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Marburg Virus Disease: Epidemiology, Transmission, and Global Health Implications

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Abstract

Marburg virus disease (MVD), a severe viral hemorrhagic fever, was first identified in 1967 following simultaneous outbreaks in Marburg and Frankfurt, Germany, and Belgrade, Serbia. The initial cases were linked to laboratory exposure to African green monkeys (*Chlorocebus aethiops*) imported from Uganda for scientific research. Since then, sporadic cases and outbreaks have been reported across sub-Saharan Africa, particularly in Angola, Uganda, the Democratic Republic of the Congo, and, more recently, in West African countries such as Ghana. Human-to-human transmission occurs through direct contact with the blood, secretions, organs, or other bodily fluids of infected individuals, as well as via contaminated materials like bedding and medical equipment. The incubation period ranges from 2 to 21 days, after which patients typically present with hemorrhagic manifestations, shock, and

multiorgan failure. Currently, there is no approved antiviral treatment, and management is limited to supportive care, including fluid resuscitation, electrolyte balance, oxygen therapy, and treatment of secondary infections. Early diagnosis, case isolation, contact tracing, and stringent infection control measures are essential to containing outbreaks. Due to its high case-fatality rate, potential for epidemic spread, and lack of licensed therapeutics or vaccines, MVD is designated a priority pathogen by the World Health Organization (WHO). In the context of increasing global attention to emerging and re-emerging infectious diseases, this review emphasizes the urgent need for investment in health system strengthening, improved diagnostic infrastructure, and the acceleration of vaccine and therapeutic development to mitigate future outbreaks.

Keywords: Marburg virus disease; Viral hemorrhagic fever; Human-to-human transmission; Epidemic preparedness; Vaccine development.

Introduction

This channel presents the Marburg virus illness and explains its symptoms, signs, diagnosis, epidemiology, and modes of transmission. (Srivastava et al.,2023)Strategies for prevention and control are also covered. Numerous outbreaks have been generated by the zoonotic illness known as Marburg virus sickness. In humans, it can result in serious sickness and even death. Research and development on the Marburg virus urgently needs to be accelerated, according to the WHO R&D Agenda list of priority illnesses' 2018 annual assessment. The recognized range of the Marburg virus in Africa has undoubtedly increased due to recent outbreaks, which is a concerning but predicted trend. This cave-dwelling bat's widely distributed range includes the new epidemic sites. This implies that unique infections with genetically different viruses or variations are most likely the cause of these apparently solitary occurrences. (Holmes et al.,2007).Although environmental changes (deforestation, habitat invasion) and human activity (urbanization, travel) might make risk assessment more difficult, bat monitoring is one method of assessing risk and forecasting future Marburg virus disease outbreaks. First of all, there are several endemic feverish disorders in Africa that are identical to Marburg virus syndrome. The course of the disease is comparable to that of other viral hemorrhagic fevers and the Ebola virus. Consequently, public health depends on accurate and timely diagnosis. Though many African nations lack sufficient infrastructure and staff, as well as limited or no access to

resources, the diagnostic tests that are required are accessible. In order to safeguard public health in developing nations, WHO Collaborating Centers are essential for both primary and confirmatory diagnosis. Building autonomous diagnostic capabilities in Africa will be essential and a guarantee for our response efforts in the future. Health institutions in Africa are now more aware of viral hemorrhagic fever, and epidemic control has improved to a level that is comparatively successful. Key components of response efforts include contact tracing and surveillance, on-site diagnosis, case identification and isolation, and community education. As of right now, outbreaks seem to be under control by regional and national organizations with assistance from Médecins Sans Frontières and the WHO. Clones of the Marburg virus vaccine are anticipated to work similarly. Clinical trials are undoubtedly crucial, but given the effectiveness of Ebola virus products in public health situations like the ongoing Marburg virus illness epidemics, it may be possible to expedite the licensing of these experimental new medications. This needs to be carried out in consultation with national authorities. The rate of advancement in Marburg virus illness treatment possibilities has been slower. Preclinical strategies that show promise include monoclonal antibodies and small molecules.

