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COMPARISON OF URINE DIPSTICK WITH URINE CULTURE IN DIAGNOSIS OF URINARY TRACT INFECTION IN CHILDREN.

Paediatrics

Dr. Tanvi Malik* Post Graduate, Department of Pediatrics. *Corresponding Author
Dr. Borate Sayali Anil Post Graduate, Department of Pediatrics
Dr. Sarvesh Pandey Senior Resident, Department of Pediatrics
Dr. Anand Kumar Bhardwaj Professor, Department of Pediatrics

ABSTRACT

BACKGROUND: Urinary tract infection (UTI) is a common cause of morbidity in the paediatric age group. In general practice, 6-8% of febrile infants who are unwell and older children having urinary complaints will have UTI. It may lead to long- term complications like loss of normal function, renal scarring and hypertension. Thus, prompt detection and treatment of UTI is important.
AIMS AND OBJECTIVES: 1. To evaluate the accuracy of dipstick leukocyte esterase and nitrite tests for rapid screening of urine samples, keeping semi quantitative Urine culture as the gold standard for the diagnosis of UTI.
2. To study the clinical profile of UTI in children.
METHOD: A hospital based, prospective, cross sectional study was conducted with a total of 100 febrile children between the age of 1year to less than 18 years who came to department of Paediatrics, MMIMSR, both inpatient and out-patient department were included in the study. Two urine samples were collected out of which one was sent for urine culture and the other was used for urine dipstick test and urinalysis.
RESULTS: Out of 100 febrile children suspected to have UTI, Urine culture was found to be positive in 49% cases. E.coli was found to be the most common organisms causing UTI. Out of 49% culture positive cases, 55% were females. The most common age group to have culture positivity was found to be 12 years to less than 18 years of age. The most common features associated with culture positive UTI were found to be vomiting and pain abdomen along with fever. The leukocyte esterase test and nitrite test have a sensitivity and specificity of 81.63%, 88.24% and 32.65%, 96.08% respectively. Thus, leukocyte esterase can be used to screen UTI in paediatric age group. Microscopic urinalysis is comparable to leukocyte esterase with sensitivity of 73.47% and specificity of 92.16%. When leukocyte esterase and nitrite tests are used in combination, the sensitivity increases to 86% and specificity to 88%. When all three are used together the ability to diagnose UTI improves further.
CONCLUSION: Urine dipstick test (leukocyte esterase and nitrite reduction test), is a rapid and feasible method to screen urinary tract infection in children.

KEYWORDS

Urinary Tract Infections, Urinalysis, Dipstick Test, Urination Disorders

INTRODUCTION

Urinary tract infection (UTI) is a common cause of morbidity in the paediatric age group. In general practice, 6-8% of febrile infants who are unwell and older children having urinary complaints will have UTI. It may lead to long- term complications like loss of normal function, renal scarring and hypertension. Thus, prompt detection and treatment of UTI is important. [1]

Approximately 90% of first symptomatic UTI and 70% of recurrent infections are caused due to E.coli. Other organisms causing UTI such as Klebsiella, Staphylococcus saprophyticus and Streptococcus faecalis may occasionally be responsible. Pseudomonas and proteus are the common causative organisms in recurrent UTI, urolithiasis, instrumentation and in hospital acquired infections.

Pathogens of low virulence and fungal infections may be causative in immunocompromised patients. Candida infections are common in immunocompromised children and following prolonged antibiotic therapy.

Overall prevalence of UTI is more in females and uncircumcised male infants.

Risk of UTI is higher in children with malnutrition and chronic diarrhoea.

Symptoms in children in preverbal stage are fever, vomiting, lethargy, poor feeding, irritability, loin tenderness, abdominal pain, haematuria and failure to thrive. Symptoms in children in verbal stage include fever, frequency, dysuria, dysfunctional voiding, incontinence, abdominal pain, loin tenderness, malaise, vomiting, and haematuria (rare).[2] Urinary tract infection in children often present with non-specific signs and symptoms that include fever, irritability, vomiting and failure to feed. This non-specific presentation of urinary tract infections makes its diagnosis difficult, often requiring use of laboratory tests on urine samples of suspected patients. [3] With this constraint, clinicians must have high index of suspicion in order to decide when to request for the designated laboratory tests.

