Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1734344
J Health Sci Med. 2025;8(5):811-817

Efficacy and safety of intravaginal gas ozone therapy in the treatment of bacterial vaginosis

Özgür Ağlamış[1], Seval Yılmaz Ergani[1], Eda Adeviye Şahin[2], Hanifi Şahin[3], Turan Şahin[4]

[1]Department of Perinatology, Ankara Etlik City Hospital, Ankara, Turkiye
[2]Departmant of Obstetrics and Gynecology, Dr. Eda Şahin Private Clinic, İstanbul, Turkiye
[3]Departmant of Obstetrics and Gynecology, İstanbul Health and Technology University, İstanbul, Turkiye
[4]Departmant of Obstetrics and Gynecology, Sancaktepe Şehit Prof. Dr. İlhan Varank Trainig Research Hospital, İstanbul, Turkiye

Cite this article as: Ağlamış Ö, Yılmaz Ergani S, Şahin EA, Şahin H, Şahin T. Efficacy and safety of intravaginal gas ozone therapy in the treatment of bacterial vaginosis. *J Health Sci Med.* 2025;8(5):811-817.

Received: 04.07.2025 ◆ **Accepted**: 04.08.2025 ◆ **Published**: 16.09.2025

ABSTRACT

Aims: The aim of this study is to share our experiences and results with our intravaginal gas ozone technique in the treatment of bacterial vaginosis (BV) by retrospective data analysis.

Methods: Salutem plus brand medical ozone device, 60 gamma 200 cc gas ozone was administered intravaginally through 50 cc syringes with the help of a nasogastric catheter to 102 patients diagnosed with BV using Amsel criteria. Patients whose hemogram parameters were checked before and after the procedure were called for 1st, 3rd, 6th, 9th and 12th month clinical controls in terms of recurrence, and the examination findings and digital data of these patients were analyzed retrospectively in terms of treatment, complications and recurrence.

Results: No life-threatening complications were encountered. Minor adverse effects were observed and resolved spontaneously in a short time without the need for any treatment. Recurrence rates were observed to be lower than in classical regimen treatments. Additionally, no more than 2 recurrences were observed during 1-year follow-up.

Conclusion: Our study is the first example of the literature in terms of evaluation of treatment, recurrence and complications of intravaginal gas ozone therapy in the treatment of bacterial vaginosis. These finding suggest that intravaginal gas ozone therapy, which is considered a safe form of treatment, will become more widespread in the future and the number and frequency of its application will increase even more. Further investigation with a larger number of patients should be conducted to confirm our data.

Keywords: Bacterial vaginosis, intravaginal, ozone therapy, ozone gas

INTRODUCTION

Bacterial vaginosis (BV) is a condition that usually affects women of reproductive age and can be symptomatic or asymptomatic. Approximately 50% of women are symptomatic. Foul-smelling vaginal discharge, itching and increased vaginal pH are observed.[1] Gardner first described BV in 1955.[2] BV is characterized by an overgrowth of opportunistic bacteria and a decrease in Lactobacilli levels, rather than an infection condition.[3] BV is diagnosed using Amsel criteria. Diagnosis is made when the vaginal pH value is above 4.5, when 10% potassium hydroxide solution is added to the vaginal discharge, there is an amine smell, when clue cells are found in wet preparations,homogeneous, non-viscous,milky-white discharge adherent to the vaginal wall.[4] Metronidazole and clindamycin are used in the treatment of BV. Antibiotics can be used orally or intravaginally. These recommended regimens have similar effectiveness.[5]

According to the guidelines, treatment is recommended only for symptomatic women because there is not enough evidence to support the treatment of asymptomatic women.[6] A high rate of recurrent infection, that is, recurrence, is observed in bacterial vaginosis treatments.[7] Ozone, trioxygen (O3), is a highly reactive inorganic molecule.[8] In animal experiments conducted on mice, it was observed that ozone had a positive effect on the treatment of Asherman syndrome, had a significant effect during pregnancy, and revealed a remodeling effect in tissues.[9] Ozone gas is also a powerful microorganism killer. It has antibacterial, antiviral, antifungal and antiparasitic properties.[8] Gas ozone can quickly and effectively oxidize the cell wall and cytoplasmic membrane of bacteria. It has a degrading effect on the cell membrane, thus preventing biofilm formation and reducing resistance to treatment.[10] It has recently been noticed that bacterial infections have developed resistance by forming biofilms, and these are almost impossible to treat with conventional methods.[11] Ozone gas is known to quickly destroy biofilms.[12] The activity of ozone against resistant biofilm is especially important in resistant cases where antibiotics have failed.[13] Ozone induces

