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Original Article

Reliability of the urine spot test in predicting urinary tract infections during pregnancy: a cross-sectional study

Gebelikte idrar yolu enfeksiyonu öngörüsünde spot idrar tetkikinin güvenilirliği: kesitsel bir çalışma

Kübra Dilbaz *[1], Elif Ece Öztürk Özen [1], Sinan Karadeniz [1]

[1] Department of Obstetrics, Etlik Zubeyde Hanım Women Health Education and Research Hospital, Ankara, Türkiye

Abstract

Background: The aim of this study was to investigate whether there is a significant difference in positive uronalysis (Total UA) results and fertility in urine cultures during pregnancy.

Material and Methods: Our retrospective observational study included 177 patients who were admitted to our hospital between September 1, 2023 and November 1, 2023 and had a complete urinalysis performed. As a result of the total UA, patients with leukocytes/bacteria> 5, leukocyte esterase positive and nitrite positive were identified. Among the patients whose urine culture was detected according to the results of urinalysis, those whose urine culture was evaluated and those who were not were divided into two groups. The results of total UA and urine culture were compared. In addition, the weeks of gestation of patients with positive urinalysis results were recorded and it was investigated whether there was a correlation between the frequency of urinary tract infections (UTI) and pregnancy.

Results: A total of 177 patients who were followed up for pregnancy were included in the study. All patients had total UA results. When the total UA abnormalities were examined, it was found that the rate of those with a high leukocyte/bacteria ratio was 80.2%, the rate of those with positive leukocyte esterase was 61%, and the rate of those who were nitrite positive was 25.4%. According to the urine culture results, 54.8% of participants had no urine culture and 45.2% of participants had one. The rate of urine cultures was 77.5% without reproduction and 22.5% with reproduction. In addition, the mean gestational weeks of the patients was 25.96±11.57 weeks, the mean week of gestation according to ultrasound measurements was 26.02±11.64. and no significant association was found between weeks of gestation and the incidence of UTI.

Conclusion: In our study, no significant association was found between positive total UA results during pregnancy and urine culture reproduction. There is a need for comprehensive multicenter studies with a larger number of patients regarding the incidence of UTIs in relation to gestational age and other tests that can be used in the diagnosis of UTIs.

Keywords: urinary tract infection during pregnancy; complete urinalysis; urine culture

Corresponding author *: Department of Obstetrics, Etlik Zubeyde Hanım Women Health Education and Research Hospital, Ankara, Türkiye
E-mail: kbrdlbz@hotmail.com
ORCID: 0000-0002-0592-7644
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Öz

Amaç: Bu çalışmada gebelikte tam idrar tetkiki (TİT) sonuç pozitifliği ile idrar kültüründe üreme açısından anlamlı farklılık olup olmadığının araştırılması amaçlanmıştır.

Gereç ve Yöntemler: Retrospektif gözlemsel çalışmamıza hastanemizde 1 Eylül 2023-1 Kasım 2023 tarihleri arasında başvuran tam idrar tetkiki görülmüş olan gebelik durumu nedeni ile takipli 177 hasta dâhil edilmiştir. Tam idrar tetkiki sonucunda lökosit/bakteri>5 olan, lökosit esteraz pozitif olan ve nitrit pozitif olan hastalar tespit edildi. İdrar tetkik sonucuna göre üreme tespit edilen hastalardan idrar kültürü değerlendirilen ve değerlendirilmeyen hastalar iki gruba ayrıldı. tam idrar tetkiki ve idrar kültür üreme sonuçları karşılaştırıldı. Ayrıca idrar tetkik sonuç pozitifliği olan hastaların gebelik haftaları kaydedildi ve idrar yolu enfeksiyonu (İYE) geçirme sıklığı ile gebelik arasındaki ilişki incelendi.

Bulgular: Çalışmaya gebelik nedeni ile takipli toplam 177 hasta dahil edildi. Hastaların tamamında TİT sonucu vardı. TİT anormalliği incelendiğinde, lökosit/bakteri oranı yüksek olanların oranı %80,2, lökosit esteraz pozitif olanların oranı %61 ve nitrit pozitif olanların oranı %25,4 olarak bulunmuştur. İdrar kültürü sonuçlarına göre, katılımcıların %54,8'inde idrar kültürü yapılmamış, %45,2'sinde ise yapılmıştır. Yapılan idrar kültürlerinde üreme olmayanların oranı %77,5, üreme olanların oranı ise %22,5 olarak belirlenmiştir. Hastaların son adet tarihi (SAT) ortalaması 25,96±11,57 hafta iken ultrason ölçümlerine göre gebelik haftası ortalaması 26,02±11,64 olarak saptanmıştır ve hastaların gebelik haftaları ile İYE geçirme sıklığı arasında anlamlı bir ilişki tespit edilmemiştir.

