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EBOLA VIRUSI INFEKSIYASINING YUQISH MEXANIZMI VA KLINIK AHAMIYATI

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ANNOTATSIYA. Ebola virusi infeksiyasi yuqori letallik darajasi, tez tarqalish xususiyati hamda og'ir gemorragik sindromlar bilan kechishi sababli zamonaviy tibbiyot va mikrobiologiyaning eng dolzarb muammolaridan biri hisoblanadi. Ushbu maqolada Ebola virusining biologik va mikrobiologik xususiyatlari, uning organizmga kirish yo'llari, yuqish mexanizmlari hamda patogenezining asosiy bosqichlari ilmiy manbalar asosida tahlil qilinadi. Shuningdek, virusning zoonotik tabiati, infeksiya rezervuarlari, kontakt va parenteral yuqish omillari hamda epidemik jarayon rivojlanishidagi ahamiyati yoritilgan. Maqolada Ebola virusining inson organizmida chaqiradigan klinik o'zgarishlari, xususan gemorragik isitma, ko'p a'zoli yetishmovchilik va immun tizim disfunksiyasi kabi patologik holatlar keng ko'rib chiqiladi. Bundan tashqari, laborator diagnostika usullari, zamonaviy profilaktik choralar va infeksiyaning global sog'liqni saqlash tizimidagi epidemiologik ahamiyati haqida ilmiy asoslangan ma'lumotlar keltirilgan. Ushbu maqola Ebola virusining yuqori xavfli infeksiyalar qatoridagi o'rni hamda uning inson salomatligiga ko'rsatadigan salbiy ta'sirini chuqur anglashga xizmat qiladi.

KALIT SO'ZLAR. Ebola virusi, gemorragik isitma, Filoviridae, epidemiologiya, zoonoz infeksiya, laborator diagnostika, virus patogenezi, yuqish mexanizmi, immun tizim, RNK virusi.

МЕХАНИЗМ ПЕРЕДАЧИ И КЛИНИЧЕСКОЕ ЗНАЧЕНИЕ ИНФЕКЦИИ ВИРУСА ЭБОЛА.

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АННОТАЦИЯ. Инфекция, вызываемая вирусом Эбола, является одной из наиболее актуальных проблем современной медицины и микробиологии вследствие высокой летальности, способности к быстрому распространению и развития тяжёлых геморрагических синдромов. В данной статье на основе научных источников рассматриваются биологические и микробиологические особенности вируса Эбола, пути проникновения в организм человека, механизмы передачи инфекции, а также основные этапы патогенеза заболевания. Освещаются зоонозная природа вируса, резервуары инфекции, контактные и парентеральные пути передачи, а также их роль в развитии эпидемического процесса. Особое внимание уделено клиническому значению инфекции, включая развитие геморрагической лихорадки, полиорганной недостаточности и дисфункции иммунной системы. Кроме того, представлены современные методы лабораторной диагностики, профилактические мероприятия и эпидемиологическая значимость вируса Эбола для мировой системы здравоохранения. Статья направлена на углублённое изучение роли вируса Эбола среди особо опасных инфекций и его влияния на здоровье человека.

КЛЮЧЕВЫЕ СЛОВА. Вирус Эбола, геморрагическая лихорадка, Filoviridae, эпидемиология, зоонозная инфекция, лабораторная диагностика, патогенез вируса, механизм передачи, иммунная система, РНК-вирус.

MECHANISM OF TRANSMISSION AND CLINICAL SIGNIFICANCE OF EBOLA VIRUS INFECTION

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ABSTRACT. Ebola virus infection is considered one of the most urgent challenges in modern medicine and microbiology due to its high mortality rate, rapid transmission potential, and severe hemorrhagic manifestations. This article analyzes the biological and microbiological characteristics of the Ebola virus, its routes of entry into the human body, mechanisms of transmission, and the major stages of pathogenesis based on scientific sources. Particular attention is given to the zoonotic nature of the virus, reservoirs of infection, contact and

parenteral transmission pathways, and their significance in the development of epidemic processes. The article also discusses the clinical importance of Ebola virus infection, including hemorrhagic fever, multiple organ failure, and immune system dysfunction. Furthermore, modern laboratory diagnostic methods, preventive strategies, and the epidemiological significance of Ebola virus infection within the global healthcare system are reviewed. This article aims to provide a deeper understanding of the role of Ebola virus among highly dangerous infectious diseases and its serious impact on human health.

