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Analysis on Human Monkeypox 2022

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Abstract. Monkeypox, a zoonotic orthopoxvirus with a clinical presentation similar to smallpox, was first reported in the DRC in 1970 and is still being reported. The vast majority of human infections are reported in West and Central Africa. The first outbreak outside of Africa occurred in the United States in 2003. A British national resident with a history of travel to Nigeria recently developed a visible skin lesion and other symptoms of monkeypox infection. Soon after, several countries that have never been exposed to monkeypox report abnormally high rates of infection, causing widespread panic. Using a literature review method, the paper provides a retrospective study of human monkeypox, including the early outbreak and current circumstances, analyzing the characteristics of MPV and providing some effective treatments. To combat the monkeypox outbreak, it is critical to have a thorough understanding of the virus.

Keywords: monkeypox, monkeypox outbreak 2022, prevention, transmission

1. Introduction

The COVID-19 outbreak began at the end of 2019 and has resulted in more than 540 million confirmed infections and more than 6.3 million deaths globally. It all started in a seafood market in China. The Omicron variation, which is the most prevalent coronavirus strain of COVID-19, is what is causing the current spike in coronavirus cases due to the virus's progressive mutation. Although the omicron variant spreads more easily than the prior variants of the virus of COVID-19, people who are infected generally do not suffer from the same grievous disease as other variants[1]. The mounting evidence supports the idea that omicron is a signal indicating that the pandemic's worst has passed. According to researchers, omicron appears to have a death rate that is 100 times lower than the delta variant [2]. More and more nations are choosing to put up with the "uncontrollable" COVID outbreak due to the disease's high degree of transmissibility and mild symptoms. An outbreak brought on by an infectious disease has drawn attention at a time when COVID-19 appears to be losing some of its worldwide impact. A kind of double-stranded DNA virus called the monkeypox virus (MPV or MPXV) causes monkeypox in both humans and other animals [3].

Animals, particularly rats and primates, carry this particular virus. It was initially studied in laboratory monkeys in 1958 and is indigenous to the tropical rainforest regions of central and West Africa. Subsequently, 2 years after the last case of smallpox appeared in Basankusu district, Zaire, the first human monkeypox case was confirmed in 1970[4]. Monkeypox has similar clinical symptoms to smallpox, but they are epidemiologically different, with the former having a case-fatality rate of about 17%. Throughout history, the outbreak of monkeypox hasn’t lasted for a long period and caused extreme deaths. Since the first case of the outbreak was detected in the UK in early May this year, cases of monkeypox have been reported in many continents and countries around the world in a short

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period of time. Plus, the epidemiological and clinical characteristics of these cases were different from those of previous years [5]. With the declaration of WHO that smallpox has been eradicated globally[3], most countries have stopped vaccination of new births. Immunity levels in the population soon decline rapidly[6], so people are more likely to be infected. Although the clinical symptoms of monkeypox have become less severe since 1980, the possibility of becoming infected with monkeypox remains a threat to humans. Because of the awareness of the severity of COVID-19, the world is paying more attention to this monkeypox outbreak. Therefore, it is essential to understand and predict the monkeypox epidemic. This paper uses the method of literature review, retrospecting the early outbreak and comparing it with the monkeypox outbreak of 2022, summarizing the characteristics of MPV and also listing several preventive measures. Since the devastating impacts of the SARS-CoV-2 virus on society were witnessed by global citizens, it is important to take a serious attitude against the monkeypox virus. Therefore, in order to eliminate the threat posed by the monkeypox virus, the first step is to improve public awareness of the monkeypox virus.