Corresponding Author: Özgür Ağlamış, ozgurztb@gmail.com

moderate oxidative stress. Moderate oxidative stress activates nuclear factor-erythroid 2-related factor 2 (Nrf2), a nuclear transcriptional factor. Ozone treatment can activate nuclear factor-erythroid 2-related factor 2 through moderate oxidative stress and suppress NF-κB and inflammatory responses. Mild immune responses are triggered through other nuclear transcriptional factors, such as nuclear factor of activated T cells and activated protein-1 (AP-1). Consequently, both free antioxidants and antioxidant enzymes not only protect cells from oxidation and inflammation but also can reverse chronic oxidative stress.[13]

In our study, the aim of this study was to retrospectively analyze the treatment of bacterial vaginosis, which is one of the most common causes of vaginal discharge and has a high recurrence rate even if treated, with intravaginal gas ozone and its long-term recurrence rates.

METHODS

After the approval by the Institutional Review Board of Dr. Özgür Ağlamış Private Clinic, İstanbul, Turkiye (Date: 29.06.2024, Decision No: 12), the records were reviewed the medical records of all patients who underwent surgery. Informed consent was obtained from each patient at admission for research use of her clinical data. The study protocol was approved by the Sancaktepe Şehit Prof. Dr. İlhan Varank Trainig Research Hospital Ethics Committee İstanbul - Turkiye (Date: 28.06.2024, Decision No: 2024/189).

The study was conducted in accordance with the standards of Good Clinical Practice (ICH-E6) and the principles of the Declaration of Helsinki. This retrospective study was conducted at our private clinic of between January 2022 and October 2024. The data were obtained from hospital database system after ethics approval.

This study was designed as a retrospective cross-sectional analysis utilizing pre-existing clinical data from patients diagnosed with bacterial vaginosis using Amsel criteria and treated with intravaginal gas ozone therapy at our clinic between January 2022 and October 2024. No clinical trial, randomization, or investigational drug administration was performed. All procedures were part of routine clinical care, and the analysis focused solely on treatment outcomes, recurrence rates, and safety findings based on digital medical records obtained during standard follow-up visits. Consequently, the study does not qualify as an interventional clinical trial but rather as an observational review of existing data. During this period, 8 patients were excluded from the study because they received intravaginal suppository, oral antibiotic treatment, and fractional carbon dioxide laser treatment at external centers. The remaining 102 patients were evaluated in terms of success, complications and recurrence and were included in the study. Flowchart of patient inclusion was showed at flow **Figure 1**.

In digital data analysis, it was observed that each patient's hemogram was checked before and within one week after the treatment, and the patients were evaluated in terms of hemolysis and pancytopenia. It was learned that all patients included in the study were monogamous and that condoms were recommended after treatment in all their relationships

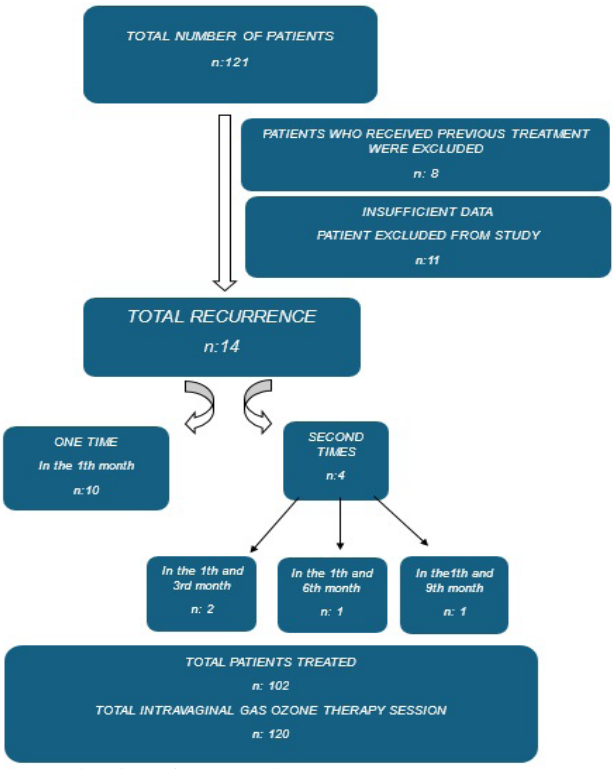

Figure 1. Flowchart of patient inclusion

during the one-year period, and condom use was confirmed verbally at the controls.

