https://doi.org/10.52973/rcfcv-e363912 Revista Científica, FCV-LUZ / Vol. XXXVI

Presumed transmission of avipoxvirus to human: Case report

Presunta transmisión del avipoxvirus al ser humano: Reporte de caso

Zahida ASNOUNE[1], Seloua MORSLI[1], Mourad ZEGHDOUDI[1]*, Latifa BELLILET[1], Riad BOUZID[1], Tahri MADJA[2]

[1]Faculty of Natural and Life Sciences, Department of Veterinary Sciences, Chadli Bendjedid University, El Tarf, Algeria
[2]Faculty of Natural and Life Sciences, Department of Biology Sciences, Chadli Bendjedid University, El Tarf, Algeria
Corresponding author: mouradzeg@yahoo.fr

ABSTRACT

Current cases of human monkeypox in the world have become a serious public health problem. According to the literature, avipoxvirus cannot be transmissible to human. The purpose of this study was to demonstrate that avipoxvirus transmission to human can occur in the poultry environment. In 2024, 1000 turkeys of 8 weeks old developed the cutaneous form of fowlpox. Three days after their vaccination on the farm by the veterinarian, who had abrasions on his left hand, skin lesions similar to those of smallpox and human monkeypox appeared on his respective hand. The clinical evolution of the veterinarian's hand lesions as well as tissue samples analyzed by histopathological examination and under transmission electron microscopy, were used to make the diagnosis. Over 35 days, the hand lesions progressed through the stages of papules, vesicles, pustules, ulcerations before to the crust, and desquamation. The histopathology of hand lesions samples revealed typical poxvirus changes in keratocytes and complete virus particles resembling fowlpoxvirus were observed using transmission electron microscopy. This study highlights that variola in human can be caused through compromised tegument in the presence of avipoxviruses. It is therefore critical to learn more about these enigmatic viruses, particularly their relationship with the host range.

Key words: Fowlpoxvirus; histopathology; human; skin lesions; variola.

RESUMEN

Los casos actuales de viruela del simio humana en el mundo se han convertido en un grave problema de salud pública. Según la literatura, el virus de la viruela aviar no puede ser transmisible a los humanos. El propósito de este estudio fue demostrar que la transmisión del virus de la viruela aviar a los humanos puede ocurrir en el entorno avícola. En 2024, 1000 pavos de 8 semanas de edad desarrollaron la forma cutánea de la viruela aviar. Tres días después de su vacunación en la granja por el veterinario que tenía abrasiones en su mano izquierda, aparecieron lesiones cutáneas similares a las de la viruela y la viruela del simio humana en su respectiva mano. La evolución clínica de las lesiones de la mano del veterinario, así como muestras de tejido analizadas por examen histopatológico y bajo microscopic electrónica de transmisión, se utilizaron para realizar el diagnóstico. Durante 35 días, las lesiones de la mano progresaron a través de las etapas de pápulas, vesículas, pústulas, ulceraciones antes de la costra y descamación. La histopatología de las muestras de lesiones en las manos reveló cambios típicos del virus de la viruela en los queratocitos, y se observaron partículas virales completas similares al virus de la viruela aviar mediante microscopía electrónica de transmisión. Este estudio destaca que la viruela en humanos puede ser causada por un tegumento comprometido en presencia de virus de la viruela aviar. Por lo tanto, es crucial conocer mejor estos virus enigmáticos, en particular su relación con el rango de hospedadores.

Palabras clave: Virus de la viruela aviar; histopatología; humano; lesiones cutáneas; viruela.

Recibido: 05/02/2026 Aceptado: 15/08/2026 Publicado: 08/09/2026

INTRODUCTION

Since antiquity, the smallpox virus has caused serious illnesses that have killed thousands of people. Monkeypox, vaccinia (smallpox vaccine), and cow poxviruses can also infect human by causing skin lesions [1]. In the 1980s, the World Health Organization (WHO) declared the eradication of smallpox due to intensive global vaccination programs [2].

Currently, cases of variola are resurfacing in several countries blamed by a monkeypox contamination that is still endemic in the tropical forests of West and Central Africa [3]. Initially, smallpox was diagnosed on the basis of clinical signs, subsequently the detection by Bollinger (1877) of the eosinophilic intracytoplasmic inclusion bodies -typical of smallpox- allowed an etiological diagnosis based on the identification of cellular viral aggregates under microscope [4].

