

Original Research Article

A study of urinary tract infection in children aged 1-5 years admitted with acute febrile illness

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ABSTRACT

Background: Urinary tract infection (UTI) is a common problem in pediatric age group and is a significant risk factor for long term sequelae. The clinical signs and symptoms of UTI are nonspecific in the first 5 years of age.

Methods: A cross-sectional study was conducted after obtaining institutional ethical clearance and informed consent from the parents, on 350 children aged 1 to 5 years admitted in with acute febrile illness.

Results: Out of 350 children with acute febrile illness 23 had culture proved UTI. The frequency of occurrence of UTI was 6.5%. Majority 8 (34.7%) of children with UTI were between 1-2 yrs. There was female preponderance with male: female ratio of 1:2.3. Twelve children with UTI belonged to lower socioeconomic status. Fourteen (60.87%) had nonspecific symptoms. Seventeen (73.9%) children had a provisional diagnosis other than UTI. pyuria >10 WBC/HPF had higher specificity (98.5%) and positive predictive value (72.2%) than >5WBC/HPF. Combined bacteruria and pyuria had specificity of 98.8 %. The most common organism isolated from children with UTI was *E. coli*, most of the organisms (73.9%) were sensitive to ceftriaxone. Abnormal ultrasonographic features was found in 17.4 % of children with UTI.

Conclusions: As the febrile children with UTI usually present with nonspecific signs and symptoms, urine culture should be considered as a part of diagnostic evaluation. Urine culture is the gold standard for diagnosis of UTI. However combined bacteruria and pyuria had specificity of 98.8% and can be used to start empirical antibiotic therapy awaiting culture reports.

Keywords: UTI, Febrile illness, Pyuria, Urine culture

INTRODUCTION

In children below five years of age, fever is the commonest reason for OPD visits. Quite often the child receives antibiotics empirically, without adequate evaluation for UTI.¹

UTI is one of the most common bacterial illnesses among febrile infants and preschool children with a prevalence between 4.1 percentages and 7.5 percentages. It accounts for four to ten percentages of febrile children admitted to

the hospital and is the third most common infection in pediatric age group next to respiratory and gastrointestinal infections.²

Urinary complaints like abdominal pain, vomiting and fever with chills, rigors or suprapubic pain which are characteristic features of UTI are rare below the age of 5 years. Symptoms are often vague and over looked.³ Most of the UTI in the first 2 years of life are “occult” and remain undiagnosed if tests are not routinely performed to detect them.⁴

Older children may present with classical symptoms of either lower UTI (dysuria, frequency, wetting) or upper UTI (systemic upset, fever, loin pain), on the other hand younger child present nonspecific manifestations that may include poor feeding, vomiting, irritability, failure to thrive, lethargy, and abdominal pain.⁵

UTI in young children may serve as a marker for urinary tract abnormalities, hence early diagnosis is of considerable significance in order to preserve kidney functions and prevent complications.

Pyelonephritis leads to renal scarring in 27% to 64% of children with UTIs in less than 5 years age group, even in the absence of underlying urinary tract abnormalities.⁶

It is crucial to recognize UTIs in febrile children, if missed it could have long-term consequences like renal scarring, and its adverse effects like hypertension, and end stage renal disease.⁷

Urinalysis is useful screening test in clinically suspected UTI for starting empirical antibiotic therapy. Microscopy performed on any freshly voided specimen (<1 hour after voiding) showing presence of >10 leucocytes/mm³ in an uncentrifuged specimen/>5 leucocytes/mm³ in a centrifuged specimen is significant. UTI should not be diagnosed on finding isolated leukocyturia, which is not uncommon in child having fever.⁵

While urinalysis is helpful in making a presumptive diagnosis. The diagnosis of UTI is confirmed on a positive urine culture and is gold standard for diagnosing UTI in children.⁵

A high index of suspicion and early detection of UTI in children is essential.

Objectives

Objectives were to determine the frequency of UTI in children with acute febrile illness in age group 1-5 years and to assess the usefulness of urine routine examination as compared to urine culture in the diagnosis of UTI.

