GENERAL GYNECOLOGY

Rapid testing for vaginal yeast detection: a prospective study

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OBJECTIVE: The purpose of this study was to determine the accuracy of rapid vaginal yeast detection assay compared with yeast cultures for the diagnosis of vulvovaginal candidiasis.

STUDY DESIGN: This was a prospective study that involved 104 subjects, 34 asymptomatic women and 70 symptomatic women with vaginitis. Vaginal swabs were obtained from all subjects for wet mount, yeast culture, and the rapid yeast detection test. Overall, the prevalence rate was 39.4%, based on positive yeast cultures. The rapid yeast test performed by the physician was positive in 30 of 41 subjects with positive cultures and 13 of 63 subjects with negative cultures.

RESULTS: The rapid yeast test had 73.1% sensitivity and 82.0% negative predictive value compared with the wet mount, which had 43.9% sensitivity and 70.9% negative predictive value. In symptomatic patients, the test had 77.4% sensitivity and 81% negative predictive value compared with wet mount, which had 51.6% sensitivity. Patient-performed test results were identical to the tests that were performed by the physicians. The cost of the rapid yeast test kit is estimated to be <$10, compared with a mean of $65 for the yeast culture.

CONCLUSION: Rapid yeast detection assay is accurate and affordable compared with the gold standard yeast culture in the diagnosis of vulvovaginal candidiasis. Relative to the wet mount, it is more sensitive, cheaper, and accurate for the rapid diagnosis of vaginal yeast infection.

Key words: rapid test, rapid yeast test, vulvovaginal candidiasis, yeast

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Vaginitis alone is 1 of the most common complaints for physician visits in the United States[1] that results in 10 million office visits per year.[2] Approximately 30% of all vaginitis cases are caused by infection with Candida species.

Approximately 70-90% of vulvovaginal candidiasis (VVC) cases are caused by *Candida albicans*, with the remainder of infections caused by *C glabrata* and *C tropicalis*.[3] VVC results from the overgrowth of the various Candida species that may already be present in the vagina.[4] The presence of organisms such as *Lactobacillus acidophilus*, the most common bacteria found in the vagina, help prevent the overgrowth and subsequent infection by pathogens such as yeast. Although VVC can occur without any identifiable precipitating factor, certain conditions that disrupt the balance of normal vaginal flora can predispose individuals to the development of symptomatic infection. The use of antibiotics, oral contraceptive pills, contraceptive devices, high estrogen levels (as during pregnancy and hormone replacement therapy), or certain medical conditions such as uncontrolled diabetes mellitus and HIV can increase an individual's risk of the development of VVC.[5-7]

Current recommended guidelines regarding screening for VVC, as published by the Centers for Disease Control and Prevention (CDC) in 2004, consist of microscopy, saline wet mount, whiff test, pH determination, or gram stain. Despite the existence of such criteria and the relative frequency with which it is encountered in the office setting, the considerable overlap of VVC symptoms with other vaginal conditions and variability in the appearance of a discharge makes the condition difficult to diagnose correctly.[8] In primary care clinical settings, a rapid presumptive diagnosis is often made on the basis of the patient's history, clinical features, vaginal pH, and direct microscopy (wet mount with saline solution and potassium hydroxide). However, several studies have shown that detection by the aforementioned approach was positive in only 50-80% of women with positive yeast cultures,[9-11] which demonstrates the limited accuracy. Other studies have shown a much lower sensitivity of wet mount (39.6%) to correctly diagnose VVC.[12] Consequently, the gold standard for diagnosis is still growth of the organism in culture (Sabouraud's agar). However, this method is not always practical because it is very expensive and can take up to 7 days to yield definitive results. In addition, self-diagnosis by patients can be inaccurate in patients with or without previous episodes of VVC, which potentially leads to inappropriate therapy, a delay in correct diagnosis and treatment, a cost that is related to unnecessary treatment, and the precipitation of vulvar dermatitis.[12]

In addition to the challenge of correctly diagnosing VVC, the cost of reaching a di-

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TABLE 1
Test results from symptomatic and asymptomatic patients

Test type	Positive culture (n)	Negative culture (n)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Rapid yeast test			73.1	79.4	69.8	82.0
Positive test result	30	13				
Negative test result	11	50				
Wet mount			43.9	88.9	72	70.9
Positive rest result	18	7				
Negative test result	23	56				

agnosis in patients with symptoms of vaginitis vary widely, depending on the amount of testing at the initial visit. The approximate cost of various tests (Table 1) was based on labor costs as reported by the US Bureau of Labor and Statistics in 2003 and laboratory and physician costs from the Medicare Fee Schedule.[13]

