Pediatric Urological Emergencies

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KEYWORDS

• Abdominal pain • Scrotal mass • Testicular torsion • Renal trauma
• Urologic emergencies

KEY POINTS

- Children with acute abdominal pain should be evaluated immediately. In addition to a thorough abdominal examination to rule out surgical disease, these children should be evaluated for urinary tract infection, constipation, and spermatic cord torsion.
- A child with acute scrotal pain must be presumed to have spermatic cord torsion regardless of age until proven otherwise; however, in some cases, an accurate evaluation may prevent an unnecessary surgical exploration.
- The differential diagnosis of a vaginal mass includes benign periurethral cysts, skin tags, urethral prolapse, imperforate hymen, prolapsed ureterocele, or rarely, malignancies such as a rhabdomyosarcoma.
- Blunt force renal trauma requires immediate evaluation but does not necessarily require operative intervention. The conservative treatment of high-grade blunt renal injuries has been successfully described in children. Children with high-grade injuries at risk for failure of conservative management include those with vascular avulsion or extensive urinary extravasation, especially in the setting of ureteropelvic junction disruptions.
- Infants with ambiguous genitalia require immediate evaluation because congenital adrenal hyperplasia may result in salt wasting, which can be life-threatening.

Urological emergencies represent a small percentage of office and emergency department visits, but the rapid assessment and management of these conditions are essential to preservation of urological health. In many cases, the initial contact with the child and family will be through a phone call to the office or an urgent office visit. A thorough understanding of the chief compliant, history of the present illness, and past medical history is vital to appropriate management of all pediatric urologic patients. In addition, the physical examination will identify abnormalities and narrow the differential diagnosis; however, because other acute processes, such as appendicitis, may mimic genitourinary disease, the clinician must be alert for evidence of disease in other organ systems.

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The initial assessment must accurately determine the degree of acuity and the level of care required. Although few children are severely ill when evaluated in the pediatric office, developing the skills to recognize an infant or child who requires hospitalization is critical. Some children will require treatment in an emergency department or direct admission to an inpatient facility, whereas other children can be managed as outpatients. Determining when an infant requires an inpatient admission is particularly important because the metabolic reserve is less abundant in the newborn.[1] Patients with hemodynamic instability must be emergently addressed. This article outlines the most common urgent and emergent pediatric urological conditions with the goal to direct initial evaluation and treatment.

ACUTE ABDOMINAL CONDITIONS

Children with acute abdominal pain should be evaluated immediately. An accurate history of the nature of the pain may be the best indicator of the source of the pain. Details about the character of the pain, including timing, acuity of onset, radiation, and migration are important and should, if possible, be elicited directly from the child. Associated loss of appetite, nausea, vomiting, or a change in bowel pattern may help to distinguish gastrointestinal from genitourinary sources. Causes of abdominal pain in children vary widely and are often unique to the pediatric population. Pyelonephritis, renal colic, or cystitis are potential etiologies within the differential diagnosis. Renal colic can result from obstructing nephrolithiasis, ureteropelvic junction obstruction, ureterovesical junction obstruction, or clot obstruction. Nonurological intra-abdominal etiologies in children include gastroenteritis, constipation, mesenteric adenitis, pyloric stenosis, midgut volvulus, appendicitis, and intussuception. Nonabdominal sources, such as sickle cell crisis, streptococcal pharyngitis, or pneumonia, should also be considered. In addition to a thorough abdominal examination designed to rule out surgical abdominal disease, these children should be evaluated for urinary tract infection (UTI), constipation, and spermatic cord torsion. Usually an acute abdominal series is ordered, which will demonstrate considerable amounts of stool throughout the colon if constipation is the cause. Occasionally, some children with spermatic cord torsion complain of abdominal pain and have minimal scrotal complaints. Therefore, a scrotal examination must always accompany an abdominal examination. Most abdominal masses originate in genitourinary organs and should be evaluated immediately.[2] In neonates, transillumination of the abdomen may assist in distinguishing between solid and cystic lesions. The most common malignant abdominal tumor in infants is neuroblastoma, followed by Wilms tumor.[3] Children with neuroblastoma typically relate a history of more constitutional symptoms than children with Wilms tumor.

