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Mini Review

Vaginal Microbiome Alterations in Gynecologic Oncology Surgery and their Infectious Implications

Andreea Guzun*

Faculty of Medicine, Lucian Blaga University of Sibiu, Romania

***Corresponding author:** Andreea Guzun, Faculty of Medicine, Lucian Blaga University of Sibiu, Romania.

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Abstract

The vaginal microflora forms a crucial biological barrier against infections; however, its balance can be destabilized by gynecological oncological treatments. Surgical interventions, exposure to radiation, and prophylactic antibiotics alter bacterial diversity, reducing protective species and allowing the establishment of pathogenic germs. Analysis of recent literature highlights the link between these changes and the increased incidence of postoperative infectious complications. Future clinical approaches could include active microbiome monitoring and the implementation of preventive measures tailored to each patient's profile, in order to optimize therapeutic outcomes.

Keywords: Vaginal microbiome; Gynecological oncology; Postoperative infections; Lactobacillus

Introduction

In the scientific world, the study of the microbial ecosystem represents a field of high attractiveness and clinical relevance, due to its role in maintaining optimal homeostasis. International data indicate that gynecological neoplasms predominantly affect women in their seventies, with advancing age representing a risk factor. Surgical intervention is considered the primary strategy for eliminating neoplastic cells in the female genital tract. In older, hormonally inactive patients, iatrogenic sterility should not raise ethical concerns. The aim of this study is to highlight the extent to which vaginal microbiome exposure influences infection in patients with an oncological status in gynecology, for whom surgery is recommended. Therefore, deepening the understanding of microbiome disturbances after oncological surgeries is essential for recognizing susceptibility to pathogenic germs.

Materials and Methods

This mini-review included 18 recent studies extracted from PubMed, the National Library of Medicine, and specialty journals such as Scientific Reports, Frontiers in Oncology, and NPJ Biofilms & Microbiomes. Works investigating the vaginal microbiome in a gynecological oncology context were analyzed, with a focus on surgical impact, adjuvant therapy, and antibiotic therapy. The study aimed to synthesize data on microbiota changes and their clinical contribution to the prevention of postoperative infections.

Architecture and Functions of the Vaginal Microbiome

Vaginal functional balance depends on microbiota composition . Researchers in Central Europe highlight the existence of dozens of distinct bacterial forms in the vaginal environment. Physiologically, the genus Lactobacillus is dominant in the mature female population.

By examining specific vaginal regions, it was found that Lactobacillus groups are predominant regardless of anatomical location, and the remaining bacterial diversity constitutes a marginal percentage. Zheng and collaborators describe the well-known role of vaginal Lactobacillus subtypes in limiting harmful microorganisms through the production of acidic metabolites, factors that protect the environment from microbes, and oxidative agents. The subtype considered to have a high favorable potential for microbial balance is Lactobacillus iners. It adapts promptly to both alkaline and acidic vaginal ecosystems, acting as an intermediate microorganism by establishing itself in the vagina following dysbiosis.

Microbiome Transformations in the Oncological Context

Impact of Surgical Interventions on the Microbiota and Infection Susceptibility

By evaluating urine and vaginal samples before and after vaginal hysterectomy in 15 menopausal patients, a cohort study revealed enrichment with Streptococcus and anaerobic species. Moreover, surgery was found to facilitate infections through the increase of Gram-negative anaerobic bacteria and those involved in bacterial vaginosis, associated with a reduced volume of Lactobacillus. These results are particularly significant given the recommendation of hysterectomy in cases of malignant or potentially malignant pathology, with clinical manifestations including metrorrhagia and others. In these conditions, endogenous estrogen production decreases considerably, leading to microbiota disturbances and heightened susceptibility to other inflammatory processes, including new types of cancer. Other data demonstrate the effectiveness of identifying causative factors a priori and indicate a connection between the appearance of female genital cancers and microbiota alteration. This connection involves the proliferation of anaerobic germs concurrent with a decline in beneficial bacteria. The necessity of preventing microbial contamination of the surgical wound through antibiotic therapy is well documented.

