

Original research article**A study on urine dipstick fast screening for UTI in children: A prospective study****¹Dr. J L Prakash Anand, ²Dr. Y. Grace Gnana Aparanji, ³Dr. Guru Prasanth G.**¹Assistant Professor, Department of Pediatrics, Government General Hospital and Kurnool Medical College, Kurnool, Andhra Pradesh, India²Assistant Professor, Department of Pediatrics, Government General Hospital and Kurnool Medical College, Kurnool, Andhra Pradesh, India³Postgraduate, Department of Pediatrics, Government General Hospital and Kurnool Medical College, Kurnool, Andhra Pradesh, India**Corresponding Author:**

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Abstract

Background and Objectives: Urinary tract infection is a common pediatric emergency room diagnosis. Renal scarring, hypertension, and end-stage renal failure can be lethal, making early diagnosis and treatment crucial. Paediatric urinary tract infections are notoriously difficult to detect due to their nonspecific symptoms. Even a single urinary tract infection that is confirmed clinically should be treated vigorously specifically in infants because of the risk of renal parenchymal damage. Diagnostic tests are essential for early diagnosis and prompt diagnosis.

Material and Methods: The research was carried out in the Department of Pediatrics, GGH Kurnool, Andhra Pradesh. The study sample consisted of 250 children who presented with symptoms suggestive of urinary tract infection (UTI) and sought medical care either through outpatient department (OPD) visits or hospital admissions at our institution. A hospital-based prospective study was undertaken from January 2022 to April 2023 the study subjects to evaluate the utility of urine dipstick as a rapid screening test for UTI.

Results: Culture-positive UTIs occurred in 89 out of 250 patients (61.9 percent). Sixty-one percent of the sample had a negative urine culture. In the study it was observed that among the urinary tract infections were more common among girls compared to boys. Furthermore, boys were more likely to experience vesicoureteral reflux and renal scarring from UTIs than girls. One possible explanation is because newborns were included.

Conclusion: Urine microscopic analysis has a low degree of sensitivity, positive predictive value, and negative predictive value. Because of this, it cannot be relied upon for use in UTI screening. The dipstick test is capable of detecting nitrites and leucocyte esterase with fair amount of accuracy as compared with semiquantitative tests.

A useful screening test for UTI, leucocyte esterase has high sensitivity but only mediocre specificity. Nitrite can be utilized accurately in the diagnosis of UTIs because of its high sensitivity and specificity.

Keywords: Urine dipstick, screening, UTI in children, prospective study

Introduction

Urinary tract infection (UTI) is a prevalent genitourinary condition frequently encountered in pediatric emergency departments. The complications of UTI range from renal scarring, hypertension and end-stage renal failure underscoring the significance of prompt and accurate diagnosis and treatment ^[1]. The symptoms of urinary tract infections might vary in their presentation, ranging from nonspecific to clearly evident. Diagnosing urinary tract infections in children poses a significant challenge due to the elusive nature of their symptoms. Hence, the utilization of diagnostic tests is imperative in facilitating timely identification and diagnosis ^[1, 2].

The discipline of diagnosing urinary tract infections has had significant advancements, particularly in the area of noninvasive approaches that enable faster and more accurate diagnosis. The importance of precise diagnosis cannot be overstated due to several factors. These include the need to prevent unnecessary treatment for children who are not susceptible to renal injury, as well as the ability to identify, treat, and assess those who are at risk of renal damage. Consequently, the need for cost-effective and efficacious therapies will be reduced. Urine samples constitute the predominant proportion of specimens examined in conventional diagnostic laboratories. A wide range of diagnostic methods, including microscopy, gram stain, automated assays, and urine cultures, are available for clinical use ^[3-5].

