

## Original Research Article

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# Role of imaging in children with urinary tract infections

Subash Sundar<sup>1</sup>, Balaji Chinnasami<sup>1\*</sup>, Kanimozhi Sadashivam<sup>2</sup>, Sekar Pasupathy<sup>1</sup>

<sup>1</sup>Department of Pediatrics, <sup>2</sup>Department of Physiology, SRM Medical College, Hospital and Research Institute, Potheri, Kattankulathur, Chennai, Tamilnadu, India

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**\*Correspondence:**

Dr. Balaji Chinnasami,

E-mail: [balaji.ch@ktr.srmuniv.ac.in](mailto:balaji.ch@ktr.srmuniv.ac.in)

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## ABSTRACT

**Background:** As per recommendation from the American Academy of pediatrics a child with first episode of urinary tract infection should be evaluated for underlying urinary tract abnormalities by undergoing voiding cystourethrogram, ultrasonogram of urinary tract and radionuclide imaging of kidney. We studied role of these imaging studies in picking up renal abnormalities.

**Methods:** We conducted a descriptive study in which 100 children aged 1mth-12 years with documented urinary tract infection (UTI) were included. Ultrasonogram (USG) and radionuclide renal scan were obtained at the time of admission. Voiding cystourethrography (VCUG) was performed after 6weeks to look for vesicoureteric reflux.

**Results:** Forty three children underwent both DMSA and follow up VCUG. Ultrasonogram picked up acute pyelonephritis (APN) in 7.1% of children with UTI while 31.1% had pyelonephritis on DMSA. Overall incidence of VUR was 16.3%. The sensitivity of USG for VUR detection was only 14.2%. The sensitivity of USG as a screening test for APN is 7%.

**Conclusions:** All children less than five years with UTI must undergo DMSA and VCUG. Ultrasonography is less sensitive in detecting VUR and acute pyelonephritis.

**Keywords:** Acute pyelonephritis, Dimercaptosuccinic acid, Vesicoureteric reflux, Voiding cystourethrogram, Ultrasonogram

## INTRODUCTION

Management of children with urinary tract infection doesn't stop with treating that episode with antibiotics alone.<sup>1</sup> There is a higher chance of associated urinary tract abnormalities like vesicoureteric reflux, pelviureteric junction obstruction, ureteroceles that may result in recurrent infections and permanent damage to kidneys in the form of renal scarring.<sup>2</sup> Hence any child with UTI episode should be evaluated for congenital abnormalities.

American Academy of Pediatrics recommend imaging studies like ultrasonogram, voiding cystourethrogram and radionuclide imaging (technetium-99m-labelled

dimercaptosuccinic acid) after a first episode of UTI.<sup>3</sup> Although imaging is performed as per protocol for evaluation of UTI by physicians, Indian studies evaluating the significance of imaging in picking up congenital urinary tract abnormalities is limited. We did this study to find out the role of imaging studies in children with first episode of culture documented urinary tract infection.

## METHODS

It's a descriptive study. Children aged 1month to 12 years attending outpatient and inpatient unit of pediatrics department of government Royapettah hospital were taken up for study from August 2002 to October 2003.

### Inclusion criteria

All children between 1m-12 years with first episode of documented urinary tract infection. They should have undergone all three modalities of imaging-ultrasonography, DMSA, Voiding cystourethrogram.

### Exclusion Criteria

- Children with preexisting urinary tract abnormality.
- Children who had renal imaging before.
- Children with immunodeficiency
- Children with lymphoreticular malignancies like leukemia.
- Children on long term steroids, immunosuppressants.

Children attending the inpatient and outpatient unit of pediatric ward, government Royapettah hospital with symptoms like fever, dysuria, urgency, frequency, nocturnal/diurnal enuresis, hematuria, malodorous urine, thin stream urine, straining on micturition, constipation, puffy face, septicemia were included in the study and subjected to complete clinical examination after obtaining a detailed history.

