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Monkeypox Virus: A Review

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Keywords: **Monkeypox**, **virus, Pathogenicity**.

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Abstract:

Monkeypox is a disease caused by the monkeypox virus, which is related to the smallpox virus. It is a double-strand DNA virus enclosed in an envelope and a member of the Orthopoxvirus genus within the Orthopoxviridae family. This disease was spread in West and Central African countries and other regions as well. It transmits through direct contact with the skin lesions of an infected person, as well as through respiratory droplets and contaminated materials. Monkeypox is generally less severe than smallpox, and most people recover completely from it; however, it is still serious, especially for young children, pregnant women, and people with weakened immune systems**.** It causes pain, fever, rash, and swollen lymph nodes.

Keywords: Monkeypox, Virus, Pathogenicity.

فيروس جدري القرود: مراجعة

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الخلاصة:

جدري القرود هو مرض يسببه فيروس جدري القرود وهو قريب من فيروس الجدري، وهو فيروس ثنائي السلسلة محاط بغلاف وهو من جنس فيروسات الأورثوبوكس ضمن عائلة الفيروسات الأورثوبوكس. انتشر هذا المرض في دول غرب ووسط أفريقيا ومناطق أخرى أيضًا. ينتقل من خلال الاتصال المباشر بآفات الجلد لدى الشخص المصاب، وكذلك من خلال قطرات الجهاز التنفسي والمواد الملوثة. جدري القرود أقل خطورة من الجدري بشكل عام ويتعافى منه معظم الناس تمامًا، ولكنه لا يزال خطيرًا، وخاصة الأطفال الصغار والنساء الحوامل والأشخاص الذين يعانون من ضعف في جهاز المناعة. حيث يسبب ألمًا وحمى وطفح جلدي وتضخم الغدد اللمفاوية.

الكلمات المفتاحية: جدري القرود، فيروس، إمراضية.

1. Introduction

Monkeypox (MPXV) is a viral infection transmitted from animals to humans that leads to a skin rash resembling smallpox, and the likelihood of death is much lower in monkeypox compared to smallpox [1]. Two chief groups of monkeypox virus have been discovered in West and Central Africa, with the former linked to another serious disease [2]. Numerous instances in the recent epidemic are linked to sexual transmission, particularly between individuals who are recognized as bisexual, gay or engage in sex with men [3]. Firstly, the monkeypox virus was discovered in monkeys [4]. Monkeypox was reported in 1958 in monkeys that were transported from Singapore to Denmark [5]. The initial incident in humans was identified in a 9-month-old boy, Zaire, in 1970 (currently known as the Democratic Republic of the Congo) [6]. Since that period, monkeypox has established itself as a common disease in the DRC where it has expanded to various African nations, particularly in West and Central Africa. The initial documented monkeypox condition outside of Africa was reported in 2003. (97.962)cases of monkeypox have been recorded on June 30, 2024, in nearly 120 countries, 110 of which have not historically announced it [7].

The monkeypox virus comes in two types: clade I and clade II [8]:

- Clade I causes more severe illnesses and deaths. Up to 10% of cases in some outbreaks have resulted in deaths, however, the death toll from more recent outbreaks has been lower. Clade I is prevalent in Central Africa.

- Clade II is the type that caused the global epidemic that began in 2022. It's not as serious. Over 99.9% of people make it out alive. Clade II is prevalent in West Africa.

2. Transmission methods of monkeypox virus

There is currently no known method of MPXV transmission to humans. It is assumed that handling monkeypox-infected animals directly by touch, bite, scratch, and indirectly causes the primary animal-to-human infection [9]. It is believed that the respiratory system, mucous membranes, and damaged skin let the virus enter the body (eyes, nose, and mouth), Secondary human-to-human transmission frequently occurs as a result of respiratory droplets, direct or indirect contact with bodily fluids, solid lesions, contaminated surfaces, and contaminated clothing. Extended interactions with patients increase the risk of infection for hospital staff and family members [10]. Generally, asleep in the same bed or room, alive in an identical home, and eating or drinking from the same dish were hazardous behaviors connected with person-to-person transmission [11]. Also, it has been established that sleeping outside or on the ground and residing close to or visiting a forest increase the likelihood of coming into contact with animals and, consequently, the risk of the monkeypox virus dispersal from animal to human [12]. Using toilet and sterility and washing wear did not have a significant connotation with obtaining monkeypox [13]. During the 2003 occurrence in the US, daily contact with sick animals and cleaning their cages were found to be dangerous factors for developing monkeypox [14].

