Fayzullayeva Zamira Rakhmatovna – associate professor
Rakhimova Nargiza Rustamdjanovna – assistant
Bositkhonova Robiakhon Shavkatovna – student
Musaeva Umida Azizovna – student
Naimov Abdumalik Nabievich – student
Kahramonova Charos Vohidjonovna – student
Kholboyev Amdukhamid Abdurakhmonovich – student
Tashkent State Medical University (Toshkent, O'zbekiston)

INFECTIOUS COMPLICATIONS IN SURGERY AND THE ROLE OF ANTIMICROBIAL PROPHYLAXIS

Annotation: *Infectious complications in the field of surgical interventions (SSIs) are among the most serious complications following cardiac surgery. They can prolong patients' hospital stays, increase the risk of mortality, raise treatment costs, and negatively affect the patient's quality of life. Nowadays, microorganisms that cause nosocomial infections are becoming increasingly resistant to antibiotics; therefore, identifying the composition of microbial flora isolated in SSIs and determining their resistance profiles are of particular importance.*

Studies on the composition and resistance of microorganisms play a key role in the multifactorial analysis of SSI etiology, which in turn allows for an objective audit and improvement of antimicrobial prophylaxis and nosocomial infection treatment protocols.

Key words: *surgical site infection, cardiac surgery, antibiotic resistance, antimicrobial prophylaxis, retrospective study.*

Файзуллаева Замира Рахматовна – доцент
Рахимова Наргиза Рустамджановна – ассистент
Боситхонова Робияхон Шавкатовна – студентка
Мусаева Умида Азизовна – студентка
Наимов Абдумалик Наби угли – студент
Кахрамонова Чарос Вахиджон кизи – студентка
Холбоев Амдухамид Абдурахмон угли – студент
Ташкентский государственный медицинский университет (Ташкент, Узбекистан)

ИНФЕКЦИОННЫЕ ОСЛОЖНЕНИЯ В ХИРУРГИИ И РОЛЬ АНТИМИКРОБНОЙ ПРОФИЛАКТИКИ

Аннотация: *Инфекционные осложнения в области хирургического вмешательства (ИОХВ) являются одними из самых серьезных осложнений после кардиохирургических операций. Они могут удлинять сроки пребывания пациентов в стационаре, повышать риск летальности, увеличивать стоимость лечения и отрицательно влиять на качество жизни пациентов. В настоящее время микроорганизмы, вызывающие нозокомиальные инфекции, становятся всё более устойчивыми к антибиотикам. Поэтому определение состава микробной флоры, выделенной при ИОХВ, и изучение её резистентности имеет особое значение.*

Исследования по составу и устойчивости микроорганизмов играют ключевую роль в многофакторном анализе этиологии ИОХВ, что, в свою очередь, позволяет проводить объективный аудит и совершенствовать протоколы антимикробной профилактики и лечения нозокомиальных инфекций.

Ключевые слова: *инфекция области хирургического вмешательства, кардиохирургия, антибиотикорезистентность, антимикробная профилактика, ретроспективное исследование.*

Fayzullayeva Zamira Raxmatovna – dotsent
Raximova Nargiza Rustamdjanovna – assistant
Bositkhonova Robiakhon Shavkatovna – talaba
Musaeva Umida Azizovna – talaba
Naimov Abdumalik Nabi o' g'li – talaba
Qahramonova Charos Vohidjon qizi – talaba
Xolboyev Amduxamid Abduraxmon – talaba
Toshkent davlat tibbiyot universiteti (Toshkent, O'zbekiston)

JARROHLIKDA YUQUMLI ASORATLAR VA ANTIMIKROB PROFILAKTIKANING AHAMIYATI

Annotatsiya: *Jarrohlik aralashuvi sohasidagi yuqumli asoratlar (YAJAS) yurak jarrohligidan keyingi eng jiddiy asoratlar sirasiga kiradi. Ular bemorlarning shifoxonada yotish muddatini uzaytiradi, o'lim xavfini oshiradi, davolanish xarajatlarini ko'paytiradi va bemorning hayot sifatiga salbiy ta'sir ko'rsatadi. Hozirgi kunda kasalxonada yuqumli kasalliklarni keltirib chiqaruvchi mikroorganizmlar antibiotiklarga tobora chidamli bo'lib bormoqda. Shu sababli YAJASdan ajratilgan mikroblar tarkibini aniqlash va ularning rezistentlik profilini o'rganish alohida ahamiyat kasb etadi.*

