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Original Research Article

Efficacy of urine screening and culture methods in childhood urinary tract infections and analysis of the causative pathogens

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ABSTRACT

Background: Urinary tract infection (UIT) is common in infants and children causing significant morbidity and long-term complications. In infants and young children symptoms and signs of UTI tend to be non-specific A presumptive diagnosis can be supported with a microscopic examination of a urine specimen. Definitive diagnosis requires a semi-quantitative culture of urine. There has been growing interest in developing efficient technology, that can rapidly and accurately diagnose UTIs and guide the clinician on antibiotic preference for maximum therapeutic benefit.
Methods: This prospective hospital-based study was conducted in patients from 2-12 years in a tertiary care hospital. Screening and confirmation of urinary tract infections by urine microscopy and urine culture and comparison, with an analysis of the bacterial strains and antibiotic sensitivity patterns was also done.
Results: Among the 214 culture positive patients analysed in the study 64 were 2-5years of age and 150 belonged to 5 -12 years. 128 (59.5%) were boys and 86 (40.2%) were girls. Proteinuria was observed in 68 children (31.8%). Significant pus cells of >5/hpf was present in 77 (36%). *E. coli* was the commonest organism in 98 children (45.8%) with 100% of organisms were sensitive to amikacin.
Conclusions: Over the years, the causative organisms of UTI in India have remained fairly constant but drug sensitivity has changed according to antibiotic usage. In the present era, the emergence of resistant strains poses a significant threat that can be ameliorated by rational and judicious antibiotic use.

Keywords: Antibiotics, Culture, Organisms, Urinary infection

INTRODUCTION

The urinary tract is a relatively common site of infection in infants and young children. Urinary tract infection (UTI) may result in a significant morbidity, as well as long term medical complications. Recent advances elucidating the pathogen-host interaction have broadened the understanding of the pathogenesis, clinical progression and diagnostic modalities of pediatric UTI.[1]Reported rates of urinary tract infection (UTI) in children consulting for any acute condition varies widely from 2%-20% depending on inclusion criteria and settings.[1,2]

UTI implies presence of actively multiplying organisms in the urinary tract.[2-4] The American Academy of Pediatrics (AAP 1999) criteria for the diagnosis of urinary tract infection (UTI) in children 2-24 months, are the presence of pyuria and/or bacteriuria on urinalysis and the presence of at least 50,000 colony-forming units (CFU) per mL of a uropathogen from the quantitative culture of a properly collected urine specimen. In

neonates younger than 2 months of age, criteria include the presence of lower amounts of a single pathogen (10,000-50,000 CFU/mL).[5]

In infants and young children symptoms and signs of UTI tend to be non-specific. Fever is the commonest symptom of UTI in infants.[6] Older children may have symptoms including loin or abdominal pain, frequency, dysuria, urgency, hesitancy, enuresis and haematuria.[7]Gram negative organisms are the commonest organisms isolated from urine samples with Escherichia coli (E. coli) accounting for 70 to 90%.[8,9] A presumptive diagnosis of UTI can be supported with biochemical or microscopic examination of a clean urine specimen, even in the absence of another fever source,

The definitive diagnosis of UTI in young children requires semi-quantitative culture of urine obtained by SPA or catheterisation. (American Academy of Pediatrics 1999). It takes 24 to 72 hours to obtain urine culture results. Urine screening tests have been investigated in many settings to assist the presumptive diagnosis and treatment of UTI. No element of the urinalysis or combination of elements is as sensitive and specific as a semi-quantitative urine culture for diagnosing UTI (American Academy of Pediatrics 1999).

There has been growing interest in developing new and efficient technology, which can rapidly and accurately diagnose UTIs and thus guide the clinician on which antibiotic to prescribe for maximum therapeutic benefit. Prompt diagnosis and treatment of UTI is necessary in reducing the morbidity and mortality associated with urosepsis.[10]

METHODS

This was a prospective hospital-based study conducted in the Institute of Social Paediatrics, Government Stanley Medical College, Chennai from July 2011 to August 2012. After ethical approval from institutional review Committee, informed consent was obtained from the parents or guardian as a questionnaire before enrolling them in the study.

