**Ureaplasma Urealyticum and Mycoplasma Hominis In Systemic Lupus Erythematosus**

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**ABSTRACT**

**Background & Aim:** Mycoplasma hominis (MH) and Ureaplasma urealyticum (UU) have been implicated in the pathogenesis of different autoimmune diseases. The participation of these microorganisms in the etiology or the prognosis of systemic lupus erythematosus (SLE) in women has not been fully established. Thus, in the present study we evaluated the occurrence of MH and UU among women with SLE and compared it to the occurrence of these agents among healthy women.

**Methods:** by examining the urine of 50 SLE female patients and 20 healthy females as controls using both Urée-Arginine LYO2 (Bio Merieux, France) as screening test for detection of urogenital mycoplasma and mycoplasma IST2 test (Bio Merieux, France) for identification, indicative enumeration and antibiotic susceptibility testing of urogenital mycoplasma.

**Results:** Mycoplasma was detected by Urée-Arginine LYO2 broth in 38 (76%) of SLE patients and 2 (10%) of control women. While by IST2 test, mycoplasma was detected in 36 (72%) of SLE patients, of which 26 (52%) was detected in titer >10^4 which means true mycoplasma infection. Of these 26 mycoplasma infection, 22 (84.6%) were UU and 4 (15.4%) were MH. All positive mycoplasma cultures from urine samples of control subjects were detected in titer <10^4. There is significant relationship between mycoplasma infection and disease activity. However, the difference in age was of no statistical significant value in relation to the test results. Pristinamycin, doxycycline and tetracycline found to be highly active agents against both MH and UU. Among MH, the highest drug resistance rate was 100% to erythromycin, 100% to clarithromycin and 75% to both azithromycin and ciprofloxacin. While the highest drug resistance rates in UU were 86.4% to ciprofloxacin and 72.8% to ofloxacin.

**Conclusion:** Urogenital mycoplasma infection occur more frequently in patients of SLE than in normal controls. MH and UU were uniformly susceptible to doxycycline, tetracycline, and pristinamycin. Urée-Arginine LYO2 broth is suitable screening test for detection of urogenital mycoplasma while mycoplasma IST2 test is suitable when data about the type, the titer and the antimicrobial susceptibility pattern of mycoplasma infection is required.

**INTRODUCTION**

Systemic lupus erythematosus (SLE) is an autoimmune disease of connective tissue involving various organs and having a broad spectrum of clinical presentation, with periods of exacerbation and remission. The disease predominates among young women and its etiology is unknown, probably being multifactorial. Genetic, hormonal, immunological and environmental factors have been implicated in its etiopathy. Among the environmental factors, we may mention the participation of sunlight, of medications and of infections induced by viruses or other microorganisms.

*Mycoplasma hominis* (MH) and *Ureaplasma urealyticum* (UU) belong to the family *Mycoplasmataceae*, which is considered to include the smallest free-living microorganisms in nature. Their size is intermediate between bacteria and viruses. They differ from the former by the lack of a cell wall and from the latter by the fact that they grow in cell-free media.

The means by which mycoplasma cause human diseases are unknown. No toxins or virulence factors have been demonstrated. The organisms generally do not invade, but live attached to the exterior of the host cell membrane. The lack of a cell wall in microorganisms of the family *Mycoplasmataceae* permits their direct contact with host cells leading to the exchange of cellular elements/substances between these agents and the tissue involved, with the consequent triggering of autoimmune reactions. Their ability to induce activation of B and T lymphocytes and of cytokines, with the possible production of superantigens has been demonstrated in vitro.

In a study of patients suffering from SLE, *Ginsburg et al.* suggested a link between SLE and chronic colonization of the female genitourinary tract with UU.

Mycoplasma infection in patients with SLE has been reported, which suggest that genitourinary mycoplasma infections can become systemic. Chronic genitourinary
mycoplasma colonization could act as a persistent source of antigen stimulation. So it can predispose to development of autoimmunity in the host(1).

