MAJOR ARTICLE

Trichomoniasis in Men and HIV Infection: Data from 2 Outpatient Clinics at Lilongwe Central Hospital, Malawi

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Background. Little is known about the epidemiologic profile of trichomoniasis in men and its relationship to human immunodeficiency virus (HIV) infection. Among men presenting for care for symptomatic sexually transmitted infections (STIs) in Malawi, trichomoniasis is not considered for first-line treatment.

Methods. We conducted a cross-sectional survey of 1187 men attending either a dermatology or STI outpatient clinic in the capital of Malawi. Men were interviewed, and the etiologies of the STIs were determined.

Results. At the STI clinic ($n = 756$ men), we identified 150 men (20%) with *Trichomonas vaginalis* infection, 358 men (47%) with HIV infection, and 335 men (44%) with *Neisseria gonorrhoeae* infection. At the dermatology clinic ($n = 431$ men), we identified 54 (13%), 118 (27%), and 2 (0.5%) men, respectively. At both clinics, a lower education level and reporting never having used a condom were predictive of *T. vaginalis* infection. Only at the dermatology clinic was older age associated with infection, and only at the STI clinic were marital, genital ulcer disease, and HIV-infection status associated with *T. vaginalis* infection. At the STI clinic, urethral symptoms attributable to trichomoniasis were more severe among HIV-positive men than among HIV-negative men.

Conclusions. Given its high prevalence and the increased risk for HIV transmission, *T. vaginalis* infection should be reconsidered for inclusion in the Malawi STI-treatment regimen for men.

Trichomonas vaginalis infection is the most common nonviral sexually transmitted infection (STI) worldwide and is highly prevalent in sub-Saharan Africa [1], where it has been implicated as a cofactor for HIV transmission [2]. Although *T. vaginalis* is recognized as a common cause of morbidity in women, its role in the pathogenicity of STIs in men is often ignored. Only recently have an increased number of studies begun to consider trichomoniasis in men [3–6]. Because it is a cofactor for HIV transmission, trichomoniasis in men is attracting increased attention as a target for controlling the spread of HIV [7, 8]; however, there remains a paucity of data on the epidemiologic profile of trichomoniasis in men and its relationship to HIV infection. Without this information, effective understanding, management, and control of *T. vaginalis* will remain problematic.

T. vaginalis is responsible for significant morbidity in both men and women. In men, it is associated with urethritis, epididymitis, and prostatitis [9]; yet infection with this organism can also be mild and persist for months [6]. HIV-positive men with trichomonal urethritis have been shown to have elevated levels of HIV RNA in their semen [5], and many trichomonad-infected men without overt signs of urethritis have subclinical urethral inflammation [5, 6]. Studies conducted in African populations have demonstrated that this infection is associated with older age in men [10], and, although infections can be self-limiting, some may persist for up to a year [6]. This long-term-carrier state, with its associated low levels of inflammation, may result in both a failure to seek treatment and an increase

Received 9 March 2004; accepted 22 April 2004; electronically published 13 September 2004.

Presented in part: Malawian National Health Research Dissemination Conference, Lilongwe, Malawi, 27–28 January 2003 (oral presentation NHRDC53).

Financial support: University of North Carolina (UNC) Fogarty Center (grant D43-TW01039); National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health (grant R01-DK49381); UNC HIV Prevention Treatment Network (grant U01-AI48005); UNC STD Cooperative Research Center (grant U19-AI31496).

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The Journal of Infectious Diseases 2004; 190:1448–55

0022-1899/2004/19008-0011$15.00

in the duration of elevated infectiousness—and perhaps not just for trichomoniasis, but possibly also for HIV infection [11–13].

In most sub-Saharan African countries, men who seek therapy for trichomonad-induced urethritis do not routinely receive appropriate treatment. A review of sexually transmitted disease management programs found that only 1 of the 12 African nations surveyed treated men attending STI clinics for infection with *T. vaginalis* [14], despite the growing evidence incriminating this pathogen as a common cause of urethritis in men across Africa [3–5]. In contrast, all 12 of the African nations considered provided their female clients with treatment with metronidazole, an inexpensive drug that effectively clears infection in both men and women [15].

