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ORIGINAL ARTICLE / ÖZGÜN MAKALE

DETERMINATION OF *UREAPLASMA UREALYTICUM* AND ANTIBIOTIC SUSCEPTIBILITY IN SEXUALLY ACTIVE WOMEN WITH DIFFERENT METHODS

CİNSEL YÖNDEN AKTİF KADINLARDA UREAPLASMA UREALYTİCUM VE ANTİBİYOTİK DUYARLILIĞININ FARKLI YÖNTEMLERLE BELİRLENMESİ

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ABSTRACT

Objective: *In this study, the presence of Ureaplasma urealyticum (U.urealyticum) in vaginal and urine samples taken from sexually active women was investigated and antibiotic susceptibilities were determined with culturing bacteria and using kits.*

Material and Method: *The vaginal and urine samples taken from 110 women who applied to Başkent University Ankara Gynecology and Obstetrics Clinic were included in this study. U. urealyticum was investigated by the culture method with using two different test kits [Mycoplasma IES (IES-Autobio, China) and Mycoplasma IST2 (IST2) Biomereux, France] and Mycoplasma Agar. Antibiotic susceptibilities of isolates were also determined.*

Result and Discussion: *We compared the results of (IES) and (IST2) used for U. urealyticum detection in 220 clinical samples. U. urealyticum was found to be positive in 82 (74,5%) by classical culture method. U. urealyticum was detected at a rate of 46.8% with the IST 2 and 53.6% with the IES. As a result of the comparison of culture method and commercial kits,it was determined that the IES kit provides a fast and accurate identification in the detection of U.urealyticum,a fast and reliable result in the detection of antibiotic resistance.A significant difference was found in the detection rate of U. urealyticum of the IES compared to the other commercial kit.It was observed that the detection rate of U. urealyticum with the kit from vaginal were significantly higher than urine samples.*

Keywords: *Antibiotic susceptibility, commercial kit, culture, U. urealyticum*

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ÖZ

Amaç: *Bu çalışmada, cinsel yönden aktif kadınlardan alınan vajinal ve idrar örneklerinde Ureaplasma urealyticum (U.urealyticum) varlığı, kültür ve kitlerle araştırılmış, ticari kitler kullanılarak da antibiyotik duyarlılıkları belirlenmiştir.*

Gereç ve Yöntem: *Başkent Üniversitesi Ankara Kadın Hastalıkları ve Doğum Kliniği'ne başvuran 110 kadından alınan vajinal ve idrar örnekleri ile çalışma gerçekleştirilmiştir. U. urealyticum'un Mycoplasma IES (IES-Autobio, China) ve Mycoplasma IST2 (IST2- Biomereux, Fransa) olarak bilinen iki farklı test kiti ile tespiti yapılmış ve antibiyotik duyarlılıkları belirlenmiştir. Ayrıca Mycoplasma Agar kullanılarak kültür yöntemiyle de varlığı araştırılmıştır.*

Sonuç ve Tartışma: *U. urealyticum tespiti için 220 klinik örnek kullanılmıştır. IES ve IST2 ticari kitleri kullanılarak yapılan tespit sonuçları ile Mycoplasma Agar besiyeri kullanılarak klasik kültür yöntemi ile yapılan çalışma sonuçları karşılaştırılmıştır. Buna göre; kültür yöntemiyle 82 (%74,5) hastada U. urealyticum pozitif bulunmuş olup, U.urealyticum, IST 2 ile %46,8, IES ile (%53,6) oranında tespit edilmiştir. Kültür yöntemi ile ticari kitlerin karşılaştırılması sonucunda, IES kitinin U. urealyticum tespitinde ve antibiyotik duyarlılıklarının saptanmasında hızlı ve doğru bir tanımlama sağladığı sonucuna varılmıştır. IES kitinin U. urealyticum tespit oranında diğer ticari kite göre anlamlı derecede iyi tespit yaptığı ortaya konmuş olup, vajinal örneklerden U. urealyticum tespit oranının, idrar örneklerinden anlamlı derecede yüksek olduğu görülmüştür.*

Anahtar kelimeler: *Antibiyotik duyarlılığı, kültür, ticari kit, U. urealyticum*

INTRODUCTION

Mycoplasma is a bacteria without a cell wall and has the smallest cells among prokaryotes and self-copying. They can be cultured *in vitro* in a medium having both RNA and DNA and live as both parasites and saprotrophs. [1]. *Ureaplasma urealyticum* (*U. urealyticum*) is potentially pathogenic bacterial species that usually associated with urogenital and respiratory system diseases, sexually transmittedand have no peptidoglycan cell wall. Hence, they are found to be responsible of infertility, prematurity, recurrent abortus and newborn respiratory distress. In some studies, *U. urealyticum* has been shown as one of the factors of infertility seen in men [2]. Laboratory diagnosis of them is relatively complicated since they are very sensitive microorganisms and they require special transport and culture media. Since the infections caused by these microorganisms exhibit importance, proper isolation and identification of these bacteria are required to make proper and reliable [3,4].

