



REVIEW ARTICLE

Lumpy skin disease virus: An updated overview

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ABSTRACT

Lumpy skin disease virus (LSDV) is the virus that causes LSD, which belongs to the genus *Capripoxvirus*, family *Poxviridae*. It is a transboundary, non-zoonotic, and vector-borne disease. It is transmitted by infected arthropod species such as *Aedes aegypti* mosquitoes, *Ixodid ticks*, *Stomoxys calcitrans*, and *Tabanids haematopota* spp. For the 1st time in India, LSD has been reported to cause 7.1% morbidity among cattle. Clinical features are high fever, anorexia, reducing milk production, enlarged lymph nodes, nasal discharge, oval and round skin lesions with a diameter of 1 to 5 cm (sometimes big), tears discharge from the eyes, saliva discharge from the mouth, leg swellings, lameness in dairy cattle, and pregnant cows may miscarry, and cattle cannot come into heat for long months. Borders with India, like China and Bangladesh, are currently suffering. We should pay attention to vector control, vaccination with quarantine measures, and vector control to stop the LSDV spread. This review article talks about the introduction and background, etiology, epidemiology, transmission, clinical features, prevention and control measures, vaccination, and the LSD outbreak in India.

KEY WORDS: *Capri poxvirus*, Diagnosis, Lumpy skin disease spread in India, Transmission, Vaccines

INTRODUCTION

Lumpy skin disease (LSD) is a viral disease that is caused by the LSD virus (LSDV) of the *Capripoxvirus* genus, subfamily *Chordopoxvirinae*, and family *Poxviridae*. It is characterized by fever, lymph node swelling, nodules on the skin, low milk production, and infertility. LSD is spread by the arthropod vectors such as biting flies, mosquitoes, and ticks. LSD is a transboundary, non-zoonotic, and vector-borne disease. It is also known by different names, such as “LSD,” “*Pseudo-urticaria*,” and “*Neethling virus disease*,” enveloped by lipids.^[1] It is a viral disease that is found mostly in young, low-weight animals, and lactating mothers.^[2] The hosts of LSD are ruminants (mainly cattle and buffalo), sheep, goats, and others who live in close contact; this is most commonly found in Africa. This virus cannot affect animals with a single-compartment stomach, such as horses, dogs, cats, and humans.^[1]

8 million cattle were infected in South Africa due to an epizootic infection. LSD was first identified in 1957 and diagnosed in East Africa, in 1972 in Sudan, and in 1974 in West Africa. From 1981 to 1986, Tanzania, Kenya, Zimbabwe, Somalia, and Cameroon also reported LSD cases with a 20% mortality rate in suffering animals. In 1986, Asian countries such as Kuwait and Saudi Arabia were also affected. In 2006, Egypt also suffered. LSD has been found in Kuwait (1991), Lebanon (1993), Yemen in 1995, the United Arab Emirates in 2000, Bahrain in 2003, Israel in 2006, and Oman in 2010, according to the World Organization for Animal Health (OIE).^[3]

LSD came to India, China, and Bangladesh in 2019. This disease affects the financial value of animals and also affects meat and milk. LSD disease is characterized by fever, lymph node swelling, oculonasal discharge, eruptions in the skin and mucous membranes, oval and

HISTORY AND BACKGROUND

From 1943 to 1945, there were many cases of LSD in Botswana, Zimbabwe, and South Africa. In 1949, almost

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round masses on the skin, decreased milk production, and infertility.^[4]

ETIOLOGY

It is a viral skin disease caused by a lumpy virus that belongs to the family *Poxviridae* and the genus *C. poxvirus*.^[2] The family *Poxviridae* has two subfamilies: One is *Chordopoxvirinae*, and the next is *Entomopoxvirinae*. The host of *Chordopoxvirinae* is a vertebrate, and the host invertebrate of *Entomopoxvirinae* is an invertebrate. There are three species of the *C. poxvirus* genus: Sheeppox virus, goatpox virus (GTPV), and LSDV. The shape of LSDV is brick-like. The viral genome of LSDV is approximately 151 kb in size, encoding 156 putative genes. LSDV contains 30 structural and non-structural genes and is similar to the sheeppox and GTPVs.^[1] LSDV contains a double-stranded, covalently linked linear DNA genome enveloped by a lipid bilayer.^[2] Interleukin-10, interleukin-1 binding proteins, G protein-coupled CC chemokine receptor, and epidermal growth factor-like protein are the homolog genes of LSDV. All homolog genes of LSDV are found in other poxvirus genera.^[1]

EPIDEMIOLOGY

Morbidity and mortality rate of LSD

The morbidity rate varies between 5% and 45% (sometimes up to 100%).

Moreover, the mortality rate is often under 10% (sometimes up to 40%).