KEYWORDS. Ebola virus, hemorrhagic fever, Filoviridae, epidemiology, zoonotic infection, laboratory diagnostics, viral pathogenesis, transmission mechanism, immune system, RNA virus.

INTRODUCTION. In Central, East, and West Africa, Ebolaviruses produce severe, frequently deadly hemorrhagic fever. Until recently, they were thought to be extremely virulent, uncommon illnesses with a limited influence on global public health. The first Ebola hemorrhagic fever outbreak in West Africa has altered this perception. This chapter includes an overview of the pathophysiology of ebolaviruses and a description of the clinical characteristics of the illness. We also outline the distinct advantages and disadvantages of each of the animal models currently employed in ebolavirus research. Since the majority of research focuses on this pathogen, we concentrate on the Ebola virus, which represents the type species Zaire ebolavirus of the genus Ebolavirus. Ebola virus (EBOV) is considered one of the most dangerous and well-studied viruses belonging to the family Filoviridae. Viruses belonging to this family are surrounded by an outer shell and have a single-stranded, negative-stranded RNA genome. (13) The genome of the Ebola virus consists of several genes that produce proteins that play an important role in the virus's reproduction, cell penetration, and the occurrence of severe pathological processes in the body. The virus contains biologically active components such as nucleoproteins, matrix proteins, glycoproteins, and RNA polymerase. Glycoproteins, in particular, facilitate the attachment and penetration of the virus into human cells. (12.7) The family Filoviridae is divided into three main groups: Ebolavirus, Marburgvirus, and Cuevavirus. The Ebola virus group includes several dangerous viruses. The most famous among them are the Zaire Ebola virus, the Sudanese virus, and the Bundibugyo virus. (4) These viruses have caused many Ebola epidemics in African countries. Outbreaks of this disease are characterized by very high mortality rates and have claimed thousands of lives in some areas. (9) In recent years, scientists have also identified new viruses similar to the Ebola virus in bats. Bombaly virus has been found in Sierra Leone and Kenya, and Mengla virus has been found in China. (7,10) It has not yet been fully proven that these viruses cause disease in humans or primates, as only genetic information is available about them, and the virus itself has not been isolated under laboratory conditions. (5) The Marburg virus group includes the Marburg virus. This virus, like Ebola, causes severe hemorrhagic fever and is characterized by high mortality rates. (3,5) In the Cuevavirus group, the Lloviu virus was identified, which is mainly found in bats in Europe. Information about this virus is currently limited. (6,14). A 2-year-old infant from Guéckédou prefecture became unwell in December 2013 with fever, vomiting, and black stool. Four days later, the youngster passed away. Five other people with comparable symptoms were ill after that one child. With 28,601 confirmed, probable, and suspected cases and 11,300 deaths, it was determined in March 2014 that these cases were caused by an ebolavirus infection. The outbreak spread to Guinea, Liberia, Sierra Leone, Mali, Nigeria, Senegal, Italy, Spain, the United Kingdom, and the United States, with a case fatality rate of approximately 40% (15).

The main purpose of the submitted manuscript is based on the results of authoritative scientific works mechanism of infection and clinical significance of ebola virus infection consists of a brief analysis of

