BACTERIAL ZOONOSES: TYPES, ROUTES OF INFECTION AND PREVENTION MEASURES

БАКТЕРИАЛЬНЫЕ ЗООНОЗЫ: ВИДЫ, ПУТИ ЗАРАЖЕНИЯ И МЕРЫ ПРОФИЛАКТИКИ

***E. A. Gunerich*[1], *V. S. Znachonak*[1]**

***Е. А. Гюнерич*[1], *В. С. Значёнок*[1]**

[1]Belarusian State University, BSU, Faculty of Biology
Minsk, Republic of Belarus
egunerich@gmail.com

[1]Белорусский государственный университет, БГУ, Биологический факультет,
г. Минск, Республика Беларусь

Because of the huge variety of existing and daily emerging zoonoses, bacterial infections, along with viral ones, still play a negative role in the occurrence of serious diseases, provoking an increase in mortality of the world's population. Zoonoses are capable of spreading over vast territories in the shortest possible time, and their outbreaks are spontaneous, which makes such phenomena most dangerous. Man, penetrating into the environment, changing, transforming it for themselves, contributes to the fact that zoonotic infections can obtain not only an epidemic, but also a pandemic character. Unfortunately, it is not always enough to respond to the manifestations of the disease in a timely manner in order to successfully suppress it. The most rational solution would be to prevent zoonoses by taking certain sanitary and epidemiological measures.

Из огромного разнообразия существующих и возникающих с каждым днем зоонозов бактериальные инфекции, наряду с вирусными, по-прежнему играют негативную роль в возникновении тяжелых заболеваний и увеличении смертности населения земного шара. Зоонозы способны в кратчайшие сроки распространятся на обширные территории, и вспышки их бывают спонтанны, в чем и заключается опасность подобных явлений. Человек внедряясь в окружающую среду, меняя, преобразуя ее под себя, способствует тому, что зоонозные инфекции могут приобретать не только эпидемический, но и пандемический характер. К сожалению, не всегда достаточно своевременно среагировать на проявления заболевания, чтобы успешно его подавить. Наиболее рациональным выходом будет упреждение зоонозов путем принятия определенных санитарно-эпидемиологических мер.

Keywords: bacteria, infections, anthropogenic factors, natural foci, infection, precaution.

Ключевые слова: бактерии, инфекции, антропогенные факторы, природные очаги, заражение, предосторожность.

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Introduction. According to the modern definition, zoonoses are infections or infectious diseases transmitted naturally from vertebrate animals to humans. Global climate change, overuse of antimicrobials in medicine, more intensive farm conditions, and greater interaction with animals are driving the emergence or re-emergence of zoonotic bacterial infections. Some fungi (trichophytosis, microsporia), viruses (rabies, hemorrhagic fevers, foot and mouth disease, various types of encephalitis) can act as pathogens. The causative agents of zoonotic invasions (parasitic diseases) are protozoa (protozoal invasions – leishmaniasis, toxoplasmosis, trypanosomiasis), as well as helminths, parasitic mites, larvae of flies and gadflies, etc. The causative agents of the bacterial zoonotic infections (bacterioses) studied in this article are bacteria and other prokaryotes.

Zoonotic infections are pathogenic for several animal species, but can often cover a wider species diversity. For example, more than 200 species of animals are registered as carriers of bubonic plague, and about 70 species suffer from tularemia. Zoonoses cannot be transmitted from person to person, therefore, when infected, the human body, as a rule, is a biological dead end for them. But there are exceptions, such as pneumonic plague, yellow fever, and some others. However, humans cannot serve as reservoirs for zoonotic pathogens.

Zoonoses have different ways of transmission: transmissible (through carriers, mainly blood-sucking insects), food, contact, with damage to the skin, and also through the air. Initially, an outbreak of a disease (epizooty) occurs in a population of animals, from which people who have direct contact with them are already infected. The probability of morbidity is often affected by the professional activity of a person. For example, farmers, veterinarians, zoo and pet store workers, and others who work with farm animals are at particular risk. Close contact with cattle can lead to skin anthrax infection, while inhalation anthrax infection is more common in workers in slaughterhouses, tanneries, and wool factories. Also, recently born sheep can be carriers of the bacterium Chlamydia psittaci, which causes chlamydia [1].

