretero-vesical junction obstruction may cause the kidney to rupture with a sudden deceleration accident. Urethral obstruction from posterior urethral valves or urethral stricture may result in bladder distention and increase the risk of bladder rupture after blunt force trauma. Other conditions, such as urinary tract calculi or a history of urinary infections (e.g., schistosomiasis/bilharziasis), may complicate the management of these patients.

Physical Findings

After the initial quick primary general assessment, the abdomen and genitalia are examined, looking for evidence of contusion or subcutaneous haematoma, which may point to serious internal injuries to the retroperitoneum or pelvic fractures. Several important points should be

noted when examining a child with suspected urogenital tract injuries:

1. Abdominal flank tenderness or bruising and lower rib fractures may suggest renal injury (Figure 31.1), although one-quarter of children with severe renal injuries may not have abdominal examination findings; therefore, a high index of suspicion and further evaluation are needed to make an accurate diagnosis.[1,2]

Figure 31.1: Patient with flank haematoma found to have fractured kidney.

2. Swelling or ecchymosis in the perineum as well as lacerations or bleeding are suggestive of urinary tract injuries, so a patient with any or a combination of the above should be further evaluated to determine the exact part of the urinary tract that is injured.

3. The presence of blood at the external urethral meatus may be the only indicator of a urethral injury. Another sinister sign is upward displacement of the prostate in boys on digital rectal examination. This physical finding may be very difficult to interpret in a child, but must be investigated further due to the risk of posterior urethral disruption.

Investigations

The suspicion of urinary tract injury on history and physical examination warrants additional investigations to accurately determine the site and extent of the injury for proper treatment and good outcome. These investigations are divided into laboratory studies and imaging studies.

Laboratory Studies

Laboratory studies supplement clinical history, good physical examination, and imaging techniques. The results of these studies, when interpreted well, would be very helpful to surgeons practicing in Africa because most of the advanced imaging techniques are unavailable in many centres, or even unaffordable in places where they are available. These investigations include a complete blood count; urinalysis; serum levels of electrolytes and urea, creatinine, and amylase; and liver function tests. The results of these laboratory investigations must be interpreted in line with the general condition of the patient. For instance, in a patient with intraperitoneal bladder rupture, the serum urea may be markedly elevated, whereas the creatinine may be normal due to the absorption of urea by the peritoneum.

Urethral catheterisation may be required to obtain an accurate urinalysis, and a clean, appropriate-sized urethral catheter should be passed gently into the bladder under aseptic conditions. This is done only when there is no blood at the urethral meatus, or gross haematuria. The presence of blood in the urine after passing the urethral catheter indicates urinary tract injury.

Imaging Studies

Abdominal and pelvic plain film x-ray

A plain film x-ray is done routinely for all abdominal and pelvic trauma, especially if intravenous contrast is to be given. This film should identify the presence and nature of bony injury, foreign bodies, and stones, and should strengthen the suspicion of bladder and urethral injury.

Abdominal/pelvic ultrasound

Ultrasound is readily available in many centres in Africa, is less expensive than many other imaging modalities, and can be readily used by the consulting surgeon. This can be done to evaluate injuries to the retroperitoneal organs, such as the kidney and bladder. It can also be a useful tool in assessing injuries to other organs in the abdomen and pelvis.

Urethrocystography

Urethrocystography is a very useful investigation, especially in Africa, because most radiological services are able to obtain plain film radiographs necessary for this investigation. It is done by the passage of a small-size catheter into the urethral meatus and held in place by inflating the balloon by with 1–2 ml of sterile water.

The patient is placed in the oblique position, and, if the patient is a male, the penis is placed on stretch. A water-soluble contrast is then injected and the retrograde urethrogram is done. This outlines the urethra, giving a diagnosis of the type of urethral trauma, if present. If the urethra is uninjured but a bladder injury is suspected, the catheter is advanced into the bladder and then filled with a water-soluble contrast. In children, the bladder should be filled to at least 50% of expected bladder capacity, calculated by

$$EBC\ (\text{ml}) = (age + 2) \times 30.$$

In adolescents or older children, fill with at least 350 to 400 ml for an adequate study to be done. If possible, have the patient void and capture an antegrade voiding view of the urethra. To be complete, a postvoid view of the bladder must be obtained. If the patient is unable to void, drain the bladder and take a second film.

