Differentiation of *Gardnerella vaginalis*, *Candida albicans*, and *Trichomonas vaginalis* Infections of the Vagina

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This study evaluated the positive predictive values of factors associated with Gardnerella vaginalis, Candida albicans, *and* Trichomonas vaginalis *for diagnosing vaginitis in a community-based population. One hundred ninety-six women with and without vaginal complaints were evaluated for historical factors, physical examination findings, and office laboratory results that were potentially associated with each of the three vaginal organisms. Extensive microbiological tests were performed to detect pathogenic organisms in the vagina and cervix.* Gardnerella vaginalis *was associated with findings of clue cells, gray or creamy vaginal discharge, amine odor on application of potassium hydroxide solution to the discharge, pH greater than 5, and a history of more than six sexual partners.* Candida albicans *was associated with the presence of pseudohyphae or budding yeast on microscopic examination and the lack of clue cells. Current use of oral contraceptives and the recent use of antibiotics were not predictive of a Candida albicans infection.* Trichomonas vaginalis *was more common in patients presenting with symptoms, but otherwise was not predicted by the factors tested.*

In 1914 Curtis[1] noted that knowledge of leukorrhea was unsatisfactory and incomplete: Physicians neither appreciated the gross aspects of vaginal discharge nor understood its source; knowledge of the bacteria involved was inadequate; and treatment was ineffective. While treatment has since improved, the office diagnosis of vaginitis is still problematic.

Vaginal complaints are a common reason women see physicians in the outpatient setting. Even when they do not complain of vaginal symptoms, women will frequently admit to bothersome discharges or odors when asked. Morbidity from vaginal disease is substantial and includes patient discomfort and embarrassment, the time spent seeking treatment, work missed, and the costs of evaluation and treatment. When the diagnosis is inaccurate, this morbidity is magnified.

Gardnerella vaginalis, *Candida albicans*, and *Trichomonas vaginalis* are the organisms most commonly associated with vaginitis; each can also be present in an asymptomatic state. Studies to define the causes of these infections have been performed, and associations between each of these organisms and various historical and physical examination factors as well as office laboratory tests have been found. *G vaginalis* has been shown to be increased in patients with findings of a gray or homogenous discharge,[2] in those with a positive amine test[3,4] or vaginal odor,[5] in those with discharge of high pH[2–4] or discharge containing clue cells,[3,4,6,7] in those using nonbarrier contraceptive methods,[3,8,9] in those with multiple sexual partners,[3,9] and in those with other sexually transmitted diseases such as *T vaginalis*.[3] In contrast, *C albicans* has been associated with the use of oral contraceptives[10–16] or antibiotics,[15–17] pregnancy,[13] presence of thick curdlike white discharge,[18,19] itching,[18–20] and presence of hyphae or budding yeast seen microscopically.[16,20,21] *T vaginalis* is more prevalent in patients with symptoms,[20] foamy gray or yellow discharge,[2,22] high pH of the discharge,[2,22] and motile trichomonads observed microscopically.[22–24] There continue to be conflicting results between studies about these findings, however.

Unfortunately, although a strong statistical association can be shown between organisms and the factors above, the

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use of these factors often lacks sensitivity and specificity for determining the offending organism. The positive predictive value of a finding indicates how often a patient will actually have the infection in question if the finding is present. This value may be low for some factors despite an impressive association suggested by odds ratios.[25] Consequently, although various diagnostic criteria have been proposed for these three infections, use of these factors in making a diagnosis requires knowledge of their predictive values in a primary care population.

This study evaluated the positive predictive values of the previously described risk factors for *G vaginalis*, *C albicans*, and *T vaginalis* in symptomatic and asymptomatic patients. Based on these results, recommendations for the evaluation of patients with vaginal complaints are proposed.

METHODS

Providers at five offices were invited to participate in this study. These physicians were selected by their demonstrated interest in research and their willingness to adhere to the study guidelines. The study sites included three family practice centers affiliated with the University of Utah Family Practice Residency program as well as a private family practice office and a family planning center in semirural outlying communities 15 to 25 miles from Salt Lake City. Physicians received instruction in the study protocol and the details of data collection from two of the investigators (B.D.R. and W.H.).

