



A STUDY OF USE OF URINE DIPSTICK AS A RAPID SCREENING TOOL FOR EVALUATION OF UTI IN CHILDREN IN TERTIARY MEDICAL CENTRE OF SOUTH BIHAR

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ABSTRACT **Intro:** Urinary tract infections (UTIs) are one of the most frequent infections that are studied in a variety of clinical settings. Bacteria, particularly Enterobacteriaceae, are the most common cause of urinary tract infections. UTI is linked to a high rate of morbidity and mortality, particularly in high-risk groups such as pregnant women, children, and immunocompromised individuals. **Aim and objective:** To detect the utility of urine dipstick in screening UTI in children, **Methodology :** An Prospective observational study will be conducted in General Medicine department in Narayan Medical College and Hospital , Jamuhar. Following an informed parental consent, clinical history will be taken, examination will be done, comorbidities will be noted, and the panel of investigations will be collected from all eligible children. **Result :** All the true positive cases had gram negative organisms in culture. Sensitivity, specificity, positive predictive value, negative predictive value of nitrite compared with urine culture were upto 85.48%, 91.83%, 86.88%, 90.9% . Among the culture positive cases 62, nitrite test was positive in 53 cases ,negative in 9 cases. Among the culture negative cases (98), nitrite test was positive in 8, negative in 90 cases. **Conclusions:** Dipstick was also found to be a good predictor of negative urine cultures. However, in comparison to quantitative urine culture, dipstick results should not be too trusted for diagnosis.

KEYWORDS : UTI, Nitrase, Leukoesterase, Urine Culture

INTRODUCTION

Urinary tract infections (UTIs) are one of the most frequent infections that are studied in a variety of clinical settings. Bacteria, particularly Enterobacteriaceae, are the most common cause of urinary tract infections. UTI is linked to a high rate of morbidity and mortality, particularly in high-risk groups such as pregnant women, children, and immunocompromised individuals. Bacteria infect and colonise the ureter, urethra, and bladder, among other parts of the urinary tract. Dysuria, urine incontinence, and haematuria are symptoms of a urinary tract infection (UTI), which can lead to kidney failure and hypertension.⁽¹⁾

Asymptomatic bacteriuria affects 4–7% of pregnant women, and it can lead to symptomatic UTI, postpartum UTI, or pyelonephritis. Bacteriuria becomes more common as you become older. Non-institutionalised old women and men had prevalence rates of 6–30% and 11–13%, respectively, but institutionalised elderly persons have prevalence rates of 25–50%.⁽²⁾

The majority of paediatric UTIs are caused by Gram negative coliform bacteria that enter and ascend the urinary tract from faecal flora colonising the perineum. The most frequent uropathogen is Escherichia coli (E. coli), which causes around 80% of paediatric UTIs. To circumvent host defences, uropathogenic E.coli strains have unique features, such as fimbriae that bind to the uroepithelial cell surface. Klebsiella, Proteus, Enterobacter, and Enterococcus species are among the most prevalent uropathogens⁽³⁾

UTIs can be diagnosed using a variety of procedures, including gram stain, dipstick, automated assay, and urine culture. Urine culture remains the gold standard for diagnosing UTIs among all diagnostics, particularly in low and middle-income countries. Urine culture, on the other hand, is an expensive and time-consuming method that necessitates the use of a well-equipped microbiology laboratory with highly trained and experienced workers and can take up to 72 hours to determine the diagnosis. The most practical and simple approach for diagnosing UTIs in resource-limited settings is the urine dipstick test, which allows for early detection of UTIs, is inexpensive, and requires less time and skill, making it a reliable and speedy diagnostic test in high-risk patients.⁽⁴⁾

The leukocyte esterase test identifies the presence of this enzyme in the urine, which is secreted by white blood cells (WBCs). By microscopy using centrifuged urine, positive leukocyte esterase is comparable to pyuria (WBC 5/HPF or around 25 WBCs/mL), with a sensitivity of about 79 percent and specificity of 87 percent. External contamination (vulvovaginitis), viral infection (roseola infantum), Kawasaki disease, acute appendicitis, or strenuous exercise can all generate false positive results. In febrile neutropenic youngsters, a false negative result is possible.⁽⁵⁾

With the above background in mind, we intend to undertake this study to evaluate the urine dipstick test for detecting UTIs.