Fowlpox is an infectious disease caused by caused members of the genus Avipoxvirus [5]. These viruses are large, enveloped, oval-shaped particles characterized by a linear double-stranded deoxyribonucleic acid (DNA) genome of approximately 260-365 kb [6]. In contrast to most DNA viruses, avipoxviruses complete their replication cycle in the cytoplasm of infected avian cells, viral replication leads to the development of characteristic cytopathic effects, which generally appear 4-6 d after infection, depending on the viral isolate [7].

Live attenuated vaccines of fowlpox strains from chickens *(Gallus gallus domesticus)* or pigeons *(Columbidae)* have been used to prevent disease in susceptible birds. However, the vaccines effectiveness has been questioned worldwide as outbreaks have been reported in previously vaccinated turkeys *(Meleagris gallopavo)* [8].

In Algeria, fowlpox appears sporadically, especially in unvaccinated hens, most cases are found in local hens. In the literature, there have been no cases of human variola transmitted by an avipoxvirus; the only observations have been made for the cowpoxvirus and the monkeypox virus transmission [2].

This study reports a specific dermatosis in human patient associated with flowpox virus transmission in a poultry environment. The potential zoonotic transmission of flowpox virus (FWPV) from poultry to humans represent the novel aspect of this study.

MATERIALS AND METHODS

Background of study

In 2024, in the Algerian eastern (Annaba region), a rearing of 1000 turkeys aged of 8 weeks were infected by FWPV. Until 8 weeks old, the mortality rate and the average weight were 1.65 % and 4.500 kg, respectively, reflecting a good technical and sanitary management of the rearing. At the beginning of the 9th week, a proliferation of blackish and crusty foci appeared on the animals' heads, quite suggestive of the cutaneous form of fowlpox Turkeys with lesions were treated locally by applying methylene blue after scraping off the crusts.

At the same time, the flock underwent an anti-fowlpox vaccination with a commercial live attenuated vaccine (Diphtosec strain DCEP 25: ≥ 103 CCID50, excipients: Glycerol and Saline solution q.s.p.).

Vaccination against fowlpox was done by transphyxiation of the wing by dipping the bifurcated needle into the open vial containing the diluted vaccine and piercing the wing membrane. Ten days (d) after treatment of infected turkeys and vaccination of uninfected, the fowlpox nodules disappeared and the turkeys showed no signs of disease during their rearing cycle.

The vaccination was carried out in the farm by a veterinarian assisted by four poultry workers for catching the turkeys. The vaccination lasted 3 hours (h) and was carried out on the farm where the temperature and humidity were around 30 °C and 75 %, respectively. After four d, progressive eruptions similar to those of smallpox and human monkeypox have appeared on the veterinarian's hand.

It is important to point out that the veterinarian had no contact with other animal species carrying the virus and had not visited any other farms either before or after vaccinating the flock. Histopathology was used to diagnose poxviruses, which were then confirmed with transmission electron microscopy (TEM) by negative staining which visualized particles with the morphology of poxviruses.

Currently, electron microscopy is the method of choice for analyzing virus morphogenesis in cell lines [9]. The histopathology and the electronic microscopy are considered as reference methods for the diagnostic of the variola [2]. Bayer-Garner [10], showed that for the human monkeypox, the most attention has been paid for the cutaneous lesions, primarily through clinical examination and biopsy collection for histopathology.

Clinical evaluation of the patient

The veterinarian, from the laboratory (ESSPRETCADS, Chadli Bendjedid University), was aged of 55 years old and received the smallpox vaccine at 10 years old. At the time of vaccination, the veterinarian was in good health but has slight scratches on his left hand, contracted four days before vaccination while tending to the garden without wearing protective gloves.

Research proposal was approved and registered under (No. 2 on 13/12/2024) by the local ethics committee of Chadli Bendjedid University, 36000-El Tarf. Informed consent was obtained from study subject.

Biopsy collection

The samples were taken on the 7th d after the appearance of the lesions in the crusty form phase in desquamation from the adjacent part of the epidermis. A small piece of skin was pinched and pulled out using a scalpel and sterile tweezers. These fragments were sectioned to contain areas of skin lesion and normal skin margin.