It was understood that all vaginal examination findings of the patients, who underwent clinical controls at the 1st month, 3rd month, 6th month, 9th month and 12th month after the treatment, were recorded. Patients were re-evaluated with Amsel criteria at all these visits. In this way, an attempt was made to achieve standardization. Vaginal discharge samples were collected from all patients using sterile swabs before and after ozone therapy. The samples were transported to the microbiology laboratory within 2 hours and cultured on selective media, including Columbia blood agar and *Gardnerella*-selective agar.

Bacterial identification and quantification were performed using standard gram staining and aerobic/anaerobic culture techniques. The presence of *Gardnerella vaginalis (G. vaginalis), Lactobacillus* spp., and other anaerobes was confirmed using MALDI-TOF mass spectrometry.

In case of recurrence, the files of the patients who were found to have received another session of intravaginal ozone therapy with the same gamma dose and amount were examined through the digital recording system. Complete cure, complications and recurrences were proportioned according to the total number of patients.

Intravaginal Gas Ozone Technique

The patients were placed on the lithotomy table. The inside of the vagina was washed twice with 10 cc of SF to prevent vaginal discharge from interfering with the procedure. Infection-related discharge in the vagina was cleaned with sterile sponge. A size 8 nasogastric tube was advanced intravaginally, touching the posterior fossa under the cervix.

Then the catheter was withdrawn 0.5 cm. Sponges were placed at the entrance of the vagina for pressure purposes to prevent gas escape during the procedure. Salutem plus brand medical ozone device was set to 60 gamma ozone dose. 60 gamma ozone gas was drawn into the 50 cc injector. The ozone-filled syringe was attached to the tip of the nasogastric tube and ozone gas was quickly injected into the vagina. This process was repeated four times, with a total of 200 cc of intravaginal gas ozone. After the procedure, the sponges at the entrance to the vagina were waited for five minutes before being removed. Afterwards, the procedure was terminated by removing the nasogastric tube. Patients were observed for one hour in the clinic environment for possible side effects. Early complications or adverse effects were recorded digitally. Figure 1 and 2 show the preparation for intravaginal ozone gas administration and the delivery of ozone gas.

Figure 1. Preparation for intravaginal ozone gas administration

Figure 2. When intravaginal ozone gas is administered

Statistical Analysis

All statistical analyses were performed using SPSS version XX (IBM Corp., Armonk, NY, USA). Continuous variables (e.g., age, BMI, hemogram values) were expressed as mean±standard deviation and compared using paired t-tests to evaluate pre- and post-treatment changes.

RESULTS

A total of 121 patients were included in the study. The mean age was 34.8±4.2 years, and the mean body-mass index (BMI) was 26.5±4.6 kg/m^2. 30.4% (n=31) of the patients were smokers. 35.3% (n=36) of the patients had a history of BV. 15.7% (n=16) of the patients had previously received BV treatment. Demographic and clinic characteristic data of the patients are shown in Table 1. In the retrospective evaluation made for one year after treatment, a total of 18 recurrences (18.36%) were observed in 14 patients. These recurrences, which were observed in 14 patients in total, were observed to recur more than once in only 3.9% (n=4) of the patients, and only once in the other 9.8% of the patients (n=10). Recurrence was observed in all of these four patients in the first month. Recurrence was observed in two of them in the 3rd month, in one in the 6th month, and in one in the 9th month. In these four patients with more than one BV attack, no more than two recurrences were observed. The maximum number of recurrences was two. It was noticed that there was no third recurrence in any patient. It was observed that there was no BV attack in any patient at 12 months. Of the ten patients with only one recurrence, six (60%) were observed to have recurrence in the 1st month, two (20%) in the 3rd month, and 2 (20%) in the 6th month. It was observed that none of the patients who had a BV attack had a recurrence in the 9th and 12th months after retreatment. Following vaginal ozone therapy, a significant reduction in *G. vaginalis* and anaerobic flora was observed, alongside a notable increase in protective *Lactobacillus* colonization. These findings support the microbiological efficacy of ozone therapy in restoring a healthy vaginal microbiota. Data of the patients are shown in Table 2.

Table 1. Demographic and clinic characteristics of patients

Parameters	Patients (n=102)
Age (years), mean±SD	34±5.7
Gravida, median (min-max)	1 (0-4)
Parity, median (min-max)	1 (0-3)
Abortion, median (min-max)	0 (0-2)
Number of live-born children, median (min-max)	1 (0-3)
BMI (kg/m^2), mean±SD	26.5±4.6
Smoking n (%)	31 (30.4)
History of BV n (%)	36 (35.3)
Previous BV treatment n (%)	16 (15.7)
Recurrence	
1 time, n (%)	10 (9.8)
2 times, n (%)	4 (3.9)

BMI: Body-mass index, BV: Bacterial vaginosis, SD: Standard deviation

Table 2. Microbiological evaluation		
	Pre-treatment (%)	Post-treatment (%)
Gardnerella vaginalis presence	78	19
Lactobacillus dominance	22	63
High anaerobic bacterial load	67	18

Ozone therapy led to significant improvement in clinical symptoms of bacterial vaginosis. Most patients reported complete or near-complete resolution of complaints, especially in terms of discharge and odor. Data of the patients are shown in Table 3.