Mikroorganizmlarning tarkibi va chidamliligini o'rganish YAJAS etiologiyasini ko'p omilli tahlil qilishda muhim rol o'ynaydi. Bu esa o'z navbatida antimikrob profilaktika va nosokomial infeksiyalarni davolash protokollarini takomillashtirishga yordam beradi.

Kalit so'zlar: *jarrohlik joyi infeksiyasi, yurak jarrohligi, antibiotiklarga chidamlilik, antimikrob profilaktika, retrospektiv tadqiqot.*

Introduction: Surgical site infections (SSIs) that occur after open surgical procedures can lead to serious consequences. According to various sources [1–8], the incidence rate of SSIs in surgical clinics is approximately 4.5% (ranging from 0.9% to 20%). Despite the predominance of wounds with a low degree of contamination, antimicrobial prophylaxis (AMP) has demonstrated high clinical and economic effectiveness in surgical practice [9, 10]. Due to the specific characteristics of the microbial environment in surgical hospitals, cephalosporins of various generations — such as cefazolin, cefuroxime, and cefamandole — are traditionally used as drugs of choice for AMP, as they are effective against S. aureus and coagulase-negative staphylococci (CoNS).

Significance of the study: Studying the dynamics of SSI incidence and the characteristics of the microbial environment in relation to the applied AMP (antimicrobial prophylaxis) protocol is of great practical importance in the context of auditing and optimizing existing preventive measures.

Purpose of the study: The aim of the study is to investigate the relationship between the incidence and etiology of surgical site infections (SSIs) following open surgical procedures and the antimicrobial prophylaxis (AMP) protocol used.

Antibiotic prophylaxis: Vancomycin was administered in cases with a high risk of infection caused by vancomycin-resistant *Staphylococcus* strains (such as prolonged hospital stay, transfer from other departments, or the presence of preoperative and intraoperative risk factors — including diabetes mellitus, obesity, chronic obstructive pulmonary disease, peripheral vascular diseases, and others), or in cases where a confirmed allergy to β-lactam antibiotics was present.

Bacteriological studies: In bacteriological analyses, liquid nutrient media were used for the cultivation of microorganisms, and their growth was subsequently identified using various methods.Data from bacteriological studies were collected and analyzed for all patients with a confirmed diagnosis of postoperative surgical site infection (SSI).

Table 1.

Antibiotic Prophylaxis Protocols

Antimicrobial Agent	Dose	Half-life in adults with normal renal function ($T_{1/2}$), hours	Administration frequency (preoperative injection/infusion), hours	Duration of administration, hours
Cefuroxime	1.5 g	1–2	4–6	48
Vancomycin	15 mg/kg	4–8	12	48

According to the collected data, cases of deep SSIs occurred four times less frequently than superficial SSIs, with an incidence rate of 0.9% (95% CI 0.87–1.0), corresponding to 42 cases.The incidence of superficial infections was on average 3.2% (95% CI 3.15–3.24).

Materials and Methods.

Among 120 patients diagnosed with SSIs, 62 patients (28.2 ± 3.0%) had positive bacteriological test results.

In cases of deep infections**,** the probability of isolating a pathogen (odds ratio) was 12.8375 (95% CI 5.901–27.930)**,** which was significantly higher compared to superficial infections.

The isolates obtained from biomaterial samples (including 17/27.4% from sources other than postoperative wound fluid) in all cases fully matched the primary source of infection**.**

The main pathogens identified in patients with SSIs were staphylococci**,** accounting for 69.4% of all cases**.** Among them:

- Coagulase-negative staphylococci (CoNS) — 56.5% (35 cases)
- S. aureus — identified in 12.9% (8 cases).

Table 2.

