Prevalence of *Mycoplasma hominis* and *Ureaplasma urealyticum* (T strains) in Urine of Adolescents

HJORDIS FOY,* GEORGE KENNY, EVA BOR, SHERREL HAMMAR, AND ROBERT HICKMAN

Department of Epidemiology and International Health and the Department of Pathobiology, School of Public Health and Community Medicine, and the Adolescent Clinic, Child Development and Mental Retardation Center, University of Washington, Seattle, Washington 98195;* and the Children's Orthopedic Hospital Seattle, Washington 98105

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Adolescent children were surveyed for colonization with *Mycoplasma hominis* and *Ureaplasma urealyticum* by culturing urine specimens. Rates were compared between three study groups: (i) 397 children attending parochial schools, (ii) 293 children attending an adolescent clinic specializing in adjustment problems, and (iii) 86 children attending a renal clinic. The recovery rate was higher among postpubertal girls attending the renal clinic (33%) and the adolescent clinic (26%) than among students attending parochial high school (males 2%, females 8%). Girls had approximately eightfold higher rates than boys of the same age. Isolation of *Mycoplasmataceae* was associated with certain sociological determinants, such as dating, cigarette smoking, and coming from a broken home, but also with abnormal findings (protein, leucocytes) in urine.

Mycoplasma hominis and *Ureaplasma urealyticum* (formerly called T strains) (13, 18) are frequently found in the urine or genital tracts of adults. They usually are considered commensals, but their role in pelvic inflammatory disease, fever post-partum, septic abortion, and possibly reproductive failure and nonspecific urethritis has been controversial (13). This situation is beginning to clear; nonspecific urethritis appears to be clearly caused by chlamydiae and not mycoplasmata (7a). On the other hand, mycoplasmata have been found in the blood stream and internal genitalia after childbirth and abortion (11, 13). Rates of recovery of *M. hominis* and *U. urealyticum* are generally higher among women than men, and the rate of colonization has been directly related to sexual experience for both sexes (12, 14).

Both organisms can be isolated from newborn infants (5, 10). We have previously shown that *M. hominis* and *U. urealyticum* can be acquired at birth without any apparent ill effects (5). Girls appeared to be more prone to acquisition than boys, and kept the organisms for a longer time. The organisms were most frequently found in the vulva, but also in throat, eye, and the umbilicus. The rate of recovery declined sharply after 3 months and the organisms were not recovered after the age of 2 years.

The prevalence of genital *Mycoplasmataceae* (includes T strains) in childhood and adolescence is not well known. In a report from England (4), these organisms were not found in the urine of 44 girls 13-18 years of age, whereas in

Sweden (16), *U. urealyticum* was isolated from 8% of prepubertal girls.

The present study was aimed at determining the prevalence of colonization with genital *Mycoplasmataceae* by age during adolescence. Obtaining genital specimens was not considered feasible or ethical. As an alternative, urine specimens were utilized. Specimens were collected from: (i) presumably healthy high school adolescents, (ii) children attending an adolescent clinic specializing in teenage problems, and (iii) a clinic specializing in disease of the renal tract.

MATERIALS AND METHODS

Population groups: school children. Urine specimens were solicited from children of five parochial high schools in Seattle. Participating children (397) ranged between 14 and 18 years of age. Approximately half of the boys and one-third of the girls enrolled in the schools donated urine specimens.

Adolescent clinic. The Adolescent Clinic of the Child Development and Mental Retardation Center of the University of Washington provides consultation and treatment primarily for teenagers with various adjustment problems, mental retardation, and obesity. Urine specimens were routinely collected from 155 boys (age 11 to 18) and 138 girls (age 10 to 19) and cultured for *Mycoplasmataceae*.

Renal clinic. The Renal Clinic of Children's Orthopedic Hospital of Seattle provides care for children primarily with renal disease, especially glomerulonephritis and nephrotic syndromes, and also those with malformation of the urogenital tract. The age of the clientele in this clinic was on the average younger than of the two population groups mentioned above. Urine specimens were obtained from 85 children.

Laboratory methods. Voided urine specimens were collected without any preparation of the genital area and before any instrumentation (renal clinic), and were stored frozen at -70°C . Specimens were subsequently inoculated into soy peptone medium (pH 6.0 and 7.4) as described in detail elsewhere (6, 9). Organisms identified as *M. hominis* were typed with specific antiserum by the disc method of Clyde (3). Organisms identified as *U. urealyticum* were transferable entities which produced ammonia from urea and formed typical small colonies.

