

MONKEYPOX VIRUS: AN OVERVIEW

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ABSTRACT

Monkey pox is a viral infectious illness originated by monkey pox virus. It is identical to smallpox which belongs to the genus orthodoxy virus. It was first detected in monkeys in 1958.

Human monkeypox was first identified in humans in 1970 in the Democratic Republic of the Congo (then known as Zaire) in a 9-year-old boy in a region where smallpox had been eliminated in 1968. Since then, most cases have been reported from rural, rainforest regions of the Congo Basin, particularly in the Democratic Republic of the Congo, where it is considered to be endemic. The main dissimilarity between monkey pox and small pox is that monkey pox produces lymphadenopathy while small pox doesn't. Monkeypox has a clinical presentation equivalent to smallpox like fever, malaise, back pain, Headache, muscle pains but only the dissimilarity is presenting lymphadenopathy

Transmission of monkeypox virus occurs when a person comes into contact with the virus from an animal, human, or materials contaminated with the virus. The virus enters the body through broken skin (even if not visible), respiratory tract, or the mucous membranes (eyes, nose, or mouth). Animal-to-human transmission may occur by bite or scratch, bush meat preparation, direct contact with body fluids or lesion material, or indirect contact with lesion material, such as through contaminated bedding.

KEYWORDS Monkeypox, Orthopoxvirus, Transmission, Prevention

INTRODUCTION

Monkeypox is a viral infection generated by monkey pox Virus. It is identical to smallpox which belongs to the genus Orthopoxvirus, family Poxviridae, and sub-family Chordopoxvirinae¹. The illness is distinctly developed in the distant areas of Central and West Africa. Initially it was identified in 1958 in animals like macaque monkeys and was first reported in Humans in 1970 in a 9-month Old boy developed illness, which was ultimately approved as human monkey pox by the World Health Organization from Zaire². Monkeypox is a rodent virus which can mostly disseminate among certain rodents in Africa³. The viruses are oval brick in appearance and have a lipoprotein layer that envelope the viral DNA. The recognition of monkeypox virus is based on biological feature and endonucleas sequence of viral DNA⁴. Monkeypox has a clinical presentation equivalent to smallpox like fever, malaise, back pain, Headache, muscle pains but only the dissimilarity is presenting lymphadenopathy⁵. Besides monkeys, reservoirs for the virus are developed in Gambian pouched rats, dormice and squirrels. Currently, there is no validate, secure treatment for monkeypox⁶.

OUTBREAKS

Human monkeypox was first identified in humans in 1970 in the Democratic Republic of the Congo (then known as Zaire) in a 9-year-old boy in a region where smallpox had been eliminated in 1968. Since then, most cases have been reported from rural, rainforest regions of the Congo Basin, particularly in the Democratic Republic of the Congo, where it is considered to be endemic. Since 1970, human cases of monkeypox have been reported from 11 African countries – Benin, Cameroon, the Central African

Republic, the Democratic Republic of the Congo, Gabon, Ivory Coast, Liberia, Nigeria, and the Republic of the Congo, Sierra Leone, and South Sudan. In 2017 Nigeria experienced the largest documented outbreak, 40 years after the last confirmed case. The true burden of monkeypox is not known. For example, in 1996–97, a major monkeypox outbreak was suspected in the Democratic Republic of Congo with, however, a lower case fatality and a higher attack rate than usual. Some patient samples tested positive for varicella virus and some contained both varicella and monkeypox viruses. Concurrent outbreaks of chickenpox and monkeypox could explain a change in transmission dynamics in this case.

The virus has been exported from Africa a few times. In the spring of 2003, monkeypox cases were confirmed in the United States of America. Most patients were reported to have had close contact with pet prairie dogs that were infected by African rodents that had been imported into the country from Ghana. Recently, monkeypox was carried to Israel in September 2018, to the United Kingdom in September 2018 and December 2019 and to Singapore in May 2019 by travelers from Nigeria who fell ill with monkeypox after arrival. A health worker was infected and became ill. Two distinct genetic clades of the virus have been identified – the Congo Basin and the West African clades with the former found to be more virulent and transmissible. The geographical division between the two clades is thought to be in Cameroon as this is the only country where both monkeypox virus clades were detected.⁷