Here we consider the epidemiologic profile and predictors of *T. vaginalis* infection in men and their relationship to HIV infection in 2 semiurban, hospital-based populations in Malawi, Africa. We outline the prevalence of *T. vaginalis* infection in men attending these 2 clinics, and we examine the signs and symptoms of trichomonal infection in men.

PATIENTS, MATERIALS, AND METHODS

We conducted a cross-sectional study at Lilongwe Central Hospital in Lilongwe, Malawi. Consecutive male attendees at the STI clinic ⩾18 years old with either syndromic urethritis, genital ulcer disease (GUD), or both were recruited, as were men presenting to the dermatology clinic without an STI. Informed consent was obtained from all participating patients, and the human-experimentation guidelines of the University of North Carolina at Chapel Hill School of Medicine Review Board and the Malawian National Health Sciences Research Committee were followed. The institutional review boards in Malawi and of the University of North Carolina at Chapel Hill approved the present study.

This study was conducted in the context of work designed to improve syndromic management of urethritis in men [16]. In brief, we assessed the chief complaint, demographic factors, and recent sexual history. Each man underwent a brief physical examination, and specimens were collected for determination of the etiologies of STIs. Treatment was administered per the Malawian National Syndromic Guidelines. A dermatology clinician managed dermatologic complaints per the standard of care.

Two *T. vaginalis* cultures (BioMed Diagnostics) were performed for each patient: 1 with first-catch urine, and 1 with a urethral-swab specimen. Urine specimens were also centrifuged and prepared for detection of *T. vaginalis* by polymerase chain reaction (PCR) [17]. A patient was considered to be infected with *T. vaginalis* on the basis of a positive result by either culture or PCR. Urethral swab specimens were Gram stained and were read, to quantify the number of white blood cells (WBCs) per high-power field and to detect the presence of gram-negative intracellular diplococci (GNID). Urine specimens were also prepared for detection of *Neisseria gonorrhoeae* by PCR (Amplicor CT/NG; Roche Applied Science). A patient was considered to be infected with *N. gonorrhoeae* on the basis of the detection of either GNID or genetic material by PCR. Ligase chain reaction (Abbott LCx) was used to detect *Chlamydia trachomatis* in a subset of men presenting with urethritis. HIV was detected by rapid test (Capillus HIV; Cambridge Diagnostics), followed by confirmation of the positive specimens by EIA (Genetics Systems HIV-1 peptide EIA; BioRad). Syphilis serologic status was determined on the basis of a positive rapid plasma reagin (RPR) assay (Becton Dickinson).

Syndromic urethritis was defined, per the Malawian Ministry of Health Guidelines, as complaint of urethral discharge and/or dysuria and sex within the past 2 weeks. Gram stain–confirmed urethritis was defined as the detection of ⩾4 WBCs/high-power field. Subclinical urethritis was defined as the presence of Gram stain–confirmed urethritis in the absence of symptomatic urethritis.

Data analysis was conducted by use of SAS (version 8.02) and STATA (version 7.0) software. Initial bivariate distributions were compared across trichomoniasis status by use of either the χ^2 test, Fisher's exact test, or the Wilcoxon rank sum test, as appropriate. Each clinic was considered separately. Effect measure modification (EMM) between *T. vaginalis*–infection status and STI symptoms across HIV-infection status were considered among STI-clinic attendees presenting with syndromic urethritis. EMM was evaluated by use of the Breslow-Day test for homogeneity of the odds ratios (ORs), where $P < .2$ is suggestive of the presence of EMM [18].

Multivariate analysis was conducted to explore independent associations between variables and *T. vaginalis* infection. Variables considered for modeling included those with bivariate $P < .2$ and those selected a priori (age, HIV-infection status, and gonorrhea status). Variables were excluded if they were seen as resulting from *T. vaginalis* infection, such as urethral inflammation and discharge. Modeling was done by use of backward-elimination logistic regression. Variables remained in the model if they had $P < .1$ or if they confounded the ORs of a predictor of *T. vaginalis* infection (as indicated by a change of >20% in the OR after the removal of the suspected confounding variable). Results are reported as adjusted ORs (AORs) for prevalence, with 95% confidence intervals (CIs) and *P* values.