METHODS

This cross-sectional study was undertaken in Children between of 1 to 5 years of age admitted with acute febrile illness in pediatric ward at ESIC medical college and PGIMS, Rajajinagar Bangalore, over a period of one and half year from January 2019 to June 2020. Informed consent was obtained from parents or guardians for enrolment of their children in the study after institutional scientific and ethical committee approval.

Inclusion criteria

Children in age group of 1-5 years, acute Febrile illness with (Axillary temp. > 37.5°C) were included in study.

Exclusion criteria

Children who have received antibiotics 48 h prior to attending hospital, known congenital genitourinary anomalies, with known neurological disorders like cerebral palsy and prev h/o UTI were excluded.

Collection of urine

In children between 1- 2 years of age the genitalia were cleaned with soap and water. Urine was collected in sterile bag, around 10 ml of urine was transferred in to sterile bottle.

In children above 2 years, midstream sample was collected, after taking the above precautions, Samples were immediately sent for urine routine and culture.

Urine routine: Urine albumin was qualitatively estimated by dip stick tests, 10 ml of the urine was centrifuged at 3000 rpm for 20- 30 mins & wet mount was prepared with the sediment which was examined under microscope for pus cells and bacteria. In the present study ≥ 5 pus cells/HPF in a centrifuged urine sample was taken as significant pyuria.

Urine culture: Urine received in sterile containers was immediately inoculated in to blood and MacConkey agar plates with a 0.01ml calibrated loop. All plates were incubated at 35-37° C for 48 hrs under aerobic condition to obtain accurate colony count and sensitivity to various antibiotics tested. An organism with zone of inhibition measuring 15 mm or more in diameter was considered to be sensitive to the particular antibiotics.

Growth of $>10^5$ /ml colonies of single organism was considered significant. Samples with multiple growth were considered as contaminated and those with a colony count less than 10^5 /ml taken as negative for infection. Samples showing insignificant growth, mixed growth of two or more pathogens not considered as culture positive.

Further investigations in culture proved UTI cases carried out as per Indian pediatric nephrology group (IPNG) revised statement and Italian society of pediatric nephrology (ISPN).

All children with culture proved UTI were treated with appropriate antibiotics and prophylactic antibiotic therapy was given wherever indicated and advised for follow-up.

Statistical analysis

Information collected was entered in MS excel sheet and analysed using SPSS software version 21.0. Data was presented as numbers, percentages, mean and SD.

Relationships between variables were Analysed by using the chi-square test wherever necessary at 5% level of significance. $P < 0.05$ considered statistically significant.

Sensitivity, specificity and positive and negative predictive values calculated for pyuria and bacteriuria in relation to urine culture results as per standards.

RESULTS

A total number of 350 children with acute febrile illness between age group of 1 to 5 years were enrolled for this study. There were 196 males and 154 females included in this study. Out of these, 23 (6.5%) children were diagnosed to have culture positive UTI.

Majority (n=8, 34.7%) of children with UTI were between 1-2 year of age, there was no statistical difference among different age group.

Female preponderance with male to female ratio of 1:2.3, which was statistically significant. Majority (n=12, 52%) of children with UTI belonged to lower class.

Majority (60.87%) had nonspecific symptoms. vomiting (56%), dysuria (52%) and loss of appetite (39.13%) were the common symptoms in children with UTI.

Majority (n=19, 82.6%) of children with culture positive UTI had temp $\geq 101^{\circ}$ F at presentation. Out of 23 children with UTI, 8 (34.7%) had sick as well as the toxic appearance.

The most common cause of acute febrile illness was respiratory infection (n=193, 55.14%) among these three children (1.55%) had UTI. Provisional diagnosis of gastroenteritis was made in 42 (12%) children among them 5 (11.9%) had UTI. Provisional diagnosis of UTI was made in 9 (2.6 %) children among them 6 (66.7%) had culture positive UTI. Among the 40 (11.4%) children with the diagnosis of fever without focus four (10%) had the UTI.

Out of 23 children with culture proved UTI, 17 (73.9 %) had a provisional diagnosis other than UTI. This suggests that 73.9% children with UTI would have been missed if urine culture was not taken as routine diagnostic method of evaluation in children with acute febrile illness.

Sixteen (69.6%) children with UTI and 95 (29%) without UTI had proteinuria which was statistically significant.