The availability of results from a urine culture is typically delayed by 24-48 hours following the onset of symptoms due to the necessary incubation period for the growth of microorganisms in culture media,

which typically requires at least 18 hours. One advantage of utilizing reagent strip testing for urine samples is its ability to facilitate prompt identification of infections in the emergency room, so as to enable the initiation of therapy at an earlier stage. Reagent strips are now available for the testing of infection signs^[6, 7]. The use of a singular dipstick for the simultaneous assessment of leukocyte esterase and nitrite in urine has emerged as a novel method for the screening of urinary tract infections. The utilization of rapid diagnostic assays is advantageous in small laboratory settings lacking a dedicated culture facility due to their cost-effectiveness, expeditiousness, and ease of use. These dipsticks possess a sufficient level of convenience for the purpose of detecting urinary tract infections within primary care clinics and educational institutions^[8, 9]. The diagnosis of both uncomplicated and complicated urinary tract infections can be expedited compared to the traditional culture-based method. Therefore, the collection of samples in young individuals can be easily achieved using a noninvasive approach. The dipstick approach for diagnosing a urinary tract infection does not require the presence of a qualified professional or access to a fully equipped laboratory^[10, 11].

Furthermore, recent findings have revealed the utility of rapid urine dipsticks in effectively identifying suitable candidates for urine culture submission, hence mitigating unnecessary expenditures. Consequently, the gold standard method for diagnosing urinary tract infections, known as urine culture, may be reserved for cases in which there is a strong clinical suspicion and a positive dipstick test result. Despite the existence of prior research on this subject, there is a notable scarcity of studies undertaken in India, particularly in the context of pediatric populations^[12, 13]. Furthermore, there is a scarcity of scholarly investigations pertaining to the subject matter of urinary tract infections inside the framework of congenital malformations of the urinary system. Hence, the objective of our study is to address this requirement.

Materials and Methods

The research was carried out in the Department of Pediatrics, GGH, Kurnool, Andhra Pradesh. The study sample consisted of 250 children who presented with symptoms suggestive of urinary tract infection (UTI) and sought medical care either through outpatient department (OPD) visits or hospital admissions at our institution. A hospital-based prospective study was undertaken from January 2022 to April 2023 to evaluate a screening test.

Inclusion criteria

- Children 2-12 years old showing signs and symptom of urinary tract infection (UTI).
- Febrile illness without focus.

Exclusion criteria

- Children younger than 2 years old.

Method of collection of data

All children who met the inclusion criteria had their clinical history, physical examination, comorbidities and investigations obtained after their parents gave their informed consent. The standard diagnostic procedures were carried out, such as a complete blood count and urinalysis. Renal function tests were done in all the study subjects. Ultrasound of abdomen with renal parenchymal details, Anteroposterior diameter of renal pelvis (APD) were carefully noted to rule out renal malformations as cause of UTI.

Children who qualified for a micturition and cyst urethrogram per IAP guidelines underwent these procedures.

Collection of sample

Urine samples were collected under sterile conditions. Two containers of urine, one for analysis and the other for culture, were collected. Midstream clean catch samples, cauterized samples, and bagged samples were used to collect urine for this investigation. Washing one's genitalia with soap and water reduces the risk of contamination from organisms that live in the per urethral and prepuccial spaces. We did not recommend antiseptic washes or invasive prepuccial retraction. Urine analysis specimens were sent to a clinical pathology facility and urine culture specimens were sent to a microbiological lab within 2 hours of collection, both in sterile glass or plastic bottles. Direct microscopy reveals the presence of WBCs, bacteria and microscopic hematuria.

Statistical analysis

Microsoft Excel was used for data entry, and SPSS was used for statistical analysis. The median was reported for continuous data that was reported as mean SD. Numbers and percentages represented the outcomes of categorical assessments. Results from tests for leucocyte esterase, pyuria, nitrites, and combined nitrite and leucocyte esterase were compared to reference levels to determine their sensitivity, specificity, negative predictive value, and positive predictive value. To achieve this, we first calculated

the standard formula for each variable, then determined its true negative, true positive, false positive, and false negative values. Culture-proven UTIs are compared to sterile cultures to check if any of the criteria are significantly higher in the former group.

Results

Table 1: Characteristics of the Sample

Age	Cases	%
3-5 YRS	90	36.00
6-10 YRS	140	56.00
>10	20	8.00
Total	250	100.0

Out of the entire sample size of 250 cases, 110 instances yielded positive results in culture, whereas 40 cases exhibited scanty growth in culture, which was considered insignificant. Moving forward, we will only focus on a total of 100 cases that have yielded positive culture results.

