Valeology: International Journal of Medical Anthropology and Bioethics
(ISSN 2995-4924) VOLUME 02 ISSUE 06, 2024

THE ROLE OF PATHOGENIC AND CONDITIONALLY PATHOGENIC MICROORGANISMS IN SURGICAL PRACTICE

Rakhimova Nargiza Rustamdzhanovna,
Mo'minova Madinakhon Abdulkhaq qizi, Boltaeva Ra'no Shotursinovna,
Dzhuraeva Zulfiya Baratovna, Gulmurotova Dilafruz Shoymardonovna,
Kadirova Kuralay Abdullaevna
Department of Microbiology, Virology and Immunology of Tashkent Medical Academy

Abstract:
For centuries, surgical infections have been one of the most important issues in surgical practice. The availability of powerful broad-spectrum antibiotics, strict adherence to the rules of asepsis and antiseptics, and new approaches to the prevention and treatment of wound infection leave this problem unresolved to this day. The development of the infectious process in the field of surgical intervention slows down the recovery of a wound defect, increases the risk of adverse outcomes and requires repeated operations, which increases the length of hospital stay and health care costs. Opportunistic or pathogenic microorganisms can infect an operating wound, causing a surgical infection, a potential complication of the operation. Gram-positive cocci, especially opportunistic Staphylococcus aureus, are the most common cause of the infectious process in general surgery. Gram-negative microorganisms also play a big role. The occurrence of an infectious process slows down the recovery processes of the surgical wound area. It also increases the rehabilitation time of patients after surgery, hospital stay and material costs of treatment. Methods of asepsis and antiseptics have been the main means of preventing surgical infections for many centuries. Methods of biological antiseptics, including the use of antibiotics, enzymes and bacteriophages, as well as methods of physical antiseptics, such as irrigation and drainage of wounds, the use of improved dressings and wound coverings, have become the most common. Methods aimed at improving the regeneration of postoperative wounds constitute a separate group of strategies for preventing infectious complications. However, despite significant achievements in this field, the problem of surgical infection remains unresolved and interest in it does not decrease. Currently, research is actively underway aimed at developing more economical, convenient and effective methods and tools.

Keywords: *Microbial species, human microbiota, mixed bacterial infection, postoperative infectious complications.*

Introduction

Relevance. Everyone agrees that the vast majority of microbial species have not yet been successfully isolated or cultured in the laboratory. It has been found that between ten and fifty percent of organisms can be successfully grown in clinical microbiological laboratories, since most of the microbes associated with the human body are located in the gastrointestinal tract. The inability to grow most organisms is the result of a lack of understanding of their nutritional and environmental needs. The reality that much of the microbial world is so poorly described is obvious to doctors, who usually rely on seeding results to treat their patients. [1, 2, 3, 4]. Despite significant advances in antiseptics and the creation of powerful antimicrobials since the early 1900s, humans are still susceptible to bacterial and fungal infections due to virulence mechanisms that are ignored by the latest developments in microbiology. Operators are still exposed to infection, and it is only through a deep understanding of the evolution and development of microorganisms and a sophisticated understanding of human immune defense mechanisms that surgeons can fight infection in the same way that historical legends have made surgery a reality. This article describes modern microbial pathogens and problems associated with surgical diseases [5,6]. In the field of nosocomial infections, infections at surgical sites continue to be a big problem. The growing problem of antibiotic resistance, a sharp increase in the number of surgical interventions and concomitant diseases in patients exacerbate this ongoing problem. Thus, it is necessary to conduct a full study of all noticeable risk factors, as well as methods of preventive prevention. In addition, multidrug-resistant microorganisms are very common. Therefore, it is extremely important to conduct an emergency study and carefully examine all possible treatments that can be used to counter this growing threat. Thus, the main purpose of this review is a thorough assessment of the origin and risk factors associated with infections at surgical sites in various types of surgical interventions. This important analysis is designed to gain an in-depth understanding of the diverse factors contributing to infections at surgical sites. The overall goal is to promote more effective treatment and mitigation methods. This is necessary in light of the constantly changing medical situation. In an era of changing healthcare challenges, we strive to improve patient safety and the quality of surgical care by comprehensively studying these aspects [7, 8, 9]. After surgery, risk factors can influence the development of surgical infection. Thus, preoperative, intraoperative and postoperative prophylaxis of infectious complications should be carried out. Preoperative identification and stratification of risk factors are also crucial [10, 11, 12].