Ways of infecting. In most cases, people fall ill with bacterial zoonoses through bites and scratches of animals, both wild and domestic. The oral cavity of healthy dogs and cats contains hundreds of different pathogenic bacteria, including

Pasteurella sp. Only 20% of dog bites become infected overall compared to 60% of cat bites. The risk of infection with Pasteurella multocida after a cat bite is 10 times higher than after a dog bite. P. multocida-infected bite wounds usually appear within 8 hours. It is estimated that approximately 20 % of animal bites or scratches infect humans. Dog bite infections are usually dominated by aerobic organisms: P. multocida (50 %), alpha-hemolytic streptococcus (46 %), staphylococcus aureus (46 %), Neisseria (32 %) and Corynebacterium (12 %). However, the following anaerobic bacteria are also isolated from infected wounds: Fusobacterium nucleatum (16 %), Prevotella heparinolytica (14 %), Propionibacterium acnes (14 %), Prevotella intermedia (8 %), and Peptostreptococcus anaerobius (8 %) [2].

Thus, harmless at first glance, minor damage to the skin and their neglect by people only contribute to the strengthening of pathogens in the body. In cities and towns, as the number of stray dogs and cats increases, the prevalence of pathogens also increases. The stability of the animal population is supported by the available food base, the availability of places to stay for the night, and in some months, the appearance of offspring. As you know, the best cure for the disease is its prevention, so measures such as neutering programs and placement of dogs and cats in shelters can compensate for the natural increase in the number of stray animals, and systemic vaccinations can develop resistance to pathogens.

It has been established that the proportion of bacterial intestinal diseases, fungal infections, echinococcosis in children in 12–18% of cases is significantly related to the number of homeless animals. In adults, this proportion is 6–14 % of cases with the incidence of bacterial intestinal infections, leptospirosis and toxoplasmosis, and chlamydia [3]. Children trustingly play with animals, stroke them, feed them and at the same time pick up infectious diseases. In addition, contaminated sandboxes, dirty hands soiled in the ground, puddles are dangerous contacts with biological agents. Free-range pets are also at risk of infection from their homeless relatives.

As noted above, farm animals, some rodents and birds, can also act as a source of infection. Pathogens can be excreted in the stool with urine milk and through the amniotic fluid of brucellosis. Human infection in this case occurs by the fecal-oral route. Brucellosis is also possible when inhaling ornithosis dust through damaged skin and mucous membranes. Live vectors, in particular arthropods, play a key role in the spread of blood zoonoses. For example, the plague pathogen Yersinia pestis is carried by blood-sucking fleas, which, in turn, were infected with it from sick rodents. The next hosts of the infection can be humans and other animal species, such as rats, cats, etc. Thus, the disease can go beyond the natural focus.

The causative agents of zoonoses are characterized by plasticity, polyadaptation, polypathogenicity and polytropism. The reservoir of zoonotic pathogens is populations of certain animal species. At the same time, being in many cases true parasites of a relatively small number of species, zoonotic pathogens are capable of infecting a very large number of vertebrates. Thus, the natural carriage of tularemia pathogens was found in 64 vertebrate species.

Zoonoses are not transmitted from person to person, the only exception is plague: in the pulmonary form of the course of the disease, it causes a complication in the form of pneumonia, and the infection is transmitted by airborne droplets.

Of the group of zoonoses of the skin, the most infamous infection is undoubtedly anthrax. Between 2,000 and 20,000 cases of anthrax are registered annually in the world. The disease is widespread in many countries in Africa, Asia, South and Central America, the Middle East and the Caribbean; isolated cases are observed in the USA and European countries. However, reports of anthrax outbreaks appear regularly in all parts of the world, including European countries. For humans, the main carriers are large and small cattle, pigs, horses, camels, reindeer, which, eating on pastures, eat grass with spores of Bacillus anthracis, and also consume food and water. Skins, wool, meat, internal organs of animals are also dangerous. Spores enter the body through mucous membranes and damaged skin. Anthrax infection is predominantly professional in nature, but there are also cases of domestic infection. For the complete destruction of anthrax, animal corpses are burned or, worse, buried deep in cattle burial grounds.

In addition, in this group of skin diseases, it is worth mentioning glanders, caused by the bacterium Burkholderia mallei and affecting mainly horses, mules, camels, and donkeys. Among susceptible animals, it spreads rather slowly in both chronic and latent forms. The causative agent cannot always be released into the environment. It has a high latency and can be transmitted to humans. Horses are often the source of infection for humans. Infection occurs through the discharge of a sick animal: nasal secretion and discharge from skin ulcers, less often intestinal contents, urine, milk. The clinical picture of glanders is made up of specific lesions of the skin, mucous membranes, muscles, joints and internal organs. Cases of intralaboratory infections of veterinary and medical workers are described. It is believed that aerosols of cultures are highly infectious for humans, because. most of the described cases of infection with glanders in the laboratory are associated with the penetration of the pathogen through the respiratory tract. Treatment of animals infected with glanders is prohibited; they are destroyed.