Table 3. Bacterial vaginosis symptoms improvement		
	Pre-treatment (%)	**Post-treatment (%)**
Vaginal discharge	95	9
Fishy odor	82	12
Itching	70	14
Burning sensation	45	11

Categorical variables (e.g., recurrence rates, presence of *G. vaginalis*, *Lactobacillus* colonization, symptom resolution) were analyzed using chi-square tests. Microbiological assessments were based on standard gram staining and aerobic/anaerobic culture techniques performed both before and after ozone therapy; bacterial identification was confirmed by MALDI-TOF mass spectrometry. A p-value of <0.05 was considered statistically significant.

Chi-square tests demonstrated a statistically significant reduction in recurrence rates and Gardnerella presence after ozone therapy ($p<0.01$). Similarly, *Lactobacillus* colonization increased significantly post-treatment ($p<0.01$). Paired t-test analysis of clinical symptoms, including discharge, odor, and itching, also revealed significant improvement ($p<0.01$). These findings confirm that the observed therapeutic benefits are unlikely to be due to chance and support the efficacy of intravaginal ozone therapy in BV management. Data of the patients are shown in Table 4.

A total of 120 sessions of intravaginal gas ozone therapy were performed on 102 patients. No situation causing serious mortality or morbidity was encountered in any patient. No statistically significant change in blood parameters was encountered during hemogram controls. Only minor adverse events were encountered. Mild vaginal irritation 5%, Pelvic discomfort 3%, burning or itching sensation 4%, no reportes side effects 88%. Minor side effects, including mild vaginal irritation (5%), transient pelvic discomfort (3%), and a burning or itching sensation (4%), were reported in 12% of patients. All symptoms were transient, resolved spontaneously within 24-48 hours, and did not require pharmacologic intervention. Patients were observed for one hour after the procedure to ensure immediate tolerance and were given communication instructions for delayed symptom reporting. Follow-up visits were scheduled at 1, 3, 6, 9, and 12 months, and no persistent or serious side effects were noted during this time. Pre- and post-treatment hemogram monitoring confirmed the absence of systemic complications such as hemolysis or pancytopenia.

Recurrence was defined as the re-emergence of bacterial vaginosis meeting at least three of four Amsel criteria (homogeneous discharge, vaginal pH>4.5, positive whiff test, and presence of clue cells) in conjunction with clinical symptoms such as malodorous discharge or vaginal discomfort. When recurrence was suspected clinically, additional confirmation was obtained through gram staining and culture for *G. vaginalis* and *Lactobacillus* species. This combined diagnostic strategy allowed for a standardized and objective evaluation of recurrence during the 12-month follow-up period.

DISCUSSION

Although the success rates in the treatment of bacterial vaginosis are high after medical treatments, high rates of recurrence are also observed.[7] In a study, recurrence rates of up to 58% were observed even one year after treatment.[14] In another study, it was stated that the recurrence rate was close to 50%.[15] The lower recurrence rates in our study and the fact that all recurrences did not extend over a period longer than one year can be considered an advantage of our study. In the study conducted by Cook et al.,[16] the recurrence rate in the first three months after treatment with metronidazole was stated to be 30-40%. This rate is above the total recurrence rate in our study. In addition, while we counted each replaced with episodes of BV one by one in our study, Cook et al. considered at least three or more attacks in the last year as recurrence. Therefore, it can be said that our recurrence rate is lower when compared to our study. Similar to our study, Marshall et al.[17] also stated that one attack is sufficient to qualify as recurrent BV.

In the treatment of BV, it is generally recommended to use 500 mg oral metronidazole twice a day for seven days or use 0.75% metronidazole gel with an intravaginal applicator every night for five days. Another treatment method is to apply 2% clindamycin vaginal cream with an intravaginal applicator for 7 nights.[18] When we compare these standard treatment protocols with our study, the fact that the treatment can be completed in only 15 minutes under clinical conditions can be considered an advantage over other treatments in terms of time. In addition, compared to the problems experienced

Table 4. Chi-square & paired T test			
Parameter	**Test**	**p-value**	**Interpretation**
Recurrence rate (pre vs post ozone therapy)	Chi-square	<0.01	Significant reduction in recurrence after ozone therapy
Gardnerella presence (pre vs post)	Chi-square	<0.01	Significant decrease in *Gardnerella* presence post-therapy
Lactobacillus colonization (pre vs post)	Chi-square	<0.01	Significant increase in *Lactobacillus* colonization post-therapy
Symptom improvement (odor, discharge, itching)	Paired T test	<0.01	Marked improvement in clinical symptoms post-treatment

by patients in adapting to oral medication use or intravaginal applicator use for 7 days, the application of this treatment by a healthcare professional in a short time can be considered as easier for the patient.

