

## Experience with routine vaginal pH testing in a family practice setting

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**Background:** Despite recommendations by Centers for Disease Control and the American College of Obstetricians and Gynecologists, pH testing is infrequently performed during the evaluation of vaginitis. Consequently, little information exists on its use in a primary care setting.

**Objective:** The aim of this study was to describe our experience with routine pH testing, particularly the relationship between symptoms, pH and wet-mount microscopy.

**Method:** A retrospective chart review was performed on 203 consecutive cases evaluated for vaginitis by wet-mount microscopy.

**Results:** Of the 203 cases, 21 had normal pH and no symptoms and 182 had symptoms, elevated pH or both; 85% of cases had abnormal wet-mount findings, including 75% with clue cells, 14% with *Trichomonas vaginalis*, 13% with yeast and 14% with mixed infections. Asymptomatic infection was present in 42% of cases with clue cells alone, 44% of cases with *Trichomonas vaginalis* alone, 38% of all trichomoniasis cases and 33% of cases with mixed infections. Elevated pH was associated with clue cells ( $p < 0.001$ ), trichomoniasis ( $p = 0.01$ ) and mixed infections ( $p = 0.003$ ). Normal pH was associated with negative wet mount ( $p < 0.001$ ) and to a lesser degree with uncomplicated vulvovaginal candidiasis ( $p = 0.06$ ).

**Conclusion:** Routine pH testing increased detection of trichomoniasis and bacterial vaginosis by prompting microscopy in a significant proportion of asymptomatic cases.

Key words: BACTERIAL VAGINOSIS; *TRICHOMONAS VAGINALIS*; ASYMPTOMATIC VAGINITIS; VAGINAL pH

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Vaginitis is a common diagnosis in primary care and accounts for 10 million office visits annually<sup>1,2</sup>. Symptoms and signs are not of much value in determining the presence and etiology of vaginitis<sup>3</sup>. Moreover, vaginitis is often asymptomatic<sup>4</sup>. Current Centers for Disease Control (CDC) and American College of Obstetricians and Gynecologists (ACOG) guidelines state that vaginitis is diagnosed by the microscopic exam-

ination of vaginal discharge (wet mount) and the measurement of vaginal pH<sup>5,6</sup>. Based on pH determination, cases can be placed in one of the two major diagnostic categories: normal/candidiasis if pH is normal, and bacterial vaginosis/trichomoniasis if pH is elevated<sup>4</sup>. However, pH testing is infrequently performed<sup>7</sup>. Consequently, little information exists on routine pH measurement in a primary care setting. We routinely

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perform pH testing for all women undergoing pelvic examination. Microscopic examination follows in all cases with vaginal symptoms and in those with elevated pH. In this report we describe our experience with pH testing and particularly the relationship between symptoms, vaginal pH and wet-mount microscopy.

## MATERIALS AND METHODS

This retrospective study took place between January 1998 and March 2000 in the Family Medicine Clinic at the University of Nebraska Medical Center in Omaha, Nebraska. The University's Institutional Review Board approved the study. Wet mounts were performed in 230 of the 470 consecutive cases of pelvic examination during the study period, i.e. for all women with vaginal symptoms and/or elevated pH and for 21 women who had no symptoms and normal pH. In these latter cases wet mounts were requested because the women either asked for sexually transmitted disease (STD) screening, presented for test of cure, or complained of pelvic pain or menstrual irregularity. Wet-mount records were matched with clinical progress notes. However, 27 cases were excluded: 6 were postmenopausal, 7 were bleeding, in 1 pH was listed as borderline, and in 13 data were incomplete (no symptoms or pH recorded). The remaining 203 cases with data on symptoms, vaginal pH and wet-mount findings were included in the current analysis. None of the women was pregnant. Two authors of the study (AP and SP) performed all the pelvic examinations, which were carried out for a variety of reasons, including routine Pap smear, vaginal complaints, pelvic pain, STD screening and menstrual irregularity. Vaginal symptoms included abnormal vaginal discharge, itching or irritation and odor. Clinicians routinely tested vaginal pH in all women undergoing pelvic examination. A Dacron swab was rubbed against the lateral vaginal wall and applied to Nitrazine paper (phenolphthalein paper, Apothecon), range 4.5–7.5. The pH was defined as elevated if the level was greater than 4.5. Immediately after the pelvic examination, two experienced laboratory technicians performed a microscopic examination of vaginal discharge mixed with saline. The technicians were

unaware of clinical presentation or pH at the time. They recorded the presence of clue cells, *Trichomonas vaginalis* (TV), yeast and white blood cells. Clue cells were identified as squamous epithelial cells whose borders were obscured by small bacteria. We defined the diagnosis of bacterial vaginosis (BV) by the presence of clue cells on microscopic examination.

Pearson chi-square tests on dichotomous or categorical factors assessed differences between the groups. Fisher's exact tests were performed when expected cell frequencies were less than 5. Two-sided tests with *p* values less than 0.05 were considered statistically significant.