Histopathology process

Tissue samples were fixed in 4 % buffered formalin for 48 h than transferred to 70 % ethanol. The tissues were dehydrated in increasing ethanol series, diaphanised in xilen. The tissue was embedded in paraffin blocks, sectioned at 5-6 µm intervals,

and stained with haematoxyline and eosine as usual. After that, the slides were examined under a light microscope for cellular changes caused by the virus.

Electron microscopy procedure

A part of tissue sample fixed in buffered formalin was refixed in Karnovsky solution (Formaldehyde/Glutaraldehyde) and processed for TEM. Fixatives containing both formaldehyde and glutaraldehyde tend to give better tissue fixation than either of these aldehydes used separately. Formaldehyde penetrates tissue more rapidly than glutaraldehyde, but its fixation is less permanent. The use of this combination provides rapid stabilization of cell ultrastructure by formaldehyde, followed by a more permanent fixation by the subsequent treatment with the slower penetrating glutaraldehyde [11].

RESULTS AND DISCUSSION

More than 50 percent of the turkey flock was affected by fowlpox typically characterized by several nodular crusted cutaneous lesions on all the head area (FIG. 1). This infection rate is explained by high viral pressure because the flock was in an enclosed livestock building. Most fowlpox diagnoses are based on clinical features of infected birds. Gross lesions seen on birds and during necropsy are usually sufficient to suspect FWPV infection, especially when dealing with the cutaneous form [12].

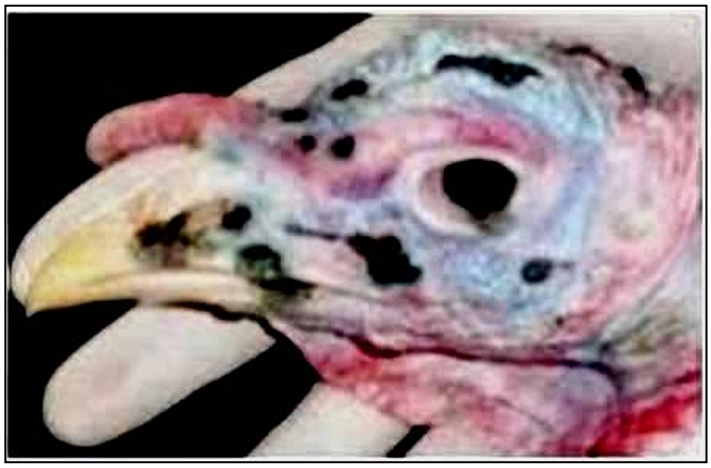

FIGURE 1. Commercial turkeys naturally infected with avipoxvirus. The cutaneous form of fowlpox typically characterized by nodular crusted lesions in the skin of beak commissure, eyes, and the rest of the head.

The diagnosis was based on the clinical evolution and tissue samples taken from the veterinarian's hand epidermis lesions. The veterinarian noticed the formation of papules surrounded by an erythematous red area at the site of the abrasions on his hands four days after vaccination. These papules were then filled with clear liquid, were developed to purulent vesicles and finally become round pustules deeply embedded in the dermis. In addition, a slight fever (37.5 °C) and pain in the affected arm were observed. The pustules quickly turn into deep ulcers that are gradually covered with a blackish crust about 1.5 cm in diameter (FIG. 2).

