

Metronidazole with Lactacyd vaginal gel in bacterial vaginosis

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Abstract

Aim: To assess the efficacy and tolerability of lactic acid (Lactacyd vaginal gel; LVG) when given as an adjunct to metronidazole in the treatment of bacterial vaginosis (BV) among Filipino patients.

Methods: A multicenter, open-labeled, controlled, randomized, three-arm comparative study on 90 women aged 18 years or over with clinically and microbiologically proven BV.

Results: The lactobacilli colony count significantly increased over time in all three arms. At day 14, growth of lactobacilli was significantly higher among patients in the lactic acid gel and combination treatment arms. Significant reduction of malodorous vaginal discharge (whiff test) and lowest recurrence of BV were noted in the metronidazole plus lactic acid gel arm. Regarding disappearance of signs of BV, there was significant decrease in the pH level and frequency of clue cell positive patients across time but was not significantly different across treatment groups. Only one patient (3%, 1/60) among those who received lactic acid gel complained of increased curd-like discharge. Six patients (10%, 6/60) who received metronidazole complained of epigastric pain/discomfort, dizziness and dyspnea.

Conclusions: Lactic acid gel (LVG) is safe and as efficacious as metronidazole in the treatment of BV. There is evidence that LVG when combined with metronidazole is superior to metronidazole alone in promoting lactobacilli colonization. LVG as an adjunct to metronidazole, having the least number of recurrent BV, appears to result in better long-term treatment effect on bacterial vaginosis.

Key words: bacterial vaginosis, lactic acid vaginal gel, metronidazole.

Introduction

A normal microbiologic ecosystem exists in the vagina. The *Lactobacilli* dominate the flora but many other species may be isolated from a healthy individual. Disequilibrium leading to changes in the vaginal content without inflammatory reaction is termed bacterial vag-

inosis. Bacterial vaginosis (BV) is the most common type of vaginitis in women in the reproductive age. Prevalence varies from 5% of college population to more than 60% of women treated at sexually transmitted disease clinics.¹ It is unclear whether or not BV is a sexually transmitted infection. It is often associated with sexually transmitted disease risk factors, such as

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multiple sexual partners, but obtaining proof of sexual transmission is impossible because no single sexually transmitted pathogen has been isolated.²⁻⁴

The vagina is a complex ecological environment with a concentration of microorganisms reaching 100-million colony forming units (CFU)/mL of vaginal fluid. The hydrogen peroxide-producing *Lactobacilli* which constitute most of the normal vaginal flora play an important role in maintaining the acidity that characterizes the normal vaginal secretion.⁵ The pH of normal vagina secretion is <4.5.⁶ This acidity is due to the presence of lactic acid formed from the splitting of glycogen present in the vaginal epithelial cells. The interaction between *Lactobacilli* and other organisms of the vaginal flora usually inhibits overgrowth of potentially pathogenic organisms. With virtual disappearance of the hydrogen peroxide-producing *Lactobacilli* agents like *Gardnerella*, mycoplasmas and anaerobes proliferate and attach to vaginal epithelial cell surfaces to form clue cells. These clue cells serve as a principal diagnostic marker for the syndrome. Therefore, altering this complex balance can increase the concentration of potential pathogens, producing symptoms of infection. Ensuring that the vagina is colonized by *Lactobacilli* reduces this possibility.⁷

The high concentration of potentially virulent bacteria in the vagina is related to other upper genital tract infection. Patient with BV have a sixfold increased rate of postpartum endometritis after cesarean section, a threefold increased rate of pelvic inflammatory disease after therapeutic abortion, and a three-fourfold increased rate of vaginal cuff cellulitis after abdominal hysterectomy. Pregnant patients with BV have a 50–100% increased rate of preterm low birthweight delivery, amniotic fluid infection and chorioamnionitis.⁸⁻¹⁰

Various studies have shown an association between urinary tract infection and abnormal vaginal infection. Harmanli *et al.* studied women who presented for routine gynecologic examination and found that 22.4% with urinary tract infection also had BV compared with 9.7% without BV. This is suggestive that BV is a risk factor for urinary tract infection.¹¹

Bacterial vaginosis has also been linked with abnormal pap smear results. The study of Platz-Christensen *et al.* showed that cervical intraepithelial neoplasia was significantly more common among women with BV (diagnosed by the presence of clue cells) than in women without BV ($P < 0.001$). This raises the hypothesis that BV can be a cofactor with human papilloma virus in the development of cervical intraepithelial neoplasia.¹²