RESULTS

The recovery rate of *Mycoplasmataceae* from urine specimens was only 2% in males and 8% in females among students attending parochial high schools, compared to rates of 4% for males and 26% for females 13 years and older attending the adolescent clinic (Table 1). The overall isolation rate from girls 13 years and older attending the renal clinic was highest (33%), but the difference was not statistically significant from the one obtained in the adolescent clinic.

When the isolation rate was compared by age, it was observed that in each age group, *Mycoplasmataceae* were isolated more frequently from girls attending the renal clinic than the adolescent clinic (Table 2). The 10 girls under the age of 13 in the adolescent clinic were negative. Thereafter, the isolation rate increased stepwise by each year of additional age from 10% among the 13-year-old girls to 34% of those 16 to 19 years old. In the renal clinic, 3 of 27 girls under the age of 13 were positive, two for *M. hominis*, and one for *M. salivarium*. Three (21%) of 14 girls 13 to 15 years of age and three of four girls (75%) over the age of 15 had positive urine cultures. On the other hand, all 41 boys attending the renal clinic, the majority

of whom were prepubertal age, were negative.

The exact age was not given on all the students attending the parochial high schools, despite our request, but the majority were between 14 and 18 years of age.

Information on history of diseases of bladder and kidney was requested from children attending the parochial schools. Only one boy gave history of repeated bladder infections. He was one of two boys carrying *M. hominis* in the urine. Three girls with similar histories were free of *Mycoplasma*.

Information of sociological data was available in the adolescent clinic only; urine analysis was performed routinely (Table 3). A higher proportion of girls with *Mycoplasmataceae* in the urine dated the opposite sex ($P < 0.01$), smoked cigarettes, and came from broken homes. The first difference was the most striking. Four (57%) or seven girls who dated but denied smoking were colonized, versus three (20%) of 15 girls who smoked but denied dating. Girls with *Mycoplasma* in the urine more frequently had abnormal urinalysis (32%) than those without (9%). The most frequently recorded abnormality consisted of large amounts of leucocytes and bacteria.

Children attending the renal clinic had diagnoses of glomerulonephritis of various classifications, nephrotic syndrome, benign hematuria, and uropathy with infection. The diagnoses of children in the renal clinic with and without *Mycoplasmataceae* were similar. The three youngest girls, ages 7, 8, and 10, from whom *Mycoplasmataceae* (two cases with *M. hominis* and one case, age 7, with *M. salivarium*) were recovered all had benign recurrent hematuria. The two cases with *M. hominis* were sisters

TABLE 1. Prevalence of *Mycoplasmataceae* in urine by study group, sex, and two age groups (pre- and post-puberty)

Study groups by sex	Under age 13			Age 13 and over			
	Total specimens	<i>U. urealyticum</i>	<i>M. hominis</i>	Total specimens	<i>U. urealyticum</i>	Pos. <i>M. hominis</i>	Pos. both <i>U. urealyticum</i> and <i>M. hominis</i>
Males							
Parochial schools	0	0	0	247	2	1	1
Adolescent clinic	30	0	0	125	2	3	0
Renal clinic	32	0	0	9	0	0	0
Females							
Parochial schools	0	0	0	150	8	4	0
Adolescent clinic	10	0	0	128	20	8	5
Renal clinic	27 ^a	0	2 ^b	18	3	2	1

^a Not included is an isolation of *M. salivarium*.

^b Ages 8 and 10, sisters.

TABLE 2. Prevalence of *Mycoplasmataceae* in urine according to age and sex in the adolescent clinic and for girls in the renal clinic

Adolescent clinic	Age group							Total
	9-12	13	14	15	16	17	18-19	
Males								
<i>U. urealyticum</i>	0	0	0	0	0	2	0	2
<i>M. hominis</i>	0	0	0	0	1	1	1	3
Total specimens	30	31	28	21	19	24	2	155
Isolation rate (percentage)	0	0	0	0	5.2	12.5	50.0	3.2
Females								
<i>U. urealyticum</i>	0	0	3	7	6	3	1	20
<i>M. hominis</i>	0	1	1	0	4	2	0	8
<i>U. urealyticum</i> and <i>M. hominis</i>	0	1	0	1	0	2	1	5
Total specimens	10	20	21	32	29	20	6	138
Isolation rate (percentage)	0	10.0	19.0	25.0	34.5	35.0	33.0	23.9
Renal clinic								
Females								
<i>U. urealyticum</i>	0	1	0	0	1	1	0	3
<i>M. hominis</i>	2	0	1	0	0	0	1	4
<i>U. urealyticum</i> and <i>M. hominis</i>	0	1	0	0	0	0	0	1
Total specimens	27 ^a	8	4	2	1	2	1	45
Isolation rate (%)	7.4	25.0	25.0	0	100.0	50.0	100.0	17.8

^a Not included is an isolation of *M. salivarium*.