Patients between 2 years to 12 years admitted to the pediatric ward and visiting the outpatient department (OPD) with diagnosis of UTI based on history/clinical examination were selected.

The objective of the study was to be screening of children with urinary tract infections by urine microscopic examination and biochemical tests in a tertiary care hospital.

Confirmation by urine culture tests and comparison of the sensitivity and specificity of the screening and confirmatory tests. Analysis of the distribution of bacterial strains and their antibiotic sensitivity patterns.

Inclusion criteria

- Signs and symptoms suggestive of urinary tract infection
- Urine culture positivity
- Children between 2 years and 12 years.

Exclusion criteria

- Age <2 years and >12 years.

Urine was collected for a bedside analysis to look for proteinuria and microscopically for deposits. Proteinuria was confirmed by doing a heat coagulation test. Three fourth of the test tube was filled with urine and upper part off the tube was heated in the flame. The urine turns cloudy if there is protein or phosphate. Dilute acetic acid is added to the test tube to look for dissolution of cloudiness. If it dissolves it is due to the presence of phosphates if it doesn't get dissolved it is due to the presence of protein.

Interpretations of amount of cloudiness are

- Trace - Faint cloudiness
- + - Definite non-granular cloud
- ++ - Heavy granular cloud
- +++ - Dense cloud with flocculation
- ++++ - Thick cloudy flocculation with coagulation

For microscopic examination 5 ml of urine is taken in a test tube and centrifuged at 2000-3000 rotations per minute and the deposit viewed under microscope for pus cells, red blood cells or white blood cell casts.

Urine specimen collection for culture was explained, to collect a clean catch midstream urine sample and its importance to the parent or guardian (boys to wash genitalia with water then retract the prepuce gently and collect the midstream sample, girls to wash genitalia with water then separate both labia and collect the midstream sample). The collected sample was immediately sent to microbiology laboratory and plating done within one hour. A clean catch mid-stream specimen in a wide mouthed container was collected. In routine and microscopic examination of urine report if white blood cell count were more than 5 per high power field it was considered as significant pyuria. A urine specimen was considered culture positive UTI, if a single organism was cultured at a concentration of more than 105 colony forming units per ml of urine. Treatment with appropriate drugs, response to the drug and complication were also recorded.[11,12]

Blood samples were drawn intravenously and sent to laboratory to measure total and differential count, haemoglobin, urea, creatinine. Outpatients were advised to review after two days for results. Febrile, toxic and children with vomiting were admitted as inpatient and treatment initiated as per hospital protocols. If the urine

culture turns out to be negative the patient was excluded from the study. If urine culture showed positive then the organism and sensitivity pattern was recorded. Repeat urine culture was done if there is mixed growth.

Then the patient was advised imaging studies. All patients underwent ultrasonogram of the abdomen. Voidingcystourethrogram was done two weeks after treatment completion, for children aged between two to five years and also for children with abnormality in kidney, ureter, bladder and urethra and with recurrent urinary tract infections. In in-patients, the duration of hospital stay was recorded. Statistical data analysis was done using the SPSS version.

RESULTS

Among the 214 culture positive patients analysed in the study 64 children were between to 2-5years of age and 150 children between 5-12years. 128 were male (59.5%) and 86 were female (40.2%) respectively. According to the modified Kuppusamy classification of socio economic class 76 patients were in class V, 118 patients in class IV and 20 to class III. Growth retardation was assessed by measuring height for age and <80% was considered severe retardation (dwarf) according to Mclaren's classification. 4 children (1.9%) had growth retardation.

Table 1: Bed side urine analysis findings.

Bed side test	N	%
Proteinuria	68	31.8
Pyuria	77	36
Hematuria	34	15.9

Table 2: Showing the organisms isolated by urine culture.