If an abdominal mass is suspected, an abdominal ultrasound evaluation should be ordered. If the mass is solid, computed tomography (CT) is almost always required. Renal pathology is the source of up to two-thirds of neonatal abdominal masses.[4] Cystic abdominal masses include hydronephrosis, multicystic dysplastic kidneys, adrenal hemorrhage, hydrometrocolpos, intestinal duplication, and choledochal ovarian omental or pancreatic cysts. Solid masses include neuroblastoma, congenital mesoblastic nephroma, hepatoblastoma, and teratoma. A solid flank mass may be caused by renal venous thrombosis, which becomes apparent with signs of hematuria, hypertension, and thrombocytopenia. Renal venous thrombosis in infants is associated with polycythemia, dehydration, diabetic mothers, asphyxia, sepsis, and coagulopathies, such as antithrombin-3 or protein C deficiencies.

NEPHROLITHIASIS

The incidence of nephrolithiasis in children is increasing in the United States: 1000 to 7500 hospital admissions in the United States result from pediatric nephrolithiasis.[5,6]

Nephrolithiasis can be associated with significant metabolic disturbances and underlying medical conditions. The presence of nephrolithiasis does not represent an emergent situation but does require urology and nephrology evaluation. Certain clinical signs and patient characteristics must be assessed to determine the acuity of the patient. Children with renal calculi often present with renal colic. Patients often complain of abdominal pain, flank pain, lower quadrant pain, and or scrotal pain. In young children, abdominal symptoms can often be vague and more difficult to localize. Although nephrolithiasis is more common in adolescents, 20% of pediatric nephrolithiasis occurs in newborns and infants.[7] Children with renal ectopia, such as pelvic kidneys, also present with atypical symptoms. Nausea, emesis, and gross hematuria often accompany the abdominal pain.

Children with obstruction of a solitary system, urinary tract infection, renal insufficiency, immunosuppression, uncontrollable pain, and/or the inability to tolerate oral intake should be evaluated emergently. These children should be assessed in the emergency department with a complete blood count, metabolic panel, urine analysis, urine culture, and abdominal imaging. A renal and bladder ultrasound often provides adequate diagnostic information, but a CT scan of the abdomen and pelvis is warranted in some cases. The sensitivity of ultrasound is significantly lower than CT imaging but the risk of malignancy associated with irradiation must be considered.[8] An infected obstructing ureteral calculus can result in urosepsis and death; therefore, these children should be stabilized, administered broad-spectrum intravenous (IV) antibiotics, and the obstructed renal unit decompressed. In an unstable patient, percutaneous nephrostomy tube placement is the safest and most efficient management.

ACUTE SCROTAL CONDITIONS

Testicular Torsion

The annual incidence of testicular torsion in boys younger than 18 years is 3.8 per 100,000.[9] A child with acute scrotal pain must be presumed to have spermatic cord torsion regardless of age until proven otherwise; however, in some cases, an accurate evaluation may save the child an unnecessary surgical exploration. The differential diagnosis of the acute scrotum includes testicular torsion, torsion of the appendix testis or epididymis, epididymitis/orchitis, hernia/hydrocele, trauma, sexual abuse, tumor, idiopathic scrotal edema, dermatitis, cellulitis, and vasculitis, such as Henoch-Schonlein purpura.[10] Gradual onset of the pain is more consistent with epididymitis, whereas abrupt pain suggests spermatic cord torsion or torsion of one of the testicular appendices. The classical presentation of testicular torsion is the sudden onset of severe, unilateral pain that is often associated with nausea and emesis. Pain is present with palpation and at rest. A history of similar intermittent episodes may suggest intermittent testicular torsion.

The acute scrotum should be examined carefully to determine the true etiology. Observation of the child's general appearance and level of distress should be recognized. Scrotal erythema, edema, or ecchymoses should be readily identifiable. To begin the scrotal examination, the inguinal canal should be inspected on each side for signs of asymmetry or mass. The inguinal canal is then palpated to identify a fullness or mass suggestive of a hernia or hydrocele of the spermatic cord. Testicular torsion may present with varied clinical findings, but the involved testis often demonstrates signs such as higher riding in the hemiscrotum, a transverse orientation, an anterior epididymis, absent cremasteric reflex, and tenderness of the testis and epididymis. Associated scrotal wall swelling or erythema is suggestive of spermatic cord torsion if presentation is delayed. The absence of edema or erythema or the presence of a cremasteric reflex does not rule out the possibility of acute testicular torsion, especially if the onset of pain was recent.

