Reagent Strip Testing for Antenatal Screening and First Meaningful of Asymptomatic Bacteriuria in Pregnant Women

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Objective: *To evaluate the diagnostic performance of reagent strip test as a screening test for asymptomatic bacteriuria (ABU) in pregnant women.*
Material and Method: *Three hundred and sixty asymptomatic pregnant women who attended their first antenatal appointment at Rajavithi Hospital from August 1st to October 31st, 2005 were enrolled. Those with symptoms of urinary tract infection within one month, those who had been prescribed antibiotics during the previous 7 days, and those with medical or obstetric complications, vaginal bleeding and a history of urinary tract diseases were excluded. Urine specimens were collected by clean-catched midstream urine technique for urine dipstick and culture*
Results: *The prevalence of ABU was 10.0% The urine dipstick nitrite leukocyte esterase and combined test had a sensitivity of 16.7%, 75.0% and 16.7%, specificity of 99.1%, 67.9% and 99.4%, positive predictive value of 66.7%, 20.6% and 75.0%, negative predictive value of 91.5, 96.1% and 91.5%, accuracy of 90.8%, 68.6% and 91.1%, respectively.*
Conclusion: *Reagent strip testing indicated a fair sensitivity for routine antenatal screening for asymptomatic bacteriuria in pregnant women.*

Keywords: *Asymptomatic bacteriuria, Reagent strip, Pregnancy*

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Urine culture is recommended as a routine laboratory test for the screening of asymptomatic bacteriuria (ABU)[1] as 25% of untreated cases subsequently develop acute symptomatic urinary tract infection during that pregnancy[2]. Reagent strip testing has been reported as a simple, cheap, and rapid test for routine screening of ABU[3,4].

Several studies reported the higher sensitivity of leukocyte esterase over the nitrite test (16.7%-77%) and 43%-45.8%respectively[3,5]. However, when both tests were combined, this synergistically, increased the overall sensitivity and specificity (50-92%) and (95-96.9%), respectively[3,5]. The only two studies in Thailand reported very poor sensitivity of combined nitrite and leukocyte esterase, which varied from 13.9% to 39.0%[6,7]. The present study was designed to find out the exact diagnostic performance of the reagent strip test for screening of ABU, especially in Thai obstetric patients.

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Material and Method

The present study recruited 360 pregnant women who attended their first antenatal appointment at Rajavithi Hospital, Bangkok from August 1st to October 31st, 2005. Those with symptomatic urinary tract infection (UTI), those who received antibiotics during the past seven days, and those with medical or obstetric complications, vaginal bleeding, and history of UTI were excluded. The present study had been

approved by the hospital's ethics committee and written informed consent was obtained from the participants.

Eligible women were advised how to correctly collect clean midstream urine into sterile containers. Beginning with hand washing, their perineums were then cleaned with soap, rinsed out with clean water and dried with sterile cotton. Randomly voided, clean-catch mid-stream urine was collected into two sterile containers and sent to the laboratory for urine culture, within 30 minutes after collection. Urine culture was performed using blood and Mac Conkey agar incubating at 35°-37° for 24-48 hours and read at 12, 24 and 72 hours. The presence of $\geq 10^5$ colony-forming units of a single type of bacteria per milliliter of urine indicated bacteriuria[5]. Antibiotic sensitivities were determined by the tube dilution method. Contamination was indicated when a urine culture revealed more than one type of organism, then urine culture and urine dipstick were repeated within seven days. If repeated urine culture was still contaminated, it was interpreted as a negative culture.

The urine in the other container was tested for nitrite, leukocyte esterase, sugar, and protein by reagent strip in dipstick (Multistick® IOSG, Bayer Bangkok Ltd, Thailand). Results were read after 60 seconds. The nitrite and leukocyte esterase portion of the test were interpreted as positive if the color on the reagent square were positive for each portion. Tests that showed zero or trace results were considered as negative.

Pregnant women with positive urine cultures were treated with a single course of appropriate antibiotics, according to susceptibility tests. In order to determine success of the treatment, they were asked to follow-up for a second urine culture one week after complete treatment.