Urethrocystoscopy

Paediatric-sized fibre-optic cystoscopes are becoming increasingly available in most tertiary centres in Africa, and these scopes can be used to diagnose and manage some urethral and bladder injuries. In certain types of urethral injuries, this may enable the surgeon to pass a wire beyond the injury and then place a catheter over the wire.

Intravenous urography

In intravenous urography (IVU), urografin, or other water-soluble contrast is given intravenously and serial abdominal films are taken at 30 seconds, and at 1, 5, and 10 minutes. If there is delay in uptake of the contrast by the kidneys, then delayed images should be obtained at 30, 60, 120, or 180 minutes, if necessary. In an urgent scenario, where the child is taken to the operating theater for exploratory laparotomy, an "on-the-table", two-shot IVU can be done by obtaining a plain film, followed by a 2-ml/kg bolus of intravenous contrast, and then imaging at 10 minutes. This evaluates renal and ureteral injuries. Bladder injuries also can be evaluated on the cystogram phase (although imprecise).

Computed tomography scan

Computed tomography (CT) is rapidly becoming available in most tertiary centres throughout Africa and is extremely useful in evaluating urinary tract injuries. Cost is a major drawback of this investigation, but as medical insurance becomes readily available to patients, CT scans are becoming more widely used. Another limitation of the use of CT in the paediatric population is the large amount of ionising radiation children receive if they require serial scanning. CT is the most accurate imaging modality for the evaluation of renal trauma and has several advantages over IVU by virtue of its three-dimensional imaging capability and exceptional anatomical clarity. CT cystography is a very

reliable method for staging bladder injuries and can be used in place of plain film cystography. Obtain CT images before contrast is given, at bladder capacity, and after the bladder is drained.

Renal scintigraphy

Nuclear renography is not readily available in most centres across Africa because of the requirement for a radiation physicist and/or nuclear radiographic pharmacist. It has almost no role in the immediate evaluation of patients with urinary trauma. Nevertheless, nuclear scintigraphy can identify the presence or absence of a functional renal unit. Scanning a trauma patient is cumbersome and yields no additional anatomical details; therefore, CT scans are the preferred imaging modality in almost every case of acute trauma. In the chronic, posttraumatic recovery phase, it may have a role to monitor differential renal function or to assess the degree of obstruction if used with furosemide (diuretic renography).

Renal angiography and interventional radiography

This imaging modality is limited to institutions where an interventional radiologist is present and where digital, multiplanar fluoroscopy is available. Most developing countries do not have access to this complex and expensive technology. However, where present, it is very useful to determine the extent of renal vascular injury and also provide an opportunity for the interventional radiologist to access actively bleeding sites within the kidney and embolise them. Arteriography is useful in nonoperative management of major renal trauma because up to 25% of complex renal injuries may have delayed bleeding. Selective embolisation is 80% effective in treating posttraumatic arteriovenous malformations or pseudoaneurysms. Interventional radiologists can also percutaneously access and drain an obstructed kidney or abdominal/pelvic fluid collection.

Retrograde pyelography

Retrograde pyelography is done during urethrocystoscopy, when the ureteric orifices are catheterised and a soluble contrast injected. It is used to confirm ureteric injuries.

Kidney Trauma

Renal injuries account for 30–70% of all urogenital tract injuries in children.[1,2] There is a higher incidence of renal injuries in children compared to adults because of several anatomical reasons. The kidney in the child is proportionately larger and more mobile than that of the adult; the abdominal wall and retroperitoneal fat in the child give little or no protection to the kidney; and foetal lobulation may initiate cleavage planes after even minor trauma to the child's abdomen. Certain conditions predispose children to renal injury, including congenital hydronephrosis, multicystic kidney, renal tumours (e.g., Wilms' tumour), duplication or fusion anomalies of the kidney, and compensatory hypertrophy (solitary kidney).

