

Short Communication

Evaluation of Rapid Urine Screening Tests to Detect Asymptomatic Bacteriuria in Pregnancy

Birgul Kacmaz*, Ozenc Cakir¹, Altan Aksoy² and Aydan Biri³

Department of Central Microbiology, ¹Department of Microbiology and

³Department of Obstetric and Gynecology, Faculty of Medicine, Gazi University, Ankara; and

²Department of Microbiology, Faculty of Medicine, Kirikkale University, Kirikkale, Turkey

(Received March 13, 2006. Accepted May 31, 2006)

SUMMARY: In order to compare the performance of leukocyte esterase and nitrite urine dipstick tests with enhanced urinalysis (uncentrifuged urine white blood cell count/mm³ plus Gram stain) in detecting asymptomatic bacteriuria in obstetric patients, clean-catch midstream urine specimens were collected from 250 consecutive asymptomatic pregnant women. Ten of the women (4.0%) showed urine culture results indicating significant bacteriuria. The nitrite test was the most specific (99.2%) of these tests, however, its sensitivity was found to be the lowest (60.0%). The sensitivity of the leukocyte esterase test was 70.0%, on the other hand, while its positive predictive value was 28.0%. The sensitivity and specificity of enhanced urinalysis were found to be 50.0 and 96.7%, respectively. None of the rapid tests was found to be a reliable alternative for culture screening of all pregnant women. Nitrite tests are useful screening tests for detecting asymptomatic bacteriuria only if their limitations are fully understood, while leukocyte esterase and enhanced urinalysis tests are not suitable for screening for asymptomatic bacteriuria. Our findings support previous conclusions that quantitative urine cultures are required to rule out asymptomatic bacteriuria in pregnant women.

Asymptomatic bacteriuria (ASB) is found in 2 to 10 % of pregnant women (1) and is associated with risks of preterm birth and pyelonephritis if left untreated (1,2). The diagnosis of ASB is based on urine culture, but culture results are typically not available until 24 to 48 h after the patient provides the specimen (3). There are many urine screening tests for bacteriuria, including microscopic examination of urine sediment (a time-honored method) and dipstick analysis of nitrite (NIT) and leukocyte esterase (LE) (4-7). To increase the reliability of microscopy, an enhanced urinalysis (UA) method has been proposed for the diagnosis of urinary tract infections (UTIs) in the pediatric population. Under this method, uncentrifuged urine is Gram-stained for bacteria, and a leukocyte count is performed using a hemocytometer (3). Hoberman et al. (8) report 96% sensitivity for enhanced UA in the pediatric population.

The aims of the present study were to evaluate the performance of enhanced UA for the detection of ASB in pregnant women, and to compare reagent strip testing with enhanced UA and urine cultures in identifying significant bacteriuria.

In this study, 250 patients who applied to the Department of Obstetrics and Gynecology, Faculty of Medicine, Gazi University, Ankara, Turkey between June and November 2003 were examined. Their mean age was 26.3 ± 4.2 (range, 18-36 years). Patients were excluded if they had symptoms of a UTI or had used antibiotics during the preceeding 2 weeks. We screened clean-catch midstream urine specimens obtained from 250 consecutive obstetric patients presenting for their initial appointment. The samples were collected in sterile cups and were taken to the microbiology laboratory within 1 h. When delays of >1 h occurred, the specimens

were stored in a refrigerator at 4°C for no more than 4 h. All specimens were also tested for LE and NIT and the dipsticks were examined by microscope for pyuria and bacteriuria.

The urine specimens were first processed by routine quantitative culture and were then tested by the screening methods under consideration. All tests were performed by the same two physicians. Quantitative cultures were performed using 0.001-mL calibrated loops for inoculation onto 5% sheep blood agar and MacConkey agar plates. The plates were incubated aerobically and read at 12, 24 and 48 h. ASB was defined as two consecutive clean-catch midstream urine cultures showing at least 100,000 cfu/mL of the same single species from an individual without symptoms of a UTI (9,10). Organisms from positive cultures were identified by BD BBL Crystal GP and E/NF ID Kits (Becton, Dickinson and Company, Sparks, Md., USA). Urine specimens were tested with URS-10 multireagent strips (Teco Diagnostics, Anaheim, Calif., USA) for the presence of NIT and LE activity, following the instructions of the manufacturer. For the white blood cell count, uncentrifuged urine was drawn into a Neubauer (Reichert, Buffalo, N.Y., USA) hemocytometer by capillary action. Leukocytes were counted on one side of the chamber and multiplied by 1.1 to obtain a total cell count/mm³. Urine specimens were examined by the Gram stain method. Smears were prepared using two drops of uncentrifuged urine on a slide within the standardized marked area (1.5 cm in diameter), air-dried, heat fixed and Gram stained. Pyuria was defined as > or = 10 white blood cells/mm³, and bacteriuria as any bacteria on any of 10 oil immersion fields in a Gram-stained smear.