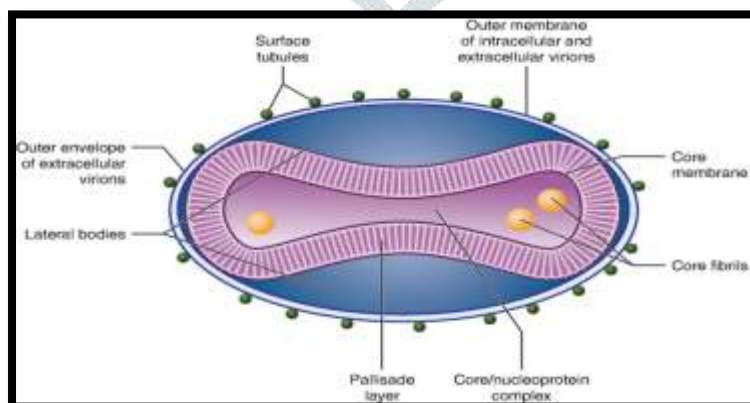
ETIOLOGY

Monkeypox is originated by *Monkeypox virus*, which belongs to the genus Orthopoxvirus, and is also generated by

A class of viruses that include chicken pox and small pox belonging to the same genus.⁸ The reservoir for monkeypox virus is unknown, but is thought to be squirrels or rodents in central Africa. In addition to African species, Studies have shown that there are multiple potential hosts for monkeypox virus encompasses primates, rabbits and rodents. Since Monkeypox virus has an animal reservoir, complete elimination of the disease is not feasible.

STRUCTURE OF MONKEYPOX VIRUS :

Virus belongs to family Poxviridae, sub-family Chordopoxvirinae and genus Orthopoxvirus. MPXV is a 200 to 250 nm brick-shaped enveloped virus with characteristic surface tubules and a dumbbell-shaped core component. The MPXV genome consists of linear double-stranded DNA. Monkeypox virus is antigenically related to the variola and vaccinia viruses



“Fig.1” Structure of Monkeypox virus



“Fig.2”, Patient infected by monkeypox virus

INCUBATION PERIOD

Incubation period is between 10-14 days, usually 12 days.

PATHOGENESIS AND PATHOLOGY

The pathogenesis of human monkeypox is very similar to that of smallpox, with the exception that viral entry from a wildlife source probably occurs via small lesions on the skin or oral mucous membranes. Viral entry may also occur via the respiratory tract in the rare cases of person-to-person transmission.

Like smallpox, monkeypox virus replicates in lymphoid tissue, although it has a greater degree of lymphadenopathy. The virus first localizes in mononuclear phagocytic cells, is released into the bloodstream, and then localizes again in skin cells. For more detailed information, please refer to the pathogenesis section of smallpox virus.⁹

TRANSMISSION

Transmission of monkeypox virus occurs when a person comes into contact with the virus from an animal, human, or materials contaminated with the virus. The virus enters the body through broken skin (even if not visible), respiratory tract, or the mucous membranes (eyes, nose, or mouth). Animal-to-human transmission may occur by bite or scratch, bush meat preparation, direct contact with body fluids or lesion material, or indirect contact with lesion material, such as through contaminated bedding. Human-to-human transmission is thought to occur primarily through large respiratory droplets. Respiratory droplets generally cannot travel more than a few feet, so prolonged face-to-face contact is required. Other human-to-human methods of

transmission include direct contact with body fluids or lesion material, and indirect contact with lesion material, such as through contaminated clothing or linens.

The reservoir host (main disease carrier) of monkeypox is still unknown although African rodents are suspected to play a part in transmission. The virus that causes monkeypox has only been recovered (isolated) twice from an animal in nature. In the first instance (1985), the virus was recovered from an apparently ill African rodent (rope squirrel) in the Equateur Region of the Democratic Republic of Congo. In the second (2012), the virus was recovered from a dead infant mangabey found in the Tai National Park, Cote d'Ivoire.¹⁰

SIGNS AND SYMPTOMS

In individuals, the manifestations of monkeypox are identical to small pox but milder than the indications of smallpox. Monkeypox initiate with fever, headache, muscle aches, and fatigue. The principal dissimilarity between indications of smallpox and monkeypox is that monkeypox produces lymphadenopathy while smallpox does not. The incubation time for monkeypox is generally 7–14 days but can range from 5–21 days¹¹.

The infection can be divided into two periods:

- 1) The invasion period (0-5 days)
- 2) The skin eruption period (within 1-3 days after appearance of fever)

➤ **The invasion period:**

The illness starts with Fever, Headache, Muscle aches, Backache, Swollen lymph nodes, Chills, Exhaustion¹².