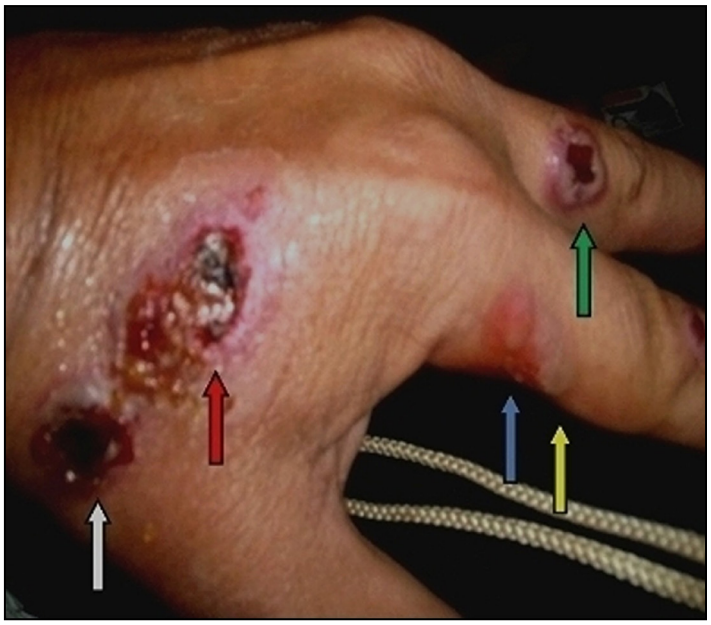

FIGURE 2. Evolution of hand lesions: Erythematous papula (blue arrow), Vesicopustules (yellow arrow), crusty form in desquamation (red arrow), crusty stage (white arrow), ulcerative stage (green arrow).

The lesions progressed to drying and epithelialization after the 35th d and crust desquamation. Between the 4th and 35th d, the lesion foci evolved differently depending on the regions of the hand where the different phases of papule, crust, and ulceration were found at the same time. The veterinarian treated his hand lesions himself without evaluated by a physician on a daily basis with an aqueous eosin-based antiseptic and a dermatological antibiotic powder, but the lesions did not improve significantly.

The main histological changes we observed were keratinocyte degeneration, swelling, and vacuolation with intracytoplasmic eosinophilic inclusions which are typical and consistent with variola [4] (FIG. 3).

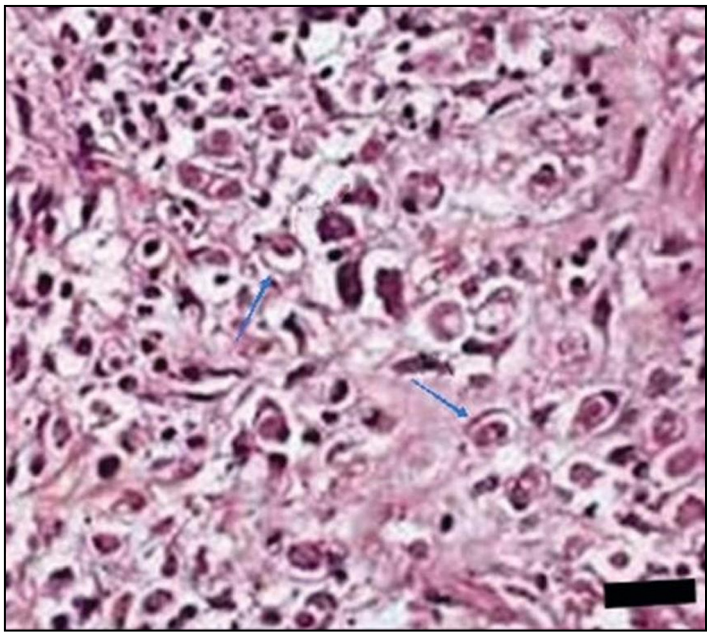

FIGURE 3. Histopathological findings: Swelling and vacuolation of keratinocytes with eosinophilic intracytoplasmic inclusions (x 400) hematoxylin & eosin.

On TEM, particles of poxvirus were observed in the eosinophilic cytoplasmic inclusion bodies (FIG. 4).