Data was collected and analyzed by using the computer software programs SPSS/PC version 10.2. Frequency table was presented together with percentage as the prevalence. Diagnostic test of urine dipstick were performed using urine culture as a gold standard.

Results

Three hundred and sixty pregnant women were enrolled in the present study, 132 showed a positive urine dipstick test, nine showed a positive nitrite test, 131 showed a positive leukocyte esterase test, eight showed both tests positive, and 36 showed positive for urine culture. Forty-eight showed contamination in the first urine culture and in the repeated urine cultures, 15 remained contaminated and 33 were negative (contamination rate 4.2%).

The prevalence of ABU in the present study was 10.0% (36/360). Table 1 shows the uropathogen responsible for the infection in these women. Both Lactobacillus species and Escherichia species (*Escherichia coli* [*E.coli*] 8, *Escherichia feacalis* 1) were the most common uropathogens (25.0%).

The diagnostic performance of urine dipstick is shown in Table 2. Using urine culture as a gold standard, leukocyte esterase alone or either leukocyte esterase or nitrite yield the highest sensitivity of 75%, and highest negative predictive value (NPV) of 96.1%. Nitrite and combined test had the same low sensitivity of 16.7% but the highest specificity of 99.1% and 99.4%, respectively.

Discussion

The prevalence of ABU in pregnant women in the present study was similar to Robertson and Duff in USA (8.3%)[3], Suntharasaj et al in Songklanagarind Hospital, southern region of Thailand (8.1%)[7] and Kutlay et al in Turkey (10.6%)[8].

The prevalence of ABU in Srinagarind Hospital in the northeastern region of Thailand increased 88.4% from 11.2% in 1994-1995[9] to 21.1% in 1999[6]. *Staphylococcus* (S) coagulase-negative, the most common uropathogen in the later study (69.8%)[6] compared with *S. epidermidis* in the earlier study (46.0%)[9] was suggested to be relevant in explaining the dramatic increased prevalence rate of ABU in Sringarind Hospital within 4 years. Contamination in both studies was suggested as Bachman et al[5] reported that *Staphylococcus* coagulase negative and *S. aureous* were not considered uropathogens but *S. saprophyticus* was.

Table 1. Microorganism of asymptomatic bacteriuria

Organism	Number	(%)
1. *Lactobacillus species*	9	25.0
2. *Escherichia coli*	8	22.2
3. *Streptococcus viridans*	8	22.2
4. *Gardnerella vaginalis*	5	13.9
5. *Proteus mirabilis*	2	5.6
6. *Staphylococcus saprophyticus*	2	5.6
7. *Escherichia feacalis*	1	2.8
8. *Klebsiella pneumoniae*	1	2.8
Total	36	100.0

Table 2. Summarizes the test statistics on the dipstick tests

Test	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)	LR* positive	LR* negative
Positive nitrite	16.7	99.1	66.7	91.5	90.8	18.0	0.8
Positive leukocyte esterase	75.0	67.9	20.6	96.1	68.6	2.3	0.4
Both test positive (combined)	16.7	99.4	75.0	91.5	91.1	27.0	0.8
Either test positive	75.0	67.6	20.5	96.1	68.3	2.3	0.4

* LR = likelihood ratio

Suntharasaj et al[7] also reported that S. species was the most common uropathogen (31.8%) in their study in the southern region of Thailand. However, unfortunately, the prevalence of *S. saprophyticus* were not separated from *Staphylococcus* coagulase negative and *S. epidermidis*, therefore, making it difficult to determine the contamination in that study.

E. Coli was the most common uropathogen in cases of pregnancy while ABU in several studies varied from 62.9% to 81.4%[3-5,8]. *Lactobacillus* species was the most common (25%) while *E. Coli* and *Streptococcus viridans* were the second most common uropathogen in the present study (22.2%). However, if all *Escherichia* species were included, they also had the same most common uropathogen as *Lactobacillus* species.