Natural foci of zoonoses. Most zoonoses are natural focal diseases. Natural foci were formed in ancient times during the evolution of parasitism. They represent vast geographic landscapes, within the boundaries of which the area of distribution in nature of a species or species of animals that are a reservoir of this infection in nature is confined. Epidemics in animal populations occur autonomously, without human intervention. With an increase in the number of individuals, the mechanisms of transmission of epizootics are naturally activated, part of the population dies, and the other, having been ill, acquires immunity. Immune resistance increases, and the epizootic declines, passing into the reservation phase. When new individuals susceptible to the disease appear in the population, the immune layer decreases and a new outbreak of the epizootic occurs, passing into the spreading phase, and everything repeats anew. Thus, epizootics occur sporadically. A person in this case is involved in the epidemic process indirectly, mastering the territory of a natural focus. From a phylogenetic point of view, a person is a very young participant in epizootics compared to animals. If natural foci formed

tens and hundreds of thousands of years ago, then a person has been involved in the epidemiological process in zoonotic infections for hundreds, at most thousands of years [4].

Based on the fact that a person only recently began to participate in epizootics with zoonoses, their body did not have time to finally form adaptations to their pathogens in such a short period of time. Bacteria also did not have time to adapt to humans. For this reason, infectious agents do not have organ tropism; selectivity in damage to organs and tissues. Consequently, they are able to act on almost any tissue and any organ, which manifests a variety of mechanisms and ways of transmission of zoonoses.

Microbiological diagnostics. Microbiological diagnostics is carried out in laboratories of especially dangerous infections, because pathogens of zoonoses belong to groups 1 and 2 of pathogenicity of microbes. In laboratory diagnostics, all five methods of microbiological diagnostics are used, namely: bacteriological, biological, serological, allergic and immune proper. Taking into account the biological hazard, work with the isolation of pure cultures should be carried out only in secure laboratories. In basic laboratories, microbiological diagnostics is also possible, but without isolating pure cultures. Since the timeliness, adequacy and, consequently, the effectiveness of therapeutic and anti-epidemic measures depend on the correctness and speed of establishing an etiological diagnosis, rapid diagnostic methods (immunofluorescence test, ELISA, PCR, phage diagnostics, etc.) are widely used in the diagnosis of zoonoses. The causative agents of zoonoses cause sensitization of the organism, therefore, skin-allergic tests with appropriate diagnostic allergens (pestin for plague, tularin for tularemia, brucellin for brucellosis, and anthraxin for anthrax) are used for their diagnosis [4]. The treatment of most zoonotic infections in modern conditions does not cause any particular difficulties, because. pathogens of bacterial zoonoses are susceptible to antibiotics. The effectiveness of recovery is also affected by a timely diagnosis.

Anthropogenic factors in the occurrence of zoonoses. Since the 20th century, the world's population has been steadily growing, which massively reduces natural landscapes. These two interrelated factors are a key link in the chain of events that led to the increase in the spread of zoonoses. Many of the new zoonoses are emerging in third world countries that are experiencing difficult development challenges such as poverty, inadequate sanitation, lack of access to clean water and waste disposal, isolation, socio-political problems, illiteracy, gender inequality, and degradation of natural resources. The trend towards an increase in the range of zoonoses is associated with the following factors.

1. Growing demand for animal protein. The increase in per capita animal protein intake in many low- and middle-income countries has been accompanied by significant population growth, particularly in Southeast Asia, where the proportion of animal protein in the daily diet has doubled since the 1960s.

2. Unsustainable intensification of agriculture. The use of more efficient means of production in agriculture contributes to the emergence of genetically similar animals with an increased level of productivity. However, such genetically uniform populations are less resistant to zoonoses than genetically heterogeneous ones, where there will be individuals more resistant to infection. Also, under conditions when animals are kept at a small distance from each other, an additional risk of infection is created.

3. Increasing the use of wildlife resources. The development of infrastructure by laying new roads to remote areas greatly facilitates people's access to wildlife and at the same time allows diseases to spread faster both in the country and abroad. In addition, recreational hunting, eating game meat in the belief that it is "healthier" and "fresher", trading animals for use in circuses and zoos, and for laboratory testing contribute negatively to the development of zoonoses.

4. Unsustainable exploitation of natural resources, accelerated by changes in land use and extractive industries. Increased movement of people, animals, food, trade associated with urbanization affects the rate of spread of zoonoses. For example, irrigation systems are associated with the transmissible transmission of zoonoses, the growth of cities and fences narrow the range of grazing and migratory movements of animals. Eco-tourism, which has recently become popular near caves and forests, strengthens the contact between humans and wild animals, increases susceptibility to insect bites, ticks and other pathogen vectors.

5. Travel and transport. Due to the growing volumes of legal and illegal human travel and animal trade, zoonoses can be transmitted faster than their incubation period.

