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" REVIEW ON SYSTEMATIC LUMPY - VIRAL INFECTION IN CATTLE"

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ABSTRACT

In Southeast Asia, Lumpy Skin Disease (LSD) has recently been portrayed as a serious menace to cattle. The early, observable clinical indications of this deadly illness are lump-like nodules in the skin and mucous membranes, along with fever and swollen lymph nodes. It is frequently an arthropod-borne infectious disease, and as a result, it spreads non-vector through bodily discharge and infected formice. Reduced milk production and quality, udder infections, thinness, poor-quality hides, loss of draught power, abortion, infertility, restrictions on meat consumption, increased morbidity, etc. all contribute to a severe socioeconomic collapse. Any age and gender of animal is prone to the illness. The frequency and immune condition of the animals affect the morbidity rate.

Keywords: Lumpy skin disease, LSDV, Livestock Industry, Treatment Outcome

Fig no 1: Lumpy skin disease

INTRODUCTION -

Lumpy Skin Disease (LSD) is an infectious condition that affects cattle and is brought on by the LSDV, a member of the Poxviridae family of viruses. In contrast to native Asian and African ruminants, high producing cattle and Asian water buffaloes frequently exhibit nodular dermatitis. The illness is fatal because it causes a sharp decrease in milk production, abortions, poor coat health, and bull infertility. In Asia, Europe, and the Middle East, the illness has now become a deadly concern for large domesticated ruminants. In1929, Zambian authorities recorded the first LSD case. Recent LSD reports have come from a number of countries, including Bangladesh, China, and India. Fever, lymphadenopathy, and skin nodules do appear to be clinical indicators of the LSDV-induced disease, which can range in severity from asymptomatic to acute and dangerous. Since the inability to identify infected communities is a significant issue in the implementation of successful and economical disease control strategies, the significance of suitable diagnostic equipment for LSD depends on responsible and inventive LSD management. The incidence of this disease has been the subject of numerous studies in the contemporary age, but there has also been research into the most recent diagnostic techniques, transmission, and control. Therefore, the goal of this research is to explain the financial effects of this disease outbreak rather than simply reflecting an effective system of disease diagnosis, control, and transmission.This paper may create awareness among the veterinarian, policy makers and farmers with providing such information to reduce further outbreaks of this disease. LSD is a condition that affects cattle and buffalo that is brought on by the capripox virus. Since 2012, LSD has expanded from Africa and the Middle East into south-eastern Europe, hitting Greece and Bulgaria, two EU members, as well as a number of other Balkan nations. India, Bangladesh, and North West China were the first Asian and Pacific nations to report LSD in 2019. in 2020, LSD outbreaks were recorded throughout a wide range of countries, including Bhutan, Hong Kong, Myanmar, Nepal, Taiwan, Vietnam, and Sri Lanka. The World Organisation for Animal Health exhorts its members to keep promptly reporting any outbreaks and to begin immunisation campaigns in high-risk areas before diseases spread there. To stop the disease's spread, the European Union has established a comprehensive (and costly) vaccine and culling programme. The likelihood that this sickness may spread to Australia is rising as LSD passes through Asia.

Due to the disruption of trade in cattle and livestock products as well as the expenses related to disease control and eradication, an incursion could have a significant negative economic impact.[1]

