ACCURACY OF URINE DIPSTICK TO PREDICT URINARY TRACT INFECTIONS IN AN EMERGENCY DEPARTMENT

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Background: Urine dipstick is a useful and commonly used test in the Emergency Department because of its rapidity and low cost; however its diagnostic accuracy is debatable. Our objective was to compare the urine dipstick and urinalysis for Urinary Tract Infection in a developing country, where there are significant cost considerations. **Methods:** This was an observational study of adults' patients presenting to Section of Emergency section (SEM) of the Aga Khan University Hospital, from March to May 1998. The patient's urine sample was tested immediately, using the Multistix 10SG. The sample was sent within one hour to the hospital laboratory for analysis, while the urinary specimen was sent for culture, where appropriate. The dipstick results were compared with the results of automated urinalysis in the laboratory, leukocyte counts on microscopy and urine culture. Sensitivity, Specificity, and predictive values were also calculated. **Results:** We evaluated 984 samples of urine during the study period. The sensitivity of nitrite test was 81% and that of leukocyte esterase 77% for positive cultures. However, the sensitivity for combined nitrite and leukocyte esterase test was 94%. Nitrite test was more specific (87%) than leukocyte esterase test (54%) or both tests taken together (50%). The predictive value of nitrite and leukocyte esterase together for a negative urine culture was 95%. Leukocyte esterase test sensitivity increased as the number of white blood cells on microscopy increased. Similarly the predictive value of leukocytes on microscopy for a positive culture increased as the number of leukocytes increased. **Conclusion:** Dipstick alone cannot accurately predict urinary tract infection in emergency department.

Key Words: urine dipstick, urinary tract infection, and emergency department

INTRODUCTION

Urinalysis is the most commonly used test for evaluation of emergency department (ED) patients with potential urinary tract infections (UTI), however it can significantly increase a patient's time in ED. Substituting a urine dipstick test for a laboratory analysis may be less time-consuming and less expensive, but the dipstick may not be as accurate.

Urine dipsticks are often done in the Emergency Room owing to their rapidity and low cost. The diagnostic accuracy of microscopic urinalysis and urine dipstick for suspected urinary tract infections has been studied; these studies have shown that the diagnostic accuracy of rapid dipstick tests is debatable[1, 2.] In clinical situations in which the symptoms and signs of UTI are present, a negative dipstick does not reliably rule it out[1]. Propp et al have shown that nitrite and leukocyte esterase assays miss significant microscopic findings with corresponding clinical pathology[3]. Urine dipstick is also a poor predictor for proteinuria and hematuria[4]. A recent meta-analysis of 75 papers carried out to establish whether negative dipstick urine analysis is sensitive enough to rule out UTI in adults with urinary symptoms, concluded it to be of insufficient sensitivity to rule out UTI in patients with one or more symptoms.[5] No such studies have been done on adults in Southeast Asia. Only one study in Malaysia showed low sensitivity and positive predictive value for nitrites, but it was done on asymptomatic school children[6].

Our objective, therefore, was to compare the urine dipstick and urinalysis for UTI in the Emergency Section of a tertiary care hospital in a developing country like Pakistan where there are significant cost considerations.

MATERIALS AND METHODS

This was an observational study of adults' patients presenting to Section of Emergency section (SEM) of the Aga Khan University Hospital, from March to May 1998, which is a tertiary care hospital and a referral center for the whole country.

We calculated our sample size by taking all the SEM patients (35,000/yr) as our target population, and using the data available from literature for sensitivities and specificities (approximately 70%). Assuming type 1 error of 0.5%, it was seen that a sample 886 would have a statistical power of 99.9%. We examined the urine samples of 984 adult patients (age cut off at 15 years) admitted to the SEM (See table 1).

The Inclusion Criteria was the patients with dysuria, urgency, and urinary frequency, hematuria, gross pyuria, flank pain, loin to groin pain, and suprapubic pain, urinary retention, and clinical suspicion of Urinary tract infection. The patients who had taken antibiotics in the last 48 hours were excluded from the study.

If patient had vaginal bleeding or were physically unable to provide a clean-catch urinalysis, urine was collected by urethral catheterization. Urine was collected in all patients by the midstream clean-catch technique after they received standardized verbal instructions.

The nurse divided each urine sample into two containers. The registered nurses and technicians performed the dipstick tests in the SEM, from the first container within five minutes of passing urine, using the Multistix 10SG (Ames Division, Miles Inc. USA, Division of Bayer Australia Ltd.) from a sealed, air-tight container. We looked for the leukocytes, nitrite, and blood.