Composition and Resistance of Microorganisms Identified in Patients with Surgical Site Infections (SSIs)

Microorganism	Number of cases	Percentage (%)	Resistance Characteristics
Coagulase-negative staphylococci (CoNS)	35	56.5	[Specify resistance if available]
S. aureus	8	12.9	[Specify resistance if available]
[Other microorganisms]	[Number]	[Percentage]	[Resistance]

- **Escherichia coli** — 8 isolates
- **Enterobacter spp.** — 5 isolates
- **Klebsiella pneumoniae** — 3 isolates

Additionally, fungi of the species candida albicans were identified in 3 cultures**,** corresponding to 4.5% of cases**.**

Antibiotic Resistance Analysis

Analysis of the isolated Gram-positive cultures showed that all staphylococci were highly sensitive to the following antibiotics: tigecycline, ceftaroline, daptomycin, vancomycin, linezolid, and fusidic acid**.**

Coagulase-negative staphylococci (CoNS) exhibited moderate resistance to:

- **Oxacillin and cephalosporins (I–III generation)** — 37.1 ± 8.2%
- **Macrolides (erythromycin and similar)** — 37.1 ± 8.2%

Among CoNS strains, resistance was also observed to:

- **Fluoroquinolones** — 22.9 ± 7.2%
- **Tetracyclines** — 8.6 ± 4.7%
- **Aminoglycosides** — 8.6 ± 4.7%

No resistant strains were detected among S. aureus isolates.

Resistance of Gram-negative Microorganisms

Extended-spectrum β-lactamase (ESBL)-producing Gram-negative microorganisms were identified in 8 cases**:**

- **6 cases** — *E. coli*
- **2 cases** — *E. cloacae*

All ESBL-producing strains were completely resistant to penicillins and cephalosporins (I–III generation)**.**

Additionally, most ESBL-producing Gram-negative microorganisms exhibited reduced susceptibility to fluoroquinolones and aminoglycosides**.** Resistance to fluoroquinolones was also observed in non-ESBL-producing *K. pneumoniae* and *E. cloacae* strains**.**

All isolated Gram-negative flora were sensitive to the following antibiotics: imipenem, tigecycline, ceftazidime/avibactam, and cefepime**.**

Conclusion.

The data on the incidence of surgical site infections (SSIs) after open surgery are consistent with the results of other researchers. This is clearly observed for both deep infections (0.1–2.9%) and superficial infections (1.5–30%) [1–8, 14].

Among cultures isolated from patients in this study, coagulase-negative staphylococci (CoNS) predominated, which aligns with the global trend observed worldwide [7, 8, 18].

The distribution of patients according to the type of antimicrobial prophylaxis (AMP) also corresponded to contemporary surgical practice, with a preference for β-lactam antibiotics [10–12]. One important reason for this choice is that using vancomycin as AMP may increase the risk of SSI development, a finding confirmed both in this study and in other scientific reports [12–14].

This situation is usually explained by the prolonged preoperative administration of vancomycin in patients belonging to high-risk groups. In such cases, vancomycin is recommended as an alternative to β-lactam antibiotics [10–12].

The data indicate that the effectiveness of AMP protocols against Gram-positive and Gram-negative microorganisms was almost equivalent. One possible explanation is related to the antibiotic resistance profile, namely the absence of resistant *S. aureus* strains and the high proportion of extended-spectrum β-lactamase (ESBL)-producing strains.

According to previous studies, using vancomycin as AMP is most effective in settings with a high prevalence of MRSA strains [6, 7]. However, an increasing share of Gram-negative, particularly ESBL-producing nosocomial strains, may reduce the effectiveness of β-lactam antibiotics [7, 12].

REFERENCES

1. Bokeria L.A., Beloborodova N.V. *Infection in Cardiac Surgery.* N.C.S.S.H. named after A.N. Bakulev, RAMS. Moscow, 2007.

2. Chernyavsky A.M., Tarkova A.R., Ruzmatov T.M., Morozov S.V., Grigoryev I.A. *Infections in Cardiac Surgery.* Surgery Journal named after N.I. Pirogov. 2016;(5):64–68.