The sex breakdown of the sample population

Out of the total study population of 250 individuals, 123 were male while 139 as female children.

Table 2: Gender breakdown of the sample population

Sex	Frequency	%
Male	110	44.00
Female	140	56.00
Total	250	100.0

Table 3: Health problems experienced by the research sample

Associated Comorbidity	Cases	%
Nocomorbidity	238	95.4
Nephroticsyndrome	3	1.1
Neurogenicbladder	4	1.5
Posteriorurethralvalve	2	0.8
Primaryvesicourethralreflux	1	0.4
Hydroureteronephrosis	1	0.4
PUJobstruction	1	0.4
Total	250	100.0

Table 3 presents the comorbidities that are related with the study population. A co-morbidity rate of 95% was recorded in this study. Only a mere 5% of the observed population consists of individuals belonging to other categories.

Nitrite test

Bacteriuria was regarded to be severe if any number of bacteria were identified during supra pubic aspiration. However, because it is an invasive technique, supra pubic aspiration was not performed on any of our subjects. Ninety of the 112 cases that were culture-positive had a colony count high enough to indicate serious bacteriuria. A colony count was judged substantial when it occurred in 12 of the children who were catheterized. They made up 4.6% of the total populace. There was no evidence of severe bacteriuria in 10 children due to poor culture growth. That leaves only 100 as the "culture-positive" percentage. All the children enrolle had renal function tests done. Eight children showed abnormal creatinine values suggesting a more serious medical problem. Two of the eight had hydroureteronephrosis, while three had a posterior urethral valves.

Micturition cyst urethrogram

About 10 patients who qualified had a micturition cyst urethrogram performed. We received anomalous reports on 8 children. Two of the kids had a linear filling defect that matched the location of the valves along with dilated prostatic urethra. This finding indicated the presence of anatomical malformation like posterior urethral valves. One subject showed signs of grade 2 vesicoureteral reflux, (VUR) which involves backflow into the upper collecting system without ureteral dilatation. Three children showed symptoms of neurogenic bladder, including inadequate bladder emptying. Post void residual urine exceeded 20 ml. Hydroureteronephrosis of the fourth degree was diagnosed in one child. One child had signs of grade 3 VUR, including dilatation of the renal pelvis and blunting of the calyceal fornices.

Discussion

A total of 89 patients out of a sample size of 250 were found to have culture-positive urinary tract

infections. A majority of the sample, specifically 61%, exhibited perspective towards culture. Our study revealed a higher prevalence of urinary tract infections in females compared to boys. In the study conducted by Gupta *et al.*, it was concluded that within their sample population of individuals diagnosed with urinary tract infections, 69.4 percent were identified as male. Additionally, it was shown that males exhibited a greater susceptibility to vesicoureteral reflux and renal scarring as compared to females. The prevalence of urinary tract infections among children in northern India was investigated by Sumit *et al.*. The prevalence of urinary tract infections was found to be greater among women compared to men within the sample population. The prevalence of culture-positive urinary tract infections was higher among females compared to males [14-16].

The research population, which included individuals of all age groups exhibiting symptoms indicative of urinary tract infection, demonstrated a higher prevalence of UTI in males compared to females. Nevertheless, the study failed to stratify participants based on their age. Among the 102 species that exhibited positive cultures, *Escherichia coli* (*E. coli*) was shown to be the most prevalent, followed by *Klebsiella*, *Proteus*, Non-Fermenting Gram-Negative Bacilli, and, to a lesser extent, *Citrobacter*. Based on our study *Escherichia coli* (*E. coli*) has been identified as the predominant microorganism. The research conducted by Palak *et al.* and A. Sharma *et al.* yielded findings that were comparable to those obtained in our study. Our research results on *Klebsiella* were consistent with the findings reported by Palak *et al.* In stark contrast to the notable incidence of *Proteus* seen in our analysis, no instances of *Pseudomonas* were isolated [17-19].

Based on the examination of symptoms, dysuria emerged as the most prevalent symptom, followed by an elevation in micturition frequency, persistent vomiting, abdominal discomfort, fever, hematuria, pyuria, and ultimately constipation. A minority of the individuals displayed symptoms of fever. The majority of the children experienced fever for a duration of less than one week, while a smaller proportion had fever for exactly one week, and only a limited number of individuals had fever lasting longer than one week [20-22].

