

Yield of Imaging Performed as per Indian Society of Pediatric Nephrology Guidelines in Children with Urinary Tract Infection

*#RAJIV SINHA, *DEVDEEP MUKHERJEE, *#JAYATI SENGUPTA, #S SUBHASIS SAHA AND *SUSHMITA BANERJEE

From Departments of Pediatric Nephrology; *Institute of Child Health, #AMRI Hospitals and \$Calcutta Medical Research Institute, Kolkata; India

Correspondence to: Dr Sushmita Banerjee, Pediatric Nephrologist, Calcutta Medical Research Institute, Kolkata, India. asban@vsnl.com.

Received: May 04, 2016;

Initial review: December 13, 2016;

Accepted: June 29, 2017.

Objectives: To assess yield of imaging performed as per Indian Society of Pediatric Nephrology (ISPN) urinary tract infection (UTI) guideline. **Methods:** Ultrasonography (USG), voiding cystourethrography (VCUG) and dimercaptosuccinic-acid (DMSA) scintigraphy were performed in 183 children (age 0-5y) with first episode (age 0-1y) of UTI or recurrent (age <5y) UTI, as per ISPN recommendations. **Results:** Significant abnormalities were detected in 110 (63%), with vesicoureteric reflux (VUR) grades 3-5 in 31% and renal scars in 43%. Combined USG and DMSA had a negative predictive value of 94% for significant VUR. **Conclusion:** ISPN guideline resulted in a high yield of detection of significant abnormalities.

Keywords: Diagnosis, Evaluation, Management, Vesicoureteric reflux.

Guidelines for imaging after urinary tract infection (UTI) in young children vary in different countries [1-4]. The Indian Society of Pediatric Nephrology (ISPN) recommends that infants after first UTI, and children between 1 to 5 years with recurrent UTI should be investigated with ultrasonography (USG), voiding cystourethrography (VCUG) and dimercaptosuccinic acid (DMSA) scintigraphy [1]. We prospectively analyzed case records of children with UTI, who had all these investigations performed as per ISPN guidelines to assess the frequency of significant renal abnormalities in such children.

METHODS

We enrolled children with diagnosis of UTI between September 2013 and August 2015 at two tertiary care centers in Kolkata, India. UTI was diagnosed as per ISPN guideline [1] *i.e.* positive urine culture in a child having symptoms suggestive of UTI. Urine was collected by clean catch, supra-pubic aspiration or urethral catheterization. We included all children with first episode of UTI in infancy, and recurrent (≥ 2) UTI up to 5 years of age. Clinical symptoms were recorded. Symptoms of constipation, poor urinary stream, hesitancy, straining or dribbling were classified as bowel bladder dysfunction (BBD). USG was performed early after diagnosis, MCUG after confirming UTI resolution, and DMSA after a minimum of 2 months. Significant abnormalities were defined as: hydronephrosis with renal pelvic diameter ≥ 10 mm, ureteric dilatation, structural bladder abnormalities

(thickened wall or diverticulum) and/or bladder residue >20 mL on USG; vesico-ureteric reflux (VUR) grades 3 to 5, bladder or urethral abnormalities on VCUG; or parenchymal scars on DMSA.

RESULTS

We enrolled 183 consecutive children. Seven were excluded as they did not complete all three investigations. Out of 176 enrolled children (90 girls), 93 (52.8%) were infants. Among infants, 56% had recurrent UTI, 84% febrile UTI and 13% had BBD. Among 83 children aged between one and five years, 89% were febrile and 24% had BBD.

Significant abnormalities were present in 110 (63%) patients: 61 among infants and 49 in 1-5 year-olds. Sixty (54%) were girls, 105 (95%) had febrile UTIs and 32 (29%) had symptoms of BBD (**Table I**). The common abnormalities detected were: hydronephrosis (unilateral in 47, bilateral in 12), renal scars (unilateral in 52, bilateral in 24), and VUR grades 3-5 (unilateral in 29, bilateral in 25). Thirty children had post-void bladder residue of >20 mL, three had posterior urethral valves and another three had bladder trabeculations.

Significant abnormalities were more common in patients with febrile UTI ($P=0.001$) or symptoms of BBD ($P<0.001$). Significant abnormalities were more common in infants who had febrile ($P<0.001$) or recurrent UTI ($P=0.047$), in girls aged 1-5 yr ($P=0.013$), and in patients with BBD ($P<0.001$ and $P=0.007$) (**Table I**).