Lifshitz and Kramer reported contamination rates that varied from 29-32% irrespective of any collecting methods used[10]. Different criteria for diagnosis of urine culture contamination significantly influenced the study results in different studies[11]. In the past, Lactobacilli species had been suggested as contamination in urine culture[12].

Recently, increased numbers of anaerobic and other fastidious microorganisms such as *Gardnerella vaginalis*, *Lactobacilli*, microaerophilic *Streptococci*, *Chlamydia trachomatis* and *Urea -plasma urealyticum* have been found to be present in an even larger percentage of pregnant women than organisms more commonly associated with bacteriuria[13]. However, it is unclear whether these organisms play a significant pathogenic role, although improved outcomes following therapy have been reported[13].

Therefore, it is difficult to decide whether the highest detection rate of *Lactobacillus* species in the present study was a result of cross contamination or a true uropathogen. However, many reasons were proposed to support that *Lactobacillus* species was a true uropathogen such as:

1) The research nurses had carefully explained to each subject the correct method for obtaining clean- catch midstream urine after cleaning the peri-urethra with soap.

2) There was a single organism of *Lactobacillus* species more than 10^5 CFU/ml in every case of *Lactobacillus* positive cultures.

3) All contaminated cases had no *Lactobacillus* species growth.

There was a marked difference in sensitivity of urine dipstick between the United States of America (USA) and Thailand. The sensitivity of either nitrite or leukocyte esterase test in Thailand varied from 13.96%[6] in the northeastern to 39%[7] in the southern region, while those in the USA varied from 50%[5] to 92%[3].

Sensitivity of leukocyte esterase in the present study (75%) was quite similar to those in Robertson's study (77%)[3] but their study[3] had much improvement in sensitivity when a combined test of leukocyte esterase and nitrite (92%) was used.

Difference in types of organism between the present study and the other Thai studies was proposed to be one of the reasons for the difference of sensitivity of the urine dipstick.

In the present study both *Escherichia* species and *Lactobacillus* species were the most common uropathogen (25%) while *Staphylococcus* species was the most common uropathogen (31.8-69.8%) in the other Thai studies[6,7,9].

The sensitivity of urine dipstick, especially the combined test in foreign countries was quite good enough to use as a screening test for ABU as the most common uropathogen was *Escherichia coli*. However, there was still poor sensitivity of the combined test in

some studies in Turkey and USA (38.7% and 50%, respectively)[8,5] even though *E. coli* was the most common pathogen in both studies. In conclusion, reagent strip testing indicated a fair sensitivity and positive predictive value for routine antenatal screening for asymptomatic bacteriuria in pregnant women.

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References

1. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Gilstrap LC III, Wenstrom KD. Williams obstetrics. 22nd ed. New York: McGraw Hill; 2005: 201-29.
2. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Gilstrap LC III. Williams obstetrics. 22nd ed. New York: McGraw Hill; 2005: 1093-110.
3. Robertson AW, Duff P. The nitrite and leukocyte esterase tests for the evaluation of asymptomatic bacteriuria in obstetric patients. Obstet Gynecol 1988; 71: 878-81.
4. Etherington IJ, James DK. Reagent strip testing of antenatal urine specimens for infection. Br J Obstet Gynaecol 1993; 100: 806-8.
5. Bachman JW, Heise RH, Naessens JM, Timmerman MG. A study of various tests to detect asymptomatic urinary tract infections in an obstetric population. JAMA 1993; 270: 1971-4.
6. Lumbiganon P, Chongsomchai C, Chumworathayee B, Thinkhamrop J. Reagent strip testing is not sensitive for the screening of asymptomatic bacteriuria in pregnant women. J Med Assoc Thai 2002; 85: 922-7.
7. Suntharasaj T, Akravinek S, Monopsilp P. The urine dipstick for screening of asymptomatic bacteriuria in pregnant women. Songkla Med J 1993; 11: 15-20.
8. Kutlay S, Kutlay B, Karaahmetoglu O, Ak C, Erkaya S. Prevalence, detection and treatment of asymptomatic bacteriuria in a Turkish obstetric population. J Reprod Med 2003; 48: 627-30.
9. Chongsomchai C, Piansriwatchara E, Lumbiganon P, Pianthaweechai K. Screening for asymptomatic bacteriuria in pregnant women: urinalysis versus urine culture. J Med Assoc Thai 1999; 82: 369-73.
10. Lifshitz E, Kramer L. Outpatient urine culture: does collection technique matter? Arch Intern Med 2000; 160: 2537-40.
11. Valenstein P, Meier F. Urine culture contamination: a College of American Pathologists Q-Probes study of contaminated urine cultures in 906 institutions. Arch Pathol Lab Med 1998; 122: 123-9.
12. Sweet RL, Gibbs RS. Clinical microbiology of the female genital tract. In: Sweet RL, Gibbs RS, editors. Infectious diseases of the female genital tract. 3rd ed. Baltimore: Williams & Wilkins; 1995: 3-15.
13. Patterson TF, Andriole VT. Detection, significance, and therapy of bacteriuria in pregnancy. Update in the managed health care era. Infect Dis Clin North Am 1997; 11: 593-608.