2. Characteristics of monkeypox

The Orthopoxvirus genus, which also includes Vaccinia (Smallpox Vaccine), Variola (Smallpox), and Cowpox, is where the monkeypox virus is found. The virus is zoonotic; it was found in Copenhagen's captivity-held Asian monkeys[7], and it may infect both people and animals. Although prolonged face-to-face or other close contact is normally required for the transmission of this type of virus in Orthopoxvirus, occasional infections of secondary contaminated objects and respiratory transmissions over large distances have also been observed. Overall, the transmission routes of the Monkeypox virus include both human-to-human transmission and nonhuman transmission. Human-to-human transmission can be carried by close contact with respiratory secretions, skin lesions or injury of an infected person or recently contaminated objects. Transmission may also occur via the placenta between the mother and the infant. Otherwise, nonhuman transmission or animal-to-human (zoonotic) transmission can occur from infected animals, either by being scratched or bitten by the animal, using products from an infected animal, or direct contact with blood, bodily fluids, etc. By the end of 1978, the injection of vaccinia virus-based vaccine into susceptible populations had efficiently interrupted the transmission of smallpox (Vaccinia). This practice was using animal viruses to boost the human immune system, hence against smallpox. It achieved immense success, resulting in the disappearance of human smallpox cases throughout the world[8]. The eradication of smallpox also led to a gradual relaxation in public. A decline in neonatal smallpox vaccination has also weakened the population's immunity.

Although monkeypox virus and Variola virus belong to the same genus of viruses (Orthopoxvirus), monkeypox is genetically different from others. According to the WHO, the MPV virus has two main evolutionary branches: the West African clade and the Central African (Congo Basin) clade. In comparison, unlike the smallpox-liked clinical features discovered in Central Africa, the West African monkeypox infections are milder in both human and animal primates. Generally, about 1% of infections cause death, while the Central African clade has a fatality rate of about 11%. The outbreak in 2003 in the United States was the West African monkeypox branch. Patients were recorded with milder symptoms. The genetic analysis pointed out that of the examined 56 virulence genes, 53 virulence genes were shared in both strains, and the main difference in their virulence is indicated in their orthologs of BR-203, BR-209, and COP-C3L [9].

According to research published by the UK Health Security Agency (UKHSA), the current UK monkeypox strain has 48 single mutations, of which 21 produce changes in viral proteins and the remaining 27 remain unchanged, according to research published by the UK Health Security Agency (UKHSA). Compared to smallpox, which has a secondary attack rate of 9.3% in cases involving unprotected contacts versus 37 to 88% for smallpox [10], monkeypox spreads less frequently. The MPV virus can enter the target's body through its oropharynx, nasopharynx, or intradermal routes, doing the replication in the receiving region and spreading itself to the lymph nodes. People infected with the MPV virus will have an incubation period of 7-17 days, followed by a prodromal period of

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1-4 days and a rash period lasting 14-28 days [11], but the general range can be between 4 days and 21 days. The initial symptoms are flu-like and are accompanied by fever, chills, headache, and muscle aches. Then the lymph nodes start to swell. After a few days, like other Orthopoxvirus, some bluster-like rash starts in one place and spreads throughout the entire body. If the individual is infected by sexual contact, a rash will first appear in the genital or peri-anal areas[12].

3. Early records

The first human case was detected in 1970, two years after the area had stopped experiencing smallpox infections, on a 9-month-old infant boy in Zaire (now the Democratic Republic of the Congo, DRC)[13]. There were a total of 48 cases recorded from various African nations and regions between 1970 and the end of 1979, with the majority occurring in Zaire and a death rate of 10%. All the cases were found in the tropical rainforest areas of Central and West Africa, where eating hunted wild animals is commonly one of the local food sources. All the infected people show similar clinical features to smallpox: the lesions develop more or less simultaneously and occur together at the same rate through papules, vesicles, and pustules before umbilicating, drying, and desquamating, with a diameter of about 0.5–1 cm. Patients usually have a febrile prodrome, accompanied by generalized headache and fatigue, and also rash or inguinal lymphadenopathy (notice that lymphadenopathy is not a characteristic of smallpox). According to the records in the [12]article, children were infected more frequently than adults, with about 83% of cases during this disease exposure being children aged below ten. The total recorded secondary attack rate among all known susceptible contacts was 3.3%, lower compared with smallpox (25%)[14].

From 1981 to 1986, the DRC reported over 300 cases of human monkeypox. The majority of cases were due to contact with animals. In 1996, the disease took place and triggered an outbreak again. It showed 88% of infections were carried by interhuman transmissions [15]. The first case diagnosed outside of Africa occurred in the United States in 2003, when more than 70 people were confirmed to have MPV infection. All the patients in these cases were close to or handled MPXV-infected prairie dogs, with no interhuman cases documented [16]. It is credible that the origin of the outbreak in 2003 was from a shipment of mammals from Ghana, located in western Africa. The ship contained approximately 800 mammals, including 6 types of rodents, and some of these infected animals were housed near the selling prairie dogs, hence transmitting the virus to humans [17]. Since 2017, Nigeria has experienced a major outbreak with more than 500 suspected cases and more than 200 confirmed cases, with a case fatality rate of about 3%. Cases are still being reported today [18]. Patients in the subsequent cases had traveled to Nigeria. Two unrelated Nigerian tourists were diagnosed with instances of monkeypox in the UK in 2018. A 38-year-old male tourist from Nigeria was diagnosed with monkeypox in 2019 and quarantined in Singapore.