According to Sobel et al.,[19] cases of bacterial vaginosis that recur after treatment with metronidazole or clindamycin should be treated more aggressively, especially if the patient has monthly relapses. Accordingly, in recurrent replaced with episodes of BV, intravaginal application of 0.75% metronidazole gel twice a week for 4-6 months is recommended. In this method, the length of the treatment period and the difficulty of using an intravaginal applicator can be seen as a disadvantage compared to our intravaginal gas ozone application, which takes only 15 minutes in case of recurrence.

According to Coundray et al.,[1] since current treatment methods are quite ineffective, it may be necessary to try alternative treatment methods for the treatment of BV. Based on this, intravaginal gas ozone therapy was applied intravaginal gas ozone as an alternative treatment method. When we look at the literature, the use of gas ozone intravaginally has been described before.[20] As far as we can check from the literature, our study is the first to use intravaginal gas ozone in the treatment of BV. This can be seen as an advantage of our study.

Ozone, a highly reactive molecule, exhibits strong bactericidal, fungicidal, antiviral and anti-protozoal activities. Ozone therapy has previously been used as an anti-inflammatory in the treatment of endometritis and successful results have been obtained.[21] In a study, it was stated that the use of ozone as a therapeutic agent in pelvic inflammatory disease inhibited the necrosis of endometrial epithelial cells and also alleviated inflammatory reactions.[22] This study utilized intravaginal ozone gas in the treatment of BV by taking advantage of this superficial cell protective effect and anti-inflammatory effect.

In an animal study conducted with sheep, antibiotic treatment was applied to one group and ozone foam spray treatment was applied to another group for the placenta fragments remaining in the uterus after birth and the inflammatory process caused by this. This study showed that ozone preparations did not cause any negative side effects and were as effective as, but not statistically better than, antibiotics.[23] In an in vitro study, fifty *Candida albicans* strains were exposed to gaseous ozone at different times. Although ozone is highly effective on the yeast form of *Candida albicans*, ozone therapy appears to induce resistance to amphotericin B.[24] This can be considered a disadvantage of ozone therapy.

Serious complications such as decrease in hemoglobin level, hemolysis, and pancytopenia may occur in systematic intravenous ozone use. Using local gas ozone in our treatment reduces our risk of encountering such serious complications. In a systematic review conducted by Mehta,[25] it was stated that male partner treatment was not statistically beneficial in preventing recurrent bacterial vaginosis and did not reduce recurrence rates. In our study, no additional treatment was applied any special treatment to the spouses of patients who presented to us for the first time or who came again with recurrence. However, it was observed that all patients were recommended to use condoms during intercourse during this period. Another study included couples in which a woman with bacterial vaginosis was in a monogamous relationship with her male partner. In the partner-treatment group, the woman received recommended first-line antimicrobial agents and the male partner received oral and topical antimicrobial therapy (metronidazole 400 mg tablets and 2% clindamycin cream applied to the skin of the penis, both twice daily for 7 days). In the control group, the woman received first-line therapy and the male partner received no treatment. The primary outcome was recurrence of bacterial vaginosis within 12 weeks.[26] In our study, we only made an evaluation for female patients. Another study investigated whether dequalinium chloride, a broad-spectrum antiseptic, was more effective than oral metronidazole in treating BV.[27] Just as this treatment is an alternative to conventional metronidazole treatment, we also investigated what could be possible other than conventional methods in our study.[28] There is a study on the positive effect of vaginal microbiota transplantation in the treatment of bacterial vaginosis. We also believe that the positive results we obtained in our ozone study are due to the positive effect of ozone therapy on the microbiota. Alternative therapies such as probiotics have been increasingly explored in the management of bacterial vaginosis. Probiotic formulations containing *Lactobacillus* species aim to restore the vaginal microbiota by increasing lactobacilli dominance and lowering pH levels, thereby indirectly suppressing anaerobic pathogens.[29,30] However, meta-analyses indicate variable efficacy and highlight the limited impact of probiotics on biofilm-associated bacteria, which are central to recurrent BV. In contrast, intravaginal ozone therapy offers direct antimicrobial and biofilm-disrupting effects in addition to immunomodulatory benefits that support mucosal healing.[9] These multimodal effects likely underlie the favorable recurrence rates observed in our study and suggest that ozone therapy may serve as a valuable alternative or complementary approach to probiotics and antibiotics in future BV management strategies.

