International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 07 July 2022
DOI: 10.47191/ijcsrr/V5-i7-29, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

Monkeypox: From Past to Present Outbreak

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ABSTRACT: Monkey pox is one of the most rare disease caused by the infection of monkey pox virus; the source of disease still remained unknown. It was discovered in 1958 where there is an outbreak in small-pox like disease. At that time monkey were kept to further analyze. In 1970, the first instance of monkeypox in a human was noted. Monkeypox cases have now been documented in a number of other central and western African nations. Prior to the 2022 outbreak, almost all cases of monkeypox in people outside of Africa were connected to either imported animals or foreign travel to nations where the illness frequently occurs. There are various symptoms that could be diagnosed as the monkey pox. The most common ones are the rash which is identical to pimples of blisters that appear on our face regularly. However, it may spread towards other part of our body including the hands, feet, chest, genitals, or anus. The monkey pox rash has different stages starting from the ones identical to pimples to the burned out. This illness typically last between 2-4 weeks. SInce the monkey pox disease is not as common, researchers is still currently work on discovering the root cause. In the present, there is still not enough resources available.

KEYWORDS: Mokeypox, Monkeypox virus,Orthopoxvirus, Variola viruses

INTRODUCTION

Monkeypox virus belongs to the Poxviridae family, genus Orthopoxvirus [1]. Variola virus, vaccinia virus, ectromelia (mousepox) virus, and cowpox virus are all members of this genus. Smallpox was caused by the Variola virus, which was eventually eradicated as a disease due to a successful containment strategy, the lack of animal or environmental viral reservoirs, and the development of a very efficient vaccine [1]. The closely related vaccinia virus was used to help eliminate smallpox [1]. It is often used as a model poxvirus in research labs [2]. Towards the end of the 1980s, the Routine smallpox vaccination was phased [3, 4]. Furthermore, after the last naturally occurring case of smallpox in 1977 and the World Health Organization's (WHO) announcement of the global eradication of smallpox in 1980 [5]. Decades ago, smallpox immunization become a concern [5]. There are predictions that monkeypox will emerge and be the next virus that will have a great effect on our world [6, 7]. One of the first few cases of the monkeypox was found in the Western Hemisphere which was shown as a result of the unintentional importation of diseased animals, raising the possibility of global spread. Because the clinical symptoms of monkeypox and smallpox are so similar, it is impossible to tell the two apart clinically unless appropriate diagnostic tests are conducted [2, 3]. There are also concerns that, given the current lack of smallpox vaccine, monkeypox could become a more effective human virus [5, 6, 8]. This review aims to address the

Epidemiology of the Disease

Monkeypox is a smallpox-like disease caused by a virus that is closely linked to the variola virus (smallpox virus), which is divided into two clades including the Congo Basin (central African) clade and the West African clade [9, 10]. The monkeypox is a re-emerging zoonotic illness caused by a DNA virus from the Poxviridae family's orthopoxvirus genus. Monkeypox has grown endemic in various African countries, including Nigeria, Benin, and Liberia [11, 12]. The first human case was confirmed in the Democratic Republic of the Congo in 1970 [13, 14]. Monkeypox is most commonly shared among monkeys, Gambian pouched rats, and squirrels, although it has been known to cross to humans and cause brief epidemics [15]. The infection causes a unique rash that starts on the face and extends to other regions of the body, including the genitals, as well as fever, headache, muscle pains, and lymphadenopathy, the swelling of lymph nodes [16]. Monkeypox is a minor, self-limiting virus spread through direct contact with sick people or through contaminated clothing, towels, or furniture, as well as respiratory droplets [16, 17]. The monkeypox virus is not as easily transmitted from person to person as SARS-CoV-2 is [17]. However, the latest outbreak is revealing information gaps about monkeypox [18, 19].

The first draft of the monkeypox virus's genome sequencing was made public by scientists in Portugal on May 19, 2022, and the virus has since been found [20, 21]. The 2022 monkeypox virus is most closely related to monkeypox viruses associated with disease

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transmission from Nigeria to the United Kingdom, Israel, and Singapore in 2018 and 2019 [19, 22], according to preliminary genetic evidence. It belongs to the west African lineage. A monkeypox vaccine (Imvamune or Imvanex) developed by a Danish biotechnology company (Bavarian Nordic) has received US regulatory approval for both monkeypox and smallpox [13, 23]. Smallpox immunization gives 85% protection against monkeypox infection, according to evidence from Africa. 8 The 2017–20 monkeypox outbreaks in Nigeria were exacerbated by a drop in population-level immunity after smallpox immunization was discontinued in the 1980s [8]. Furthermore, on May 19, 2022 tecovirimat (Tpoxx) was approved for the treatment of human smallpox disease in the United States, Canada, and Europe. Lastly, the European Medicines Agency has approved tecovirimat for the treatment of monkeypox as well [6, 24].