The microbiological composition present in the human body. Human microbiota consists of bacteria, fungi, viruses and protozoa that live in our body. The most widespread and undoubtedly one of the most important is the gut microbiota, which consists of about 100 trillion microorganisms with a total weight of 1.5 to 2 kilograms. The intestinal microbiota is rightfully considered a separate metabolically active organ, and it is difficult to determine its functions. Gut bacteria are involved in the enzymatic breakdown of nutrients and the formation of a large number of signaling molecules and metabolites. They are also involved in the synthesis of vitamins, control the growth and differentiation of immunocompetent intestinal cells and participate in the synthesis of vitamins. The products of bacterial digestion also increase intestinal peristalsis and serve as full-fledged plastic materials necessary to maintain homeostasis in the human body [13, 14, 15]. After childbirth, bacteria begin to colonize the digestive tract. During natural delivery, the intestines of a newborn are populated by *Lactobacillus* and *Prevotella*, common bacteria of the birth canal, and during cesarean section — *Streptococcus, Corynebacterium* and *Propionibacterium*, which are found on the mother's skin. After the first inoculation, the intestinal microbiota of an infant changes depending on the type of feeding and only by the age of three it becomes similar to the microbiota of an adult. In children receiving artificial feeding, *Bifidobacterium spp* predominates in the intestine. and *Lactobacillus spp.*, while *Enterobacter spp., Bacteroides spp., Clostridium spp.* and

Streptococcus spp. predominate in breastfed children. The human gut microbiota is still changing in adulthood. External factors play a big role. Diet, medications, diseases of the digestive tract and abdominal surgery are the most important factors [16, 17, 18].

The standard classification of wounds depends on the degree of contamination with a microorganism. The standard classification of wounds divides them into four classes based on the level of contamination: class II: conditionally clean wounds, meaning wounds entering the genital, respiratory, or digestive tracts under supervision and without unusual contamination; class I: clean, non-infectious surgical wounds; class III: contaminated (contaminated) wounds, encompassing recent, open trauma wounds, operations involving serious sterility technique violations, or significant gastrointestinal tract contents leakage; Class IV wounds are dirty or infected wounds, such as old traumatic wounds with non-viable tissues and wounds exhibiting clear clinical indications of internal organ perforation [15, 16, 17]. Among all operations in colorectal surgery, the highest SSI level is 10.1 per 100 operations. Deep infections or involvement of organs and body cavities occur in 61% of cases. SSIs continues to be the leading cause of morbidity, hospitalization, and death, despite advances in infection control, surgical techniques, and antimicrobial prevention. Most SSIs are caused by a mixed bacterial infection, while viral and fungal infections are rare. In abdominal surgery, most SSI are caused by *E. coli*, *Enterococcus spp.*, *Bacteroides spp.*, and less often *staphylococci* and *streptococci*. The number of potential bacteria that cause MDR increases after surgery, in particular. Here, the majority of isolates are gram-negative enterobacteria, followed by enterococci. The small number of fungal infections is 2.7% in 100 SSI cases, but this is higher than in other types of surgical interventions [18, 19, 20, 21].