Cost and accessibility are important considerations when evaluating intravaginal ozone therapy in comparison to traditional treatments such as metronidazole. While metronidazole is inexpensive and widely available in both oral and intravaginal forms, it often requires repeated courses due to high recurrence rates, potentially increasing cumulative treatment costs and contributing to antimicrobial resistance. Ozone therapy, by contrast, involves a single clinical session but requires specialized devices and trained personnel, which may initially limit its accessibility and increase upfront costs. However, the reduced recurrence rates and shorter overall treatment duration observed in our study suggest that ozone therapy may offer long-term cost benefits for patients with recurrent BV. Wider adoption of ozone technology and potential cost reductions with broader use may further enhance its feasibility in clinical practice.

Future studies should aim to optimize the application of intravaginal ozone therapy for bacterial vaginosis. Dose-ranging and frequency studies are needed to determine the most effective and safest protocol, as the ideal gamma concentration and session number remain to be established.

Combining ozone therapy with other modalities, such as probiotics or conventional antibiotics, could provide complementary benefits by simultaneously disrupting biofilms and reestablishing a protective *Lactobacillus*-dominant microbiota. Moreover, prospective randomized controlled trials with larger cohorts are warranted to confirm efficacy, evaluate recurrence rates over longer follow-up periods, and explore cost-effectiveness and patient-centered outcomes. Such investigations will help define the role of ozone therapy in the evolving therapeutic landscape of BV management.

Among the few studies investigating ozone therapy for bacterial vaginosis, Yarustovskaya et al.[32] conducted a randomized controlled trial comparing standard therapy, local intravaginal ozone, and combined local plus systemic ozone therapy with an interferon inducer. While their findings demonstrated significant benefits for combined therapy, our study uniquely focuses on local intravaginal gas ozone therapy alone, providing evidence for its standalone efficacy and safety.

Similarly, Khairy et al.[33] conducted a randomized clinical trial on intravaginal ozone insufflation for recurrent vulvovaginal candidiasis and reported high clinical and microbiological cure rates, further supporting the antimicrobial and mucosal healing potential of ozone therapy, which may also be relevant for bacterial vaginosis management.

In an ultrastructural study, Alia and Kholoud[34] demonstrated that ozone therapy disrupts the biofilm architecture of *G. vaginalis*, which plays a central role in the persistence and recurrence of bacterial vaginosis, thereby supporting the mechanistic rationale for its therapeutic use.

Limitations

The limitations of our study are the limited number of patients participating in the study, although all patients were diagnosed with BV according to the Amsel criteria, other causes of vaginal infection that may accompany it are not known, and most BV conditions resolve spontaneously over time without requiring treatment, the absence of a control group, and the retrospective design of the study. It may be a disadvantage that our study is not a randomized controlled study comparing conventional methods. This study has several limitations that must be acknowledged. First, the retrospective design inherently carries a risk of selection bias and reliance on pre-existing medical records. Second, the absence of a randomized control group receiving conventional antibiotic therapy limits direct comparisons of treatment efficacy. Third, the single-center nature of the study and relatively small sample size may reduce the generalizability of the results to broader populations. Additionally, potential confounding factors, such as variations in sexual behavior or hormonal status, were not fully assessed. Nevertheless, the use of standardized Amsel criteria for diagnosis, uniform application of the ozone protocol, and regular follow-up visits at 1, 3, 6, 9, and 12 months help to mitigate these biases and provide valuable preliminary data supporting ozone therapy as an alternative treatment for bacterial vaginosis. Our primary aim here was to show the effectiveness of intravaginal ozone therapy in treatment and symptom reduction. Transvaginal ozone treatment does not kill microorganisms that may be located outside the vagina (skin, vestibular glands). This may be the cause of recurrence. In addition, the need to have an ozone device to apply this treatment, the need for a healthcare professional who knows how to use the device, and the cost of the procedure can be considered as limitations of this method for the patient and the healthcare professional. The strengths of the study are that the risk of resistance is reduced since antibiotics are not used and that, as previously stated in the literature, the remodeling effect of ozone is utilized in the treatment.