Several difficulties are highlighted by the distinct diversity in human monkeypox epidemiology during this present outbreak [7, 25]. For instance, in some circumstances, the absence of prodromal signs like fever, malaise, and headache, as well as the presence of herald skin lesions at the site of sexual contact, strongly support sexual transmission in imported animals. [26]. However, there are worries that the way the media portrays men who have sex with men as the outbreak's at-risk demographic may overly stigmatize this group. [27]. Monkeypox disease case criteria have been modified to account for cases that have no history of travel to endemic countries. The UKHSA is also working on new clinical guidelines to address crucial issues like the use of appropriate personal protective equipment in sexual health clinics and the revision of standard operating procedures in laboratories [28]. Considering that there have been numerous instances of monkeypox discovered in 12 different countries, the risk of cross-border transmission is now considerable. [27]. To combat this hazard, robust public health surveillance and control measures are required [21].

Multi-country monkeypox outbreak in non-endemic countries

Monkeypox cases have been reported to WHO from 12 non-endemic Member States in three WHO regions since May 13, 2022 [29]. Epidemiological investigations are ongoing, but there have been no confirmed travel ties to endemic areas as of yet [30]. According to current evidence, incidents have been detected primarily, but not solely, among men who have sex with men (MSM) seeking care in primary care and sexual health clinics [31]. The goal of this Disease Outbreak News is to increase awareness, provide technical assistance for immediate recommended actions, and inform readiness and response efforts [32]. The situation is changing, and WHO anticipates that as observation in non-endemic countries expands, there will be more cases of monkeypox found [33]. The first step will be to accurately notify those who are most at risk of contracting monkeypox in order to stop the spread of the disease [17, 34]. The most vulnerable group, according to the most recent research, is anyone who has been in close contact with someone who has monkeypox while they are still symptomatic. [35]. The World Health Orgaization is also creating policies to safeguard frontline healthcare workers and other delicate health workers, such cleaners [27]. Later, the World Health Organization will provide more technical suggestions [12].

Monkeypox virus (MPXV): clinical manifestation

Camelopox, cowpox, vaccinia, and variola viruses including mokeypox are all belong into the Orthopoxviruses [36]. Since the eradication of smallpox in 1980, the virus has been the most common Orthopoxvirus impacting human populations [6]. In resource-poor endemic locations where monkeypox is found, clinical detection, diagnosis, and prevention continue to be problems [37]. Studies conducted near the conclusion of smallpox eradication inform monkeypox epidemiology, but new assessments are needed now that routine smallpox vaccination has finished and herd immunity is declining [16]. Furthermore, foundational ecological studies are required to better understand the animal species involved in virus transmission and maintenance, as well as to influence preventative strategies [38].

Until the virus was isolated from a patient who had smallpox infection in the Democratic Republic of the Congo in 1970 as part of efforts to eradicate the disease, human monkeypox was not recognized as a distinct condition in people (DRC) [13, 36]. The majority of the clinical features of human monkeypox infection are similar to smallpox [39]. A widespread headache and weariness accompany the early febrile prodrome [4]. Many individuals have maxillary, cervical, or inguinal lymphadenopathy (1–4 cm in diameter) before to and concurrent with the development of the rash [25]. Lymphoma nodes that have grown in size are hard, sensitive, and occasionally painful [40]. More importantly, s mallpox was not associated with lymphadenopathy [41]. Its

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occurance could indicate that the immune system recognizes and responds to infection by the monkeypox virus more effectively than the variola virus, but this idea has to be investigated further [42].

After 3 days of having rash on you skin, the fever will usually gradually drops [11]. Frequently, the rash begins on the face and spreads outward in a centrifugal pattern, slowly distributed [14]. Macular, papular, vesicular, and pustular lesions are the most common types of lesions [10]. A patient's number of lesions might range from a few hundred to thousands [43]. Oral lesions are common, and can make drinking and eating difficult [44]. Digital pictures and the Internet are 21st-century clinical consultation tools, given the unique presentation of lesions [45]. The significant skin damage raises questions about potential skin infections caused by bacteria, which have been observed to affect 19% of exposed monkeypox patients [46]. Until crusts appeared, the patients' skin was described as swollen, rigid, and painful. A worsening of the patient's condition has been connected to the emergence of a second febrile phase when skin lesions became pustular [12].

