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ORIGINAL ARTICLE

Utility of Urine Dipstick Test for the Screening of Urinary Tract Infection in Catheterized Women Following Gynecological Surgeries

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Abstract

Objectives Our objective was to determine the utility of urine dipstick test for the screening of urinary tract infection in catheterized women following gynecological surgeries.

Methods This was a descriptive study carried out in a tertiary care centre. Five hundred post-operative women were enrolled in the study whose urine samples were collected under sterile precautions from their catheters and simultaneously subjected to the dipstick test at the bed side of the patient and submitted to the laboratory for semi-quantitative culture and microscopy. Data were expressed as proportion. The results of the culture, microscopic examination, and the dipstick test were analyzed using Chi-square test.

Results When culture results were compared with the leukocyte esterase (LE) test and the nitrite reduction (NR) test, the P value obtained was <0.0001, respectively. Sensitivity was 88.24, 85.29, and 87.88 %, respectively, for the LE test, NR test, and when both these tests were combined. The specificity for the LE test and the combination were, respectively, 98.46 % while for the NR test was 96.71 %. The positive predictive value decreased from 81.08 to 80.56 % on combining the tests while the negative value remained unchanged at 99.11 %.

Conclusions These bedside tests could considerably reduce the laboratory workload and allow important clinical decisions to be made early.

Keywords Urine · Catheter · Dipstick test · Semi-quantitative culture · Post-operative

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Introduction

Urinary tract infection (UTI) is one of the commonest indications in a hospital setting for sending urine sample for culture and also for initiating empirical antibiotics. Hence, routinely, in laboratories where the sample load is huge and generates a significant workload. In majority of the cases, the specimens submitted to a laboratory generally show no evidence of infection when tested. Consequently, a considerable amount of time and resources are spent on processing and analyzing such samples. Hence, screening out of negative specimens before processing them for culture especially in busy laboratories seems to be worthwhile.

There are many tests available for the diagnosis of bacteriuria or UTI. Routinely, a semi-quantitative culture of a urine specimen is the only method that can provide detailed documentation of UTI. However, such conventional methods take at least 24 h [1].

On the other hand, rapid tests like the dipstick test can bring down this delay. The dipstick test is capable of detecting nitrites and leukocyte esterase (LE) with fair amount of accuracy, compared with a semi-quantitative culture [2]. Several studies using these dipsticks have been conducted targeting asymptomatic bacteriuria in antenatal women [3, 4], asymptomatic bacteriuria in children [5], and in patients with spinal injury [6] as a cost-effective alternative to culture. These studies indicated that when the tests were performed on adult populations, degree of accuracy was good unlike in the pediatric population wherein variable results were noted [7].

Routinely, our laboratory receives >30,000 samples annually. Overall, 80 % of urine samples from hospitalized patients are found to be sterile, of which samples from post-operative patients form the majority. The culture negativity in these cases is high. Thus, in such a scenario, a rapid bedside test which is highly accurate and inexpensive may be the optimum solution both for the clinicians as well as the laboratory specialists and also, it may reduce the unnecessary use of empirical antibiotics.

There are very few studies from our country and none from our centre. Considering these facts, laboratory resources and patient care could be improved by the appropriate use of a validated bedside test for UTI which can be used to rule out or rule in UTI.

Methods

This study was approved by the institutional ethical committee and with the Helsinki declaration of 1975 that was revised in 2000 all samples were collected after obtaining informed consent from the patients.

Five hundred post-operative (post-gynecological surgery) patients were enrolled. The sample was collected from the catheter using sterile precautions as per the guidelines. Briefly, while collecting samples from the catheter all sterile precautions were taken. The person collecting the sample from the catheter washed hands thoroughly. Then the sampling port of the catheter was cleaned with spirit. After this dried, using a sterile needle and syringe, the sample was collected in two sterile, leakproof, screw-capped, and labeled containers. One of these containers was sent to the laboratory for culture while the other was subjected to the dipstick test at the bedside of the patient [8]. Culture was performed by the semi-quantitative culture method using a 1 µl loop without intermittent heating on the cysteine lactose electrolyte deficient medium (HiMedia, Mumbai, India). Routine microscopic examination was performed as mentioned earlier [1]. On culture, colony count ($\geq 10^5$ colony forming units per ml) and more than one type of isolate were given significance as per the guidelines mentioned earlier [8]. The dipstick test was performed and interpreted as per the instructions of the manufacturer (Multistix 10 G reagent strip, Siemens Healthcare, Germany).

The microbiologist and the laboratory technician were blinded and were unaware of the results of the dipstick test, which were known only to the clinician.

Statistical Analysis

Data were expressed as proportion. The results of the culture, microscopic examination, and the dipstick test were analyzed using Chi-square test. Since, the dipstick could detect LE and nitrite, only these were taken into consideration.

Results

Out of 500 samples obtained from the catheterized patients, ten specimens were found to be contaminated as they had more than three isolates, mixed with aerobic spore-bearing bacilli. Hence, these ten were excluded from the analysis. Only 34 (7 %) yielded bacteria on culture.

The outcome of culture and the LE test was compared (Table 1). The P value was <0.0001, indicating a highly significant association between the culture and the detection of LE by the dipstick.

When the outcome of culture and the nitrite test was compared (Table 2), the P value was <0.0001, indicating a highly significant association between the culture and the detection of LE by the dipstick.

