SHORT COMMUNICATION

Trichomonas vaginalis is Rare Among Women in Iceland

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Accepted Jul 5, 2017; Epub ahead of print Jul 6, 2017

Trichomonas vaginalis causes vaginitis in women, urethritis in both sexes and is associated with significant complications, including preterm delivery, low birth-weight and increased risk of HIV infection (1). Microscopical detection of *T. vaginalis* in wet-mount preparations of genital fluids may miss up to half of infections, and culture has a highly suboptimal sensitivity compared with modern molecular diagnostic tests (1). Thus, nucleic acid amplification tests (NAATs), with a sensitivity and specificity of 95–100% (1), have revolutionized the diagnosis of trichomoniasis and are providing new insights into the epidemiology of the disease. Recent NAAT-based studies on women attending sexually transmitted diseases (STD) clinics have shown unexpectedly high prevalence rates (14.6–27%) of trichomoniasis in the USA (2, 3). In contrast, the prevalence in Western European countries and Australia appears to be substantially lower, i.e. 0.6–3.6% (4, 5). The prevalence of *T. vaginalis* infection in the Nordic countries in Northern Europe is largely unknown, with the exception of a single NAAT-based study in Sweden, where 1,121 consecutive STD clinic attendees in Örebro demonstrated prevalence rates of 0.16% in women and 0% in men, using the APTIMA TV Assay (6). The aim of the present study was to examine the prevalence of *T. vaginalis* infection and selected STDs among consecutive Icelandic women attending an STD clinic and a cervical cancer screening programme.

MATERIALS AND METHODS

From 1 February to 16 March 2016, consecutive women were recruited from the Department of Sexually Transmitted Diseases at Landspítali University Hospital (the only STD clinic in Iceland) and the Icelandic Cancer Society, both located in the capital area of Reykjavík, whose population is approximately 214,000 individuals. All consecutive women who were 18 years of age or older at the STD clinic and between 35 and 64 years of age at the Cancer Society were invited to participate, and those who accepted provided written informed consent. Information about age distribution was available for STD clinic attendees only. The STD clinic collected urine specimens in the APTIMA Urine Specimen Transport Tubes (Hologic) from all participants for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* APTIMA NAAT on the Tigris instrument (Hologic). High vaginal swabs were also collected from women with genitourinary symptoms (e.g. abnormal vaginal discharge, vulvovaginal itch or burning, dyspareunia, or dysuria), for bacterial vaginosis test and yeast culture that were done by Nugent's Gram stain method (7) and 5-day culture on Sabouraud dextrose agar with chloramphenicol. White, creamy and restricted colonies composed of non-arthroconidial yeast cells were presumptively identified as *Candida* species. The Cancer Society collected cervical smears into PreservCyt Solution liquid Pap (Cytic Corporation, Marlborough, MA, USA) and 1 ml of the liquid was subsequently transferred into the APTIMA Specimen Transfer Kit (Hologic). Due to lack of appropriate ethical approval, women recruited at the Cancer Society could not be tested for infections other than trichomoniasis. Urine specimens, after *C. trachomatis* and *N. gonorrhoeae* testing, and cervical smear liquids were stored at –80°C for 4 months prior to testing for *T. vaginalis*, which was done by the use of APTIMA TV Assay on the Panther instrument (Hologic). The study was approved by the National Bioethics Committee (permission no. 14-161).

RESULTS

A total of 431 women were included in the study. The 231 STD clinic attendees had a median age of 22 years (interquartile range (IQR) 22–26 years; range 18–56 years); 23 and 13 women were ≥35 years and ≥40 years of age, respectively. The 200 women recruited at the Cancer Society had an age ranging from 35 to 64 years. All 431 participants were negative for *T. vaginalis*. *C. trachomatis* was detected in 37 (16%) of the STD clinic attendees and *N. gonorrhoeae* in none. Eighty-three (36%) of the women from the STD clinic were symptomatic and among these 18 (22%) had *C. trachomatis*, 28 (34%) had bacterial vaginosis and 15 (18%) had positive *Candida* culture. *C. trachomatis* was associated with bacterial vaginosis in 7 cases and with *Candida* in 6 cases.

