A RETROSPECTIVE ANALYSIS OF URINE CULTURE AND URINE ANALYSIS RESULTS IN FEMALES AGED 18 TO 65 WITH A SUSPECTED URINARY INFECTION

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ABSTRACT

Introduction: *The aim of the present study was to assess the urine analysis of women aged 18-65 years with a preliminary diagnosis of urinary infection, as well as the retrospective examination of urine culture results and the status of requesting when necessary.*

Materials and method: *The study was completed with the retrospective evaluation of the urine analysis and urine culture results of the female patients aged between 18-65 with a pre-diagnosis of urinary infection, chosen among the patients who applied to our family practice polyclinics in our university hospital for any reason between January 1, 2015, and January 1, 2022.*

Results: *The study included 1624 female patients with a pre-diagnosis of urinary infection who applied to our outpatient clinic. The incidence of positive culture results was found to be 6.401 times higher in individuals with turbid urine than in those with less turbidity (p=0.017). There was a statistically significant difference in urine protein distributions according to culture request (p<0.001). There was a statistically significant difference in the distribution of blood in the urine based on the culture request (p<0.001).*

Conclusion: *Urinary infections are easily diagnosed, and treatment can begin as soon as possible. Urine analysis is thought to be sufficient for this diagnosis, but the addition of a urine culture is suitable when necessary and significant since it may change the course of treatment. It appears appropriate to examine the clinical characteristics of the patient as well as the properties of the urine for the effective use of urine culture.*

Keywords: *Urinary tract infections, urine, urine analysis, urine culture.*

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Introduction

Urinary infections, particularly urinary tract infections, are among the most often diagnosed infections based on laboratory test findings, and the culprit bacteria are frequently identified. In epidemiological studies, the prevalence of urinary infections in women in general varies according to age and varies between 10-60%. It is generally accepted that the prevalence is 25% for all women[1-4]. Although anamnesis and clinical symptoms can be used to diagnose urinary infection, a thorough urinalysis, including chemical and microscopic analysis of the urine, may be necessary for a definitive diagnosis, and in situations deemed appropriate, urine culture may be required to direct treatment[1-5]. Urine analysis has become widely employed in primary health care services in recent years, and automatic urine equipment have both facilitated and standardized the analysis with appropriate sensitivity and specificity[3-7]. Urine culture is often regarded as the gold standard for diagnosing urinary infection4-6. Urine culture, on the other hand, can be reported in a longer period and with more effort than urine analysis. As a result, some people and studies believe that the first application of urine culture is ineffective[4-9]. The culture result may vary depending on the method of taking urine culture, the type and brand of agar to be used[1, 3, 5]. In addition, another important issue is that antibiotic use in the last 6

months before urine culture is taken significantly increases antibiotic resistance[6-8]. Our study's aim is to compare the urine analysis and urine culture results of women with a pre-diagnosis of urinary infection, to evaluate the situation of requesting when necessary, and to investigate the results and effects of requesting these two tests at separate times on diagnosis and treatment. Since the results of the analysis cover 7 years, new information will be used in the diagnosis and treatment of urinary infections in order to reduce both the cost and the workload.

Materials and methods

The study with a retrospective design was conducted in XXXX University Faculty of Medicine Family Medicine outpatient clinics using data records between February 16, 2022, and May 16, 2022. The study's population consists of people who applied to the polyclinic for any reason between January 1, 2015, and January 1, 2022. The study's population includes female patients between the ages of 18 and 65 who were pre-diagnosed with any of the urinary infections (ICD-10 code: N30) and sub-crimes according to the International Classification of Diseases–10 (ICD-10) identification system and whose urine culture and urine analysis were performed. Data recordings were accessed by obtaining necessary permissions in accordance with the ethical informed consent, between the dates February 16, 2022, and May 16, 2022.

XXXX University Faculty of Medicine, Department of Family Medicine, has three polyclinics that serve people of all ages. According to the patient's application and admission examination evaluation, admission diagnoses are entered as preliminary or definitive diagnoses. The data for the retrospective design study were acquired from patient applications recorded in the Patient Information System between 2015 and 2022 (7 years). The data form asked for age, gender, urine culture, and urine analysis results, but no personal information was included.