Using the Fisher's exact test, the sensitivity, the specificity, the positive predictive value, and the likelihood ratio

Table 1 Comparison of the outcomes of the culture versus the detection of leukocyte esterase by the dipstick

Outcome of the dipstick test	Outcome of culture		Total
	Positive	Negative	
Leukocyte esterase positive	30 (6 %)	7 (1 %)	37 (8 %)
Leukocyte esterase negative	4 (1 %)	449 (92 %)	453 (92 %)
Total	34 (7 %)	456 (93 %)	490

$P < 0.0001$

Table 2 Comparison of the outcomes of the culture versus the detection of nitrite by the dipstick

Outcome of the dipstick test	Outcome of culture		Total
	Positive	Negative	
Nitrite positive	29 (6 %)	15 (3 %)	44 (9 %)
Nitrite negative	5 (1 %)	441 (90 %)	446 (91 %)
Total	34 (7 %)	456 (93 %)	490

$P < 0.0001$

were calculated (Table 3). On comparing the outcome of culture with the LE and the nitrite reduction (NR) tests, the *P* value was <0.0001 indicating highly significant association between the culture and the detection of the LE and the NR by the dipstick. But, there was no improvement in the sensitivity and specificity, and also the NPV showed no increase as against the use of the LE test alone (Table 3).

Discussion

The number of urine samples received in 2008 was 18,000 which increased to 27,000 by 2011. Amidst the rising numbers, to provide good quality service takes an enormous effort on the laboratory personnel.

The current conventional method of detection of UTI generates a report after 24 h if sterile or contaminated. If the culture is indicative of any growth of significance, it takes a total duration of 48 h. Majority (>90 %) of the samples in our case were sterile. If collected appropriately most of the samples would be sterile. Hence, if we have a rapid method of detection of such cases, the load of samples on the laboratory and processing them will be reduced considerably. The available urinary dipstick tests offer such an advantage and can be valuable resources to screen out negative urine specimens at the bedside, thereby reducing the clinical decision-making time [9]. These tests detect LE, nitrite, glucose, catalase, and albumin. Depending on the type of the dipstick, the number of tests may vary.

We have used a dipstick which can detect both the LE and the nitrite in the sample. The sensitivity of the urine dipstick test for nitrite was 85 % while the specificity was 96.7 %. Sensitivity of the urine dipstick test for leukocyte esterase was slightly higher than for the dipstick test for nitrites (88 %), while the specificity was 98 %. Combining the results of both parts of the dipstick tests with one or both did not increase the sensitivity any further as it was only 87.88 % which was lower than the sensitivity of the LE test, but the specificity was similar to that of the LE test. We did not note any discrepancy in the microscope findings and the LE test responses when the pus cells were >5/HPF. Hence, LE test can be taken as a surrogate marker for the presence of pus cells >5/HPF. Pyuria as detected by the LE test and bacteriuria as detected by the nitrite test had a good correlation (Table 3).

A negative dipstick test result excluded the presence of infection in this study. When the LE test was used alone, the negative predictive value (NPV) was 99.12 %, when the nitrite test was used alone the NPV was 98.88 %, and when both these tests were combined a NPV of 99.11 % was obtained. False negative result was noted in only 1 % of the samples, where culture was positive but either or of these dipstick tests were negative (Tables 1, 2). These findings are similar to the findings of Deville et al. [2] Patel et al. [9] and St John et al. [10] but are contradictory to the findings of Hurlbut and Littenbug [11].

A study using nitrite and LE to detect UTIs showed nitrite to be more reliable [12]. Another advocated a double marker screening approach using nitrite and leukocyte detection [13, 14], whereas other workers recommended the use of a combination of three infection-associated markers (nitrite, LE, and blood), which gives a NPV of over 98 % [15]. In this study, we found a very high NPV with a less than 5 % false negative rate (1 %). This degree of false negativity was much lower than that experienced by Zaman et al. [16].

In a dipstick test, there can be false negatives. The reasons for this are many, most of them due to technical errors or due to dilute urine or acidic urine. One cannot be sure of the bladder incubation time in a catheterized patient, which is always a dilemma in identifying catheter-associated UTI (CAUTI); this can also result in the dipstick being falsely negative which will be reflected on culture. Also, in case of certain organisms like *Staphylococcus* or *Enterococcus*, the nitrite test will not be positive but LE test may be positive. In these cases, one has to correlate with the clinical findings.

On the other hand, false positive results can arise due to certain drugs like levodopa or alkaline urine or exposure of the dipstick itself to air. Dietary intake has no effect on the test.

Table 3 Comparison of the leukocyte esterase versus the nitrite reduction test

Outcome	LE	NR	LE + NR
Sensitivity	0.8824 [95 % CI (0.7256–0.9670)]	0.8529 [95 % CI (0.6896–0.9505)]	0.8788 [95 % CI (0.7181–0.9660)]
Specificity	0.9846 [95 % CI (0.9687–0.9938)]	0.9671 [95 % CI (0.9642–0.9815).]	0.9846 [95 % CI (0.9686–0.9938)]
PPV	0.8108 [95 % CI (0.6482–0.9205)]	0.6591 [95 % CI (0.5005–0.7952)]	0.8056 [95 % CI (0.6396–0.9180)]
NPV	0.9912 [95 % CI (0.9775–0.9976)]	0.9888 [95 % CI (0.9741–0.9964)]	0.9911 [95 % CI (0.9774–0.9976)]
Likelihood ratio	57.479	25.929	56.996

$P < 0.0001$

Conclusions

The results indicate that the laboratory workload could be reduced considerably using such tests at the bedside itself and allow important clinical decisions to be made early. The high NPV in the present study is indicative of the fact that the dipstick test could be used at the bedside in case of catheterized individuals; if the LE and the nitrite are not detectable, it favors a sterile culture more predictively.

Compliance with ethical requirements and Conflict of interest The study was approved by the Institute Ethics Committee on 14.8.2010; Reference No. DME/EC(34)/2010. All the patients were screened only after obtaining their informed and written consent. The authors stated that they have no conflict of interest.

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