Blunt trauma is responsible for up to 80% of the injuries.[2] Direct trauma crushes the kidneys against the lumbar spine or paravertebral muscles. Indirect acceleration-deceleration injury, when applied to the kidney, may disrupt the ureteropelvic junction.

Renal injury may be classified as minor, major, or complex.

1. Minor injuries account for 85% of renal injuries and include contusions, subcapsular haematoma, and superficial lacerations. There is parenchymal damage without capsular tears or pelvicalyceal system involvement.

2. Major injuries account for 10% of renal injuries. There is cortical laceration, deep parenchymal laceration involving the collecting system with limited extravasation.

3. Complex injuries account for 5% of renal injuries. They include rupture of a solitary or malformed kidney, kidney fragmentation, significant renal vascular injury, or rupture of the renal pelvis or ureter.

Management of Renal Injuries

The management of renal injuries in a child depends on the stability of the child and the extent of injury sustained by the child. It is, however, pertinent to define the goals of management of renal injuries in children. These goals are to preserve renal tissue and function and to minimise morbidity.

Following careful imaging and stratification of the renal injury, children are either managed nonoperatively (i.e., expectantly) or operatively. Whichever management option is chosen, it is important to bear in mind the goals of management stated above.

Minor Injuries

There is little controversy over the management of minor renal injuries. Most cases are managed nonoperatively with the expectation that complete renal tissue will be preserved and full renal function will return. Microscopic haematuria in a stable child with a renal contusion would not require hospitalisation of the child, but that child's activity should be restricted until the haematuria clears. Gross haematuria would, however, require strict bed rest in hospital. Ambulation starts when the haematuria clears. If the haematuria persists, then IVU or contrast enhanced CT is done and bed rest continued. If the bleeding is due to small-calibre renal vessels, angiography with embolisation is done if facilities are available. In Africa, where interventional radiology facilities for embolisation are not routinely available, expectant management is usually the preferred management.[4] If bleeding persists, however, then open laparotomy with direct repair of bleeding sites is done. A follow-up ultrasound or CT scan is then done 6–8 weeks later. Renal scintigraphy, where available, or IVU in many centres in Africa, is done to assess renal function. The blood pressure is monitored at each clinic follow-up.

Major Injuries

Children with major renal injuries pose a significant challenge to the surgeon in Africa. In children whose vital signs are stable, either immediate or delayed surgery is employed, depending on the circumstances.

Early or immediate surgery

As a general rule, if the vital signs of the child with major renal injury are unstable, an expanding flank mass is present, and the haematocrit is decreasing, then renal vascular injury is likely and immediate operative intervention should be carried out. The only absolute indication for early surgery is haemodynamic instability. Because most complex renal injuries in children are associated with hypotension, bleeding, and other organ injury, almost all require exploration if the goals of management are to be achieved. Early operation may also decrease the incidence of morbidity such as abscesses, sepsis, and intestinal ileus. Early operation also reduces the duration (and cost) of the hospital stay, which is important to practitioners in Africa, as a short hospital stay means there would be bed space available for other patients. Early operation also reduces the incidence of postoperative hypertension.

McAninch[6] has described a transabdominal approach to gain early access to the renal pedicle before mobilising the overlying colon laterally and entering the Gerota's fascia of the injured kidney. This method resulted in a higher renal salvage rate due to better vascular control and less bleeding. An incision is made through the posterior peritoneum and base of the mesentery immediately on top of the aorta; the inferior mesenteric vein is used to guide the surgeon to the site of incision on the aorta. Through this more medial incision, the renal vessels are readily identified (compared to a lateral approach through the bed of the injured kidney) and secured with a temporary Rommel tourniquet or bulldog clamp. The colon can then be reflected and Gerota's fascia entered in a more controlled fashion.