To diagnose UTI rapidly, bedside investigations such as Leukocyte esterase and nitrite reduction test in urine dipstick are now being practised.

Tests to be carried out:

1. URINE ROUTINE MICROSCOPY- presence of more than 10 leukocytes (WBCs)/mm 3 in an uncentrifuged urine sample is suggestive of UTI.
2. LEUKOCYTE ESTERASE (L.E.)- It refers to enzymatic remnant of WBCs. Esterase catalyses the hydrolysis of an indoxyl ester derivative. The indoxyl ester generated reacts with a diazonium salt to produce a beige-pink to purple color. This test can detect as low as 10-15 WBC/uL.
3. NITRITE TEST- Some bacteria especially gram negative bacteria (ex. E.Coli) convert dietary nitrates into nitrites. Nitrite reacts with p-arsanillic acid to form diazonium compound in an acid medium. The diazonium compound reacts with 1,2,3,4-tetrahydro-benzoquinolin to produce pink colour. If nitrites are present in a freshly collected urine sample, it is highly suggestive of UTI. Lowest level of Nitrite which can be detected is 0.075mg/dl.
4. URINE CULTURE - It is the gold standard for diagnosing urinary tract infection in both, symptomatic and asymptomatic cases. Cultures used for urine are MacConkey agar and Blood agar plates.

Tests And Standards Used.

1. Pyuria - more than 10WBCs per high power field.
2. Nitrite and leukocyte esterase - Athenese- Dx Urine reagent strips for urinalysis.
3. Urine culture on MacConkey agar and Blood agar plates.

The criteria for diagnosing bacteriuria uses colony count which is significant if more than 1 lac. Urine culture is the gold standard investigation but is least accessible, requires high-level laboratory set

up and is difficult to execute. Urine routine and Dipstick on the other hand are found to be cost effective and reliable in ruling out UTI. On the basis of the results of these tests, urine culture can be performed selectively. Urine culture can also be performed if there is a strong suspicion clinically or the child has received prior antibiotics. [4] These tests were also helpful in initiating an empirical treatment in children with strong suspicion of UTI, while the Urine culture reports are awaited. [5] Urine microscopy (to detect pyuria and bacteriuria) is a commonly used method for evaluation of patients with suspected urinary tract infection. The presence of pyuria (>10WBCs/hpf) on microscopic examination is less sensitive and less specific than bacteriuria while presence of both pyuria and bacteriuria make the likelihood of urinary tract infection greater. It has been studied that urine dipstick in combination with urine microscopy has high sensitivity and specificity. [6,7] These tests help in early initiation of treatment and thus prevent complications. [8,9] This study will assess the predictive validity and reliability of urine dipstick tests & urine microscopy as independent tests, then in simultaneous combination using urine culture as gold standard.

MATERIALS AND METHODS

After obtaining Ethical Committee Clearance from Maharishi Markandeshwar (Deemed to be University), Mullana. Hundred patients were selected above the age of 1 year and less than 18 years after fulfilling the inclusion and exclusion criteria for the study.

Definition:

1. Febrile Child: Children with history of fever (Axillary temperature ≥37.8°C).
2. Urinary Tract Infection: Urinary tract infection is defined as growth of a significant number of organisms of a single species in the urine, in the presence of symptoms. Significant bacteriuria is growth of >10 5 /ml CFU of a single species in a clean catch urine sample collected mid- stream.

AIMS AND OBJECTIVES

1. To evaluate the accuracy of dipstick leukocyte esterase and nitrite tests for rapid screening of urine samples, keeping semi quantitative Urine culture as the gold standard for the diagnosis of UTI.
2. To study the clinical profile of UTI in children.

Method of collection of data:

Febrile children between 1 year to less than 18 years of age attending outpatient department or admitted in MM Institute of Medical Sciences and Research, Mullana, were submitted to preliminary screening interview to suspect urinary tract infection. Children with symptoms suggestive of urinary tract infections were enrolled and interviewed using structured questionnaire for urinary tract infection.