It is true that the monkeypox virus may infect a wide range of mammalian species, but it is not yet clear how the virus spreads throughout the entire animal population or what particular host or agency it uses [19]. Although the previous records all pointed to some evidence that the monkeypox virus is likely contained by rodents.

4. Current outbreak of monkeypox

Since the first case of human monkeypox was discovered in 1970, many regions in the world are still intermittently threatened by the virus. The most recent worldwide outbreak of monkeypox began in May 2022. Unlike the past, most of the cases were reported from countries that are not endemic to monkeypox disease, and several endemic countries are still reporting cases. This first case in 2022 was reported on May 7, when a British resident showed the signs of monkeypox after traveling to Lagos and Delta State in Nigeria, where the area is considered an endemic region for monkeypox[20]. The person first had the rash appear in Nigeria on April 29th, later flew back to the UK and made the disease susceptible. In the reports of the BBC, two more cases were diagnosed in England five days later, on May 12. Two patients live together in the same household but are strangely unrelated to the person previously diagnosed on May 7. Almost every day since March 17, there have been new cases

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in the UK, and the daily number of new cases has increased a lot, which is numerically two digits. Subsequently, other countries in Europe experienced similar cases, including Spain, Portugal, Belgium, Italy, Sweden, France, Germany, Netherlands, Switzerland, Austria, Denmark, etc.

This outbreak has spread more widely and faster than previous outbreaks, with cases detected in multiple countries in a short period of time. Until now, a total of 28 European countries have been affected by the outbreak. On the other hand, the Massachusetts Department of Public Health (MDPH) laboratory in the United States confirmed the presence of the Western African monkeypox virus from a Massachusetts resident on May 18, and then nine states declared confirmed cases[21]. Within the 17 patients that were identified during the early stage of this epidemic, 14 of them had recent experience of international travel, which involved staying in 11 countries. As of July 1, there were more than 6,178 confirmed cases of monkeypox worldwide.

The outbreak in 2022 is concentrated in Britain, Spain, and Germany, in which these three countries have aggregated cases of 1236, 1196, and 1054, respectively. The cases in North America are accumulated in the United States and Canada, where there are relatively few compared to the previous three countries, but the cumulative cases are over 459 and 287 [22]. After a one-month period, in the middle of August, the confirmed cases in the United States have mounted up to over ten million. As of August 4, 2022, the US government officially considered the monkeypox outbreak a public health emergency, claiming the disease is considerably threatening people's lives and security. California, Florida, New York, and other populated regions encountered the relatively serious effects of the monkeypox epidemic compared to other regions. So far, only one to twenty confirmed cases of monkeypox have been discovered in Asian countries (Singapore, India, Japan, North Korea, China (Taiwan), and the Philippines). Overall, the disease hasn't caused much spray, with only one case of death in India reported. For most of the countries that have presented cases this time, it is the first outbreak of monkeypox in their history, with an unimaginable number of diagnosed patients. To a certain extent, it also proved that the leading virus of the current pandemic may be different from the previous ones. Although the world should pay much attention to this "repopularized" disease, the recovery is continuous and most of the patients heal after medication treatment. Another point to emphasize is that, regardless of children with compromised immunity, the majority of cases of the monkeypox outbreak in 2022 will be concentrated on men having sex with other men and their close contacts. A spooky case such as an HIV and MPV patient's nose is rotting after being dismissed as sunburn[23]. Therefore, a doubt arises: Is there any specific relation between MPV and HIV? According to the answer released by the CDC, there is no evidence to support that having HIV increases the likelihood of getting monkeypox [24].