3. Epidemiology

Human monkeypox infections have been reported in African countries, the most affected countries are Nigeria, the Democratic Republic of the Congo, and the Central African Republic, which has only a few hundred cases reported [15], together with a very great rise in case numbers above the previous thirty years [16], with national observation data showed in assumed cases from 2001 to 2018: from fewer than 500 cases to more than 2500 cases [15]. The majority of cases reported in the 1970s and 1980s involved young children, while the average age at identification in Nigeria during the 2017–2018 epidemic was 20-29 years old [17].

In Africa, both person-to-person and animal-to-person transmissions have been acknowledged. Transmission of zoonotic organisms happens by connection with the lesions or biological fluids of an infested animal [18]. These associates happen during hunting, butchering, or game consumption. Person-to-person transmission occurs mainly by contact with biological fluids, infected skin lesions of patients, and polluted resources such as bedding also can be transferable. The cause of transmission in Africa is unknown, and studies have found

significant differences in the amounts of suspected person-to-person and animal-to-person transmissions. Of the 122 patients in Nigeria, 10 had contact with animals and 36 had contact with people who had an interrelated skin lesion [17]. Intra-familial communications have been reported for viral clades 1 and 2 [19]. Sexual transmission has been reported in uncommon cases in African countries [20]. Chains of transmission are commonly stumpy up to seven transmission goings on within a lone household have been reported [21].

4. Pathogenicity

Symptoms of infection of monkeypox include headaches, body aches, chills, sore throat, fever, fatigue, swollen lymph nodes, malaise, and a severe rash that develops into blisters or papules that crust over and heal [22]. Monkeypox Lymphadenopathy appears in MPXV infections but may be misdiagnosed as chickenpox [23]. Numerous patients experience different diseases including few or no lesions, which are restricted to the genital perianal area, hurt, and hemorrhage [24].

The beginning monkeypox signs varieties start from 6 to 21 days, and naturally, the infection restores to its personnel in 2–4 weeks [25]. Monkeypox Virus infections may cause lengthy viral DNA remaining in the higher respiratory tract that persists later in the skin lesion resolves, but it's inexact if this is connected with communicable virus transmission [26]. The common monkeypox Virus infection patches up on their particular. Though, it is more severe, and potency needs hospitalization in immunosuppressed patients and young children [27]. HIV-1-infected people have lengthy monkeypox disease, greater lesions, secondary microbial skin infections, and genital abscesses [22]. Also, monkeypox Virus may be diffused through the placenta in the pregnancy and clue to fetal death [28].

In several cases, possibly life-threatening problems such as encephalitis secondary infection of the instrument, and bronchopneumonia [23]. An additional rare but serious, long-term problem of monkeypox is the loss of vision resulting from infection of the tissue damage and eye cornea [28]. The overall mortality rate differs depending on patient age, infection types, and localization of the occurrence. Also, it is more fatal in children than in adults [29].

5. Immune response

The first line of defense against a monkeypox infection is thought to be the innate immune system. Innate immune cells, which produce inflammatory cytokines, and type I interferons, such as monocytes and NK cells, play a vital role. However, NK cells and cytotoxicity can be overcome by monkeypox [30]. Th2-related cytokines (IL-4, IL-5, IL-6, and IL-10) are elevated in response to monkeypox infection, whereas Th1-associated cytokines (IL-2, IL-12, TNF-α,

and IFN-γ) stay within the normal range, suggesting complex immune deregulations during the infection [31]. Antibody response, which is a key component of adaptive immunity, is essential for eliminating monkeypox. Detection of specific IgG and IgM antibodies in infected individuals is commonly used for diagnosis, while B cells play a crucial role in providing protection against monkeypox through vaccination [30]. Also, T cells contribute to the protecting responses to monkeypox, as T cell response to monkeypox has been identified in healthy persons, especially persons born before the year 1976 who likely expected the smallpox vaccine, which affords cross defense against monkeypox [32].

Some factors affect the immune response to monkeypox disease, people who have had smallpox in the past tend to be more immune to monkeypox because of the relationship between the viruses and the presence of cross-immunity, leading to a more robust genetic makeup and immune reaction. Younger people tend to have a stronger immune response to the monkeypox virus compared to older people, due to the immune system declining with age [33]. But immune-compromised persons like persons with cancer, HIV, and organ transplant receivers are at a greater hazard of constricting monkeypox and my knowledge of elongated recovery periods and their conceded immune status hinders their bodies' capability to effectually conflict with the monkeypox virus, as **Figure 1 [34]**.

