Urinary Tract Infections in the Pediatric Patient

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KEYWORDS

• Urinary tract infection • Cystitis • Pyelonephritis • Urologic anatomic abnormality
• Vesicoureteral reflux • Voiding dysfunction

KEY POINTS

- Appropriate collection of a urine specimen is paramount to diagnosing a urinary tract infection (UTI). A urine culture in a pre–potty trained child should be a catheterized sample or suprapubic aspirate.
- Obtaining a clear history of symptoms is helpful in determining whether the UTI is likely to be cystitis or pyelonephritis, which then informs type and duration of treatment.
- Current recommendations and clinical acumen should be used to determine which patients should have radiologic imaging after a UTI.
- Differentiating between anatomic abnormalities versus suboptimal habits as the cause of UTIs is essential to correctly treating the underlying cause of the UTI.
- Medical and surgical management options to treat the underlying cause of UTIs are reviewed as well as review of medical options to prevent UTIs.

INTRODUCTION

Urinary tract infections (UTIs) in the pediatric patient are common. One study estimates that UTIs affect 2.4% to 2.8% of children each year.[1] Three common times for UTIs are infancy,[2] potty training age,[3] and when a female patient becomes sexually active.[4] Appropriate diagnosis and treatment is essential to protecting renal health. Determining whether further workup is needed after a UTI occurs is important. UTIs can be related to voiding and stooling behaviors,[3] but can also have an underlying anatomic abnormality as the cause[5]; determining the underlying cause is paramount to helping prevent future UTIs.

PATHOGENESIS

Although bacterial pathogens are the most common cause of UTIs, fungal, parasitic, and viral UTIs can also occur but are much less frequent.[6] UTIs caused by bacteria have 3 main origins: retrograde ascent from enteral bacteria colonizing urethral and

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vaginal tissue, nosocomial caused by catheterization, and hematogenous spread through systemic infection. The most common origin is retrograde ascent.[7] *Escherichia coli*, *Klebsiella*, *Proteus*, *Enterococcus, Citrobacter*, *Serratia*, and *Pseudomonas* were found to be the most common urinary pathogens in several recent pediatric studies, with *E coli* being the most common causative bacteria.[8,9] Any child can get a UTI; however, there are certain risk factors and congenital anomalies that can increase a child's risk.

ANATOMIC ABNORMALITY RISK FACTORS FOR URINARY TRACT INFECTIONS

Anatomic abnormalities that may increase the risk of a UTI include vesicoureteral reflux (VUR), ureterocele, ectopic ureter, megaureter, ureterovesical junction obstruction, multicystic dysplastic kidney, ureteropelvic junction obstruction (UPJO), horseshoe kidney, cross-fused renal ectopia, kidney stones, posterior urethral valves (PUV), neurogenic bladder, bladder diverticulum, bladder duplication, urogenital sinus, and cloaca. VUR is the most common underlying congenital abnormality that is found in the workup of febrile UTIs; the other less common congenital causes that are risk factors for UTI are often diagnosed based on antenatal imaging findings that are confirmed postnatally.

Congenital ureteral abnormalities that can increase the risk of a UTI include VUR, ureterocele, ectopic ureteral insertion, and megaureter. VUR increases the risk of a kidney infection by giving bacteria in the bladder easier access to the kidney. VUR is a congenital abnormality where the ureter does not tunnel correctly into the bladder and, therefore, urine washes back up from the bladder toward the kidney. VUR is diagnosed with either a voiding cystourethrogram or contrast-enhanced ultrasonography (see section on Imaging in Urinary Tract Infections), and is graded from low grade (grade 1) to high grade (grade 5; **Fig. 1**).[10]

Another ureteral anomaly that can increase the risk of a UTI is a ureterocele, a balloonlike out pouching at the end of the ureter, which is an abnormality in ureteral formation. The ureterocele can cause urine to not drain normally, cause bladder outlet obstruction by obstructing the bladder neck if the ureterocele is large, and can be associated with VUR and thus increase the risk of a UTI.[10] An ectopic ureter is a ureter that inserts into an abnormal location; common insertion sites of an ectopic ureter include the urethra, vagina, and bladder neck. The abnormal insertion site is associated commonly with slowed urinary drainage along with an increased risk of VUR, thus increasing the risk of UTI (**Figs. 2–4**).[10]

Megaureter is an abnormally dilated ureter; this occurs owing to a segment of ureter near the ureterovesical junction that does not have normal peristalsis; if there is sluggish drainage or inadequate drainage such as with a ureterovesical junction obstruction or if there is associated VUR, there is an increased risk of UTI.[10]

Renal abnormalities that can increase the risk of UTI are multicystic dysplastic kidney, UPJO, horseshoe kidney and cross-fused renal ectopia. Multicystic dysplastic kidney is a congenital anomaly that is composed of a collection of cysts and nonfunctioning renal parenchyma.[10] When a multicystic dysplastic kidney is present, there is an increased risk of contralateral VUR, which increases the risk of UTI (**Fig. 5**).[11]

UPJO occurs when there is a narrowed segment of ureter where the ureter inserts into the renal pelvis or when there is an extrinsic compression of the UPJ by a crossing vessel. UPJO causes the kidney to not drain well and can increase the risk of UTI (**Fig. 6**).[10]

A horseshoe kidney, where the kidneys are joined by an isthmus of tissue and their ascent is stopped by the inferior mesenteric artery, carries an increased risk of VUR and UTI (**Fig. 7**).[12]