In contrast, torsion of the appendix testis or epididymis often results in localized tenderness at the superior pole of the testis or caput epididymis and is often associated with a reactive hydrocele. Additionally, in boys with thin scrotal skin, the "blue dot" sign can be seen reflective of a necrotic appendix. Epididymitis classically has a gradual onset and is not associated with nausea or emesis but can have similar clinical signs, including a firm, tender, enlarged testis with an erythematous and edematous scrotum.[10]

The normal newborn scrotum is relatively large. Its size may be increased with the trauma of breech delivery or by a newborn hydrocele. A hydrocele can be distinguished from hernia by palpation and transillumination, as well as from the absence of a mass in the inguinal canal. In the absence of volume changes within the hydrocele, the processus vaginalis is usually not patent and the newborn hydrocele resolves by 1 year of age without surgery. Neonatal extravaginal testicular torsion can also occur prenatally resulting in a firm, enlarged, nontender mass in the hemiscrotum that is usually associated with dark discoloration of the overlying skin. A normal scrotal examination at birth and subsequent development of erythematous, tender, edematous hemiscrotum suggests postnatal extravaginal testicular torsion and should be addressed immediately with surgical intervention if the neonate is clinically stable.

Traditionally significant ischemic damage is believed to occur after 4 to 8 hours. Therefore, testicular torsion represents a true surgical emergency. If there is a concern for testicular torsion, the patient should be sent to the emergency department for immediate evaluation. Patients presenting after 8 hours are usually still explored because the viability of the testis is difficult to predict.[11,12] Despite emergent scrotal exploration and detorsion, 32% of testes are nonviable and result in orchiectomy based on a review of the Pediatric Health Information System database.[13] Intraoperatively, the ipsilateral hemiscrotum will be explored and the testis will be identified and the spermatic cord torsion is released. At that time, the affected testis is observed for return of blood flow and wrapped in moist gauze. The contralateral hemiscrotum is then explored and a contralateral scrotal orchidopexy or septopexy is performed. The objective of exploring the contralateral testis and performing a septopexy is to prevent metachronous testicular torsion. If the ipsilateral testis appears healthy, a septopexy is performed. If the affected testis is unable to be salvaged, an orchiectomy is performed.

Hernia/Hydrocele

Infants and children with an inguinal hernia or a hydrocele that changes in volume should be seen within 24 hours and sooner if there is history of inguinal or scrotal pain. Most of these children will need surgical intervention, but a few will require emergent surgery. If there is a history of scrotal or inguinal pain, the child's parents should be taught to recognize the signs of an incarcerated inguinal hernia and instructed to go to the emergency department if symptoms occur before the planned surgical correction. Infants with asymptomatic hydrocele rarely require surgery initially. In most cases, the hydrocele will resolve in the first year of life. An exception should be made if the hydrocele is particularly large or palpable in the inguinal region. A large hydrocele with a palpable inguinal component or one that is enlarging may indicate the presence of an abdominoscrotal hydrocele. These do not spontaneously resolve and usually enlarge. These should be corrected, usually at 6 to 12 months through an initial scrotal incision that will decompress the hydrocele.[14]

Testicular Masses

Testicular masses should be evaluated immediately. Prepubertal testicular and paratesticular tumors should be considered in the differential diagnosis of a scrotal mass.

Although much less common than epididymal cysts or spermatoceles, a complaint of a painless testicular or paratesticular mass should be addressed urgently. A physical examination and scrotal ultrasound should determine if the mass is concerning for neoplasia. Scrotal masses can be transilluminated to determine if the component is primarily fluid, such as a tense hydrocele or solid, such as a testicular tumor. If a firm intratesticular mass is palpated, a thorough examination of the lymph nodes should be performed to evaluate for lymphoma, leukemia, or metastatic disease. Patients with a nontender testicular mass and signs of precocious puberty should be evaluated for a Leydig cell tumor or, less commonly, a Sertoli cell tumor.[15] Epididymal cysts and spermatoceles can present as extratesticular masses but are characteristically smooth, round, and located within the epididymis. A scrotal ultrasound can further differentiate these physical examination findings. Boys with a complaints of a scrotal mass should be assessed by a pediatric urologist urgently due to the rapid growth and malignant potential of many lesions. If the ultrasound or examination are suggestive of a intratesticular or paratesticular mass, tumor markers including beta human chorionic gonadotropin, alpha fetoprotein, and lactate dehydrogenase must be obtained. Additionally, in most instances a CT scan of the abdomen and pelvis with oral and IV contrast is indicated.