DISCUSSION

This study, in the Northern European country Iceland, evaluated the prevalence of trichomoniasis in a population at risk for STDs and in women at the age of 35 years and older who, in many studies, have had higher rates of *T. vaginalis* infection than younger women (3, 8). No case of trichomoniasis was detected. In contrast, the prevalence of *C. trachomatis* in the STD attendees was 16%, which is higher than the rates of 3.8–8.6% reported from studies at STD clinics in Western and Northern Europe, the USA and Australia, where women were tested for both *T. vaginalis* and *C. trachomatis* (2, 4, 6, 9). This is not surprising, as the prevalence of diagnosed *C. trachomatis* infections in Iceland for the past 20 years has been among the highest in Europe, or up to 739 cases per 100,000 population (http://www.landlaeknir.is/english/statistics/diseases/). Although this

doi: 10.2340/00015555-2747
Acta Derm Venereol 2017; 97: 1258–1260

high chlamydial prevalence is believed to be largely explained by widespread testing, it may also be an indicator of unprotected sex and liberal attitudes towards sexual activity; the mean age of first sexual intercourse is among the lowest in Europe, i.e. approximately 15 years (10). Such an environment should facilitate transmission of an STD, such as trichomoniasis, that is frequently asymptomatic in both sexes and long-lasting in women (11). One plausible explanation for the rarity of trichomoniasis in Iceland is the exposure to metronidazole. *T. vaginalis* was a common finding in laboratories in Iceland 3–4 decades ago, and coincidental detection of the organism in urine specimens and in Pap smears, following the implementation of a nationwide screening programme in the 1960s, would have prompted metronidazole therapy. In addition, metronidazole has long been used for suspected bacterial vaginosis, whose symptoms may resemble trichomoniasis. A recent report from Australia described a high prevalence (20–30%) of trichomoniasis among women in the 1950s. After the introduction of metronidazole, in the 1960s, the prevalence declined steadily over the following 20 years and was below 1% in 1990 (12).

Studies indicate that access to healthcare affects the prevalence of trichomoniasis. While the prevalence has been estimated at only 5.8% in Europe, in contrast to 22% and 20.2% in the Americas and Africa, respectively (11), recent NAAT studies reveal socioeconomic and racial disparities within well-resourced countries. Thus, although prevalence is low, i.e. 0.016–3.6%, among women who attend STD clinics or physicians' offices in Northern and Western Europe and Australia (4–6, 9), a study at an English sexual health clinic revealed a significantly higher prevalence of trichomoniasis in black Caribbean women compared with white women, which may be partly explained by disparities in access to healthcare (5). Similarly, trichomoniasis was detected in 29.1% of black women attending an STD clinic in the USA, where access to healthcare is not universal (3). Risk analyses have indeed demonstrated significant association of trichomoniasis with factors such as ethnicity (black race), lower educational level and poverty (3, 8).

However, the persistence of high rates of *C. trachomatis* infections in Iceland and other countries that provide universal access to healthcare, contrasts with the decline in trichomoniasis. The reasons for this are probably multifactorial and can only be hypothesized. For example, both specific and fortuitous detection of *T. vaginalis* in a number of tests have contributed to management of trichomoniasis before diagnosis of *C. trachomatis* infections, via culture and subsequently non-culture methods (13), became widely implemented. Before the highly sensitive NAATs were available, many *C. trachomatis* cases were also missed. Furthermore, most women in industrialized countries become sexually active in their late teens (10) when susceptibility to *C. trachomatis* infections is higher than in older women (13). This, together with the high number of sexual contacts, including new contacts, and repeat infections after treatment, contributes to persistence of infection in the young population. In addition, *C. trachomatis* infections are more likely than trichomoniasis to be asymptomatic in women (8, 13). These asymptomatic infections can be detected mainly through screening or contact notification. However, the uptake of screening might not have been sufficiently high for long enough, and in most settings the contact notification is suboptimal. As suggested recently, autoinoculation in women of cervical *C. trachomatis* infection from the rectal site might also contribute to repeated detection of *C. trachomatis* in urogenital samples (14). In addition, whereas metronidazole therapy cures undiagnosed trichomoniasis when used for the most frequent vaginal disorder, bacterial vaginosis, no such benefits are associated with doxycycline, whose sole indication in female genital infections is *C. trachomatis*.

There were a few limitations to our study. First, the *T. vaginalis* NAAT was performed 4 months after specimen collection, and unpublished experiments have shown that some proportion of positive specimens might become negative after 4 months despite storage at –80°C (15). Secondly, vaginal swabs are considered the optimal specimens for detection of *T. vaginalis* in women. Thus, it cannot be excluded that the urine specimens, as well as cervical smears collected in PreservCyt Solution liquid Pap, had a slightly lower sensitivity for *T. vaginalis* detection. However, both urine specimens and liquid cytology specimens are considered acceptable specimens for *T. vaginalis* detection using NAAT (1).

ACKNOWLEDGEMENTS

This work was supported by grants from Landspítali University Hospital, the Örebro County Council Research Committee and the Foundation for Medical Research at Örebro University Hospital, Örebro, Sweden.

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