The study was planned with the aim of reaching all patients who applied to our polyclinics between the specified dates and whose urine analysis and urine culture were performed from 18-65 years old female patients without sampling. The study was completed by analyzing the data of 1624 female patients with prediagnosis of urinary infection among the patients who applied to our outpatient clinic during the 7-year period between 2015-2022. Urine culture was requested from 345 patients along with urine analysis, and laboratory results showed that 295 of them had growth in their urine cultures. Patients whose culture results could not be evaluated due to contamination and similar reasons were excluded from the study. Patients with missing data, missing diagnoses, and inaccurate/incomplete laboratory results were excluded from the study. In our Hospital Laboratory, we use European Committee on Antimicrobial Susceptibility Testing (EUCAST) standards. Antimicrobials that do not have an equivalent in EUCAST are evaluated using Clinical and Laboratory Standards Institute (CLSI) standards.

Statistical analyses

Data were analyzed using the IBM SPSS V23 software. For categorical variables, analysis results were provided as frequency (%). When comparing categorical data, the Yates Correction and Pearson Chi-Square Test were employed, and multiple comparisons were made using the Bonferroni Corrected Z Test. Kappa statistics were used to examine the concordance between categorical variables. The cut-off for variables to determine the culture result was determined using ROC Analysis. Binary Logistic Regression Analysis was used to examine the risk factors influencing culture development outcomes. The significance level was $p<0.05$.

Results

The study comprised a total of 1624 female patients with a pre-diagnosis of urinary infection who applied to our outpatient clinic between 2015 and 2021. During the same examination, urine analysis was requested from 1624 female patients, and urine cultures were sought from 345 individuals. There was no growth in the urine cultures of 50 of these 345 patients, but there was reproduction in 295 of them. Binary Logistic Regression Analysis was used to examine the risk factors influencing culture development outcomes. In the univariate model, the risk of having a positive culture result in light yellow urine is 3,473 times higher than in light amber; straw yellow ones 26,286 times more than light amber ones; It was determined that it was 13,099 times higher in those with yellow urine color than those with light amber (p 0.028; 0.004; 0.001, respectively). The incidence of positive culture results was found to be 5.261 times higher in individuals with clear urine than in those with reduced turbidity ($p<0.001$). The risk of positive culture results was found to be 2.801 times higher in individuals with cloudy urine than in

those with less turbid urine (p=0.012). The incidence of positive culture findings was found to be 0.332 times higher in individuals with a low quantity of bacteria than in those without bacteria (p=0.016), and this value shows that it reduces the positive result of the culture test. The incidence of positive culture results was found to be 5.629 times higher in those with uncommon bacterial counts than in those without bacteria (p<0.001). According to the multivariate model, the risk of a positive culture result in straw-yellow urine was 72.827 times higher than in light amber urine (p=0.009). The incidence of positive culture results was found to be 22.832 times higher in those with yellow urine than in those with light amber urine (p=0.002).

The incidence of positive culture results was found to be 5.169 times higher in individuals with clear urine compared to those with minimal turbidity (p=0.014). The incidence of positive culture results was found to be 6.401 times higher in individuals with turbid urine than in those with less turbidity (p=0.017). The incidence of positive culture results for those with leukocyte esterase positive was found to be 4.091 times higher than the risk of negative culture results (p=0.042). Since the risk of positive culture results of those with a low number of bacteria is 0.193 times higher than those without bacteria, it has been determined that the culture positive result is reduced (p=0.028). It was revealed that those with uncommon bacterial counts had a 23.529 times higher probability of achieving a positive culture growth result than those without bacteria (p<0.001). Other variables had no effect on the positive outcome of culture growth (Table 1).

There was a statistically significant difference in the distribution of urine colors based on the status of the culture request (p<0.001). The highest rate of culture desired appearance was clear (42.60%), while the lowest rate was very cloudy appearance (4.64%). There was a statistically significant difference in urine protein distributions according to culture request (p<0.001). The maximum rate of culturing desired protein value was discovered to be negative (74.20%), with the lowest rate as trace (5.51%). There was a statistically significant difference in the distribution of blood in the urine based on the culture request (p<0.001). Culture was sought by 29.57% of the positive respondents and 70.43 percent of the negative respondents. There was a statistically significant difference in the distribution of nitrite in urine based on the status of the culture request (p<0.001). While culture was sought by 10.43 percent of the positive respondents, it was requested by 89.57% of the negative respondents. There was a statistically significant difference in the distribution of leukocyte esterase in urine based on the culture request (p<0.001). Culture was requested by 44.93% of the positives and cultivated by 55.07% of the negatives. There was a statistically significant difference in the bacterial count distributions in the urine based on the culture request (p<0.001). Whereas the highest culture request rate was 43.76%, the lowest culture request rate was 8.12% (Table 2).