All women aged 15 to 45 years who came for a pelvic examination by one of the study physicians at any of these sites between January and April 1985 were eligible to participate. These women consisted of patients with pelvic complaints (itching, discharge, pelvic pain, odor, bleeding) as well as those requesting a Papanicolaou smear or contraception. Informed consent was obtained, and each patient immediately completed a 100-item questionnaire that covered demographic factors, medical history, contraceptive and sexual history, and history of vaginitis or other pelvic disorders. A complete pelvic examination was performed by a physician, and all findings were recorded on a form designed for the study. Vaginal and cervical specimens were collected. The patient was treated according to the physician's diagnosis at the time of the visit; modifications were made as microbiological results became available.

The following tests were performed: (1) 10% potassium hydroxide and normal saline preparations to look microscopically for white blood cells, *T vaginalis*, *C albicans* pseudohyphae or spores, and epithelial cells; (2) "whiff" test for aromatic amines volatilized on addition of 10% potassium hydroxide solution; (3) pH of the vaginal discharge using pH indicator strips; and (4) cultures plated as follows: For *G vaginalis*, vaginal discharge was streaked for isolation on a V/starch differential agar plate, incubated at 35°C in a candle-extinction jar, and examined at 24, 48, and 72 hours for characteristic colony morphology. For *T vaginalis*, vaginal discharge was placed in a tube containing Hollander medium, incubated at 35°C for 3 days in ambient air, and examined daily by wet mount. *C albicans* was isolated from the discharge by inoculation on selective and nonselective media, incubated at 25 and 35°C, respectively, in an aerobic environment, and examined at 24, 48, and 72 hours. Colonies were tested and confirmed by the Germ tube test and a commercial yeast identification system (API 20C Clinical Yeast System). All microbiological tests were performed by one of the authors (W.H.) in a private laboratory in Salt Lake City, Utah.

A potential risk factor was defined as any historical, physical examination, or office laboratory finding that may be associated with infection. Risk factors selected were those previously identified in the literature as well as factors that may be confounders in the analysis (age, socioeconomic status, age at first intercourse) or those that have not been previously studied but are associated with pelvic disease (smoking). Historical factors included age, household income, ethnic group, educational level, marital and smoking status, recent use of antibiotics, current and past contraceptive practices, sexual history (age at first intercourse, number of lifetime and recent sexual partners), history of pelvic infections, and presence of pelvic symptoms. Physical findings noted included erythema of pelvic structures; amount, color, and consistency of vaginal and cervical discharge; appearance of the cervix; and uterine and adnexal size and tenderness.

G vaginalis is associated with infection that often does not cause an inflammatory response—commonly referred to as vaginosis. In this article, vaginosis will be used when describing the entity associated with *G vaginalis*, and vaginitis will be used when describing other vaginal infections. While controversy exists regarding the relative contributions of *G vaginalis* and anaerobic bacteria in causing clinical bacterial vaginosis,[26,27] *G vaginalis* is strongly associated with this entity.[2–4,6] For purposes of this study, *G vaginalis* was used as a marker for this infection.

Data analysis included frequency determinations of the study pathogens and the potential risk factors. Associations between each organism and risk factor were performed using chi-square tests; odds ratios and 95% test-based confidence limits were also calculated. Risk factors found to be associated with the various organisms were stratified by other potential risk factors to evaluate possible confounding or interaction. Positive predictive values, negative predictive values, sensitivities, and specificities were determined for those factors found to be statistically associated with a specific infection.

RESULTS

One hundred ninety-six patients were evaluated at the five study sites. Less than 5% of the eligible women declined to participate.