CONCLUSION

The use of intravaginal gas ozone in the treatment of bacterial vaginosis is a minimally invasive procedure. The fact that we have not seen any major complications, that it is easily applicable, that the treatment success rates are high, and that recurrences are low can be seen as the success of the technique. These findings suggest that with the increase in the use of intravaginal gas ozone, the area of use and the number and frequency of applications in BV and other vaginal infections will increase. Further investigation with a larger number of patients should be conducted to confirm our data.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Sancaktepe Şehit Prof. Dr. İlhan Varank Trainig Research Hospital Ethics Committee (Date: 28.06.2024, Decision No: 2024/189).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Availability of data and material

The datasets of the current study are available upon reasonable request.

REFERENCES

1. Coudray MS, Madhivanan P. Bacterial vaginosis-a brief synopsis of the literature. *J Obstet Gynecol Reprod Biol.* 2020;245:143-148. doi:10.1016/j.ejogrb.2019.12.035
2. Gardner HL, Dukes CD. Haemophilus vaginalis vaginitis: a newly defined specific infection previously classified "nonspecific" vaginitis. *Am J Obstet Gynecol.* 1955;69(5):962-976.

3. Ranjit E, Raghubanshi BR, Maskey S, Parajuli P. Prevalence of bacterial vaginosis and ıts association with risk factors among nonpregnant women: a hospital based study. *Int J Microbiol*. 2018;2018:8349601. doi: 10.1155/2018/8349601
4. Martin DH, Marrazzo JM. The vaginal microbiome: current understanding and future directions. *J Infect Dis*. 2016;214(Suppl 1): S36-S41. doi:10.1093/infdis/jiw184
5. Chen JY, Tian H, Beigi RH. Treatment considerations for bacterial vaginosis and the risk of recurrence. *J Womens Health (Larchmt)*. 2009; 18(12):1997-2004. doi:10.1089/jwh.2008.1088
6. Koumans EH, Sternberg M, Bruce C, et al. The prevalence of bacterial vaginosis in the United States, 2001-2004; associations with symptoms, sexual behaviors, and reproductive health. *Sex Transm Dis*. 2007;34(11):864-869. doi:10.1097/OLQ.0b013e318074e565
7. Bradshaw CS, Brotman RM. Making inroads into improving treatment of bacterial vaginosis-striving for long-term cure. *BMC Infect Dis*. 2015; 15:1-12. doi:10.1186/s12879-015-1027-4
8. Zanardi I, Burgassi S, Paccagnini E, Gentile M, Bocci V, Travagli V. What is the best strategy for enhancing the effects of topically applied ozonated oils in cutaneous infections? *Biomed Res Int*. 2013;2013:702949. doi:10.1155/2013/702949
9. Ergani SY, Dilbaz B, Ergani HM, Tekin ÖM. Effect of intrauterine ozone therapy on Asherman syndrome, an experimental rat model. *Eur J Obstet Gynecol Reprod Biol*. 2022;277:90-96. doi:10.1016/j.ejogrb.2022.08.014
10. Sen S, Sen S. Ozone therapy a new vista in dentistry: integrated review. *Med Gas Res*. 2020;10(4):189-192. doi:10.4103/2045-9912.304226
11. Bjarnsholt T. The role of bacterial biofilms in chronic infections. *APMIS Suppl*. 2013;(136):1-51. doi:10.1111/apm.12099
12. Bialoszewski D, Pietruczuk-Padzik A, Kalicinska A, et al. Activity of ozonated water and ozone against *Staphylococcus aureus* and *Pseudomonas aeruginosa* biofilms. *Med Sci Monit*. 2011;17(11):BR339-BR344. doi:10.12659/msm.882044
13. Sagai M, Bocci V. Mechanisms of action ınvolved in ozone therapy: is healing induced via a mild oxidative stress? *Med Gas Res*. 2011;1:29. doi:10.1186/2045-9912-1-29
14. Rowen RJ. Ozone therapy as a primary and sole treatment for acute bacterial infection: case report. *Med Gas Res*. 2018;8(3):121-124. doi:10.4103/2045-9912.241078
15. Bradshaw CS, Morton AN, Hocking J, et al. High recurrence rates of bacterial vaginosis over the course of 12 months after oral metronidazole therapy and factors associated with recurrence. *J Infect Dis*. 2006;193(11):1478-1486. doi:10.1086/503780