AIMS AND OBJECTIVE

Aims

To detect the utility of urine dipstick in screening UTI in children.

Objective

To determine the performance characteristics of urine nitrite and leukocyte esterase test compared with urine culture, which was set as the gold standard in diagnosing UTI.

MATERIALS AND METHODS

Study Design: An Prospective observational study will be conducted in General Medicine department in Narayan Medical College and Hospital , Jamuhar.

Sample Size: Sample size is calculated depending upon the prevalence of Urinary tract. It was found in the previous study that prevalence of urinary tract infection by dipstick test positive was 73%(As per study by Katunzi L et al⁽⁶⁾) Diagnostic accuracy of dipsticks test among clinically suspected urinary tract infected patients at National Hospital, Tanzania) the maximum error in the estimate we were willing to tolerate, say $\pm 7\%$, at 2-sided test with 95% confidence level ($\alpha=5\%$) and design effect =1, expected sample size is 155 patients.so total 160 sample size will be taken.

Formulas

Following formulas is used to compute sample size

$$n = \text{deff} * Npq / (d^2 / z^2 * (N-1) + pq)$$

where,

n is sample size

deff is design effect

N is population size

P is estimated prevalence

q = 1-p

d = absolute level of precision

Duration of Study: 6 months.

Nature of Study: Prospective Observational study.

INCLUSION CRITERIA:

1) CHILDREN AGE 2 -12 YRS OF AGE WITH Symptoms suggestive of UTI or Febrile Children with undetectable focus

EXCLUSION CRITERIA

Children < 2 yr (excluded because of decreased chances of urinary

retention for four hours which is a requirement for nitrite test, difficulty in urine collection in children who are not yet toilet trained)

METHOD OF COLLECTION OF DATA

Following an informed parental consent, clinical history will be taken, examination will be done, comorbidities will be noted, and the panel of investigations will be collected from all eligible children. Basic investigations like complete blood count, urinalysis will be done Renal function tests will be carried out for all children .USG Abdomen and pelvis Will be done in all children .As per IAP guidelines, Micturiting Cystourethrogram will be done for eligible children.

COLLECTION OF SAMPLE:

Under strict aseptic precautions, urine samples. Will be obtained for both, urine analysis and urine culture in 2 different containers. The methods of urine collection practised in our study will be mid stream clean catch sample or catheterised or bag method. Contamination by periurethral and prepuccial organisms will be minimized by , washing the genitalia with soap and water. Antiseptic washes and forced prepuccial retraction will be not advised.

The samples collected for urine analysis and . urine culture will be sent to clinical pathology lab and microbiology lab . respectively within 2 hours of collection The specimen will be directly collected in a sterile glass or plastic bottle. A urine culture will be repeated in case contamination was suspected, for eg, mixed growth of two or .more pathogens, or growth of organisms that normally constitute the periurethral flora (lactobacilli in healthy girls and enterococci in toddlers). The culture will also repeated in situations. where UTI will strongly suspected but colony counts will be equivocal. The initiation of empirical treatment will be decided by the treating physician.

Urine dipstick test- dipstick is dipped in urine for 60 sec to detect the presence of nitrite in urine .Nitrite will be considered as positive if there is a change in colour of dipstick , from colourless towards pink within 60 seconds. Depending on intensity of colour change, the results were graded as 0 , 1+ ,2+ ,3+,4+ .Except for no change in colour ,others will be considered positive. Leukocyte esterase will be considered as positive if there is a change in colour from white towards purple within 2minutes. Depending on intensity of colour change ,the results will be graded as 0 , 1+ ,2+ ,3+,4+ .Except for no change in colour ,others will be considered positive . Urine culture will be done to detect the organism responsible for causing urinary tract infection. Because of the high risk of contamination in conventional method of urine collection, a quantitative cut off or ,significant colony forming units will be fixed to help differentiate between contamination , infection or colonization.