The aim of this study was to determine the rate of *U. urealyticum* from vaginal and urinary samples obtained from 110 sexually active women from Başkent University Ankara Hospital Obstetrics and Gynecology Clinic. Also to compare the results and detection ability of different clinical methods including culture method with Mycoplasma agar media, commercially available kit methods Mycoplasma IST 2 and Mycoplasma IES.

MATERIAL AND METHOD

Study Design and Sample Collection

We used two commercially available diagnostic kits; Mycoplasma IES (IES) and Mycoplasma IST–2 (IST-2). *U. urealyticum* ATCC 27618 strain was used as control.

A total of 220 clinical samples consist of 110 urine and 110 vaginal were included in the study. These samples were collected from 110 sexually active women in Obstetrics and Gynecology Clinic, Başkent University Ankara Hospital, Ankara, Turkey. All samples were analyzed by the classical culture method and two commercial diagnostic kits method. The vaginal samples were collected with steril cotton swaps and urinary samples with steril container. Then samples were transffered to suitable diluent vial (supplied with the diagnostic kits) that contains selective agents to inhibit the growth of other microbes present in the sample and transported in a suitable medium that containing urea/ arginine diluent supplied with the Mycoplasma IST-2 and Mycoplasma IES diagnostic kits, stored either at 4 °C for culture. For the detection of *U. urealyticum* in the samples, *in-vitro* culture, and diagnostic kit methods were used. If the presence of *U. ueralyticum* detected by the culture method, it was confirmed by the two commercial kits. Included in the kit content, the sensitivity of the samples to various antibiotics was also determined.The susceptibility strip contained 11 antibiotics (Pristinamycin (PRI), Minocycline (MIN), Roxythromycin (ROX), Clindamycin (CLI), tetracycline (TET), josamycin (JOS), Ofloxacin (OFL), ciprofloxacin (CIP), clarithromycin (CLA), erythromycin (ERY) and Levofloxacin (LEV)) in IES kit and 9 antibiotics in IST–2 kit (Pristinamycin (PRI), doxycycline (DOT), tetracycline (TET), josamycin (JOS), Ofloxacin (OFL), ciprofloxacin (CIP), clarithromycin (CLA), erythromycin (ERY) and azithromycin (AZI)).

Culture Methods

Mycoplasma Agar Medium (MAM) (CM0401, Oxoid) is a basic medium that can be used for the isolation and cultivation of mycoplasmas from clinical specimens after enrichment with a supplement. MAM was used for the detection of *U. urealyticum* by classical culture method. In 1 L of distilled water 35.5 g agar were dissolved and distribute in 80 mL volumes. Sterilized by autoclaving at 121 °C for 15 min. Cool to 50 °C and one vial of Mycoplasma Supplement-G SR0059 (Oxoid) reconstituted were added to sterilized medium as directed. *Mycoplasma* species are grown at pH 7.4-8.0, but *U.urealyticum* (T-strains)* prefer pH 6.0-6.5 for growing in Mycoplasma Agar [5]. *Mycoplasma spp*. colonies were expected to appear by tissue culture microscopy as typical fried egg [6,7].

Kits Methods (IES and IST-2)

Vaginal and urine samples, collected by the suitable technical, were inoculated to the two different commercial kits: IES and IST-2.