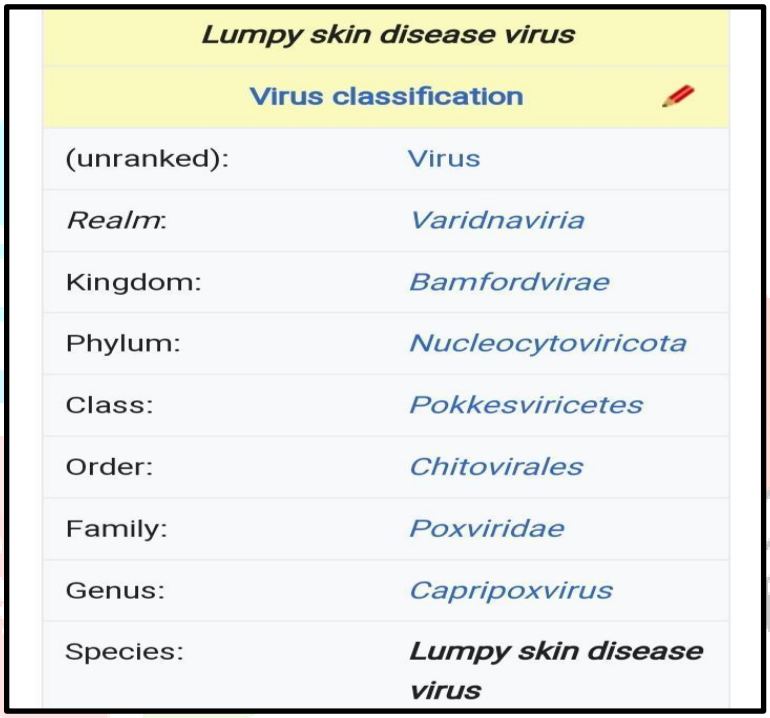
LUMPY SKIN DISEASE -

by the Poxviridae virus family, specifically the Neethling virus. The symptoms of the illness include fever, enlarged superficial lymph nodes, and many nodules with sizes of 2-5 centimetres (1-2 in) or more on the skin and mucous membranes (including those of the respiratory and gastrointestinal tracts).[2] Infected cattle may also develop lameness and edematous swelling in their limbs. Because the virus typically results in permanent skin damage in animals, lowering the market value of their hide, it has substantial economic repercussions. In addition, the illness frequently causes chronic weakness, decreased milk production, stunted growth, infertility, abortion, and even death. Nearly a week after virus infection, fever starts to develop. This first fever could reach 41 °C (106 °F) and last for a week. All of the superficial lymph nodes enlarge at this point.

Seven to nineteen days after virus inoculation, the disease's distinctive nodules start to show up. The discharge from the eyes and nose turns mucopurulent at the same time as the nodules emerge.[3]

The clinical signs and lesions in mild cases of LSD are sometimes mistaken for pseudo-lumpy skin condition, which is also known as Bovine Herpesvirus 2 (BHV-2). Lesions linked to BHV-2 infections are more superficial, nevertheless. In addition to being milder than LSD, BHV-2 also has a shorter course.

To distinguish between the two illnesses, employ electron microscopy. Contrary to LSD's intracytoplasmic inclusions, BHV-2 is characterised by intranuclear inclusion bodies. It's crucial to remember that BHV-2 isolation or detection in biopsy samples stained adversely can only occur about a week after the onset of skin lesions [4].



Lumpy skin disease virus	
Virus classification	
(unranked):	Virus
Realm:	*Varidnaviria*
Kingdom:	*Bamfordvirae*
Phylum:	*Nucleocytoviricota*
Class:	*Pokkesviricetes*
Order:	*Chitovirales*
Family:	*Poxviridae*
Genus:	*Capripoxvirus*
Species:	***Lumpy skin disease virus***

Fig no : 2 Virus Classification

CLASSIFICATION -

A double-stranded DNA virus called LSDV causes lumpy skin condition. It belongs to the Poxviridae family's capripoxvirus genus. One of the eight genera that make up the Chord Poxvirus (ChPV) subfamily is the capripoxviruses (CaPVs). LSDV, sheep pox virus, and goat pox virus are all members of the capripoxvirus genus. Despite being serologically identical, CaPV infections are typically host specific within specified geographic distributions. Capripox viruses are brick-shaped, just like the other Poxviridae viruses. In addition to having bigger lateral bodies, capripoxvirus virions differ from orthopoxvirus virions in that they have a more oval appearance. Capripoxviruses are typically 320 nm by 260 nm in size.