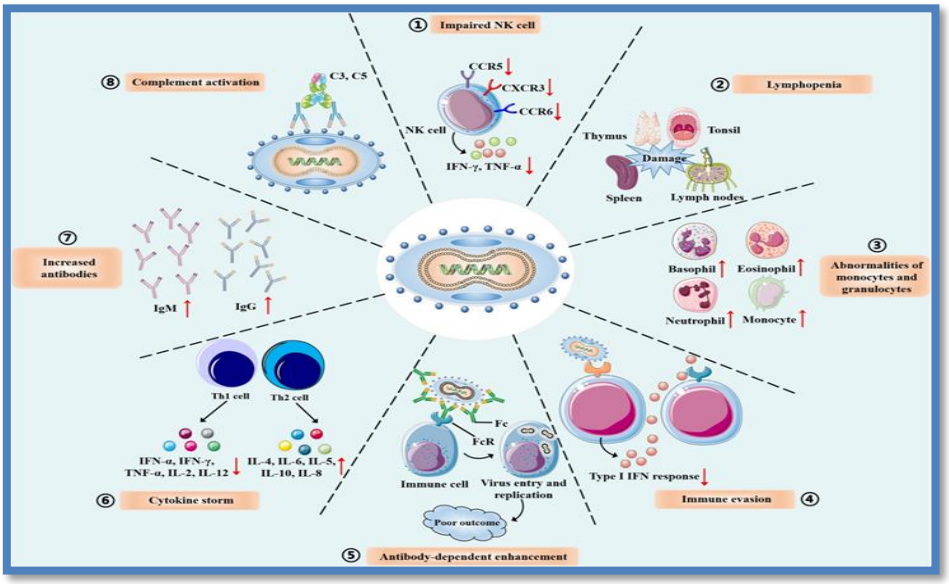

Figure 1: The immunopathogenesis of monkeypox virus [34]

6. Diagnosis methods

Diagnosis is considered the key to detection and keeping monkeypox under control. We can simply distinguish monkeypox from other orthopox viruses by electron microscopy. Clinical characteristics can help differentiate poxvirus infections from other causes of vesiculopustular

eruptions, a laboratory examination is necessary for a conclusive diagnosis [35]. IgM and IgG ELISA, immune fluorescent antibody assay, PCR, electron microscopy, virus isolation, and histopathology analysis are laboratory diagnostic methods for monkeypox [36]. We can distinguish between a herpes virus and poxvirus infection by using immunohistochemistry analysis with monoclonal or polyclonal antibodies against all orthopox viruses [37]. Electron microscopes have played a chief role in viral diagnosis, they can be the main mode for diagnosis of poxvirus infection. We can be detected under electron microscopy the characteristic morphology of poxvirus [36]. The definitive identification of MPXV often involves virus isolation in the culture of mammalian cells and their characterization using different PCR techniques, either by sequencing of amplicons or by restriction fragment length polymorphism analysis [38]. Also, the accessibility of many real-time PCR assays that use monkeypox Virus definite targets has improved in recent years [39]. A new rapid method for identifying orthopox viruses was created using a DNA microarray with the TNF receptor gene crmB [40].

The main diagnostic problem is distinguishing between monkeypox and varicella. Laboratory authorization can be done by PCR technique of vesicle liquid or scab in active disease, however when disease determination, testing of convalescent stage serum specimen for anti varicella virus IgM can be done[36]. Identifying anti-poxvirus antibodies in a person who has not ever been vaccinated and has a past of serious infection and skin rash suggests a diagnosis of monkeypox [40].

7. Prevention

The prevention of the monkeypox virus in healthcare clinicians and specialists is an additional challenge since they are normally in close contact with infected people [41]. To decrease the infection risk, healthcare professionals should follow the commendations such as carefully handled connection with special protective equipment such as gloves, a gown, eye protection, and a fitted N95 mask (**Figure 2**) [42]. Patients with disbelieved monkeypox infections should also be hidden, and their skin lesions must be covered with a gown or cloth, and be placed in isolation, if at all possible, in a single-person room [43]. Patients should remain in the home and border contact with others for 3–6 weeks and evade close contact such as sexual connection with someone exposed or infected with the monkeypox virus, persons should maintain good hand sanitization and respiratory system by wearing a fitted mask and lidding coughs and sneeze with the bend of a limb after taking visitors at home, proper cleaning are advised [44]. The obtainable documents show that smallpox vaccination might ensure 85% cross-protection against monkeypox [45].