Symptoms Of Uti

Children in the preverbal stage have symptoms and signs such as fever, vomiting, lethargy, poor feeding, irritability, loin tenderness, abdominal pain, haematuria and failure to thrive.

Children in their verbal stage have complaints like fever, burning micturition, increased frequency, dysuria, dysfunctional voiding, urinary incontinence, abdominal pain, loin tenderness, malaise, vomiting and hematuria(rare).

For all symptomatic children who were suspected to have UTI, two clean catch samples were collected. One was sent for culture and with the other sample Dipstick test (leukocyte esterase test and nitrite test) was done and the uncentrifuged urine was sent for microscopic analysis.

Inclusion Criteria

1. Ethical committee approved consent form signed by the legal guardian of the child.
2. All febrile children with suspected urinary tract infection between 1 year to less than 18 years of age.
3. Fever {Axillary temperature ≥37.8°C}.

Exclusion Criteria

1. Not willing to participate.
2. Children below 1 year and above 18 years of age.
3. Any child who has received antibiotics 48 hours prior to evaluation.

Study Design: Cross sectional comparative study

Sample Size:

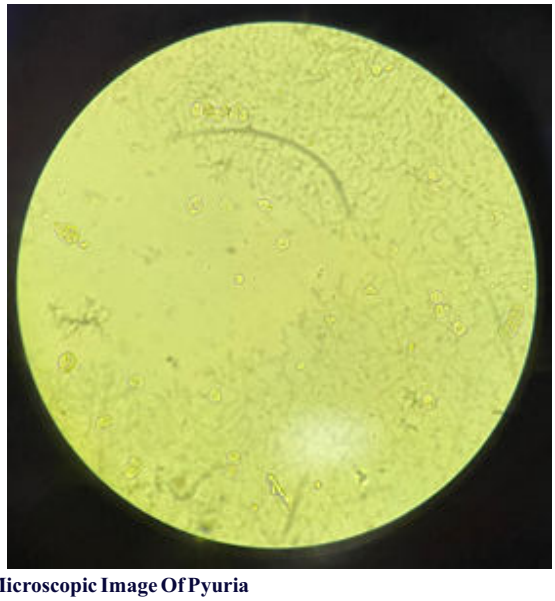
Hundred febrile children with suspected urinary tract infection between 1 year to less than 18 years of age attending outpatient department or admitted in Department of Paediatrics Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana constitute the study population.

Collection Of Urine Sample

The principal investigator or trained research assistants (nurses) participated in collection of urine samples. We collected two urine specimens from each patient, one for dipstick and microscopy and the other for culture. Both the samples were collected undertaking all aseptic precautions in two universal containers. For all symptomatic children, I performed Dipstick test (leukocyte esterase test and nitrite test) and the uncentrifuged urine was sent for microscopy while preserving another sample in a boric acid containing tube and sending for culture. The methods for collecting the urine sample adopted for my study were clean catch midstream urine and catheterised sample.

The samples were sent to pathology laboratory and microbiology laboratory for urinalysis and culture respectively within two hours of collection.

Urine Dipstick



Microscopic Image Of Pyuria

Statistical Analysis

Microsoft Excel was used to tabulate the data collected from patients to generate a master chart. Diagrammatic representation with the help of graphs and tables were used to depict significant data. The sensitivity, specificity, PPV and NPV for the screening tests were calculated keeping urine culture as a reference group for the diagnosis of UTI. Overall accuracy was also calculated.

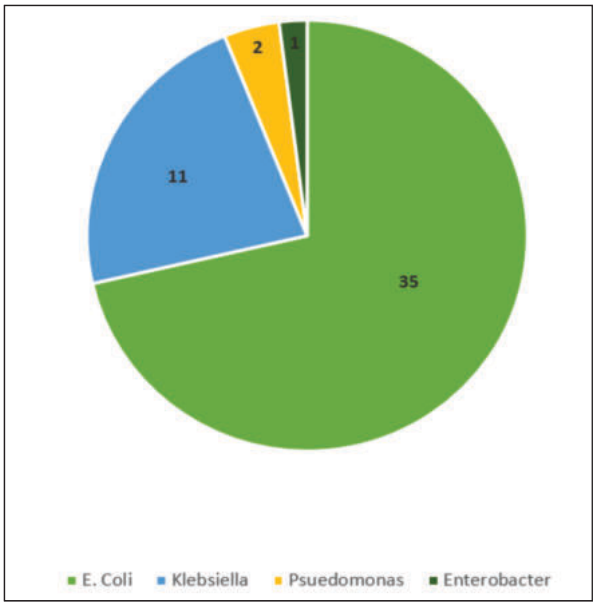
- Sensitivity = True positive/ (True positive - False negative)
- Specificity = True negative/ (True negative + False positive)
- Positive predictive value = True positive/ (True positive + False positive)
- Negative predictive value = True negative/ (True negative + False negative)