Sonuç: Çalışmamızda gebelikte TİT sonuç pozitifliği ile idrar kültüründe üreme açısından anlamlı bir ilişki bulunmamıştır. Gebelik haftasına göre İYE görülme sıklığı ve İYE tanısında kullanılabilecek diğer tetkikler ile ilgili çok merkezli ve daha çok hasta sayılı kapsamlı çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: gebelikte idrar yolu enfeksiyonu; tam idrar tetkiki; idrar kültürü

1. Introduction

The diagnosis of asymptomatic bacteriuria is made by the presence of bacterial growth in a urine culture, even if there are no symptoms suggestive of a urinary tract infection (UTI). If left untreated, 20 to 35 percent of pregnant women with asymptomatic bacteriuria have been shown to develop symptomatic UTIs during pregnancy, including pyelonephritis (1,2). The Infectious Diseases Society of America has recommended that all pregnant women should be screened for asymptomatic bacteriuria at least once in early pregnancy (3).

Asymptomatic bacteriuria is observed in 2-7% of pregnant women (3,4). If asymptomatic bacteriuria is not treated, a UTI may develop. The dilatation of the smooth muscle and ureter that occurs during pregnancy can facilitate the ascent of bacteria from the bladder into the kidney (5,6) and increase the risk of pyelonephritis. In addition, untreated bacteriuria may be associated with an increased risk of prematurity, low birth weight and perinatal mortality (1,4,5,7-11).

Screening for asymptomatic bacteriuria by urine culture is performed at the first use of pregnancy (3,12). As the urine culture test is relatively expensive, requires intensive work to evaluate the test and has a waiting time of 24-48 hours, many studies have investigated alternative tests to urine culture (13-15).

Dipsticks to determine leukocyte esterase and nitrite in urine as part of a total urinalysis (total UA) can be used as a screening tool for the diagnosis of UTIs. The presence of leukocyte esterase corresponds to pyuria. Leukocyte esterase can be used to detect > 10 leukocytes per high-power field (sensitivity 75-96%; specificity 94-98%) (16). A positive nitrite test is a reliable indicator of bacteriuria, but a negative test does not rule out bacteriuria. The role of urine culture prior to treatment of a suspected UTI is to confirm the presence of bacteriuria, identify the causative organism, and provide information on antibiotic susceptibility. The American College of Obstetricians and Gynecologists (ACOG) guidelines recommend that another urine culture be obtained after treatment of asymptomatic bacteriuria, but more data are needed to determine the efficacy of this strategy (17).

The aim of this study was to investigate whether there is a significant difference in terms of positive a total UA results and urine culture reproduction during pregnancy.

2. Materials and methods

For our retrospective cross-sectional observational study, complete urine samples from pregnant women (18-45 years) who registered for a routine check-up at the Faculty of Health Sciences of Etlik Zubeyde Hanım Gynecology Training and Research Hospital between September 1, 2023 and November 1, 2023 were analyzed. Patients who agreed to participate

in the study and continued treatment at our hospital were included in the study. Patients' data were retrospectively scanned from the patient record system. 177 patients whose demographic data were available and whose complete blood count and glucose values were available in the system were analyzed. The study protocol was approved by the Medical Specialization Training Board of the Health Sciences College Etlik Zuebeyde Hanım Gynecology Training and Research Hospital (Decision No.: 11/23.11.2023). All participants signed written informed consent and gave verbal consent, and the principles of the Declaration of Helsinki were followed. Age, gravida, parity, presence of concomitant diseases, blood tests (hemoglobin (HB), white blood cell (WBC), glucose level), a total UA test results and urine culture results (if available) were examined. Total urinalysis results were analyzed using the Dirui FUS-200/H-800 automated urinalyser, and values noted as leukocyte or bacteriuria > 5, nitrite positivity, or leukocyte esterase positivity as a result of a total UA were recorded on the patient's follow-up form.