STATISTICAL ANALYSIS:

Data will be entered into Microsoft excel and results will be analysed using SPSS software . Continuous data will be reported as mean ± SD (if normally distributed) ,as median (range) , (if non-normally distributed). Results on categorical measurements , will be presented in Number and percentages. Sensitivity, specificity, negative and , positive predictive values for ,leucocyte esterase, pyuria, nitrites and combined nitrite and leucocyte esterase will be , analyzed by comparing the test results with the gold standard norms (culture proven UTI cases and sterile culture.

RESULT

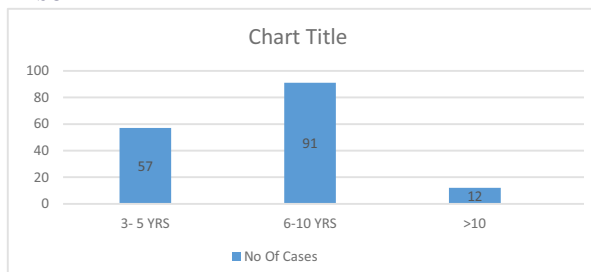


Fig 1- Distribution of Study Population As Per Age

Out of the 160 cases ,57 cases (35.6%) were in the age group 3-5years,91 cases with 6-10 years (56.9%),12 cases above 10 years of age (7.5%). Median age of distribution was 6years with a SD of +/-2.36 .Out of the 160, 62 were culture positive. Among the culture positive group,3-5 years were 21(33.87%), in 6- 10 yrs were 37(

59.68%)and >10 years were 4 (6.45%).There was no statistical significance between different age groups for culture positive and culture negative individuals.(p value 0.365). Among the 160 study population, 74(46.25%) were male children and 86(53.75%) were female children

TABLE 2-SEX DISTRIBUTION OF STUDY POPULATION

SEX	Frequency	Percentage
Male	74	46.25
Female	86	53.75
Total	160	100.0

Among the study population, in males, 35 (47.29%) were culture positive, among the female children, 44 (51.16%) were culture positive. Most common symptom was dysuria in 145 cases (90.62%) followed by increased frequency of micturition (139) 86.87%, persistent vomiting (105) 65.62% , abdominal pain(91) 56.87% fever (73) 45.62% , hematuria (25) 15.62%, pyuria (19) 11.87%, followed by constipation (17) 10.62%. Fever as a symptom was present in 73 patients(45.62%).Out of this ,fever of < one week was present in 54 children (33.75%), 1 week fever was present in 17 children (10.63%), more than one week fever was present was present in 2 children(1.25%). Urine microscopy for pus cells showed that, in 100 (62.5%)cases , no pus cells were observed. In 32 cases (20.0%), upto 5 pus cells were noted, in 22 cases (13.75%) 5-10 pus cells,and in 6 cases (3.75%) , more than 10 pus cells were noted .

LEUKOCYTE ESTERASE:

Among the 160 cases, Leukocyte esterase was negative in 81 cases(50.62%), positive in 79 cases .Out of this 79 cases, in 16(20.25%)cases - 1+ colour change was noted, in 46 cases (58.22%)- 2+ colour change was noted, in 11 cases (13.92%) 3+ colour change was noted ,in 6(7.59%) cases 4+ colour change was noted.

	Culture +	Culture -	
LE +	57	22	79
LE -	5	76	81
Total	62	98	160

Sensitivity, specificity, positive predictive value, negative predictive value of Leukocyte esterase compared to urine culture were upto 91.93% ,77.55% ,72.15% ,93.82% respectively. P value is statistically significant <0.001. Among the culture positive cases 62, Leukocyte esterase was positive in 57, negative in 5. The p value calculated by chi square test was <0.001 and was statistically significant.