RESULTS

Study population. A total of 1187 men were enrolled at the STI ($n = 756$) and dermatology ($n = 431$) clinics over the course of 12 months, beginning in late January 2000. The mean age of the study population was 26.0 years (SD, 6.0 years; range, 18.0–63.0 years). The men at the dermatology clinic were older than their counterparts at the STI clinic, but this age difference was modest (26.5 vs. 25.2 years [$P < .001$]). Levels of education

were similar at both clinics, with 59% of all attendees having less than a secondary school education. More men at the STI clinic were married (343/756 men [45%]), compared with the men at the dermatology clinic (162/431 men [38%]) ($P = .009$).

Clear differences in sexual behavior during the 4 weeks preceding enrollment were evident between the men at the 2 clinics. The men at the STI clinic reported a greater number of partners (mean, 1.32 partners; range, 0–30 partners) than did their counterparts at the dermatology clinic (mean, 0.64 partners; range, 0–4 partners) ($P < .001$) and were more likely to report that they had used a condom (516/755 men [68%] vs. 230/425 men [54%] [$P < .001$]). Although the men at the STI clinic were as likely as the men at the dermatology clinic to report having had sex with their spouse during the 4 weeks preceding enrollment, reports of sexual activity with a girlfriend were more common among the men at the STI clinic (366/754 [49%] vs. 94/423 [22%] [$P < .001$]), and reports of sexual activity with commercial sex workers and strangers (new partners previously unknown to patients, with no financial or material transactions) were nearly 4 times as frequent among the men at the STI clinic than among the men at the dermatology clinic (260/754 men [34%] vs. 39/423 men [9%] [$P < .001$]).

Prevalence of STIs. *T. vaginalis* infection was common at both clinics: 54 asymptomatic infections (13%) were detected at the dermatology clinic, and 150 asymptomatic infections (20%) were detected at the STI clinic (table 1). HIV infection was also common: 118 infections (27%) were detected at the dermatology clinic, and 358 infections (47%) were detected at the STI clinic. *T. vaginalis* prevalence tended to increase with age among the men at the dermatology clinic but not among the men at the STI clinic, whereas HIV prevalence increased with age among the men at both clinics. At the STI clinic, HIV infection was more common among the men presenting with GUD than among the men presenting without GUD (243/445 men [55%] vs. 115/311 men [37%] [$P < .001$]). Gonorrhea, mostly with urethritis, was common among the men at the STI clinic (335/756 men [44%]). Very few patients ($n = 2$; 0.5%) with asymptomatic gonorrhea were identified at the dermatology clinic. Chlamydia was uncommon; only 2 positive patients (0.5%) were identified in a subset of 365 men tested. Both of these men were attending the STI clinic and also had gonorrhea. Finally, 18 men (4%) had a positive RPR assay at the dermatology clinic, and 56 men (7%) had a positive RPR assay at the STI clinic.

T. vaginalis *infection at the dermatology clinic.* *T. vaginalis* was the most common non-HIV STI detected among the men at the dermatology clinic (54/431 men [13%]). Nearly one-half of the men reported that their last sexual contact was >4 weeks before enrollment (23/53 men [43%]). Although 4 (7%) of the 54 men with *T. vaginalis* infection at the dermatology clinic had subclinical urethritis, this rate was not significantly higher than that among the men without *T. vaginalis* infection (21/377 men [6%]) ($P = .56$). However, at the dermatology clinic, the rate of subclinical urethritis was significantly higher among the HIV-infected men than among the men not infected with HIV (12/118 men [10%] vs. 12/304 men [4%] [$P = .01$]). Neither *T. vaginalis*–infection, *N. gonorrhoeae*–infection, nor RPR-assay status could explain this association.

When multiple factors were controlled for in a logistic regression model, age and reported condom use were the strongest predictors of *T. vaginalis* infection (table 2). The odds of the men 21–25 years old and ⩾30 years old being infected were 6–7 times those of the men <21 years old being infected, and the men who reported never having used a condom were also significantly more likely to present with *T. vaginalis* infection (AOR, 3.0 [95% CI, 1.6–5.6]). Lower education level and having higher-risk sex partners remained modest predictors of *T. vaginalis* infection. Circumcision, marital, and HIV-infection status were not independently associated with *T. vaginalis* infection among the men at this clinic.