In a contemporary series from a tertiary center, the most common prepubertal testis tumor was a teratoma followed by rhabdomyosarcoma, epidermoid cyst, yolk sac tumor, and germ cell tumor, respectively.[16] This histologic distribution was corroborated by a multicenter review including 4 tertiary pediatric hospitals demonstrating that 74% of tumors were benign with 48% teratoma.[17] Testicular tumors occur in the newborn and in early childhood as well as after adolescence. The peak incidence of testicular tumors in young children and infants occurs at age 2. In this population, yolk sac tumors are most common and approximately 75% of tumors are malignant.[18,19] Tumors of nontesticular origin, such as leukemia and lymphoma, must also be considered in the pediatric population.

Varicocele

Varicoceles are uncommon in prepubertal boys and increase in incidence to around 15% by 15 years of age.[20] A physical examination and scrotal ultrasound confirm the diagnosis. From the 3-dimensional measurements on ultrasound, the relative testicular volumes may be calculated and used to guide further treatment.[21] Varicoceles are 90% left-sided and 10% right-sided.[22] Although a left-sided varicocele is not a urological emergency, a right-sided varicocele in the absence of a left-sided varicocele should prompt an evaluation for a retroperitoneal process. If only the right side is involved, there exists a possibility that a retroperitoneal tumor is present and compressing the vein.

MALE PENILE OR URETHRAL SYMPTOMS

Boys with painful priapism must be evaluated immediately. Pain may suggest ischemia of the corporeal bodies, which may progress to corporeal fibrosis if untreated. Children with sickle cell anemia are especially at risk for priapism, with 75% of patients experiencing their first episode by the age of 20 years.[23] Outpatient treatment with penile aspiration and epinephrine irrigation has successfully been used in the treatment of this condition.[24] Patients receiving epinephrine should be observed in a monitored setting because of the risk of cardiac effects.

Paraphimosis also requires immediate attention and manual reduction. In children, this procedure may require some level of sedation. Conversely, phimosis is

physiologic in young infants and attempts to manually retract the foreskin in boys less than 2 years of age should be avoided. Phimosis in older children is typically treated with 1 or 2 courses of low-dose steroid cream and circumcision if necessary.[25]

FEMALE GENITAL SYMPTOMS

Infant girls with introital masses commonly present to the pediatric outpatient office. Vaginal masses may be palpable or may protrude from the introitus. The differential diagnosis of these masses includes benign periurethral cysts, skin tags, urethral prolapse, imperforate hymen, prolapsed ureterocele, or rarely, malignancies such as a rhabdomyosarcoma. Bladder outlet obstruction may result from a prolapsed ureterocele. Most of these lesions are differentiated by physical examination, but historical information, such as pain, bleeding, or voiding difficulties help solidify the diagnosis.

Urethral prolapse is relatively common, particularly in young African American females. The prolapse is through the meatus, forming a hemorrhagic, often sensitive mass that bleeds with palpation or when in contact with the underwear. Girls may have difficulty with urination depending on the size of the prolapse and whether it compromises the urethral meatus.

Benign and malignant tumors of the vagina should be considered when vaginal bleeding occurs in young girls. A broad spectrum of entities ranging from capillary hemangioma, rhabdomyosarcoma, or carcinoma may be associated with vaginal bleeding. Labial masses may be associated with hernia or hydrocele of the canal of Nuck.[26]

We evaluate adolescent girls who have not menstruated and in whom there is concern about ureteral or vaginal anomaly. Many of these girls have an imperforate hymen or uterine anomaly that results in poor uterine drainage that may be uncomfortable. If left untreated, retrograde drainage of the uterus may place these patients at risk of endometriosis and infertility.[27] Patients with complete androgen insensitivity can also present with primary amenorrhea. A pelvic ultrasound or magnetic resonance imaging can further delineate the anatomy and guide intervention if necessary.

URINARY TRACT INFECTION

Febrile UTIs in the newborn are treated emergently because newborns are particularly susceptible to significant renal damage if the infection is not treated promptly. A urine culture should be obtained, and these infants require IV antibiotics as early as possible after the urine culture is obtained because they have a higher prevalence of concomitant bacteremia (10%–22%).[28] Appropriate antibiotic therapy administered without delay has been shown to reduce the incidence of renal scarring.[29]

Febrile UTIs in children older than newborns should be treated acutely. Children of all ages with a severe UTI may be subject to renal scarring and should be seen within 24 hours or sooner.[30] Children older than newborns with nonfebrile UTI should be seen semi-urgently. Nearly all children with culture-proven UTI should be evaluated with ultrasound and, if indicated, voiding cystourethrogram (VCUG). Some groups are reevaluating the role of renal nuclear scans in these children.