Patients who were not immunized (74%) had more severe problems and sequelae than those who were vaccinated [28]. Patients with pulmonary discomfort or bronchopneumonia have been observed, generally late in the course of disease, which could indicate a secondary infection of the lungs [47]. By the second week of illness, vomiting or diarrhoea may have set in, leading to severe dehydration [36]. With almost 4500 lesions, one patient had encephalitis, while another developed septicemia [48]. Ocular infections can happen, and they can cause corneal scarring and visual loss that is irreversible [49]. Pitted scarring is the most typical long-term consequence of infection survivors [25]. Unvaccinated patients have an average case-fatality rate of 11%, and children are particularly susceptible to severe disease [50]. Before vaccination around 3–19 years prior to monkeypox illness in these clinical investigations [51].

Varicella is a febrile rash illness caused by the Herpesviridae family's varicella zoster virus (VZV) [52]. It's commonly confused with monkeypox, although there are a few distinguishing characteristics between the two [43]. A protracted febrile prodrome (1–2 days if present) is uncommon in varicella, and the fever is usually mild during this time [53]. VZV causes a rash that progresses faster than monkeypox and smallpox, and the lesion appearance varies [45]. Furthermore, although lesions on the palms and/or soles of varicella patients are rare, in the Republic of the Congo, 5 household contacts who were initially thought to have monkeypox infections but tested positive for VZV have also been found to have lesions on their palms and/or soles (ROC)[54, 55]. One characteristic that distinguishes monkeypox from varicella is the occurrence of lymphadenopathy in patients. The vesiculopustular rash disorders in the differential include other herpetic infections, drug-associated eruptions, syphilis, yaws, scabies, and, more rarely, rickettsialpox. [16, 42].

In the absence of a diagnostic test, clinical differentiation between rash illnesses is challenging [53]. A smallpox algorithm that takes into account major and minor smallpox criteria (febrile prodrome, classic lesions, lesions at the same stage of development) could be modified for monkeypox and used for diagnostic management. [40]. In particular, including lymphadenopathy as a primary criterion would allow monkeypox to be included in the algorithm while smallpox would remain in the differential [21, 54]. In view of biosecurity issues and the necessity to systematically rule out probable smallpox infections, this will be a significant consideration [1, 25]. With the examination of clinical and surveillance data from an endemic area, such a procedure can be implemented [44]. When there is a clinical suspicion of an Orthopoxvirus infection, public health officials should be contacted right away [56]. Consultation and diagnostic testing are available from state health agencies and the US Centers for Disease Control and Prevention [5, 57].

There are discrepancies in the genomes of the monkeypox and variola viruses.

To appreciate the prospective differences in sickness induced by infection with the monkeypox and variola viruses, as well as the potential for the monkeypox virus to become a more effective human pathogen, the major genetic differences between the two viruses must be understood. [23]. Smallpox and monkeypox symptoms are similar, but monkeypox is more common in lymphadenopathy, has a lower death rate, and is less contagious from person to person [57]. The middle parts of the genomes of monkeypox and variola viruses are around 96% identical, although the terminal sections, where the majority of virulence and host-range genes are situated, are dissimilar [11, 52]. Two variola virus strains—strain India-1967 (VARV IND) and strain BSH-75—as well as a monkeypox virus strain from Central Africa [4, 58]. The terminal regions of MPXV ZAI-96 and VARV IND have 83.5-93.6% identity in terms of amino acid sequence similarity [35]. Additionally, It has been sequenced and analyzed the pathogenicity family orthologs of the monkeypox virus strain ZAI-96 from Central Africa and the variola virus strain (strain BSH-75) [59]. Using

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the website poxvirus.org to compared the genomes of a Central African strain of monkeypox virus (strain Zaire-1979) and variola virus (strain Bangladesh-1975maj) in search of genes found in one but not the other [60]. The majority of differences between the variola and monkeypox viruses are found in ORFs with ambiguous functionality [36]. Between virulence genes and other genes with known functions, there are a number of differences [7, 34]. A full-length COP-A44L (hydroxysteroid dehydrogenase) protein is produced by the monkeypox virus, but the variola virus is thought to produce a protein that is roughly 140 amino acids shorter [59]. The orthologs of the virulence proteins COP-B7R and BR-203 are present in monkeypox but absent in the variola virus [61]. BR-209 (IL-1 binding protein) are full-length in certain Central African strains and fragmented in others; nevertheless, the variola virus homologue of this gene is absent [62]. The orthologs of COP-C3L (complement control protein), COP-C10L (IL-1 antagonist protein), COP-E3L [interferon (IFN)-resistance protein], and COP-K3L (eIF-2 homolog protein) are absent/fragmented in monkeypox virus but present in full length in variola virus [63].