The performance of UA tests was evaluated by calculating sensitivity, specificity, and positive and negative predictive values using standard methods.

Of the 250 specimens sent for culture, 10 patients (4%) showed culture evidence of ASB. *Escherichia coli* was identified in 5 (50%) of the 10 positive specimens, *Klebsiella* spp. in

*Corresponding author: Mailing address: Gazi Üniversitesi Tıp Fakültesi, Merkez Mikrobiyoloji Laboratuvarı, 06500 Beşevler, Ankara, Turkey. Tel: +90-312-2025477, Fax: +90-312-2129908, E-mail: kacmazbirgul@mynet.com

Table 1. Results of rapid screening tests compared with urine cultures

Screening test (n = 250)	Sensitivity ¹⁾ (%)	Specificity ²⁾ (%)	Positive predictive value ³⁾ (%)	Negative predictive value ⁴⁾ (%)
Leukocyte esterase	70.0	92.5	28.0	98.7
Nitrite	60.0	99.2	75.0	98.3
Enhanced urinalysis	50.0	96.7	38.5	97.9

¹⁾: Sensitivity = true positives/(true positives + false negatives) × 100.

²⁾: Specificity = true negatives/(true negatives + false positives) × 100.

³⁾: Positive predictive value = true positives/(true positives + false positives) × 100.

⁴⁾: Negative predictive value = true negatives/(true negatives + false negatives) × 100.

2 (20%), *Enterococcus* spp. in 2 (20%) and *Pseudomonas* spp. in 1 (10%). Table 1 presents the calculated sensitivity, specificity, and positive and negative predictive values of the screening urine tests compared to culture results.

In the present study, the NIT test was found to have very high specificity (99.2%) for detecting ASB; however, it also showed a low sensitivity (60.0%). A positive NIT test indicates that NIT has been produced from the reduction of nitrate by enteric bacteria, most commonly by genera of the *Enterobacteriaceae* family (11). However, false-negative assays are also common with this test (12). In the present study, we obtained negative NIT test results in 4 of the cases with positive culture results, 3 of which were found to have infections with microorganisms that do not routinely reduce nitrates. We detected *Klebsiella* spp. in the urine cultures of 2 patients, but in one of these, the NIT test was found to be negative by reagent strip test. False-negative results may occur when a UTI is caused by organisms that do not contain nitrate reductase, when urine has been in the bladder for insufficiently long periods for the reduction of nitrate to occur, or when dietary nitrate is absent (13). The sensitivity of the NIT test has been found to be low (37-67%) by several studies (1,2,9,10). As can be seen in Table 1, the LE test for pyuria showed a sensitivity of 70.0%. Although some investigators have reported dipstick LE sensitivity to be 100% (14), other studies show much lower values (1,2,9,10). In the present study, 23% of our patients were diagnosed to have pyuria in the absence of bacteriuria. In the presence of pyuria, the absence of bacteriuria is associated with other urogenital pathogens such as *Chlamydia*, *Neisseria gonorrhoeae*, agents of vaginitis or "low-count" coliforms (15). Thus, the LE test might be considered to be a rapid, nonspecific screening test for genitourinary tract infections. According to some previous studies, the LE and NIT tests in pregnant women were not effective as rapid screening tests for the diagnosis of ASB (1,2,9,10).

Enhanced UA is a combination of the urine cell count described in 1927 by Dukes (16) and the urine Gram stain (17). It has been found that this method is more sensitive than other screening methods in detecting UTIs in young children (8). In the present study, the sensitivity of enhanced UA was found to be lower than that of the LE and NIT tests. The investigators who have reported the sensitivity of enhanced UA at higher percentages recommend that the results of this test be evaluated only by trained personnel (8). In the present study, the same two physicians evaluated all of the specimens for both the leukocyte count and Gram staining. We recommend that instructions for cleaning the vulvar area be explained to the patients properly in order to prevent false-positive results. In the present study, urine specimens were obtained after educated staff carefully explained the urine collection method to the patients. Having paid particular

attention to the points mentioned above, we found the sensitivity and specificity of this test to be 50.0 and 96.7%, respectively. There were two main differences between Hoberman's study (8) and the present study. First, while Hoberman et al. (8) define a positive urine culture as $\geq 50,000$ cfu/ml, we accepted $\geq 100,000$ cfu/ml as positive in two consecutive urine cultures in pregnant women in accordance with the definition of ASB. Additionally, Hoberman et al. (8) collected urine samples by urethral catheterization, therefore detecting no contamination from urethral and/or vaginal flora, while we used clean-catch midstream urine samples. The low sensitivity of enhanced UA in the present study may be attributed at least in part to these two differences.