Nonoperative or delayed management

Proponents of nonoperative management of major renal injuries argue that no controlled trials have conclusively shown a benefit of early

surgery.[5,6,7] In fact, with a delayed approach, the risk of early nephrectomy is avoided. However, delayed surgery is necessary in up to 13% of cases.[1,2] Nonoperative management is generally favoured in children with major blunt renal trauma, except in the presence of haemodynamic instability.[7,8] Central to the nonoperative management of renal and other solid organ trauma is the use of serial CT scanning. Operative management should not be overdelayed, however, due to the general unavailability of CT scanners in most hospitals in Africa.[4]

Penetrating Renal Injuries

Penetrating renal injuries should be explored immediately (Figure 31.2). This is especially true in children who sustain a gunshot wound to the flank in which there is a high incidence of associated intraabdominal injuries and complex renal injuries. Adequate debridement of devitalised tissues must be carried out.

Ureteric Injuries

Injuries to the ureters are not common in children.[1,2] Rapid deceleration accidents (falls or motor vehicle accidents) may result in severe hyperextension of the trunk and possible disruption of the pelviureteric junction by stretch-induced injury. In cases of isolated ureteral injury, one must have a high index of suspicion to make this diagnosis, as patients may present in a delayed fashion with fever, ileus, sepsis, and flank pain. Severe blunt trauma may be associated with fractures of ribs, spine, and pelvis, which can also injure the ureters, much like penetrating trauma. Penetrating trauma to the flank and abdomen may transect or destroy a significant segment of the ureter. The cavitation effect of high-velocity gunshot wounds can result in ureteral necrosis and require extensive reconstruction.

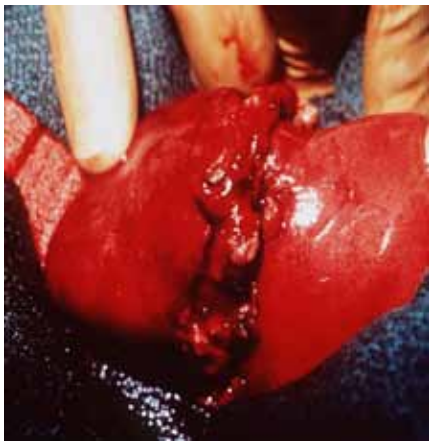
Once the diagnosis of pelviureteric junction disruption is made, the best course of action is to perform an immediate primary repair by using the dismembered pyeloplasty technique. If there is extensive loss of a portion of the ureter, one may need to perform one or more of the following procedures:

- For distal ureteral injuries, one may be able to excise and reimplant the ureter into the bladder.
- For lower-half ureteral injuries, a bladder Boari flap, with or without a psoas hitch technique, may be required.
- For more extensive injuries, the kidney may be mobilised and nephropexy may allow several additional centimetres of length.
- If just the upper ureter remains, a trans-uretero-ureterostomy can be performed.
- If there is significant damage to the renal pelvis and pelviureteric junction, a ureterocalicostomy may be employed with wide amputation of the inferior-most renal parenchyma and anastomosis of the ureter to the lower pole calyx.
- With complete loss of the ureter, one may be required to place a segment of tapered ileum as an interposition tube flap. The appendix has also been used as an interposition tube flap for midureteral injuries on the right side.[9] As a last resort, autotransplantation of the kidney to the iliac vessels can be performed.

Bladder Injury

The bladder is an intraabdominal organ in young children; therefore, it can be easily injured in trauma to the abdomen, regardless of whether it is full or empty. As the bony pelvis grows, the bladder becomes more protected from injury. Blunt trauma is responsible for most bladder injuries. Road traffic accidents and falls from heights are the most common causes of bladder injury in the paediatric age group in the African setting. Pelvic fractures cause injury near the bladder neck, whereas the dome of the bladder is usually affected by direct blow to the lower abdomen. Only a small number of patients with pelvic fractures sustain bladder injury. Patients who present with bladder injury are found to have associated pelvic fractures in 75–90% of the cases. About one-half of bladder injuries in children are associated with other intraabdominal organ injuries.