Data on the role of BV as a risk factor for HIV infection are accumulating. In a prospective study, Martin *et al.* reported that HIV seroconversion was associated with BV and loss of *Lactobacilli*.¹³ Cu-Uvin *et al.* showed in a study of genital tract shedding that among women with well-controlled HIV infection, women with BV were nearly sixfold more likely to shed virus than women with candidiasis.¹⁴

Oral metronidazole is currently the treatment of choice for bacterial vaginosis with a reported cure rate of 80–90%.^{15,16} Studies have shown that even after treatment with metronidazole, 50–70% women will develop recurrence in 4–6 weeks, nearly 70% will have BV again within 90 days, and up to 80% will experience at least another episode within a year.¹⁷ After normal hydrogen peroxide-producing *Lactobacilli* disappear, it is difficult to reestablish the normal vaginal flora, thus, recurrence of BV is common.¹⁸ The concept of recolonizing the vagina with healthy strains of *Lactobacilli* that produce large amounts of hydrogen peroxide to prevent relapse after treatment is being investigated.¹⁹

Lactacyd vaginal gel (LVG; Sanofi-Synthelabo Philippines, Makati City, Philippines) is an acidifying gel composed of lactic acid which helps reestablish the vaginal microbial environment by lowering the vaginal pH and glycogen which serves as nutrient that encourages the growth of *Lactobacilli*. One 5-g tube of LVG contains 225 mg of lactic acid, 5 g of glycogen, and excipients composed of propylene glycol, methylhydroxypropyl cellulose, sodium hydroxide and purified water. The efficacy of LVG has been shown in controlled clinical trials: Vaginal application of LVG for 7 days was shown to be as effective as metronidazole 500 mg b.i.d. given orally for 7 days in the treatment of bacterial vaginosis.²⁰ It was also shown to be effective in preventing the recurrence of vaginosis when administered intermittently for 3 days following menstruation in women with recurrent bacterial vaginosis.²¹

This study aims to assess the effect of locally applied lactic acid (LVG) when given as an adjunct to oral metronidazole in bacterial vaginosis among Filipino patients.

Materials and Methods

The study was designed as multicenter, open-labeled, randomized, controlled, three-arm comparative study on 90 women aged 18 years or over with clinically and microbiologically proven BV. In a study by Andersch *et al.*,²⁰ where lactic acid was used as intermittent

Table 1 Basic characteristics of patients

	Lactic acid gel group	Metronidazole group	Metronidazole + lactic acid gel group	P-value
No. of patients enrolled	30	30	30	
No. of patients who returned for follow up after 1 week	30	27	26	
No. of patients who returned for follow up after 2 weeks	30	26	27	
No. of patients who were followed up by phone in week 8	30	28	27	
Age (mean \pm SD)	36.0 \pm 9.2	34.9 \pm 9.8	32.9 \pm 10.3	0.4977*
Parity (no. with >1 children)	21	15	15	0.9368**
Marital status (no. married)	24	17	18	0.7350**

*ANOVA, $\alpha = 0.05$, 2-sided, $P > 0.05$: not significant. ** χ^2 test, $\alpha = 0.05$; two-sided: $P > 0.05$: not significant.

prophylaxis for recurrent bacterial vaginosis, the clinical and microbiological diagnosis of BV was established if the patient's discharge fulfilled at least three of the following criteria: (i) vaginal pH \geq 4.7; (ii) a positive amine test; (iii) presence of clue cells in the wet smear; and (iv) a characteristic homogeneous vaginal discharge. The same criteria were used in this study.

At baseline, the vaginal secretion collected from the posterior fornix was cultured and subjected to whiff test, Gram stain, and pH measurement. Patients who met the selection criteria were randomly assigned to one of the three treatment groups. The first group received 5 g of lactic acid vaginal gel at bedtime for 7 days. The second group received oral metronidazole 500 mg two times a day for 7 days. The third group received the combination of oral metronidazole 500 mg two times a day and 5 g of lactic acid vaginal gel at bedtime for 7 days.

