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НОВЫЙ ДЕНЬ В МЕДИЦИНЕ
NEW DAY IN MEDICINE**

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NOSOCOMIAL INFECTIONS: AN ACTUAL PROBLEM OF MEDICINE

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✓ *Resume*

Nosocomial infections have long been a recognized public health problem worldwide. It is obvious that nosocomial infections lead not only to an increase in morbidity and mortality, but also significantly increase the economic costs on the part of both the medical organization and the patient. Despite the progress in medicine, the burden of nosocomial infections has not lost its relevance for many medical organizations in the world.

Key words: nosocomial infections, infections associated with medical care, epidemiology.

ВНУТРИБОЛЬНИЧНЫЕ ИНФЕКЦИИ: АКТУАЛЬНАЯ ПРОБЛЕМА МЕДИЦИНЫ

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Нозокомиальные инфекции являются уже давно признанной проблемой общественного здравоохранения во всем мире. Очевидно, что нозокомиальные инфекции приводят не только к увеличению заболеваемости и смертности, но и заметно увеличивают экономические расходы со стороны как медицинской организации, так и пациента. Несмотря на прогресс в медицине, бремя нозокомиальных инфекций не потеряла своей актуальности для многих медицинских организаций в мире.

Ключевые слова: нозокомиальные инфекции, инфекции, связанные с оказанием медицинской помощи, эпидемиология.

KASALXONA ICHI INFEKSIYALARI: TIBBIYOTNING DOLZARB MUAMMOSI

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Nozokomial infeksiyalar butun dunyo bo'ylab uzoq vaqtdan beri tan olingan sog'liqni saqlash muammosidir. Shubhasiz, nozokomial infeksiyalar nafaqat kasallanish va o'limning ko'payishiga olib keladi, balki tibbiy tashkilot va bemorning iqtisodiy xarajatlarini sezilarli darajada oshiradi. Tibbiyotda taraqqiyotga qaramay, nozokomial infeksiyalarning yuki dunyodagi ko'plab tibbiyot tashkilotlari uchun o'z ahamiyatini yo'qotmadi.

Kalit so'zlar: nozokomial infeksiyalar, tibbiy yordam bilan bog'liq infeksiyalar, epidemiologiya.

Relevance

Nosocomial infection (nosocomial infection), according to the World Health Organization (WHO), is considered to be any clinically recognizable infectious disease that affects a patient as a result of his admission to the hospital or seeking medical help, or an infectious disease of a hospital employee due to his work in this institution, regardless of the appearance of symptoms of the disease before or during hospital stay time [1]. Recently, a new term has been used in scientific circles for infections caused by prolonged hospital stay as "infections associated with the provision of medical care" (IAMC). The risk of infection with IAMC is an acute global problem, as it is present in every medical organization and the absence of uniform criteria for the diagnosis of IAMC remains important.

Nosocomial infections (NI) are one of the main causes of morbidity and mortality, they cause enormous economic damage not only to patients, but also to hospitals around the world [2]. In the United States, about 2 million people suffer from nosocomial infections and approximately 90,000 of them are fatal. Nosocomial infections are positioned as the fifth leading cause of death in emergency hospitals in the United States [3]. In Europe, 5 million are registered annually. nosocomial infections, leading to 25 million additional days of hospital stay and death in 2.7% of cases [4]. In this regard, nosocomial infections can be considered an even more important problem of the XXI century.

The epidemiology of NI includes understanding and causes of NI, the condition of the infected patient and the frequency of these infections. Assessment of the condition of infected patients and risk groups allows not only to apply existing preventive measures, but also to improve them. Measures to control NI make it possible to reliably assess trends in the spread of infections at the hospital, city and country levels. The results of studies conducted by WHO and the Centers for the Control of Infectious Diseases indicate the incidence of NI everywhere. Thus, in North America and Europe, only 5%-10% of all hospitalizations lead to NI, while in Latin America, sub-Saharan Africa and Asia, more than 40% of hospitalizations are observed [5]. According to the WHO, on average, 8.7% of hospitalized patients suffer from nosocomial infections [6]. The problem of NI remains open and unresolved, since no medical organization and no country in the world can claim to have been able to solve this problem.

