Role Of Automated Urine Analyser In The Diagnosis Of Urinary Tract Infection

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Abstracts: Aim: Although urine culture is used as the reference standard to determine presence or absence of urinary tract infection (UTI), culture is an expensive and time-consuming method. The objectives of the study were to compare automated dipstick urinalysis with microscopic urinalysis and form an algorithm to reduce time and labour of the pathologist and faster initiation of treatment to the patient. Method: 500 morning urine samples were analysed by using automated dipstick analyser(Cobas u 411) and those samples showing abnormal results were subjected to microscopy. Leucocyte esterase and nitrite positivity were taken into consideration as predictive indicators of UTI. Result: 34% of the samples showed abnormal results on automated urine analyser. Total 28% samples showed positive results for leucocytes, nitrite, protein and RBC's were sent for urine culture. 5% samples grossly turbid were sent for culture. Conclusion: Automated urinalysis method can be used for the rapid diagnosis of UTI. The algorithm presented in this study will guide the pathologist to decide when culture should be advised after urinalysis. Urine culture is an expensive test for routine use and should not be applied unless the result of nitrite, leukocyte or RBC's are positive on automated dipstick/ microscopic examination. [Kate M et al NJIRM 2012; 3(5) : 48-52]

Key words: automated urinalysis, dipstick, algorithm

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Introduction: Urinary tract infections (UTIs) are one of the most commonlyencountered ailments in the community andhospitals. The diagnosis of UTIs and treatment choices are important and complex pathologic processes that require the collaboration of clinicians and laboratory specialists. The symptoms of the patient, urine analysis and bacterial culture are used for the diagnosis of UTIs. One or more of these diagnostic materials are used together according to the situation.[1,2,3]Currently, bacteriologic urine cultures are the gold standard for the diagnosis of UTIs.[4]

Nevertheless, analysis of bacteriologic cultures is a time consuming and expensive method requiring skill and experience. In addition, the results of the bacteriologic culture are negative in 50 to 80% of the patients with UTI.[4,5,6]Therefore, clinicians are in need of an appropriate screening test for patients with UTIs. Any screening test that can be applied prior to the analysis of the urine culture in patients with UTIs will save a considerable amount of time and cost, reducing the number of unnecessary bacteriologic culture samples.[4,5]Currently, with the increase in the number of patients admitted to hospitals, the need for fully automated systems that can perform both chemical and sediment analysis of the urine from a single specimen via a strip has increased and is widely used in clinical laboratories.

The aim of this study was to determine the microscopic review rate from randomly selected urine samples in a tertiary care hospital after a simultaneous dipstick measurement with Cobas u 411 semiautomated dipstick reader. Our aim was to establish an algorithm for positive selection of those urine samples that needed microscopic confirmation and urine culture. The benefits of such an algorithm would be considerable reduction in manual labor and optimization of the workflow without any loss of sensitivity and specificity.

Materials and Method : The study was carried out at ESI-PGIMSR, Mumbai. We studied 500 random urine samples which had been collected in compliance with standard guidelines from patients with complaints of UTI.[7] The urine samples included in present study were collected from the patients regardless of age and gender, were analysed with Cobas u 411 semiautomated urine analyser and microscopically. Samples showing abnormal findings on Cobas u 411 were subjected to microscopic sediment analysis and bacterial culture wherever advised as per the algorithm formulated.Patients who had been using antibiotics for any reason, who had structural urinary anomalies, who were being treated as inpatients, who had urinary catheter and pregnant women were excluded from the study

Automated Dipstick Urinalysis: Dipstick urinalysis was done using Combur 10-Test M strips and Cobas u 411 semi-automated reflectance photometer (Roche Diagnostics). The strips had reagent pads for semiquantitative assessment of specific gravity, pH, leucocytes, nitrite, protein, glucose, ketones, urobilogen, bilirubin, and erythrocytes. As a predictive parameter for UTI, we evaluated leucocyte esterase and nitrite reaction.

Microscopic Sediment Urinalysis: Manual microscopic sediment inspection was performed as follows: each urine sample (10 mL) was centrifuged at 1500rpm for 5 min and the supernatant was removed. At least 20 random microscopic fields were examined at x400 (HPF) for each sample and the mean number of cells and particles/HPF were calculated.

Results: Automated dipstick analysis was done for all 500 urine samples. Out of 500, (170)34% samples showing abnormal automated dipstick analysis were subjected for manual microscopic analysis. . Out of these 170 samples 31% were positive for nitrite reaction and were sent for culture. 65% samples showed positive results for protein and 38% samples showed positive results for leucocytes while 53% showed positive results for glucose were also advised culture. In total 140/170 samples were sent for urine culture. 30/170 samples showing negative results for protein, nitrite, leucocyte and glucose were not sent for culture. 5% samples were grossly turbid and hence were sent for urine culture. Of the 500 samples (330) 66% samples showed normal results for all the 10 parameters i.e. specific gravity, pH, leucocytes, nitritite, erythrocytes, protein, glucose, ketones, bilirubin, urobilinogen on Cobas u 411 automated dipstick analyser.

Cobas u 411 is an automated dipstick reader in which identification of bacteria is done by nitrate reduction method.

The primary aim of the present study was to screen urine samples by means of an easy and reliable method in order to increase the probability of diagnosing UTIs prior to the culture tests and to reduce time and cost consumption as well.