(A)



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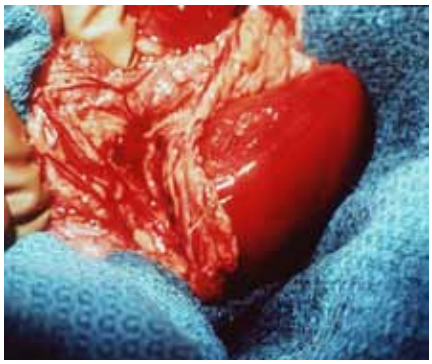


(C)

Figure 31.2: (A) Child who sustained a stab wound to left flank. (B) Renal exploration revealed laceration of the kidney. (C) Following repair of the renal laceration, omentum is placed into the wound to promote healing and prevent urine leakage.

Classification

Bladder injuries in children can be classified as blunt or penetrating.

Blunt trauma

In a contusion, there is a disruption in bladder muscularis without loss of continuity of the wall. With a rupture, there is complete disruption of the bladder wall.

The cystogram is the ideal radiographic study to diagnose intra- or extraperitoneal rupture. As previously mentioned, the bladder must be filled to at least one-half the expected capacity in a child, or more than 350

ml in the adolescent or adult. Three films should be obtained: the scout, or plain, film; an anteroposterior (AP) film; and a postdrainage film.

Penetrating injury

Penetrating bladder injuries may result from a pelvic fracture with boney penetration or laceration, gunshot wounds, a stabbing, falls onto sharp objects, surgical mishaps (e.g., trochar placement during laparoscopy), migration or erosion from drains, or manipulation of the umbilical artery catheter in neonates.

Management of Bladder Injuries

Contusion

Most cases of bladder contusion do not need treatment and they usually have an excellent outcome. Pelvic haematoma may cause difficulty in micturition, and in these patients, catheter drainage is all that is required.

Extraperitoneal rupture

An extraperitoneal rupture accounts for 80% of bladder injuries. Cystography often reveals a flame-shaped area of contrast extravasation that is confined within the pelvis. In one-fifth of patients, it is associated with urethral injury as well.

The preferred treatment is urethral catheterisation and drainage alone for a period of about 2 weeks. Tears usually heal completely, even if extensive extravasation has occurred. If laparotomy is done for associated intraabdominal injuries, the dome of the bladder is opened and the tear repaired without disturbing any pelvic retroperitoneal haematoma. If the bladder is opened, a temporary suprapubic bladder catheter should be left in place. Repeat cystography should be performed prior to removal of the urethral or suprapubic catheter.

Intraperitoneal rupture

An intraperitoneal rupture occurs mainly at the dome of the bladder and is usually due to a direct blow to the distended bladder or a sudden deceleration injury. Contrast may be seen within the peritoneal cavity outlining the intestines.

Intraperitoneal rupture occurs more commonly in children than adults. Thus, early operative repair is the treatment of choice for children because the presence of urine in the peritoneal cavity can lead to life-threatening metabolic and infectious problems.[10]

Operative Details

The bladder is approached through a lower abdominal incision. One must carefully inspect the ureteral orifices and bladder neck. Overlooking an injury in these areas may result in ureteral obstruction, sepsis, and/or incontinence. An extraperitoneal tear is closed from within the bladder by using absorbable sutures, taking care to avoid occlusion of the ureteric orifices. Suprapubic bladder drainage is maintained for 7–10 days and removed once the cystogram has shown resolution of the extravasation. The peritoneum is drained by using a closed suction drain. The drain is removed when the patient is voiding normally.