Compared with testing strategies, empiric treatment strategies resulted in fewer referrals (40 vs 41% to 46%) but more adverse effects (11-19% vs 6%).[14] Depending on the testing strategy, the savings that were associated with adding empiric treatment while awaiting test results ranged for $8 to $63 (mean savings, $39) and shortened symptom duration by 0.6 and 1.3 days, even after accounting for additional side-effects and cost related to empiric treatment.[14] Moreover, over-the-counter treatments for VVC are becoming more available. As a result, more women are self-diagnosing VVC and buying antifungal creams, tablets, or suppositories over the counter for use in the vagina. However, misdiagnosis is common because bacterial vaginosis, trichomoniasis, and yeast infection are difficult to distinguish on the basis of symptoms alone, and studies have shown that as many as two-thirds of all over the counter drugs that are sold to treat VVC were used by women without the disease. Overuse of these antifungal medications can increase the chance of the development of resistance to medications. Therefore, it is important to have a sure, easy, and rapid diagnostic tool. Accurate diagnosis, both in the clinical and home settings with the use of self-collected vaginal swabs, therefore, can have a significant impact on health care costs and better management of VVC.

The objective of this study was to determine the role, cost effectiveness, and accuracy of a rapid vaginal yeast detection assay that has been developed by Savyon Diagnostics Inc, when performed by a physician and/or patient in diagnosing VVC, compared with the gold standard yeast culture.

Materials and Methods

The Institutional Review Board of Temple University School of Medicine approved the protocol and gave consent for this study. This was a prospective study in which both symptomatic and asymptomatic patients were recruited. Patients who were recruited were not pregnant and at least 18 years old. Symptoms included vaginal discharge, itching, irritation, and/or odor. Vaginal samples were taken for wet mount, yeast culture, and the rapid yeast test manufactured by Savyon Diagnostics. Subsequent to examination, all patients were asked to perform their own rapid yeast detection test after reading the instructions provided by the manufacturer in the test kit. To maintain uniformity, the senior author performed all saline solution wet mount and 10% potassium hydroxide preparations. Patients with a positive wet mount were treated with an antifungal agent, even if their rapid yeast detection test was negative. The cultures that were obtained were sent to the same laboratory for analysis.

The rapid yeast detection test that was used for this study uses the concept of lateral flow immunoassay systems. In the assay, the sample is added to 1 end of the device and is carried through the interstitial spaces of the material by capillary action. A capture binding protein (yeast antibody) is immobilized on a nitrocellulose membrane strip. Attached to the membrane strip is a conjugate pad that contains tagged conjugate (antibody). The conjugate pad is in contact with a sample pad that receives the liquid sample. When applied to the sample pad, the liquid sample migrates by capillary diffusion through the conjugate pad, rehydrating the tagged conjugate and allowing interaction of the analyte in the sample with the conjugate. The newly formed complex moves into the membrane strip and migrates toward the capture binding protein, where it becomes immobilized and produces a visual signal across the strip because of the formation of concentrated colored tags at this position. A second control line is formed on the membrane downstream of this line by an excess of tagged conjugate, which indicates proper function of the test. The excess of the fluid is absorbed by an absorbent pad, which is located at the distal end of the assay strip, that applies a pulling effect on the flow in addition to the capillary force.[15]

Results

The results of the office wet mount, physician-performed rapid test, patient-performed rapid test, and yeast cultures were analyzed. A yeast culture was reported as positive, even if it grew 1 colony. A total of 104 patients, 70 symptomatic patients and 34 asymptomatic patients, were enrolled in the study. Table 1 shows the overall results; Ta-

TABLE 2
Test results from symptomatic patients

Test type	Positive culture (n)	Negative culture (n)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Rapid yeast test			77.4	76.9	72.7	81
Positive test result	24	9				
Negative test result	7	30				
Wet mount			51.6	89.7	80	70
Positive test result	16	4				
Negative test result	15	35				

bles 2 and 3 categorize the results by symptoms.

Symptomatic and asymptomatic patients

The physician-performed rapid yeast test correctly identified 30 of the 41 patients with VVC (sensitivity 73.1 %), which was superior to wet mount (sensitivity 43.9%; Table 1). The specificity and positive and negative predictive values were 79.4%, 69.8%, and 82% respectively.