T. vaginalis *infection at the STI clinic.* *T. vaginalis* infection was common among the men at the STI clinic, but it was most pronounced among the men presenting with GUD (table 3). When multiple factors were controlled for, education status, marital status, and reported condom use were all significant predictors of *T. vaginalis* infection (table 2). HIV-infection status remained in the model, although, when these other covariates were controlled for, its predictive ability was attenuated. GUD status

Table 1. Prevalence of *Trichomonas vaginalis* and HIV infection in men at the dermatology and sexually transmitted infection (STI) clinics, by age.

	Dermatology clinic		STI clinic	
Age	*T. vaginalis* [P^a]	HIV [P^a]	*T. vaginalis* [P^a]	HIV [P^a]
18–20 years	2/87 (2.3)	5/87 (5.7)	14/83 (16.9)	26/83 (31.3)
21–25 years	28/176 (15.9)	31/176 (17.6)	71/329 (21.6)	118/329 (35.9)
26–30 years	9/98 (9.2)	42/98 (42.9)	37/205 (18.0)	113/205 (55.1)
⩾31 years	15/70 (21.4)	40/70 (57.1)	28/139 (20.1)	101/139 (72.7)
All	54/431 (12.5) [<.001]	118/431 (27.4) [<.001]	150/756 (19.8) [0.68]	358/756 (47.4) [<.001]

NOTE. Data are proportion (%) of positive patients.

[a] χ^2 test for trend.

Table 2. Crude and adjusted odds ratios (ORs) for prevalence of predictors (or factors selected for modeling a priori) for *Trichomonas vaginalis* at the dermatology and sexually transmitted infection (STI) clinics.

	Dermatology clinic			STI clinic		
	OR (95% CI)			OR (95% CI)		
Category, variable	Crude	Adjusted	*P*	Crude	Adjusted	*P*
Age						
18–20 years	1.0	1.0	…	1.0	1.0	…
21–25 years	8.0 (1.9–34.6)	6.6 (1.5–29.7)	.01	1.4 (0.7–2.6)	1.4 (0.7–2.7)	.36
26–30 years	4.3 (0.9–20.5)	2.9 (0.6–15.1)	.21	1.1 (0.6–2.2)	0.8 (0.4–1.7)	.55
⩾31 years	11.6 (2.6–52.7)	7.1 (1.3–37.2)	.02	1.3 (0.6–2.6)	0.7 (0.3–1.5)	.33
Education level						
Less than secondary school	1.0	1.0	…	1.0	1.0	…
Secondary school or more	0.4 (0.2–0.7)	0.5 (0.3–1.1)	.09	0.6 (0.4–0.8)	0.6 (0.4–0.9)	.01
Marital status						
Single	1.0	1.0	…	1.0	1.0	…
Divorced or widowed	1.2 (0.5–2.9)	1.1 (0.4–3.6)	.81	2.1 (1.2–3.8)	2.7 (1.4–5.2)	.004
Married	2.0 (1.1–3.5)	1.7 (0.8–3.8)	.16	1.4 (1.0–2.1)	1.6 (1.0–2.5)	.06
Reported condom use						
Ever	1.0	1.0	…	1.0	1.0	…
Never	2.6 (1.4–4.7)	3.0 (1.6–5.6)	.0008	1.9 (1.3–2.7)	1.8 (1.2–2.6)	.005
Type of sex partner						
Spouse/girlfriend or none	1.0	1.0	…	1.0	NS	…
Higher risk[a]	1.9 (0.8–4.4)	2.2 (0.9–5.6)	.09	0.8 (0.5–1.1)	…	…
Circumcised						
No	1.0	NS	…	1.0	NS	…
Yes	0.6 (0.3–1.1)	…	…	0.7 (0.4–1.1)	…	…
HIV status[b]						
Negative	1.0	NS	…	1.0	1.0	…
Positive	0.8 (0.4–1.5)	…	…	1.4 (1.0–2.0)	1.4 (0.9–2.1)	.096
Gonorrhea[c]						
Negative	…	…	…	1.0	NS	…
Positive	…	…	…	0.7 (0.5–1.0)	…	…
GUD[c]						
Absent	…	…	…	1.0	1.0	…
Present	…	…	…	1.7 (1.1–2.4)	1.7 (1.2–2.6)	.007

NOTE. Although marital status itself was not an independent predictor of *T. vaginalis* infection at the dermatology clinic, it did affect the predictive ability of age and was therefore kept in the model. Likewise, although age was not an independent predictor of *T. vaginalis* infection at the STI clinic, it did affect the predictive ability of marital status and was therefore kept in the model. CI, confidence interval; GUD, genital ulcer disease; NS, not significant.