➤ **The skin eruption period:**

Within 1 to 3 days after the arrival of fever, the patient appears a rash, often developing on the face then extending to other parts of the body¹³. The face and palms of the hands and soles of the feet are most affected. Three weeks might be necessary before the complete withdrawal of the crusts. Lesions progress through the following stages:

- Rash
- Macules
- Papules
- Vesicles
- Pustules
- Scabs

LABORATORY DIAGNOSIS OF MONKEYPOX

Because the clinical features of smallpox and monkeypox are similar, laboratory diagnosis is of great importance, and newer methods that exploit differences in the host immune responses to orthopoxviruses are under development. There are several laboratory tests that can be performed at reference labs to differentiate between these viruses. Although the genomes of variola and monkeypox viruses are very similar, there are differences that allow the viruses to be distinguished by molecular techniques. Recently, real-time polymerase chain reaction (PCR) assays have been used to identify monkeypox virus that target two genes.¹⁴ In one assay that targets the DNA polymerase gene that is an ortholog to the vaccinia virus strain Copenhagen (COP) E9L gene, 13 different Eurasian orthopoxviruses can be detected. Another assay targets the vaccinia virus ortholog envelope protein B5R gene. This assay takes advantage of single nucleotide polymorphisms within a small sequence of the monkeypox virus ortholog gene to COP-B5R that makes this assay sensitive and specific to only monkeypox virus.¹⁴ Such DNA testing requires collection of a specimen while the virus is still present and cannot be used to diagnose monkeypox after the infection has cleared; thus, other techniques are currently being developed that rely on the host immune response to the virus. The development of a standard antibody test for monkeypox is complicated by cross-reactive immune responses induced by prior smallpox vaccination. An immunoglobulin M (IgM) antibody

assay has been used since anti-vaccinia IgM antibodies from distant past smallpox vaccination should not be present.¹⁵ Another approach under investigation that relies on subtle antigenic differences between the viruses is a whole-virus enzyme-linked immunosorbent assay (ELISA), where antibody titers to monkeypox and vaccinia viruses are measured and their ratio is determined. An example of such an epitope difference that might be used to diagnose monkeypox is a Protein encoded by the monkeypox ortholog of the cowpox virus strain Brighton red (BR) 219 gene. This gene encodes a putative membrane-associated glycoprotein that is not present in vaccinia virus¹⁶. An ELISA using a peptide from this protein was used to distinguish between prior smallpox vaccination and recent monkeypox infection. These prior assays rely on antibody responses, but another potential target of diagnostics may

Focus on cellular immune responses to specific pathogens. Such a technique under development is the measurement of a number of Orthopoxvirus-specific T cells.¹⁷

TREATMENT

- A smallpox vaccination should be administered within two weeks of exposure to monkeypox.
- Cidofovir an antiviral drug is suggested for patients with severe, life-threatening symptoms.
- Vaccinia immune globulin may be used, but efficacy of use has not been documented.

For severe symptoms, supportive measures such as mechanical ventilation may rarely be needed. Consultation with an infectious-diseases expert and the CDC is recommended.¹⁸

PROGNOSIS OF MONKEYPOX

The usual prognosis of patients with monkeypox is good to excellent. Many patients have mild symptoms. However, patients with immune or other compromised health problems (malnutrition, lung problems) may develop complications of secondary bacterial infections, pneumonia, and dehydration. Older estimations of a 10% death rate were published, but in the last 10-15 years, this has been revised to less than 2% of infected individuals, with the worst cases originating from animal-to-human infection, not person to person.

PREVENTION

There are number of measures that can be taken to prevent infection with monkeypox virus:

- Avoid contact with animals that could harbor the virus (including animals that are sick or that have been found dead in areas where monkeypox occurs).
- Avoid contact with any materials, such as bedding, that has been in contact with a sick animal.
- Isolate infected patients from others who could be at risk for infection.
- Practice good hand hygiene after contact with infected animals or humans. For example, washing your hands with soap and water or using an alcohol-based hand sanitizer.
- Use personal protective equipment (PPE) when caring for patients.

CONCLUSION

Monkeypox occurs mainly in the jungles of central and western Africa. The disease, unlike smallpox, is a typical zoonosis in that most cases occur as a result of direct contact with an infected animal. The symptoms of the disease in humans can be very similar to those of smallpox, chickenpox, or other causes of vesiculopustular rash; therefore, accurate and rapid laboratory diagnostics are paramount in controlling an outbreak. However, patients with immune or other compromised health problems (malnutrition, lung problems) may develop complications of secondary bacterial infections, pneumonia, and dehydration. Older estimations of a 10% death rate were published, but in the last 10-15 years, this has been revised to less than 2% of infected individuals, with the worst cases originating from animal-to-human infection, not person to person.

