Early Effect of American Academy of Pediatrics Urinary Tract Infection Guidelines on Radiographic Imaging and Diagnosis of Vesicoureteral Reflux in the Emergency Room Setting

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Abbreviations and Acronyms

AAP = American Academy of Pediatrics
DMSA = dimercaptosuccinic acid
ER = emergency room
fUTI = febrile UTI
RBUS = renal-bladder ultrasound
UTI = urinary tract infection
VCUG = voiding cystourethrogram
VUR = vesicoureteral reflux

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Purpose: In 2011 the AAP revised practice parameters on febrile urinary tract infection in infants and children 2 to 24 months old. New imaging recommendations invigorated the ongoing debate regarding the diagnosis and management of vesicoureteral reflux. We compared evaluations in these patients with febrile urinary tract infection before and after guideline publication.

Materials and Methods: During 2 separate 6-month periods 350 patients 2 to 24 months old were evaluated in the emergency room setting. Demographics, urine culture, renal-bladder ultrasound, voiding cystourethrogram and admission status were assessed.

Results: A total of 172 patients presented with initial febrile urinary tract infection in 2011, of whom 47 (27.3%) required hospitalization, while 42 of 178 (23.6%) were admitted in 2012. Admission by year did not significantly differ ($p = 0.423$). After guideline revision 41.2% fewer voiding cystourethrograms were done (72.1% of cases in 2011 vs 30.9% in 2012, $p < 0.001$). A 17.2% decrease in renal-bladder ultrasound was noted (75.6% in 2011 vs 58.4% in 2012, $p < 0.001$). Of 55 voiding cystourethrograms 21 (38.2%) were positive in 2012 compared to 36.3% in 2011 ($p = 0.809$). Mean ± SD maximum vesicoureteral reflux grade was unchanged in 2011 and 2012 (2.9 ± 1.2 and 2.5 ± 0.93, respectively, $p = 0.109$). There was no association between abnormal renal-bladder ultrasound and voiding cystourethrogram positivity ($p = 0.116$).

Conclusions: AAP guidelines impacted the treatment of infants and young children with febrile urinary tract infection. We found no relationship between renal-bladder ultrasound and abnormal voiding cystourethrogram, consistent with previous findings that call ultrasound into question as the determinant for additional imaging. Whether forgoing routine voiding cystourethrogram results in increased morbidity is the subject of ongoing study.

Key Words: urinary bladder, vesico-ureteral reflux, urinary tract infections, diagnostic imaging, practice guidelines as topic

URINARY tract infections are frequent in children, accounting for almost 1% of pediatric office visits, and between 5% and 14% of ER visits.[1–3] Approximately 15% of children with UTI have renal scarring on followup

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DMSA scan and the percent increases as the number of UTIs increases.[4–6] The potential for significant morbidity has placed emphasis on early and accurate diagnosis of pediatric UTI as well as appropriate antibiotic therapy.[7] In August 2011 the AAP revised practice parameters on the diagnosis and management of initial fUTIs in infants and children 2 to 24 months old.[8] The AAP recommends screening RBUS but no longer recommends routine VCUG after an initial fUTI in this age cohort.

The new AAP guidelines have raised concern among pediatricians, urologists and nephrologists regarding potential misdiagnosis and under treatment of young children with clinically significant VUR. We hypothesized that more selective VCUG use would not affect the severity of the VUR detected. To determine the early imaging related impact of the guidelines we evaluated the treatment of patients 2 to 24 months old who presented with an initial fUTI during 2 separate 6-month periods before and after, respectively, publication of the AAP UTI guideline revision.

MATERIALS AND METHODS

Institutional review board approval was obtained. To evaluate differences before and after publication of the AAP guidelines we reviewed the electronic medical charts of all patients 2 to 24 months old who presented with an initial fUTI to urgent care or ER in our pediatric health care system during 2 separate 6-month periods (January to June 2011 and January to June 2012, respectively). Study locations included 5 urgent care clinics and 2 ERs. Patients were identified by ICD-9 codes for acute pyelonephritis (590.0) and UTI (599.0). Those 2 to 24 months old with culture documented UTI and fever 101.5F or greater during the ER visit were included in analysis.