	Results of culture reproduction n (%)		Univariate*		Multivariate*	
	Negative	Positive	NPV (95% CI)	p	NPV (95% CI)	p
Colour						
Light Amber	8 (53.33)	7 (46.67)	References			
Light Yellow	26 (24.76)	79 (75.24)	3.473 (1.148 - 10.505)	**0.028**	7.577 (1.003 - 57.247)	0.051
Amber	1(25.00)	3 (75.00)	3.429 (0.287 - 40.946)	0.330	---	---
Red	1 (20.00)	4 (80.00)	4.571 (0.409 - 51.138)	0.217	2.068 (0.046 - 93.129)	0.708
Dark Amber	0 (0)	1 (100)	---	---	---	---
Dark yellow	0 (0)	14 (100)	---	---	---	---
Colorless	0 (0)	14 (100)	---	---	---	---
Straw Yellow	1 (4.16)	23 (95.84)	26.286 (2.786 - 248.005)	**0.004**	72.827 (2.964 - 1789.352)	**0.009**
Yellow	13 (8.02)	149 (91.98)	13.099 (4.098 - 41.868)	**<0.001**	22.832 (3.219 - 161.923)	**0.002**
Orange	0 (0)	1 (100)	---	---	---	---
Appearance						
Slightly Cloudy	20 (29.85)	47 (70.15)	References			
Clear	11 (7.48)	136 (92.52)	5.261 (2.347 - 11.791)	**<0.001**	5.169 (1.389 - 19.239)	**0.014**
Cloudy	12 (13.19)	79 (86,81)	2.801 (1.257 - 6.245)	**0.012**	6.401 (1.397 - 29.32)	**0.017**
Extremely Cloudy	0 (0)	16 (100)	---	---	---	---
Very Slightly Cloudy	7 (29.17)	17 (70.83)	1.033 (0.371 - 2.877)	0.950	0.976 (0.198 - 4.813)	0.976
Protein						
Trace	2 (10.53)	17 (89.47)	References			
Negative	38 (14.84)	218 (85.16)	0.675 (0.15 - 3.04)	0.609	0.462 (0.043 - 5.004)	0.525
Positive	10 (14.29)	60 (85.71)	0.706 (0.141 - 3.534)	0.672	1.865 (0.111 - 31.457)	0.666
Blood						
Negative	32 (13.17)	211 (86.83)	References			
Positive	18 (17.65)	84 (82.35)	0.708 (0.377 - 1.329)	0.282	0.443 (0.142 - 1.385)	0.161
Nitrite						
Negative	50 (16.18)	259 (83.82)	References			
Positive	0 (0)	36 (100)	---	---	---	---
Leukocyte esterase						
Negative	29 (15.26)	161 (84.74)	References			
Positive	21 (13.55)	134 (86.45)	1.149 (0.627 - 2.108)	0.653	4.091 (1.053 - 15.888)	**0.042**
Bacteria						
No	23 (30.67)	52 (69.33)	References			
Low	16 (57.14)	12 (42.86)	0.332 (0.136 - 0.812)	**0.016**	0.193 (0.045 - 0.838)	**0.028**
Plenty	0 (0)	61 (100)	---	---	---	---
Rare	11 (7.28)	140 (92.72)	5.629 (2.565 - 12.352)	**<0.001**	23.529 (5.308 - 104.304)	**<0.001**
Moderate	0 (0)	30 (100)	---	---	---	---

Table 1: The examination of the risk factors influencing the positivity of the culture growth result by logistic regression analysis.

