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ORIGINAL ARTICLE

# Prevalence and antimicrobial susceptibility of *Ureaplasma urealyticum* and *Mycoplasma hominis* in female outpatients, 2009–2013



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## KEYWORDS

antibiotic  
susceptibility;  
*Mycoplasma hominis*;  
*Ureaplasma urealyticum*

**Purpose:** The aim of this study was to estimate the prevalence and antimicrobial susceptibility of *Ureaplasma urealyticum* and *Mycoplasma hominis* among female outpatients treated for genital infection at a Chinese hospital from January 1, 2009 to December 31, 2013.

**Methods:** Samples from 6051 female outpatients were analyzed using *Mycoplasma* Identification and Antimicrobial Susceptibility Testing (ID/AST).

**Results:** The overall prevalence of *U. urealyticum* was higher than the prevalence of single *M. hominis* infection (31.2% vs 0.7%) and coinfections (31.2% vs. 1.9%). The percentage of *U. urealyticum* and/or *M. hominis* detected in the 30–39 year age group was greater than in the other age groups. More than 94.6% of the *U. urealyticum* isolates, 100% of the *M. hominis* isolates, and 84.3% of the isolates from coinfections were susceptible to doxycycline, minocycline, and tetracycline. More than 69.2% of the *U. urealyticum* isolates were susceptible to azithromycin, erythromycin, clarithromycin, and roxithromycin, but > 95.6% of the *M. hominis* isolates and 89.6% of the isolates from coinfections were resistant to these antibiotics. Acetylsparmycin, sparfloracin, levofloxacin, ciprofloxacin, and ofloxacin were inactive against more than one-half of the isolates. More than 75.6% of the *M. hominis* isolates were susceptible to spectinomycin, but > 87.1% of the *U. urealyticum* and 93.3% of the coinfection isolates were resistant to this antibiotic. Isolates from three coinfections were completely resistant to the 14 antibiotics.

**Conclusion:** The determination of antimicrobial susceptibility of these mycoplasma species is often crucial for optimal antimicrobial therapy of infected outpatients.

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## Introduction

Ample evidence from clinical studies using culture, serology, and polymerase chain reaction (PCR) assays in humans, and from experimental infection of laboratory animals indicates that *Ureaplasma urealyticum* and *Mycoplasma hominis* are etiologic agents of a variety of urogenital diseases in women. These diseases include urinary calculus formation, pyelonephritis, bacterial vaginosis, pelvic inflammatory disease, infertility, chorioamnionitis, spontaneous abortion, prematurity, intrauterine growth retardation, postpartum fever, and extragenital disease.<sup>1</sup> Antibiotic resistance among urogenital mycoplasmas develops via gene mutation or the acquisition of new genetic material. The prevalence of these pathogens and the results of surveillance of their antibiotic resistance profiles change in relation to the patient's country of origin. Testing should be performed for optimal antimicrobial therapy of infected patients, and to monitor the spread of resistant organisms.<sup>2-4</sup> Some related research studies have been performed in China. However, the resistance characteristics were different and may be related to local antibiotic use regulations. It is important to perform a detailed analysis on the characteristics of the area in which the resistant strains occur. The aim of this study was to estimate the prevalence of *U. urealyticum* and *M. hominis* infections and the antimicrobial susceptibilities of isolates of these bacteria. Analyses of patient age groups and some multidrug-resistant strains were also included.