### Collection of urine samples

The early morning sample of urine was collected by following methods. In children less than 2 years, urine was collected by suprapubic aspiration.

In children above 2 years, midstream clean catch urine was obtained.

The urine samples collected were transported within half an hour to the microbiology laboratory of the hospital for quantitative urine culture and routine urine analysis.

### Significant bacteriuria

Children with more than 105 colonies of single organism per ml of midstream clean catch urine and any number of bacteria in urine from suprapubic aspiration was

considered significant bacteruria. Children with significant bacteriuria were subjected to further diagnostic imaging studies. Children with UTI were subjected to renal imaging by real time grey scale ultrasonogram. Renal DMSA scintigraphy was carried out in children during the period of admission. Cortical scarring was defined as areas of decreased trace uptake with defect in normal reniform outline. Acute pyelonephritis changes were defined as areas of non-uniform trace uptake with preservation of normal reniform outline. Voiding cystourethrogram was carried out in 49 children after 6 weeks. Vesicoureteral reflux was graded using international system of radiographic grading of VUR.

## RESULTS

Only 43 children underwent both DMSA and VCUG. Two children with normal DMSA scan were lost to follow up and VCUG not performed. Six children had VCUG but DMSA scan not done. Out of 43 children who underwent DMSA scan 29 children were less than 5 years and 14 were more than 5 years. In children less than 5 years of age 10 had pyelonephritis while 4 children above 5 years of age had similar changes.

Voiding cystourethrogram was carried out in 49 children. Out of 43 children who already had cortical imaging with DMSA 7 children had vesicoureteral reflux. Out of six children less than 5 years of age with VUR 4 children had pyelonephritis. VUR was noticed in only one child with pyelonephritis, remaining 13 children above 5 years of age had no VUR on VCUG (Figure 1).

A total of 100 children with culture proven UTI aged between 1 month to 12 years were included in our study. Age wise and sex wise distribution of children enrolled in the study is given below (Table 1).

With regard to clinical features with which children presented fever was present in 68 children, dysuria in 16 children, straining on micturition in 5 and pyuria in 4 children (Table 2).

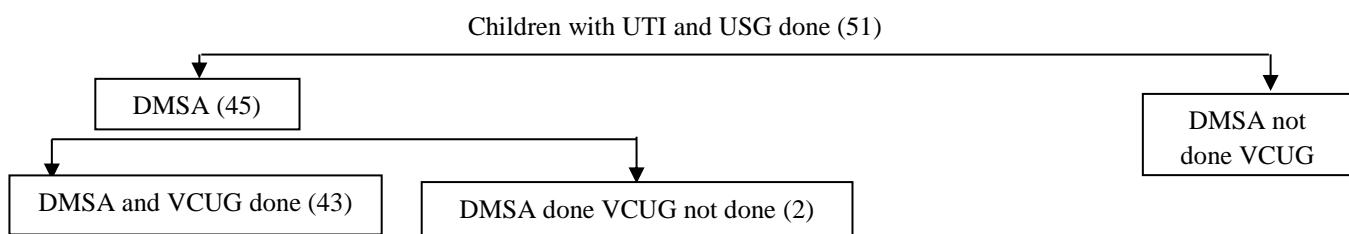


Figure 1: Flowchart of patient enrolment.

**Table 1: Demographic characteristics.**

Age	Male child	Female child	Total
< 1 year	9	6	15
1-3	11	14	25
3-5	5	7	12
5-7	8	7	15
7-9	4	8	12
9-12	5	16	21
<b>Total</b>	<b>42</b>	<b>58</b>	<b>100</b>

**Table 2: Clinical presentation of children with UTI.**

Presenting symptoms	No. of children
Fever	68
Dysuria	16
Oliguria	10
Macroscopic hematuria	8
Urgency/ Frequency	6
Malodorous urine	6
Thin stream urine	5
Dribbling of urine	5
Straining on micturition	5
Pyuria	4
Puffy face	13
Conversion	11
Diarrhea	3
Vomiting	3
Abdominal Colic	1