16. Bradshaw CS, Vodstrcil LA, Hocking JS, et al. Recurrence of bacterial vaginosis is significantly associated with posttreatment sexual activities and hormonal contraceptive use. *Clin Infect Dis*. 2013;56(6):777-786. doi:10.1093/cid/cis1030
17. Cook RL, Redondo-Lopez V, Schmitt C, Meriwether C, Sobel JD. Clinical, microbiological, and biochemical factors in recurrent bacterial vaginosis. *J Clin Microbiol*. 1992;30(4):870-877. doi:10.1128/jcm.30.4.870-877.1992
18. Marshall AO. Managing recurrent bacterial vaginosis: insights for busy providers. *Sex Med Rev*. 2015;3(2):88-92. doi:10.1002/smrj.45
19. Bagnall P, Rizzolo D. Bacterial vaginosis: a practical review. *JAAPA*. 2017;30(12):15-21. doi:10.1097/01.JAA.0000526770.60197.fa
20. Sobel JD, Ferris D, Schwebke J, et al. Suppressive antibacterial therapy with 0.75% metronidazole vaginal gel to prevent recurrent bacterial vaginosis. *Am J Obstet Gynecol*. 2006;194(5):1283-1289. doi:10.1016/j.ajog.2005.11.041
21. Mandhare M, Jagdale D, Gaikwad P, Gandhi P, Kadam V. Miracle of ozone therapy as an alternative medicine. *Int J Pharm Chem Biol Sci*. 2012;2(1):63-71.
22. Đuričić D, Valpotić H, Samardžija M. Prophylaxis and therapeutic potential of ozone in buiatrics: current knowledge. *Anim Reprod Sci*. 2015;159:1-7. doi:10.1016/j.anireprosci.2015.05.017
23. Wei A, Feng H, Jia XM, Tang H, Liao YY, Li BR. Ozone therapy ameliorates inflammation and endometrial injury in rats with pelvic inflammatory disease. *Biomed Pharmacother*. 2018;107:1418-1425. doi:10.1016/j.biopha.2018.07.137
24. Đuričić D, Valpotić H, Žura Žaja I, Samardžija M. Comparison of intrauterine antibiotics versus ozone medical use in sheep with retained placenta and following obstetric assistance. *Reprod Domest Anim*. 2016; 51(4):538-540. doi:10.1111/rda.12715
25. Zargaran M, Fatahinia M, Zarei Mahmoudabadi A. The efficacy of gaseous ozone against different forms of *Candida albicans*. *Curr Med Mycol*. 2017;3(2):26-32. doi:10.18869/acadpub.cmm.3.2.26
26. Mehta SD. Systematic review of randomized trials of treatment of male sexual partners for improved bacteria vaginosis outcomes in women. *Sex Transm Dis*. 2012;39(10):822-830. doi:10.1097/OLQ.0b013e3182631d89
27. Vodstrcil LA, Plummer EL, Fairley CK, et al. Male-Partner treatment to prevent recurrence of bacterial vaginosis. *N Engl J Med*. 2025;392(10):947-957. doi:10.1056/NEJMoa2405404
28. Raba G, Durkech A, Malík T, Bassfeld D, Grob P, Hurtado-Chong A; Fluomizin Study Group. Efficacy of dequalinium chloride vs metronidazole for the treatment of bacterial vaginosis: a randomized clinical trial. *JAMA Netw Open*. 2024;7(5):e248661. doi:10.1001/jamanetworkopen.2024.8661
29. Luo H, Zhou C, Zhou L, He Y, Xie RH. The effectiveness of vaginal microbiota transplantation for vaginal dysbiosis and bacterial vaginosis: a scoping review. *Arch Gynecol Obstet*. 2024;310(2):643-653. doi:10.1007/s00404-024-07611-1
30. Van de Wijgert JHHM, Jespers V. The role of lactobacilli in vaginal health and bacterial vaginosis: evidence from clinical studies. *FEMS Microbiol Rev*. 2020;44(6):773-792.
31. Machado D, Castro J, Palmeira-de-Oliveira A, Martinez-de-Oliveira J, Cerca N. Bacterial vaginosis biofilms: challenges to current therapies and emerging solutions. *Front Microbiol*. 2016;7:1528. doi:10.3389/fmicb.2015.01528
32. Yarustovskaya OV, Kulikov AG, Shtro LP. Combined treatment of patients with bacterial vaginosis using ozone therapy and an interferon inducer. *Vopr Kurortol Fizioter Lech Fiz Kult*. 2015;92(3):17-21. doi:10.17116/kurort2015545-49
33. Khairy AM, Abdelkhalek AM, Elsharkawy M, et al. Intravaginal ozone insufflation for recurrent vulvovaginal candidiasis: a randomized clinical trial. *Egypt Bullet Women Health J*. 2021;11(3):45-53.
34. Alia A, Kholoud R. The impact of ozone on bacterial vaginosis biofilms: ultrastructural evidence via transmission electron microscopy. *EJ Med*. 2014;6(2):45-52.