Organism	N	%
E. coli	98	45.8
Klebsiella	51	23.8
Proteus	21	9.8
Pseudomonas	13	10.1
Coagulase negative staphylococcal	9	4.2
Staphylococcus aureus	4	1.9
Enterococcus	17	7.9
Citrobacter	1	0.5

Among the 214 children 160 had a history of fever (64.8%) which was the commonest symptom. 47 children (22%) had <3 days fever,40 children had 3-5 days (18.7%) and >5 days in 73 children (34.1%). Burning micturition was present in 86 children (40.2%). Increased frequency of micturition was present in 111 children (51.9%). Haematuria in the children was 4.2%. Cloudy urine was 1.9%. Abdominal pain was present in 98 patients constituting the second commonest complaint (45.8%). Vomiting was present in 47 patients (22%). Proteinuria was observed in 68 children. Among them 22 had trace proteinuria and 46 had (+) proteinuria (31.8%). Significant pus cells of >5/hpf was present in 77 (36%) and hematuria was present in 34 (15.9%) (Table 1). Anaemia and leukocytosis was present in most of the children.

Table 3: Comparison of etiology.

Organism	Study population	Sharma et al	Akram et al
E. coli	45.8%	67.5%	61%
Klebsiella	23.8%	20%	22%
Proteus	9.8%	10%	
Psedomonas	6.1%	2.5%	4%

E. coli was the commonest organism in 98 children (45.8%). Others were *Klebsiella* in 51 (23.8%), *Proteus mirabilis* in 21 (9.8%), Coagulase negative *staphylococcusin* 9 (10.1%), *Staphylococcus aureus* in 4 (1.9%), *Enterococcus* in 17 and Citrobacter in 1 child constituting 7.9% and 0.5% respectively (Table 2).

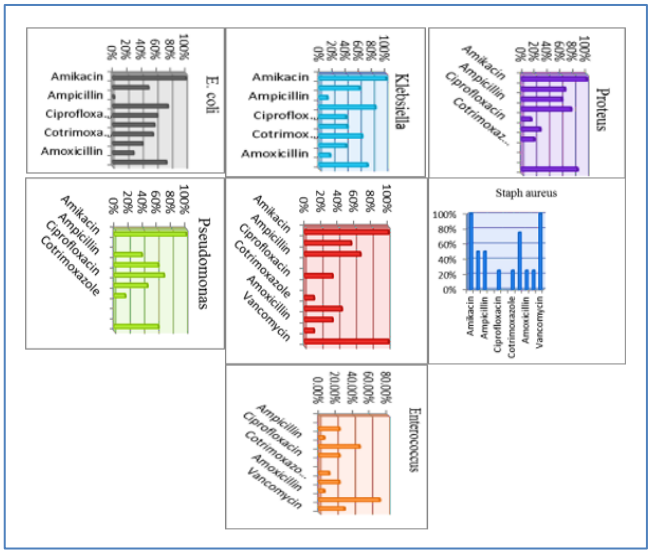

Figure 1: The antibiotic culture sensitivity pattern of the various organisms.

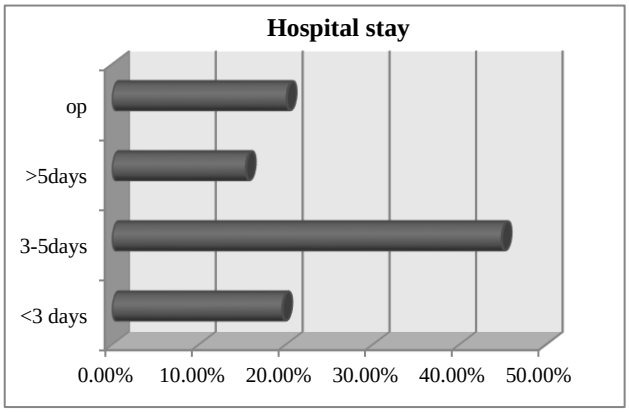

Figure 2: Depicts that most of the children were treated as inpatients for 3-5 days.

All organisms were 100% sensitive to amikacin, *E. coli* showed 48.9% to erythromycin, ampicillin, 75.5% to cefotaxime, 61.2% to ciprofloxacin, 57.1% to norfloxacin, 55.1% to cotrimoxazole, 40.8% to cephelexin, 28.5% to amoxicillin and 73.4% to gentamycin. *Klebsiella* showed a sensitivity of 60% to erythromycin, 12% to ampicillin, 84% to cefotaxime, 40% to ciprofloxacin, 42% sensitive to norfloxacin, 64% sensitive to cotrimoxazole, 40% to cephelexin, 16% to amoxicillin and 72% to gentamycin. Proteus organism was 66.6% sensitive to erythromycin, 61.9% to ampicillin, 76.1% to cefotaxime, 14.2% to ciprofloxacin, 28.5% to norfloxacin, 19% were sensitive to cotrimoxazole and 85.7% to gentamycin. Sensitivity for Pseudomonas was 38.4% to ampicillin, 61.5% to cefotaxime, 69.2% to ciprofloxacin, 46.1% to norfloxacin, 15.3% were sensitive to cotrimoxazole and 61.5% to gentamycin.