The software used to perform statistical analysis is SPSS for windows version 21, p value of <0.05 was considered significant.

RESULTS

Out of 100 febrile children suspected to have UTI, Urine culture was found to be positive in 49% cases. E.coli was found to be the most common organisms causing UTI.

Distribution Of Different Organsims In Urine Culture



Out of 49% culture positive cases, 55% were females. The most common age group to have culture positivity was found to be 12 years to less than 18 years of age. The most common clinical features associated with culture positive UTI were found to be vomiting and pain abdomen along with fever. The leukocyte esterase test and nitrite test have a sensitivity and specificity of 81.63%, 88.24% and 32.65%, 96.08% respectively.

Urine Culture Vs Leukocyte Esterase

LEUKOCYTE ESTERASE	URINE CULTURE				Total	Chi-square value	p-value
	Positive		Negative				
Yes	40	82%	6	12%	46	49.110	0.001
No	9	18%	45	88%	54		

Urine Culture Vs Nitrite Reduction Test

	URINE CULTURE				Total	Chi-square value	p-value
NITRITE	Positive		Negative				
Yes	16	33%	2	4%	18	13.976	0.001
No	33	67%	49	96%	82		

Thus, leukocyte esterase can be used to screen UTI in paediatric age group. Microscopic urinalysis is comparable to leukocyte esterase with sensitivity of 73.47% and specificity of 92.16%. When leukocyte esterase and nitrite tests are used in combination, the sensitivity increases to 86% and the specificity to 88%. When all three are used together the ability to diagnose UTI improves further.

Microscopic pyuria and urine culture

	URINE CULTURE				Total	Chi-square value	p-value
MICROSCOPIC PYURIA	Positive		Negative				
Yes	36	73%	4	8%	40	44.845	0.001
No	13	27%	47	92%	60		

Analysis of leukocyte esterase, nitrite and pyuria in combination

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
LEUKOCYTE ESTERASE	81.63%	88.24%	86.96%	83.33%	85.00%
NITRITE	32.65%	96.08%	88.89%	59.76%	65.00%
MICROSCOPIC PYURIA	73.47%	92.16%	90.00%	78.33%	83.00%
LE AND NITRITE	86.00%	88.00%	87.76%	86.27%	87.00%
LE, NITRITE AND PYURIA	88.00%	82.00%	83.02%	87.23%	85.00%

DISCUSSION

In the present study, sensitivity, specificity, negative and positive predictive values for leukocyte esterase, pyuria, and nitrites has been analysed by comparing the test results with the gold standard norms (culture proven UTI cases and sterile culture cases).This is done by identifying the true negative, true positive, false positive and false negative values for each variable and substituting it by the standard formula. Each parameter was compared in both the groups to see if these parameters were significantly higher in the culture proven UTI group as compared to the sterile culture group. Further combination of parameters was compared to find out the maximum sensitivity and specificity. Chi-square was computed. Graphical illustrations have also been done.

CONCLUSION

From this study, we conclude that **use of dipstick test (leukocyte esterase and nitrite reduction test) and microscopic pyuria can be used individually to screen urinary tract infection in children.** When all three used in combination the sensitivity to predict UTI improves. As it is rapid and cost effective it will decrease the time to diagnosis and help in early initiation of treatment.

Limitations

- Due to limited sample size in the study, results cannot be generalized to general population.
- Infants were not included in this study as collecting aseptic urine sample is difficult. The ideal way to do so is taking a suprapubic aspirate which has its own complications.

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