NITRITE TEST:

Among the 160 cases , nitrite was negative in 99(61.87%), positive in 61 cases .Out of this 61 cases ,in 16(26.22 %)cases - 1+ colour change was noted ,in 25 cases (40.98%) - 2+ colour change was noted ,in 11 cases (18.03 %) 3+ colour change was noted ,in 9 (14.75%) cases 4+ colour change was noted

	Culture +	Culture -	
NITRITE +	53	8	61
NITRITE -	9	90	99
Total	62	98	160

All the true positive cases had gram negative organisms in culture. Sensitivity, specificity, positive predictive value, negative predictive value of nitrite compared with urine culture were upto 85.48%, 91.83%, 86.88%, 90.9% .

Among the culture positive cases 62, nitrite test was positive in 53 cases ,negative in 9 cases. Among the culture negative cases (98),nitrite test was positive in 8, negative in 90 cases. The p value calculated by chi square test was <0.001 and was statistically significant.

COMBINED NITRITE / LEUKOCYTE ESTERASE:

Among the 160 cases, combined dipstick was positive in 78(48.75%) cases and negative in 82(51.25%) cases.

	Culture +	Culture -	
DIP +	59	19	78
DIP -	3	79	82
Total	62	98	160

Sensitivity, specificity, positive predictive value and negative predictive value of combined dipstick compared with urine culture were upto 95.16% , 80.61% , 75.64% and 96.34% respectively. Among the culture positive group (62), combined dipstick was positive in 59 cases, negative in 3 cases. Among the culture negative cases (98),

combined dipstick was positive in 19 and negative in 79 cases. The p value obtained by chi square test was <0.001 and was statistically significant. Urine culture was positive in (62)38.75% of cases and negative in (98) 61.25% of cases. All the organisms were gram negative in nature.

DISCUSSION

In the total 160 patients analysed, 38.75% were culture positive UTI. 61.25% were culture negative. In our study, urinary tract infection occurred more in female children than in male children. Culture positive female children constituted more than half of the study population. In the cross sectional study done by **Gupta et al**⁽⁶⁾, of the total number of cases studied, 69.4% were boys i.e. the majority population with UTI was boys, that too they had high risk of vesicourethral reflux and renal scarring than girls. The reason could be because it included infants also. **Sumit et al**⁽⁷⁾ did a study regarding the urinary tract infections in the pediatric population in north India. Among the population studied, UTI was higher in females than in the male population. Culture positive UTI was seen in 11.8% females as against 8.9% males. In the study done by **Nayak et al**⁽⁸⁾, of the study population which included all age groups with symptoms suggestive of UTI was found to be more common in males, 60% as against females 40%. But age wise grouping have not been done in the study. **Sanath et al**⁽⁹⁾ studied that during preschool and school age, females tend to suffer more episodes of UTI than males. He also observed that the risk of developing symptomatic UTI, before the age of 14 years is 1-2% in boys and 3-8% in girls.

On assessment of age wise distribution of the study group, in our study, UTI was more common in the 6-10 yrs age group (56.9%) followed by 3-5 yrs age group (35.6%) followed by >10 yrs (7.5%). In the study done by **Sumit et al**⁽⁷⁾, UTI was highest in >16 yrs age (30.58%) followed by 11-15 yrs (28.82%) followed 6-10 yrs (20.58%) finally in the 0-5 yr age group (20%). **Nayak et al**⁽⁸⁾ had his study results regarding age distribution as follows-5-12 yrs (46.4%) followed by 2-5 yrs (33.3%) followed by <2 yrs -20.3%, which is consistent with our study. In the study by **Mod HK et al**⁽¹⁰⁾, 20.3% were between 1 to 2 years of age, 33.3% were between 2 and 5 years and 46.4% were between 5 to 12 years of age. By this, 6-10 yrs seems to be common age for UTI.