In Greece, the morbidity and mortality rates of outbreaks were, respectively, 8.7% and 0.4%, and in Turkey, they were 12.3% and 6.4%.^[5]

Morbidity and mortality rates of LSD in 10 countries are given below in Table 1.^[6]

Table 1: Morbidity and mortality of lumpy skin disease in different countries and areas^[6]

Country	Morbidity (%)	Mortality (%)
Bangladesh	23	0.002
Greece	8.7	0.4
China	19.5	0.9
Egypt	100	1.8
Hong Kong	91–94	0.07–0.10
India	7.1	0.0
Myanmar	3–6	0.0
Nepal	100	0.0
Turkey	12.3	6.4
Vietnam	93	7

LSD spread in India 2022

A minimum of 97000 cattle died between July and September 2022.^[7-9] LSD starts in Gujarat and Rajasthan; from July to September, 15 states of India suffer.^[7] In Rajasthan, on September 21, out of 18,50,000 cases, over 65% were found.^[10] Almost 50,000 cattle died in Rajasthan.^[11] In five states such as Rajasthan, Punjab, Gujarat, Himachal Pradesh, and Haryana, many cattle have died.^[7] In mid-September 2022, Madhya Pradesh reported its first case of lumpy virus.^[12]

CLINICAL FEATURES

Incubation period: From 4 to 7 days to 5 weeks.^[13]

Major symptoms



High fever, anorexia, reduction in milk production, enlarged lymph nodes, nasal discharge, oval and round skin lesions with a diameter of 1 to 5 cm (sometimes big), tears discharge from the eyes, saliva discharge from the mouth, leg swellings, lameness in the dairy cattle, and pregnant cows may miscarry; cattle cannot come into heat for a long time.^[13]

TRANSMISSION OF LSDV

LSD is transmitted in different ways, such as (a) mechanically by the bite of infected arthropod species such as *Aedes aegypti* mosquitoes, *Ixodid ticks*, *Stomoxys calcitrans*, and the *Tabanids haematopota* spp.; (b) direct contact between ruminant animals; and (c) by contaminated food and water.^[14]

There are two routes for LSDV

Primary route

By insect vectors, mosquitoes, and biting flies (mechanical transmission).

Secondary route

By direct contact with cattle, saliva, nasal discharge, semen of infected animals, and contaminated food and water.^[13]

By vectors, mechanical transmission occurs often in seasonal rains and the summer season, when disease

incidences increase and in the winter season decrease. Moreover, start again in the spring and summer seasons. The infection may be transmitted from the infected mother to the calf through milk feeding and skin abrasions. In the semen, the virus presents up to 42 days post-infection.^[1] The virus may affect people over a few kilometers and cover large distances due to uncontrolled animal movements across international borders.^[15] The transmission cycle of the LSD virus is given in Figure 1.^[3]

Another iatrogenic route involves medication through needles, single needle used in many vaccinations in cattle-through infected semen during sexual intercourse and ingestion of milk. Intrauterine is a mode of transmission that acts as a source of infection.^[1,6]

DIAGNOSIS

An antigen test is done by direct immunofluorescent staining or ELISA. Areas should have identification. LSD is also diagnosed by field-based investigations such as skin nodules, high fever, and nasal discharge. A PCR test was also done. The diagnostic procedures for the LSD are given below in Figure 2.

HEALTH CONCERN OF EFFECT OF LSD ON PUBLIC LSD

LSD is a transboundary, non-zoonotic, and vector-borne disease.^[1] LSD has been seen in large ruminants (e.g., water buffalo and cattle). Humans cannot be affected by infected cattle. The milk of the cattle is good and safe for human use. It is not good to eat the flesh of infected cattle. However, no harmful effect has been presented by its use. Viruses can affect humans; that is not proven. There is no risk associated with using meat or dairy products.^[6] We are

currently finding in Cairo, Egypt, that humans were also infected. In recent findings, person-to-person transmission was also seen where infected animals crowd, with clinical features such as fatigue, weight loss, high fever, itching around nodules of skin, edema, and swollen lymph nodes.^[16]

PREVENTION AND CONTROL OF LSD

There are a lot of techniques for the prevention and control of LSDV infection. These techniques are: Stopping the movements of weak animals; regular testing; quarantine; avoiding common feed and water sharing; and vector control.^[6] Vaccination plays an important role in the prevention of diseases.^[16] Affective vaccines against *C. poxvirus* are listed in Table 2.^[4] Although there is a chance that live vaccinations could spread foreign agents, they are the only ones that have been used to stop LSD to date.^[17] The decrease in cases during dry conditions with few or no insects has demonstrated the importance of insect vectors in disease transmission as opposed to direct or indirect contact, which are both deemed inefficient routes (Gumbe 2018; Carn and Kitching 1995).^[1]

TREATMENT

There are no specific antiviral drugs for LSDV, but supportive treatment gives a good response in the infected animals for treatment of skin lesions, antibiotics for secondary skin infections and pneumonia, and some anti-inflammatory drugs. Diclofenac gel for swelling and sulfonamide power for nodular lesions were found effective. Combination therapy with dexamethasone for 3 days. For LSD virus infection, broad-spectrum antibiotics are effective. Dexamethasone is an anti-inflammatory drug, and broad-spectrum antibiotics are both effective against secondary bacterial growth. The tropical antiseptic ointment is a good choice for skin