Table 1 :Comparison between various studies showing reduction of samples for microscopy after introduction of an automated urine analysis.[8,9,10,11]

Author	Percentage of samples examined by microscopy before introduction of automated urine analysis.	Percentage of samples examined by microscopy after introduction of automated urine analysis.
Hannemann-Pohl	100	10-20
Delanghe	80	15
Kouri	60-70	25-30
Fenili	100	14
Present study	100	34

Table 2 : Results of automated dipstick analysis (n=500)

Proteins	65%
Glucose	53%
WBC's	38%
RBC's	30%
Nitrite	31%
Ketones	17%
Bilirubin	2.5%
Urobilinogen	2.5%

Discussion: Manual analysis of urine sediment is fraught with methodological problems. Many factors may impair its precision and accuracy,ranging from centrifugation to the different interpretations of cell or cast in a urine sediment by different examiner's.[12,13] In addition, the process requires approx. 5–10 min of examiners time per specimen.[14] Therefore, there have been attempts to automate the process to improve accuracy and precision and to save examiner's time. At the same time, bacterial culture is even more time consuming, taking at least 48 hours to give a result. More rapid methods

of urinary tract infection diagnosis are therefore desirable.

With the advent of automated analytical systems, solutions have been developed to automate urine analysis. This reduces the turnaround time and thus avoiding treatment with in those cases in which it is not needed.Moreover,the highly qualified personnel become free for cases in which their expertise is actually needed instead of occupying them with readily distinguishable negative cases simultaneously allowing the generation of reproducible results with standardized procedures.[15]

Meta analysis demonstrates the significant decrease in samples requiring microscopy after the introduction of automated urine analysers, which is consistent with our study which showed only 34% samples needed microscopic analysis after automated dipstick analysis (table 1).[15]

Analogously, other studies show a reduction of bacteria cultures of up to 75%, depending on what ratio of false negative results is acceptable.[12] Thus, the average sample turnaround time is drastically reduced. Assuming a turnaround time of 72 seconds per sample, 30 samples can be analysed in 36 minutes. For negative samples this already conclude the sample analysis. If this is the case for example for 50% of the samples, the statistical mean turnaround time is –aside from the system analysis time also reduced by half.[15]

The algorithm formed in this study helped us to decide which samples should be sent for urine culture (figure 1).

Of the n=500 samples, 66%(330) showed normal results for all the 10 parameters i.e. specific gravity, pH, leucocytes, nitrite, erythrocytes, protein, glucose, ketones, bilirubin, urobilinogen on Cobas u 411 automated dipstick analyser and hence they were not subjected to microscopic examination.

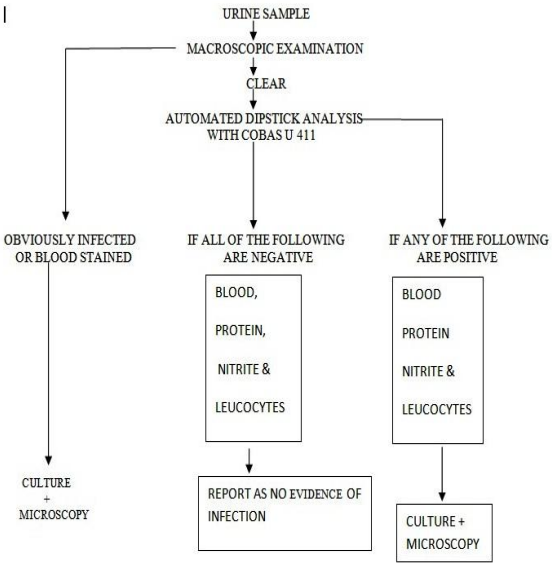

Fig 1: Suggested algorithm for processing of urine samples in the diagnosis of UTI.

However, remaining 34%(170) samples showed abnormal results on urine analyser; so were subjected to microscopic sediment analysis. And out of these 170 samples 28%(140) showing positive results for leucocyte, protein, glucose and nitrite on automated urine analyser were sent for culture (figure 2).

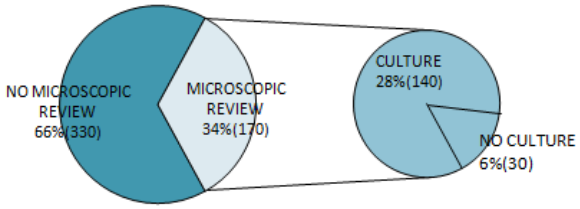

Fig 2: Classification of results for n=500 samples.

6%(30) samples showing negative results for leucocyte, protein, glucose and nitrite were reported as no evidence of infection and culture was not advised in these cases. According to previous studies nitrate positivity gave specificity and sensitivity of 99.5% and 38.9% respectively.[16] A positive result for nitrite is reliable indicator of significant bacteriuria. Other studies also found that when leukocyte and bacteria count values and the strip nitrite results were used in combination, the probability of the culture being negative is quite high in the case of all being negative.[16] The present study demonstrates that bedside urine dipsticks and microscopic urinalysis may be

substituted for rapid urinalysis to diagnose uncomplicated urinary tract infections. Use of dipsticks and microscopic urinalysis instead of urine culture may decrease patient time and the cost of test.

In routine cases of initial presentation with symptoms of UTI, the analyser result alone may be sufficient for the diagnosis. In recurring disease, pregnant women, hospitalized patients and other complex cases, a positive analyser result should in any case lead to bacteria culture for identification of the pathogenic organism and screening for its susceptibilities.

Conclusion: Urine analysis, one of the oldest medical techniques, has arrived in the 21st century with automated analyzers. Time consuming methods dependent on significant expertise can be saved for those cases in which such expertise is actually needed and negative cases can be quickly identified.The algorithm suggested has resulted in reduced number of microscopic urine sediment analysis and judicious advice of culture wherever needed. The patient as end user is benefitted by the early initiation of treatment. The use of automated systems allows reproducible and independently comparable assessment of the WBC's concentration in urine, a reliable screening procedure for UTI and consequently a significant improvement of the laboratory workflow.Hence, we recommendtheuse of automated dipstick analyser along with microscopic sediment analysis for early andreliable diagnosis of UTI.

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