Diagnostic accuracy of leukocyte esterase in confirmed cases of urinary tract infection in children

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Abstract

Introduction: Gold standard for the diagnosis of urinary tract infections (UTIs) is urine culture, but it takes longer for bacterial growth on culture media. Leukocyte esterase is a simple strip testing of urine sample, so it takes less time in diagnosing cases of UTI.

Objective: To determine the diagnostic accuracy of leukocyte esterase for detection of urinary tract infection in children taking urine culture as the gold standard.

Materials and Methods: This cross-sectional study was conducted in the Department of Pediatrics, Mayo Hospital Lahore from April to October 2017. Children of both genders between 2-12 years of age having clinical findings consistent with the operational definition of UTI were included in this study. Clean catch, midstream urine sample was collected in a sterile container for culture and test strip was dipped in urine sample for leukocyte esterase.

Results: Total 215 Children were included in the study. The mean age of the children was 7.15±3.36 years. There were 118 (54.9%) males and 97(45.1%) females in this study.37 (17%) were culture positive. Sensitivity, specificity, positive and negative predictive value of leukocyte esterase was 69.77%, 87.79%, 58.82%, and 92.07% respectively. Diagnostic accuracy was 84.19%.

Conclusion: Leukocyte esterase is a reliable marker for the screening of urinary tract infection in children 2 years to 12 years of age.

Keywords: Leukocyte esterase, urinary tract infection, urine culture.

Introduction

Urinary tract infections (UTI) can be defined by the presence of a significant bacterial count in the urine along with signs and symptoms of infections, including fever, dysuria, burning, frequency and desire to micturate despite empty bladder, and flank pain. Girls are more prone to UTI than boys. Risk factors leading to UTI are constipation, poor hygiene, congenital urinary tract anomaly and indwelling catheter.[1] The most common causative organism for UTI is Escherichia coli (38%), followed by Klebsiella (13%), pseudomonas (12.5%), candida (9%), enterococcus (7%), and Staphylococcus saprophyticus (5-10%).[2]

The prevalence rate of UTI is 3.3% in the United States.[3] Reported prevalence of UTI in febrile children from Pakistan is 11.8%.[4] Quantitative urine culture is the gold standard for diagnosis of UTI. Urine culture requires 18 hours for bacterial growth on culture media, so diagnosis remains undecided for first 24-48 hours after presentation. Many prompt diagnostic tests including wet mount microscopy, gram stain, and dipstick leukocyte esterase are also available. Leukocyte esterase is a simple strip testing of urine sample, so it takes less time in diagnosing cases of urinary tract infection. Sensitivity, specificity, positive predictive value of leukocyte esterase is reported to be 100%, 24.6% and 32.8% respectively.[5]

Early detection of UTI leads to the early initiation of therapy. Urine culture is expensive and requires well-equipped laboratories with experienced technicians. Leukocyte esterase is an inexpensive test, and the sample is easy to collect by noninvasive technique. It can be performed in a laboratory with no special staff or equipment. The facility of urine culture may not be available everywhere in our settings. The objective of this study was to determine the diagnostic accuracy of leukocyte esterase in confirmed cases of urinary tract infection in children, so that if found useful, we may use this test for the diagnosis of UTI where culture facility is not available.

Materials and Methods

This cross-sectional study was conducted in the Department of Pediatrics, Mayo Hospital Lahore from April to October 2017. A total of 215 children of both genders between 2- 12 years of age having clinical findings consistent with the UTI as detailed below were included by non-probability consecutive sampling. Sample size of 215 patients was estimated by using 95% confidence interval, expected prevalence of UTI as 11.8%, sensitivity as 75.74% and specificity of urine dipstick Leukocyte esterase as 68.9% with 10% margin of error[5]. UTI was considered as having fever of >38°C for >72 hours and with abdominal pain in upper quadrant and /or in flanks and/or in suprapubic region. Presence of bacterial count of 105 colonies forming units per milliliter of urine was considered as confirmed UTI.[1] Patients who have already taken antibiotics within 48 hours before presenting to the hospital were excluded from the study. Clean catch, mid-stream urine sample with symptoms of UTI was collected in a sterile container by the mother and the test strip was dipped in the urine sample. The strips were blotted with a blotting paper to remove excess urine, the colors of the reagent pad were compare within 60 seconds with the color chart on the vial label by Dr Anam Arif. Samples were tested for leukocyte esterase by using (COMBI-10SL, UK) strip. Leukocyte esterase was considered as positive if there is a change in color from off-white towards purple within 2 minutes. For urine culture mid-stream urine sample was collected in a wide-mouth bottle. The semi-quantitative culture was done by plating 1ul urine using a calibrated bacteriological loop on cysteine lactose electrolyte deficient agar and colonies were counted after overnight incubation at 37° C.