6. Changes in logistics. The expansion of the product range and the reorientation of sales markets contribute to the lengthening of the food supply chain. As a result, it becomes more difficult to trace the origin of products and quickly respond to potential problems. The so-called open-air markets that supply fast-growing cities, although they have a number of advantages, especially for poor people, in the form of the convenience of low prices, etc., but the level of hygiene and biosecurity of the products they sell is far from high.

7. Climate change. Bacteria, like other living things, are also susceptible to climate, and some of them will thrive in a warmer, wetter and more disaster-prone world that is predicted in the near future. Some pathogens, vectors and hosts are likely to do worse in changing environmental conditions, disappearing in certain regions, which will lead to the loss of their deterrent effect on populations or to the colonization by other species of new ecological niches formed after their departure [5].

Prevention of zoonotic infections. A significant barrier to an epidemic-free future is the fact that many efforts to control infectious diseases are reactive rather than preventive. Quite a lot of budget funds are spent on developing immediate response measures during any of the epidemics. However, the most rational would be to make efforts to increase resistance to pathogens and, more importantly, to identify the main patterns of recurrence of outbreaks in humans and animals. Environmental monitoring helps in understanding the ecological relationships that underlie zoonoses, such as habitat change and degradation, climate pollution, etc.

The first important step is to establish the root causes of zoonoses. This will require a change in the relationship between man and nature, namely: ending overuse of land, combating degradation, sustainable agriculture, maintaining

the health of ecosystems and reducing the impact of anthropogenic factors on the climate. Further, safety in the food production process and sustainability in the extraction of bushmeat should be ensured through proper control of the animal population. By investing in the food industry and traditional food markets, their protection and safety can be improved. In addition, the key to addressing bacterial infections will be the establishment of a robust public health system, the adoption of preventive measures to control disease outbreaks, cooperation between ecology, agriculture and public health, and the development of a research-based control program. Disease surveillance, rapid response and control require the use of new technologies, especially biotechnology and information and communication technologies. Finally, raise awareness of the need to increase investment in prevention and control of emerging diseases at the political level [5].

Conclusion. Having analysed all the mentioned above information, we came to the following conclusions.

Bacterial zoonoses still pose a serious threat to both developed and developing countries, which is proved by the statistics provided on the research carried out. This means that not only economic or sanitary factors are the cause of spreading zoonoses-caused diseases, but it is the cause of human poor adaptability to such microorganisms.

Taking into account the multiplicity of pathogen transmission routes and their high resistance to antibiotics, as well as the ability to retain their pathogenic properties for a long period in nature, it is necessary to prevent the spread of infections outside their natural foci and quickly respond to the slightest outbreaks of the disease in a certain region. Thus, we can not but admit that, unlike humans, are very adaptable to outside effects and the environment, and they get resistant very quickly. The scope of remedies at the disposal of scientists and medicals is still rather limited and needs further research and experimentation.

Taking into account comparatively insufficient ways of curing such diseases, we can claim that prevention of infection with zoonoses can also be a broad education of the masses in sanitary and hygienic issues, in particular, representatives of those professions that are directly related to working with animals and the agricultural sector.

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ЭКОЛОГИЯ АТМОСФЕРНОГО ВОЗДУХА И НАБЛЮДЕНИЯ ЗА ЭКОЛОГИЧЕСКИ ЗАВИСИМЫМИ ЗАБОЛЕВАНИЯМИ НА ПРИМЕРЕ ГОРОДОВ АРМЕНИИ АРАРАТ И ДИЛИЖАН

ECOLOGY OF ATMOSPHERIC AIR AND OBSERVATIONS OF ENVIRONMENTALLY DEPENDENT DISEASES ON THE EXAMPLE OF THE ARMENIAN CITIES ARARAT AND DILIJAN

***Т. М. Астабацян*[1,2,3]**

***T. M. Astabatsyan*[1,2,3]**

[1] Белорусский государственный университет, БГУ , Minsk, Republic of Belarus
[2]Учреждение образования «Международный государственный экологический институт имени А. Д. Сахарова» Белорусского государственного университета, МГЭИ им. А. Д. Сахарова БГУ, Minsk, Republic of Belarus
[3]Институт Физиологии им. Л.А.Орбели НАН, г. Ереван, РА
tigran.astabacyan.88@bk.ru

[1]Belarusian State University, BSU, Minsk, Republic of Belarus
[2]International Sakharov Environmental Institute of Belarusian State University, ISEI BSU, Minsk, Republic of Belarus
[3]Institute of physiology NAS RA, Yerevan, Armenia

В данной статье проводится обзор сравнительно-сопоставительного анализа качества атмосферного воздуха двух крупных городов Армении, имеющих разветвленную структуру экономически важных объектов