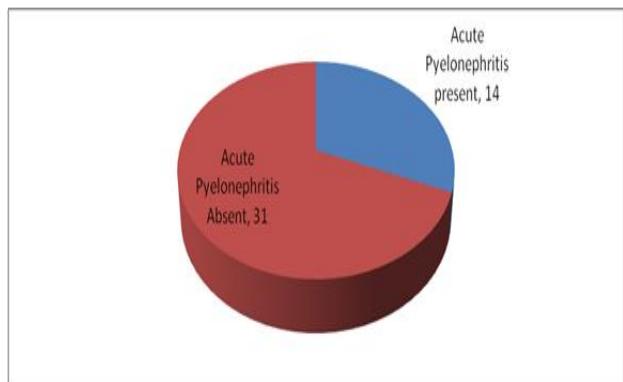
The most common organism isolated in urine culture was *E. coli* followed by *Klebsiella* (Table 3).

**Table 3: UTI -Organism isolated in culture.**

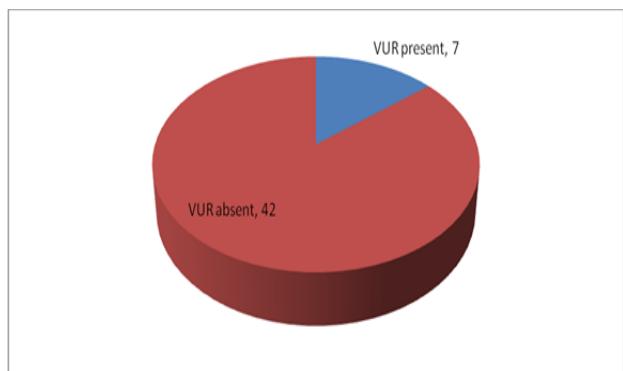
Observation	No. of children
<i>E. coli</i>	59
<i>Klebsiella</i>	23
<i>Proteus</i>	14
<i>Pseudomonas</i>	2
Mixed growth	2

**Table 4: Ultrasonogram among children with UTI.**

Age	Sex	USG Observation
6	Female	Multiple vesicle calculus with right ureteric calculus proximal to U-V junction with mild hydronephrosis right
1	Male	Left ureteric dilatation
4	Female	Right renal calculus
2.6	Male	Acute Pyelonephritis



**Figure 2: UTI- DMSA findings.**



**Figure 3: Voiding cystourethrogram In UTI.**

**Table 5: Children with DMSA and ultrasonogram.**

Ultrasonogram	DMSA		Total
	APN positive	APN negative	
Positive	1	0	1
Negative	13	29	42
Sensitivity of USG = 7% Specificity of USG = 100%			

**Table 6: Children with VCUG and USG.**

Ultrasonogram	VCUG		Total
	VUR positive	VUR negative	
Positive	1	0	1
Negative	6	36	42
Sensitivity of USG = 14% Specificity of USG = 100%			

**Table 7: Children with VCUG and DMSA.**

DMSA	VCUG		Total
	VUR positive	VUR negative	
APN positive	5	9	14
APN negative	2	27	29
Sensitivity of DMSA = 71% Specificity of DMSA = 75%			

## DISCUSSION

Urinary tract infection is one of the most frequently encountered clinical problems. It has been estimated that 8% of girls and 2% of boys will have a UTI during childhood.<sup>4</sup> UTI serves as a marker of underlying anatomic and functional abnormalities. Infants and young children are at higher risk than older children for incurring acute renal injury.