Table 1

List of common pathogens and types of NI

| Type of infection | Common pathogens | Less common pathogens |
|--|---|---|
| Bloodstream infections | Coagulase-negative staphylococci (CNS) S. aureus P. aeruginosa Candida | Enterococci Klebsiellasp Serratia marcescens Enterobacter sp Malasseziasp |
| Respiratory tract infections | CNS S. aureus P. aeruginosa Respiratory syncytial virus | Enterococci Klebsiellasp Serratia marcescens Influenza |
| Infections of the skin and subcutaneous tissue/area of surgical intervention | CNS S. aureus | Enterococci Serratia marcescens Aspergillus sp |
| Gastrointestinal tract | Rotavirus | Anaerobic bacteria coronavirus |
| Urinary tract infections | Gram-negative bacilli Enterococci | Candida sp |
| Infections of lymphatic and blood vessels | CNS S. aureus | Candida sp |
| Central nervous system | CNS S. aureus | Candida sp Serratia marcescens Enterobacter sp |
| Infections of the musculoskeletal system | S. aureus Group B streptococci | Candida sp Gram-negative bacilli |

Risk factors for nosocomial infections can be grouped into three main categories: medical procedures and the use of antibiotics, organizational factors and the patient's health status. The causative agents of nosocomial infections are both bacteria, viruses, fungi, and parasites. The bacterial origin of nosocomial infections accounts for approximately 90% of all infections. Do not overlook parasitic pathogens that have

their own transmission path: through water, household items and dirty hands. Common strains are *Staphylococcus aureus*, coagulase-negative staphylococci, enterococci (Table 1) [7].

Among gram-positive bacteria, *S. Aureus* remains to this day one of the most important problematic pathogens of nosocomial infections. Its importance in the etiology of nosocomial infections is extremely high in surgery, traumatology, orthopedics and neonatology. The difficulty of treating infections caused by *S. Aureus* lies in its resistance to penicillin (PRSA) and methicillin (MRSA). Methicillin-resistant *Staphylococcus aureus* (MRSA) is the main category of nosocomial pathogens worldwide. According to official statistics of the European Center for Infection Control, there are over 170,000 MRSA infections per year, of which about 5,000 are fatal [8]. A study conducted in 29 European countries found a large cross-country difference in the prevalence of MRSA from 0.9% (Norway) to 56.0% (Romania). The percentage of MRSA, as a rule, was lower in northern Europe and higher in the southern and southeastern parts [9]. Patients with MRSA infection have a long duration of hospitalization and are more likely to receive antimicrobial therapy. This is due to the increased use of antibiotics such as ceftazidime, cefsulodine, fluoroquinolones and co-amoxiclav [10].

The progressive development of medicine, new therapeutic and surgical interventions does not solve the problem of the prevalence of infections caused by coagulase-negative staphylococci. Recently, coagulase-negative staphylococci have become increasingly recognized agents of nosocomial infections in ophthalmology, neuro- and cardiac surgery, in immunodeficient and prosthetic patients [11]. As with many other nosocomial pathogens, increasing the rate of antibiotic resistance is an even more serious problem for coagulase-negative staphylococci [12]. Clinical studies have shown that *Staphylococcus epidermidis*, *Staphylococcus haemolyticus*, *Staphylococcus warneri* and *Staphylococcus hominis* are the most common coagulase-negative staphylococci in nosocomial infections.

In intensive care units, enterococci are one of the most common causes of nosocomial infections. Of more than 20 species of enterococci, only 2 species are particularly pathogenic to humans: *Enterococcus faecalis* causes infections in 85-90% and *Enterococcus faecium* in 5-10% [13]. In the USA, 12% of all VBI are infections of enterococcal origin. In 2005, 7,066 cases of enterococcal bacteremia were reported in the UK, 63% of which were caused by *E. faecalis* and 28% by *E. faecium*, which have increased antibiotic resistance [14].

To date, one of the acute problems related to nosocomial infections is considered to be the new pathogen *Candida Auris*, first registered only in 2009 [15]. The harm caused by *Candidaturas* may be underestimated due to the fact that it has multiple drug resistance and the difficulty of identifying it by standard laboratory methods. It should be noted that sometimes this species is often identified as *Candida famata*, *Candida haemulonii*, *Candidasake*, *Saccharomyces cerevisiae* or *Rhodotorula glutinis*. Due to insufficient information, 30-60% of patients expected a fatal outcome from *Candida Auris* infection. However, it should not be excluded that most of the patients had other serious diseases that could also increase the risk of death [16].

Infections of the urinary system, surgical intervention area, respiratory tract and blood flow are the most common among NI.