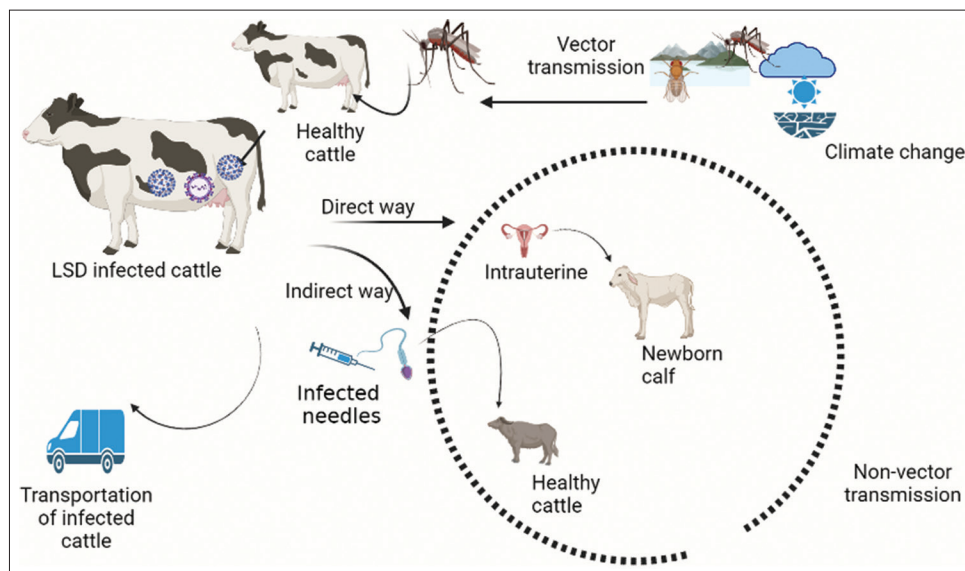


Figure 1: Transmission cycle of lumpy skin disease virus

Table 2: Vaccines list against *Capri poxvirus*^[4]

Vaccine/strain	Sheep	Goat	Cattle
GPV Gorgan safe	Safe, partially protective	Safe protective	Safe protective
GPV Mysore	-	Safe and protective	-
GPV Uttarkashi	-	Safe and protective	-
GPV Kedong and Isiolo	-	-	Safe and protective
SPV RM65	Safe and protective	-	Partially protective
SPV perego	Safe and protective	-	-
SPV Rumania Fanar	Safe and protective	-	-
SPV Romania	Safe and protective	Safe and protective	Partially protective
SPV Bakirkoy	Safe and protective	-	Partially protective
LSD Neethling	Partially protective	-	Causes Neethling disease, protective
LSD KSGP 0–180	Safe and protective	Safe and protective	safe and protective
LSD KSGP 0–240	Safe and protective	Safe and protective	Residual virulence, partial protection

*GPV: Goat pox virus, SPV: Sheeppox virus, LSD: Lumpy skin disease, KSGP 0-180: Kenyan sheep and goat pox o-180

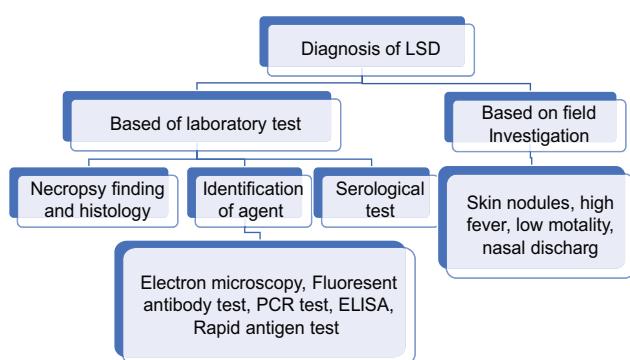


Figure 2: The diagnostic procedures of the lumpy skin disease^[5,13]

infections. Ethnoveterinary medicine is used in various cow shelters (gaushalas) in Nepal with good recovery.^[16]

CONCLUSION

LSD is a viral disease caused by LSDV in cattle, which belongs to the genus *C. poxvirus*, family *Poxviridae*. LSD was first seen in Zambia and is also found in other African countries. At present, many cases are found in India. For LSD spread, we should pay attention to measures to control and vaccination. In addition, to prevent the direct importation of transboundary illnesses, cattle imported from Europe and Russia are subject to stringent testing procedures and a 21–28 day quarantine. Armenia has avoided additional LSD outbreaks thanks to the quarantine and vaccine measures that have been put in place, and they should be kept up for long-term security.^[18] A BEI-inactivated and copolymer-adjuvanted LSDV-“Serbia” vaccine could provide full clinical protection without having any negative side effects after administration. Furthermore, according to our data, the inoculated calves were able to develop sterile immunity as a result of this prototype vaccine.^[19]

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not Applicable.

CONSENT FOR PUBLICATION

Not Applicable.

AVAILABILITY OF DATA AND MATERIALS

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AUTHOR'S CONTRIBUTIONS

Mr. Alok Kumar Aditya is the major contributor to the writing, literature, and drafting of the manuscript; Dr. Amit Sharma is the major contributor in editing and drafting the manuscript, all authors read and approved the final manuscript.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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