In our study comprising of 100 children with culture proven UTI 58% were girls and 42% were boys. Female children are more commonly involved in older age group. Children in 1-3 years are more commonly affected. Fever is the most common presenting complaint and *E. coli* is the predominant organism grown in culture. Das et al and Winberg et al also found that *E. coli* is the most common organism isolated in UTI.<sup>5,6</sup>

In our study USG was able to pick up 7.1% of children with acute pyelonephritis. 31.1% of children with first episode of culture proven UTI had acute pyelonephritis on DMSA scan. In children less than 5 years old pyelonephritic changes noticed in 34.5% while in older children the prevalence is 28.57%.

Daivy Benador et al found 67% of children with UTI had pyelonephritis in DMSA. In a study by Kass et al 36.6% children with UTI had acute pyelonephritis on DMSA. In a study by Howard et al found 28% of boys with UTI had pyelonephritis.<sup>7-9</sup>

In our study vesicoureteric reflux was noticed in 29.68% of children with first UTI who are younger than 5 years. In children above 5 years reflux was found in 7.14% of children. Overall incidence of VUR was 16.3% of children with UTI. A study by Jothilakshmi et al found VUR in 15.3% of 45 children with UTI. Martin charron et al found a prevalence of 39% VUR in UTI children. In a study of 234 children with UTI Craig et al reported VUR in 28.3% of children. Michelle et al found VUR in 31% of children with UTI.<sup>10-13</sup>

In our study VCUG was able to pick up VUR in 40% of children less than 5 years with pyelonephritis changes in DMSA scan. Reflux was also noted in 10.5% of children without evidence of parenchymal abnormalities in less than 5 years old.

In children above 5 years of age, VUR was noticed in 25% of those with pyelonephritis. Reflux was not found in any children with normal renal parenchyma in our study group.

Kass et al studied 453 children and found that 38.6% of children with acute pyelonephritis had VUR. Kass et al in his study found that 23% of the children with normal DMSA had VUR. Belman et al reported 19% of children with normal DMSA found to have VUR.<sup>8,14</sup>

In our study the agreement between DMSA and VCUG is fair. The sensitivity and specificity of DMSA in detecting VUR in comparison with VCUG is 71% and 75% respectively. Hence VUR cannot be expected to be present in all cases with acute pyelonephritis.

In our study USG abnormalities was found in only 4% of children with UTI. USG showed parenchymal changes consistent with pyelonephritis in only 7.1% of cases. In a retrospective study by Christian et al found that sensitivity of USG for detection of renal cortical damage was 21.7%.<sup>15</sup>

In our study the agreement between ultrasonography and VCUG as well as DMSA is poor statistically. The sensitivity of ultrasonography as a screening test for acute pyelonephritis is 7% and vesicoureteric reflux is 14%. But USG is a highly specific test in detecting them.

Out of 7 children with VUR detected by VCUG 14.2% showed dilatation of ureter on USG suggestive of VUR. Blane et al retrospectively evaluated 493 children with VCUG and ultrasonogram and found only 26% of those with VUR in VCUG was detected by ultrasonogram. Mahant et al studied 162 children with UTI and found that sensitivity of USG for detection of VUR was 40%.<sup>16,17</sup>

The sensitivity of USG for detection of VUR was only 14.2% in our study. USG is less sensitive in detecting VUR.

The prevalence of acute pyelonephritis is 31.1% and VUR is noted in 16.3% of children with UTI in our study group.

The lower prevalence noticed in our study group is due to the small number of children enrolled in our study. USG is found to be less sensitive in detecting pyelonephritis and VUR in our study group. Since the study group is small a larger study is needed to conclusively establish the role of ultrasonogram for screening children with pyelonephritis and vesicoureteric reflux.

## CONCLUSION

All children with urinary tract infection less than 5 years should undergo DMSA scan and voiding cystourethrogram. Children more than 5 years of age with UTI should undergo DMSA scan. In children, more than 5 years of age voiding cystourethrogram can be done in only those with parenchymal abnormalities. Ultrasonogram is less sensitive in detecting acute pyelonephritis and vesicoureteric reflux.

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