Samples such as scabs or cutaneous tissues should be handled with care because the simplicity of transmission by direct contact or air particles, and instantaneous ring vaccination and quarantine are considered the simply actual public health protecting procedures as there is no effective, approved antiviral healing for monkeypox [46].

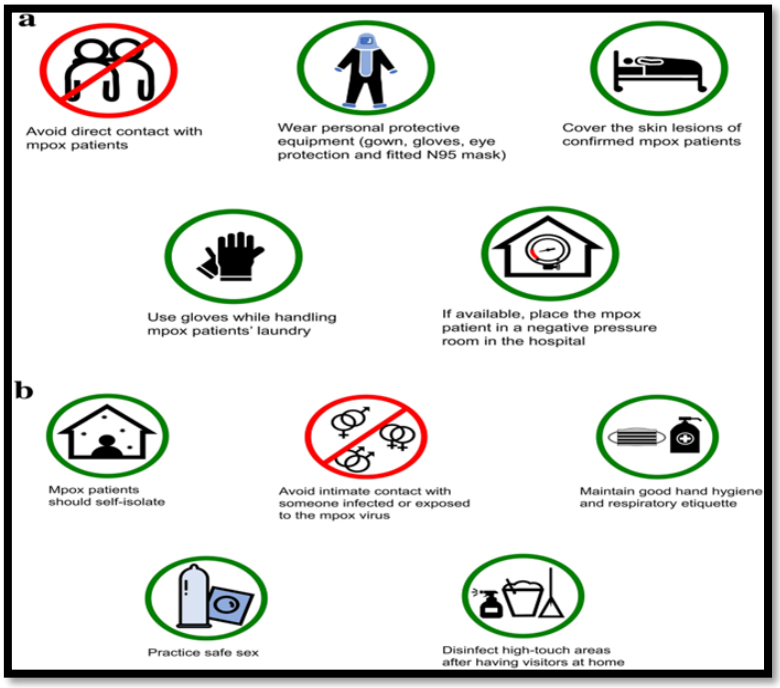

Figure 2: Prevention ways from monkeypox virus [42].

8. Treatment

Most individuals infected with monkeypox infection recover without medicinal treatment, while patients with gastrointestinal warning signs such as nausea, and diarrhea will need oral or venous rehydration to decrease losses of gastrointestinal fluid [47]. The number of antivirals might be effective in handling monkeypox infection [48]. Tecovirimat also known as ST-246 or TPOXX completely that chemical considered the best antiviral directed for treating smallpox in adults and children weighing over 3 kg [49]. Double therapy with brincidofovir and tecovirimat can be used in patients with severe infection. Tecovirimat mechanisms inhibit viral envelope protein VP37, which controls the final steps of virus maturation and release from infected cells, thereby inhibiting virus spread within the infected host [50]. Even though the efficiency of this agent in persons contrary to monkeypox has not been tried, revisions have informed advanced persistence from deadly monkeypox virus infections in recoverin at treated animals associated to palliative treated animals at changed periods of disease [51]. In some research studies, tecobilimatosis has been used in combination with vaccinia immune globulin in patients with difficult-to-administer smallpox vaccination, such as those with vaccinia

eczema and advanced vaccine reactions [52]. The CDC New protocol enables us of Tecovirimat in non-variola orthopoxvirus infections as monkeypox [53]. It also includes information for pediatric patients under 13 kg to open an oral capsule and combine the liquid or soft food inside of it [54]. It was also approved to utilize brincidofovir for treating smallpox in the US in the meantime in 2021 [55]. Brincidofovir by oral considered an equivalent to the intravenous drug cidofovir, a lesser amount of kidney toxicity related to cidofovir, these medicines work throw inhibit the viral DNA polymerase [56]. Clinical documents about the efficacy of cidofovir against monkeypox in humans are unknown, but the in vitro activity and efficacy of cidofovir against lethal monkeypox virus infections in animals are known. The efficacy of cidofovir against monkeypox in humans is missing, yet in vitro activity and efficiency against fatal monkeypox virus infections in animals have been informed [57]. Liver function examinations must be prepared before and through treatment with brincidofoviras, these medications may lead to a rise the serum transaminases and serum bilirubin. It can use Vaccinia hyperimmune globulin which is qualified by the FDA for cooperation of certain complications of vaccination [58]. VIG subsidy for patients with severe immunodeficiency in T-cell function, and use of VIG must be under IND application [59].

9. Conclusions

The public health importance of monkeypox disease cannot be underestimated, as the potential for person-to-person transmission is an issue not only among household residents but also among caregivers of sick individuals. Also, the monkeypox virus has the potential to spread via zoonotic reservoirs.

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