การใช้แถบทดสอบสำหรับการคัดกรองภาวะการติดเชื้อแบคทีเรียในปัสสาวะแบบไม่มีอาการของสตรีตั้งครรภ์ในระยะก่อนคลอด

เอกชัย โควาวิสารัช, เมทินา วิชัยพฤกษ์, สุวัฒนา กาญจนหฤทัย

วัตถุประสงค์*: เพื่อเปรียบเทียบความสามารถในการใช้แถบทดสอบเพื่อคัดกรองภาวะการติดเชื้อแบคทีเรียในปัสสาวะแบบไม่มีอาการในสตรีตั้งครรภ์*

วัสดุและวิธีการ*: สตรีตั้งครรภ์ทั้งหมด 360 คนที่มาฝากครรภ์ครั้งแรกที่โรงพยาบาลราชวิถี จากวันที่ 1 สิงหาคม พ.ศ. 2548 ถึง 31 ตุลาคม พ.ศ. 2548 ได้รับการคัดเลือก ส่วนสตรีที่มีอาการของการติดเชื้อในทางเดินปัสสาวะภายใน 1 เดือน ได้รับยาปฏิชีวนะภายใน 7 วันที่ผ่านมา มีภาวะแทรกซ้อนทางสูติกรรมหรืออายุรกรรม มีเลือดออกทางช่องคลอด และมีประวัติโรคทางระบบทางเดินปัสสาวะมาก่อนถูกคัดออกจากการศึกษา เก็บปัสสาวะโดยวิธีเก็บส่วนกลางอย่างสะอาดเพื่อทำการตรวจปัสสาวะโดยใช้แถบทดสอบและเพาะเชื้อ*

ผลการศึกษา*: ความชุกของภาวะติดเชื้อแบคทีเรียในปัสสาวะแบบไม่มีอาการของสตรีตั้งครรภ์เท่ากับร้อยละ 10 การตรวจแถบทดสอบสำหรับไนไตร์ท ลูโคโซท์ เอสเทอเรส และทั้งสองวิธีร่วมกันพบว่ามีความไวเท่ากับร้อยละ 16.7, 75.0 และ 16.7 ความจำเพาะเท่ากับร้อยละ 99.1, 67.9 และ 99.4 ค่าทำนายผลบวกเท่ากับร้อยละ 66.7, 20.6 และ 75.0 ค่าทำนายผลลบ เท่ากับร้อยละ 91.5, 96.1 และ 91.5 ความแม่นยำ เท่ากับร้อยละ 90.8, 68.6 และ 91.1 ตามลำดับ*

สรุป*: การใช้แถบทดสอบมีความไวพอใช้ในการใช้เพื่อคัดกรองภาวะติดเชื้อแบคทีเรียในปัสสาวะแบบไม่มีอาการของสตรีตั้งครรภ์*