Symptomatic patients

Of 70 symptomatic patients, 31 patients had positive cultures, and 39 patients had negative cultures, with a prevalence rate of 44.3%. The rapid yeast test was positive in 24 of 31 patients with positive cultures and 9 of 39 patients with negative cultures (Table 2). Subjects with positive yeast cultures had a sensitivity of 77.4%, compared with wet mount, which was positive in only 16 of the 31 patients (sensitivity, 51.6%).

Of the 39 symptomatic patients who had negative yeast cultures, the physician-performed rapid yeast test was negative in 30 patients (specificity, 76.9%); the wet mount was negative in 34 patients (specificity, 89.7%; Table 2).

Asymptomatic patients

Of 34 asymptomatic patients, 9 patients had positive cultures, and 25 patients had negative cultures, with a prevalence rate of 26.5%. The sensitivity, specificity, and positive and negative predictive values for the rapid yeast test in this group were 55.6%, 84.9%, 55.6%, and 84%, which were comparable with or better than the wet mount. Patient-performed tests had results similar to those done by physicians.

COMMENT

VVC is 1 of the most common complaints encountered by physicians in the office setting. Diagnosis is based currently on clinical history and symptoms and microscopy. However, the accuracy of VVC with this method is limited; the sensitivity of wet mount is reported to be as low as 39.6%.[12] The gold standard of diagnosis for VVC is still growth of the organism in culture; however, this method is considerably more costly, and definitive results can take up to 2 days. In addition, many patients with nonspecific symptoms of vaginitis will attempt to self-diagnose without the help of a physician. Studies have shown that such patients diagnose themselves accurately only 34% of the time. Ultimately, such methods can lead potentially to inappropriate therapy, a delay in the correct diagnosis, and increased cost. The rapid yeast test can be used to identify, confirm, or rule out disease in symptomatic patients and thereby lead to accurate therapy. The ability to provide test results rapidly to the patient is 1 of the most important properties of the test kit being studied. In addition, the test kit is simple to use; requires little in the way of facilities, equipment, or training; is easily interpretable; and is stable when stored under extreme conditions. Obviously, more accurate diagnosis will reduce inappropriate over-the-counter antifungal therapy for other forms of diagnosis, such as bacterial vaginosis.

TABLE 3
Test results from asymptomatic patients

Test type	Positive culture (n)	Negative culture (n)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Rapid yeast test			55.6	84.9	55.6	84
Positive test result	5	4				
Negative test result	4	21				
Wet mount			22.2	88	40	75.9
Positive test result	2	3				
Negative test result	7	22				

TABLE 4
Cost of various tests

Test	Cost ($)
Wet mount	8.06
Gram stain	8.06
Vaginal culture (Candida species)	15.86
Physician office visit	50.32
One hour of patient time for office visit	24.48
Specialist consultation	164.34

The rapid yeast detection test, which can be administered either by a health care provider or by the patient at home, can potentially help alleviate misdiagnosis of VVC. In both symptomatic and asymptomatic patients, the rapid yeast detection test had a higher sensitivity than the wet mount (73.1% vs 43.9%). In addition, the negative predictive value of the rapid yeast detection test was higher than the wet mount (82.0% vs 70.9%), potentially helping prevent unnecessary treatment of patients. Our study shows that patients are able to perform the test as well as physicians. The availability of an over-the-counter test to detect VVC would eliminate millions of physician office visits and allow the patient to self-diagnose accurately and self-treat, thereby reducing health care costs related to this common condition. It would also allow primary care physicians and obstetricians and gynecologists to diagnose accurately and to treat patients with lower costs. Misdiagnosis and over treatment would significantly decrease as a result of the availability of this rapid test.

The cost of the rapid yeast detection kit to the consumer, once available over the counter as per the manufacturer (Savyon Diagnostics), is estimated to be <$10 (Table 4). The results of this study propose that the rapid yeast detection test is potentially cost-effective and time-saving, compared with yeast culture ($65 for culture). This test would help alleviate the problems, such as increased cost, an increase in vestibulitis/ vulvar dermatitis, and excess time spent by the clinician, that are associated with misdiagnosis and subsequently incorrect treatment. The rapid testing will shorten the time to diagnosis for yeast infection and improve the turnover of patients in the clinician's office. The prompt availability of results will improve the efficiency of patient care in the outpatient setting.

FIGURE
Rapid test kit for vaginal yeast infection: Savyon Diagnostics

The test appears to perform similarly among symptomatic and asymptomatic women. However, the main application of the test will be in the evaluation of symptomatic women with vulvovaginitis. An added advantage is the potential for use by patients for self-diagnosis over the counter, which will result in time and cost savings. ■

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