The 22 (95.6%) children with UTI and 39 (11.9%) without UTI had pus cells >5 per HPF on urine microscopic examination, which statistically significant.

If only pyuria was taken as a diagnostic method for UTI, 39 (11.9%) children without UTI would have been considered as UTI. Bacteriuria was found in 13 (56.5%) children with culture positive UTI, whereas 4 (1.22%) of children without UTI had bacteriuria which was statistically significant. However, UTI would have been missed if only presence of bacteriuria was taken as a method of diagnosis for UTI in 10 (43.4%) children with UTI. In diagnosing UTI, pyuria with >10 WBC/HPF had higher specificity with higher positive predictive value than the conventional pyuria of >5 WBC/HPF. Bacteriuria occurring along with pyuria had a specificity of 98.77% in predicting infection.

The most common organism isolated were *E. coli* followed by *Klebsiella*.

Majority 73.9% of microorganisms were sensitive to ceftriaxone. A 65% were sensitive to amikacin, cephalexin and 43.5% were sensitive to norfloxacin. (56.5%) of the organisms were resistant to ampicillin. In 19 (82.6%) children with UTI, renal ultrasonography was normal, four (17.4%) children had abnormal ultrasonographic findings of which two had unilateral hydronephrosis and other two showed acute cystitis.

Table 1: Age wise distribution of study population and UTI cases.

Age (In months)	Children without UTI, (C)	Children with UTI, (n=23)	Total	Percentage, C/n $\times 100$	P value
12-24	83	8	91	8.8	0.779
25-36	75	4	79	5	
37-48	90	6	96	6.25	
49-60	79	5	84	5.95	
Total	327	23	350		

$\chi^2=1.09$, $p<0.05$ (S)

Table 2: Various symptoms among UTI cases.

Symptoms	Culture positive, children (n)	Percentage (%)
Fever	23	100
Vomiting	13	56.52
Dysuria	9	39.13
Loss of appetite	9	39.13
Increased frequency	8	34.78
Chills and rigors	8	34.78

Continued.

Symptoms	Culture positive, children (n)	Percentage (%)
Irritability	6	26.09
Burning Micturition	5	21.74
Passing high coloured urine	4	17.39
Abdominal pain	4	17.39
Refusal of feeds	4	17.39
Dribbling of urine	4	17.39
Decreased urine output	3	13.04
Loose stool	2	8.70
Cough and cold	2	8.70
Foul smelling urine	1	4.35

Table 3: Physical findings in UTI cases.

Signs	Culture positive children, (n)	Percentage (%)
Sick and toxic appearance	8	34.783
Bladder distension	6	26.087
Dehydration	5	21.739
No other signs	4	17.39
Phimosis	3	13.04
Renal angle tenderness	2	8.696
Supra pubic tenderness	2	8.696
Signs of AURI	2	8.696
Signs of ALRI	1	4.348

Table 4: Distribution of UTI cases with foci of infection.

Diagnosis	Total no. of children		Total no. of children	Culture positive children		Total	Percentage (C/n x 100)	P value	Inference
	Male	Female		Male	Female				
ALRI	65	50	115	1	1	2	1.74	≥0.05	NS
AURI	44	34	78	0	1	1	1.28	≥0.05	NS
Acute gastroenteritis	24	18	42	1	4	5	11.90	<0.05	S
Fever without focus	21	19	40	1	3	4	10.0	<0.05	S
Dengue fever	18	12	30	0	2	2	6.67	≥0.05	NS
Enteric fever	8	10	18	0	1	1	5.56	≥0.05	NS
Malaria	1	1	2	0	0	0	0	≥0.05	NS
UTI	6	3	9	3	3	6	66.7	<0.05	S
Viral hepatitis	4	2	6	0	0	0	0	≥0.05	NS
Total	196	154	350	7	16	23	6.5	≥0.05	-

Table 5: sensitivity, specificity and predictive values of microscopic urinalysis.

Component	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
>5 WBC/HPF	95.65	88	36	99.6
>10 WBC/HPF	56.52	98.47	72.22	96.98
>20 WBC/HPF	26	99.69	85.7	95
Any bacteriuria	56.52	98.77	76.47	96.99
Combined pyuria and bacteriuria	56.52	98.77	76.47	96.99

Table 6: Organisms isolated in UTI cases.