Coagulase negative Staphylococcus aureus was 55.5% sensitive to erythromycin, 66.6% to ampicillin, 33.3% to ciprofloxacin, 11.1% were sensitive to cotrimoxazole, 44.4% to cephelexin, 33.3% to amoxicillin, 100% to vancomycin and 11.1% to gentamycin. Staphylococcus aureus showed 50% sensitivity to erythromycin, 50% to ampicillin, 25% to ciprofloxacin, 25% were sensitive to cotrimoxazole, 75% to cephelexin, 25% to amoxicillin, 100% to vancomycin and 25% to gentamycin. Enterococcus was 3.5% sensitive to erythromycin, 5.8% to ampicillin, 47% to cefotaxime, 23.5% to ciprofloxacin, 11.7% were sensitive to cotrimoxazole,23.5% to cephelexin, 5.8% to amoxicillin, 29.4% to vancomycin and 70.5% to gentamycin.

Only one child had citrobacter grown in culture and was sensitive to amikacin, erythromycin, cefotaxime and gentamycin.43 patients were treated as outpatients (20.1%). Febrile toxic patients or with vomiting were hospitalised for the need of parenteral antibiotics 171 (79.9%) (Table 3).

DISCUSSION

In this study group, there was a male preponderance from the low socio-economic class. Fever and increased frequency were the common clinical features. Common organisms causing urinary tract infection in our study population are *E. coli* followed by *Klebsiella*, *proteus* and *pseudomonas*. Amikacin was the most sensitive antibiotic among the isolates in the study population. USG abnormality was present in 2.3%, thus ultrasound is mandatory for identifying structural abnormalities and for further management. The most common causative organism was E. coli (45.8%) followed by *Klebsiella*, *Proteus* and *Pseudomonas* constituting 23.8%, 9.8% and 6.1% respectively. This is comparable with the study by A Sharma et al from Nepal and Akram M etal from Aligarh, India.[13,14] Studies by Mantadakis E et al and Islam M et al showed *E. coli* as most common organism but with varying proportions.[15,16] Sensitivity to antimicrobials showed that 92% of the organisms were sensitive to Amikacin whatever may be the organism and 69.6% sensitive to Gentamycin and Cefotaxime. Among oral antibiotics 62.1% of organisms were sensitive to Cotrimoxazole and 41.5% to Norfloxacin. In our hospital when there is a situation to start empirical antibiotic awaiting culture and sensitivity report Amikacin can be the preferred parenteral drug and cotrimoxazole oral drug.

CONCLUSION

UTI is a common problem in the pediatric population with significant morbidity. It is important to clinically identify UTI in young children. A positive urinary culture confirms the diagnosis of UTI if the urine specimen is appropriately collected. When a child responds appropriately to antimicrobial therapy, further imaging studies are seldom necessary. The goals of treatment for UTI include, relief of acute symptoms, elimination of infection and prevention of urosepsis

Escherichi coli is the most common pathogen in pediatric UTI of all ages Over the years, the causative organisms of UTI in India have remained fairly constant but drug sensitivity has repeatedly changed according to antibiotic usage. In the present era, the emergence of resistant strains poses a significant threat that can be ameliorated by rational and judicious antibiotic use. Treatment protocols need to be revised periodically according to changing sensitivity patterns. Diagnosis is based on the culture of an appropriately collected specimen of urine; urinalysis can only suggest the diagnosis. So, urine culture sensitivity remains the gold standard investigation concluded from this study. Imaging studies should be performed on all infants and young children with a documented initial UTI. With a limited antibiogram for the culture positive samples an improvement in the sensitivity and specificity pattern can be achieved with the addition of more drugs in the antibiogram.

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