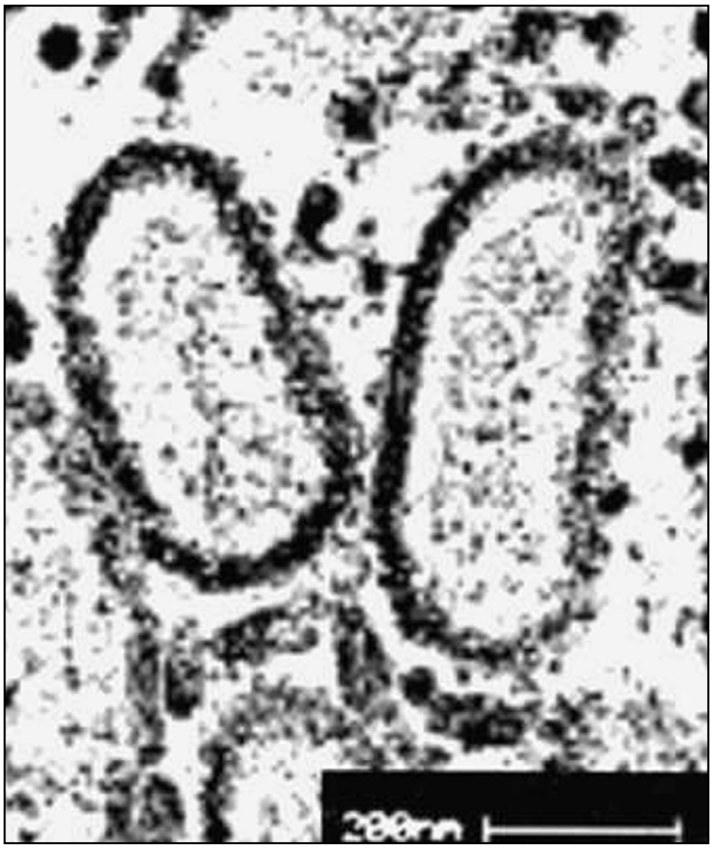

FIGURE 4. Complete virus particles characteristic of poxvirus on TEM by negative staining (200 nm). The entire virus is visible and not particles, and describe the morphology, although formalin fixes tissue did not preserve very well to see all details.

The direct transmission of the poxvirus to human has been documented in cows (cowpoxvirus) and monkeys (monkeypoxvirus), but no zoonotic cases of FWPVhave been reported. Replication of avipoxvirus in mammalian cell cultures, and baby hamster kidney cellswhich raise questions about the species specificity and mechanisms that restrict these viruses to certain hosts, and challenge the hypothesis that avipoxvirus cannot undergo a full replication cycle in mammalian cells [13]. This explains that avipoxvirus can be transmitted to other species and not restricted only to avian species;

These findings support the diagnosis of accidental human infection with avipoxvirus in this study, potentially associated with skin abrasion, a high viral load, and inadequate biosafety measures.

The lesion evolution period in this study is any confirmatory and highly specific and sensitive test wasn't perform of human monkeypox, except that the lesion stages from papule to ulceration are encountered concurrently; however, in the classical monkeypox form, the transition from the papule to the ulcer stage is successive and uniform. Furthermore, generalized lymphadenopathy appears during human monkeypox infection [2] whereas it is absent here.

In the present study, cutaneous eruptions on the hand through the papulo-vesicular, pustule-ulcerative, and crusts stages are indistinguishable from smallpox or human monkeypox. Four d after being exposed to the virus, the erythematous papules appeared, along with a fever of 37.5 °C from the pustular stage.

Human monkeypox eruption occurs in stages of macules, papules, vesicles, and pustules followed by ulceration before crusting over and desquamation over a period of 2-3 weeks [14]. Shchelkunov and Shchelkunov [15] showed the pre-eruptive phase of smallpox generally lasted 2 to 3 d, accompanying by a slight increase in body temperature (38.5 °C) during the vesicles and pustules development. Between the 4th and 35th d, the lesion foci evolved differently depending on the hand regions where the different phases of papule, crust, and ulceration were present at the same time.

According to Fenner *et al*. [16] the rash usually appears after 1 to 3 d and papules, vesicles, pustules, crusts, and ulcers appear concurrently to evolve. The infection can last up to four weeks before the lesions peel off.

This study highlights that avipoxvirus could be transmitted to human from a turkey flock infected with fowlpox via an abraded tegument a time of exposure lasting more than 3 h, a high viral charge, direct contact of the virus with lesions, and lack of biosafety measure.

Human infection with vaccine virus can be caused by zoonotic infections, occupational exposure to infected laboratory animals, or laboratory accidents such as needle stick injuries or mucous membrane self-inoculation [17]. Rimoin *et al.* [18] discovered that rural areas and regions with the most forest cover had the highest incidence of human monkeypox, with an average case age of 12 years. This allows us to hypothesize that in these areas; the risks of scratches for children make them much more vulnerable to poxvirus contamination.

Fenner *et al*. [16] discovered that primary cases were more common in the 5 to 14-year-old age groups, most likely because they were trapped and playing with small rodents and their carcasses. Reynolds *et al.* [19] reported that monkeypox rash starts on the palms of the hands and soles of the feet and spreads to the face, occasionally involving the oral mucous membranes, conjunctiva, cornea, and/or genitals.