**Binary Logistic Regression Analysis, Cox & Snell R^2= 37.9%; Nagelkerke R^2= 67.3%.*

	Request for Culture n (%)		Total	Test Stat.	p
	Not Requested	Requested			
Color					
Light Amber	0 (0)[a]	15 (4.35)[b]	15 (0.92)		
Light Yellow	419 (32.76)[a]	105 (30.43)[a]	524 (32.27)		
Amber	6 (0.47)[a]	4 (1.16)[a]	10 (0.62)		
Red	10 (0.78)[a]	5 (1.45)[a]	15 (0.92)		
Dark Amber	7 (0.55)[a]	1 (0.29)[a]	8 (0.49)		
Dark yellow	36 (2.81)[a]	14 (4.06)[a]	50 (3.08)	67.731	**<0.001***
Blue	2 (0.16)[a]	0 (0)[a]	2 (0.12)		
Colorless	77 (6.02)[a]	14 (4.06)[a]	91 (5.60)		
Straw Yellow	87 (6.80)[a]	24 (6.95)[a]	111 (6.84)		
Yellow	635 (49.65)[a]	162 (46.96)[a]	797 (49.08)		
Orange	0 (0)[a]	1 (0.29)[a]	1 (0.06)		
Appearance					
Slightly Cloudy	112 (8.76)[a]	67 (19.42)[b]	179 (11.02)		
Clear	856 (66.93)[a]	147 (42.60)[b]	1003 (61.76)		
Cloudy	154 (12.04)[a]	91 (26.38)[b]	245 (15.09)	91.364	**<0.001***
Extremely Cloudy	69 (5.39)[a]	16 (4.64)[a]	85 (5.23)		
Very Slightly Cloudy	88 (6.88)[a]	24 (6.96)[a]	112 (6.90)		
Protein					
Trace	41 (3.21)[a]	19 (5.51)[b]	60 (3.69)		
Negative	1086 (84.91)[a]	256 (74.20)[b]	1342 (82,64)	21.709	**<0.001***
Positive	152 (11.88)[a]	70 (20.29)[b]	222 (13.67)		
Blood					
Negative	1053 (82.33)	243 (70.43)	1296 (79.80)	23.853	**<0.001***
Positive	226 (17.67)	102 (29.57)	328 (20.20)		
Nitrite					
Negative	1238 (96.79)	309 (89.57)	1547 (95.26)	29.859	**<0,001****
Positive	41 (3.21)	36 (10.43)	77 (4.74)		
Leukocyte esterase					
Negative	990 (77.40)	190 (55.07)	1180 (72.66)	68.211	**<0.001***
Positive	289 (22.60)	155 (44.93)	444 (27.34)		
Bacteria					
No	1123(87.80)[a]	75 (21.74)[b]	1198 (73.77)		
Low	83 (6.49)[a]	75 (21.74)[b]	111 (6.83)		
Plenty	0 (0)[a]	28 (8.12)[b]	61 (3.76)	784.523	**<0.001***
Rare	73 (5.71)[a]	151 (43.76)[b]	224 (13.79)		
Moderate	0 (0)[a]	30 (8.70)[b]	30 (1.85)		

Table 2: The comparison of the distribution of the variables according to the request of culture status.
**Pearson Chi-Square Test; **Yates's correction; [a-b]: There is no difference between the groups with the same letter.*

There was no statistically significant relationship between the culture result and the erythrocyte. There was no statistically significant relationship between culture results and leukocytes (Table 3). In determining the culture results, there was no significant cut-off value for erythrocytes. In determining the culture results, there was no significant cut-off value for leukocytes. In determining the culture results, squamous epithelium had a substantial cut-off value (p=0.007). The squamous epithelium cut-off value was ≤4. The sensitivity value was 62.03 percent, the specificity value was 64 percent (Table 4), and Figure 1 depicts the ROC analysis curves.

	Culture results n (%)		Total	Kappa Test Stat.	p
	Negative	Positive			
Erythrocyte					
Negative	31 (62.00)	212 (71.86)	243 (70.43)	-0.038	0.158
Positive	19 (38.00)	83 (28.14)	102 (29.57)		
Leukocyte					
Negative	30 (60.00)	152 (51.53)	182 (52.75)	0.04	0.267
Positive	20 (40.00)	143 (48.47)	163 (47.25)		

Table 3: The analysis of the compatibility of erythrocyte and leukocyte levels based on culture results.

	cut-off	AUC (95% CI)	P	Sensitivity	Specificity	PPV	NPV
Erythrocyte	---	0.518 (0.425-0.611)	0.683	82.37	28	87.1	21.21
Leukocyte	---	0.547 (0.470-0.625)	0.283	23.39	94	95.83	17.22
Squamous Epithelium	4.	0.620 (0.540-0.700)	**0.007**	62.03	64	91.04	22.22

Table 4: Cut-off values for erythrocytes, leukocytes, and squamous epithelial levels in determining culture results.