The nitrite test depends upon the presence of nitrate in urine. If there is significant growth (10^5 CFU/ml) of bacteria in urine, these bacteria produce nitrate reductase, which reduces nitrate to nitrite. Streptococci do not produce this enzyme; so streptococcal urinary tract infection gives a false negative nitrite result. Leukocyte esterase (LE) test uses derivatized pyrrole amino acid ester to detect leukocyte esterase in white blood cells.

The second container was sealed and sent within an hour of collection to the hospital laboratory for analysis. Laboratory analysis included automatic dipstick reading, and a manual or semiautomatic microscopic analysis of urine sediment. In the laboratory, a trained technician centrifuged urine sample for five minutes at 2,000 rpm and the sediment put on a glass slide to be examined microscopically. The laboratory technicians interpreted the results as the number of WBCs and RBCs per high-power field (hpf).

Urine was cultured for patients whose dipstick tests were positive for either nitrite or white blood cells (WBC) or both. Urine cultures were also sent for patients with negative nitrite and WBC on dipstick but where the clinical suspicion was high. For cultures, 0.01 ml of urine was inoculated onto cysteine-lactose deficient (CLED) agar. These were inoculated at 37ºC for at least 24 hours and the number of colony forming units (CFU) was calculated by multiplying the number of colonies on Agar with 1,000. A urine specimen that grew more than 10^5 CFU/ml of one or two species was regarded as a positive culture. A sample that was sterile or grew less than 10^5 CFU/ml or obvious contamination was regarded as negative. Both the technicians performing the urinalysis and the microbiologist were blinded to the results of the dipstick test done in the SEM.

The comparative diagnostic value of test strips, conventional urinalysis and culture was evaluated in terms of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), by using 2 x 2 tables, and urine culture as gold standard. The PPV and NPV define the probability that the patient has or does not have a UTI. Informed consent was obtained from all the patients enrolled in the study.

RESULTS

A total of 984 urine dipstick tests were done between March and May 1998. There was no difference in any of the results between the urine dipstick done manually in the SEM and the automated strip analysis in the laboratory. However, differences were noted on clinical microscopy. Comparison of the leukocyte esterase test results with leukocytes viewed on microscopy showed that the sensitivity of dipstick for detecting white blood cells increased as the number of leukocytes in urine increased (Table 1). With 4 to 9 white blood cells on microscopy, the sensitivity of dipstick done in the SEM was 25%, with 10 to 20 leukocytes 56% and with more than 20 leukocytes 86%.

Table 1: Sensitivity of leukocyte esterase on Urine dipstick for detecting pyuria on clinical microscopy

Leukocyte Esterase ⇓	**Clinical Microscopy**		
	WBC 5-9	WBC 10-20	WBC>20
True positive	112	90	119
False negative	325	72	20
Sensitivity (%)	25	56	86

Urine culture was done for 404 patients. Culture was ordered when either or both nitrite and leukocyte esterase results were positive and in cases where both tests were negative but the clinical suspicion was high. The number of patients in each category is given in table 2.

Table 2: Reasons for ordering Urine culture

Reasons For Urine Culture	No. Of Patients (%)
Leukocyte positive, nitrite negative	121 (30.0)
Leukocyte positive, nitrite positive	102 (25.2)
Leukocyte negative, nitrite positive	33 (8.2)
Leukocyte negative, nitrite negative, high clinical suspicion	148 (36.6)

Of all the samples on which cultures were done, 123 grew organisms. Among these, 8 (5%) patients had negative urine dipsticks for nitrite and leukocyte esterase in the SEM. The sensitivity of leukocyte esterase for detecting urinary tract infection was 77%. The sensitivity of nitrite for positive culture was 81%; and it was 94% when both nitrite and white blood cells were considered (See table 3). However, the specificity of nitrite alone (87%) to rule out UTI was greater than either WBC (54%) or WBC and nitrite taken together (50%). When both LE and nitrite tests are considered, a negative dipstick usually meant that 95% of the times the patient would be culture negative (Table 3).

The positive predictive value of pyuria for significant growth on culture also increased as the number of white blood cells on clinical microscopy increased. The predictive value for positive culture for 4 to 9 white blood cells was 3%, for 10 to 20 leukocytes 15% and for more than 20 leukocytes 63% (Table 4).