## RESULTS

Of the 443 women undergoing pelvic examination, 261 (59%) were asymptomatic and had a normal pH. Wet mounts were completed for a small proportion of these women (21/261 or 8%) and for all 182 women who were symptomatic (118/443 or 27%) or had elevated pH (162/443 or 37%). The demographic characteristics and prevalence of symptoms and elevated pH in the group with wet mounts (203 women) are depicted in Table 1. The average age of women with wet-mount results was 30.5 years, and ranged from 14 to 49 years. A majority of women were black (62%). More than half (58%) of

**Table 1** Demographic characteristics and prevalence of symptoms and elevated pH in study population of 203 women

Characteristics	Number (%)
Mean age in years (range)	30.5 (14–49)
Race*	
black	126/202 (63%)
white	69/202 (34%)
other	7/202 (3%)
Symptoms and signs	
pH > 4.5	162/203 (80%)
Vaginal symptoms	118/203 (58%)
discharge	105/203 (52%)
odor	50/203 (25%)
pruritus	47/203 (23%)
No elevated pH or symptoms	21/203 (10%)

The information on race is missing in one case

**Table 2** Symptoms, vaginal pH and wet-mount microscopy

Microscopy	Asymptomatic				Symptomatic			
	Normal		pH > 4.5		Normal		pH > 4.5	
	n	%	n	%	n	%	n	%
Negative	17	81	2	3	11	55	0	0
Yeast alone	1	5	0	0	8	40	3	3
Clue cells alone	2	9	49	76	1	5	70	71
TV* alone	1	5	3	5	0	0	5	5
Mixed	0	0	10	16	0	0	20	21
Total	21	100	64	100	20	100	98	100

n, number; \*of additional 20 cases of TV (*Trichomonas vaginalis*) found within mixed infections 7 were asymptomatic

women for whom wet-mount testing was performed had symptoms associated with vaginal infection, including abnormal vaginal discharge (52%), odor (25%) and pruritus (23%). A majority (63%) of symptomatic women had more than one symptom, and the symptoms of odor and pruritus were rarely noted without abnormal discharge.

Overall, 85% of women with wet-mount results had abnormal findings, including 75% with clue cells, 14% with TV, and 13% with yeast; 30 women (14%) had mixed infections, including 15 with clue cells and TV, 10 with clue cells and yeast, and 5 with clue cells, TV and yeast. The relationship between symptoms, vaginal pH, and findings on wet-mount microscopy is presented in Table 2. Elevated pH was significantly associated with clue cells ( $p < 0.001$ ), TV ( $p < 0.01$ ) and mixed infections ( $p = 0.003$ ). Normal pH was associated with negative wet mount ( $p < 0.001$ ) and to a lesser degree with uncomplicated vulvovaginal candidiasis (VVC) ( $p = 0.06$ ). Among 41 women with normal vaginal pH levels, 28 (68%) had normal wet-mount findings, in contrast to only 2 (1%) of 162 women with elevated pH. None of the 30 women with mixed infections had normal vaginal pH. In symptomatic cases with TV, clue cells or both on wet mount, elevated pH had sensitivity of 98.9% (95/96), specificity of 86.4% (19/22), PPV of 96.9% (95/98), and NPV of 95% (19/20). In 138 cases, *Neisseria gonorrhoeae* (GC) and *Chlamydia trachomatis* (CT) DNA probe analysis was performed and 8 (6%) were found positive (2 GC, 5 CT, 1GC + CT) (data not shown). All 6 cases with CT had elevated pH, clue cells, TV or mixed infection on wet mount. Of the 2 cases with GC alone, 1 had elevated pH and

clue cells present on wet mount and 1 had normal pH and negative wet mount.

Asymptomatic infection was found in 44% cases with TV alone, 41% cases with BV alone, 38% of all TV cases and 33% cases with mixed infections (Table 2). Wet-mount findings were associated with symptoms ( $p = 0.02$ ); 22% of asymptomatic women had normal wet-mount findings compared with only 9% of symptomatic women. However, symptoms and vaginal pH were less correlated ( $p = 0.2$ ). In women with and without symptoms, elevated pH was strongly associated with wet-mount findings ( $p < 0.01$  in each group). Among a total of 85 asymptomatic women, 62 (97%) of 64 women with elevated pH had abnormal wet-mount findings, whereas only 4 (19%) of 21 women with normal pH had abnormal wet mounts. Similarly, in a total of 118 symptomatic women, all 98 women with pH levels  $> 4.5$  had abnormal wet mounts, whereas 9(45%) of 20 women with normal vaginal pH had abnormal wet mounts. Of the 9 women with vaginal symptoms and normal vaginal pH, 8 had VVC and 1 had clue cells detected on wet mount. In the subgroup of 20 symptomatic women with normal vaginal pH, the complaint of vaginal pruritus was marginally associated ( $p = 0.09$ ) with VVC detected on wet mount (Table 3). Of the 7 women with discharge but no pruritus, 6 (86%) had no abnormal wet-mount findings, whereas 7 (54%) of 13 women with pruritus had VVC diagnosed on wet mount.