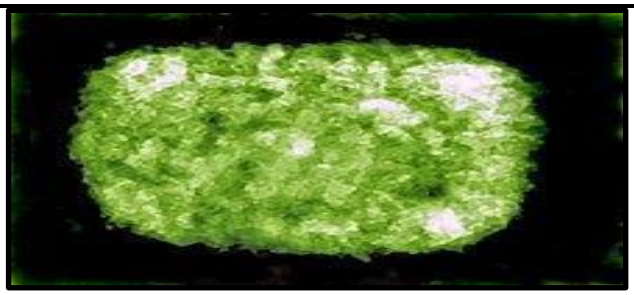


Fig no : 3 Brick-Like Structure Typical of Poxviridae Viruses

GENOME -

The virus's 151-kbp genome is made up of a core coding region that has 156 genes and is surrounded by identical 2.4 kbp-inverted terminal repeats. When LSDV is compared to chord poxviruses from other genera, 146 genes are conserved. These genes produce proteins that are essential for virion structure and assembly, transcription and mRNA biogenesis, nucleotide metabolism, DNA replication, protein processing, viral pathogenicity, and host range. The genes of other mammalian poxviruses and the genes of LSDV exhibit significant collinearity and amino acid identity within the central genomic region. Sui poxvirus, yatapoxvirus, and leporipoxvirus are some examples of viruses with similar amino acid identities. However, collinearity is broken at terminal regions. The majority of these variations involve genes that are probably related to viral pathogenicity.

The majority of these genetic variations are probably linked to genes that affect viral virulence and host range.

Interleukin-10 (IL-10), IL-1 binding proteins, G protein-coupled CC chemokine receptor, and epidermal growth factor-like protein homologues, which are prevalent in other poxvirus genera, are not present in Chordopoxviridae.[5]

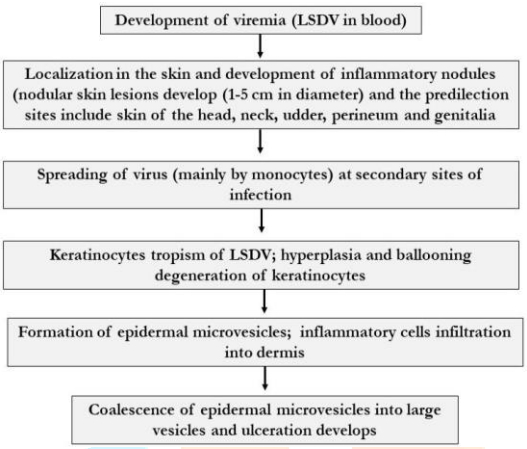
EPIDEMIOLOGY -

LSD was initially discovered in Zambia in 1929, but it went unnoticed. However, the degree of infectiousness was first documented when it struck Zimbabwe, Botswana, and the Republic of South Africa from 1943 to 1945 and spread rapidly in the cattle population across African countries except some countries like Algeria, Libya, Tunisia and Morocco which have been spared from devastation and wrath of this disease [14]. LSDV mainly affects cattle and zebus, but has also been seen in giraffes, water buffalo, and impalas. Fine-skinned Bos taurus cattle breeds such as Holstein-Friesian and Jersey are the most susceptible to the disease. Thick-skinned Bos indicus breeds including the Afrikaner and Afrikaner cross-breeds show less severe signs of the disease. This is probably due to the decreased susceptibility to ectoparasites that Bos indicus breeds exhibit relative to Bos taurus breeds. Young calves and cows at peak lactation show more severe clinical symptoms, but all age-groups are susceptible to the disease.[6]

The first confirmed transcontinental spread of LSD from the African to Middle-East Asian countries occurred when the disease was reported in Israel in 1989.Researchers have reported that LSD spread to Israel via Stomoxys calcitrans vector transmission that migrated from

Egypt. China became the second country in Southeast Asia to have an epidemic where 65

animals were infected in the Ili Kazak region, near the border of Kazakhstan which reported the last outbreak in 2016. In India, first outbreak of the disease was reported in Odisha state in the month of August, 2019, in monsoon season with high humidity and vector density.[13]



COALESCENCE OF EPIDERMAL MICRO VESICLES INTO LARGE VESICLES AND ULCERATION DEVELOPMENT

After formation of skin lesion, cells such as fibroblasts, pericytes, and endothelial cells of lymphatic and blood vessels, lesions are produced in those sites. Microscopic changes in acute skin wounds include edema, vasculitis, thrombosis, lymphangitis, infarction, and necrosis Large nodules may become necrotic and eventually fibrotic and persist for several months (sitfasts); the scars may remain indefinitely. Small nodules may resolve spontaneously without consequences.