One of the most dangerous aspects of the Ebola virus is that it damages immune system cells, destroys blood vessel walls, and causes severe hemorrhagic syndromes in the body. (7,9) Once in the body, the virus multiplies rapidly and can lead to multi-organ failure within a short period of time. For this reason, the Ebola virus is one of the most important and dangerous research objects in modern microbiology and epidemiology. (1,8) EBOV is a non-segmented, negative-chain RNA virus with a genome size of approximately 19 kb. The viral genome is arranged in a specific sequence, containing nucleoprotein (NP), VP35, VP40, glycoprotein (GP), VP30, VP24, and RNA polymerase (L) genes. The conservative leader and trailer regions located at the beginning and end of the genome are important for viral replication and the formation of new viral particles. (8.13) Each gene is surrounded by untranslated regions (UTRs) that contain specific transcriptional start and end signals. Unlike other genes, the GP gene of the Ebola virus produces three types of glycoproteins: membrane-binding GP, soluble sGP, and low-soluble ssGP. This process is controlled by an RNA-editing mechanism carried out by the viral polymerase complex, and it is this feature that distinguishes the Ebola virus from the Marburg virus. (11.12) Although Ebola virus particles have a diameter of about 80 nm, their length is highly variable, sometimes reaching 14,000 nm. The most characteristic form of the virus is the appearance of a filament. The virus nucleus consists of the RNA genome, NP, VP35, VP30, and L proteins, which function in a bonded state with VP24. VP40 is a membrane-bound matrix protein that forms the filament form of the virus and connects the nucleocapsid to the host cell membrane. The carboxyl end of the GP protein serves as a membrane-bound transmembrane glycoprotein. (4,6) Each protein in the Ebola virus plays a specific role in the replication cycle. The nucleoprotein envelops the viral genome, protecting it from decay, and constitutes the main part of the ribonucleoprotein complex. VP35 plays an important role in the replication and transcription of viral RNA as a polymerase cofactor. Thus, the complex molecular structure and protein system of the Ebola virus ensure its high pathogenicity and ability to spread rapidly in the body. (2,7)

Once in the body, the Ebola virus reproduces very rapidly and spreads widely. The main reason for this is the virus's ability to effectively hide from the human immune system. EDVs use several complex techniques to suppress the body's natural defense mechanisms. In particular, the proteins VP24 and VP35 help the virus escape immune control by blocking the interferon system. (3,6) The protein VP24 disrupts intracellular signaling processes, weakening the immune cells' response to the virus. VP35 "hides" viral RNA inside the cell, making it difficult for the body to recognize it as a foreign substance. As a result, interferon production decreases, and the virus continues to reproduce freely. (10) In addition, VP35 disrupts the maturation of dendritic cells and the transfer of antigens to T-lymphocytes. This disrupts the link between innate and acquired immunity and weakens the body's effective response to the virus. (6) Another important protein of the Ebola virus is sGP, which circulates in large quantities in the blood and acts as a "deceptive protein." This protein binds to neutralizing antibodies produced against the virus, preventing them from affecting actual viral particles. Although the virus does not directly infect lymphocytes, it causes mass apoptosis—that is, cellular death—in them. As a result, lymph nodes and lymphoid tissue in the spleen decrease sharply, further weakening the immune system. (4)

Pathological examinations of patients who died due to the Ebola virus revealed petechial hemorrhages in the mucous membranes and internal organs, hemorrhages in the gastrointestinal tract, and enlarged liver and spleen. Hepatocyte necrosis, cholestasis, fibrin clots,

and viral eosinophilic inclusions are observed in the liver. Virus antigens have been detected in hepatocytes, Kupfer cells, and portal tracts. (7) Lymphocyte breakdown and accumulation of cell residues are detected in the spleen and lymph nodes. Skin biopsies show edema, hemorrhages, endothelial necrosis, and fibrin clots. Viral antigens were also detected in endothelial cells, fibroblasts, and sweat glands of the skin. Furthermore, the Ebola virus causes severe damage to the digestive system, lungs, kidneys, heart, and bone marrow. Alveolar edema, hemorrhages, and congestion are observed in the lungs, while viral antigens are detected in alveolar macrophages. Thus, the Ebola virus damages almost all vital systems of the body, developing severe hemorrhagic syndrome and multi-organ failure in a short period of time. (2,9,12) Ebola virusiga qarshi ko‘plab antiviral preparatlar laboratoriya va hayvonlar ustida o‘tkazilgan tajribalarda ijobiy natijalar ko‘rsatgan. Ayrim dori vositalari G‘arbiy Afrikadagi Ebola epidemiyasi vaqtida bemorlarda ham sinab ko‘rilgan. Biroq hozirgi kungacha Ebola virusiga qarshi maxsus va to‘liq tasdiqlangan samarali davo usuli mavjud emas.(4) Shu sababli Ebola bilan kasallangan bemorlarni davolashda asosiy o‘rin simptomatik va qo‘llab-quvvatlovchi terapiyaga beriladi. Bunday davolash usullari organizmdagi suyuqlik va elektrolit muvozanatini tiklash, qon bosimini nazorat qilish, kislorod yetkazib berish hamda ikkilamchi infeksiyalarni oldini olishga qaratilgan.(7)