Culture of this group of nutritionally fastidious bacteria in the laboratory requires the use of complex growth media. For these reasons, routine culture for MH and UU is performed by relatively few laboratories, and antibiotic sensitivity testing of genital mycoplasmas is not carried out in routine laboratories. Therefore, various commercial media, which are more practical and faster for the isolation and evaluation of antibiotic susceptibility testing of these agents, were developed(5). Of the commercial kits, mycoplasma IST2 kits (Bio Merieux, France) that enables culture, identification, indicative enumeration and antibiotic susceptibility testing of MH and UU.

SUBJECTS, MATERIALS & METHODS

Subjects:
This study was conducted on 50 female patients with SLE and 20 apparently healthy females as a control group.

The patients were attending the outpatient or the inpatient clinic of Rheumatology & Rehabilitation Department of Benha University Hospital from February 2011 to January 2012. The patients should fulfilled the diagnostic criteria for SLE of the American College of Rheumatology(6). All patients were married and not receiving antibiotics in the last 3 weeks. Their ages ranged from 18 to 49 years with mean of 29.4 years ± 8.6 years. The patients' medical records were reviewed for features of SLE, current medications and the physician's assessment of disease activity.

The control group was healthy females, matched with patients as regards their age and not receiving any medications.

Materials:
From all cases and controls, early morning midstream urine samples were collected. The collected samples were examined for the presence of MH and UU in urine using 2 methods of cultivation, namely:

I. Urée -Arginine LYO2 broth (Bio Merieux, France): as screening test for detection of urogenital mycoplasma. The medium provides optimal growth of mycoplasma (pH, substrates and growth factors) and includes specific treatment substance (urea for UU and arginine for MH) and an indicator (phenol red) that allow in the case of positive cultures to display a color change in the stock, related to an increase in pH. The combination of three antibiotics and one antifungal agent provides selectivity, ensuring that any contaminating flora present in the specimen does not affect the test.

II. Mycoplasma IST2 kits (Bio Merieux, France): It enables culture, identification, indicative enumeration and antibiotic susceptibility testing of UU and MH. Mycoplasma IST2 combines a selective culture broth with a strip containing 22 tests. Cupules 1—3 provide informations about the presence or absence of MH and UU, cupules 4&5 estimate the titre of each organism (Threshold of 10^4 CFU), and cupules 6—22 show the antimicrobial susceptibilities to doxycycline, josamycin, ofloxacin, erythromycin, tetracycline, ciprofloxacin, azithromycin, clarithromycin, and pristinamycin. This kit allows pathogen identification within 48 hours (hs) and determines the amount of bacteria, thus making differentiation possible between colonization and infection (cell count above 10^4 is the evidence of infection).

Methods:
I- Urée -Arginine LYO2 broth:
Two hundreds (200) µL of the collected urine sample was placed in Mycoplasma R1 solution. After mixing, 3 ml of the inoculated Mycoplasma R1 solution was transferred to the vial of Mycoplasma R2. The mixture was shaken on a vortex to ensure that the lyophilization pellet is completely dissolved. The Urée -Arginine LYO 2 broth (Mycoplasma R1 +Mycoplasma R2) was incubated for 48 hs at 36 °C ± 2 °C. The change in colour of the Urée -Arginine LYO 2 broth can be detected after 24 hours and 48 hs of incubation.

II. Mycoplasma IST 2:
Mycoplasma R1 + R2 processed as in Urée - Arginine LYO 2 broth. From reconstituted R2 broth, 55 µL was dispensed into each of the 22 test wells on the strip. Two drops of mineral oil were added to each well. The remainder of the R2 medium and the inoculated strip were then incubated at 36 °C ±2 °C and observed for colour changes at 24 and 48 hs. Interpretation: Change in colour from yellow to red in Urée - Arginine LYO 2 broth indicates the presence of mycoplasma (M. hominis and/or U. urealyticum).
Table (1) the Interpretation of cultured mycoplasma IST2 Strip

<table>
<thead>
<tr>
<th>Identification</th>
<th>Enumeration</th>
<th>Susceptibility tests (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOT</td>
<td>JOS</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Positive reading</td>
<td>Orange to red</td>
<td>Red</td>
</tr>
<tr>
<td>Negative reading</td>
<td>Yellow</td>
<td>Yellow to orange</td>
</tr>
<tr>
<td>Interpretation of positivity</td>
<td>Presence of Uu and/or Mh</td>
<td>Uu $\geq 10^4$ UFC</td>
</tr>
</tbody>
</table>

RESULTS

Both culture methods used in this study gave nearly the same results as regards the detection of mycoplasma in patient and control groups. Mycoplasma was detected by Urée-Arginine broth in 38 (76%) out of 50 SLE patients and 2 (10%) out of 20 control women. While by IST2 test, mycoplasma was detected in 36 (72%) out of 50 SLE patients and 2 (10%) out of 20 control women.