Table 3: Characteristics of nitrite and leukocyte esterase (LE) tests for positive culture

Positive Biochemical Test	**Positive Culture n=404**	**Sensitivity (%)**	**Specificity (%)**	**Positive predictive value (%)**	**Nega-tive predi-ctive value (%)**
LE positive	95	77	54	43	85
Nitrite positive	99	81	87	73	91
LE and nitrite	115	94	50	45	95

DISCUSSION

Urinary tract infection is a problem that is commonly treated in Emergency Departments. Use of dipsticks instead of urinalysis may decrease patient time and the cost of testing. However, basing treatment decisions on either urine dipsticks or urinalysis is questionable.

Table 4: Sensitivity and Positive predictive value of pyuria on clinical microscopy for culture

	Urine culture

Clinical microscopy ⇓	True positive (n)	False Positive (n)	Positive predictive value (%)
WBC 5-9	11	326	3
WBC 10-20	25	137	15
WBC >20	87	50	63

Almost every test has false-positive and false-negative rates. False-negative tests may result in under treatment, and untreated urinary tract infections could cause renal damage or sepsis. False-positive tests that result in misdiagnosis of urinary tract infections may lead to the wrong diagnosis, increase costs, and expose patients to the risks of unnecessary antibiotics.

The diagnostic accuracy of microscopic urinalysis and urine dipstick for suspected urinary tract infections has been studied extensively, but results of these investigations have varied depending on patient population and laboratory techniques.[2, 7- 16] Our results show that there was no difference in the results of manually performed dipsticks in the Emergency Section and the automated multireagent strip analysis in the laboratory. Other studies have also suggested that the diagnostic accuracy of these 2 tests is similar.[7, 9] Blum and Wright, [7] reported a positive predictive value of 78% and 79% for urine dipsticks and urinalysis. The negative predictive values were 82% for urine dipsticks and 96% for urinalysis.[7] Using similar cutoffs for dipstick and urinalysis and the same cutoff for urine culture, Lammers[17] showed a positive predictive value of 77% for dipstick and 80% for urinalyses. Negative predictive values were 79% and 73% for dipstick and urinalysis, respectively.

Although the sensitivities of Nitrite and leukocyte esterase for positive culture were 81% and 77% respectively, the sensitivity increased to 94% when both nitrite and leukocyte results were considered. This differs from the results of other studies where leukocyte esterase has been shown to be a better predictor of bacteriuria than the nitrite test [1, 3]. Nitrite is also shown to be less sensitive (69%) by Wenk et al in a series of 200 urine samples[18]. This may be because nitrite identifies principally Gram-negative bacteria[6]. It may also be due to improper techniques for collection or transportation to the laboratory, allowing the colonizing bacteria to multiply, which result in positive nitrite test with positive culture. On the other hand, leukocyte esterase result would be negative in such a case. There is a general agreement that the combined leukocyte esterase and nitrite tests diagnose much better results than when they are used alone. Wenk et al using both tests found a sensitivity of 86.2%[17]. Similarly, Sewell et al showed a sensitive figure of 78.3% in a series of 469 urine specimens[18].

The specificity of nitrite was found to be higher (87%) than either leukocyte esterase (54%) or both nitrite and leukocyte esterase considered together (50%). This is consistent with the results shown by Zainal and Baba in Malaysia, however, they show almost 100% specificity for nitrite[6]. This difference may either be because of different sample populations for the two studies or because of different strips used for urinalysis, as the authors do not mention the brand name of the strip used.

The sensitivity of leukocyte esterase test for pyuria increased as the number of white blood cells on clinical microscopy increased. Similarly, the predictive value of clinical microscopy for a positive culture increased as the white cell counts in urine increased. This is consistent with the observations made by Propp et al [3].

Some investigators have studied the utility of urine dipsticks in populations with even lower incidences of urinary tract infection and found higher negative predictive values (84% to 93%) than in our study. [13-15] Nevertheless, they concluded that negative results for the urine dipstick alone resulted in an unacceptable under treatment rate if used as the sole criterion for excluding urinary tract infection. Several investigators have concluded that the urine dipstick is nonspecific in diagnosing urinary tract infection.[2, 8 11-13, 16] Some of these have suggested that negative dipstick results are sufficiently accurate to preclude further testing or treatment.[2, 8-11]

This study demonstrated that in ED setting, significant numbers of positive urinalysis for leukocytes and bacteria were missed by dipstick examination. The microscopy was more sensitive, but still not infallible.

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