3. Kazachek Ya.V., Pomeshkina S.A., Barbarash O.L. *Prevention of Infectious Complications in Cardiac Surgery.* Complex Problems of Cardiovascular Diseases. 2014;4:62–69.

4. Lednev P.V., Belov Yu.V., Stonogin A.V., Lysenko A.V., Salagaev G.I. *Postoperative Sternomediastinitis.* Surgery Journal named after N.I. Pirogov. 2018;(4):84–89.

5. Gelijns AC, Moskowitz AJ, Acker MA, Argenziano M, Geller NL, PuskasJD, Perrault LP, Smith

PK, Kron IL, Michler RE, Miller MA, GardnerTJ, Ascheim DD, Ailawadi G, Lackner P, Goldsmith LA, Robichaud S,Miller RA, Rose EA, Ferguson TB Jr, Horvath KA, Moquete EG, Parides MK, Bagiella E, O'Gara PT, Blackstone EH; Cardiothoracic Surgical Trials Network (CTSN). Management practices and major infections after cardiac surgery. *J Am Coll Cardiol.* 2014;64(4):372-381.

6. Filsoufi F, Castillo JG, Rahmanian PB, Broumand SR, Silvay G, Carpentier A, Adams DH. Epidemiology of deep sternal wound infectionin cardiac surgery. *J Cardiothorac Vasc Anesth.* 2009;23(4):488-494.8. Kunal S, Vishal K, Deepak KS. Mediastinitis in cardiac surgery: A review of the literature. *Int J Med Biomed Res.* 2012;1(2):97-110.9. Källman J, Friberg O. Antibiotic prophylaxis in cardiac surgery--general principles. *APMIS.* 2007;115(9):1012-1015.

7. Branch-Elliman W, O'Brien W, Strymish J, Itani K, Wyatt C, GuptaK. Association of Duration and Type of Surgical Prophylaxis With Antimicrobial-Associated Adverse Events. *JAMA Surg.* 2019; 154(7): 590-598.11. Berríos-Torres SI, Umscheid CA, Bratzler DW. Healthcare InfectionControl Practices Advisory Committee Centre's for Disease Controland Prevention guideline for the prevention of surgical site infection,2017. *JAMA Surg.* 2017;152(8):784-791.

8. Bratzler DW, Dellinger EP, Olsen KM. American Society of HealthSystem Pharmacists. Infectious Disease Society of America. Surgical Infection Society. Society for Healthcare Epidemiology of America Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Am JHealth Syst Pharm.* 2013;70(3):195-283.

9. Lador A, Nasir H, Mansur N, Sharoni E, Biderman P, Leibovici L, PaulM. Antibiotic prophylaxis in cardiac surgery: systematic review and meta-analysis. *J Antimicrob Chemother.* 2012;67(3):541-550.

10. Garey KW, Lai D, Dao-Tran TK, Gentry LO, Hwang LY, Davis BR.Interrupted time series analysis of vancomycin compared to cefuroximefor surgical prophylaxis in patients undergoing cardiac surgery. *Antimicrob Agents Chemother.* 2008;52(2):446-451.

11. Aslanov B.I. et al. *Principles of Organization of Perioperative Antimicrobial Prophylaxis in Healthcare Institutions.* Federal Clinical Guidelines. Moscow, 2014. Accessed September 28, 2021.

12. Anonymous. National Nosocomial Infections Surveillance (NNIS) System report, data summary from January 1992 through June 2004. TheAmerican Journal of Infection Control. 2004; 32 (2)470-485.17.Briko N.I. et al. *Prevention of Surgical Site Infections.* Clinical Guidelines. Nizhny Novgorod: Remedium Privolzhye, 2018.

13. Tegnell A, Arén C, Ohman L. Coagulase-negative staphylococci and sternal infections after cardiac operation. *Ann Thorac Surg.* 2000; 69(4): 1104-1109.19.Granichnaya N.V., Zaitseva E.A., Bondar V.Yu. *Phenotypic Characterization of the Biological Properties of Coagulase-Negative Staphylococci Isolated in a Cardiac Surgery Hospital.* Almanac of Clinical Medicine. 2017;45(2):127–132.