Data was entered and analyzed in SPSS 22. Quantitative variable (age) was presented as mean and standard deviation. Qualitative variables such as gender, UTI on leukocyte esterase and culture were presented as frequency and percentages. A 2x2 tables were constructed to calculate Positive Predictive Value (PPV), Negative Predictive Value (NPV), sensitivity, specificity and diagnostic accuracy of leukocyte esterase taking urine culture as the gold standard.

Results

The mean age of the children was 7.15±3.36 years. There were 118 (54.9%) males and 97 (45.1%) females. Urine culture was positive in 41 (19.1%) and negative in 174 (80.9%) patients. Leuccyte esterase was positive in 165 (76.7%) and negative in 50 (23.3%) patients. The sensitivity and specificity of leukocyte esterase were 69.77% and 87.79%. PPV and NPV were 58.82% and

92.07% respectively. Overall diagnostic accuracy was 84.19%. (Kappa 0.528, p-0.000) (Table 1)

Table 1: Diagnostic accuracy of leukocyte esterase (n=215)

Leukocyte Esterase	Urine Culture		Total
	Positive	Negative	
Positive	30(69.8%)	21(12.2%)	51
Negative	13(30.2%)	151(87.8%)	164
Total	43	172	215

Sensitivity: 69.77%, Specificity: 87.79%, PPV: 58.82%, NPV: 92.07%, Diagnostic accuracy: 84.19%
(Kappa 0.528, p-0.000)

Discussion

The present study assessed the diagnostic accuracy of leukocyte esterase (dipstick) for detection of UTI in children while taking urine culture as the gold standard. Najeeb et al5 reported combined sensitivity of LE and nitrites as 75.74% while specificity was 68.90% whereas in our study the sensitivity and specificity of leukocyte esterase was 69.77% and 87.79%. Laosu-angkoon6 determined the sensitivity and specificity of urine leukocyte esterase in an outpatient clinic. His study showed the sensitivity of combined leukocyte esterase and nitrites as 66.7% while that of leukocyte esterase alone was 63.6% whereas the sensitivity of our study was 69.77% which is slightly higher as compared to the above-mentioned study. Their study concluded that dipstick should be added in ER department for quick diagnosis of UTI especially in children to prevent potential sequel like hypertension and renal scarring. Taneja et al7 showed that sensitivity, specificity, PPV and NPV of leukocyte esterase were 73.5%, 58.5%, 33.0% and 88.8% respectively, whereas in our study the sensitivity, specificity, PPV and NPV of leukocyte esterase were 69.77%, 87.79%, 58.82% and 92.07% respectively, which are better compared to the above-mentioned study. Dadzie et al8 reported sensitivity of leukocyte esterase 60.0 (47.1–72.0), specificity of 73.9 (95% CI = 69.1–78.3), and positive predictive value of 29.1 (95% CI = 21.6–37.7). Glissmeyer et al9 worked to assess urine dipstick screening test in febrile children of 1-90 days and showed that dipstick alone is a screening tool to rule out UTI in infants and showed

higher predictive values for leukocyte esterase. They concluded that dipstick is a reliable screening tool, and could be used in the emergency department for diagnosis of UTI.

Although, the sample size of our study was 215, but still there is a need to conduct the study on a large sample size to generalize the results on population. Secondly, the study was done in a single setting due to cost and less study duration. Furthermore, a multi-centered study must be done to achieve more reliable results.

Conclusion

Leukocyte esterase is a reliable marker for the screening of urinary tract infection in children aged 2 years to 12 years.

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