GROSS HEMATURIA

Gross hematuria in children is less common than microscopic hematuria, with an estimated prevalence of 1.3 per 1000.[31] The most common diagnoses are UTI (26%), perineal irritation (11%), trauma (7%), meatal stenosis with ulceration (7%), coagulation abnormalities (3%), and urinary tract stones (2%). Children with gross hematuria associated with trauma, nephrolithiasis, flank pain, fever, or bladder outlet obstruction should be

assessed emergently with abdominal imaging. The most common glomerular causes of gross hematuria in children are poststreptococcal glomerulonephritis and immunoglobulin A (IgA) nephropathy. An antecedent sore throat, pyoderma, edema, or red blood cell casts suggest glomerulonephritis. IgA nephropathy can cause recurrent gross hematuria with flank or abdominal pain and may be preceded by an upper respiratory tract infection.[32] Adenoviral infection, hypercalciuria, and hyperuricosuria are other sources to consider. In the setting of asymptomatic gross hematuria, an ultrasound of the kidneys, ureters, and bladder should be performed, although the yield is low.[33] Contrary to the adult patient, cystoscopic examination in children rarely reveals a cause for hematuria but should be performed when bladder pathology is a consideration.

Gross hematuria in the newborn is an emergency because it may indicate renal venous thrombosis or renal arterial thrombosis. Both may be life-threatening. Renal venous thrombosis affects boys twice as often as girls, with a left-sided predominance. These infants require resuscitation and, occasionally, anticoagulant or operative therapy.[34] Gross hematuria outside the newborn period, although not life-threatening, should be evaluated without delay. Many children have an easy-to-recognize source, such as UTI, urethral prolapse, trauma, and meatal stenosis with ulceration, coagulation abnormalities, or urinary tract stones. Less obvious sources include acute nephritis, ureteropelvic junction obstruction, cystitis cystica, epididymitis, or tumor.[32,35] As with adult patients, a thorough history including a specific description of the color of the urine, the presence of clots, and timing of hematuria, such as terminal hematuria or hematuria on initiation of micturation, should facilitate the diagnostic process. A directed history should include medications, exercise habits, propensity for bleeding diathesis, and a travel history to rule out exposure to infectious diseases such as schistosomiasis or tuberculosis.

RENAL TRAUMA

The pediatric trauma patient usually presents to the emergency department and is evaluated by the emergency medicine and trauma teams often with the assistance of the urology service. Blunt force trauma is the primary mechanism for major renal trauma.[36] The pediatric kidney is particularly susceptible to trauma because of the limited visceral adipose tissue, limited chest wall protection, relatively increased renal size, and increased mobility of the kidney.[37] The mechanism of injury should be determined and a thorough history obtained from the patient and caregivers or observers. Epidemiologic data demonstrate that most renal injuries result from motor vehicle accidents, falls, or high-velocity activities, such as sledding, skiing, all terrain vehicle accidents, and skateboarding.[38,39] Therefore, injuries of this nature should alert the clinician to potential renal damage. The history should include any congenital renal anomalies, such as an ureteropelvic junction obstruction, a solitary kidney, or renal ectopia. Finally, evaluation of associated injuries must be undertaken. Any abdominal injury in a toddler or young child without an antecedent history of blunt force trauma should be evaluated for physical abuse.[40]

Blunt force renal trauma represents a urologic emergency that requires immediate attention but does not necessarily require operative intervention. It is well accepted that low-grade blunt renal injuries are managed conservatively. More recently, the conservative treatment of high-grade blunt renal injuries have been successfully described in children. A consecutive series of 101 patients from The Children's Hospital of Philadelphia with blunt renal injury demonstrated that a nonoperative management strategy was advantageous and successful in 94.7% of pediatric blunt renal injuries.[41] The children with high-grade injuries at risk for failure of conservative management include those with major vascular avulsion or extensive urinary

extravasation, especially in the setting of ureteropelvic junction disruptions.[42] These patients require close urological observation and repeated examinations. We recommend conservative management and recognize that a complete evaluation is necessary to accurately determine which patients require further intervention.

Many patients presenting with blunt force renal trauma will have associated extrarenal injuries, such as other solid organ injuries, a pneumothorax, pelvic fractures, and bladder or urethral injuries. Therefore, complete physical examination in trauma patients is essential.[36,38] During examination for renal trauma, the urine should be assessed for gross hematuria. A urethral catheter should be postponed in the setting of gross hematuria until the lower urinary tract is assessed by the urology team.