Viral hemorrhagic fever

Put on face shields, masks, gloves, and gowns, for instance. For information on the nations you want to visit, contact the Centers for Disease Control and Prevention. You may be required to provide proof of vaccination in certain situations. Avoid ticks and mosquitoes as much as possible when visiting regions where viral hemorrhagic fever epidemics are occurring. Contact with animals that are infected can result in the transmission of viral hemorrhagic fevers. Numerous animal hosts are home to the viruses that cause viral hemorrhagic fevers. These hosts are most frequently bats, non-human primates, rodents, mosquitoes, and ticks. Certain viral hemorrhagic fevers are spread via mosquito or tick bites. Different viral hemorrhagic fevers are spread by contaminated bodily fluids such blood, saliva, or semen. Certain kinds can be contracted by breathing in contaminated rat urine or excrement. Additionally, certain viral hemorrhagic fevers can transfer from one person to another. Traveling to a region where hemorrhagic fever is prevalent can make you infected there, but you won't exhibit any symptoms until you go back home. It may take two to twenty-one days for symptoms to show up. The kind of

virus determines this. Obtain a vaccination. If you are providing care for someone who could have the viral hemorrhagic fever virus, use the proper PPE, such as masks, gloves, goggles, and aprons. Your doctor will treat you in the hospital to keep an eye on your symptoms and any problems if you are really sick. (Paessler et al.,2013)

Human-to-human transmission

Gaon reported a dentist who had hemorrhagic fever with renal syndrome (HFRS) after hurting himself with tainted forceps while extracting a patient's teeth during an international symposium on the condition that was held in Belgrade in 1987. The dentist denied ever coming into touch with rats and said he had never been in a forest. This instance could be the first indication of potential Hantavirus transmission from person to person in Europe. One of the biggest areas in Europe with endemic HFRS is Bosnia and Herzegovina. During the war in 1995, the most recent RSF outbreak in Bosnia and Herzegovina was reported. Researchers have shown that when contaminated food or aerosols from diseased rats' saliva or droppings are consumed by humans, it can lead to illness. The general consensus was that there had been no documented human-to-human transmissions. Could hanta viruses, however, change this opinion? We have been shocked by hanta viruses before, particularly those that cause HPS. It makes sense for hanta viruses to spread from person to person through blood. Is it reasonable to anticipate respiratory transmission in HPS? It sounds awful. In any event, we need to be very careful when analyzing epidemiological data and transmission channels. Unquestionably, the hanta virus has not yet had its final say. The dissemination of 2019-nCoV will be influenced by two important characteristics. Second, individual differences in the quantity of secondary cases offer more information about the anticipated dynamics of the epidemic and the possibility of super spreading incidents. While a big number of instances will not transmit the pathogen at all, as if the number of secondary cases is widely distributed. Even though super spreading is extremely uncommon, it can lead to a massive and explosive transmission event and significantly alter how an epidemic develops. Low dispersion, on the other hand, would result in a more uniform increase in the number of secondary cases per index case and a more steady spread of the epidemic. This has significant ramifications for efforts at control. (De et al.,2017)

Hemorrhagic symptoms

Determining the extent of your excessive blood loss can occasionally be challenging. For instance, nosebleeds are frequent and usually not harmful. However, the bleeding may be serious and challenging to control if it originates from a large artery or blood vessel. This also applies to vaginal bleeding after giving birth. After birth, it is typical. On the other hand, severe bleeding indicates postpartum hemorrhage, which can be fatal. The best course of action is to pay attention to your body and your symptoms, and if you are not sure whether you are bleeding excessively, you should always get medical care. Learn to recognize the signs of excessive blood loss, which include exhaustion, shortness of breath, and dizziness. Never be afraid to get medical attention if you are worried about blood loss. One of the main potentially avoidable causes of mortality, particularly for traumatized individuals, is hemorrhage. Complications may arise from specific bleeding types. For instance, neurological issues and irreversible brain damage might result from a brain bleed. Damage to the pituitary gland caused by severe blood loss is known as Sheehan's syndrome, and it can be brought on by postpartum hemorrhage. It can pose major issues when it leaks, particularly if there is a significant loss of blood. In the case of a hemorrhage, it is imperative to seek medical attention immediately. If you suspect internal bleeding or if you or a loved one is experiencing continuous outward bleeding, don't be afraid to see the hospital. Medical experts use indicators (low blood pressure, fast heartbeat) and symptoms (dizziness) to identify bleeding. Finding its cause and location are the next stages. Internal bleeding can be harder to spot than outward bleeding, which is frequently evident. A medical practitioner will examine you physically and evaluate your medical history and symptoms. Laboratory testing and imaging may be necessary. This happens when blood builds up in the pleural space, which is the area between the rib cage and the lungs. Breathing difficulties or chest discomfort may result from lung compression. Brain hemorrhage, or intracranial hemorrhage: Either the brain or the tissues between the brain and skull are bleeding uncontrollably. When the bleeding happens in the brain, it is referred to as a hemorrhagic stroke. This kind of stroke is particularly dangerous and can get worse very fast. It is not the same as an ischemic stroke, which occurs when blood supply to the brain is blocked. PPH, or postpartum hemorrhage: This is severe postpartum vaginal hemorrhage. It is a dangerous illness that can be fatal. It may happen right after delivery or up to 12 weeks later. (Castaman et al.,2006)