## Materials and methods

Between January 1, 2009 and December 31, 2013, a total of 6051 specimens were examined by the Department of Clinical Laboratory at the Xiyuan Hospital, China Academy of Chinese Medical Sciences (Beijing, China). Consistent with the manufacturers' guidelines and standard laboratory protocols, all specimens were immediately transported to the laboratory without additional transport medium. They were then refrigerated and examined within 48 hours after collection. The microbiological principle used by *Mycoplasma* identification verification and antibiotic susceptibility testing kits was as follows: during growth, *U. urealyticum* and *M. hominis* metabolize urea and arginine, respectively, which changes the color of the culture medium (e.g., from yellow to red). Susceptibility results were obtained at two concentrations for 14 antibiotics: erythromycin, acetylspiramycin, josamycin, tetracycline, doxycycline, minocycline, roxithromycin, levofloxacin, ofloxacin, azithromycin, clarithromycin, sparfloxacin, ciprofloxacin, and spectinomycin. The three possible results were "susceptible", "intermediate", and "resistant". Bacterial growth was evaluated after a 2-day incubation period (at 37°C). The results were interpreted as follows: a negative result was clear and a color change of more than 10<sup>4</sup> units was evidence of infection. Clinical and Laboratory Standards Institute (CLSI) guidelines were used to categorize the results for bacterial susceptibility or resistance to antibiotics.<sup>2,5</sup> The breakpoints for the 14 antibiotics (mg/L) were: erythromycin,  $S \leq 1, R \geq 4$ ; acetylspiramycin,  $S \leq 1, R \geq 2$ ; josamycin,  $S \leq 2, R \geq 8$ ; tetracycline,  $S \leq 4, R \geq 8$ ;

doxycycline,  $S \leq 4, R \geq 8$ ; minocycline,  $S \leq 4, R \geq 8$ ; roxithromycin,  $S \leq 1, R \geq 4$ ; levofloxacin,  $S \leq 1, R \geq 4$ ; ofloxacin,  $S \leq 1, R \geq 4$ ; azithromycin,  $S \leq 0.12, R \geq 4$ ; clarithromycin,  $S \leq 1, R \geq 4$ ; sparfloxacin,  $S \leq 1, R \geq 4$ ; ciprofloxacin,  $S \leq 1, R \geq 2$ ; and spectinomycin,  $S \leq 4, R \geq 8$ . For all analyses,  $p < 0.05$  indicated statistical significance. Ethics Committee approval and informed patient consent were not required for this study.

## Results

The total positive rate of infection for the 6051 female outpatients was 33.9% (Table 1). The overall prevalence of *U. urealyticum* infection was greater than the prevalence of *M. hominis* infection (31.2% vs. 0.7%) and was greater than the prevalence of coinfection (31.2% vs. 1.9%).

The results for the distribution of *M. hominis* and *U. urealyticum*, according to age group, are presented in Table 1. During our study period, 49.7% of positive results occurred in the 30–39 year age group, which was significantly higher in comparison to the other age groups ( $p < 0.05$ ).

There was no resistance to any of the three tetracyclines (i.e., tetracycline, doxycycline, and minocycline) for any *M. hominis* isolate, and 91.1% of these isolates were susceptible to the macrolide josamycin. These four antibiotics were also effective against > 87.9% of the *U. urealyticum* isolates and 73% of the bacteria isolated from coinfections. More than 95.6% of the *M. hominis* isolates and 89.6% of the isolates from coinfections were resistant to four of the macrolide antibiotics (i.e., azithromycin, erythromycin, clarithromycin, roxithromycin), but > 69.2% of the *U. urealyticum* isolates were susceptible to these antibiotics.

More than 50% of the bacteria isolated from the study population were resistant to four of the quinolone antibiotics (i.e., sparfloxacin, levofloxacin, ciprofloxacin, and ofloxacin) and one of the macrolide antibiotics (i.e., acetylspiramycin). The bacteria isolated from three of the coinfections (i.e., *U. urealyticum* and *M. hominis*) were completely (100%) resistant to the 14 antibiotics.

## Discussion

Mycoplasmas are the smallest free-living microorganisms. They are commonly isolated from the genitourinary tract of symptomatic patients, but also from asymptomatic patients. The aim of this study was to evaluate differences in the prevalence and antibiotic resistance of *U. urealyticum* and *M. hominis*. Single infections with *U. urealyticum* were most prevalent (31.2%), followed by coinfections with *U. urealyticum* and *M. hominis* (1.9%) and single infections with *M. hominis* (0.7%). The infection rate was significantly higher in young women than in older women. This result is consistent with results reported in other studies.<sup>5-7</sup> Except for age and sex distribution of the outpatients, no other demographic or clinical characteristics were examined in this study. Other characteristics will be examined in a follow-up study.

Mycoplasmas are normally susceptible to antibiotics that inhibit protein synthesis, but are resistant to antibiotics that act on bacterial cell wall components because

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