Penetrating Injuries

Penetrating injuries of the bladder are managed by laparotomy due to the high incidence of associated injury to other organs. These bladder injuries are often more extensive than seen on radiographic images. Meticulous debridement and dual layer closure of the bladder are key to a successful outcome. If there is also a bowel injury, a flap of omentum should be placed over the bladder repair to prevent formation of a fistula. After thorough debridement of the injury and bladder closure, a suprapubic bladder catheter is left in place and the perivesical area is drained by closed suction drain.

Urethral Injury

Urethral injuries in children can occur as a result of blunt or penetrating trauma to the abdomen, pelvis, and perineum. Blunt trauma with pelvic fracture accounts for most posterior urethral injuries in children. The mechanism of most of these types of injuries include motor vehicle accidents, falls from heights (commonly occurring during fruit harvesting season in Africa), crushing and straddle injuries, and sporting injuries. Instrumentation of the urinary tract with catheters, scopes, and sounds may also cause urethral injury, especially in the patient with underlying urethral stricture. Children with congenital anorectal malformations (high imperforate anus) or girls with disorders of sexual differentiation may require surgery that involves the urethra. Prepubertal girls who sustain a pelvic fracture are four times more likely than adult women to have a urethral injury.

Classification of Urethral Injuries

Urethral injuries are classified into four grades:

- *Grade I:* Contusion. Normal urethrogram.
- *Grade II:* Stretch injury. Elongation of urethra with extravasation of contrast on urethrogram, but with visualisation of the bladder. These are usually located in the anterior urethra (penile and bulbar portions). See Figure 31.3.
- *Grade III:* Partial disruption. Elongation without visualisation of bladder on urethrogram. These can occur in either the anterior or posterior urethra (prostatic and membranous portions).
- *Grade IV:* Complete disruption. Complete transection with separation or extension into the prostate or vagina. In children, complete disruption usually occurs in the posterior urethra between the prostatic and membranous portions of the urethra (Figure 31.4).

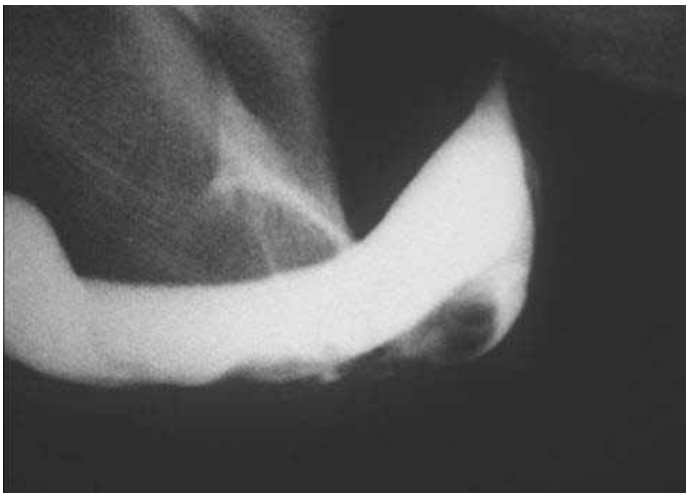


Figure 31.3: Retrograde urethrogram showing grade II urethral stretch injury with extravasation of contrast.

Figure 31.4: Retrograde urethrogram after pelvic fracture showing complete urethral disruption.

Diagnosis

Blood at the external urethral meatus, gross haematuria after trauma, and inability to void after trauma in the presence of the urge to micturate are physical findings in children with urethral injuries. Other findings that may indicate underlying urethral injury include a sensation of micturition without passing urine; swelling; or ecchymosis of the penis, scrotum, and perineum. The urethral tunics include the corpus spongiosum, Buck's fascia, and the outer layer, or Colle's fascia. Urethral rupture is usually confined by Colle's fascia, giving the classic finding of a perineal butterfly haematoma. A digital rectal examination should be done, and if upward displacement of the prostrate is encountered, one should suspect urethral disruption. In girls with blood at the introitus, careful inspection of the vagina should be done. Retrograde urethrography should be done in all children suspected of having urethral injury. This may reveal a filling defect cause by haematoma or contusion or extravasation of contrast.