Culture of the vaginal discharge, whiff test, Gram stain and pH measurement were repeated on the third, seventh and 14th day. Symptoms of vaginosis, adverse events and treatment compliance were recorded. Patients were followed up by telephone on day 56 and were asked about recurrence of foul-smelling vaginal discharge or need for hospital attendance for re-treatment covering the period from day 15 to day 56.

Table 1 presents the basic characteristics of recruited patients. The mean age, parity and marital status of patients were comparable across treatment groups (P -values > 0.05) (Table 1). All patients in the lactic acid gel arm completed the study while three from the metronidazole + lactic acid group and two from metronidazole group were lost to follow-up. Four patients each from metronidazole and metronidazole + lactic acid groups had missed visits. None of the drop-out cases were treatment-related.

Microbiological laboratory tests

Amine/whiff test

After the removal of the speculum, a small amount of 10% potassium hydroxide (KOH) was dripped on the speculum where some secretion was always found. A rotten fishy odor was recorded as positive.

pH measurement

Vaginal discharge collected was scraped off to a pH paper (Merck, Darmstadt, Germany) and read in comparison to the standard reading provided by the manufacturer.

Wet smear

Vaginal discharge was collected from the posterior fornix and mixed with normal saline for microscopic examination. Yeast cells and *Trichomonas vaginalis* were searched for in the vaginal smear. Clue cells were identified as vaginal epithelial cells with adherent bacteria which obscured the cell border. The ratio of leukocytes to epithelial cells was observed. A value of >1 was taken as a sign of inflammatory disease.

Gram stain

Two smears were made from the vaginal discharge and Gram stained. One smear was read by the research assistant at the study site. The second smear was sent to the microbiology laboratory for validation by the microbiologist. The Gram stain was performed to double check the presence of clue cells and yeast cells and other bacteria.

Culture/colony count of Lactobacilli and other bacteria

A 10- μ L measure of vaginal discharge was diluted to a 1:200 dilution. Then, 10 μ L of that dilution was

inoculated onto Wilkins Chalgren agar for the isolation of *Lactobacilli* and other bacteria that may have been present. The inoculated agar medium was placed in an anaerobic jar then sent as soon as possible to the microbiology laboratory for incubation at 35–37°C.

After 48-h incubation, the agar plate was examined for the presence of *Lactobacilli*. Suspected colonies were Gram stained and API 20 A was put up for identification. *Lactobacilli* colonies were counted. Other bacterial colonies present were counted and properly identified as well by using standard procedures. Culture procedure was performed in duplicate.

Statistical analysis

The *Lactobacilli* colony counts were log-transformed. The changes in vaginal pH levels and lactobacilli colony counts (log₁₀ CFU/mL) over time were analyzed using repeated measure ANOVA. Cochran’s Q was used to analyze the change in the proportion of patients with positive whiff test and clue cells over time. An χ^2 test was used to analyze the difference in the proportion of patients with positive whiff test and clue cells across treatment arms.

Data management was performed in MS Excel and SAS v.8 software programs (SAS Institute, Cary, NC,

USA). All statistical tests were two-sided with a 0.05 level of significance.

Results

Colonization of *Lactobacilli*

At baseline, the mean *Lactobacilli* colony count (log₁₀ [CFU/mL]) was comparable across the treatment arms ($P = 0.5847$; Table 2). While the mean *Lactobacilli* colony count consistently increased in the lactic acid arm during the course of treatment, it decreased in the other treatment arms on day 8 after initial increase at day 3. But although the mean colony count decreased in the combination arm right after treatment, its increase at day 14 followed the growth pattern of *Lactobacilli* in the lactic acid arm, which was significantly higher than those in the metronidazole arm ($P < 0.010$; Fig. 1).

Change in pH level

Table 3 presents descending pH levels through time but such changes were not significantly different across treatment groups ($P > 0.05$). Likewise, the distribution of patients with vaginal pH < 4.7 significantly increased through time ($P < 0.001$; Fig. 2). Although there was no substantial difference across

Table 2 Signs and symptoms of bacterial vaginosis (BV) at baseline

	Lactic acid gel group	Metronidazole group	Metronidazole + lactic acid gel group	P-value
pH in vaginal fluid (mean \pm SD)	5.1 \pm 0.67	5.4 \pm 0.86	5.2 \pm 0.76	0.4497*
No. with pH \geq 4.7	26	23	22	0.4993**
No. with whiff test (+)	27	29	29	0.0831**
Clue cells (+)	29	30	29	0.3371**
<i>Lactobacilli</i> (log ₁₀ [CFU/mL])	4.2 \pm 2.66	3.8 \pm 3.16	3.4 \pm 2.90	0.5847*

*ANOVA, alpha = 0.05, two-sided, $P > 0.05$: not significant. ** χ^2 test, alpha = 0.05, 2-sided: $P > 0.05$: not significant.

