

Predictive Value of Urinalysis with Reflex to Urine Culture

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Introduction

Boyce & Bynum Pathology Laboratories offers within its test menu Urinalysis with Urine Culture if Indicated (UCI). This reflexive test was designed to assist the clinician with the diagnosis of urinary tract infection through initial screening of the urine sample by urine chemistry analysis (urinalysis) with defined result criteria triggering a urine culture. The theory behind this reflexive testing was to minimize the number of urine samples cultured, saving patient and laboratory expense as well as maintaining efficiency within the microbiology department. A modification of workflow between the microbiology department where urine samples are cultured and the hematology department where urinalysis is performed allowed us to examine over a period of time all urine samples where UCI was requested for bacterial growth.

A brief review of the literature has shown that in women with uncomplicated urinary tract infection (colony counts 10^2 to 10^3 colony forming units/mL) the positive predictive value of a positive leukocyte esterase and nitrite urine dipstick chemistry is low, and while reducing the number of cultures performed many uncomplicated urinary tract infections would not be diagnosed (Semeniuk and Church, J Clin Microbiol, 37(9):3051-3052, 1999). The authors conclude based on their parameters that as many as 20% of those urinary tract infection would be missed. Additionally the authors concluded that 19% of those urinary tract infections would be missed when the leukocyte esterase and nitrite results are negative. In a separate study a combination of urine dipstick chemistry and automated urine microscopy parameters were evaluated in predicting the outcome of urine cultures (Zaman, Roggeman and Verhaegen, J Clin Microbiol, 39(11):4169-4171, 2001). The authors concluded that, using a reference cutoff for culture of 10^4 colony forming units/mL, urine dipstick results separate or in combination with microscopy had relatively poor positive predictive value, suggesting that those tests were unsuitable for screening urine samples for urinary tract infection.

Methods

Urine samples analyzed were not differentiated by the presence of preservative or collection type, met the specimen requirements established by our laboratory, and represented samples typically received by a reference laboratory.

All urine samples were plated onto a blood agar plate and a MacConkey agar plate using standard protocol and incubated at 35°C. Plates were examined for growth at 24 hours and again at 48 hours if scant or no growth at 24 hours. For those plates

determined to have significant growth of potential pathogenic organisms, organisms were isolated for identification and antimicrobial sensitivity testing.

During the data collection period 1042 UCI samples were examined. Data was separated based on whether or not the reflexive testing criteria was met and then by urine culture outcome. For simplification of analysis urine culture outcome was defined as positive for growth of one or more pathogenic organisms or negative for growth of pathogenic organisms. The negative results included both no growth as well as non-pathogenic mixed growth.

In order for urine samples to meet reflex criteria urine dipstick/microscopic results needed to meet two of three of the following: 1. 2+ bacteria on microscopic examination and/or positive nitrite, 2. 4-8 white blood cells/high power field and/or positive leukocyte esterase, 3. 4-8 red blood cells/high power field and/or positive for occult blood. Some clients have requested client-specific criteria that may differ from our standard criteria and those were not differentiated within this study, i.e. any urine sample meeting any reflex criteria was analyzed during the data collection period.

Results

Urine culture results can be seen in Table 1. Of the 1042 urines samples for UCI 497 (47.6%) met reflex to urine culture criteria and 545 (52.4%) did not. Of the 497 urine samples meeting the urine culture criteria 362 (72.8%) were positive for one or more pathogenic organisms. Of the 545 that did not meet the urine culture criteria 136 (25.0%) were positive for the growth of one or more pathogenic organisms. Further analysis of the 1042 urine samples can be seen in Table 2. The data in Table 2 represents additional distillation of the primary data. The distillation includes separation of the No Growth results into two categories: No Growth and Growth of Non-pathogenic Organisms.

Analysis of the 1042 urine samples received for UCI showed 363 True Positive and 136 False Negative results for a Sensitivity of 72.7%; 409 True Negative (did not meet reflex to Urine Culture criteria and was not positive for one or more pathogenic organisms) and 120 False Positive (did meet reflex to Urine Culture criteria and was negative for any organism) results for a Specificity of 77.3%. Positive Predictive Value was 75.1% and Negative Predictive Value was 75.0%.

Table 1. Culture results of UCI

| | Positive | Negative | Total |
|------------------------------|-----------------|-----------------|--------------|
| Culture Indicated | 362 (72.8%) | 135 (27.2%) | 497 (47.7%) |
| Culture Not Indicated | 136 (25.0%) | 409 (75.0%) | 545 (52.3%) |
| Total | 498 (47.8%) | 544 (52.2%) | 1042 |

Table 2. Breakdown of culture results for UCI

| | No Growth | Non-pathogen | Pathogen | Total |
|------------------------------|------------------|---------------------|-----------------|--------------|
| Culture Indicated | 120 | 17 | 362 | 497 |
| Culture Not Indicated | 90 | 319 | 136 | 545 |

Conclusions

The application of urinalysis (urine dipstick) with or without microscopic examination as a screening test for the prediction of urine culture outcome has been pursued to mitigate the financial burden to the patient or health insurance provider as well as to improve operational efficiency within the microbiology department, including cost control. Many laboratories have evaluated the benefit of such a screening test employing a variety of reflex criteria with the goal of achieving excellent sensitivity and specificity as well as high positive and negative predictive values. The consensus opinion is a satisfactory positive predictive value cannot be achieved, that a clinically significant number of urine samples are not cultured when in fact those samples are positive for the presence of one or more pathogenic organisms. We observed this outcome in our study as well.

We conclude the use of urinalysis with or without microscopic examination does not adequately predict urine culture outcome. Boyce & Bynum Pathology Laboratories has offered the UCI and analyzed the predictive value of this screening test. Our findings support previous results suggesting a clinically significant number of urine samples are positive for the growth of pathogenic organisms in culture yet do not meet the reflex criteria of the urinalysis screen. This may delay or possibly prevent the treatment of the patient with urinary tract infection. Boyce & Bynum Pathology Laboratories considers the best practice of medicine to be urinalysis with urine culture when urinary tract infection is suspected and will no longer offer the UCI.

References

- Semeniuk, H., and Church, D. 1999. Evaluation of the Leukocyte Esterase and Nitrite Urine Dipstick Screening Tests for Detection of Bacteriuria in Women with Suspected Uncomplicated Urinary Tract Infection. *J. Clin. Microbiol.* 37:3051-3052.
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