https://ijmsphr.com
DOI: - 10.37547/ijmsphr/Volume07Issue03-06
Open Access Research Paper
INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND PUBLIC HEALTH RESEARCH
Vol. 07, No. 03, March 2026, 38-39
eISSN 2767-3774

A Comprehensive Approach Based on Phage Therapy in The Treatment of Purulent-Inflammatory Complications Developing After Cesarean Section

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Article Received: 20/02/2026, Article Accepted: 13/03/2026, Article Published: 31/03/2026

Abstract
Purulent-inflammatory complications developing after cesarean section remain one of the leading causes of maternal morbidity and complications in obstetric practice. Despite the widespread use of antibiotic therapy, the increasing prevalence of antibiotic-resistant microorganisms and biofilm formation significantly limits treatment effectiveness. This literature review analyzes scientific studies published over the past five years and highlights the potential of a comprehensive approach based on phage therapy in the treatment of post-cesarean purulent-inflammatory complications. The high specificity of bacteriophages, their ability to disrupt biofilms, and their synergistic effect with antibiotics make them a promising therapeutic option for the management of postoperative infections.

Keywords: Cesarean section, purulent-inflammatory complications, postoperative infection, bacteriophages, phage therapy.

Introduction

Cesarean section is one of the most frequently performed surgical interventions in obstetric practice, and its incidence has been steadily increasing worldwide in recent years. However, despite its widespread use, purulent-inflammatory complications following cesarean section, including endometritis, surgical site infections, pelvioperitonitis, and sepsis, remain among the major causes of maternal morbidity and mortality [1,8,9].

The effectiveness of conventional antibacterial therapy has significantly decreased due to the growing prevalence of antibiotic-resistant microorganisms, biofilm formation, and polymicrobial infections. In this context, scientific and clinical interest in bacteriophage-based phage therapy has increased in recent years.

According to contemporary literature, Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, as well as anaerobic flora, are identified as the leading etiological agents in the development of infectious complications after cesarean section [2,6]. Researchers emphasize that the ability of these microorganisms to form biofilms contributes to chronic inflammation of surgical wounds, reduced antibiotic penetration, and recurrence of infection (Wang et al., 2024). In particular, the presence of multidrug-resistant strains significantly complicates the treatment of post-cesarean infections.

Phage Therapy in the Treatment of Postoperative Purulent-Inflammatory Complications

Bacteriophages are viruses that selectively lyse bacteria and possess the ability to target and eliminate pathogenic microorganisms. An analysis of the literature published over the past five years highlights several key advantages of phage therapy: high specificity toward pathogens, minimal impact on the normal microbiota, the ability to disrupt biofilm structures, and synergistic effects when used in combination with antibiotics.

Review articles published in MDPI and Antibiotics journals (2024–2025) evaluate phage therapy as a promising alternative or adjunctive treatment for antibiotic-resistant infections.

Recent studies have demonstrated the effectiveness of phage therapy in postoperative purulent processes [11]. Wang et al. (2024) reported that the use of phage therapy in severe wound infections reduces purulent discharge, accelerates granulation tissue formation, and stimulates re-

epithelialization. In addition, studies published in BMC Microbiology (2025) indicated that phage cocktails significantly reduced bacterial load in severe infections associated with Pseudomonas aeruginosa [5,8].

In post-cesarean endometritis and surgical site infections, phage therapy can be administered both locally (via irrigation or drainage) and systemically. According to contemporary scientific perspectives, phage therapy demonstrates the highest effectiveness when applied within a comprehensive treatment approach. Such an approach includes etiologically selected phage preparations, low-dose or targeted antibiotic therapy, adequate drainage of the surgical wound, as well as immunomodulatory and detoxification therapy.

Data from the Journal of Intensive Care (2024) indicate that the combination of phages and antibiotics exerts a strong synergistic effect against biofilms and reduces the risk of reinfection. This approach is particularly relevant in severe postoperative conditions complicated by resistant infections [4,7].

The literature also notes certain limitations of phage therapy, including the need for individualized phage selection, the potential for neutralization by the host immune system, and the insufficient development of regulatory and legal frameworks [10,12]. Nevertheless, many authors consider phage therapy a promising direction in obstetrics and gynecology, particularly in the treatment of purulent-inflammatory complications following cesarean section.

Conclusion

In infections associated with antibiotic-resistant microflora and biofilm formation, a comprehensive approach based on phage therapy contributes to improved treatment outcomes and a reduction in the frequency of complications and recurrences. In this regard, conducting large-scale clinical studies and developing standardized treatment protocols are of crucial importance.

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