TABLE 3. Characteristics (%) of girls attending the adolescent clinic with and without *Mycoplasmataceae* in urine specimen

Result of culture for <i>Mycoplasmataceae</i>	Total cases	Percentage with characteristic				
		Abnormal urin-analysis	Enuresis	Cigarette smoker	Broken home	Dating
With <i>Mycoplasmataceae</i>	33	32	16	69	70	72
Without <i>Mycoplasmataceae</i>	105	9	17	33	43	19

whose brother had a negative urine specimen. The diagnoses of the remaining girls with *Mycoplasmataceae* in the urine was glomerulonephritis (three cases), familial nephritis, renal insufficiency, and hydrocephalus with pyelonephritis.

DISCUSSION

It is generally agreed that mycoplasmas can be isolated more frequently from the urogenital tract of persons who are sexually active than of those who are not. The significance of this relationship is obscure, particularly since 60 to 70% of normal women carry *U. urealyticum* (13). The present study suggests again that sexual activities correlate with the isolation of the organisms. However, the relatively high isolation rate obtained in females, compared with the low rate obtained in males, in this study as well as in other studies (13), is paradoxical, and could not easily be explained by difference in sexual activity between the sexes. An alterna-

tive explanation is that sexual maturation and changed vaginal flora associated with sexual activity enhance the growth potentials for mycoplasmas, which then become easier to isolate. Genital mycoplasma are known to prefer acid environment, which is present in the mature vagina (18). It is conceivable that in some cases the organisms are dormant since birth, but are not isolated until the proper conditions for sufficient multiplication and growth occur. Thus, several other microparasites are more easily isolated from genitalia of the female than the male, such as lactobacilli, *Candida albicans*, and *Trichomonas vaginalis*. The isolation of *Mycoplasmataceae* from young children with renal disease and in adolescents with pathological findings in urine suggest strongly that factors other than sexual activity are involved as well.

The low rate among children attending parochial schools may be an artifact. The children were openly suspicious of the survey and a

certain amount of self-selection may have taken place in the participation.

Isolation of the organisms in children before puberty was rare, and the isolation rate increased with increasing age, especially for girls. The organisms were present in the urine of girls at an earlier age than in boys, which may reflect the earlier sexual maturation in girls. Whether the organisms were dormant in the girls since birth or whether they had been acquired by other routes is open for speculation. The data in Table 3 would suggest that girls who had adopted a more advanced life style, as exemplified by dating and smoking, were more likely to have *Mycoplasmataceae* in the urine. Many patients were referred to the adolescent clinic for behavior problems, including sexual experimentation. This suggests that in at least a proportion of cases, the organisms were acquired through sexual contact.

In the present study we chose to survey the prevalence of genital mycoplasma by culturing urine specimens, a method shown to be acceptable for epidemiological purposes, in both women (1) and men (8, 19). However, in a study comparing the isolation rates by various sources (cervix, vagina, and urine), collection of urine gave slightly lower rates than culture from the genital tract, especially for *U. urealyticum* (2). The source of *Mycoplasmataceae* in the urine can be assumed to be the lower urethra, or contamination from the perineal area during urination. The high rates of isolation obtained in postpubertal girls attending the renal clinic or in adolescent girls having abnormal findings in the urinalysis (Table 3) suggests that the urinary tract may occasionally become invaded with *Mycoplasmataceae*.

The seemingly higher rate of *Mycoplasmataceae* in the urine of postpubertal girls attending the renal clinic is not easily explainable and needs confirmation. Most of these children had diagnoses similar to those of the younger children attending the clinic (glomerulonephritis or nephritis), and in many cases the older children's disease was clearly in remission. Boys of similar age and diagnoses did not carry *Mycoplasmataceae* and thus such organisms could not conceivably be etiologically related to the renal disease. On the other hand, it is possible that the presence of albumin and erythrocytes in the urine of patients with renal disease may favor the growth and persistence of these organisms. *Mycoplasmataceae* have been recovered by suprapubic puncture in patients with bladder disease (15, 20), and inoculation of *U. urealyticum* to the renal system of rats has led to stone formation in the bladder (7).

More sophisticated clinical studies would be

necessary to determine the role of *Mycoplasmataceae*, if any, in disease of the renal system of humans, including adolescents.

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