The kits were used for the identification, detection, enumeration, and antimicrobial susceptibility testing of *U. urealyticum* in the samples following to the manufacturer's instructions. The kit reagents were mixed with the samples and incubated at 36–38 °C for 24–48 h. At the end of the incubation period, the color change of the medium from yellow to deep pink was considered positive for *U. urealyticum.*

The IST-2 kit contains R1 (transport medium) and R2 (selective growth medium) tubes. All samples were collected with sterile swab. Swabs were taken into the liquid transport medium R1 and delivered to the clinical laboratory within 4 h of collection for the identification of *U. urealyticum*. R1 swabs were transferred to the R2 medium after vortexed for 10 sec. Than the R2 medium was then dispensed into wells to detect the presence of mycoplasmas and the wells were overlaid with mineral oil to prevent drying. The kits were incubated at 37 °C for 48 h and observed for any color change at 24 h and 48 h. The color alteration from yellow to orangered in the culture medium is related to an increase in pH and remarks growth of mycoplasmas. The determination of orange to red color of the antimicrobial susceptibility well shows the resistance of mycoplasmas to an antimicrobial agent. From the R2 positive tube, 0.1 mL was also inoculated onto Mycoplasma agar medium with Supplement G (Oxoid). Three hundred μL of the inoculation suspension was transffered into the medium. Then, the suspension (100 μL) was inoculated into the wells of the strip. Each strip well was covered by mineral oil. The incubation period was applied at 37 °C for 24 h. The appearance of red color indicated positive reaction and microbial growth.

In addition, all samples were inoculated on blood agar. To determine that the *Proteus spp*. for differentiate from *U. urealyticum* and to reveal the status of interference with *Proteus spp* colonies cultured on blood agar. All positive samples were confirmed as *U. urealyticum*.

Statistical Analysis

The suitable sample size was determined on the basis of the kappa statistics for power of test 0.80. Descriptive statistics were presented as frequency and percentages for categorical variables (Table 2).

For the determination the effect of independent variables on the *U. urealyticum* asset that a generalized estimating equation (GEE) was used. Positive predictive value, negative predictive value, sensitivity, and specificity values were calculated for IES, IST-2 by agar culture data. In addition, for the samples (164 positive), the relationship between the results of the vaginal and urinary samples obtained with the IES and IST–2 kits was analyzed by chi-square test. Significance level (α) of the tests was accepted to be $p < 0.05$. The SPSS software, version 21.0 (SPSS Inc., Chicago, IL, USA), and R 3.4.2 [https://www.r-project.org/] were used for statistical analyses.

RESULT AND DISCUSSION

A total of 110 sexually active women (urine and vaginal, a total of 220 samples) were included in this study and *U. urealyticum* was detected positive with Mycoplasma agar plates in 82 (74,5%) patients. One hundred and three positive results was detected in 220 samples (46,8%) as *U. urealyticum* by Mycoplasma IST 2 kit and 118 positives in 220 samples (53,6%) by Mycoplasma IES kit. The

antibiotic resistance rates of isolates were evaluated by using the Mycoplasma IES assay as 3% for levofloxacin, 19% for erythromycin, 20% for tetracycline, and 6% for ciprofloxacin. With the Mycoplasma IST 2 assay resistance rates were 17% to tetracycline, 9% to ciprofloxacin, 11% to erythromycin. All isolates were found susceptible to pristinamycin, josamycin, and doxycycline.

The Mycoplasma IES kit was found to be accomplished compared to other commercial culture-based assays for a rapid and accurate identification of *U. urealyticum* and detection of resistance. Also, the detection rates of *U. urealyticum* was found higherin vaginal specimens than urine samples (Table 1).

Table 1. Distribution of positive specimens by origin and kit types

Sample Type	**IES**		**IST-2**		**Culture**	
	positive	negative	positive	negative	positive	negative
Vaginal (110)	67(61%)	15 (14%)	58(53%)	24 (22%)	82(74%)	0
Urine (110)	51(46%)	31(28%)	45(41%)	37 (34%)	82(74%)	0
Total (220)	118(54%)	46 (21%)	103(47%)	61 (28%)	164(74%)	0

Diagnostic test evaluation results according to sample types are shown in Table 2. When the results are evaluated; For IST 2 and IES methods, vaginal sample sensitivity, NPV and accuracy values are higher than urine sample values.

Table 2. Diagnostic test evaluation IST-2, IES and agar culture by sample type

Statistic	**IST 2**	**IES**	**Agar Culture**
Sensitivity (VS)	88.89%	97.22%	100.00%
Sensitivity (US)	55.56%	63.89%	100.00%
Specificity (VS)	100.00 %	100.00 %	100.00%
Specificity (US)	100.00 %	100.00 %	100.00%
Positive Predictive Value (PPV) (VS)	100.00 %	100.00 %	100.00%
Positive Predictive Value (PPV) (US)	100.00 %	100.00 %	100.00%
Negative Predictive Value (NPV) (VS)	94.87%	98.67 %	100.00%
Negative Predictive Value (NPV) (US)	82.22 %	85.06 %	100.00%
Accuracy (VS)	96.36%	99.09%	100.00%
Accuracy (US)	85.45%	88.18%	100.00%