5. Vaccine and physical protection against human monkeypox

5.1. Vaccine protection

Unlike the early days of the global outbreak of COVID-19, when the world was helpless against this unknown virus, monkeypox outbreaks have come to the public eye over and over again. Plus, decades of research have shown that treatment for monkeypox isn't out of reach. The CDC has recently published some efficient vaccines to protect against monkeypox. The preferred vaccine is JYNNEOS(two-dose vaccine), which takes 14 days to maximize its immune protection after getting the second dose. The JYNNEOS vaccine is the only FDA-licensed vaccine in the US that is approved for the prevention of monkeypox disease. ACAM2000(single-dose vaccine) is an FDA-licensed live replicating vaccinia virus vaccine, also known as the alternative to JYNNEOS, approved for the prevention of smallpox. It takes 4 weeks after vaccination for the immune protection to reach its maximum performance.

In comparison, JYNNEOS is safer in use than ACAM2000 for all populations, including some significantly compromised individuals who may not have received certain live attenuated vaccines[24]. Cidofovir, an injectable antiviral medication, is also an accessible treatment. It has been verified to have broad-spectrum activity against almost all types of DNA viruses and poxviruses, including

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vaccinia, variola(smallpox), cowpox, monkeypox, camelpox, molluscum contagiosum and orf. The listing viruses have proven sensitive to the inhabitory effects of cidofovir [25].

5.2. Physical protection

The monkeypox epidemic has caused psychological panic around the world because of its spooky, widespread skin damage and loss. In general, human genes do not spontaneously mutate to cause the emergence of monkeypox viruses. The early records which were found in the tropical forest in Africa all suggest that close contact with wild animals which were monkeypox virus infected is the main source of human monkeypox. According to the latest study, it is still uncertain about all the species that harbor monkeypox virus and the whole circulation process, so we cannot fully eliminate the virus from its origin (like vaccinations for smallpox eradication). During the current outbreak, the remarkable identifications of monkeypox cases in several countries that don't have cluster endemic monkeypox and involving patients with no direct travel history to monkeypox's popular regions manifest the interhuman and secondary transmission.

According to the reported cases, effective transmission of the monkeypox virus involves direct physical contact with infected patients (both sexual and non-sexual) and animals, as well as contaminated objects. Because the transmission range in the population is not explosive, it is more controllable than respiratory infectious diseases such as the SARS-CoV-2 virus. Moreover, although vaccinations like JYNNEOS and ACAM2000 are capable of preventing MPV, the inventory of these two injections is limited, which means they can only support a high-risk population. And people who have had contact with diagnosed MPV patients or have been exposed to contaminated objects are determined to face a high risk of contracting MPV.

Therefore, in the case of limited vaccines, individual prevention of disease can greatly reduce epidemic transmission and medical stress. Some prevention measures can be taken to avoid and diminish the transmission of MPV, including: 1) Isolating or avoiding close contact between infected patients and healthy people to prevent interhuman transmission; 2) Ensuring self-hygiene, washing hands or using an alcohol-based hand sanitizer after close contact with the masses; 3) Avoiding close direct contact with wild animals that have the potential to contain MPV; 4) Using protection during sexual contact within the MSM population; 5) Wearing masks or other proper personal protective equipment that is capable of preventing airborne infectious agents like respiratory droplets of infected patients. Monkeypox virus can be diagnosed by several tests, such as polymerase chain reaction (PCR) testing, which tests a patient's lesion materials (blood samples, etc.) to diagnose infection, but this assay requires expensive equipment and reagents, making it only suitable for testing in a major laboratory with professional technicians[10]. Other tests, including Anti-Orthopoxvirus lgG (previous exposure) and lgM (recent exposure), are also applicable in determining the cause of the cases.

6. Conclusion

Since the first outbreak of the monkeypox virus, there are still sporadic infections. The outbreak of monkeypox in 2022 was the most widespread and most infected outbreak of the virus in the world so far. Even if the zoonotic disease cannot be eradicated, the West African strain is relatively mild and not as lethal as the strains that have been circulating in central Africa, according to a review of existing cases and laboratory studies. Infected patients will recover at the end of the infection. The current effective vaccine can prevent monkeypox infection, but cannot support the whole society. Individual preventive measures should be promoted by the community and the government. In areas where no cases have been found, the import and export of goods and people should also be strengthened to avoid the inflow of monkeypox virus. Hopefully, in the future, the monkeypox virus will be precisely studied and the infected cases will cease to climb.

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