TABLE 1. PREVALENCE AND ODDS RATIOS (with 95% confidence intervals) OF *Gardenerella vaginalis* AND *Candida albicans* IN PATIENTS (N = 196) BY RISK FACTORS

Risk Factors	*Gardnerella vaginalis*		*Candida albicans*	
	No. (%)	Odds ratio (95% CI)	No. (%)	Odds ratio (95% CI)
Overall prevalence (n = 196)	64 (33)		48 (25)	
Historical factors				
Symptomatic (n = 105)	39 (37)	1.4 (0.8-2.5)	27 (26)	1.3 (0.6-2.7)
>5 sexual partners ever (n = 74)	35 (47)*	2.5 (1.3-4.8)	18 (24)	1.1 (0.3-4.5)
Smoke cigarettes (n = 59)	25 (42)	1.6 (0.8-3.3)	8 (14)†	0.4 (0.2-0.9)
Using oral contraceptives (n = 65)	21 (32)	0.9 (0.3-2.8)	9 (14)†	0.4 (0.2-0.9)
Use of antibiotics in the past 2 months (n = 48)	13 (27)	0.6 (0.3-1.3)	12 (25)	1.0 (0.4-2.1)
Physical examination factors				
Gray discharge (n = 9)	8 (89)‡	20.0 (4.4-89.0)	1 (11)	0.3 (0.02-3.7)
Creamy discharge (n = 38)	19 (50)*	2.9 (1.2-7.0)	13 (34)	1.5 (0.5-4.5)
Office laboratory factors				
Fishy odor with KOH (n = 22)	16 (73)‡	7.6 (2.9-19.8)	2 (9)	0.3 (0.1-1.5)
pH>5 (n = 95)	39 (41)*	2.5 (1.2-5.3)	21 (22)	0.8 (0.3-1.9)
Clue cells (n = 30)	21 (70)‡	7.1 (3.1-16.3)	3 (10)†	0.3 (0.1-1.2)
Budding yeast (n = 22)	3 (14)	0.3 (0.1-1.2)	11 (50)*	4.0 (1.5-10.5)
Yeast pseudohyphae (n = 18)	2 (11)	0.3 (0.1-1.3)	12 (67)§	9.0 (4.3-18.7)

** P = <.05; † P = <.001; ‡ P = <.01; § P = <.1*

The mean age of participants was 28 years (range 15 to 58 years). Thirty-nine percent had a household income of less than $13,000, with both modal and median income categories of $13,001 to $20,000. Seventy-nine percent were white (not including Hispanic), 31% smoked, and 57% were married. Current contraception included oral contraceptives in 33%, none in 29%, and pregnancy in 12%, with each other potential mode making up less than 9% of the group. Thirty-seven percent had been sexually active before the age of 17 years, 38% had had at least six sexual partners, and 12% had had more than one partner in the past 2 months. Fifty-seven percent had a history of "yeast" infections, 16% had infections caused by *Trichomonas*, 13% had infections caused by *Gardnerella* or nonspecific organisms, and 32% had vaginitis of unknown type. Of the participating patients, 56% (110/196) currently had pelvic symptoms (burning, discharge, itching, bleeding, pelvic pain) and 44% (86/196) were being seen for routine preventive care or contraceptive planning.

Thirty-three percent of the 196 women had a positive culture for *G vaginalis*, and 25% for *C albicans*. Difficulties with bacterial overgrowth in the cultures for *T vaginalis* during the first month of the study resulted in an alteration of the culture media. *T vaginalis* cultures were therefore reliable only for the last 154 patients: of these 14% were positive. Only 4% of the patients had more than one of these organisms present on culture and 30% had none. Patients with *G vaginalis* organisms were less likely to also have *C albicans* than were those without the organism, and vice versa (odds ratio = 0.33, $P = .006$). Patients with one type of organism did not differ significantly from those with another type of these three organisms or from the entire patient population in age, socioeconomic status, ethnic group, marital status, use of antibiotics in the previous 2 months, age at first intercourse, number of recent sexual partners, current contraceptive method, or history of vaginitis or cervicitis caused by any of the organisms studied.

When stratified by the presence or absence of symptoms, patients were similar. The only statistically significant differences found in historical risk factors were as follows. Smokers were more likely than nonsmokers to present with symptoms (odds ratio = 2.3, $P = .02$), and fewer married patients than single or divorced women were symptomatic (odds ratio = 0.5, $P = .02$). Symptomatic patients were more likely to have a history of *Trichomonas* vaginitis (odds ratio 4.7, $P = .01$) or of *Gardnerella* vaginosis (odds ratio = 4.9, $P = .01$). Also, symptomatic patients had a higher risk of having *T vaginalis* present than did asymptomatic patients (odds ratio = 3.0, $P = 0.04$). There was no significant difference in the prevalence of *G vaginalis* or *C albicans* between the symptomatic and asymptomatic groups. The amount of growth of *G vaginalis* and *C albicans* (no growth to heavy growth on a 5-point scale) was also not related to the presence of symptoms.