The monkeypox virus encodes an ortholog of COP-A44L expected to encode a 346-aa protein [64]. The variola virus has a 210-aa segment of the ortholog that lacks the N-terminal domain and is hence likely inactive in the variola virus [1, 19]. Predictions indicate that COP-A44L encodes a 3-hydroxysteroid dehydrogenase that converts pregnenolone to progesterone and dehydroepiandrosterone to androstenedione [52]. This process is required to produce all steroid hormones, including glucocorticoids (GCs) [65]. Immunosuppressive and anti-inflammatory GCs can influence the host's antiviral immune response [6]. Although A44L was not required for viral replication, A44L-deleted vaccinia viruses were attenuated *in vivo* [56]. Mice treated intranasally with the vaccinia A44L-deleted virus exhibited a robust pulmonary inflammatory response, which comprised early and rapid recruitment of lymphocytes and increased IFN-production [60]. Additionally, they recovered from an infection faster and experienced less weight loss than mice inoculated with the wild-type vaccinia virus. It is believed that A44L impacts virulence via boosting steroid synthesis, suppressing the immune system and thus altering the immunological response [58]. Unlike the variola virus, the monkeypox virus possesses an ortholog of COP-B7R consisting of 182 amino acids [60]. COP-B7R is an ER-resident protein; however, because it lacks a recognised retention signal, it is unknown how this protein is maintained [60]. When this gene is removed, it does not affect viral replication [58]. In contrast, the B7R-deleted vaccinia virus is less pathogenic in an intradermal mouse model. The unknown is the mechanism through which B7R impacts virulence [58]. It is believed that B7R either affects apoptosis-like the myxoma virus M-T4 gene or interacts with and maintains in the endoplasmic reticulum (ER) an often released or cell surface-expressed protein essential for the immune response [58].

Therapeutic medications and immunisations

Three of the most promising chemicals are given here [47]. Several substances have shown promise as antiviral therapy against Orthopoxvirus species. Cidofovir has antiviral activity against many viruses by inhibiting viral DNA polymerase [65]. The nephrotoxicity of cidofovir has been removed in the form of CMX-001 [6]. Numerous orthopoxvirus species have shown antiviral effectiveness when exposed to CMX-001 [66]. The medication ST-246 has shown efficacy against a variety of orthopoxvirus species, including the variola virus [66]. It prevents the release of the intracellular virus from the cell. In order to alleviate severe vaccine-related side effects, a variety of pharmacologic combinations, including vaccinia immune globulin, have been studied [6]. It is important to think about how to use these drugs to treat diseases that are endemic to certain areas [6].

Vaccines against smallpox, composed of an utterly replicative vaccinia virus, are not currently used in monkeypox-endemic regions because of fears of significant adverse reactions in a population with an undetermined immunocompromised profile [7]. The danger of pathogenic monkeypox must be weighed against the possibility of adverse effects associated with replicative vaccinations such as ACAM 2000 [7, 41]. The ideal vaccine for usage in locations where monkeypox is endemic would not contain these risk categories and could also be easily administered to children [61]. No vaccination fits all of these criteria, although certain vaccines of the next generation get us closer to this aim [12]. MVA is an attenuated vaccinia virus that is incapable of achieving full reproduction in mammalian cells [60]. In primate animals confronted with fatal amounts of monkeypox virus, MVA demonstrated protection [63]. However, this vaccination has not shown protection in primates with substantially impaired T-cell activity [38]. LC16m8 is another vaccination that has been modified to limit viral replication and has been found to protect nonhuman primates against severe monkeypox sickness [67]. LC16m8 was used to vaccinate more than 50,000 Japanese schoolchildren with minimal adverse effects documented [68].

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CONCLUSION

The recorded increase in the prevalence of human diseases necessitates more remarkable examination and analysis and additional research to comprehend better the variety of elements involved in disease transmission and dissemination. There are still many unsolved concerns regarding human disease, animal reservoirs, and the virus itself; improvements in our understanding of this significant zoonotic disease will aid in developing more effective prevention techniques and mitigating human sickness. The United States epidemic proved that human monkeypox could spread through zoonotic reservoirs. Concerns exist about spreading the virus into a region lacking monkeypox or for the relocation of humans into densely wooded regions where they are more likely to interact with wildlife and a variety of zoonoses. Serologic research in Africa suggests that monkeypox infection may cause more illnesses than previously thought. If a virulent strain of monkeypox were introduced into a community that lacked orthopoxvirus immunity, the virus would have the opportunity to exploit this vulnerable population, potentially resulting in an epidemic.

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DOI: 10.47191/ijcsrr/V5-i7-29, Impact Factor: 5.995
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DOI: 10.47191/ijcsrr/V5-i7-29, Impact Factor: 5.995
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International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 07 July 2022
DOI: 10.47191/ijcsrr/V5-i7-29, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

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Cite this Article: *Patcharipa Jeerapa (2022). Monkeypox: From Past to Present Outbreak. International Journal of Current Science Research and Review, 5(7), 2454-2461*