Among the 62 culture positive organisms, the most common organism isolated was Ecoli followed by klebsiella then by proteus, followed by non fermentative gram negative bacilli, finally by citrobacter which constituted a very few percentage. Our study showed that Ecoli was the most common organism. Our study result was comparable with **Palak et al**⁽⁶⁾ and **A Sharma et al**⁽¹¹⁾. Our results for klebsiella was comparable with **Palak et al**⁽⁶⁾. Our study showed high percentage of proteus and no isolation of Pseudomonas.

On analysing the symptomatology, in our study, most common symptom was dysuria followed by increased frequency of micturition, followed by persistent vomiting, abdominal pain, then by fever, then by hematuria, pyuria, followed lastly by constipation.

Fever as a symptom was present in less than half of cases. Out of this, fever of < one week was present in the majority, 1 week fever was present in few cases, more than one week fever was present was present only in very few children. In the study done by **Sumit Gupta et al**⁽⁷⁾, most common symptom was fever followed by dysuria, followed by burning micturition, followed by abdominal pain, smelly urine, followed by poor feeding, followed by vomiting. In the study done by **Tamizarasu et al**⁽¹²⁾, children from 2 months to 12 yrs of age were studied for UTI in kancheepuram. The symptoms in descending order were dysuria, abdominal pain, fever, frequency of micturition, vomiting, oliguria. **Nayak et al**⁽⁸⁾ study showed that fever was the most common complaint followed by dysuria.

In our study, pallor was observed in few children, facial puffiness in few children. Pedal oedema was present in very few children. High grade temperature was recorded in less than children. The sensitivity for leucocyte esterase laid by AAP norms was 83% (67-94%) which was in range with our study. The specificity laid by AAP norms was 78% (64-92%) which was in range with our study. Comparing our study with **Ruchika et al**⁽¹³⁾ (51.2%), **Nayak et al**⁽⁸⁾ (61%) in our study sensitivity was very high compared to other studies. The specificity in our study was high and comparable to most of the studies such as **Mod hk et al**⁽¹⁰⁾, **Nayak et al**⁽⁸⁾ (25%). Positive predictive value of leukocyte esterase was less (73%) and was in range with most of the studies such

as **Nayak et al**⁽⁸⁾ (69%). Negative predictive value in our study was high (92.6%) and was in range with most of the studies such as **Tamizarasu et al**⁽¹²⁾ (92.8%).

The sensitivity for nitrite laid by AAP norms was 53% (15-82%) but our study showed higher sensitivity. The specificity laid by AAP norms was 98% (90-100%) which was in range with our studies. **Ratna Barel et al**⁽¹⁴⁾ did a study on urine samples, and tested the efficacy of urine nitrite alone in UTI, found that it is highly specific. Most of the studies showed a specificity of around 90%. Similarly in our study also, nitrite was highly specific, and had a good negative predictive value in diagnosing UTI. In contrast to other studies, our study showed a high sensitivity for nitrite test. Positive predictive value was also good compared with other studies. The sensitivity of combined dipstick laid by the AAP norms was 93% (90-100%) which was in par with our study findings. The specificity of combined dipstick laid by AAP norms was 72% (58-91%) which was in par with our study. On comparing our study to other studies regarding the utility of combined dipstick in diagnosing UTI, Our study showed a very good sensitivity, moderately good specificity, good negative predictive value and relatively good positive predictive values compared to other studies. Majority of studies had sensitivity around 60-70% which is in contrast with our study. Our study had the maximum sensitivity. Majority of studies had specificity > 80% which is in par with our study.

CONCLUSIONS

The findings of this study imply that combining nitrite and leucocyte esterase results produces superior diagnostic results than either nitrite or leucocyte esterase results alone. Dipstick was also found to be a good predictor of negative urine cultures. However, in comparison to quantitative urine culture, dipstick results should not be too trusted for diagnosis. As a result, quantitative urine cultures should be promoted.

Conflict of Interest: No

Fundings: No

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