According to McCollum and Damon [20] exposures were considered non-invasive when the individual came into contact with an infected animal or cleaned the cage of an infected animal, or complex when the exposure was caused by a bite or scratch from a sick animal.

Human monkeypox is rarely reported outside of Africa, and the virus is transmitted from person to person through close contact with lesions, body fluids, respiratory droplets, and contaminated materials [21]. Here, the treatment had no discernible effect. So far, no effective treatment has been found for smallpox. In the event of an infection, treatment would focus on alleviating symptoms and preventing dehydration [2].

The findings of this research highlights that in the presence of high poxvirus pressure, the variola foci in humans could appear through a scratched tegument. The lesioned evolution, the epidemiology, the histopathological modification and the poxvirus identification by the TEM in a fowlpox outbreak suggest a human transmission of the avipoxvirus.

Fowlpox is ubiquitous in unvaccinated chicken's farm; therefore, veterinarians and poultry farm workers who come into direct contact with the FWPVmust wear gloves and protective masks to avoid possible contamination. This study suggests that current cases of human monkeypox may be linked to direct contact with the poxvirus via compromised skin, especially given that the lesions are mostly found on the hands and feet primarily in brushy areas.

CONCLUSION

This apparently specific dermatosis linked to fowlpox virus was diagnosticated by combining the clinical exam, the epidemiology, the histopathology, and the electronic microscopy: a PCR should definitively confirm the poultry-human transmission of the virus. A best comprehension of the infectious potential of this enigmatic virus in a specific environnemental condition will help to master the variola outbreak like those caused by the monkeypox virus.

The most recommendation is to provide a maximum protection in a high-risk area especially when certain parts of the body have scratches and are therefore in direct contact with the poxvirus.

ACKNOWLEDGEMENTS

This study was fully supported by the Laboratory of Epidemiology Research (ESPRETCADE) of Chadli Bendjedid University, El Tarf, Algeria. We thank the general direction of scientific research and technological development (DGRSTD).

Conflict of interest

The authors declared that there is no conflict of interest.

BIBLIOGRAPHIC REFERENCES

[1] Shah S, Fulmali D. Monkeypox: Treatment, Vaccination, and Prevention. Cureus. [Internet]. 2023; 15(1):e33434. doi: https://doi.org/rngc

[2] World Health Organization (WHO). Clinical management and infection prevention and control for monkeypox: Interim rapid response guidance, 10 June 2022. Geneva, Switzerland: WHO. [Internet]. 2022 [cited 20 May 2025]. Available in: https://goo.su/JAWf8YC

[3] Adler H, Gould S, Hine P, Snell LB, Wong W, Houlihan CF, Osborne JC, Rampling T, Beadsworth MBJ, Duncan CJA, Dunning J, Fletcher TE, Hunter ER, Jacobs M, Khoo SH, Newsholme W, Porter D, Porter RJ, Ratcliffe L, Schmid ML, Semple MG, Tunbridge AJ, Wingfield T, Price NM. Clinical features and management of human monkeypox: a retrospective observational study in the UK. Lancet Infect. Dis. [Internet]. 2022; 8(22):1153-1162. doi: https://doi.org/gp7cpk

[4] Bolte AL, Meurer J, Kaleta EF. Avian host spectrum of avipoxviruses. Avian Pathol. [internet]. 1999; 28(5):415–432. doi: https://doi.org/cxxmh6

[5] Ferreira BC, Ecco R, Couto RM, Coelho HE, Rossi DA, Beletti ME, Silva PL, . Outbreak of cutaneous form of avian poxvirus disease in previously pox-vaccinated commercial turkeys. Pesq. Vet. Bras. [Internet]. 2018; 38(03):417-424. doi: https://doi.org/gk8z5r

[6] Tulman ER, Afonso CL, Lu Z, Zsak L, Kutish GF, Rock DL. The genome of canarypox virus. J. Virol. [Internet]. 2004; 78(1):353-366. doi: https://doi.org/fjmdm5

[7] Tripathy DN, Schnitzlein WM, Morris PJ, Janssen DL, Zuba JK, Massey G, Atkinson CT. Characterization of poxviruses from forest birds in Hawaii. J. Wildl. Dis. [Internet]. 2000; 36(2):225-230. doi: https://doi.org/gh8t9h