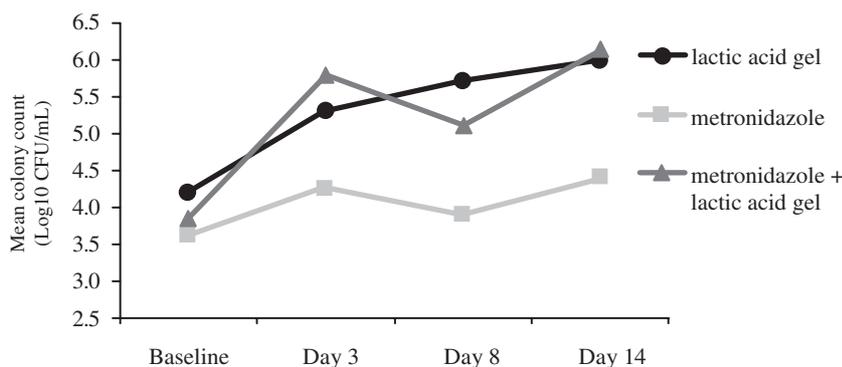


Figure 1 Change in *Lactobacillus* colony count. *Repeated measures ANOVA: $P < 0.001$ across visits; $P = 0.0045$ at day 8 between lactic acid gel group and metronidazole group; $P = 0.0002$ at day 14 between combination arm and metronidazole arm and between lactic acid gel arm and metronidazole arm.

Table 3 Mean pH level at each clinic visit by treatment group

Treatment arm**	Clinic visit*				
	Day 1	Day 3	Day 8	Day 14	
Lactic acid gel group	5.11	5.14	4.88	4.94	
Metronidazole group	5.38	4.93	4.85	4.79	
Metronidazole + lactic acid gel group	5.23	5.26	4.84	4.64	

*Repeated measures ANOVA: $P < 0.001$; mean pH level across time. **ANOVA: $P > 0.05$; mean change in pH level across treatment groups.

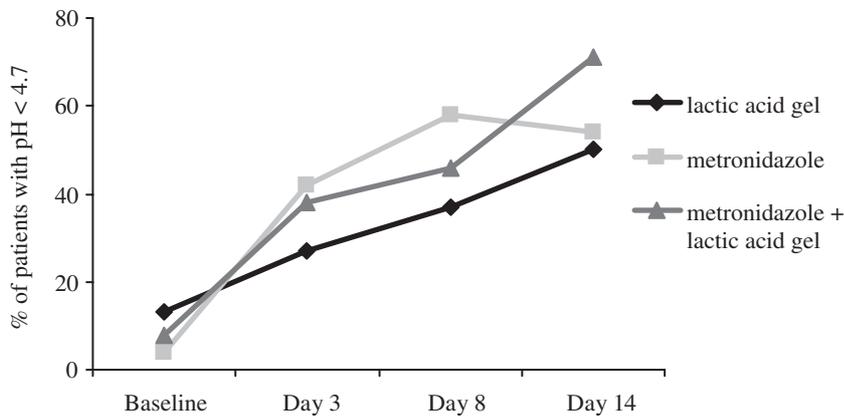


Figure 2 Frequency of patients with vaginal pH < 4.7* across clinic visits. *Cochran's Q-test: $P < 0.001$ across visits; χ^2 test: $P > 0.05$ across treatment groups.