The most frequently used antibiotics are narrow- to moderately-spectrum cephalosporins. General guidelines for antibiotic use in this context for oncological surgical procedures are undifferentiated from those for other interventions. However, it is recognized that antibiotic action on pathogenic microbes also causes changes in the vaginal and cutaneous microbiome, among others. Vaginal microbiome sensitivity to cephalosporins, as well as other classes such as aminoglycosides or penicillins, lies in the impact on Lactobacillus. Oncological management through surgery and radiotherapy in the treatment of endometrial, cervical, and carefully selected ovarian or vulvar neoplasms indicates superior outcomes compared to monotherapy. Radiotherapy influences the microbial ecosystem by creating an imbalance that leads to epithelial lesions, cytokine response initiation, and inflammatory activation. Although the effects of anesthesia on the vaginal flora remain insufficiently studied, experimental animal data on intestinal microbiota suggest a reduction in bacterial diversity; for example, a few hours after propofol induction, a decrease in Lactobacillus and Prevotella was observed, with recovery after approximately two weeks.

Factors Facilitating Infection Development

At the same time, the topic is somewhat controversial regarding infection susceptibility. A microbiota rich in Lactobacillus protects the body from sexually transmitted infections. However, the microbiome itself is affected by sexually transmitted diseases, contraceptive treatment, intimate habits, overexertion, or diet. A cohort study analyzing the ecosystem composition of women with diverse racial and ethnic backgrounds noted distinctions that may be influenced only by genetic sequences, not exclusively by lifestyle.

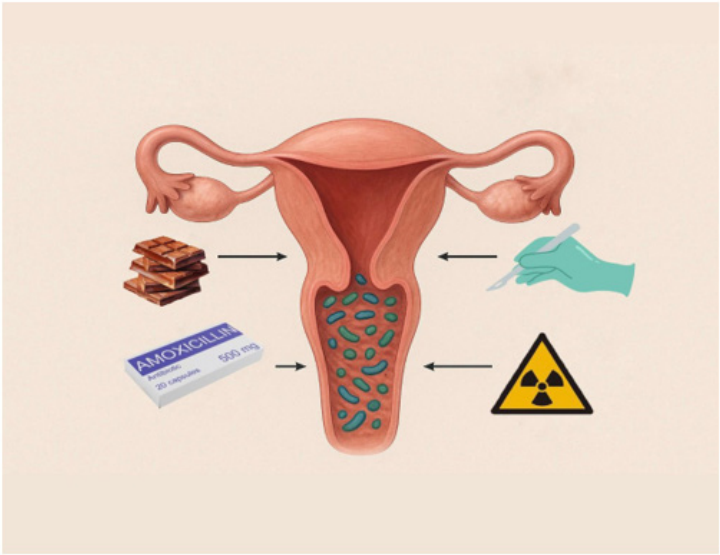

Figure 1: Factors altering vaginal microbiota: surgery, radiation exposure, antibiotics, diet.

Discussion

Clinical Perspectives and Prevention

As Gholiof and coauthors show, vaginal microbiota disruption is characterized by the absence of the majority prevalence of protective Lactobacillus bacteria. Considering the importance of surgery in gynecological cancer therapy, modulation of cancer cell progression should remain a priority, although certain literature perspectives raise concerns regarding the effects of antibiotics or anesthesia on the vaginal microbiome. The hazard risk in hysterectomy, chosen as a surgical option for these neoplasms, may also involve exposure to other carcinogenic forms, as mentioned in previous sections. Increasing clinical studies addressing the concrete consequences on vaginal bacterial functionality in the context of invasiveness in organisms already affected by mutations and abnormal cellular proliferation could play a key role in infection prophylaxis.

Conclusion

Vaginal bacterial imbalances associated with gynecological oncological surgery show a clear correlation with increased infection vulnerability. Although surgical procedures and adjuvant treatments remain essential for neoplasm control, they can disrupt the microbial ecosystem, with potential effects on patient health. Understanding these transformations and applying preventive strategies, including microbiota monitoring and judicious antibiotic use, can contribute to reducing infection risk and optimizing clinical outcomes. Future studies could explore how microbial ecosystem modulation can integrate with oncological therapeutic strategies, supporting a holistic and personalized approach [1-18].

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Conflicts of Interest

None.

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