*VS: Vaginal Sample *US: Urine Sample

Diagnostic test evaluation results according to kit types were shown in Table 3. The results were evaluated IES of sensitivity, NPV and accuracy values 80.56%, 91.36%, 93.64% respectively. IST 2 of sensitivity, NPV and values 72.22%, 88.10%, 90.91% respectively. IES method has higher sensitivity and accuracy value than IST 2 method. The concordance of IST 2 and IES methods with agar culture method was examined with kappa coefficient. The kappa coefficients were found to be statistically significant and high fit, respectively (0.778, $p<0.001$; 0.848, $p<0.001$).

Antibiotic Susceptibility of the *U. urealyticum* Isolates with IST-2 Kit

Samples were also evaluated with IST–2 kit for antibiotic susceptibilities. The greatest sensitivity among all strains was 100% against pristinamycin (PRI), josamycin (JOS), and doxycycline (DOT). The resistance rates were; 11% to erythromycin (ERY), 83% to tetracycline (TET), and the highest resistance was found to ciprofloxacin (CIP) 91% (Table 4). Minimal inhibition concentrations (MICs)s were performed according to CLSI guidelines (tests repeated two times). MICs were interpreted according to the IST 2 kit criteria (see the legend to Table 4) [3,8].

Table 3: Diagnostic test evaluation, IST- 2, IES and Agar Culture

Statistic	IST2	IES	Agar Culture
Sensitivity	72.22%	80.56%	100.00%
95%CI for Sensitivity	60.41% to 82.14%	69.53% to 88.94%	95.01%–100.00%
Specificity	100.00 %	100.00 %	100.00%
95%CI for Specificity	97.54% to 100.00%	97.54% to 100.00	97.54%–100.00%
Positive Predictive Value (PPV)	100.00 %	100.00 %	100.00%
Negative Predictive Value (NPV)	88.10 %	91.36 %	100.00%
95%CI for NPV	83.60% to 91.48%	86.85% to 94.42%	100.00%
Accuracy	90.91%	93.64%	
95%CI for Accuracy	86.31% to 94.36%	89.55% to 96.48%	98.34%–100.00%

Table 4. Antimicrobial susceptibilities of the *U. urealyticum* isolates with IST-2 kit and MIC values (µg/mL)

	***U. urealyticum* (n[1]=82)**		***MIC (µg/mL)***	
	S	***R***	***S***	***R***
***Doxycycline* (DOT)**	82(100.0)	0(0)	*≤4*	*≥8*
***Josamycin* (JOS)**	82(100.0)	0(0)	*≤2*	*≥8*
***Ofloxacin* (OFL**	60(72.5)	22(27,5)	*≤1*	*≥4*
***Erythromycin* (ERY)**	73(88.9)	9(11.1)	*≤1*	*≥4*
***Tetracycline* (TET)**	68(83.0)	14(17.0)	*≤4*	*≥8*
***Ciprofloxacin* (CIP)**	75(91.0)	7(0.9)	*≤1*	*≥2*
***Azithromycin* (AZI)**	63(76.5)	19(15.6)	*≤0.12*	*≥4*
***Clarithromycin* (CLA)**	69(84.3)	13(10.7)	*≤1*	*≥4*
***Pristinamycin* (PRI)**	82(100.0)	0(0)	*≥2*	

Mycoplasma IST 2 kit (bioMérieux).U. urealyticum, Ureaplasma urealyticum; S, susceptible; I, intermediate; R, resistant. n[1]=82 (patient). Results are n (%). The breakpoints (µg/mL) according to the Clinical and Laboratory Standards Institute are as follows: Tetracycline S≤4, R≥8; Doxycycline S≤4, R≥8; Azithromycin S≤0.12, R≥4; Clarithromycin S≤1, R≥4; Erythromycin S≤1, R≥4; Josamycin S≤2, R≥8; Ciprofloxacin S≤1, R≥2; Ofloxacin S≤1, R≥4; Pristinamycin R≥2.

Antibiotic Susceptibility of the *U. urealyticum* Isolates with IES Kit

The antibiotic susceptibilities of microorganisms were also evaluated by IES kit. Accordingly, all strains showed greatest sensitivity to pristinamycin (PRI) with100% rate, tetracycline (TET) sensitivity was followed this result with 80%, and 95% rate was found to josamycin (JOS). The highest antibiotic resistance was seen 97% to levofloxacin (LEV), 100% to clindamycin (CLI), 94% to ciprofloxacin (CIP), and 51% to roxithromycin (ROX). The resistance to erythromycin (ERY) (81%) and

clarithromycin (CLA) (32%). (Table 5). MICs were performed according to CLSI guidelines (tests repeated two times). MICs were interpreted according to the IES kit criteria (see the legend to Table 5) [8].