AMBIGUOUS GENITALIA

Infants with ambiguous genitalia also require immediate evaluation. In the newborn period, all patients require a karyotype and laboratory evaluation by serum electrolytes, 17-OH progesterone, testosterone, luteinizing hormone, and follicle stimulation hormone levels. Once the karyotype is determined, serum analysis will assist in narrowing the differential diagnosis. Noninvasive, quick, and inexpensive, an ultrasound should be the first radiologic examination obtained. Although only 50% accurate in detecting intra-abdominal testes, ultrasound can detect gonads in the inguinal region and can assess Müllerian structures.[43] Although more expensive, magnetic resonance imaging scan can further delineate the anatomy. Because congenital adrenal hyperplasia (CAH) may result in salt wasting, which can be life-threatening, infants with ambiguous genitalia must be evaluated quickly and stabilized.[44] If CAH is suspected, the infant should not be discharged home from the nursery before appropriate testing is complete. In some cases, a genotypic female neonate with CAH may be incorrectly identified as a male neonate. The correct diagnosis should be made as quickly as possible to establish the appropriate sex of rearing. A history of a discordant karyotype from an amniocentesis and infant phenotype should prompt an evaluation. The parents should be asked about a family history of infertility, amenorrhea, and infant mortality. The complete evaluation of infants with ambiguous genitalia should include urology, neonatology, endocrinology, genetics, and psychology.

ANTENATAL HYDRONEPHROSIS

In neonates with prenatally detected hydronephrosis and a normal bladder, the postnatal evaluation of the hydronephrosis should begin within the first few days of life. If the postnatal renal and bladder ultrasound demonstrates bilateral hydronephrosis, a solitary kidney, or a thickened bladder wall, the child should be evaluated in the newborn nursery. The infant must be thriving and have normal electrolytes and normal blood urea nitrogen and creatinine levels before discharge home.

The postnatal history should also include the sex of the infant, laterality of the hydronephrosis, the level of obstruction (ie, ureteropelvic junction [UPJ], ureterovesical junction [UVJ], urethra), the presence or absence of oligohydraminos, and any other associated anomalies. The additional tests to be scheduled include a repeat ultrasound, a renal scan, or a VCUG to evaluate the relative drainage and percentage of function of the kidneys, as well as to evaluate for vesicoureteral reflux. Until this postnatal evaluation is completed, most infants are maintained on amoxicillin prophylaxis. The differential diagnosis for antenatal hydronephrosis most commonly includes UPJ obstruction, vesicoureteral reflux, ectopic ureter, ureterocele, megaureter (UVJ obstruction), multicystic dysplastic kidney, posterior urethral valves, prune belly syndrome, and megacystis microcolon syndrome.

Certain conditions require more immediate intervention, especially when bladder outlet obstruction is present. If posterior urethral valves are considered, the bladder should be drained with a feeding tube and a VCUG performed at an appropriate interval. Conversely, if prune belly syndrome is considered, urethral catheterization should be avoided if possible to minimize the risk of UTI. Additionally, a ureterocele may obstruct the bladder outlet and result in bilateral upper tract dilation. This situation can be ameliorated by placement of a urinary catheter.

CONGENITAL ANOMALIES IN THE NEONATE

Patients with major abdominal defects, such as bladder or cloacal exstrophy, require direct admission to the neonatal nursery for stabilization and surgical planning. In many cases, a team is assembled and provides orthopedic, general surgical, and urologic care during the surgery.[45] Patients with imperforate anus and variants, such as a cloacal anomaly, require decompression of the intestinal tract, usually within the first 24 to 48 hours.[46] At the time of the colostomy, the urologist may evaluate the perineum and perform endoscopy to further assess the urinary anomalies. In bladder exstrophy, the posterior bladder wall is visible through a midline defect in the abdominal wall and a pubic diastasis is appreciated. In addition, a bifid clitoris or epispadias is present. In cloacal exstrophy, an omphalocele is superior to the cecal plate and lateral bladder halves with prolapsed ileum typically in the midline. Additionally, a bifid clitoris or penis, imperforate anus, and spinal abnormalities are present. Procedures to correct these major defects must be planned by surgeons who are familiar with the potential risks and complications associated with the reconstruction of the urethra, vagina, and colon. The anesthesia team must be skillful in the management of the complex metabolic changes that may occur in infants who are under anesthesia for long periods. The neonatologists must be expert in the management of infants who have undergone major surgical procedures.

