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Can Lumpy Skin Disease be Considered a Zoonosis?

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Abstract The lumpy skin disease virus (LSDV), a member of the *Poxviridae* family of viruses, causes lumpy skin disease (LSD). The virus is highly host-specific and causes disease in cattle and water buffalo. The disease was endemic in most Sub-Saharan African countries, spreading to the Middle East, Europe, and Asia. The World Organization for Animal Health (OIE) has classified LSD as one of the diseases that must be reported due to its tendency to spread quickly across borders and to the significant productivity losses it causes in cattle. It is frequently an arthropod-borne infectious disease but also spreads through bodily discharges and infected fomites. The symptoms of LSD can range from subclinical to severe illness. Fever, nodules on the skin, mucous membranes, and internal organs, emaciation, swollen lymph nodes, skin edema, and occasionally death are some symptoms. The lumpy skin disease virus was believed not to be zoonotic in nature. However, a recent human infection in Cairo, Egypt, proved that LSD is communicable to humans. The area where the infected animals were also where the person-to-person transmission was observed. Due to its potential to cause temporary decreases in milk production, infertility, temporary or permanent sterility in bulls, damage to hides, and death due to secondary bacterial infections, LSD is significant economically. Based on the typical clinical features of the disease, LSD is frequently diagnosed in the field. The most popular method for diagnosing LSD is using conventional or real-time polymerase chain reaction (PCR) to find viral DNA. Strict quarantine, vector control, and prophylactic vaccination are the best methods for preventing and controlling the disease. Since LSD has emerged as a zoonosis, proper care must be observed by the staff working with livestock, especially cattle, to check the spread of infection.

Keywords: *bovine, epidemiology, lumpy skin disease virus, poxviridae, transboundary animal diseases, zoonosis*

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1. Introduction

The poxvirus lumpy skin disease virus (LSDV) causes lumpy skin disease that affects cattle [1]. The disease, an important transboundary viral disease with significant economic impact, is thought to have originated in Zambia, Africa [2]. The virus is a rising hazard to cattle populations in Europe and Asia; it is endemic in most African countries [3]. The lumpy skin disease virus has experienced an unheard-of worldwide spread in recent years, spanning Africa to the Middle East, Southeast Europe, and Asia [4].

The OIE has enlisted the disease because of its possibility for rapid cross-border spread [5]. According to the guidelines of the World organization for Animal Health (OIE), the disease is classified as a notifiable disease because it results in financial loss, decreased production, poor skin quality, stunted growth, infertility, and even death of the animal [6]. The United States government views *Capripoxvirus* group viruses, such as the lumpy skin disease virus, as possible agroterrorism agents [1].

With LSDV infections, there is a wide range of clinical symptoms, from asymptomatic infection to mortality [7]. Lumpy skin disease virus (LSDV) recently appeared to be zoonosis (animal to human). Additionally, the direct person-to-person transmissions were also recorded [8]. Awareness of the disease, openness in disease notification, regionally synchronized control/eradication plans, and effective surveillance programs in affected and at-risk areas are necessary to fully eradicate LSD [4]. It is critical for animal caregivers to quickly identify disease symptoms as LSDV spreads to new areas [3]. Therefore, the main objective of this review is to raise public awareness of this newly emerging viral disease and its potential public health threat.

2. Etiology

The lumpy skin disease virus, a member of the *Poxviridae* family, subfamily *Chordopoxvirinae*, and genus *Capripoxvirus*, is the disease's causal agent [9,10]. Three species of poxvirus that cause high-impact transboundary disease in ruminants belong to the genus

Capripoxvirus. While the lumpy skin disease virus affects cattle and water buffalo, sheep pox and goat pox viruses severely affect sheep and goats. The three species are highly specific in their hosts [3,11]. The genome of the LSDV is about 151 kbp and is made up of double-stranded DNA [12]. In addition to air-dried hides at room temperature (minimum 18 days), LSDV also exhibits a unique ability to survive in necrotic skin nodules (33 days), desiccated crusts (35 days), sunlight-protected infected tissue (6 months), and desiccated crusts (35 days) [13]. Although heat resistance varies, most isolates become inactive at 55°C for a few hours or 65°C for 30 minutes [14].