Postoperative measures based on the phenomena of asepsis and antiseptics are aimed at cleansing wounds and accelerating their healing in order to reduce the risk of contamination and reproduction of microorganisms. These measures play an important role in preventing surgical infection. As mentioned above, rinsing the wound during surgery with solutions of various antiseptics is a widespread method. Drainage of postoperative wounds, which includes the removal of discharge from wounds, is an important component of physical antiseptics. Full-fledged drainage ensures sufficient outflow of wound exudate, which allows necrotic tissues to be rejected and allows the wound process to enter the regeneration phase. Flow-aspiration drainage is of the greatest interest. This method uses a system with an antiseptic solution that passes through the wound area and then is aspirated through the lower end of the drainage tube [22, 23, 24]. The use of a polyvalent bacteriophage is an alternative method of preventing infections in the field of surgical intervention. Viruses, known as bacteriophages, are able to infect and destroy bacteria without harming human cells. As a result, it is believed that they can be used to treat and prevent bacterial infections, including during surgical operations, alone or in combination with antibiotics. In addition, many modern studies confirm that bacteriophages are effective in treating infections caused by bacteria resistant to multiple drugs. Enzyme preparations of various origins, such as bacteriophages, are also used to treat wounds and prevent infectious consequences in the postoperative period. Crystallized preparations of trypsin and chymotrypsin are most common because of their necrolytic, anti-inflammatory, fibrinolytic, antioxidant and anti-infective functions. They also reduce the resistance of microorganisms to antibiotics and their virulence, stimulate collagen synthesis and have an analgesic effect [25, 26]. However, since proteolytic enzymes act only in a humid environment at a fixed pH value of 6 and have the ability to destroy the regenerating connective tissue matrix, this group of drugs does not have a wide clinical application. Advanced dressings can help prevent surgical infections after surgery. Currently, there is a wide range of highly effective wound coatings and dressings that not only provide mechanical protection of wounds, but also have antiseptic properties, support and stimulate the regeneration process. This reduces the risk of developing infectious processes after surgery and facilitates the recovery of patients [27, 28, 29].

Discussion. To prevent postoperative infectious complications, it is necessary to take into account several factors that can significantly affect the frequency of their occurrence in certain conditions. The most important factors are the general condition of the patient, the state of his immune system and potential concomitant diseases. In addition, it is very important how the operation is performed. The frequency of postoperative complications in some operations can reach 40% or more, especially in elderly patients with diabetes mellitus or other concomitant infectious or non-communicable diseases. To understand the basics of preventing infectious complications in the field of surgical intervention, it is necessary to have an idea of the existing classifications of surgical infections, as well as the generally accepted classifications of wounds. The classification is based on several principles. They divide surgical infections into superficial and deep, depending on how widespread the infection is. There are also early infections that occur thirty days after surgery, and late infections that occur from thirty-one to one year [1, 11, 24, 27, 28]. To reduce the risk of infection with opportunistic and pathogenic microorganisms of postoperative wounds, various methods of direct exposure to the area of surgery are used. These methods include the basic principles of surgery and wound closure, as well as various drugs, physiotherapy, chemical and physical methods that are used both during and after surgery. Surgical infection prevention methods are aimed at improving the regeneration of postoperative wounds and reducing the risk of infection. Nevertheless, despite the significant achievements made in this area, interest in this issue is not fading. Currently, active research is underway to find more effective, simple and cost-effective methods of preventing postoperative infectious complications [29, 30, 31, 32].

Conclusions. Thus, in modern surgical practice, a wide range of antimicrobial prophylaxis agents and methods are used both in the preoperative, intraoperative and postoperative periods.

There is a wide range of methods and means of infection prevention in the field of surgical intervention in modern surgical practice. They are based on the effects of asepsis and antiseptics.

Methods of biological antiseptics are the use of antibiotics, enzymes and bacteriophages; methods of physical antiseptics are the washing and drainage of wounds, the use of improved dressings and wound coatings. Improved suture material with antibacterial activity is also of great importance in modern surgical practice.