Twenty-three of the patients were pregnant. Of these, 48% had at least one of the three common organisms present—26% (6/23) had *G vaginalis*, 17% (4/23) had *C albicans*, and 22% (4/18) had *T vaginalis*. Twenty-nine percent of the 17 asymptomatic pregnant patients and all of the six symptomatic pregnant patients were infected with one of these organisms ($P < 0.05$), with *G vaginalis* being the most prevalent organism in each group.

TABLE 2. PREVALENCE AND ODDS RATIOS (with 95% confidence intervals) OF *Trichomonas vaginalis* (N = 154) IN PATIENTS BY RISK FACTORS

Risk Factors	*Trichomonas vaginalis* No. (%)	Odds ratio (95% CI)
Overall prevalence (n = 154)	22 (14)	
Historical factors		
Symptomatic (n = 85)	17 (20)*	3.0 (1.1-7.7)
>5 sexual partners ever (n = 57)	8 (14)	0.9 (0-248)
Smoke cigarettes (n = 50)	5 (10)	0.6 (0.2-20)
Using oral contraceptives (n = 50)	4 (8)	0.4 (0.2-1.4)
Use of antibiotics in the past 2 months (n = 38)	6 (16)	0.8 (0.3-2.3)
Physical examination factors		
Gray discharge (n = 0)	0 (0)	0.0 (-------)
Creamy discharge (n = 31)	5 (16)	0.9 (0.6-1.6)
Office laboratory factors		
Fishy odor with KOH (n = 20)	1 (5)	0.3 (0.0-2.7)
pH>5 (n = 80)	12 (15)	2.0 (0.6-7.3)
Clue cells (n = 27)	4 (15)	1.2 (0.04-38)
Budding yeast (n = 16)	3 (19)	1.4 (0.0-247)
Yeast pseudohyphae (n = 15)	2 (13)	0.9 (0.3-2.8)

* *P* = <.001

TABLE 3. SENSITIVITY, SPECIFICITY, POSITIVE PREDICTIVE VALUE (PPV), AND NEGATIVE PREDICTIVE VALUE (NPV) OF THE RISK FACTOR AND THE TYPE OF INFECTION DETECTED

Type of Infection and Factor	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Gardnerella vaginalis				
Gray discharge	22	99	89	71
Fishy odor with KOH	29	95	73	74
Clue cells seen	37	92	70	75
Creamy discharge	50	74	50	74
Six or more sexual partners in lifetime	55	68	47	74
pH >5	72	49	41	78
No yeast seen	96	16	36	90
Candida albicans				
Pseudohyphae seen	29	96	67	82
Budding yeast seen	27	92	50	80
No clue cells seen	93	19	27	89
Not a smoker	82	35	28	86
Not on oral contraceptives	82	39	30	88
Trichomonas vaginalis				
Symptomatic	78	46	20	92

The historical, physical examination, and office laboratory factors were evaluated for possible association with the three pathogens. Those found to be statistically associated with one or more of the infections are listed in Table 1 and Table 2.

The presence of *C albicans* was not associated with the use of oral contraceptives or recent antibiotic use. Also, smoking was associated with a decreased prevalence of this organism. The data were stratified by several potential confounders, including the age of patient, number of lifetime sexual partners, number of recent sexual partners, smoking history, socioeconomic status, marital status, ethnic group, educational level, recent antibiotic use, history of previous yeast infections, and past use of oral contraceptives. None was found to modify the associations seen.