The presence of bacteria alone in a urine specimen may not necessarily be of clinical significance. Bacteriuria may occur due to colonization or contamination, as well as because of infection (18). Pyuria has been reported to be present in up to 30% of negative cultures and bacteriuria and bacilluria in up to 10% of nonbacteriuric women (10). In the present study, 23% pyuria and 9% bacteriuria and bacilluria were found in negative cultures.

In conclusion, we were unable to establish any advantage of enhanced UA for detecting ASB in pregnant women. None of the rapid tests was able to detect all cases of ASB in pregnant women. Given the high specificity of NIT test, it might be considered as an indicator for *Enterobacteriaceae* infections. Nevertheless, it is recommended that physicians send urine for culture from all pregnant women.

REFERENCES

1. Etherington, J. and James, D. K. (1993): Reagent strip testing of antenatal urine specimens for infection. *Br. J. Obstet. Gynaecol.*, 100, 806-808.
2. Millar, L., Debuque, L., Leialoha, C., Grandinetti, A. and Killeen, J. (2000): Rapid enzymatic urine screening test to detect bacteriuria in pregnancy. *Obstet. Gynecol.*, 95, 601-604.
3. Armengol, C. E., Hendley, J. O. and Schlager, T. A. (2001): Should we abandon standard microscopy when screening for urinary tract infections in young children? *Pediatr. Infect. Dis. J.*, 20, 1176-1177.
4. Bachman, J. W., Heise, R. H., Naessens, J. M. and Timmerman, M. G. (1993): A study of various tests to detect asymptomatic urinary tract infections in an obstetric population. *JAMA*, 270, 1971-1974.
5. Lenke, R. R. and Van Dorsten, J. P. V. (1981): The efficacy of nitrite test and microscopic urinalysis in predicting urine culture results. *Am. J. Obstet. Gynecol.*, 140, 427-430.
6. Blondeau, J. M., Yaschuk, Y., Galenzoski, P., Hrabok, D., Isaacson, M., Lee, L., et al. (1995): Evaluation of the

- Cult-Dip Plus dip slide method for urinary tract infection. *J. Clin. Pathol.*, 48, 710-713.
7. Graninger, W., Fleischmann, D., Schneeweiss, B., Aram, L. and Stockenhuber, F. (1992): Rapid screening for bacteriuria in pregnancy. *Infection*, 20, 9-11.
 8. Hoberman, A., Wald, E. R., Reynolds, E. A., Penchansky, L. and Charron, M. (1996): Is urine culture necessary to rule out urinary tract infection in young febrile children? *Pediatr. Infect. Dis. J.*, 15, 304-309.
 9. Robertson, A. W. and Duff, P. (1988): The nitrite and leucocyte esterase for the evaluation of asymptomatic bacteriuria in obstetric patients. *Obstet. Gynecol.*, 71, 878-881.
 10. Hagay, Z., Levy, R., Miskin, A., Milman, D., Sharabi, H. and Insler, V. (1996): Uriscreeen, a rapid enzymatic urine screening test: Useful predictor of significant bacteriuria in pregnancy. *Obstet. Gynecol.*, 87, 410-413.
 11. 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 infections. *J. Clin. Microbiol.*, 37, 3051-3052.
 12. Pappas, P. G. (1991): Laboratory in the diagnosis and management of urinary tract infections. *Med. Clin. North. Am.*, 75, 313-325.
 13. Mills, S. J., Ford, M., Gould, F. K., Burton, S. and Neal, D. E. (1992): Screening for bacteriuria in urological patients using reagent strips. *Br. J. Urol.*, 70, 314-317.
 14. Nuns, D., Smith, A. R. B. and Hosker, G. (1995): Reagent strip testing of urine for significant bacteriuria in a urodynamic clinic. *Br. J. Urol.*, 76, 87-89.
 15. Komaroff, A. L. (1984): Acute dysuria in women. *N. Engl. J. Med.*, 310, 368-375.
 16. Dukes, C. (1928): Some observations on pyuria. *Proc. R. Soc. Med.*, 21, 1179.
 17. Shaw, K. N., McGowan, K. L., Gorelick, M. H. and Schwartz, J. S. (1998): Screening for urinary tract infection in infants in the emergency department: Which test is best? *Pediatrics*, 101, e1-e5.
 18. Stevens, M. (1989): Screening urines for bacteriuria. *Med. Lab. Sci.*, 46, 194-206.