Epidemic preparedness

The integration of therapeutic and preventive treatment options for infectious illnesses, such Marburg virus sickness, is often subpar, despite advancements in standard and critical patient care. The Ebola virus epidemic is an exception in this regard and a good illustration of where we ought to go in the future. It should be mentioned, nonetheless, that approved defenses against the Ebola virus do not work against other filoviruses, including the Sudan, Ravn, and Marburg viruses. The current state of Marburg virus countermeasures seems to be similar to that of the Ebola virus before to the West African outbreak. Although there is a dearth of clinical-grade material for vesicular stomatitis virus and adenovirus-based vaccines, preclinical research has produced a number of intriguing vaccine candidates that will be promptly assessed in clinical trials communication, improving safe infection control, and making necessary equipment and training available. Epidemics and pandemics of infectious diseases (ID) are significant and persistent worldwide issues. As cross-border trade, cattle production, and international connections and travel have grown over the past century, so too has the danger of developing IDs. Moreover, increasing human population density and shifting human-wild animal interactions are linked to waves of diseases and pandemics; in reality, the world's population has quadrupled since the turn of the 20th century, reaching 8 billion in 2022. Much of the globe is ill-equipped to handle ID risks, even with large investments in capacity building and global health surveillance. The appropriate distribution of information was another crucial element. Scientific results from clinical investigations can be made public relatively fast during a pandemic. For instance, press releases and preprint articles were quickly and extensively distributed without providing a sufficient description of the data; in this case, it may be extremely challenging to discern between high- and low-quality data, and it is impossible to reject false information from studies with methodological flaws. (Lee et al.,2020)

Vaccine development

This approach uses technology that has been proven effective in humans, including the flu and polio vaccines, and allows for the production of vaccines on a manageable scale. To properly develop the virus or bacteria, however, it takes specialized laboratory equipment, can take a long time to create, and likely requires two or three doses. A live-attenuated vaccination uses a live but weakened strain of the virus or one that is substantially similar.

These vaccinations include the measles, mumps, and rubella (MMR) vaccine and the immunizations against chickenpox and shingles. This process uses technology similar to the inactivated vaccine and allows for large-scale production. However, those with weakened immune systems could not benefit from these vaccinations. This kind of vaccination delivers certain proteins—subparts of the target germ—using a harmless virus, eliciting an immune response without really causing illness. This is accomplished by inserting instructions into a safe virus that produce particular components of the target disease. This harmless virus serves as a platform or vector to ultimately transport the protein to the body. The protein sets off the immune reaction. The Ebola vaccine can be produced rapidly since it is a viral vector vaccine. A subunit vaccine uses only the specific parts (subunits) of a virus or bacteria that the immune system needs to recognize. (Perrie et al.,2008).It does not include the entire microbe or use a harmless virus as a vector. Most childhood immunizations are subunit vaccines, which protect against diseases including whooping cough, tetanus, diphtheria, and meningococcal meningitis. A nucleic acid vaccine only employs a portion of the genetic material that codes for particular proteins, not the full bacterium, in contrast to vaccinations that use the entire, weakened, or deceased organism, or portions of it. The instructions our cells utilize to produce proteins are found in DNA and RNA. Messenger RNA, which serves as a template for the synthesis of certain proteins, is initially created in our cells from DNA. Vaccines contain other components that enhance their safety and efficacy, in addition to antigens or their genetic material. The majority of vaccinations contain these components, which have been used in billions of doses throughout the years. (Cunningham et al., 2016)

Conclusion

Marburg virus disease (MVD) exemplifies the profound challenges posed by high-fatality emerging infectious diseases, particularly in settings with fragile healthcare systems. The absence of approved therapeutics or vaccines, coupled with its rapid transmission dynamics and severe clinical outcomes, underscores the critical need for global vigilance and preparedness. Strengthening surveillance, accelerating the development of medical countermeasures, and enhancing rapid response capacities are essential to mitigating the risks associated with MVD. Moreover, this disease underscores the necessity of adopting

integrated One Health approaches that recognize the interconnectedness of human, animal, and environmental health in addressing contemporary and future epidemiological threats.

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