ABBREVIATIONS

DNA- Deoxyribonucleic acid
 MPXV-Monkeypox virus
 CDC- Centers for Disease Control and Prevention

REFERENCES

- [1] Arita I, Jezek Z, Khodakevich L, and Ruti K. 1985. Human monkeypox: a newly emerged Orthopoxvirus zoonosis in the Tropical rain forests of Africa. *Am J Trop Med Hyg.* 34: 781-789.
- [2] Jezek Z, Khodakevich LN, and Szczeniowski MV. 1988. Human monkey pox: its clinico-epidemiological characteristics. *Zh Mikrobiol Epidemiology Immunobiol.* 6:23-30.
- [3] "2003 U.S. Outbreak Monkeypox" (<https://www.cdc.gov/poxvirus/monkeypox/outbreak.html>). CDC. 11 May 2015. Archived (<https://web.archive.org/web/20171015202731/https://www.cdc.gov/poxvirus/monkeypox/outbreak.html>) from the original on 15 October 2017. Retrieved 15 October 2017.
- [4] "About Monkeypox" (<https://www.cdc.gov/poxvirus/monkeypox/about.html>). CDC. 11 May 2015. Archived (<https://web.archive.org/web/20171015202400/https://www.cdc.gov/poxvirus/monkeypox/about.html>) from the original on 15 October 2017. Retrieved 15 October 2017.
- [5] Monkeypox [<http://www.who.int/mediacentre/factsheets/fs161/en/>] (World Health Organization) Also in Spanish [<http://www.who.int/mediacentre/factsheets/fs161/es/>]
- [6] "Monkeypox" (<https://www.cdc.gov/poxvirus/monkeypox/index.html>). CDC. 11 May 2015. Archived (<https://web.archive.org/web/20171015113128/https://www.cdc.gov/poxvirus/monkeypox/index.html>) from the original on 15 October 2017. Retrieved 15 October 2017.
- [7] <https://www.who.int/news-room/fact-sheets/detail/monkeypox>
- [8] "About Monkeypox" (<https://www.cdc.gov/poxvirus/monkeypox/about.html>). CDC. 11 May 2015. Archived (<https://web.archive.org/web/20171015202400/https://www.cdc.gov/poxvirus/monkeypox/about.html>) from the original on 15 October 2017. Retrieved 15 October 2017.
- [9] https://virus.stanford.edu/pox/2000/monkeypox_virus.html
- [10] <https://www.cdc.gov/poxvirus/monkeypox/transmission.html>
- [11] "Monkeypox" (<https://www.cdc.gov/poxvirus/monkeypox/symptoms.html>). CDC. 11 May 2015. Archived (<https://web.archive.org/web/20171015202514/https://www.cdc.gov/poxvirus/monkeypox/symptoms.html>) from the original on 15 October 2017. Retrieved 15 October 2017.
- [12] "Breman JG, Kalisa R, Steniowski MV, Zanotto E, Gromyko AI, Arita I. Human monkeypox, 1970–79. *Bull World Health Organ* 1980; 58:165–82.
- [13] Human monkeypox and other poxvirus infections of man. In: Fenner F, Henderson DA, Arita I, Jezek Z, Ladnyi ID, eds. *Smallpox and its eradication*. Vol. 29. Geneva, Switzerland: World Health Organization, 1988:1287–319.
- [14]. Li Y, Olson VA, Laue T, Laker MT, Damon IK. Detection of monkeypox virus with real-time PCR assays. *J Clin Virol.* 006; 36:194–203. [PubMed: 16731033]

- [15]. Karem KL, et al. characterization of acute-phase humoral immunity to monkeypox: use of immunoglobulin M enzyme-linked immunosorbent assay for detection of monkeypox infection during the 2003 North American outbreak. *Clin Diagn Lab Immunol*. 2005; 12:867–872.[PubMed: 16002637]
- [16]. Shchelkunov SN, et al. Analysis of the monkeypox virus genome. *Virology*. 2002; 297:172–194. [PubMed: 12083817]
- [17] Hammarlund E, et al. Multiple diagnostic techniques identify previously vaccinated individuals with protective immunity against monkeypox. *Nat Med*. 2005; 11:1005–1011. [PubMed:16086024]
- [18]https://www.medicinenet.com/monkeypox/article.htm#what_is_the_treatment_for_monkeypox