Organisms	No. of children with UTI	Percentage (%)
<i>E. coli</i>	18	78.3
<i>Klebsiella</i>	04	17.4
<i>Proteus</i>	01	4.34
Total	23	100

DISCUSSION

UTI is a common problem in the pediatric age group and is a significant risk factor for long term sequelae. The clinical signs and symptoms of UTI are nonspecific and vague in the first 5 years of age. It may be present in febrile children with other illnesses, without clinical evidence of UTI. Such infection, if untreated can lead to subsequent renal scarring and is an established risk factor for end stage renal disease.

Out of the 350 children, 23 had culture proven UTI giving an overall prevalence of 6.5%, which is comparable with study done by Rongala et al (5.5%).⁸

In contrast to our study, Saheb and Masika et al reported higher prevalence of UTI, (13% and 11.9% respectively), high prevalence in their study could be due to inclusion of children below 1 year.^{9,10}

In this study, there was female preponderance for UTI with a male to female ratio of 1:2.3 which was statistically significant. studies done by Shetty et al, Masika et al, Rongala et al and Saheb showed female preponderance with male: female ratio of 1:1.5, 1:1.44, 1:1.15 and 1:1.46 respectively.⁸⁻¹⁰

In the present study, 12 (52 %) of children with UTI belonged to lower socioeconomic class. Similarly, Saheb also observed high frequency (45.83%) of UTI in Lower socioeconomic class.⁹ This high frequency may be due to poor perineal hygiene, poor toilet training and associated malnutrition which is prevalent among this population.

In present study symptoms suggestive of UTI were found in 9 (39.13%) children. Nonspecific symptoms were found in majority of children like vomiting 13 (56.52%), loss of appetite (39.13%) irritability (26.09%), refusal to feed 4 (17.39%), abdominal pain (17.39%) and loose stool 2(8.7%). Similar to present study, nonspecific symptoms were also seen in a study done by Rongala et al like refusal to feed (45%) and vomiting (63%).⁸ Shetty et al reported vomiting, diarrhea, irritability and loss of appetite in 40%, 20%, 25% and 15% respectively.¹¹

Majority (n=19,82.6%) of children with UTI had temperature of $\geq 101^{\circ}$ F. Shetty et al observed significant prevalence of UTI in febrile children with temperature $>102.7^{\circ}$ F.¹¹

Fever appears to be consistently present in young children with UTI, Rongala et al observed that fever was consistent symptom common to all children with UTI.⁸ In our study 4 (17.39%) children had no other signs other than fever indicating the importance of recognition of UTI in such children.

In the present study, 341 (97.42%) children had a provisional diagnosis other than UTI such as respiratory infection (55.14%), gastroenteritis, dengue fever and

enteric fever whereas provisional diagnosis of UTI was made in 9 (2.58%).

Of 193 children with respiratory infection, 3 (1.55%) children had UTI. Similar observation was made by Shetty et al (1.4%).¹¹

Of 42 children with gastroenteritis, 5 (11.9 %) children had UTI which is statistically significant ($p<0.05$). This observation is in accordance with studies by Shetty et al who reported prevalence of 7.5% among children with Gastroenteritis. Masika et al observed that out of 23 cases with gastroenteritis one (4.34%) had UTI.¹⁰ Heavy periurethral colonization often associated with perineal contamination following gastroenteritis may explain the high degree of prevalence in these patients.

In the present study, out of 9 children with provisional diagnosis of UTI, 6 (66.7%) children had culture proven UTI. In a study done by Shetty et al out of 29 children with provisional diagnosis of UTI, 6 (20.7%) children had culture proven UTI.¹¹ Masika et al in their study made a clinical impression of UTI in 6 (1.6%) of all the assigned clinical diagnosis and reported that only one (16.6%) had a positive urine culture.¹⁰

Among 40 children who presented with fever without focus, 4 (10%) children had UTI. Shetty et al had reported high prevalence (25 %) of UTI in children with no definite source of fever and recommended urine culture in such patients.¹¹

In the present study, two children with provisional diagnosis of enteric fever and one child with provisional diagnosis of Dengue fever had UTI. In a study by Dharnidharka et al involving 28 children with enteric fever, had found 2 children with positive urine culture. This indicates there may be co-infection.¹²

All these observations suggest that UTI would have been missed in children with acute febrile illness if urine culture was not taken as a routine diagnostic method of evaluation.

