Understanding Bacterial Vaginosis: Insights into Definition, Epidemiology, Signs and Symptoms, Pathogenesis, Risk Factors, Complications, Diagnosis, and Management

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Abstract

Bacterial vaginosis (BV) is a condition where there is a shift from a microbiota dominated by Lactobacillus to one dominated by anaerobic and facultative bacteria. In reproductive-age women, the most common cause of abnormal vaginal discharge is bacterial vaginosis (BV). Women with BV typically complain of thin, grayish-white discharge that has a "fishy" odor, which is more noticeable after sexual intercourse. When bacterial vaginosis occurs, the number of lactobacilli decreases and may even disappear, while the number of anaerobic and facultative anaerobic organisms increases. Having a new sexual partner is the most significant risk factor for BV incidence. For diagnosing bacterial vaginosis, Gram staining and Nugent scoring are the gold standard. Treatment of BV primarily aims to reduce or eliminate the symptoms, most commonly excessive vaginal discharge and unpleasant odor. This review article aims to provide a general overview and information about bacterial vaginosis so that women of reproductive age can prevent the occurrence of bacterial vaginosis.

Keywords: bacterial vaginosis, sexual health, reproductive health, sexual and reproductive health-care

1. Introduction

Bacterial vaginosis (BV) is the most common vaginal infection worldwide and is associated with important public health issues, such as preterm labor and the acquisition and transmission of sexually transmitted infections (STIs) and human immunodeficiency virus (HIV). BV is highly prevalent, affecting approximately 10-30% of women in the United States, with higher rates reported in African American women and women from Sub-Saharan Africa. One of the signs of BV is a shift from a flora dominated by lactobacillus to one where the lactobacilli dramatically decline, and anaerobic and facultative anaerobic organisms increase (Muzny and Schwebke, 2016; Srinivasan and Fredricks, 2008).

The risk of BV increases with the number of partners, the use of vaginal douches, and tight jeans or trousers (Chiaffarino et al, 2004). Previous studies have shown that the most significant risk factor for the acquisition of BV among women at high risk for sexually transmitted diseases is exposure to a new male

sexual partner (Schwebke and Desmond, 2005). Women with BV may have a malodorous vaginal discharge or local irritation, but about half of the women with diagnosable BV have no clear symptoms. Some women do not report abnormal vaginal discharge, but it is nonetheless noted on examination by a clinician, highlighting that many women with BV are not aware of their diagnosis or consider their discharge to be within normal bounds (Srinivasan and Fredricks, 2008). Therefore, this article review aims to provide a general overview and information about bacterial vaginosis to help reproductive-aged women prevent the occurrence of bacterial vaginosis.

2. Bacterial Vaginosis

2.1. Definition

Bacterial vaginosis (BV) is a condition characterized by the partial loss of natural vaginal lactobacilli on one side and the massive polymicrobial anaerobic overgrowth of the vaginal mucosa on the other side (Verstraelen and Verhelst, 2009). Bacterial vaginosis (BV) is a condition where there is a shift from a microbiota dominated by Lactobacillus to one dominated by anaerobic and facultative bacteria (Nasioudis et al, 2017). In reproductive-age women, the most common cause of abnormal vaginal discharge is bacterial vaginosis (BV). The cause is unknown, and this syndrome is marked by an excessive overgrowth of anaerobes in the vagina, a decrease in the normal Lactobacillus population, and the loss of normal vaginal acidity (Hay, 2010). BV was initially considered a sexually transmitted infection caused by bacteria now known as G. vaginalis (Turovskiy et al, 2011). Gardnerella vaginalis, Mobiluncus, Bacteroides spp., and Mycoplasma hominis are some of the agents commonly associated with bacterial vaginosis (Morris et al, 2001).

2.2 Epidemiology

The prevalence of BV varies both nationally and globally (Coudray and Madhivanan, 2020). Up to 30% of people experience bacterial vaginosis (BV). Among women aged 14 to 49 years evaluated in the 2001-2004 National Health and Nutrition Examination Survey, 29% were reported to have bacterial vaginosis, and the prevalence was 3.13 times higher among African American individuals than white individuals (Livengood III, 2009). More than 50% of women in East/Southern Africa are estimated to be affected, ranging from 12% in Australian women to 29% in North American women (Bradshaw and Sobel, 2016). In the UK, the rate of bacterial vaginosis is between 10 and 20 percent in unselected populations; however, this rate can reach 36% in women visiting sexually transmitted infection (STI) clinics and 28% in women seeking elective termination of pregnancy (Hay, 2010). In the United States (29%), BV is estimated to be lower compared to Europe, with the highest prevalence in Poland and Norway (over 20%). BV prevalence tends to be high in Africa. However, BV prevalence is lowest in West Africa (6-8% in Burkina Faso, 14.2% in Nigeria) compared to Southern and Eastern Africa: 32.5% in Zimbabwe, 37% in Kenya, 38% in Botswana, and 68.3% in Mozambique (Chacra et al, 2022).