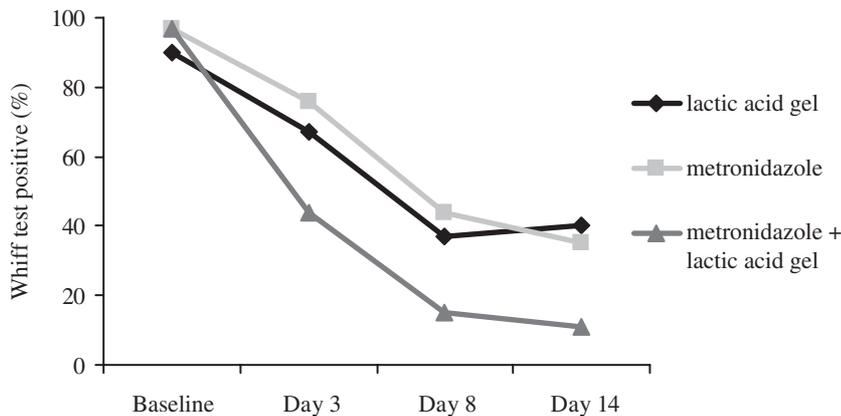


Figure 3 Frequency of patients with positive* whiff test. *Cochran's Q-test: $P < 0.001$ across visits; χ^2 test: P -values < 0.05 between combination arm and metronidazole arm across follow-up visits.

treatment arms, a trend for higher number of patients achieving pH < 4.7 was observed in the metronidazole plus lactic acid gel arm.

Whiff test

There was a significant decrease in the proportion of patients with positive whiff tests across clinic visits ($P < 0.001$; Fig. 3).

In all visits after baseline, the proportion of whiff test positive patients were significantly lower in the com-

bination arm compared to those in the metronidazole arm ($p_{\text{day3}} = 0.0162$, $p_{\text{day8}} = 0.0212$, $p_{\text{day14}} = 0.0410$). On the other hand, during and immediately after treatment, no significant difference between the combination arm and lactic acid gel arm was observed ($P > 0.05$). One week after the last dose of treatment, however, the combination arm proved to be better compared to lactic acid gel monotherapy in decreasing the proportion of patients with positive whiff test ($P = 0.0134$).

Clue cells

The improvement of patients was associated with the disappearance of clue cells in the Gram stain. Only 3 days after the first administration of treatment, a significant drop in the number of clue cells positive patients was observed ($P < 0.001$; Fig. 4). After a week of treatment, only 3% in the lactic acid group, 4% in the metronidazole group, and 0% from the combination group were positive of clue cells. While all patients in the combination group remained free of clue cells at day 14, clue cell positive patients in the monotherapy groups each increased by 4% compared to day 8 ($P = 0.564$).

Recurrence of foul-smelling vaginal discharge

Within the period from day 15 to day 56, two (6.7%) of those given lactic acid gel, four (14.3%) in the metron-

idazole arm, and one (3.6%) in the metronidazole plus lactic acid arm, were observed to have recurrent foul-smelling vaginal discharge. The incidence of recurrent symptoms of bacterial vaginosis was not significantly different across treatment arms (P -value = 0.4965; Fig. 5) but with a trend of lower incidence in favor of the combination arm.

Tolerability and safety

Table 4 presents the observed adverse events in each of the treatment arms. Epigastric pain/discomfort, dizziness, and dyspnea were observed in 10% (6 of 60) of patients who received metronidazole. On the other hand, 1.7% (1 of 60) patients who received lactic acid experienced curd-like vaginal discharge. The incidence of adverse events is not significantly different across treatment arms ($P = 0.1363$).

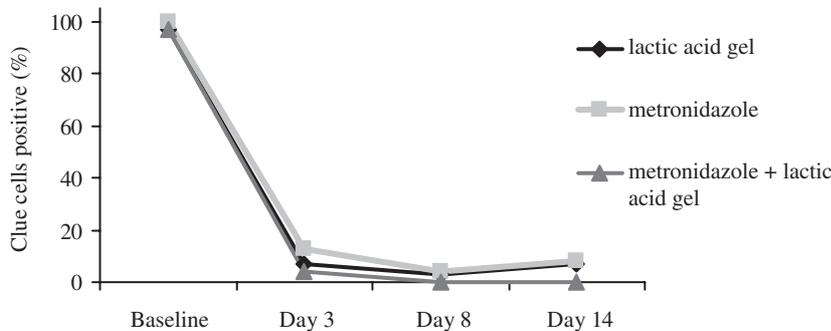


Figure 4 Frequency of clue cells positive* patients. *Cochran's Q-test: $P < 0.001$ across visits.