The positive predictive values for the variables statistically associated with each infection are shown in Table 3. For infection associated with *G vaginalis*, if none of the first four risk factors were present (those with a positive predictive value of 0.50 or greater), only 16.2% of patients had *G vaginalis* present. If only one factor was present suggesting infection, the findings of clue cells, odor on application of potassium hydroxide, or presence of gray or creamy discharge predicted the organism in 40% to 55% of cases. If more than one of the first four risk factors were positive, the positive predictive value improved to 89% or more. Although the pH of the vaginal fluid was statistically associated with the presence of *G vaginalis*, when stratified by the other risk factors, the pH was found to be useful only in the absence of the other factors.

In the case of *C albicans* infection, only the presence of budding yeast or pseudohyphae had a positive predictive value of 0.50 or greater. If both forms were seen, the positive predictive value did not increase. If no yeast were seen, 18% to 20% still had the infection. Furthermore, if budding yeast were noted without any of the other listed risk factors for a yeast infection, only 10% of these patients had *C albicans* on culture. If yeast pseudohyphae alone were seen, 43% of patients had *C albicans* on culture.

The presence of *T vaginalis* was not predicted by historical factors, examination findings, or office laboratory tests. Although the presence of symptoms was statistically associated with *T vaginalis* infection, the positive predictive value was low (0.20).

DISCUSSION

Most patients with vaginal complaints have an infection associated with *G vaginalis*, *C albicans*, or *T vaginalis*. In this community-based study of symptomatic and asymptomatic women, *G vaginalis* was found in 33%, *C albicans* in 25%, and *T vaginalis* in 14%. These values are consistent with previous large surveys.[20] This study suggests which factors are and which are not useful in predicting the presence of these three common organisms.

The positive predictive value of a test indicates how often a positive test is a true indication of the disease in question. In contrast to the sensitivity of a test, which is independent of the frequency of the disease in question, positive predictive values vary as the prevalence of the

disease changes. The positive predictive values of tests for venereal diseases may be high in a sexually transmitted disease clinic, but lower in a community setting where the prevalence of this type of disease is less. Also, although a factor may be strongly associated with the presence of an organism in retrospect, the value of that factor for predicting the infection may be low.[25] For this reason, the positive predictive value of each factor found to be associated with an infection was evaluated to assess its usefulness in predicting the organism in a community-based population.

The several factors found to be predictive of one of the three infections studied are discussed below. Numerous historical, physical examination, and office laboratory factors, however, were not helpful. Historical factors were not useful in predicting which patients were at increased risk for these infections. The presence of symptoms was also not helpful in the diagnosis of the two most common organisms—*G vaginalis* and *C albicans*. Furthermore, while a gray color or creamy consistency of the vaginal discharge was predictive of *G vaginalis* infections, the discharge characteristics were otherwise not reliable clues to diagnosis. Similarly, white blood cells on the normal saline slide did not predict any of the organisms studied. Reliance on such factors—such as not looking for a sexually transmitted organism in a married, well-educated woman—hinders diagnosis.

The variables that are statistically predictive of *G vaginalis*, *C albicans*, or *T vaginalis* infection are described below.

Gardnerella vaginalis

G vaginalis was the most common organism isolated in this study. It was seen in symptomatic and asymptomatic patients and could be diagnosed fairly accurately using common office procedures. These include (1) the findings of a gray or creamy discharge in the vagina, (2) a fishy or amine odor when 10% potassium hydroxide solution is added to the discharge, (3) microscopic verification of clue cells in the discharge, and (4) a vaginal pH greater than 5. A history of six or more sexual partners in a lifetime was also associated with *G vaginalis*.

Other authors have also shown that certain factors—primarily clue cells,[3,6,28,29] an elevated pH,[3,30] and an amine odor[3,31]—are increased in patients with *Gardnerella*-associated vaginosis. In fact, the first paper describing the role of *G vaginalis* in nonspecific vaginitis described the presence of all three findings in this disorder.[2] Since then, good correlations between these factors and the positive culture of *G vaginalis* have been reported.[3–5,20,32,33] As shown in this study, using only one factor, such as clue cells alone, does result in lower sensitivity.[29,34]