2.3 Signs and Symptoms

Women usually experience vaginal discharge, odor, and sometimes irritation (Bagnall and Rizzolo, 2017). Women with BV typically also complain of thin, grayish-white discharge that has a "fishy" odor, which is more noticeable after sexual intercourse. There is usually no inflammation or erythema. The cervix is usually normal, and cervicitis is usually caused by other pathogens. Many women with BV do not have any symptoms (Sobel, 2000). BV presents with some symptoms of mucosal inflammation, such as vaginal

discharge, itching, and a burning sensation, but it lacks leukocytic exudate, redness, or swelling. Therefore, it is termed vaginosis to distinguish it from common vaginitis (Onderdonk, et al., 2016).

2.4 Pathogenesis

Bacterial vaginosis can be sexually assisted and sexually transmitted, but its cause is unknown. The discovery of Gardnerella vaginalis on the penis skin and urethra of men suffering from bacterial vaginosis supports the theory of sexual transmission (Bagnall and Rizzolo, 2017). Lactobacilli dominate the normal vaginal flora, although other organisms may be present in small numbers. When bacterial vaginosis occurs, the number of lactobacilli decreases and may even disappear, while the number of anaerobic and facultative anaerobic organisms increases (Hay, 2010). With BV, the vaginal flora undergoes complex changes. This is indicated by a decrease in the number and concentration of lactobacilli that produce H2O2 and an increase in the number and concentration of G. vaginalis, Mycoplasma hominis, anaerobic gram-negative rods such as Prevotella, Porphyromonas, and Bacteroides, as well as anaerobic Peptostreptococcus species (Sobel, 2000).

Increased production of proteolytic carboxylase enzymes is associated with significant growth of anaerobic vaginal flora. These enzymes break down vaginal peptides into various amines, especially trimethylamine, which at high pH becomes volatile and malodorous. There is a relationship between these amines and increased vaginal transudation and squamous epithelial cell exfoliation, resulting in the typical discharge. In conditions of high pH, G. vaginalis more efficiently adheres to exfoliating squamous epithelial cells, producing clue cells. Additionally, amines provide a suitable substrate for the growth of M. hominis. Whether the loss of lactobacilli occurs before or after this massive upheaval in flora is still unknown (Sobel, 2000).

2.5 Risk Factors

Epidemiological studies indicate that women of African ethnicity are more susceptible to BV. Other risk factors include low socioeconomic status, smoking, douching with specific fluids, antibiotic treatment for other diseases, young age at first sexual intercourse, acquiring a new sexual partner, and having multiple previous sexual partners (Turovskiy et al, 2011). Having a new sexual partner is the most significant risk factor for BV incidence. Having regular sexual partners is also a risk factor for BV recurrence (Muzny et al, 2019). Additionally, other risk factors for BV include black or Hispanic ethnicity, regular douching, not using condoms, and sexual intercourse with women (usually both women are affected) (Bagnall and Rizzolo, 2017). On the other hand, a decrease in the number of BV cases is associated with the use of hormonal contraception (Kenyon et al, 2013).

2.6 Complications

The relationship between BV and mucopurulent endocervicitis has been demonstrated in numerous studies. Up to 50% of women attending sexually transmitted infection clinics and diagnosed with mucopurulent endocervicitis also have BV. In women with mucopurulent endocervicitis, concurrent BV should be treated regardless of other pathogens. Failure to do so can lead to excessive persistent cervicitis. Additionally, research indicates an association between BV and inflammatory changes noted in cervical cytology (Sobel, 2000).

Bacterial vaginosis is associated with preterm birth and second-trimester miscarriage. According to reports, the odds ratio ranges between 1.4 and 7.0. Chorioamnionitis, which can lead to preterm birth through the release of pro-inflammatory cytokines, is considered more common in women with bacterial vaginosis (Hay,

2010). Moreover, women with recurrent bacterial vaginosis may experience psychological distress due to the odor, leading them to avoid sexual relations and feel shame (Bagnall and Rizzolo, 2017). In fact, BV is often associated with the acquisition of sexually transmitted infections (STIs), including HIV (Hay, 2017).

Bacterial vaginosis can cause vaginal cuff cellulitis, wound infection, and abscess formation after hysterectomy. Additionally, there is a connection between bacterial vaginosis and a higher frequency of non-gonococcal urethritis in male partners (Hay, 2010). There is an association between asymptomatic BV and postoperative infections, such as post-hysterectomy cuff cellulitis, post-Caesarian endomyometritis, and post-abortion pelvic inflammatory disease (PID). Furthermore, the likelihood of these complications can be reduced through preoperative antibiotic prophylaxis covering BV-associated flora (Sobel, 2000).