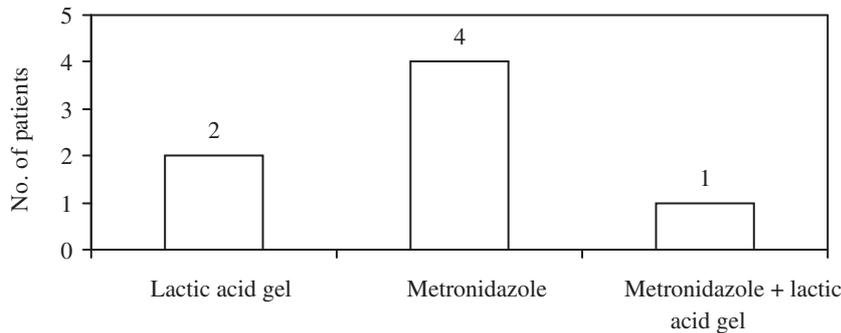


Figure 5 Frequency of recurrent* foul-smelling vaginal discharge at day 56. *Fisher's exact test: $P = 0.4965$ across treatment groups.

Table 4 Frequency of adverse event/s

Treatment arm*	Adverse event	No.
Lactic acid gel group:	Increase in curdy, white vaginal discharge	1
Metronidazole group:	Mild hypogastric discomfort	1
	Mild hypogastric pain and nausea	1
Metronidazole + lactic acid gel group:	Dizziness	1
	Epigastric pain and dyspnea	1
	Mild epigastric discomfort	2
	Flatulence, epigastric pain, loose stools	1

*Fisher's exact test: $P = 0.1363$; proportion of adverse incidence across treatment arms.

Discussion

The premise that normal vaginal flora protects the host against pathogen colonization has intensified the interest of researchers in the various factors that may control the vaginal ecosystem. The predominant organism in the vagina is the *Doderlein bacillus*, member of the genus *Lactobacillus*. However, recent studies have found that the flora is made up of a diversity of anaerobic and aerobic organisms.

The low vaginal pH appears as the primary mechanism in controlling the composition of the microflora.²² Typically, the normal vaginal pH among women of reproductive age ranges 3.8–4.2.²³ *In vitro* studies have shown that acidification by the *Lactobacilli* group can inhibit the growth of pathogenic organisms such as *Candida albicans*, *Escherichia coli*, *Gardnerella vaginalis*, *Mobiluncus* spp., and other bacteria cultured from women diagnosed with BV.

This condition, formerly known as non-specific vaginitis; *Haemophilus*, *Corynebacterium* or *Gardnerella* vaginitis; non-specific vaginosis; anaerobic vaginitis or anaerobic vaginosis is characterized by malodorous vaginal discharge and increased discharge that is homogenous, low in viscosity, and smoothly coats the vaginal mucosa. There is little vulvar or vaginal irritation associated but the pungent odor is the usual complaint. The anaerobes produce catabolic enzymes, such as aminopeptidases and decarboxylases. These enzymes degrade proteins and amino acids to amines. In turn, the amines contribute to the signs and symptoms of BV by elevating the vaginal pH and producing the characteristic fishy odor. The decarboxylation of betaine, derived from choline, produces trimethylamine, which may produce the rotten odor that provides a strong diagnostic clue as to the existence of this syndrome.^{24–26}

In this study, addition of lactic acid gel (LVG) to standard treatment (oral metronidazole 500 mg) for BV was utilized. *Lactobacilli* being the most prevalent organisms are found to be 10^7 – 10^8 CFU/ml of vaginal fluid among healthy reproductive women.^{27–29} The result showed that the study population with bacterial vaginosis has a lower *Lactobacilli* colony count which ranged from 10^3 to 10^4 CFU/mL.

We also found that the isolation rate of *Lactobacilli* was significantly higher in the treatment arm with lactic acid gel alone or metronidazole plus lactic acid gel. The increased production of lactic acid provided by the lactic acid gel has resulted in growth of *Lactobacilli* to the level of 10^6 CFU/mL. Slower growth of *Lactobacilli*

was seen in the metronidazole arm alone. Metronidazole is a nitroimidazole drug with potent antibacterial activity against anaerobes that can inhibit *Lactobacilli*. Regrowth of *Lactobacilli* in the metronidazole arm was noted a week after therapy when complete excretion of the drug occurred.

Likewise, treatment of BV with any of the three regimens resulted in the increased number of patients with normal vaginal pH (<4.7). The mean pH level significantly decreased across time ($P < 0.001$) but was not significantly different across treatment groups ($P > 0.05$). The pH readings did not seem to correlate with the changes in *Lactobacilli* colony count. Rosestein *et al.*³⁰ observed that, despite the presence of certain strains of *lactobacilli*, other factors such as host–microbe interaction and interactions among microbial species, which contribute to vaginal acidity, have yet to be identified. Our findings suggest that combination treatment, metronidazole and lactic acid gel, produced the lowest effect on vaginal pH on day 14.