The urine culture tests were examined in our hospital's microbiology laboratory. After the urine sample was collected using a calibrated loop and inoculated on blood agar and emb agar media, it was observed for 16-24 hours. When a pure growth colony was detected (1000 for Gram-positive bacteria, 100000 for Gram-negative bacteria), the urine culture was considered positive and they were examined for antibiogram study.

As a result of total UA, the number of patients with leukocytes/ bacteria > 5 was 142, the number of patients with positive leukocyte esterase was 108 and the number of patients with positive nitrite was 45. Of the patients whose urine culture was detected according to the results of urinalysis, the patients whose urine culture was evaluated were included in the study group (n = 80) and the patients who were not evaluated (n = 97) were included in the control group. The correlation between the results of the total UA and the reproduction of the urine culture was compared between these 2 groups. In addition, the weeks of gestation of patients with positive urinalysis results were recorded. Patients who had taken antibiotics in the last 15 days, had vaginal discharge or an infection or were immunocompromised were not included in the study.

Statistical analysis

The data were analyzed using IBM SPSS V23. ROC analysis was used to determine the cut-off values of urine culture positivity parameters. The effect of independent variables on urine culture positivity was analyzed by binary logistic regression analysis. The kappa statistic was used to examine the agreement between urine culture results and total UA results. The significance level was set at $p < 0.05$.

The sample size was calculated by power analysis based on the previous study by Lumbiganon et al. [12]. With an impact power of 2.1491714 and α-value set at 0.05 in the independent sample's t-test, power (1-β) was calculated as 0.95 with 56 participants. Since our sample size is larger than this number, we assume that the significance of our study is greater than 95%.

3. Results

The demographic characteristics of the patients included in the study are listed in Table 1. The mean age of the participants was 28.76±5.48 years. When pregnancy status was examined, the mean gravida score (number of pregnancies) of the participants was 2.41±1.44 and the parity score (number of births) was 1.04±1.17. While the average week of gestation of the patients was 25.96±11.57 weeks, the average week of gestation according to the ultrasound measurements was 26.02±11.64 and no significant association was found between the patients' weeks of gestation and the occurrence of urinary tract infections. When comorbidities were examined to assess the general health of the patients, it was found that 88.8% of the participants had no comorbidities, while 11.2% had various diseases. These comorbidities included hypertension (5%), heart disease (5%), thyroid disease (50%), diabetes (5%), asthma (10%) and others (30%). While 95.5% of the patients smoked, 4.5% did not smoke.

When analyzing the laboratory values (hemogram, white blood cell, glucose level, total UA and urine culture results) of the patients included in the study, the glucose value was 84.69±19.48 mg/dl, the Hb value was 12.65±8.51 mg/dl, the white blood cell value was determined to be 9859.20±3356.0 3mg/dl. When the total UA abnormalities in the urine sample were examined, it was also found that the rate of those with a high leukocyte/bacteria ratio was 80.2% (n=142), the rate of those with positive leukocyte esterase was 61% (n=108) and the rate of those with positive nitrite was 25.4% (n=45).) were found. According to the urine culture results, 54.8% (n=97) of participants had no urine culture and 45.2% (n=80) had one. The proportion of urine cultures without growth was determined to be 77.5% (n=62), and the proportion of cultures with growth was 22.5% (n=18). Among the cultured microorganisms, various microorganisms such as E.coli (38.9%), skin flora (11.1%), S.aureus (11.1%) and Strep.viridans (11.1%) were identified (Table 1).

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Table 1. Descriptive statistics of variables		
	Frequency (n) / mean±standard deviation	Percentage (%) / median (min. - max.)
Total Urine Analysis Abnormality (n)		
Bacterium	29	16.3
Leukocyte	113	63.5
Nitrite	36	20.2
Age	28.76±5.48	28.00 (18.00 – 44.00)
Gravida (n)	2.41±1.44	2.00 (1.00 – 9.00)
Parity(n)	1.04±1.17	1.00 (0.00 – 5.00)
Living births(n)	1.03±1.15	1.00 (0.00 – 5.00)
Previous birth history		
None	75	42.4
Vaginal delivery	62	35
Ceserean section	40	22.6
Weeks of gestation	25.96±11.57	27,86 (5,43 - 41,14)
Body mass index	28.71±5.26	28,50 (17,90 - 43,00)
Smoking		
No	170	95.5
Yes	8	4.5
Glucose	84.69±19.48	81.00 (54. 00 – 182.00)
Hemogram	12.65±8.51	12.05 (6.70 – 123.00)
White blood cell	9859.20±3356.03	9285.00 (1040.00 – 26660.00)
Total Urine Analysis		
Leukocyte/bacteria>5	142	80.2
Leukocyte esterase +	108	61
Nitrite+	45	25.4
Urine culture		
No	97	54.8
Yes	80	45.2
Urine culture results		
No growth	62	77.5
Growth+	18	22.5
Breeding microorganism		
Acinetobacter enterococcus	1	5.6
Skin flora	2	11.1
E.coli	7	38.9
Gr(-)Rod	1	5.6
Mixed flora	1	5.6
Pseudomonas	1	5.6
S.aureus	2	11.1
Strep.agactia	1	5.6
Strep.viridans	2	11.1