We assessed demographics, temperature, urine culture results and subsequent imaging, including RBUS and VCUG. Abnormal RBUS was defined as any degree of calyceal or ureteral dilatation, parenchymal echogenicity or scarring, renal atrophy, alterations in corticomedullary differentiation or urothelial thickening. Abnormal VCUG was considered positive when there was any grade of VUR. Positive urine culture was defined as a single organism of greater than 50,000 cfu obtained by catheterization. Excluded from study were patients outside the age range of the new guidelines and those with a history of VUR or VCUG, known genitourinary anomalies, a prior fUTI documented in the electronic medical record or by caregiver history and undocumented urine cultures or afebrile UTI, defined as a body temperature of less than 101.5F.

We determined the correlation between abnormal RBUS and VCUG positivity. The chi-square or Fisher exact test as appropriate was used to compare the distribution of categorical variables. Statistical analysis was done using SAS®, version 9.3 with $p < 0.05$ considered statistically significant.

RESULTS

During the 2011 study period 114 female and 58 male patients met all inclusion criteria, of whom 47 (27.3%) required hospitalization. During the 2012 study period 137 female and 41 male patients presented with an initial fUTI and 42 (23.6%) were admitted. Hospitalization by year did not significantly differ ($p = 0.423$). Table 1 lists demographics and radiographic studies by year. While the percent of children who presented with an initial fUTI and underwent VCUG decreased significantly in 2012 vs 2011, the likelihood of VUR and its severity were unchanged. Urine culture results were equivalent in the 2 cohorts (table 2).

In 2011 RBUS was performed in 130 patients (75.6%) a mean of 4.2 days (range 0 to 206) after the initial ER presentation. Of those patients 37 (28.5%) had an abnormality and the remaining 93 (71.5%) showed normal findings. Table 3 lists RBUS results. During the ER visit or associated hospital admission 17 RBUS studies (13.1%) were performed and 113 (86.9%) were done in an outpatient setting. In 2012 only 104 patients (58.4%) underwent screening RBUS and statistically fewer with an initial fUTI underwent RBUS after publication of the new guidelines ($p < 0.001$). RBUS was done an average of 5.2 days (range 0 to 177) after ER presentation with an initial fUTI. Of the ultrasounds performed in 2012 abnormal findings were noted on 24 (23.1%) while the remaining 80 (76.9%) showed no renal or bladder anomaly (table 3). At ER presentation and discharge 19 (18.3%) and 85 (81.7%) RBUS studies were done, respectively.

In 2011 VCUG was subsequently performed in 124 patients (72.1%) compared to only 55 (30.9%) in 2012, representing a statistically significant 42.1% decrease ($p < 0.001$). Patients underwent VCUG a mean of 11.7 days (range 5 to 206) after the ER visit. In 2011 and 2012 VCUG was positive in 45 of 124 (36.3%) and 21 of 55 patients (38.2%), which did not statistically significantly differ ($p = 0.809$). Mean ± SD maximum VUR grade was also unchanged in

Table 1. *Demographics and imaging by year in patients who presented to emergency setting with initial fUTI*

	2011 Cohort	2012 Cohort	p Value
No. pts	172	178	
Mean age (yrs)	0.74	0.77	0.682
No. female (%)*	114 (66.3)	137 (76.9)	0.033
No. male (%)*	58 (33.7)	41 (23.1)	0.033
No. uncircumcised males (%)	35 (60.3)	28 (68.3)	0.525
No. RBUS (%):*	130 (75.6)	104 (58.4)	<0.001
At ER/hospital admission	17 (13.1)	19 (18.3)	0.281
Abnormal RBUS	37 (28.5)	24 (23.1)	0.372
No. VCUG (%):*	124 (72.1)	55 (30.9)	<0.001
Pos	45 (36.3)	21 (38.2)	0.809
Mean ± SD max grade	2.9 ± 1.2	2.5 ± 0.93	0.109
No. hospital admission (%)	47 (27.3)	42 (23.6)	0.423

* Statistically significant decrease between 2011 and 2012.