The incubation period of disease in natural condition is between 2 and 5 weeks but in experimental condition, the duration ranges from 7 to 14 days. There are three clinical manifestations of lumpy skin disease: acute, subacute, and chronic. The infection begins with biphasic fever. Clinical signs of a mild infection include one or two lumps of nodules that occur within two to three days of the initiation of fever, emaciation, ocular discharge, and agalactia. Later, it is possible to see nodular lesions on the animal's body that are painful and hyperemic, notably in the skin of the muzzle, nares, back, legs, scrotum, perineum, eyelids, lower ear, nasal and oral mucosa, and tail

HISTOPATHOLOGICAL ALTERATIONS

Microscopic examination of skin lesions and lymph nodes in lumpy skin disease virus affected cattle.

a) Eosinophilic intracytoplasmic inclusion bodies

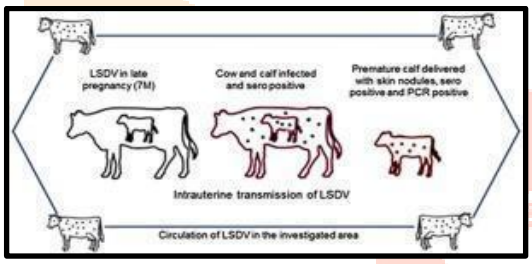
b) Necrotic vasculitis in dermal arteriole with infiltration of neutrophils

c) Zenker's necrosis in the dermal muscles and mononuclear cells aggregation

d) Severe edema and infiltration of neutrophils [14]

TRANSMISSION -

Outbreaks of LSDV are associated with high temperature and high humidity. It is usually more prevalent during the wet summer and autumn months, especially in low-lying areas or near bodies of water, however, outbreaks can also occur during the dry season. Blood-feeding insects such as mosquitos and flies act as mechanical vectors to spread the disease. A single species vector has not been identified. Instead, the virus has been isolated from Stomoxys, Biomyia fasciata, Tabanidae, Glossina, and Culicoides species. The virus can be transmitted through blood, nasal discharge, lacrimal secretions, semen and saliva. The disease can also be transmitted through infected milk to suckling calves.In experimentally infected cattle, LSDV was found in saliva 11 days after the development of fever, in semen after 22 days, and in skin nodules after 33 days. The virus is not found in urine or stool. Like other pox viruses, which are known to be highly resistant, LSDV can remain viable in infected tissue for more than 120 days.[7]



Figer no : 4 Intrauterine transmission of LSDV

Viral transmission happens when livestock are moved. Animals who have lesions on their skin, mucous membranes in their mouths, or nasal canals and are infected with the contagious LSDV virus excrete it in their saliva, nasal discharges, and ocular discharges, which can contaminate public eating and drinking locations.Due to the virus' persistence in infected bulls' semen, both natural mating and artificial insemination may expose females to it. It is well known that infected cows that are pregnant deliver calves that have skin lesions. Suckling calves may get the virus from milk that has been contaminated with it or from skin sores in the teats. Blood-sucking insect vectors that graze on cattle can potentially disseminate the virus locally. The Aedes aegypti mosquito, several Rhipicephalus and Amblyomma spp. tick species, and the common stable fly (Stomoxys calcitrans) have all demonstrated the capacity to distribute the LSDV.[9]

There is a dearth of knowledge on how this virus spreads. Direct transmission from an infected to an uninfected animal is extremely ineffective, according to several experimental studies. According to some evidence, arthropods like mosquitoes or ticks—which are referred to as virus "vectors"—transmit the virus. But it's not obvious which species of vector are responsible for transmission. According to some experts, it is spread by ticks, flies, and mosquitoes. occasionally through contaminated water, food, and saliva. Unknown factors determine which animals experience moderate disease and which experience severe disease. The migration of infected animals is one of the important elements that might cause LSD to spread over great areas.[10]

CAUSES FOR LUMPY –

The poxvirus, which causes lumpy skin disease (LSD), is contracted by cattle or water buffalo (LSDV). The virus is one of three closely related species of the genus capripoxvirus, along with the goat pox and sheeppox viruses. In Zambia in 1929, LSD was first described. It gradually migrated into the Middle East and most of Africa over the course of the following 85 years. The virus made its way into continental Europe in 2015 through Russia, the Caucasus, and Greece. In 2016, the virus further migrated east into the Balkans, up north toward Moscow, and across western Kazakhstan. The disease is currently regarded as fast emerging and serious. It is reportable when epidemics seriously harm trade and productivity.[8]