ROC analysis was used to determine the cut-off values for week of gestation, glucose, hemogram and white blood cell values to determine the positivity of urine culture results. No significant area under curve (AUC) value was determined for these parameters (p> 0.050) (Figure 1), (Table 2).

The effect of independent risk factors on the urine culture result was examined by binary logsitic regression analysis as both univariate and multiple models, and the independent variables in both models did not have a statistically significant effect on the culture result (p>0.050) (Table 3).

There was no statistically significant agreement between the urine culture result and the leukocyte/bacteria>5 result (p=0.822). Of those who had no urine culture results, 14.5% had no leukocyte/bacteria results either. Of those with positive culture results, 83.3% were found to have positive leukocyte/bacteria results. There was no statistically significant agreement between the urine culture result and the leukocyte esterase positivity result (p = 0.438). There was no statistically significant agreement between the urine culture result and the nitrite positivity result (p = 0.542) (Table 4).

The sensitivity of leukocyte/bacteria positivity is 83.3%, the specificity is 14.5%, the positive predictive value is 26.5%; The sensitivity of nitrite was 27.8%, its specificity was 49%, and its positive predictive value was 100%. The corresponding figures for leukocyte esterase were sensitivity 66.7%, specificity 24.2%, positive predictive value 30.5%.

Table 2. ROC analysis result of parameters for urine culture positivity

	AUC (%95 CI)	p
Weeks of gestation	0.422 (0.285 – 0.558)	0.326
Glucose	0.618 (0.484 – 0.751)	0.141
Hemogram	0.467 (0.295 – 0.638)	0.676
White blood cell	0.392 (0.239 – 0.545)	0.177