Table 1 COMPARISON OF PATIENTS WITH AND WITHOUT SIGNIFICANT ABNORMALITIES ON IMAGING

Characteristics	Infants n=93		Children (aged 1-5y) n=83	
	NSA, n=32	SA, n=61	NSA, n=34	SA, n=49
Male gender	16 (50)	35 (57.4)	20 (58.8)	15 (30.6)*
Febrile	18 (56.3)	60 (98.4)*	29 (85.3)	45 (91.8)
Symptoms of BBD	0	12 (19.7)*	0	20 (40.8)*
Recurrent UTI	13 (40.6)	39 (63.4)*	NA	NA

* $P < 0.05$, SA = significant abnormality, NSA: no significant abnormality, BBD: bladder bowel dysfunction; Values in No.(%).

Thirty (17%) patients had abnormal DMSA and/or abnormal VUCUG in presence of a normal USG (**Fig. 1a**). The two investigations that in combination would have detected the most number of significant abnormalities were USG and DMSA. These, if performed without VUCUG, would have missed significant VUR in only 4 (2%) patients. Of these 4, all were infants with febrile UTIs, 3 were males with unilateral grade 3 VUR while one girl had unilateral grade 4 VUR. The negative predictive value of a normal USG + DMSA for excluding VUCUG abnormality was 94%.

In infants, USG ($P=0.012$) and DMSA ($P=0.033$) abnormalities but not VUCUG ($P=0.088$) abnormality was significantly more common in those with recurrent UTI. 29 infants with a first UTI had normal USG of which 4 had significant VUR, 3 had renal parenchymal scars and 3 had both VUR and scars (**Fig. 1b**). Significant abnormalities would have been missed in 10/41 (25%) infants with first episode of UTI if NICE (National Institute for Health and Clinical Excellence, UK) [2] or AAP (American Academy of Pediatrics) [3] guidelines were followed, which do not advocate further investigation if USG is normal, and there are no atypical features or risk factors.

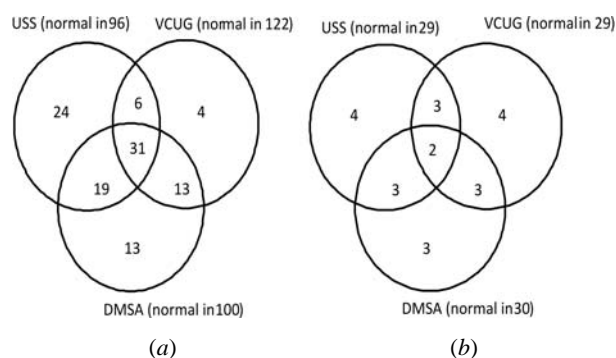


Fig. 1 Venn diagrams showing results of imaging in the whole study population (a) and in infants with first UTI (b) (The figures within the circles represent numbers with significant abnormalities).

DISCUSSION

In children, UTI may unmask underlying structural or functional anomalies of the urinary tract, and may be associated with renal parenchymal scars. Debate persists on the range of follow-up investigations [5-7], and is reflected in the differences in published guidelines [1-4]. Our assessment of the yield of investigations performed as per ISPN guidelines [1], focusing on the highest risk groups, revealed 63% children to have significant abnormalities. Our study also identified febrile UTI and symptoms of BBD as groups particularly needing close attention and follow-up.

While all guidelines are in agreement of more extensive investigation for children with recurrent UTI, prime differences lie in the imaging of infants after first UTI. The ISPN [1] advocates all three investigations (USG, VUCUG and DMSA), in this group. NICE and AAP guidelines [2,3] are more selective in their use of VUCUG/DMSA and rely on the result of USG. Similar to observations by Tse, *et al.* [8], we demonstrated that had the latter guidelines been followed, 25% of significant abnormalities would have been missed among infants with UTI.

Previous publications have suggested that a normal DMSA may obviate the need for VUCUG and *vice-versa* [9-14]. In our study, if only DMSA was done, we would have missed significant VUR in 10 patients (**Fig. 1a**). Performing only VUCUG would have missed renal scars in 32 patients. Similar to a recent publication by Lee, *et al.* [15], we found that the combination of normal USG and DMSA had a high negative predictive value of 94% for VUR.