Management

If a urethral injury is suspected from the history and physical examination of a child, no urethral catheterisation should be done until urethral rupture has been ruled out. An emergency retrograde urethrogram is done to ascertain the nature (grade) of the injury. If the urethrogram is not possible on an emergency basis, a suprapubic bladder catheter is inserted and urethrogram done the following day.

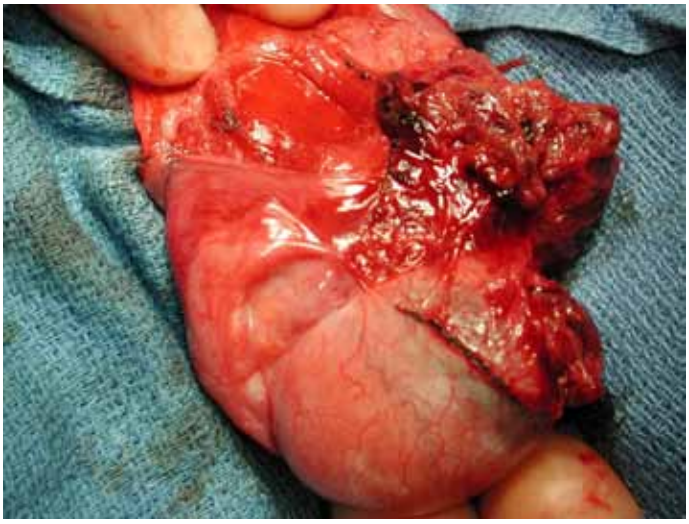
Grade I and II injuries are managed without surgery and without an indwelling urethral catheter.

For grade III injuries, a suprapubic bladder catheter usually is inserted. However, if the urethra is not completely transected and contrast is seen entering the posterior urethra and bladder, a Foley catheter (especially one with a coude-tip) can be inserted carefully under fluoroscopic guidance. Another option is to use a cystoscope to place a wire across the defect and then a council-tip catheter over the wire into the bladder. After 10–14 days, a cystourethrogram is performed. If there is no extravasation or stricture, the catheter is removed. Careful follow-up is necessary because a stricture may occur months or years later. The best results are obtained by ensuring the urethral lumen is patent, even if this requires open repair of the urethra tear within 10–14 days, before the tissues have become rigid.

For grade IV injuries, or complete disruption, a suprapubic catheter should be inserted. Usually, these patients are severely injured, and an attempt to reapproximate the disrupted bladder neck and prostatic urethra to the membranous urethra may provoke further bleeding from the pelvic haematoma and worsen the child's condition. The sooner the ends of the urethra are brought together, however, the better. This is usually facilitated by accurate reduction and fixation of the pelvic fractures. Once the child is stabilised, immediate (within 2 days) realignment of the urethra over a catheter can be attempted. If the child is unstable, delayed repair (2–14 days) can be attempted by using cystourethrography and limited suprapubic manipulation and downward displacement of the bladder. If the anterior urethra is completely blocked, perineal urethroscopy can be performed. In some situations, late repair (>3 months) must be done and may require extensive pelvic surgery, including transpubic urethroplasty or a combined suprapubic and perineal approach with or without pubectomy.[11,12] Long-term complications from complete urethral disruption may include erectile dysfunction and incontinence. Urethral injuries are rare in girls; however, in the presence of pelvic fracture and blood at the meatus/introitus, one must carefully inspect the vagina and retrograde urethrogram or cystoscopy for injury. Urethral injuries in girls may result in urethral stenosis, urethrovaginal fistula, urinary incontinence, and vaginal stenosis. Meticulous management is needed to avoid these serious complications.

(A)

(B)



(C)

Figure 31.5: (A) Scrotal/perineal haematoma with (B) ultrasound showing disruption of the tunica albuginea. (C) Exploration reveals rupture of the inferior pole of the testis.