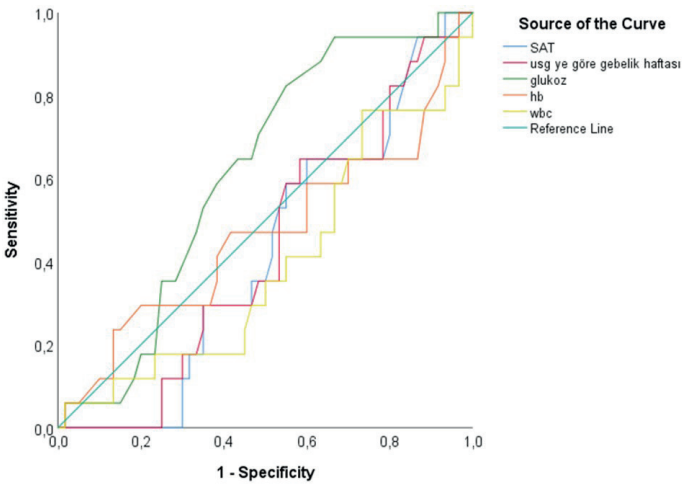

Figure 1. ROC curve of parameters for urine culture positivity

4. Discussion

Due to the cost of urine cultures, the labor involved and a 24-48 hour waiting time, many studies have investigated alternative tests to urine culture, but a cost-effective, rapid, sensitive and specific alternative test has not been demonstrated in comparison to urine culture. Urinalysis and urine smears are specific for bacteriuria but not sensitive, and a specific alternative test to culture has not been demonstrated (12-15,18). Today, urine culture remains important for the diagnosis of UTIs and is the gold standard screening test for asymptomatic bacteriuria during pregnancy (19-21). If a UTI is suspected, a urinalysis should be performed to determine the presence of pyuria, as well as a urine test for leukocyte esterase and nitrite positivity. However, if pyuria is present or the urine test strip is positive for leukocyte esterase or nitrite, it is recommended that a urine culture be performed to determine the presence of bacteriuria and to document antimicrobial susceptibility (22). Another study recommends performing a urine test and urinalysis in cognitively intact older adults with symptoms suggestive of a UTI to determine nitrite or leukocyte esterase positivity and the presence of pyuria. Although not necessary in all cases of uncomplicated UTI, urine culture may be preferred to confirm the presence of bacteriuria and to assess antimicrobial susceptibility (23). In our study, the total UA values of laboratory tests were examined, and no statistically significant correlation was found between urine culture test results and their correlation. Our study showed that a positive total UA test result during pregnancy cannot predict the presence of growth in urine culture, and we recommend a urine culture test when symptoms are present. In a study of 343 patients conducted by Lammers et al, it was suggested that although the urine dipstick is equivalent to urinalysis in the diagnosis of UTI, the limitations of the diagnostic accuracy of both tests should be considered in medical decision making (24). In addition, nitrite positivity in patients with symptoms of UTI on examination is more specific for bacterial infection; it was concluded that leukocyte esterase positivity on examination may be due to inflammation and infection (25).

However, in the study conducted by Sundvall et al. in which 655 residents in 32 nursing homes were examined, the negative predictive value of the urine test stick in detecting bacteriuria was 88%. For this reason, it was recommended that in most cases with negative leukocyte esterase and nitrite dipstick tests, a urine culture should not be performed and causes other than a urinary tract infection should be considered (26).

Table 3. Examining the effect of independent variables on urine culture positivity using binary logistic regression analysis				
	Univariate		Multiple	
	OR (%95 CI)	p	OR (%95 CI)	p
Age	1.071 (0.971 – 1.18)	0.170	1.081 (0.954 – 1.226)	0.222
Birth history	1.381 (0.473 – 4.03)	0.555	0.807 (0.214 – 3.043)	0.752
Weeks of gestation	0.968 (0.92 – 1.019)	0.211	0,702 (0.294 – 1.675)	0.425
Smoking	1.765 (0.151 – 20.658)	0.651	25.149 (0.647 - 978,289)	0.084
Glucose	1.012 (0.985 - 1,039)	0.406	1.028 (0.991 – 1.066)	0.140
Hemogram	0.97 (0.615 – 1.53)	0.897	0.809 (0.462 – 1.415)	0.457
White blood cell	1 (1 - 1)	0.257	1 (0.999 - 1)	0.073

OR: Odds ratio; CI: Confidence interval

Table 4. Examining the consistency between urine culture results and total urine analysis results				
	Urine culture result		Kappa	p
	No growth	Positive growth		
Leukocyte/bacteria>5				
Negative	9 (14.5)	3 (16.7)	-0.011	0.822
Positive	53 (85.5)	15 (83.3)		
Leukocyte esterase +				
Negative	15 (24.2)	6 (33.3)	-0.051	0.438
Positive	47 (75.8)	12 (66.7)		
Nitrite+				
Negative	49 (79)	13 (72.2)	0.068	0,542
Positive	13 (21)	5 (27.8)		

Although the mean gestational age of the patients in our study was 25.96±11.57 weeks, no significant association was found between gestational age and the incidence of UTI. In addition, no comprehensive study examining the association between the incidence of UTI and gestational age was found in the review of the literature.

Although the negative impact of UTIs on pregnancy and pregnancy outcomes has been studied in academic source research, there are not enough literature studies on the incidence of UTIs in relation to gestational week and other tests that can be used in the diagnosis of UTIs. The small number of patients and the fact that the study was retrospective limited the study. The strengths of our study are that the patients are treated and followed up in the tertiary center and their information is complete and accessible in the data system. There is a need to conduct a study with a larger number of patients on this topic. Further research is needed to understand the utility and methods of alternative urine culture tests for screening asymptomatic bacteriuria and diagnosing UTIs in pregnancy.

Author contribution

Study conception and design: KD, EEO, RSK Data collection: KD, EEO; analysis and interpretation of results: KD, RSK; draft manuscript preparation: KD. All authors reviewed the results and approved the final version of the manuscript.

Ethical approval

The study was approved by the Ethics Committee for Noninterventional Studies of Etlik Zubeyde Hanım Women Health Education Research Hospital (Decision No: 11/23.11.2023).

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Conflict of interest

The authors declare that there is no conflict of interest.

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