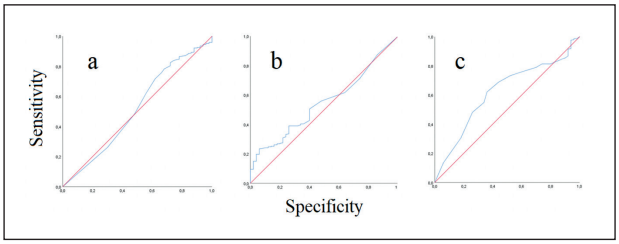

Figure 1: ROC curve for erythrocyte (a), ROC curve for leukocyte (b), ROC curve for squamous epithelium (c).

Discussion

In the analysis of the results of our study, it was determined that the risk of positive culture results in women with a cloudy urine appearance was higher than those with less turbidity in women with a preliminary diagnosis of urinary infection. In addition, a relationship was found between the distributions of urine colors, urine protein distributions and the distribution of blood in the urine according to the culture request status.

The literature on the correlation between urine color and infection is contradictory[10]. However, it should be noted that color changes and turbidity in urine are affected by additional factors such as drug usage, improper collection/storage/transportation of urine, and contamination[11-15]. Straw yellow and yellow color were shown to be substantially related to bacterial growth in urine culture in our investigation. However, the increased rate of positive urine culture in patients with light yellow urine color compared to those with light amber urine color in our study suggests that the urine color questioned during anamnesis may still be misleading.

Furthermore, requesting that the patient exhibit it over a urine color scale while questioning the urine color will provide greater impartiality. In Carter et al.' systematic review, there are conflicting studies for the association between urinary infection and proteinuria, and the general consensus is that there is a weak relationship[16]. In our study, patients with a growth in the urine culture were generally those who did not have proteinuria.

Hematuria is a common finding in women with urinary infections, and a urine culture was ordered at a rate of 29.56 % in our sample when blood was seen in the urine[17, 18]. The rate of culture request was found to be considerably greater in individuals who did not have hematuria, were nitrite negative, and did not have leukocyte esterase positivity ($p<0.001$). This could be because a thorough urinalysis and urine culture are frequently ordered at the same time to prevent wasting time. When the culture's growth status was evaluated, however, 85% of the desired urine cultures were grown.

In our study, a significant cut-off value for squamous epithelium was identified in determining the culture result, but no significant cut-off value was observed for leukocytes or erythrocytes. Ayan et al. discovered that the leukocyte and erythrocyte values of the group with growth were statistically substantially greater than the group without growth; however, no significant difference was identified between the two groups' squamous epithelial values[19] The resulting difference is probably due to the use of different devices for urine analysis. According to the preliminary diagnosis of urinary infection, the rate of requesting a urine culture in addition to urine analysis was found to be reasonable in our study. It has been discovered that results with high bacterial counts necessitate rapid urine culture. In Yüksel et al.'s study, no growth was observed in the urine culture at a high rate of 67%, however in our investigation, no growth was observed in the urine culture at a rate of just 15%1. We think that the reason for such different results may be that the number of patients in the study was 4.5 times less than our study, and that, in addition, the use of a different device for urine analysis and the use of a different brand of agar for urine culture.

Since the study was planned retrospectively, the evaluation of the patients was made based on the data. The number of patients in the study decreased due to the lack of data or the exclusion of those with data errors. In addition, there were errors in the data entries, and the patients for whom the appropriate diagnosis was not entered could not be included in the study despite the laboratory test results. However, since our study was analyzed with 7 years of data from 6 outpatient clinics in 3 different socio-economic levels, it can be considered that a sufficient number of patient data was obtained. Urinary infections are common, particularly in women, and urine tests are critical because they can be treated quickly if diagnosed early. Although the

urine culture test results do not come back quickly, a comprehensive urine analysis is typically sufficient, and the urine culture is also significant for the course of treatment. Our study, which reveals that urine culture is requested more efficiently than prior studies, demonstrates that urine analysis is typically sufficient in regard to urinary infection.

The type of laboratory examination and the time of request will be clarified with future prospective studies with more participants.

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