Urinary tract infections. Urinary tract infections (UTIs) account for almost 30-40% of all nosocomial infections and up to 70% of nosocomial infections in intensive care [17]. The most common pathogens are *Escherichiacolii* *Candidasp*, *Enterococcuspp*, *Pseudomonasaeruginosa*, *Klebsiellapneumoniae* and *Enterobacterspp*. Antimicrobial resistance among these pathogens is constantly increasing. More than a quarter are isolated. *coli* and one third of *P. aeruginosa* are resistant to fluoroquinolone [18]. A recent analysis of data from the National Project for the Prevention of Surgical Infections showed that in 86% of patients who underwent major operations, urinary catheters were used in the perioperative period. According to the results of the study by WaldH.L., MaA., BratzlerD.W. et al., it was noted that, with catheterization for more than 2 days, the risk of infection with UTI was significantly higher than with two-day catheterization and less (9.4% vs. 4.5%; logranktest, $P=0.004$) [19]. Approximately 3-7% of patients become infected on the day of catheterization, and the prevalence of bacteriuria reaches 100% on the 30th day after catheterization. Complications from urinary catheters lead to increased morbidity, prolonged hospitalization and increased health care costs. In medical organizations in the USA, the incidence of UTI is approximately 1 million per year or 3.1-7.5 infections per 1000 catheter days [20]. The additional cost per patient with UTI for diagnostic tests and treatment is on average US\$ 896 (95% CI, \$603-\$1189) [21].

Infections in the area of the surgical site. Surgical site infections (IHS) are the main source of postoperative disease, and less often the cause of death among surgical patients in the United States. The American Department of Health and Human Services has identified ICU as one of the 4 main categories of nosocomial infections [22]. According to the prevalence of ICU, they occupy the 2nd place and account for

20% of all nosocomial infections [23]. According to standardized criteria developed by the Center for Control of Infectious Diseases, there are three types of ICU: superficial infection in the field of surgical intervention, deep infection in the field of surgical intervention and infection in the field of surgical intervention of an organ/cavity [24]. In most cases, the source of the causative agent of IHU is the natural flora of the patient's skin, mucous membranes or hollow internal organs. Concomitant factors, such as diabetes, smoking, obesity, or infection, only increase the risk of IHU infection [25]. The economic impact of ICU in hospitals in North America is estimated at 1.6 billion US dollars per year. Preventing postoperative infection caused by MRSA will save \$60,000 in just one hospital [26]. The calculation of additional costs per 1 patient was US\$ 20,786 (95% CI, \$18 902-\$22 667) [21]. In 40-60%, ICU can be prevented due to effective control of ICU based on surveillance, antimicrobial prevention, infection control programs and a sufficiently high level of education.

Respiratory tract infections. Weakened immunity, high doses of antimicrobial drugs, during the treatment of patients hospitalized in high-risk WBI units (intensive care units, hematology, etc.), lead to the greatest susceptibility to respiratory tract infections. Nosocomial respiratory tract infection, like nosocomial pneumonia, is common and occurs in 10.7% of patients who have undergone intra-abdominal surgery. The risk of infection with nosocomial infection is higher in women than in men. There is also a racial predisposition to infection [27]. Studies on the economic harm from these infections show an extension of hospitalization by 11.03 days in the United States, an increase in total costs by \$28,160.95 [27]. In England, preventive measures contributed to a 10% reduction in infections with savings of £693 (US\$984) [28]. Undoubtedly, nosocomial respiratory tract infections lead to huge economic losses in the health care system in the form of improper use of medical resources, prolonged hospitalization and the use of antimicrobials.

Infections of the bloodstream. Approximately 677,000 cases of nosocomial bloodstream infections (NBI), resulting in 94,000 deaths, are reported annually in North America [29]. More than 1.2 million cases of NBI and 157,000 deaths per year are registered in European countries [30]. One of the common gram-positive pathogens of *Enterococcus* spp. It is the fourth leading cause of NBI in North America. In 30% of cases, patients are prescribed inadequate antimicrobial therapy [29].

Conclusion

Against the background of numerous foreign studies, there is a complete absence or insignificant data on the prevalence of nosocomial infections in medical organizations of post-Soviet countries. The reasons for this may be not only the imperfection of hospital hygiene, but also the lack of adequate laboratory diagnostics and knowledge about preventive measures. This dictates the need to study this problem at all levels of the medical service and healthcare.

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