3. Geographic Distribution

There have been reports of LSD in many different countries worldwide [15]. In 1929, Zambia reported the first case of the disease [16]. Till 1986, the disease was limited to Sub-Saharan Africa. The first LSD outbreak outside of this area happened in Egypt in 1988 and then in Israel in 1989 [1]. The virus moved across the Middle East and Europe during the 2012–2018 Eurasian LSD epidemics [3]. Since 2019, LSD has spread to some of Asia's major trading and cattle-producing nations [4]. In Southeast Asia, LSD has recently been shown as a scary threat to cattle [15]. The first hotspot in South Asia, according to an OIE assessment, was Bangladesh [17]. The epidemiological explanations for the rapid spread are mostly lacking [18,19]. However, the causes could be related to the movement of cattle across international boundaries or the migration of vectors from nearby countries [20].

4. Host

Lumpy skin disease virus is a disease that is peculiar to its host, severely affecting cattle and Asian water buffalos [6]. The virus does not affect sheep and goats [21,22]. The virus also does not affect non-ruminants [23]. In experimental inoculations, the giraffe (*Giraffa Camelopardalis*) and impala (*Aepyceros melampus*) demonstrated susceptibility to LSDV [1]. African buffaloes, blue wildebeest, eland, and greater kudu are other animals that have tested seropositive for the virus [24,25,26]. It is necessary to clarify the role of wildlife as potential virus reservoirs [27].

5. Mode of Transmission

Lumpy skin disease virus can transmit by several routes, including direct and indirect contact, arthropod transmission, and seminal transmission [28]. It is mechanically transmitted by blood-sucking mosquitoes, biting flies, and some species of ticks [29,30]. The transmission of LSDV in sub-Saharan Africa has been linked to several blood-sucking hard ticks, including *Rhipicephalus appendiculatus* (brown ear tick), *Rhipicephalus decoloratus* (blue tick), *Amblyomma hebraeum*, mosquito *Aedes aegypti*, and flies *Stomoxys calcitran*, *Haematobia irritans*, and *Musca domestica* [32,33,34]. The disease is typically present during wet seasons when the environment is abundant with blood-sucking insects [35]. When clinically infected animals come into contact with contaminated objects, non-vectored LSD transmission occurs. Saliva, nasal, and ocular secretions contain infectious LSDV, which spreads the infection by contaminating shared eating and drinking places [27,34]. Milk ingestion, intrauterine transmission, and contamination of vaccination needles are potential sources of infection. Through natural or artificial insemination, the infected bull may transmit the virus to adult females as well, and the infected female may give birth to calves with skin lesions [32,37].

6. Public Health Importance

Earlier, it was thought that LSD is not communicable to human beings. Cattle are not a source of human infections, and milk from cows is safe to enter the human food chain [38,39]. However, a human infection due to LSDV was noticed in a recent finding in Cairo, Egypt [8]. This interesting observation confirmed that LSDV has a zoonotic potential. Person-to-person transmission was also seen in the area with infected animals. In affected persons, the clinical signs were observed, such as fatigue, weight loss, a high temperature (38.5-38.9°C), itching surrounding the skin nodules, edema, and enlarged lymph nodes. In some patients, the disease symptoms were aggressive, severely affecting their bodies and legs with multiple nodules and ulcerations. During the progress of LSD, the skin nodules spread all over the body. Modes of transmission are by direct contact with the infected animals, contaminated objects, aerosol, laboratory-acquired infections, and person-to-person transmission. It appears to have a highly contagious tendency. People who come into contact with infected cattle could easily become infected with LSDV [8].

7. Economic Importance

Lumpy skin disease has been reported in several nations, including Ethiopia and India (12,18). Major sectors and industries have documented the direct and indirect socio-economic effects of LSD [15]. The disease is severe because it results in a sharp decrease in milk production, abortions, poor coat conditions, and sterility in bulls [40]. Additionally, any breaches, scars, or lesions in the raw skin or hide of cattle may reduce the value of leather, as was the case with animal skins that had been significantly impacted by LSD [41]. The costs of diagnosis and treatment have been calculated to be 5 USD per cow, whereas the economic losses in the dairy industry have been assessed to be 141 USD per lactating cow [42]. Trade restrictions, vaccine expenses, quarantine and treatment costs, feed and labor costs, eradication efforts, and farm biosecurity are all included in the indirect economic burden of LSD [43].

8. Clinical Signs in Animals

The disease incubation period ranges from one to four weeks before viremia develops [15]. The peculiar and

many raised cutaneous lesions with a diameter of 0.5 to 5 cm, which appear as macules, papules, and nodules over 3 to 4 days, are the characteristic clinical indication of LSD. The skin nodules turn necrotic after 1 to 2 weeks, and eventually the center sloughs. The cutaneous lesions are frequently accompanied by lethargy, anorexia, oral, nasal, and ocular discharge, as well as a sharp decrease in milk production in lactating animals. Also reported are brisket edema and superficial lymphadenopathy [7,44,45]. In a few cases, edema of the legs and lameness were seen [1]. Additionally, infected animals may experience emaciation, persistent fever, infertility, and abortion [15]. The mortality rate is typically under 10% (sometimes up to 40%), whereas the morbidity rate ranges from 5% to 45% (occasionally up to 100%) [46,47].