References

1. Morowitz MJ, Babrowski T, Carlisle EM, Olivas A, Romanowski KS, Seal JB, Liu DC, Alverdy JC. The human microbiome and surgical disease. Ann Surg. 2011 Jun;253(6):1094-101. doi: 10.1097/SLA.0b013e31821175d7.
2. Rappé MS, Giovannoni SJ. The uncultured microbial majority. Annu Rev Microbiol. 2003;57(1):369–394.
3. Zoetendal EG, RajilicStojanovic M, de Vos WM. High-throughput diversity and functionality analysis of the gastrointestinal tract microbiota. Gut. 2008;57(11):1605–1615.
4. Wilson M. Bacteriology of Humans: An Ecological Perspective. Malden, MA: Blackwell Publishing; 2008.
5. Qadan M, Cheadle WG. Common microbial pathogens in surgical practice. Surg Clin North Am. 2009 Apr;89(2):295-310, vii. doi: 10.1016/j.suc.2008.09.002.
6. Bucataru A, Balasoiu M, Ghenea AE, Zlatian OM, Vulcanescu DD, Horhat FG, Bagiu IC, Sorop VB, Sorop MI, Oprisoni A, et al. Factors Contributing to Surgical Site Infections: A Comprehensive Systematic Review of Etiology and Risk Factors. Clinics and Practice. 2024; 14(1):52-68. https://doi.org/10.3390/clinpract14010006
7. Kathju, S.; Nistico, L.; Tower, I.; Lasko, L.A.; Stoodley, P. Bacterial biofilms on implanted suture material are a cause of surgical site infection. Surg. Infect. 2014, 15, 592–600.

8. Trevejo-Nunez, G.; Kolls, J.K.; de Wit, M. Alcohol Use As a Risk Factor in Infections and Healing: A Clinician's Perspective. Alcohol Res. Curr. Rev. 2015, 37, 177–184.
9. Pinchera, B.; Buonomo, A.R.; Schiano Moriello, N.; Scotto, R.; Villari, R.; Gentile, I. Update on the Management of Surgical Site Infections. Antibiotics 2022, 11, 1608.
10. Морозов А.М., Сергеев А.Н., Жуков С.В., Морозова А.Д., Рыжова Т.С., Пахомов М.А., Беляк М.А., Хорак К.И., Думанов В.Ф. Профилактика инфекции области хирургического вмешательства // Современные проблемы науки и образования. – 2020. – № 6. ; URL: https://science-education.ru/ru/article/view?id=30268
11. Liu Z., Dumville J.C., Norman G., Westby M.J. and Cochrane Wounds Group Intraoperative interventions for preventing surgical site infection: an overview of Cochrane Reviews. Cochrane Database Syst Rev. 2018. vol. 12. DOI: 10.1002/14651858.CD012653.pub2.
12. Florschutz A.V., Fagan R.P., Matar W.Y., Sawyer R.G., Berrios-Torres S.I. Surgical Site Infection Risk Factors and Risk Stratification. J Am Acad Orthop Surg. 2019. vol. 23. P. 8-11. DOI: 10.5435/JAAOS-D-14-00447.
13. Wilfried Obst; Torben Esser; Achim Jens Kaasch Gernot Geginat; Frank Meyer; Roland S. Croner; Verena Keitel. The Need of Antimicrobial Stewardship in Post-Operative Infectious Complications of Abdominal Surgery. Visc Med (2022) 38 (5): 345–353. https://doi.org/10.1159/000526785
14. Gabriel Birgand, Puneet Dhar, Alison Holmes, The threat of antimicrobial resistance in surgical care: the surgeon's role and ownership of antimicrobial stewardship, British Journal of Surgery, Volume 110, Issue 12, December 2023, Pages 1567–1569, https://doi.org/10.1093/bjs/znad302
15. Гаус О.В., Беляков Д.Г. Современные взгляды на роль кишечной микробиоты в формировании патологии кишечника. РМЖ. 2021;4:10-16.
16. Jandhyala S.M., Talukdar R., Subramanyam C. et al. Role of the normal gut microbiota. World J Gastroenterol. 2015;21(29):8787–8803. DOI: 10.3748/wjg.v21.i29.8787.
17. Ivashkin V.T., Shelygin Yu.A., Baranskaya Ye.K. et al. Diagnosis and treatment of the irritable bowel syndrome: clinical guidelines of the Russian gastroenterological association and Russian association of coloproctology. Russian Journal of Gastroenterology, Hepatology, Coloproctology. 2017;27(5):76–93 (in Russ.)]. DOI: 10.22416/1382-4376-2017-27-5-76-93.
18. Maev I.V., Cheremushkin S.V., Kucheryaviy Yu.A., Cheremushkina N.V. Irritable bowel syndrome. Rome criteria IV. Consilium Medicum. 2016;18(8):79–85 (in Russ.).
19. Prävention postoperativer Wundinfektionen Empfehlung der Kommission für Krankenhaushygiene und Infektionsprävention (KRINKO) beim Robert Koch-Institut. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2018;61(4):448–73.
20. Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for disease control and prevention guideline for the prevention of surgical site infection, 2017. JAMA Surg. 2017;152(8):784–91.
21. European Centre for Disease Prevention and Control. Healthcare-associated infections: surgical site infections. Stockholm: ECDC; 2019. ECDC. Annual epidemiological report for 2017.
22. Strobel R, Kreis M, Lauscher JC. Postoperative Wundinfektionen – Vermeidungs- und Behandlungsstrategien. Chirurg. 2021;92(4):385–94.
23. Strobel RM, Leonhardt M, Krochmann A, Neumann K, Speichinger F, Hartmann L, et al. Reduction of postoperative wound infections by Antiseptica (RECIPE)?: a randomized controlled trial. Ann Surg. 2020;272(1):55–64.