In a study conducted by Gupta *et al.*, it was determined that fever emerged as the predominant symptom, followed by dysuria, burning micturition, stomach pain, bad urine, poor appetite, and vomiting. A study conducted by Tamilarasu *et al.* examined the prevalence of urinary tract infections (UTIs) among children aged 2 months to 12 years in Kancheepuram. The symptoms seen in the patient included dysuria, abdominal pain, fever, frequency of micturition, vomiting, and oliguria, arranged in descending order of severity. According to the research conducted by Nayak *et al.*, fever was identified as the most frequently reported symptom, with dysuria being the subsequent symptom most commonly observed. A limited proportion of children within our sample exhibited indications of pallor, while a comparable number displayed indications of facial puffiness. Pedal edema was observed in a minority of children. A minority of young individuals experienced a high-grade fever [23-25].

Although less than 50% of the children exhibited normal abdominal examinations, over 50% of them had tenderness in the suprapubic region. A small proportion of children reported experiencing lumbar soreness. According to our research findings, a prevalence rate of 10% was observed among male children who underwent genitourinary tests, indicating the presence of phimosis. No instances of vulval synechia were seen among female children, and all examined youngsters demonstrated normal blood pressure levels. A proportion of 10% of the children within the study sample were found to have an additional medical problem. The co-existing conditions were classified in descending order as follows: nephrotic syndrome, neurogenic bladder, posterior urethral valve, vesicoureteral reflux, hydronephrosis and PUJ obstruction [26-28].

The American Academy of Pediatrics has developed recommendations for the detection of pyuria, with a reported sensitivity of 73% and a specificity ranging from 45% to 98%. The study conducted revealed that the sensitivity of pyuria was approximately 60%, a value that falls below the established requirements outlined by the American Academy of Pediatrics. Conversely, the specificity of pyuria was approximately 80%, a value that aligns with the aforementioned guidelines. Our study is compared with four similar studies that also investigate the use of a urine microscope for screening urinary tract infections. Based on our research findings, urine microscopy exhibits limited sensitivity, although demonstrates notable specificity and negative predictive value. The positive predictive value of our investigation was consistent with the findings of the bulk of previous research studies [27-29].

In comparison to four previous studies, our research exhibited a significantly higher level of sensitivity. Our research exhibits a notable degree of specificity, comparable to the bulk of other studies. The bulk of investigations have consistently found that leukocyte esterase has a modest positive predictive value. The present investigation demonstrated a robust negative predictive value, which exhibited similarity to findings reported in previous studies [28, 29].

According to our research findings, it was observed that a quarter of the children exhibiting abnormal results in their MCU had been diagnosed with a posterior urethral valve. The prevalence of both grade 2 and grade 3 vesicoureteral reflux was observed to be 10% among the population. Neurogenic bladder constitutes approximately one-third of all documented anomalies. A prevalence of 10% was observed for grade 4 hydronephrosis. In their study, Mod *et al.* observed that a small proportion of participants

had anomalous results in the context of MCU, without providing any details regarding the nature of these deviations. A study was undertaken by the Government Stanley Medical College to investigate the etiology of urinary tract infections. The findings of the study revealed that a minority of the participants exhibited anomalies in their micturating cyst urethrograms. Specifically, 50% of the subjects displayed vesicoureteral reflux, while the remaining 50% exhibited bilateral double ureters^[29-31].

Conclusion

Microscopical examination of urine has a low degree of sensitivity, positive predictive value, and negative predictive value. As a result, it lacks the accuracy necessary for use in UTI screening. Leukocyte esterase is an excellent screening test for UTIs because of its high sensitivity and intermediate specificity. Nitrite is a reliable diagnostic tool for UTIs because to its high sensitivity and specificity. When compared to urine culture, the combined dipstick has higher sensitivity, specificity, positive predictive value, and negative predictive value. While waiting for urine culture results, a positive leukocyte esterase test can be used reliably due to its high sensitivity; a positive nitrite test can be used consistently due to its high specificity; and a positive combination dipstick can be used reliably due to its high sensitivity and specificity.

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