[a] Sex with a stranger or commercial sex worker during the 4 weeks preceding enrollment.

[b] Excluding 9 men at the dermatology clinic and 6 men at the STI clinic with indeterminate HIV antibody test results.

[c] Too few cases of asymptomatic gonorrhea at the dermatology clinic to report; men with GUD were excluded from enrollment at the dermatology clinic.

also remained predictive of *T. vaginalis* infection (AOR, 1.7 [95% CI, 1.2–2.6]), whereas gonorrhea status did not. Circumcision status, a weak predictor of infection on bivariate examination, did not contribute to the model. Age was not associated with *T. vaginalis* infection among the men at the STI clinic.

T. vaginalis *infection, gonorrhea, and syndromic urethritis.* Of the men at the STI clinic, 332 (44%) presented with GUD, 311 (41%) presented with urethritis, and 113 (15%) presented with both. *N. gonorrhoeae* was the most common pathogen recovered from the men with urethritis, accounting for 311 (73%) of the 424 cases of syndromic urethritis (in patients with or without GUD), including from 45 men who were infected with both *N. gonorrhoeae* and *T. vaginalis* (table 4). Among the men presenting with urethritis, *T. vaginalis* infection alone was associated with a less severe urethritis than was *N. gonorrhoeae* infection alone ($P < .001$), in terms of WBC counts of Gram-stained urethral exudate smears. The men with trichomonal urethritis were less likely to present with visible urethral discharge ($P < .001$) and dysuria ($P = .01$) and were more likely to present with GUD ($P < .001$) than were the men with gonococcal urethritis. The men with idiopathic urethritis had similar rates of these complaints as did their counterparts infected with *T. vaginalis* only; however, the men infected with *T. vaginalis* were more likely to present with laboratory-confirmed

Table 3. Prevalence of sexually transmitted pathogens across the sexually transmitted infection (STI) syndrome among men at the STI clinic.

Pathogen	All (n = 756)	STI syndrome: Urethritis (n = 311)	STI syndrome: GUD (n = 332)	STI syndrome: Urethritis and GUD (n = 113)
HIV	358 (47.4)	115 (37.0)	176 (53.0)	67 (59.3)
Neisseria gonorrhoeae	335 (44.3)	242 (77.8)	24 (7.2)	69 (61.1)
Trichomonas vaginalis	150 (19.8)	48 (15.4)	77 (23.2)	25 (22.1)

NOTE. Data are no. (%) of patients. Note that data do not sum due to multiple infections. GUD, genital ulcer disease.

urethral inflammation than were the men with no detectable cause of their urethritis ($P = .07$). Inguinal lymphadenopathy and scrotal pain and/or swelling were no more or no less common among the men infected with *T. vaginalis* alone than among the men with infected with *N. gonorrhoeae* alone ($P = .78$ and $P = .77$, respectively) or among the men with idiopathic urethritis ($P = .67$ and $P = .55$, respectively). The men for whom *T. vaginalis* infection was the sole cause of their urethritis may have been infected for a longer period of time, because they were more likely to report that their last sexual contact was >4 weeks before enrollment than were the men with gonococcal urethritis (4/28 men [14%] vs. 10/266 men [4%] [$P = .01$]).

T. vaginalis *and HIV infection.* *T. vaginalis* infection was associated with HIV infection among the men at the STI clinic (AOR, 1.4 [95% CI, 0.9–2.1]) (table 2) but not among the men at the dermatology clinic (OR, 0.8 [95% CI, 0.4–1.5] (table 2). HIV infection among the men at the STI clinic also appeared to be associated with a more severe trichomoniasis. Among the men at the STI clinic with *T. vaginalis* infection, those who were HIV negative tended to present with milder signs and symptoms than did those who were HIV positive (table 5). Among the HIV-negative men with syndromic urethritis, *T. vaginalis* infection was less likely to provoke dysuria (OR, 0.2 [95% CI, 0.1–0.5]), and these men were less likely to present with severe (≥10 WBCs) urethral inflammation (OR, 0.4 [95% CI, 0.2–0.8]) than were the men with nontrichomonal urethritis. Additionally, the HIV-negative men with *T. vaginalis* infection tended to present without visible discharge (OR, 0.4 [95% CI, 0.1–1.2]); however, this finding only approached statistical significance. The HIV-positive men with *T. vaginalis* infection presented with signs and symptoms indistinguishable from urethritis of other etiologies. Finally, the HIV-positive men with *T. vaginalis* infection tended to wait fewer days before attending the clinic than did the HIV-negative men with *T. vaginalis* infection (7.1 vs. 11.0 days of symptoms before attending the clinic [$P = .09$]), further implying that symptoms were more severe among the HIV-positive men. When GUD or urethritis etiology was controlled for, these relationships were not affected. HIV infection did not influence the presentation of *T. vaginalis* infection either among the men with GUD only or among the men at the dermatology clinic.