Out of 36 positive mycoplasma cultures from urine samples of SLE patients detected by IST2 test, 10 (20%) were detected in titer $<10^4$ which indicates only colonization, while 26 (52%) were detected in titer $>10^4$ which indicates true infection. So a total of 26 SLE cases were considered as having infection with mycoplasma. All positive mycoplasma cultures from urine samples of control subjects were detected in titer $<10^4$. The result was highly significant as regard the difference of growth between patients and controls \((P<0.001)\) (Table 2).

Out of the 26 mycoplasma infected cases detected by IST2 test, 22 (84.6%) were \(Uu\) and 4 (15.4%) were \(Mh\). Mixed growth with both organisms was not be detected in this study (Table 2).

The mean age of patients with positive mycoplasma infection was 33.2, while that of patients with negative mycoplasma infection was 31.6 and the difference in age was of no statistical significant value in relation to the test results \((P>0.05)\) (Table 3).

As regard the disease activity, it was scored using modified SLE Disease Activity Index (SLEDAI)\(^7\), of the 32 SLE patients whose disease was in remission, 12 (37.5%) had positive cultures, and of the 18 SLE patients with active disease, 14 (77.8%) had positive cultures. These proportions were significantly different \((P=0.0062)\) (Table 3).

Antimicrobial susceptibilities determined by mycoplasma IST2 test are shown in (Table 4). All mycoplasma strains were susceptible to pristinamycin (100%). In addition, all \(Mh\) isolates were susceptible to doxycycline (100%). The majority of \(Uu\) isolates were susceptible to tetracycline and doxycycline (95.5% and 90.9% respectively). Among \(Mh\), the highest drug resistance rate was 100% to erythromycin, 100% to clarithromycin and 75% to both azithromycin and ciprofloxacin. While the highest drug resistance rates in \(Uu\) were 86.4% to ciprofloxacin and 72.8% to ofloxacin.

Table (2): Results of Urée arginine broth culture and IST2 test in the studied groups.

<table>
<thead>
<tr>
<th>IST2 test</th>
<th>SLE cases (50)</th>
<th>Control (20)</th>
<th>Total</th>
<th>(&gt;10^4)</th>
<th>(&lt;10^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urée arginine</td>
<td>IST2 test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>broth</td>
<td>Total</td>
<td>(Uu)</td>
<td>(MH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLE cases (50)</td>
<td>38 (76%)</td>
<td>36 (72%)</td>
<td>26 (52%)</td>
<td>10 (20%)</td>
<td></td>
</tr>
<tr>
<td>Control (20)</td>
<td>2 (10%)</td>
<td>2 (10%)</td>
<td>0 (0%)</td>
<td>2 (10%)</td>
<td></td>
</tr>
</tbody>
</table>
Table (3): IST2 test results in relation to age and disease activity in SLE cases.

<table>
<thead>
<tr>
<th>IST2 test</th>
<th>Mean age</th>
<th>Active (n=18)</th>
<th>Inactive (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ve test</td>
<td>33.2</td>
<td>14 (77.8%)</td>
<td>12 (37.5 %)</td>
</tr>
<tr>
<td>-ve test</td>
<td>31.6</td>
<td>4 (22.2%)</td>
<td>20 (62.5%)</td>
</tr>
</tbody>
</table>

Table (4): Antibiotic sensitivity by mycoplasma IST2.

