

# Imaging after Urinary Tract Infection in Older Children and Adolescents

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## Abbreviations and Acronyms

DMSA = dimercaptosuccinic acid  
RBUS = renal and bladder ultrasound  
SFU = Society for Fetal Urology  
UTI = urinary tract infection  
VCUG = voiding cystourethrogram  
VUR = vesicoureteral reflux

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**Purpose:** There are few guidelines and little data on imaging after urinary tract infections in older children. We determined the clinical yield of renal and bladder ultrasound, and voiding cystourethrogram in older children and adolescents after urinary tract infection.

**Materials and Methods:** We analyzed findings on voiding cystourethrogram, and renal and bladder ultrasound as well as the clinical history of patients who underwent the 2 studies on the same day between January 2006 and December 2010. We selected for study patients 5 to 18 years old who underwent imaging for urinary tract infection. Those with prior postnatal genitourinary imaging or prenatal hydronephrosis were excluded from analysis.

**Results:** We identified a cohort of 153 patients, of whom 74% were 5 to 8 years old, 21% were 8 to 12 years old and 5% were 12 to 18 years old. Of the patients 77% were female, 78% had a febrile urinary tract infection history and 55% had a history of recurrent urinary tract infections. Renal and bladder ultrasound findings revealed hydronephrosis in 7.8% of patients, ureteral dilatation in 3.9%, renal parenchymal findings in 20% and bladder findings in 12%. No patient had moderate or greater hydronephrosis. Voiding cystourethrogram showed vesicoureteral reflux in 34% of cases and bladder or urethral anomalies in 12%. Reflux was grade I, II-III and greater than III in 5.9%, 26% and 2% of patients, respectively. For any voiding cystourethrogram abnormality the sensitivity and specificity of any renal and bladder ultrasound abnormality were 0.49 (95% CI 0.37–0.62) and 0.76 (95% CI 0.66–0.84), respectively. Positive and negative predictive values were 0.58 (95% CI 0.44–0.71) and 0.69 (0.59–0.77), respectively.

**Conclusions:** In older children with a history of urinary tract infection the imaging yield is significant. However, imaging revealed high grade hydronephrosis or high grade vesicoureteral reflux in few patients. Renal ultrasound is not reliable for predicting voiding cystourethrogram findings such as vesicoureteral reflux.

**Key Words:** urinary tract infections, vesico-ureteral reflux, hydronephrosis, ultrasonography, adolescents

URINARY tract infections are common in adolescents and young children.<sup>1</sup> The 2011 AAP (American Association of Pediatrics) guidelines for evaluation after UTI focus on ages 2 to 24 months<sup>2</sup> but there are few guidelines

and little data on assessing older children and adolescents. VCUG and RBUS have been done in such patients but the value of such tests is uncertain.<sup>3,4</sup> The 2 procedures carry costs in terms of invasiveness and

resource use. In addition, it would be useful for the practicing clinician to counsel patients accurately on the anticipated probability of a positive test. Moreover, if 1 test could provide information on the other (ie if RBUS findings were reliably predictive of VCUg findings), a stepwise approach could be performed in which imaging tests could be ordered sequentially, each contingent on the results of the other.

While RBUS is a poor predictor of VCUg findings such as VUR in younger children 0 to 5 years old,<sup>5</sup> the predictive value of RBUS in the older age group is not well defined. We determined the clinical yield of RBUS and VCUg after UTI in older children and adolescents, and tested the predictive ability of RBUS with respect to VCUg findings in this patient population.

**METHODS**

The study was approved by the institutional review board and informed consent was waived. Single institution billing records were used to identify all patients 60 months to 18 years old who on a single day underwent VCUg (CPT code 74455) plus RBUS (CPT codes 76700—abdominal, 76705—abdominal, limited, 76770—retroperitoneal, 76775—retroperitoneal, limited, 76856—pelvic or 76857—pelvic, limited) between January 1, 2006 and December 31, 2010. Imaging reports were reviewed, and demographic and clinical histories were compiled from the electronic or paper medical record.

Patients with prior postnatal genitourinary imaging such as VCUg, RBUS or other studies during which the urinary tract was imaged, or a history of prenatal hydronephrosis were excluded from analysis. In all studies the indication was UTI, which was classified as febrile or nonfebrile and initial or recurrent.

	Normal	←←←←←←←←←←←←←←←←	↔	→→→→→→→→→→	Abnormal
	<b>Normal</b>	<b>RBUS-D</b>	<b>RBUS-C</b>	<b>RBUS-B</b>	<b>RBUS-A</b>
<b>Renal Collecting System</b>	Normal	Normal	“Fullness” or “prominence”	Mild hydronephrosis	>Mild hydronephrosis
<b>Ureter</b>	Normal	Normal	Normal	Mild dilatation	>Mild ureteral dilatation
<b>Renal parenchyma</b>	Normal	Duplication, Solitary Kidney	Simple cyst (single)	Size discrepancy  Renal ectopia	Stone(s), Dysplasia/ Increased echogenicity, Cortical thinning/scar, Abnormal cortico-medullary differentiation, Multicystic/polycystic kidney
<b>Bladder</b>	Normal	Normal	Debris, Wall thickening	Trabeculation, Diverticulum	Ureterocele, Dilated posterior urethra
	<b>VCUG-E</b>	<b>VCUG-D</b>	<b>VCUG-C</b>	<b>VCUG-B</b>	<b>VCUG-A</b>
<b>VUR</b>	Any VUR	Any VUR	VUR >Grade I	VUR > Grade II	VUR > Grade III
<b>Peri-ureteral diverticulum</b>	Any peri-ureteral diverticulum	Any peri-ureteral diverticulum	Any peri-ureteral diverticulum	Any peri-ureteral diverticulum	Any peri-ureteral diverticulum
<b>Bladder</b>	Diverticulum, Trabeculation, Ureterocele, Large volume, Small volume, Bladder wall thickening	“Significant” abnormalities: Diverticulum Trabeculation Ureterocele	“Significant” abnormalities: Diverticulum Trabeculation Ureterocele	“Significant” abnormalities: Diverticulum Trabeculation Ureterocele	“Significant” abnormalities: Diverticulum Trabeculation Ureterocele
<b>Urethra</b>	Any abnormality	Any abnormality	Any abnormality	Any abnormality	Any abnormality

**Figure 1.** RBUS and VCUg positivity thresholds in abridged form. To determine threshold met by findings of given imaging study first identify specific imaging finding furthest to right (most abnormal). RBUS or VCUg would then meet positive criteria of threshold at top of column (A, B, C, D or E) as well as of less stringent thresholds further to left. For instance, RBUS with most abnormal finding of mild ureteral dilatation would meet definition of positive RBUS for threshold B as well as thresholds C and D. This RBUS would be negative under threshold A.

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