DISCUSSION

In the present hospital-based study, we found that 20% of the men with urethritis and/or GUD and 13% of the men without symptoms of an STI were infected with *T. vaginalis. T. vaginalis* infection was associated with an increased likelihood of HIV infection at the STI clinic but not at the dermatology clinic. A lower education level and reporting never having used a condom were both independently associated with *T. vaginalis* infection regardless of which clinic was attended. That a very crude measure for condom use (never/ever) was a highly significant and—at the dermatology clinic, at least—powerful predictor (OR of nearly 3) of *T. vaginalis* infection implies that certain common patterns of high-risk sexual behavior are driving the infection rates across clinics. In the asymptomatic population, additional markers for higher-risk sexual behavior were associated with an increased risk for *T. vaginalis* infection, as the men who reported recently having had sex with higher-risk partners were more likely to be infected with *T. vaginalis*. We did not observe this phenomenon at the STI clinic; however, the population at this clinic differed considerably in terms of unsafe sexual behavior.

Few studies exist that examine the epidemiologic profile of trichomoniasis in men and its relationship to HIV infection. A population-based study in rural Tanzania found that the marital status, religion, and employment type of men were independently associated with *T. vaginalis* infection. Circumcision and recent sexual activity were not predictive of *T. vaginalis* infection, and HIV infection was not considered [6]. A survey of an urban Kenyan workplace found that sexual behavior, travel for business, age, marital status, and spousal cohabitation were not independently associated with urethral infection, but trichomoniasis was not evaluated independently [10]. In a study by Hobbs et al., conducted in Malawi 4 years before the present

Table 4. Specific signs and symptoms among 424 men with syndromic urethritis (urethral discharge and/or dysuria and sex during the 2 weeks preceding enrollment), by etiology.

Category, variable	Idiopathic urethritis[a] (*n* = 85)	*Trichomonas vaginalis* only (*n* = 28)	*Neisseria gonorrhoeae* only (*n* = 266)	*T. vaginalis* and *N. gonorrhoeae* (*n* = 45)
Complaint of dysuria				
No	6 (7.1)	3 (10.7)	10 (3.8)	7 (15.6)
Yes	79 (92.9)	25 (89.3)	256 (96.2)	38 (84.4)
Visible urethral discharge				
No	10 (11.8)	5 (17.9)	0 (0)	0 (0)
Yes	75 (88.2)	23 (82.1)	266 (100)	45 (100)
Urethritis severity[b]				
None, 0–3 WBCs	42 (49.4)	8 (28.6)	0 (0)	0 (0)
Low, 4–10 WBCs	18 (21.2)	9 (32.1)	1 (0.4)	0 (0)
Moderate, 11–30 WBCs	15 (17.6)	5 (17.9)	48 (18.0)	10 (22.2)
Severe, >30 WBCs	10 (11.8)	6 (7.1)	217 (81.6)	35 (77.8)
Presence of GUD				
No	51 (60.0)	18 (64.3)	212 (79.7)	30 (66.7)
Yes	34 (40.0)	10 (35.7)	54 (20.3)	15 (33.3)
Inguinal lymphadenopathy				
No	67 (78.8)	21 (75.0)	193 (72.6)	31 (68.9)
Yes	18 (21.2)	7 (25.0)	73 (27.4)	14 (31.1)
Scrotal pain/swelling				
No	71 (83.5)	25 (89.3)	242 (91.0)	43 (95.6)
Yes	14 (16.5)	3 (10.7)	24 (9.0)	2 (4.4)

NOTE. Data are no. (%) of patients. GUD, genital ulcer disease; WBC, white blood cell.