<table>
<thead>
<tr>
<th>Mycoplasma</th>
<th>Ureaplasma urealyticum</th>
<th>Mycoplasma hominis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n.22</td>
<td>n.4</td>
</tr>
<tr>
<td>antibiotics</td>
<td>S</td>
<td>I</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>20 (90.9%)</td>
<td>2 (9.1%)</td>
</tr>
<tr>
<td>Josamycin</td>
<td>18 (81.8%)</td>
<td>4 (18.2%)</td>
</tr>
<tr>
<td>Ofloxacin</td>
<td>3 (13.6%)</td>
<td>3 (13.6%)</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>14 (63.6%)</td>
<td>4 (18.2%)</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>21 (95.5%)</td>
<td>1 (4.5%)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>2 (9.1%)</td>
<td>1 (4.5%)</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>15 (68.2%)</td>
<td>4 (18.2%)</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>17 (77.3%)</td>
<td>3 (13.6%)</td>
</tr>
<tr>
<td>Pristinamycin</td>
<td>22 (100%)</td>
<td>0 (0.0%)</td>
</tr>
</tbody>
</table>

The breakpoints (mg/L) according to CLSI 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

**DISCUSSION**

The present study showed that women with SLE have a higher frequency of genital infection with MH and UU (52%) compared to healthy women (0%). Ginsburg et al.\(^4\) found a significant difference in the isolation rate of UU in their patients with SLE (63%) and controls (4.5%). AlYcone et al.\(^1\) found that 52.5% of SLE patients and 11.8% of controls had UU.

On the other hand, Runge et al.\(^8\) found that the detection rates of UU in urine of patients with SLE and healthy individuals were almost identical (24.4% and 23.3% respectively) either by culture on A7agar or by PCR.

The increased frequency of infection with MH and UU among patients with SLE, reported in the present study, may suggest the participation of environmental factors in the pathogeny of SLE.

The role of environmental factors in the development of autoimmune disease has not been fully elucidated. In vitro studies have suggested that these mycoplasma species can provoke polyclonal activation of B cells and production of superantigens. Thus, it is possible that mycoplasma peptides may stimulate the production of auto-reactive clones, as observed in SLE\(^1\).

The presence of MH and UU in a large proportion of healthy women complicates the
assessment of the pathogenic role of these organisms. As it is very important to distinguish between mycoplasma colonization and true infection, quantitative criteria should be used to interpret cultures of urogenital mycoplasma and the decision to treat rests on the titer of mycoplasma in the specimen. Alcyone et al. reported that in samples collected from the lower genital tract, consideration should be given, particularly with the ureaplasma, to culturing tenfold dilutions of the specimen in an effort to distinguish the number (≥10^3 – 10^4/ml) of organisms likely to represent in an active infection from those of chronic low level carriage.

In the present study, Out of 36 (72%) positive mycoplasma cultures from urine samples of SLE patients detected by IST2 test, 10 (20%) were detected in titer <10^4 which indicates only colonization, while 26 (52%) were detected in titer ≥10^4. So a total of 26 SLE cases were considered as having infection with mycoplasma. All positive mycoplasma cultures from urine samples of control subjects were detected in titer <10^4.

Alison et al. in their study, found that of the 69 specimens in which MH was detected by mycoplasma IST2 test, MH was present at a titer of ≥10^4 in 24 specimens; 56 of the 82 specimens with UU had titers of ≥10^4. Also, in a study by Dalia and Manal, UU was detected by mycoplasma IST2 in 29 cases (58%), with only 12 cases (24%) having the organism in a count of ≥10^4. MH was detected by mycoplasma IST2 in 13 cases (26%), with only 2 cases (4%) having the organism in a count of ≥10^4 i.e. infection.

In a study by Alcyone et al., they showed that women with SL have a higher frequency of genital infection with MH and UU compared to healthy women. The difference in age between groups does not explain this fact, since the literature correlates young age with a higher frequency of infection. Since the lupus patients, on average, were older than the controls, they could expect a lower risk with respect to this variable. This result is in agreement with our result that show insignificant difference regarding the mean age of patients with positive and negative mycoplasma infection (33.2 and 31.6 respectively) (P>0.05).