9. Diagnosis

A presumptive LSD diagnosis can be made using an animal's clinical history, signs, and symptoms. A confirmatory laboratory diagnosis is made at the stage of nodular skin lesion appearance [1]. Most confirmatory tests are traditional or real-time Capri poxvirus-specific polymerase chain reactions (PCR) [48]. Clinically infected animals' bodily fluids, such as saliva, nasal swabs, or whole blood, can be taken for viral isolation and molecular testing [49]. Indirect fluorescent antibody test (IFAT), indirect immunofluorescence test (IIT), virus neutralization test (VNT), and serum neutralization test (SNT) are additional serological assays that can be used to identify the disease [42,50]. It has been determined that an assay known as the immuno-peroxidase monolayer assay (IPMA) may be helpful in diagnosing LSD. Compared to VNT and commercial ELISA, it is a less expensive, more practical test that is more sensitive and specific [51].

10. Treatment, Prevention, and Control

Lumpy skin disease virus has no specific treatment; only supportive therapy is available [2]. Treatment of skin lesions, antibiotics to prevent additional skin infections and pneumonia, and various anti-inflammatory drugs are all supportive therapies that can be administered to the affected animals [11,51]. It was discovered that broad-spectrum antibiotics effectively stopped the development of secondary bacteria. Antiseptic ointments with fly-repelling characteristics can be applied topically [51]. The skin can be soothed by some treatments. Glacial acetic acid and ascorbic acid were helpful for removing the skin nodules and eliminating the virus in the field [8]. To prevent incursion and the spread of the disease, the focus should be on vector control, movement restrictions, stringent quarantines, improved vaccination programs, appropriate veterinarian treatment, and general farm sanitary management [15].

The best medical prophylaxis for LSD is prophylactic immunization with homologous (Neethling strain) or heterologous live attenuated vaccine (sheep/goat pox vaccine). Cross-protection is a known property of *Capripoxvirus* members [27,52]. The effectiveness of a vaccine is determined by its efficiency to prevent the development of clinical symptoms, to block viremia, and to minimize virus excretion, leading to sterile immunity [53]. By restricting livestock movement, removing diseased and infected animals from the population, placing them in quarantine before being introduced to the herd, and avoiding herd mixing during grazing and watering, are effective measures for preventing infections [54]. Additionally, it is crucial that a clinical diagnosis is quickly established to implement eradication measures like quarantine, slaughtering of affected and infected animals, proper carcass disposal, cleaning and disinfecting of the premises, and insect control as soon as possible during the eruption [55,56]. It would be prudent for residents in locations where LSDV epidemics occur to refrain from eating meat from cattle, including fish, because dead cattle can be thrown into water bodies [8].

11. Conclusion

Lumpy skin disease virus is one of the most economically significant transboundary viral diseases affecting domestic cattle. The virus that causes lumpy skin disease is primarily transmitted by flies, mosquitoes, and possibly ticks. Additionally, it can be spread by fomites and, in some situations, from animal to animal. Clinically speaking, the disease can range from subclinical disease to severe infection or death. LSDV was once considered not be zoonotic. However, the recent human infection in Cairo, Egypt, established the zoonotic role of the animal virus. Direct contact with infected animals, contaminated tools, aerosol, laboratory-acquired infections, and person-to-person transmissions are the modes of transmission to humans. The disease is frequently identified by observing specific clinical symptoms.

On the other hand, quicker and more precise laboratory testing is needed to confirm the diagnosis in milder and subclinical forms. To stop the incursion and spread of the disease, it is emphasized to focus on vector control, movement restrictions, stringent quarantines, improved vaccination programs, appropriate veterinarian treatment, and overall farm sanitary management. As LSDV has a zoonotic potential, cattle owners, livestock handlers, and veterinarians are advised to take suitable measures to prevent the transmission of infection. A person having skin nodules, edema, and enlarged lymph nodes with a history of contact with cattle must be thoroughly investigated for LSD infection.

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Contribution of Authors

All the authors contributed equally. They read the final version and approved it for publication.

Conflict of Interest

The authors declare that they do not have a conflict of interest.

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