[a] No etiologic agent of urethritis was detected; 2 of these men were positive by rapid plasma reagin assay.

[b] Calculated as no. of WBCs per high-power field, on examination of Gram-stained urethral exudate.

work and using similar methods of detection, it was found that the prevalence of *T. vaginalis* infection was 21% in symptomatic men and 12% in asymptomatic men [5]. The rate of HIV positivity was not different across *T. vaginalis* status; however, 6 symptomatic men infected with *T. vaginalis* only had significantly higher seminal plasma HIV RNA concentrations than did 18 men with nonspecific urethritis (log-transformed median values, 5.5 vs. 3.7 copies/mL [$P = .02$]).

At the dermatology clinic, the prevalence of *T. vaginalis* infection tended to increase with age, whereas this was not the case at the STI clinic. This is an uncommon presentation for STIs and could be indicative of longer-lasting, clinically silent infections that do not prompt the host to seek treatment [13]. HIV infection was associated with *T. vaginalis* infection at the STI clinic, although, when other covariates were controlled for, the predictive ability of HIV infection was attenuated. Even if the observed association is not artifactual, this does not tell us whether HIV infection increases susceptibility to *T. vaginalis* infection or whether *T. vaginalis* infection increases susceptibility to HIV infection, because our data are cross-sectional. However, our data show that the clinical presentation of trichomoniasis is worsened during coinfection. Given that increasing severity of urethritis has been shown to increase seminal plasma HIV RNA concentrations [19], the presence of a more severe trichomoniasis with HIV infection may increase the efficiency of HIV transmission. Despite a more severe trichomoniasis, coinfection with HIV in our population did not affect metronidazole's ability to clear *T. vaginalis* infection [16].

Although the present study did not find occult infection with *T. vaginalis* to be associated with subclinical urethritis, others have [5, 6, 10]. At the dermatology clinic, >7% of the men with occult trichomoniasis had elevated urethral WBC counts; however, nearly 6% of the men without trichomoniasis also had elevated urethral WBC counts. Schistosomiasis is highly prevalent in Malawi and may have been responsible for a significant proportion of asymptomatic urethral inflammation observed among the men at the dermatology clinic. Rather disturbingly, we did note that HIV infection at this clinic was associated with elevated levels of subclinical urethritis. Any increase in urethral inflammation may influence seminal plasma HIV RNA concentrations and, therefore, the risk of transmission [19].

Previous work at this clinic [19] had indicated that syndromic urethritis and syndromic GUD frequently present together. For this reason, we were interested in evaluating men with GUD alone and men with both urethritis and GUD. An unexpected and unexplained finding of the present study was the high prevalence of *T. vaginalis* infection among the men presenting with GUD (table 3). It is not clear what role *T.*

Table 5. Relationships of *Trichomonas vaginalis* infection with sexually transmitted infection (STI) signs and symptoms among men presenting with syndromic urethritis, by HIV-infection status.

Category, variable	HIV positive		HIV negative		*P* for EMM
	OR (95% CI)	*P*	OR (95% CI)	*P*	
Infection with *T. vaginalis* and urethral discharge					
Not visible	1.0	…	1.0	…	…
Visible	0.5 (0.04–5.3)	.54	0.4 (0.1–1.2)	.10	.84
Infection with *T. vaginalis* and dysuria					
No complaint	1.0	…	1.0	…	…
Complaint	0.6 (0.2–1.9)	.36	0.2 (0.1–0.5)	.003	.15
Infection with *T. vaginalis* and urethritis severity[a]					
<10 WBCs	1.0	…	1.0	…	…
⩾10 WBCs	2.0 (0.6–7.0)	.29	0.4 (0.2–0.8)	.01	.02

NOTE. CI, confidence interval; EMM, effect measure modification (where $P < .2$ is suggestive of potential EMM); OR, odds ratio for prevalence (odds of trichomoniasis and the presence of STI sign or symptom vs. trichomoniasis without the sign or symptom); WBC, white blood cell.

[a] Calculated as no. of WBCs per high-power field, on examination of Gram-stained urethral exudate.

vaginalis may play in GUD, and HIV infection did not appear to influence the presentation of either GUD alone or trichomoniasis with GUD.