In this work, there is significant relationship between mycoplasma infection and disease activity (P=0.0062) and this result come in disagreement with Ginsburg et al (4) and Alcyone et al (1) who found that the disease activity not accounted for any difference

In comparison of the two methods used for detection of mycoplasma in this study, they gave nearly the same results as regards the detection of mycoplasma in patient and control groups. They were easy to use, required no prior preparation of media, the reagents have a shelf life of up to 12 months and the results were available in 48hs whereas those from the broth-agar culture method required an additional 6 to 18 h. Mycoplasma IST2 kit in addition to determining the presence or absence of genital mycoplasma; it identifies the type of mycoplasma infection (either UU or MH), provides information on the density of colonization and provides the antimicrobial susceptibility pattern for the related infection.

The most appropriate system for use in the laboratory will depend upon the number and frequency of specimens to be tested, the need for rapid results, and information on antimicrobial susceptibilities. In laboratories where the detection of genitourinary mycoplasma is a part of a large study; Urea arginine broth s a suitable screening test. However, in laboratories where a small number of samples are received sporadically or when antibiotic susceptibilities are required (e.g. neonatal infection); mycoplasma IST2 kit can be used although it is more expensive than the Urea arginine broth.

Regarding antimicrobial susceptibility, pristinamycin (streptogramin group), doxycycline and tetracycline had potent activity against both MH and UU. The antimicrobial susceptibilities to macrolides, were different between the two species. MH strains are known to be intrinsically resistant to C14 macrolides (erythromycin, clarithromycin, and azithromycin) Kenny and Cartwright, which is fully in agreement with our results. MH was resistant to the three types of the macrolides tested, except josamycin. While those of UU are moderately susceptible. Ofloxacin and ciprofloxacin proved to be ineffective against the majority of strains of MH and UU, Our.

On the other hand, Cakan et al. in their study found that in total of 68 UU isolates from vaginal discharge all were sensitive to Ciprofloxacine, Ofloxacin and Azithromycin, 90% were sensitive to Erythromycin and 70% were sensitive to Clarithromycin.

Resistance to doxycycline and tetracycline has been reported for both MH and UU. High-level resistance to tetracyclines has been associated with the presence of the tet(M) determinant the sole tetracycline resistance mechanism acquired by clinical isolates of human mycoplasmas De'grange et al.,
Waites et al. (18) in their study, stated that tetracycline resistance occurs in 20-40% of isolates. These results are discordant with our results which found that doxycycline and tetracycline were highly active agents against these pathogens.

The quinolones have the advantage of exhibiting some cidal activity, and are also attractive choices for treating genitourinary tract Ureaplasma infections. However, the rate of resistance to fluoroquinolones (ofloxacin, ciprofloxacin) is showing an increasing rate in different studies. For example, Xie and Zhang (19) reported >50% resistance in a large number of strains isolated during 1999 and 2004 which is in agreement with our results. The explanation of this high resistance percentage to fluoroquinolones occurred in MH and UU strains isolated from human patients, may be the frequent prescription of these drugs by the general practitioners for the treatment of urinary and respiratory tract infections, pneumonia, otitis or prostatitis, due to their reduced price and low percent of side reactions Mares et al. (20).

The pattern of susceptibilities of mycoplasmas to antimicrobial agents is unique in that mycoplasmas do not have a cell wall that is the target for antibacterial agents like penicillin and cephalosporins. Tetracyclines, macrolides, and quinolones are the major antibiotics used in the treatment of urogenital infections caused by mycoplasmas. However, their therapeutic efficacy may be unpredictable due to increasing resistance. Mycoplasmas may be difficult to eradicate from human or animal hosts by antibiotic treatment because of resistance to the antibiotic, or because it lacks cidal activity, or because there is invasion of eukaryotic cells by some mycoplasmas Mehmet et al. (21).

The antimicrobial susceptibility of genital mycoplasmas has changed over time and is different by geographic area Kilic et al. (22). Results regarding the antimicrobial susceptibilities of genital mycoplasmas, originating from various countries, are very controversial. The discrepancies may be due to the different antimicrobial-use policies, which lead to the emergence of resistance to one or other antimicrobial group. Thus, it is very uncertain to establish common guidelines for the empirical treatment of genital mycoplasmal infections Kechagia et al. (23). The simplest way to avoid therapeutic failures would be the implementation of rational treatment regimens. This requires the in vitro determination of the antimicrobial susceptibility of the isolated genital mycoplasmas in each clinical case, which has now become a simple routine laboratory procedure, through the use of commercially available systems Eunha et al. (13).