Currently, most spinal dysraphisms in children are diagnosed antenatally.[47] These infants are referred by direct admission to the neonatal intensive care nursery. Most of these children are not in urinary retention initially, but many develop spinal shock after neurosurgery in the newborn period and have a transient period of overflow urinary drainage. As soon as possible after closure of the spinal defect, a baseline renal and bladder ultrasound is performed to evaluate for evidence of bladder or upper tract abnormalities. If the newborn is not voiding spontaneously or has elevated postvoid residual volumes, clean intermittent catheterization should be initiated. Initial urodynamics investigation is performed after resolution of the spinal shock to ensure that bladder storage pressures are not excessive.[48,49] High-risk infants (those with a detrusor leak-point pressure greater than 40 cm H_2O or detrusor-sphincter dyssynergia) are started on anticholinergic therapy and intermittent catheterization.[50]

Emergent urological conditions occur in every age group and involve the entire genitourinary tract. Many acute signs and symptoms are not unique to genitourinary etiologies and a broad differential diagnosis should be considered. A thorough understanding of emergent urological conditions results in efficient assessment and management.

REFERENCES

1. Park JW. Fever without source in children: recommendations for outpatient care in those up to 3. Postgrad Med 2000;107:259–62, 265–6.
2. Chandler JC, Gauderer MW. The neonate with an abdominal mass. Pediatr Clin North Am 2004;51:979–97.

3. Golden CB, Feusner JH. Malignant abdominal masses in children: quick guide to evaluation and diagnosis. Pediatr Clin North Am 2002;49:1369–92.
4. Pinto E, Guignard JP. Renal masses in the neonate. Biol Neonate 1995;68: 175–84.
5. Walther PC, Lamm D, Kaplan GW. Pediatric urolithiases: a ten-year review. Pediatrics 1980;65:1068–72.
6. Milliner DS, Murphy ME. Urolithiasis in pediatric patients. Mayo Clin Proc 1993; 68:241–8.
7. Mohamed J, Riadh M, Abdellatif N. Urolithiasis in infants. Pediatr Surg Int 2007; 23:295–9.
8. Fowler KA, Locken JA, Duchesne JH, et al. US for detecting renal calculi with nonenhanced CT as a reference standard. Radiology 2002;222:109–13.
9. Zhao LC, Lautz TB, Meeks JJ, et al. Pediatric testicular torsion epidemiology using a national database: incidence, risk of orchiectomy and possible measures toward improving the quality of care. J Urol 2011;186(5):2009–13.
10. Gatti JM, Murphy JP. Current management of the acute scrotum. Semin Pediatr Surg 2007;16:58.
11. Bartsch G, Frank S, Marberger H, et al. Testicular torsion: late results with special regard to fertility and endocrine function. J Urol 1980;124(3):375.
12. Beard CM, Benson RC Jr, Kelalis PP, et al. The incidence and outcome of mumps orchitis in Rochester, Minnesota, 1935 to 1974. Mayo Clin Proc 1977;52(1):3.
13. Cost NG, Bush NC, Barber TD, et al. Pediatric testicular torsion: demographics of national orchiopexy versus orchiectomy rates. J Urol 2011;185(Suppl 6): 2459–63.
14. Belman AB. Abdominoscrotal hydrocele in infancy: a review and presentation of the scrotal approach for correction. J Urol 2001;165:225–7.
15. Agarwal PK, Palmer JS. Testicular and paratesticular neoplasms in prepubertal males. J Urol 2006;176:875.
16. Metcalfe PD, Farivar-Mohseni H, Farhat W, et al. Pediatric testicular tumors: contemporary incidence and efficacy of testicular preserving surgery. J Urol 2003;170:2412.
17. Pohl HG, Shukla AR, Metcalfe PD, et al. Prepubertal testis tumors: actual prevalence rate of histological types. J Urol 2004;172:2370.
18. Levy DA, Kay R, Elder JS. Neonatal testis tumors: a review of the Prepubertal Testis Tumor Registry. J Urol 1994;151:715–7.
19. Ciftci AO, Bingol-Kologlu M, Senocak ME, et al. Testicular tumors in children. J Pediatr Surg 2001;36:1796–801.
20. Schiff J, Kelly C, Goldstein M, et al. Managing varicoceles in children: results with microsurgical varicocelectomy. BJU Int 2005;95:399–402.
21. Diamond DA, Paltiel HJ, DiCanzio J, et al. Comparative assessment of pediatric testicular volume: orchidometer versus ultrasound. J Urol 2000;164:1111–4.
22. MacLellan DL, Diamond DA. Recent advances in external genitalia. Pediatr Clin North Am 2006;53:449.
23. Adeyoju AB, Olujohungbe AB, Yardumian A, et al. Priapism in sickle-cell disease: incidence, risk factors and complications—an international multicentre study. BJU Int 2002;90:898–902.
24. Mantadakis E, Canvender JD, Rogers ZR, et al. Prevalence of priapism in children and adolescents with sickle cell anemia. J Pediatr Hematol Oncol 1999; 21:518–22.
25. Ashfield JE, Nickel KR, Siemens DR, et al. Treatment of phimosis with topical steroids in 194 children. J Urol 2003;169(3):1106.