Furthermore, in a study performed by Aroutcheva *et al.*³¹ the number of bacteria (biocell mass) in the vaginal environment was found to be responsible for pH changes and a relationship found to exist between the production of lactic acid and vaginal pH. According to Boris and Barbers,²⁷ lactic acid and other fatty acids produced by *Lactobacillus* metabolism may contribute to vaginal acidity, although this is not necessarily the primary source of low vaginal pH. Acids produced by the vaginal epithelial cells and released into the secretions are probably a more important source.

One of the factors controlling the growth of organisms in the vagina is *Lactobacilli*. However, our knowledge of the various elements that control the vaginal microflora is still incomplete. More controlled and well-designed studies with a larger sample size are required to clarify some of the inconsistent results presented.

On the other hand, the fishy odor produced by the alkalization of vaginal fluid in BV is due to the presence of amines. The discharge contains an increased concentration of several amines such as putrescin, cadaverine, histamine, phenethylamine, tyramine, isobutylamine and methylamine, which are produced by anaerobic bacterial decarboxylation.^{23,32}

The study showed a significant decrease in the number of patients with positive whiff test for all three arms. The decrease was more pronounced in the combination arm compared to the metronidazole arm during treatment and 1 week after ($p_{\text{day}3} = 0.0162$,

$p_{\text{day}8} = 0.0212$, $p_{\text{day}14} = 0.0410$). Lactic acid gel alone was as effective as the combination treatment during the treatment period but was less effective 1 week after treatment ($P = 0.0134$) (Fig. 3). Clinical cure based on the disappearance of unpleasant odor or negative whiff test is closely related to the regrowth of *Lactobacilli* and to the potent antibacterial activity of metronidazole on the anaerobe.

The criteria developed by Amsel *et al.*³ in 1983 are the current standard method for diagnosing bacterial vaginosis. The diagnosis is made by identifying three of the following four findings: (i) thin, dark or dull-gray, homogenous discharge; (ii) elevated vaginal pH (≥ 4.7); (iii) positive whiff test; and (iv) presence of clue cells on wet-mount microscopic evaluation. These criteria have a sensitivity of 90% and a positive predictive value of 90%. The presence of clue cells on wet-mount is highly specific and virtually pathognomonic of the syndrome. Clue cells are vaginal epithelial cells that have a stippled appearance due to adherent *Coccolobacilli*. The edges of the cells are obscured and appear fuzzy compared with the normally sharp edges of vaginal epithelial cells. To be significant for bacterial vaginosis, more than 20% of the epithelial cells on the wet-mount should be clue cells.²⁴ In a study by Andersch *et al.*,³² it was reported that the diagnosis of BV should be based more on clinical objective criteria than on microbiological findings and that the most reliable clinical objective criteria is the positive amine test.

In our study, there was a consistent decline in the number of clue cell positive patients in all three arms from day 3 to day 8 of follow up. Between days 8 and 14, total disappearance of clue cells in the combination arm was seen. However, this was not noted in both single-arm regimens. Results showed a trend in favor of the combination of lactic acid gel and metronidazole in the eradication of clue cells (Fig. 4).

Recurrence of foul-smelling vaginal discharge at day 56 was lowest in the combination arm while the highest recurrence was seen in the metronidazole group.

One patient in the lactic acid arm was noted to have increased curd-like vaginal discharge. Upon investigation, the patient's partner was found to be using some kind of sexual paraphernalia (penile-embedded pellets). Ten percent of the patients who received metronidazole had minimal side-effects like epigastric discomfort, dizziness and dyspnea. None of the women in the lactic acid gel group reported these side-effects.

Conclusion

We therefore conclude that: (i) lactic acid gel is safe and as efficacious as metronidazole in the treatment of bacterial vaginosis; (ii) there is evidence that lactic acid gel, when combined with metronidazole, is better than metronidazole alone in promoting *Lactobacilli* colonization; (iii) there is less recurrence of foul-smelling vaginal discharge in the combination of lactic acid and metronidazole arm; and (iv) lactic acid gel is well tolerated.

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