CONCLUSIONS & RECOMMENDATIONS

Urogenital mycoplasma infection occurs more frequently in patients of SLE than in normal controls and thus mycoplasma infections may have a role in the etiology or in the prognosis of the disease. So we recommend that all patients with SLE should be investigated for urogenital mycoplasma and genitourinary mycoplasma colonizers should be followed up as it may predispose to autoimmune diseases like SLE. Continous study is needed to understand the correlation between SLE disease activity and mycoplasma infection. Ureê - Arginine LYO 2 is a suitable method for screening of mycoplasma while mycoplasma IST2 test is suitable when data about the type, the titer and the antimicrobial susceptibility pattern of mycoplasma infection is required. In vitro determination of the antimicrobial susceptibility of the urogenital mycoplasma in each clinical case is required to avoid therapeutic failures.

REFERENCES


20- Mareş Mihai; Năstăsă Valentin; Gabriela Anton; Bleotu Coralia ;Miron Nora and Socolov Demetra (2011): High prevalence of fluoroquinolones resistance in Ureaplasma and Mycoplasma strains isolated from infertile women under initial evaluation in north-east Romania. Romanian Biotechnological Letters Vol. 16, No. 1.

البلازما يوريلتكم والفيكوبلازم هومينيس في مرضى الذنبة الحمرة

النسبة الجغرافية والوظيفة
قسم الميكروبيولوجي والمناخ والروماتيزم والتأهل - كلية طب بنها

لقد أثبت دراسات عدة تورط ميكروب البلازما يوريلتكم والفيكوبلازم هومينيس في حدوث أمراض المناعة الذاتية وذلك كان الهدف من هذا البحث هو دراسة العلاقة بين هذين الميكربين ومرض الذنبة الحمرة وذلك عن طريق فحص البول الخاص بعد (0.5) سنة مسحية لمريض الذنبة الحمرة بالإضافة إلى (0.5) من السيدات الأسماح كمجموعة ضابطة للكشف عن وجود ميكروب البلازما يوريلتكم والفيكوبلازم هومينيس وذلك باستخدام اختبار بوريا أرجينين ليو200

كانت نتيجة البحث هو اكتشاف ميكروب الفيكوبلازم في عدد 26 (63%) من حالات البول المصابة بمرض الذنبة الحمرة كان منهم 22 (84.6%) يوريلتكم وال (15.4%) فيكوبلازم ، ولم يستطع على وجود هذين الميكربين في العينات الضابطة وقد أثبت البحث وجود علاقة إحصائية بين الإصابات بهذين الميكربين ونشاط مرض الذنبة الحمرة بينما لم يستطع على وجود علاقة إحصائية ذات داله بين وجود هذين الميكربين وأعمار المرضى ، وقد أثبت البحث أيضا وجود هسامية عالية لعقار البيستيميدين والتراسيليدين والدوكسيلوكين لكل فصائل الميكوبلازمما ، بينما كانت مقاومة الميكوبلازم هومينيس عالية علقاء للأربادوموسيين والأكلارثريوموسين والسيروفلوكساسين ، أما بالنسبة لميكروب البلازما يوريلتكم فقد كانت مقاومته عالية لعقار السيروفلوكساسين والأكلارثريوموسيين

وكانت خلاصة هذا البحث أن معدل الإصابة بفيكوبلازم يوريلتكم والفيكوبلازم هومينيس في مرضى الذنبة الحمرة أكثر منه في الأسماح، وأن المضادات الحيوية البيستيميدين والتراسيليدين والدوكسيلوكين له فاعلية عالية ضد هذين الميكربين، وأن اختبار بوريا أرجينين ليو 20 ماسب كاختبار مسحي، أما اختبار بوريا أرجينين أي تي 20 فله دور قيم في تشخيص وتحديد نوع ومكروبوميكلوبلازمومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومومة مترات حالات المرض ذات الحمالة المختلفة.