Genital and Scrotal Injuries

Boys

Circumcision mishap is the commonest cause of penile injury in boys and includes partial glans and/or meatal amputation or skin degloving.[13,14] The penis may also be injured in motor vehicle accidents, falls and straddle injuries, and animal or human bites. Penile injuries may also be associated with scrotal and testicular injuries.

Circumcision injuries should be immediately debrided and lacerations repaired. In cases of partial glans amputation, reattachment of the excised segment should be done immediately. Complete amputation in children is exceedingly rare. If significant skin loss has occurred, a split-thickness skin graft may be required.

Scrotal and testicular injuries occur from mechanisms similar to those for penile and urethral injuries. Trauma from sports is perhaps the most common form of blunt injury to the scrotum. If there is significant swelling of the scrotum and one cannot completely or adequately examine the testes, an ultrasound or CT scan should be immediately obtained. Ultrasound documentation of disruption of the tunica albuginea of the testis or the presence of a haematocele should prompt immediate exploration of the scrotum, given the high likelihood of testicular rupture (Figure 31.5). A drain should be placed into the scrotum following exploration and repair of testicular rupture.

Girls

Genital injuries in girls may result from sexual abuse or straddle injuries.[15] Types of injuries include lacerations or contusions of the perineal body, vagina, and labia. Adequate evaluation for abuse is necessary if this is suspected. Necrotic tissues should be debrided and lacerations repaired.

Evidence-Based Research

Table 31.1 presents a study to develop a prediction model for the need for exploration after renal trauma.[7]

Table 31.1: Evidence-based research.

Title	Development of a highly accurate nomogram for prediction of the need for exploration in patients with renal trauma
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Institution	Department of Urology, University of Texas Southwestern Medical Center, Dallas, Texas, USA; Cancer Prognostics and Health Outcomes Unit, University of Montreal, Montreal, Quebec, Canada; Brooke Army Medical Center (AFM), Fort Sam Houston, Houston, Texas, USA
Reference	J Trauma Injury Infect Crit Care 2008; 64(6):1451–1458
Problem	To develop a highly accurate nomogram for predicting which patients would need exploration after renal trauma.
Comparison/ control (quality of evidence)	Logistic regression models were used to develop a nomogram for prediction of the need for renal exploration after renal trauma. Internal (200 bootstrap resamples) and 50% split sample validations were performed.
Outcome/effect	Overall, 89 patients (21.2%) underwent renal exploration, from which 60.7% (54 of 89) underwent nephrectomy and 39.3% (35 of the 89) underwent renorrhaphy. Nine percent of patients with grade II injury underwent renal exploration, 16% with grade III injuries, 41% with grade IV injuries, and 100% of grade V injuries. The kidney injury scale, the mechanism of injury, the need for transfusion, blood urea nitrogen level, and serum creatinine represented the most informative predictors of the need for renal exploration, and were included in the nomogram. The split sample accuracy of the nomogram for prediction of the need for renal exploration was 96.9%. It significantly ($p < 0.001$) exceeded the accuracy of each of its components, including the American Association for the Surgery of Trauma kidney injury scale (87.7%).
Historical significance/ comments	This article gives the scientific basis for predicting which patients with renal injury would need exploration, and whether it could be applied to children with renal injury. The nomogram generates highly accurate and reproducible predictions of the probability for renal exploration according to the authors' decision-making process. It could help standardise the management of patients with renal trauma (i.e., inclusion criteria for clinical trials) and serves as a proof-of-principle that predictive tools can be applied to the trauma setting. Its use may improve the management of renal trauma patients at institutions with limited trauma experience.

Key Summary Points

1. The urogenital tract is involved in up to 12% of children with injuries.
2. Perineal injuries are quite common in children.
3. Most urogenital and perineal injuries follow blunt trauma. Road traffic accidents are the most common. Child abuse should be suspected in unusual cases.
4. Due to advances in radiological imaging, evaluation and identification of most urological tract injuries in children can be made nonoperatively; the operation rate has therefore greatly decreased.
5. The aim of managing a child with renal trauma is the preservation of renal function.

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