Approximately 10% of the male attendees of the dermatology clinic are asymptomatic partners of previously treated women who come in at their behest for treatment, and another 15% are men with swollen scrotums, balanitis, and inguinal bubo (Malawi Ministry of Health, unpublished data). Therefore, we did not collect specimens from ~25% of the clinic's population. It is unclear what the prevalence of infection might be among these attendees, but likely it would not be less than that observed in the population we did collect specimens from at the dermatology clinic (13%). Several of the symptoms, including balanitis and swollen or tender scrotum, are associated with trichomoniasis [9]. We also do not have comprehensive data on chlamydia from our study population. Earlier work at this clinic showed chlamydia to be uncommon [5], a finding supported by our present data on men with syndromic urethritis.

Detection methods are a major hurdle facing work on *T. vaginalis* infection in men. Many earlier studies relied exclusively on culture [6, 10] or even wet mount [20, 21]. Newer work has utilized PCR to detect infection [3, 4]. The strengths of the present work are that our detection methods are based on both culture and PCR [22] and that we collect specimens from >1 anatomical site [23]. Any study that relies solely on culture to detect *T. vaginalis* infection in men may report a considerable underestimate of the true prevalence; reported prevalences may also vary with the site chosen for culture [23]. Detection issues complicate attempts to study the epidemiologic profile of this organism in humans and plague the development of any rapid and sensitive laboratory diagnostic tool. Techniques such as PCR and culture are often not appropriate for use in the developing world, and attempts to introduce easy-to-use tools to diagnose this pathogen, such as the leukocyte esterase dipstick, have met with mixed results [6, 10].

In the present study, we detected *T. vaginalis* in 1 of every 5 men presenting to the dermatology clinic with an STI-related complaint and in 1 of every 8 men presenting to the dermatology clinic without an STI-related complaint. Trichomoniasis is common in men throughout sub-Saharan Africa [3, 4, 24], has been associated with increased seminal plasma HIV RNA concentrations in infected men [19], and has been associated with an increased risk for HIV transmission [25]. The present work also suggests that coinfection with HIV may increase the severity of the clinical presentation of trichomoniasis in men. Traditionally, trichomoniasis has been associated with a milder presentation than that of gonococcal urethritis [15]; however, we found this to be true only among HIV-negative men. In the present cross-sectional study, HIV-positive men were more likely to present with *T. vaginalis* infection at the STI clinic (table 2), and those with urethritis had a more severe presentation of trichomoniasis than did their HIV-negative counterparts (table 5). Trichomoniasis in men is not considered to be significant enough to merit first-line syndromic treatment for urethritis; however, those men most in need of proper management of their STIs—HIV-positive men—are not receiving appropriate treatment. Given the high prevalence of *T. vaginalis* infection, the increased risk for HIV transmission attributable to these untreated cases of trichomoniasis, even if only modest, may represent a significant opportunity to improve public health [12, 13].

In those parts of the world where laboratory confirmation of suspected pathogens is impractical or impossible, the syndromic approach adopted in Malawi is a common method of managing STIs. This management scheme depends on an understanding of the local epidemiologic profiles and etiologies

of STIs, including their microbial susceptibilities. Although a certain amount of overtreatment is accepted, attempts to make treatment schedules as specific as possible are important. As noted above, no rapid, easy-to-use, and sensitive diagnostic tool exists for detecting *T. vaginalis*. The best method for managing trichomonad infection in men may therefore be to simply treat everyone who fits a specific syndromic profile; however, we found that *T. vaginalis* infection was unexpectedly prevalent among men with GUD and without syndromic urethritis (table 3), complicating the delineation of a simple syndromic profile. Given that others have also observed this unexpected association between *T. vaginalis* infection and GUD in men [6], in addition to an association between *T. vaginalis* infection and urethritis, it may be prudent to treat all men who attend the STI clinic for trichomoniasis. It is time to seriously consider first-line metronidazole for the treatment of *T. vaginalis* infection in men in Malawi and possibly elsewhere, and any treatment scheme should not focus on any 1 syndromic profile without a thorough understanding of local trichomoniasis in men.

Acknowledgments

We thank the hardworking UNC Project study staff and clients of Lilongwe Central Hospital who participated in this work; Marcia Hobbs, for her assistance with the *T. vaginalis* polymerase chain-reaction assays and laboratory guidance; and Dickman Zimba, who, as part of the UNC Project team, helped to get this work under way but, unfortunately, died before its completion.

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