24. Холамханов К.Х., Гаджиев Х.А. Способ активного дренирования и контроля активности воспалительного процесса послеоперационных ран // Актуальные проблемы медицины 21 века. 2014. С. 12-13.
25. Principi N., Silvestri E., Esposito S.Advantages and Limitations of Bacteriophages for the Treatment of Bacterial Infections. Front Pharmacol. 2019. vol. 10. P. 513.
26. Cisek A.A., Dąbrowska I., Gregorczyk K.P., Wyżewski Z.Phage Therapy in Bacterial Infections Treatment: One Hundred Years After the Discovery of Bacteriophages. Curr. Microbiol. 2017. vol. 74. no 2. P. 277-283.
27. Shah D., Mital K. The role of trypsin:chymotrypsin in tissue repair. J. Advances in Therapy. 2018. vol. 35. no 1. P. 31-42. DOI: 10.1007/s12325-017-0648-y.
28. Морозов А.М., Сергеев А.Н., Сергеев Н.А., Дубатолов Г.А., Жуков С.В., Городничев К.И., Муравлянцева М.М., Сухарева Д.Д. Использование современных раневых покрытий в местном лечении ран различной этиологии // Современные проблемы науки и образования. 2020. № 2. [Электронный ресурс]. URL: http://www.science-education.ru/ru/article/view?id=29705 (дата обращения: 10.10.2020). DOI: 10.17513/spno.29705.
29. Pieper D., Rombey T., Doerner J., Rembe J.D., Zirngibl H., Zarras K., Ambe P.C. The role of saline irrigation prior to wound closure in the reduction of surgical site infection: protocol for a systematic review and meta-analysis. Syst Rev.2018. vol. 7. no 1. P. 152. DOI: 10.1002/14651858.CD012234.pub2.
30. Dumville J.C., Gray T.A., Walter C.J., Milne T. K.G., Reeves B.C., Blazeby J. and Cochrane Wounds Group Dressings for the prevention of surgical site infection. Cochrane Database Syst Rev. 2016. vol. 12. DOI: 10.1002/14651858.CD003091.pub4.
31. Liu Z., Dumville J.C., Norman G., Westby M.J. and Cochrane Wounds Group Intraoperative interventions for preventing surgical site infection: an overview of Cochrane Reviews. Cochrane Database Syst Rev. 2018. vol. 12. DOI: 10.1002/14651858.CD012653.pub2.
32. Florschutz A.V., Fagan R.P., Matar W.Y., Sawyer R.G., Berrios-Torres S.I. Surgical Site Infection Risk Factors and Risk Stratification. J Am Acad Orthop Surg. 2019. vol. 23. P. 8-11. DOI: 10.5435/JAAOS-D-14-00447.