Fig no: 4

SYMPTOMS -

Cattle are susceptible to Lumpy Skin Disease (LSD), which manifests as fever, depression, skin nodules and oedema, enlarged lymph nodes, as well as nodules on the mucous membranes, nasal and ocular discharges, milk drop, leg swellings, and lameness. fever, depression, oedema and skin nodules, swollen lymph nodes, as well as nodules on the mucous membranes, nasal and ocular discharges, milk drop, swellings in the leg, and lameness.[11]

It's crucial to regularly inspect your herd for symptoms of ill cattle. Establish a regular feeding routine for your cattle using a round bale feeder or livestock trough so they will line up for inspection on their own. Watch for indications that a cow is ill, such as:

1) Eye problems:

Cattle with eye issues may close one eye and rub their faces against rocks, trees, or fence posts. When the cow opens its eye, it can seem foggy and have a runny, weeping discharge from one or both of its eyes. They might also stay out of the sunlight and look for cover under a tree. Eye discharge could indicate an eye injury or, more frequently, conjunctivitis or pink eye. If not identified and treated promptly, this highly contagious bacterial disease in beef cattle can cause corneal scarring and even blindness.

2)Hoof problems:

Affected cattle will limp or prefer one hoof over the other. It may look like the hoof is heated, bloated, or cracked. You might be able to look at the hooves if you can get close enough to handle your animal or if you can put your cow in a chute for inspection. Any kind of discharge, including pus, needs to be treated right away.

3)Skin lesions:

Cows occasionally have skin visible, which is normal. In beef cattle, it's equivalent to what a scratched knee is in humans. However, back sores or circular patterns might be signs of ringworm, rain rot, or another fungal ailment that would be terrible for your animals.

4)Respiratory problems:

When buying cattle at auction or after transportation, when many cattle from many farms may be confined together during the sale, respiratory problems in beef cattle are more frequent. Cattle may be susceptible to respiratory illnesses during these stressful periods. The presence of symptoms including coughing, wheezing, mucus discharge, and others might indicate respiratory issues. Viral infections can cause common respiratory illnesses.

5)Neurological problems:

Stumbling cattle should be looked into right away. It's possible that these animals have a serious neurological condition. Some cattle can't get up when they lie down. Microorganisms or nutritional deficits brought on by grazing on lush, fresh pastures that are lacking in minerals might result in neurological issues. Other potential causes include grazing on ground with a high concentration of lead or arsenic in the soil or poisonous flora. A veterinarian should examine downed cows to make a diagnosis and recommend a course of action.[12]

DIAGNOSIS –

Other clinical signs include fever, discharge from the eyes and nose, malaise overall, and a sudden decrease in milk supply. The latest Eurasian pandemic had a morbidity and fatality rate of about 10% and 1%, respectively. The 10% of the herd's afflicted cattle might range in illness severity from moderate to lethal. Some cattle produce extremely few nodules that might be hard to see. Others grow many nodules with a diameter of 3 cm. Unknown variables determine which animals have moderate illness and which experience severe disease. A laboratory diagnosis of the illness is possible, and tests are available to find the virus' DNA or ANTIBODIES**.** Numerous illnesses, such as Pseudo lumpy skin disease (caused by Bovine Herpesvirus2), Bovine papular stomatitis, Pseudocowpox, Cowpox, cutaneous tuberculosis, Demodicosis (Demodex), insect or tick bites, urticarial, photosensitization, Papillomatosis (Fibropapillomas, "warts"), Rinder Fever and a reduction in milk production are non-specific symptoms that can occur with a variety of illnesses.[8]

TREATMENT -

The disease known as lumpy skin has no known cure.

PREVENTION:

Once an area has been contaminated, it is difficult to stop cattle attacks by infected vectors (flies, etc.). Risky behaviours raise the likelihood that an illness may spread from one place to another. Preventative methods can increase your herd's degree of protection against

Lumpy Skin Disease and other infectious diseases:

Implement biosecurity measures:

• Avoid entering or opening such vehicles within or adjacent to animal holdings, unless they have been properly disinfested with authorised treatments, as livestock and vehicles can transport live vectors (flies, mosquitoes, etc.) across locations.