The presence of each of these risk factors, although statistically associated with each other, individually increased the probability of finding *G vaginalis*, with the exception of vaginal pH. For clue cells, amine odor, and gray or creamy discharge, the presence of more than one finding increased the probability to 89% or greater. Forty-seven percent of patients with six or more lifetime partners had *G vaginalis* present, while one in four without this history also had the organism. The number of sexual partners in the past 2 months, however, was not significantly associated with this organism. An association with sexual activity has been noted before[3] and supports a sexually transmitted mode of spread.[2,6,7,33,35,36]

Symptoms were not associated with the presence of *G vaginalis*. Other studies support this lack of association,[3,7–9] although a few authors have found this organism to be present more often in women with symptoms.[6,37] In general, historical information does not predict *G vaginalis*.[3,7,9]

Some have used other laboratory tests to diagnose *G vaginalis*. Spiegel et al[38] found Gram stain to be a sensitive test for diagnosing *G vaginalis*-associated vaginosis. Nonvolatile fatty acids have similarly been associated with the diagnosis of nonspecific or bacterial vaginosis,[4,27,39] as has determination of diamines in the vaginal fluid.[40] The value of these tests for the clinical diagnosis of *G vaginalis* still needs to be addressed.

This study indicates that clue cells, gray or creamy discharge, and an amine odor with 10% potassium hydroxide solution are highly predictive of *G vaginalis* in a community-based population, and that their presence decreases the probability that *C albicans* is causing the infection. The low rate of concomitant *G vaginalis* with *C albicans* infection has been documented.[41] Thus, these factors are differentiating as well as predictive.

Candida albicans

C albicans infection was the second most common organism detected; its prevalence was not statistically different in symptomatic and asymptomatic women. Bergman and Berg have demonstrated an asymptomatic carrier rate of 11% compared with 17% in symptomatic patients.[42] They and others have documented the poor predictive values of clinical symptoms.[10,43–45] Some have found increased rates of *C albicans* in symptomatic patients, however.[15,18,19,46] The microscopic presence of yeast was the best office predictor, but the culture was negative in approximately one half of these cases. Sensitivity was also low, as has been reported previously.[5,10,16,21,47] Therefore, the microscopic diagnosis of *C albicans* lacks accuracy.

Historical factors similarly were not predictive of *C albicans*. Two factors previously thought to be risk factors for *C albicans* were not associated with this organism: use of oral contraceptives and recent antibiotic use. Current use of oral contraceptives was statistically associated with the absence of *C albicans*; this finding contrasts with some studies that demonstrated an increased risk of *C albicans* vulvovaginitis in women using oral contraceptives.[7,10,11–16] Others have found no positive association between the use of oral contraceptives and the presence of this organism.[19,47–56] In contrast to other reports,[15,17,45] the use of antibiotics in general or any specific antibiotic in the previous 2

months was not found to be a risk factor for *C albicans* in this study.

Smoking was found to be negatively associated with the presence of *C albicans*. No literature could be found to support or refute this finding. Further study is needed to confirm this negative association.

Pregnant women with vaginal complaints are often treated for *C albicans* because it is commonly believed to be more prevalent in pregnancy. Previous articles have demonstrated that symptoms of vaginal pruritus and discharge during pregnancy are not useful in diagnosing *C albicans* vaginitis.[57] Furthermore, the prevalence of *C albicans* in pregnant women has been shown in some studies to parallel that of nonpregnant women,[58] and in others to be increased only mildly.[48] Although 48% of the pregnant women in this study did have at least one of these three common organisms present, only 17% had *C albicans*, while 26% had *G vaginalis* and 22% had *T vaginalis*. This high prevalence of *G vaginalis* during pregnancy has been previously described.[59] Evaluation of vaginal complaints during pregnancy requires as careful an evaluation as in the nonpregnant patient.

A history of *C albicans* vulvovaginitis was not predictive of a current yeast infection. Furthermore, the distribution of the histories of vaginal infections—13% with *Gardnerella*, 57% with *Candida*, and 16% with *Trichomonas*—is not consistent with the expected frequencies of these organisms.[5,7,20] This information suggests that past diagnoses of the cause of vaginitis in these patients may have been inaccurate, and that historical information in general, without culture documentation, may be an unreliable method of assessing past infections.