26. Kizer JR, Bellah RD, Schnaufer L, et al. Meconium hydrocele in a female newborn: an unusual cause of a labial mass. J Urol 1995;153:188–90.
27. Rock JA, Zacur HA, Dlugi AM, et al. Pregnancy success following surgical correction of imperforate hymen and complete transverse vaginal septum. Obstet Gynecol 1982;59:448–51.
28. Pitetti RD, Choi S. Utility of blood cultures in febrile children with UTI. Am J Emerg Med 2002;20:271–4.
29. Ransley PG, Risdon RA. Reflux nephropathy: effects of antimicrobial therapy on the evolution of the early pyelonephritic scar. Kidney Int 1981;20:733–42.
30. van der Voort J, Edwards A, Roberts R, et al. The struggle to diagnose UTI in children under two in primary care. Fam Pract 1997;14:44–8.
31. Ingelfinger JR, Davis AE, Grupe WE. Frequency and etiology of gross hematuria in a general pediatric setting. Pediatrics 1977;59:557–61.
32. Meyers KE. Evaluation of hematuria in children. Urol Clin North Am 2004;31: 559–73.
33. Fernbach SK. The dilated urinary tract in children. Urol Radiol 1992;14:34–42.
34. Kuhle S, Massicotte P, Chan A, et al. A case series of 72 neonates with renal vein thrombosis: data from the 1-800-NO-CLOTS Registry. Thromb Haemost 2004;92: 729–33.
35. Diven SC, Travis LB. A practical primary care approach to hematuria in children. Pediatr Nephrol 2000;14:65–72.
36. Mohamed AZ, Morsi HA, Ziada AM, et al. Management of major blunt pediatric renal trauma: single center experience. J Pediatr Urol 2010;6(3):301–5.
37. Brown SL, Elder JS, Spirnak JP. Are pediatric patients more susceptible to major renal injury from blunt trauma? A comparative study. J Urol 1998;160:138.
38. Margenthaler JA, Weber TR, Keller MS. Blunt renal trauma in children: experience with conservative management at a pediatric trauma center. J Trauma 2002; 52(5):928.
39. Rogers CG, Knight V, Macura KJ, et al. High-grade renal injuries in children: is conservative management possible? Urology 2004;64(3):574.
40. Barnes PM, Norton CM, Dunstan FD, et al. Abdominal injury due to child abuse. Lancet 2005;366:234.
41. Nance ML, Lutz N, Carr MC, et al. Blunt renal injuries in children can be managed nonoperatively: outcome in a consecutive series of patients. J Trauma 2004;57: 474.
42. Henderson CG, Sedberry-Ross S, Pickard R, et al. Management of high grade renal trauma: 20 year experience at a pediatric level I trauma center. J Urol 2007;178:246.
43. Kolon TF. Intersex. In: Schwartz MW, editor. The 5-minute pediatric consult. New York: Lippincott, Williams & Wilkins; 2003. p. 480–1.
44. Forest MG. Recent advances in the diagnosis and management of congenital adrenal hyperplasia due to 21-hydroxylase deficiency. Hum Reprod Update 2004;10:469–85.
45. Gearhart JP. Bladder exstrophy: staged reconstruction [review]. Curr Opin Urol 1999;9:499–506.
46. Chen CJ. The treatment of imperforate anus: experience with 108 patients. J Pediatr Surg 1999;34:1728–32.
47. Babcook CJ, Goldstein RB, Filly RA. Prenatally detected fetal myelomeningocele: is karyotype analysis warranted? Radiology 1995;194:491–4.
48. McGuire EJ, Diddel G, Wagner F. Balanced bladder function in spinal cord injury patients. J Urol 1977;118:626–8.

49. Bauer SB. The challenge of the expanding role of urodynamic studies in the treatment of children with neurological and functional disabilities [editorial; comment]. J Urol 1998;160:527–8.
50. Snodgrass WT, Adams R. Initial urologic management of myelomeningocele. Urol Clin North Am 2004;31:427–34.