Table 5. Antibiotic susceptibility of the *U. urealyticum* isolates with IES kit: MIC (µg/mL)

	***U.urealyticum* (n[1]=82)**		***MIC (µg/mL)***	
	S	*R*	*S*	*R*
***Pristinamycin* (PRI)**	82(100.0)	0(0)	*≥2*	
***Minocycline* (MIN)**	56(68.5)	26(31.5)	*≤2*	*≥8*
***Josamycin* (JOS)**	78(95.0)	4 (5.0)	*≤2*	*≥8*
***Erythromycin* (ERY)**	66(81.0)	16(19.0)	*≤8*	≥16
***Roxythromycin* (ROX)**	60(74.0)	22(26.0)	*≤1*	*≥4*
Clindamycin (CLI)	0(0.00)	82(100.0)	*≤0.25*	*≥0.5*
Ofloxacin (OFL)	56(68.7)	26(31.3)	*≤1*	*≥4*
***Ciprofloxacin* (CIP)**	77(94.0)	5(6.0)	*≤1*	*≥2*
***Clarythromycin* (CLA)**	56(68.0)	26(32.0)	*≤1*	*≥4*
***Tetracycline* (TET)**	66(80.0)	16(20.0)	*≤1*	*≥2*
Levofloxacin (LEV)	59(72.0)	23(28.0)	*≤2*	*≥4*

Mycoplasma IES kit (Autobio).U.urealyticum, Ureaplasma urealyticum; S, susceptible; I, intermediate; R, resistant. n[1]=82 (patient). Results are n (%). The breakpoints (µg/mL) according to the Clinical and Laboratory Standards Institute are as follows: Tetracycline S≤1, R≥2; Minocycline S≤2, R≥8; Roxythromycin S≤1, R≥4 Clarythromycin S≤1, R≥4; Erythromycin S≤8, R≥16; Josamycin S≤2, R≥8; Ciprofloxacin S≤1, R≥2; Ofloxacin S≤1, R≥4; Clindamycin S≤0.25, R≥ 0.5; Levofloxacin S≤2, R≥4; Pristinamycin R≥2. (30).

Mycoplasmas are microorganisms that can be in the oral and genital system of humans but can form a disease with the effect of certain factors. The most common mycoplasmas isolated from the urogenital system are *M. hominis* and *U. urealyticum* in many studies [9].

Ureaplasmas have also been consistently associated with Nongonococcal Urethritis (NGU) and pregnancy complications [10]. *U. urealyticum* is an opportunistic pathogen in humans and can often be isolated from the genitourinary system of young women, causing diseases such as acute urethritis, bacterial vaginitis, pelvic inflammatory disease, and pyelonephritis. It can cause miscarriage in pregnant women and chorioamnionitis and congenital pneumonia in infants, and it can be isolated from the fetus and cerebrospinal fluid. It is also known to cause infertility in women [11,12].

It has become a necessity to use effective and rapid diagnostic methods to control these infections and reduce their complications because of the pathogenic role of ureaplasmas is increasing [12, 13]. Mycoplasma IES and Mycoplasma IST-2 kits are commercial test kits that are used for *Ureaplasma spp*. detection and give faster results compared to the culture method.

In this study, it was found that the sensitivity of the IES kit was higher than the IST-2 kit, and the sensitivity rates were found to be 80.56% and 72.22%, respectively. Regarding antibiotic sensitivity, the conformity rate between Mycoplasma IES and Mycofast Revolution has been reported as 100% [14, 15]. In our study, the concordance rate between IES and IST 2 was determined as 100% for both samples

and it is compatible with the study data. Similarly, D'Inzeo et al. (2017) compared the sensitivities of Mycoplasma IES, Mycoplasma IST 2 and Mycofast, and they found the sensitivity results as 100%, 95.3% and 96.2%, respectively, and reported the highest result for Mycoplasma IES [13]. In a study by Kusanovic et al. (2020), the sensitivity of Mycoplasma IES, MYCOFAST RevolutioN and Mycoplasma IST 2 kits was determined as 100%, 96 and 95% for *U. urealyticum*, respectively, and it is consistent with the results we obtained from this study [16].