Our results should be interpreted with caution because of the relatively small sample size. Also, the study was performed in tertiary centers where there is the possibility of a referral bias.

In conclusion, the current study demonstrates that compliance to ISPN UTI guidelines for infants with first UTI and children below 5 years with recurrent UTI,

WHAT THIS STUDY ADDS?

- In Indian children (age 0-5 y) with UTI, following the ISPN guidelines for imaging resulted in a high yield of detection of significant underlying abnormalities.

results in a high yield of detection of significant abnormalities. The ISPN guidelines seem to be the most appropriate in the Indian scenario, where early specific diagnosis alerts caregivers to the need for requisite follow-up.

Acknowledgement: Dr Surupa Basu (Department of Biochemistry, Institute of Child Health) and Mrs Sayantani Majumdar (Statistician) provided valuable inputs with statistical analysis.

Contributors: All authors contributed to data collection. SS performed the VCUG. RS, DM and SB were involved in data analysis and writing of the manuscript. JS and SS reviewed and edited the paper.

Funding: None; *Competing interests:* None stated.

REFERENCES

1. Indian Society of Pediatric Nephrology; Vijayakumar M, Kanitkar M, Nammalwar BR, Bagga A. Revised statement on management of urinary tract infections. *Indian Pediatr.* 2011;48:709-17.
2. National Institute for Health and Clinical Excellence. Urinary Tract Infection in Children: Diagnosis, Treatment and Long Term Management. 2007. Clinical Guidelines, No. 54.
3. Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management, Roberts KB. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. *Pediatrics.* 2011;128:595-610.
4. Ammenti A1, Cataldi L, Chimenz R, Fanos V, La Manna A, Marra G, *et al.* Febrile urinary tract infections in young children: Recommendations for the diagnosis, treatment and follow-up. *Acta Paediatr.* 2012;101:451-7.
5. South M. Radiological investigations following urinary tract infection: changes in Australian practice. *Arch Dis Child.* 2009;94:927-30.
6. Tullus K. Outcome of post-infectious renal scarring. *Pediatr Nephrol.* 2015;30:1375-7.
7. McDonald K, Kenney I. Paediatric urinary tract infections: A retrospective application of the National Institute of Clinical Excellence guidelines to a large general practitioner referred historical cohort. *Pediatr Radiol.* 2014;44:1085-92.
8. Tse NK, Yuen SL, Chiu MC, Lai WM, Tong PC. Imaging studies for first urinary tract infection in infants less than 6 months old: can they be more selective? *Pediatr Nephrol.* 2009;24:1699-703 .
9. Leonardo CR, Filgueiras MF, Vasconcelos MM, Vasconcelos R, Marino VP, Pires C, *et al.* Risk factors for renal scarring in children and adolescents with lower urinary tract dysfunction. *Pediatr Nephrol.* 2007;22: 1891-6.
10. Ajdinoviæ B, Jaukoviæ L, Krstiaë Z, Dopuda M. Technetium-99m-dimercaptosuccinic acid renal scintigraphy in children with urinary tract infections. *Hell J Nucl Med.* 2006;9:27-30.
11. Nammalwar BR, Vijayakumar M, Sankar J, Ramnath B, Prahlad N. Evaluation of the use of DMSA in culture positive UTI and culture negative acute pyelonephritis. *Indian Pediatr.* 2005;42:691-6.
12. Hansson S, Dhamey M, Sigström O, Sixt R, Stokland E, Wennerström M, *et al.* Dimercapto-succinic acid scintigraphy instead of voiding cystourethrography for infants with urinary tract infection. *J Urol.* 2004;172: 1071-3.
13. Tseng NH, Lin WJ, Lo WT, Wang SR, Chu ML, Wang CC. Does a normal DMSA obviate the performance of voiding cystourethrography in evaluation of young children after their first urinary tract infection? *J Pediatr.* 2007;150:96-9.
14. Preda I, Jodal U, Sixt R, Stokland E, Hansson S. Normal dimercaptosuccinic acid scintigraphy makes voiding cystourethrography unnecessary after urinary tract infection. *J Pediatr.* 2007;151:581-4.
15. Lee HY, Soh BH, Hong CH, Kim MJ, Han SW. The efficacy of ultrasound and dimercaptosuccinic acid scan in predicting vesicoureteral reflux in children below the age of 2 years with their first febrile urinary tract infection. *Pediatr Nephrol.* 2009;24:2009-13.