[8] Odoya EM, Abegunde A, Agyogbo BG, Omatainse SO, Gwankat E, Okpara UG. Outbreak of turkey pox disease in fowl pox vaccinated poults in Vom Plateau State of Nigeria. Afr. J. Clin. Exp. Microbiol. [Internet]. 2006; 7(2):136-138. doi: https://doi.org/c96dpg

[9] Weli SC. Nilssen Ø, Traavik T. Morphogenesis of fowlpox virus in a baby hamster kidney cell line. Med. Electron Microsc. [Internet]. 2004; 37(4):225-235. doi: https://doi.org/dqdbnd

[10] Bayer-Garner IB. Monkeypox virus: histologic, immunohistochemical and electron-microscopic findings. J. Cutan. Pathol. [Internet]. 2005; 32(1):28–34. doi: https://doi.org/dnprzv

[11] Karnovsky MJ. A Formaldehyde-Glutaraldehyde fixative of high osmolarity for use electron microscopy. J. Cell. Biol. [Internet].1965 [cited 12 May 2026]; 27:137A-138A. Available in: https://goo.su/uWKHII

[12] Umar BN, Adamu J, Ahmad MT, Ahmad KH, Sada A, Orakpoghenor O. Fowlpox virus: an overview of its classification, morphology and genome, replication mechanisms, uses as vaccine vector and disease dynamics. World's Poult. Sci. J. [Internet]. 2021; 77(4):929-947. doi: https://doi.org/rngf

[13] Weli SC, Tryland M. Avipoxviruses: infection biology and their use as vaccine vectors. Virol. J. [Internet]. 2011; 8:49. doi: https://doi.org/dxbb9r

[14] Brown K, Leggat PA. Human monkeypox: current state of knowledge and implications for the future. Trop. Med. Infect. Dis. [Internet]. 2016; 1(1):8. doi: https://doi.org/gqtptj

[15] Shchelkunova GA, Shchelkunov SN. Smallpox, Monkeypox and Other Human Orthopoxvirus Infections. Viruses. [Internet]. 2023; 15(1):103. doi: https://doi.org/rngg

[16] Fenner F, Henderson DA, Isao A, Zdenek J, Ladnyi A, Danilovich I. Smallpox and its Eradication. [Internet]. Geneva, Switzerland: World Health Organization. 1988 [cited 15 May 2025]. Available in: https://goo.su/gVJMv

[17] Nawadkar R, Dravid A, Paprunia U, Rosamund L, Kazunobu K, Priya A, Arvind S. Case report of laboratory acquired vaccinia virus infection in India. Weekly Epidemiol. Rec. [Internet]. 2021 [cited 15 May 2025]; 96:33-44. Available in: https://goo.su/AuV9JCX

[18] Rimoin AW, Mulembakani PM, Johnston SC, Lloyd-Smith JO, Kisalu NK, Kinkela TL, Blumberg S, Thomassen H, Pike B, Fair J, Wolfe N, Shongo R, Graham B, Formenty P, Okitolonda E, Hensley L, Meyer H, Wright L, Muyembe J. Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo. Proc. Natl. Acad. Sci. [Internet]. 2010; 107(37):16262–16267. doi: https://doi.org/fhd8d4

[19] Reynolds MG, Yorita KL, Kuehnert MJ, Davidson WB, Huhn GD, Holman R, Damon I. Clinical manifestations of human monkeypox influenced by route of infection. J. Infect. Dis. [Internet]. 2006; 194(6):773–780. doi: https://doi.org/cz8prd

[20] Mc Collum AM, Damon IK. Human monkeypox. Clin. Infect. Dis. [Internet]. 2014; 58(2):260–267. doi: https://doi.org/gqhzqp

[21] Isidro J, Borges V, Pinto M, Ferreira R, Sobral D, Nunes A, Santos JD, Mixão V, Santos D, Duarte S, Vieira L, Lopes de Carvalho I, Borrego MJ, Núncio S, Pelerito A, Cordeiro R, Gomes JP. Phylogenomic characterization and signs of microevolution in the 2022 multi-country outbreak of monkeypox virus. Nat. Med. [Internet]. 2022; 28(8):1569-1572. doi: https://doi.org/gqd3ng