The *U. urealyticum* detection rate was found to be 61% with IES, 52% with the IST-2 kit, and 74% with the culture method in our study. Skiljevic et al. (2016) reported the rate of detection of *U. urealyticum* in urethral and endocervical swab samples as 77.8% in their study with IST-2 and including 132 female patients [17]. In another study using IST-2; 9956 sample was included in the study, and 1856 of them were found to be positive. *U. urealyticum* was detected in 1652 patients (89%) among these positives [18]. In our study, *U. urealyticum* detection rate (52%) was found with the IST-2 kit, and it was concluded that this difference may be due to factors such as living conditions, socioeconomic status, and age.

The other aim of this study was to compare the effectiveness of commercial mycoplasma kits for different clinical samples including vaginal and urine. The results of the sensitivity study performed with different samples with these three methods were IES (97.22%), IST2 (88.89%) and culture method (100%) for vagina, while the data for urine were 63.89%, 55.56% and 100%. The rate of detecting *U. urealyticum* with the IES kit was significantly higher than the IST-2 kit for both samples ($p < 0.001$). In our literature survey, no study was found that determined these two kits in comparison with two different sample types.

In most clinical studies, it appears that the presence of *U. urealyticum* was usually determined by studying a single biological sample. It was concluded that the vaginal sample was a more suitable material for the detection of *U. urealyticum* than the urine sample, and no significant difference was found in the antibiotic sensitivity tables.

In our study, antibiotic resistance rates measured by IES were found to be ciprofloxacin, 6.0%, clindamycin 100%, levofloxacin 28.0%, ofloxacin 31.3%, tetracycline 20%, clarithromycin 32.0%, erythromycin 11.1%, minocycline 31.5% and roxithromycin 26%. Similarly, antibiotic resistance rates in Tuzemen et al. study (2017) with IES were reported as ciprofloxacin 84.65%, clindamycin 85.96%, levofloxacin 15.35%, ofloxacin 23.49%, tetracycline 19.42%, clarithromycin 12.6%, erythromycin 14.96%, minocycline 0.39% and roxithromycin 13.39% [12]. Longdoh et al. (2018) found *U. urealyticum* detection rate 78.57% in their study performed by IES kit from cervical specimens in pregnant women, and reported antibiotic susceptibilities as 72.4%, 93.1% and 41.3% for erythromycin, ciprofloxacin and tetracycline, respectively [19]. When these results were evaluated, it was seen that the sensitivity rates in the samples taken from the cervical swabs were similar.

Likewise, the results obtained from the studies conducted with IST-2 in the literature are compatible with our study. In the study conducted by Koh et al. (2009) with the IST2 kit, the antibiotic sensitivity rates were found to be tetracycline 81%, erythromycin 82.9%, ofloxacin 56.2% and pristinamycin 100% [20]. While Jang et al. (2019) in their studies, the sensitivities of *U. urealyticum* to doxycycline, erythromycin, ciprofloxacin and azithromycin were determined as 94.8%, 87.9%, 5.2% and 81%, respectively [21].

In the study performed by Skiljevic et al. (2016) with the IST2 kit, the resistance rate to erythromycin was determined as 83.8%, and it shows an inverse correlation with our resistance rate (11%) that we determined with the IST2 kit [17]. In other studies, conducted by Bayraktar et al. (2010) and Tüzemen et al. (2017) resistance rates against erythromycin are similar to our study with 22.2% and 14.36%, respectively [12, 22]. All these differences can be attributed to differences in the local use of antibiotics.

Recent studies support the use of commercially available kits for the diagnosis of *Ureaplasma spp*. The use of kits is preferred to determine the frequencies of *U. urealyticum* and *M. hominis* in urine and other biological samples as well as vaginal and endocervical fluid, and antibiotic susceptibility profiles, especially against tetracyclines and fluoroquinolones.

As a result, it was found that the detection rate of the culture method was superior to both kits and concluded that the detection rate of the IES kit was higher in both samples. The IES kit can be preferred over the IST2 kit, considering the high rate of detection, availability, and price. Our findings will be useful in terms of being guide on clinical studies to be conducted on *U. urealyticum*.

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AUTHOR CONTRIBUTIONS

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CONFLICT OF INTEREST

The authors declare that there is no real, potential, or perceived conflict of interest for this article.

ETHICS COMMITTEE APPROVAL

Ankara University Faculty of Medicine Clinical Research Ethics Committee. No: 12-500-13. 26.08.2013.

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