In present study, 69.56% children with UTI had proteinuria in contrast to 29% children without UTI which statistically significant ($p<0.01$). These findings correlate well with study by Matthai et al who found that 78% and 20% of children had proteinuria in culture positive and culture negative groups respectively.¹³

In the present study, 95.65% children with UTI had pus cells >5 /HPF in urine in contrast to 11.9% children without UTI which was statistically significant (<0.05), 11.9% children without UTI would have been considered as infected if only pyuria was taken as a diagnostic method for UTI.

In our study pyuria defined as >5 WBC/ HPF had a sensitivity of 95.65% and specificity of 88%. However

positive predictive value was low (36%). These findings correlate well with the study by Saheb with sensitivity and specificity of 100% and 90% respectively.⁹ Chidambaranathan et al noted that >5 WBC/HPF had sensitivity and specificity of 89.47% and 100% respectively.¹⁴ Jeeyani et al noted a very low sensitivity and specificity of 63.5% and 25% respectively.¹⁵

In the present study, 13 (56.52%) children with UTI and 4 (1.22%) children without UTI had bacteria in their urine which was statistically significant. However, 10 (43.47%) children with UTI would have been missed if presence of bacteria alone on microscopy was taken as a method of diagnosis for UTI.

Urine microscopy for bacteria significantly improves the reliability of urinalysis for detection of UTI, with a sensitivity of 56% and specificity of 98.77%. Similar observations were made by Shetty et al who noted sensitivity of 60% and specificity of 99% using centrifuged urine sediments.¹¹

Bacteriuria occurring along with Pyuria had a specificity of 98.8% in predicting infection which is similar to the observation made by Hoberman et al.¹⁶ Although microscopic urinalysis cannot substitute for a urine culture in diagnosing UTI, it may be valuable in selecting patients for prompt initiation of antibiotic therapy while awaiting the results of urine culture

The most common organism isolated were *E. coli*, (78.26%) followed by *Klebsiella* (17.39 %). This is in accordance with most of the previous studies done by Jeeyani et al (52%), Gaikwad et al (75%), Rongala et al (50%), Chidambaranathan et al (58%).^{8,14,15,17}

Majority 73.9% of microorganisms were sensitive to ceftriaxone and 56.5% were resistant to ampicillin. Our findings were similar to study done by Shetty et al who reported that 75% of microorganisms were sensitive to ceftriaxone and 55% of organisms were resistant to ampicillin.¹¹

Out of 23 children with UTI who underwent abdominal ultrasonography, 4 (17.4%) had abnormal ultrasound findings of which two had unilateral hydronephrosis and other two showed acute cystitis. Nineteen (82.6%) had normal study, which is similar to study by Shetty et al who reported normal renal ultrasound in 80% of children with UTI.¹¹

Limitations

It was single centre study with limited sample size. Infants and out patients were not included in this study. Community-based study could not be carried out for reasons of practicability and technical feasibility. Hospitalized cases may not be representative of all cases in the community. This needs extensive population-based research. Urine sample collection in under-2-year-old

girls is challenge and may have contributed to contaminants.

CONCLUSION

UTI should be considered as a potential cause of fever in children below Five years of age. As children with UTI usually present with nonspecific signs and symptoms, urine culture should be considered as a part of diagnostic evaluation. High yield was obtained in children with provisional diagnosis of UTI, Fever without focus and gastroenteritis. Hence urine culture should be done routinely in such children. The predictive value of pyuria >5 WBC/ HPF, as an isolated finding is poor and it cannot be recommended for making a presumptive diagnosis of UTI. However, in diagnosing UTI, pyuria >10 WBC/HPF was more specific with higher predictive value than conventional >5 WBC/HPF. Urine microscopy for bacteria significantly improves the reliability of microscopic urinalysis for detection of UTI, particularly when one combines this with examination of the urinary sediment, for pyuria. However, positive result neither detect all children with UTI nor the negative test completely rules out infection. Hence, urine culture is the gold standard for diagnosis of UTI in children

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