Discussion. Favipiravir is one of the promising drugs against the Ebola virus. This drug was found to be capable of inhibiting the proliferation of RNA viruses, thereby reducing mortality rates in experimental animals. However, in human studies, its effectiveness has not been sufficiently proven. (8.12) A method of using blood plasma from people who have recovered from Ebola has also been used, but in large-scale studies, this method has not significantly reduced mortality. The drug ZMapp, consisting of monoclonal antibodies, showed effective results in experimental monkeys and stopped the development of the virus. Nevertheless, clinical trials conducted among humans have not yet been fully completed. In addition, other drugs have been developed that disrupt the synthesis of viral RNA or block the activity of RNA polymerase. (6,13) Although some have shown good results in animals, their safety and effectiveness in the human body have not yet been sufficiently studied. Scientists are also researching drugs aimed at correcting blood coagulation disorders observed during Ebola. In general, modern medicine is actively working to create effective therapies against the Ebola virus, and more powerful antiviral agents are expected to appear in the future. (5) Ebola virus kasalligini davolashda qo‘llab-quvvatlovchi terapiya eng muhim usullardan biri hisoblanadi. G‘arbiy Afrika, Yevropa va AQShda olib borilgan intensiv tibbiy yordam natijasida kasallikdan o‘lim ko‘rsatkichlari avvalgi epidemiyalarga nisbatan sezilarli darajada kamaygan. Yevropa va AQShda davolangan bemorlarning aksariyati og‘ir holatda shifoxonaga yotqizilgan bo‘lsa ham, ularning katta qismi omon qolgan. Bunga zamonaviy reanimatsion yordam, doimiy kuzatuv va ayrim hollarda eksperimental antiviral preparatlar hamda antitanachalar bilan olib borilgan davolash usullari sabab bo‘lgan deb hisoblanadi. Bu holat Ebola kasalligida sifatli va tezkor tibbiy yordam hayotni saqlab qolishda nihoyatda muhim ekanligini ko‘rsatadi.(5,9) Supportive therapy is one of the most important methods for treating Ebola virus disease. As a result of intensive care in West Africa, Europe, and the United States, mortality rates from the disease have significantly decreased compared to previous epidemics. Although most of the patients treated in Europe and the United States were hospitalized in critical condition, a significant portion of them survived. This is attributed to modern resuscitation care, constant observation, and in some cases, treatment methods involving experimental antiviral drugs and antibodies. This situation shows that quality and prompt medical care in Ebola disease is extremely important for saving lives. (5,9)

Conclusion. Effective intensive care for Ebola patients requires almost continuous monitoring of the patient's condition. Doctors regularly monitor arterial blood pressure, heart activity, oxygen saturation levels, and fluid and electrolyte balance. (3,10) Taking blood samples through special venous catheters and administering medications intravenously facilitates the treatment process. Ultrasound examinations are also used to assess changes in cardiac activity and the circulatory system. Electrolyte content by laboratory analysis,

During treatment, antiemetic, diarrheal, analgesic, sedative, antibiotic, and anti-malarial drugs are used. When selecting medications, their negative impact on heart, liver, and kidney function is taken into account. Furthermore, feeding is performed enteral or parenterally depending on the patient's general condition. Thus, complex supportive therapy significantly increases the chances of survival in Ebola virus disease. (10)

As previously mentioned, EBOV causes a serious and frequently fatal hemorrhagic illness for which there are presently no approved treatments or vaccinations. Fluid and electrolyte replacement is often the primary supportive treatment for EHF; however, the latest outbreak in 2014 has enhanced the urgency of developing vaccinations and treatments. In addition to a number of treatment approaches, such as the transfusion of convalescent plasma and monoclonal antibodies, a number of vaccine candidates are presently undergoing Phase I–III clinical trials. To stop future outbreaks that have the same fatal potential as the one that occurred in 2014, however, further study on EBOV and other filoviruses is required.

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