## DISCUSSION

Testing for vaginal infections is not usually part of a routine gynecological evaluation. Routine

**Table 3** The relationship between type of symptoms and microscopy in 20 symptomatic cases with normal pH

Wet-mount result*	Discharge without pruritus		Pruritus alone or with discharge	
	n	%	n	%
Negative	6	86	5	38
Yeast alone	1	14	7	54
Clue cells alone	0	0	1	8
Total	7	100	13	100

n, number; \*No TV (*Trichomonas vaginalis*) or mixed infections were detected in these women

microscopic evaluation would be time consuming and probably not cost effective (we would have done an additional 240 wet mounts in cases with no symptoms and normal pH). Screening for vaginitis is not recommended by current guidelines, but some believe that it should be part of routine clinical practice since vaginitis is often asymptomatic and diagnostic sensitivity of health-care providers is often low<sup>8,9</sup>. Whereas many women with vaginitis are truly asymptomatic, others do not volunteer their symptoms for various reasons<sup>4</sup>. A whiff test and pH testing are recommended in evaluation of vaginitis<sup>4-6</sup> and can be used as screening tools<sup>8</sup>. The whiff test is, in our experience, less practical because it requires a good sense of smell and the willingness of laboratory personnel and/or the clinical provider to perform it. On the other hand, hydrogen ion concentration is a good predictor of vaginal health<sup>10,11</sup>. In our experience, pH testing provides an excellent opportunity for women's education on vaginal physiology. It is well accepted by our patients, and it reminds clinicians to ask about potentially harmful practices, such as douching, and to offer reassurance when there are unnecessary worries.

Routine screening with a pH test detected a significant number of asymptomatic infections in our study population. This provided enabled us to treat asymptomatic trichomoniasis and to counsel women about BV. At this time, treatment of asymptomatic BV is not recommended except perhaps for women undergoing certain invasive gynecologic procedures or those who are pregnant and at high risk for preterm labor<sup>5</sup>. This will probably change as our understanding of the

pathophysiology of BV improves and more effective treatments become available. In fact, results of the recent large randomized controlled trial indicate that treatment of asymptomatic bacterial vaginosis with oral clindamycin early in the second trimester significantly reduces the rate of late miscarriage and preterm birth in the general obstetric population<sup>12</sup>. The authors infer that the best time to screen and treat could be before any pregnancy<sup>12</sup>.

Riordan *et al.* reported that measurement of vaginal pH was the most useful clinical finding directing empirical therapy<sup>13</sup>. Our data in symptomatic cases support this observation: 99% of the patients for whom metronidazole was appropriate therapy had high pH, whereas only 3% (3/98) of those with elevated pH had neither TV nor clue cells on microscopy. We do not support empirical treatment of vaginitis; however, in many settings in the USA microscopy is not available and diagnosis and treatment remain largely empirical and inaccurate<sup>14</sup>.

Our study has several limitations. One limitation is the retrospective design; however, the aim was to describe our routine clinical practice. We could not evaluate the value of pH testing as a screening test for infectious vaginitis because microscopy was not performed for the majority of asymptomatic cases with normal pH, under the assumption that they were normal. Consequently, our group with normal pH was disproportionately small. Previously, pH testing was reported to be a highly sensitive but less specific screening tool<sup>8,9,15</sup>, e.g. 100% sensitive for BV and trichomoniasis in a family planning clinic in Peru<sup>8</sup>. One study from Thailand found that sensitivity of pH testing for infectious vaginitis was only 50%, but here the study population and design were different<sup>2</sup>. The gold standard for vaginitis also included presence of yeast (which is negatively associated with elevated pH), positive cervical cultures for gonorrhea, chlamydia, group B streptococcus and herpes simplex virus<sup>16</sup>.

We defined BV by the presence of clue cells on microscopy and not by Amsel's composite clinical criteria<sup>17</sup> or Gram-staining criteria<sup>18</sup>. It was previously reported that presence of clue cells was the single most reliable indicator of bacterial vaginosis<sup>19,20</sup>. Clinical criteria may be more

suitable for settings where no trained microscopists and/or working microscopes are available. Furthermore, Amsel's criteria are rarely used in European family practices and attempts were made to develop more practical wet-mount criteria for diagnosis of BV<sup>9,21</sup>. Gram-stain criteria are widely used in research settings, but are impractical for clinical use as the results are not available immediately.

Our results may not be applicable to other primary care settings for several reasons. Our study population was predominantly African-American, with a high prevalence of elevated pH, TV and BV. Microscopists and clinicians were well trained and experienced and study clinicians had additional training and experience in gynecology.

In summary, routine pH testing detected a significant number of asymptomatic infections in our study population. This provided an opportu-

nity to treat asymptomatic TV and counsel patients with asymptomatic BV. In symptomatic cases, elevated pH was associated with clue cells, TV and mixed infections, i.e. conditions where metronidazole might be appropriate treatment. On the other hand, normal pH was only weakly associated with VVC if pruritus was present and with negative wet mount if pruritus was absent. A larger prospective study including all women with normal pH is needed to assess this observation and to evaluate the value of a pH test as a screening tool for infectious vaginitis.

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