Other diagnostic tests for the presence of *C albicans* vulvovaginitis have been studied. Papanicolaou smears are not a sensitive test for diagnosing *C albicans* infection.[23,48] The in-office use of the *C albicans* culture slide has good sensitivity (91% to 100%) and, when positive, is comparable to other cultures.[47] Also, a new latex particle agglutination test is being studied, but preliminary data suggest its current sensitivity for the presence of *C albicans* to be only 36%.[60] Further study is needed on these office methods.

Currently, the diagnosis of *C albicans* vulvovaginitis based solely on clinical grounds is inaccurate. A culture for *C albicans* should be obtained when precise diagnosis is desired.

Trichomonas vaginalis

Except for a positive association with symptoms, *T vaginalis* infection was not statistically associated with any of the historical, physical examination, or office laboratory tests evaluated. In only three of the 22 cases of *T vaginalis* (14%) was the organism identified microscopically; this finding, combined with the lack of other predictive historical or physical examination findings, suggests in-office diagnosis of this entity is not accurate.

The office diagnosis of *T vaginalis* by microscopic examination on a normal saline slide has previously been shown to be insensitive.[5,22,24,61] As in this study, Fouts and Kraus[22] found no difference between patients with and without *T vaginalis* in the presence of discharge, leukorrhea, history of *T vaginalis* infection, or the use of oral contraceptives. Their data suggested that patients with *T vaginalis* had an increased prevalence of frothy leukorrhea, a pH $>$ 4.5, lack of contraception, *Neisseria gonorrheae* cervicitis, and a lack of microscopically identified yeast. Despite a 32% prevalence of *T vaginalis* in the population, none of the factors associated with the infection had a positive predictive value of 0.50 or more. The findings in the current study support the conclusions that *T vaginalis* is not readily recognized microscopically, and that clinical manifestations are not reliable diagnostic parameters.

The Papanicolaou smear has been shown to have a sensitivity of 78% to 85%[23,48] and a positive predictive value of 81% to 97%[23,48] (prevalence 20.4%[48]) in the diagnosis of *T vaginalis*. If adjusted for a population with a prevalence of *T vaginalis* of 14% (as seen in this study), the positive predictive value would be expected to be 93%. Confirmation of this finding is necessary.

SUMMARY AND RECOMMENDATIONS

It is impossible to predict the type of vaginal infection a patient has by marital status, socioeconomic status, educational level, sexual history, past history of vaginal or cervical infections, pregnancy status, and mode of birth control. An open mind and an objective evaluation of the patient are imperative to prevent erroneous diagnoses.

Of the three organisms studied, *G vaginalis* is the most common potential pathogen found in the vagina, both in symptomatic and asymptomatic women. Presence of a gray or creamy discharge, amine odor on application of potassium hydroxide to discharge, or clue cells on microscopic examination have a positive predictive value of 50% or greater when at least one is present, and 89% or greater if more than one are present. Therefore, for this infection, the diagnosis can often be made confidently in the office without confirmatory cultures. If *G vaginalis* infection is diagnosed by the above criteria, treatment for that organism should be started and the patient reevaluated if symptoms persist.

C albicans is the second most frequent potentially pathogenic organism found in the vagina—again in both symptomatic and asymptomatic women. Historical and physical examination findings were not predictive of the presence of this organism, even when including use of oral contraceptives, recent use of antibiotics, or pregnancy. The microscopic identification of budding yeast or pseudohyphae were the best office tests for identifying this organism, but the lack of these was not evidence that the organism was absent. Office diagnosis of this organism is therefore inexact. If a definitive diagnosis is needed, or if the evaluation

does not suggest a diagnosis, a culture for *C albicans* (office or referral laboratory) should be done.

T vaginalis was more common in patients with symptoms than in asymptomatic patients; however, the positive predictive value of symptoms was only 20%. Other historical, physical examination, and office laboratory factors were not predictive of this organism. Previous studies suggest Papanicolaou smear diagnosis is promising; this method needs further evaluation. Also, further study of office cultures for identification of this organism is necessary. Cultures for *T vaginalis* should be considered in resistant cases of vaginitis and in cases in which the diagnosis is unclear.

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