•Animals should be moved to areas of the holding where there are less biting flies in order to protect them from insects, such as treatment with authorised repellents.

• Change needles when treating animals.

General measures to reduce the risk of LSD and other diseases:

• Disinfectant foot bath at the entrance of the stable.

• Disposable boot covers and suits for the visitors.

•. Prior to and after moves, vehicles must be cleaned and deinfested.

AVOID:

• interactions between animals from various herds (e.g. on pasture).

• grazing places with lots of bothersome flies

• Exchanging livestock, equipment, trucks, and workers with other farms.

AWARENESS:

Your herd could be in danger. It is crucial to frequently inspect each animal. A veterinarian and the Veterinary services must be alerted right away if there is any indication of Lumpy Skin Disease. To stop the illness from spreading further, notification is crucial.

No particular antiviral therapy for lumpy skin disease has been discovered to yet. Animals who are sick should be removed from the herd and given supportive and symptomatic medication such as antibiotics, anti-inflammatory medications, and vitamin injections. These treatments are meant to reduce the likelihood of subsequent microbial infections, inflammation, and fever, increasing the animal's appetite.

Animals infected with LSD typically recover as death is typically less than 3% despite extremely significant morbidity. Complete healing might take over a month or more if secondary microorganism infection occurred. Early discovery of all clinical and subclinical index cases, followed by a swift and comprehensive mass immunisation programme, are essential for the effective management and eradication of LSD. The simplest form of defence is preventive immunisation of the whole herd of cattle, distributed in high-risk locations well in advance.

Vaccines against LSD are now in use in various regions of the world and include: vaccinations against LSDV attenuated Attenuated LSDV vaccines are now being produced by vaccine manufacturers. If 80% of the recommended vaccinations are received, live, attenuated LSDV vaccines provide sensible protection for cattle. In reality, all herds of cattle, including young calves and pregnant cows, need to be immunised. Ring vaccination should be preferred over regional immunisation efforts.

Examples of live attenuated strains of the capripox virus vaccines that have been used to control LSDV outbreaks but are not permitted for use in the United States include:

• Kenyan variant of the sheep- and goat-pox virus
• Yugoslavian strain RM 65 of sheep pox
• Romanian sheep pox strain, and
• The Republic of South Africa's LSDV strain. vaccinations against attenuated SPPV In areas with both LSD and SPP, cattle are protected against LSDV using sheep pox virus vaccinations. Because it is thought that SPPV vaccinations only partially protect against LSDV, the immunising agent should be chosen based on the vaccine's ability to protect against LSDV in a challenge experiment that is conducted under controlled conditions.[13]

CONCLUSION -

Lumpy skin disease (LSD) is a widespread skin condition that affects cattle and is brought on by a virus connected to the Neethling poxvirus, a member of the genus Capri poxvirus and family Poxviridae. LSD was initially documented in Zambia and is today endemic in the majority of African nations. It has also lately migrated outside of Africa and into the Middle East areas, Asia, and Europe. LSD was first noticed in Ethiopia in the country's north-western region in 1983. (south-west of Lake Tana). Arthropods' mechanical vectors are the primary means by which the virus is spread, and wildlife serves as a reservoir for outbreaks of LSDV, which are frequently linked to the rainy and warm seasons.The three primary risk factors for the disease are the host, environment, and pathogen. Depending on the breed, age, and sex of the cow, LSD clinical symptoms might be acute or subacute in nature. Young animals and cows that are lactating heavily are more severely affected by the illness. Using the proper serological and molecular methods, LSD may be identified. The illness may have an adverse financial impact on the international commerce in both live animals and animal products. Vaccination, limiting animal mobility, and the elimination of diseased and exposed animals are all

effective ways to reduce LSD. The recommendations that are made below are based on the aforementioned finding.

- implementing a targeted vaccination campaign, and removing affected and afflicted animals from populations, in order to effectively manage and eradicate the illness.
- To understand vector insects implicated in the transmission of LSDV and their behaviour in various agro-ecologies, more study is needed.
- The introduction of a quarantine system before adding additional animals to the herd.
- Widely accepted local wisdom that herd owners should use exclusive grazing areas and irrigation sources to prevent herd interaction and mixing.
- The development of mass vaccination of cattle and the use of rings as a primary tool to regulate LSD

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