2.7 Diagnosis

Gram staining and Nugent scoring are the gold standard for diagnosing bacterial vaginosis. This method involves identifying and quantifying lactobacilli as well as Bacteroides, Mobiluncus, and G. vaginalis (Bagnall and Rizzolo, 2017). Gardner and Dukes described the clinical findings of BV in 1181 patients over fifty years ago. The symptoms include (i) vaginal squamous cells with indistinct borders and a granular appearance, (ii) an "unpleasant" odor, (iii) a decreased pH between 5.0 and 5.5, and (iv) a thin, gray, adherent discharge. These findings were later detailed and are now known as the Amsel criteria. Amsel and colleagues suggested that BV could be diagnosed if 3 out of 4 findings are present: (a) vaginal pH 4.5; (b) thin, homogeneous ("milk-like consistency") discharge, unaffected by color or quantity; (c) accentuation of the fishy odor of the discharge with the addition of 10% potassium hydroxide, and (d) clue cells on microscopic examination of vaginal swabbing samples in saline. For clinical use, the Amsel criteria were published in 1983 (Redelinghuys et al, 2020). Further studies by Eschenbach and colleagues found that if a vaginal pH of 4.7 is used instead of a pH of 4.5 and if more than 20% of vaginal squamous cells are clue cells, the accuracy of these criteria can be enhanced (Livengood III, 2009).

Gram stain with Nugent scoring is used to diagnose BV (Coudray and Madhivanan, 2020). The diagnosis of BV with Gram staining has been suggested as an alternative. For Gram staining, vaginal fluid or discharge is collected on a glass slide, allowed to air-dry, stained in the laboratory, and examined under oil immersion to identify specific bacteria. Several advantages of this diagnostic method include a permanent record, a high frequency of interpretable results, low cost, and ease of transport and storage. Additionally, Gram-stained vaginal smears can be evaluated repeatedly or independently by more than one assessor, thereby increasing diagnostic reliability (Verstraelen and Verhelst, 2009).

Table 1. Nugent scoring for diagnosing bacterial vaginosis

Nugent scoring for diagnosing bacterial vaginosis	
If lactobacilli are found in normal amounts, they are given a score of 0, and if the quantity is low or absent. The Nugent score consists of three subscores: 0-3 is normal, 4-6 is intermediate, and 7-10 indicates bacterial vaginosis.	
Number	**Subscore**
Number of lactobacillus Gram-positive rods	
≥30	0
5-20	1
1-4	2
<1	3
0	4
Number of Gardnerella/Bacteroides Gram-variable coccobacilli	
0	0
<1	1
1-4	2
5-30	3
≥30	4
Number of Mobiluncus curved Gram-negative bacilli	
0	0
<1	1
1-4	1
5-30	2
≥30	2
The table is adapted from Bagnall and Rizzolo (2017).	

2.8 Management

Treatment of BV primarily aims to reduce or eliminate the symptoms, most commonly excessive vaginal discharge and unpleasant odor (Verstraelen and Verhelst, 2009). Triple-sulfa creams, erythromycin, tetracycline, acetic acid gel, and providone-iodine vaginal douches have shown poor efficacy. Ampicillin and amoxicillin are the only ones achieving a moderate cure rate (average 66%). Metronidazole is the most effective oral therapy. With multiple divided-dose regimens of 800–1200 mg/day for one week, most studies achieve clinical cure rates of over 90% immediately and cure rates of over 80% at 4 weeks. A report suggests higher recurrence rates with single-dose therapy of 2 grams of metronidazole, despite achieving comparable

immediate clinical-response rates. The beneficial effect of metronidazole is mainly due to its antianaerobic activity and G. vaginalis susceptibility to the hydroxymetabolites of metronidazole. During this course, the presence of lactobacilli in fermented dairy products, particularly yogurt, has led to the idea that yogurt could be used as an alternative treatment for vaginal infections. Over the past decades, eating yogurt or inserting yogurt into the vagina by soaking a tampon in it has been a popular alternative treatment for vaginal infections (Verstraelen and Verhelst, 2009).

Table 2. Treatment guidelines for bacterial vaginosis

Treatment guidelines for bacterial vaginosis according to the CDC.
Recommended regimens (CDC, 2006)
• Metronidazole 500 mg orally twice daily for 7 days, or • Metronidazole gel (0.75%), one full applicator (5 g) intravaginally, once daily for 5 days, or • Clindamycin cream (2%), one full applicator (5 g) intravaginally at bedtime for 7 days
Alternative regimens (CDC, 2006)
• Clindamycin 300 mg orally twice daily for 7 days, or • Clindamycin ovules 100 mg intravaginally once at bedtime for 3 days
Recommended regimens for pregnant women (CDC, 2006)
• Metronidazole 500 mg orally twice daily for 7 days, or • Metronidazole 250 mg orally three times daily for 7 days, or • Clindamycin 300 mg orally twice daily for 7 days
The table is adapted from Verstraelen and Verhelst (2009).

3. Conclusion

Bacterial vaginosis often occurs in women of reproductive age. By understanding the general overview of bacterial vaginosis, especially the risk factors, it is hoped that its occurrence can be prevented, leading to a reduction in cases of bacterial vaginosis. Furthermore, it is also important for healthcare professionals to be knowledgeable about bacterial vaginosis so that they can accurately establish the diagnosis, provide appropriate management, and offer education to both patients and the general public.

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