

Case Study

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Clinical Management of Lumpy Skin Disease (LSD) in Cattle

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ABSTRACT

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Lumpy skin disease (LSD) is a potentially infectious emerging viral disease of cattle and buffalos in India, caused by the Lumpy skin disease virus (LSDV) which belongs to the family Poxviridae. The main source of transmission of the disease is arthropods vector-borne (mosquitoes, biting flies, culicoides midges and blood sucking hard ticks) which act as mechanical vectors. Major clinical signs include characteristic skin nodules all over the body, pyrexia, lacrimal discharge, nasal discharge, anorexia, profuse salivation, mastitis, decreased milk yield, emaciation, depression and reluctance in movement. Since the first recent report of lumpy skin disease in Kutch, Gujarat India in April, it is spreading rapidly across the country including J&K causing a possible threat to the cattle and buffalo population in terms of milk production, fertility, abortions, import restrictions and in some cases death in the livestock animals. The disease usually shows seasonal pattern due to the vector borne mode of transmission. The morbidity rate is high but with low mortality rate however death rates are higher in calves.

Introduction

Most of the population in India is directly involved in the dairy industry. LSD is an emerging viral infection of cattle having huge economic significance across the world. Lumpy skin disease (LSD) was first reported in North Rhodesia (Zambia) in the year 1929, which was initially thought to be due to an allergic reaction in cattle caused by biting insects. In India, lumpy skin disease had been first reported from Mayurbhanj and

Bhadrak Districts in Odisha in August, 2019 (Sudhakar *et al.*, 2020). Now the recent reports of outbreaks has been reported all over the country including J&K. LSD is an important infectious viral disease of cattle and buffalos of all age groups. LSD is also called as pseudo urticaria, exanthema nodularis bovis, neethling virus disease and knopvelsiekte causing temporary to permanent damage to the skin characterized by characteristic nodular lesions all over the body leading to detrimental effect on the commercial value of hides

(Amenu *et al.*, 2018). Lumpy skin disease causes severe loss to the farmers in terms of chronic debility, decreased milk yield, poor growth rate, infertility, abortion and even death (Abutarbush *et al.*, 2013). LSD is caused by the LSDV, which belongs to the Capripoxvirus genus in the Poxviridae family. It is closely antigenically related to sheep and goat pox virus (Woods *et al.*, 1988). However, these viruses cannot be differentiated using routine serological test (Alexander *et al.*, 1957). All three viruses can infect ruminants however no zoonoses has been reported (Limon *et al.*, 2020). Also, the LSD disease has not been reported in sheep or goats when kept in close contact with the infected cattle (Davies *et al.*, 1991). However, mechanical vectors such as biting flies and mosquitoes (*Aedes aegypti*) and tick species like, *Amblyomma hebraeum*, *Rhipicephalus appendiculatus* and *Rhipicephalus decoloratus* are the most prevalent carriers of this disease (Shen *et al.*, 2011). The symptoms can range from mild to severe. Pyrexia occurs within 5–7 days of incubation period, nodules (1-5 cm in diameter) on skin (Brenner *et al.*, 2006), nodules on mucosal surfaces and enlargement of the superficial lymph nodes especially pre scapular lymph node (Figure 14) are all the symptoms of LSD. All the secretions and excretions contain LSD virus. Ulcerated nodules on the skin (Figure 11, 13), eyes, mouth, nose, rectum, udder mucous membranes and genitalia contain virus. The animal's limbs may be edematous (Figure 8) and it is reluctant to move. Infection can also get transmitted to suckling calves via milk (Figure 5). Pregnant cows may abort and there may be intrauterine transmission of LSD virus. Breeding bulls can become permanently infertile and the virus is present in the semen also (Al-Salihi, 2014). The affected animal is weak, may develop pneumonia or mastitis and the necrotic plugs of skin are prone to fly strike. When the necrotic plugs are shed leaving holes in the hide, thus reducing their commercial values (Jameel, 2016).

LSD virus affects all sexes and ages, however the young animals are more vulnerable to this deadly disease. The mortality and morbidity rate depends

depends on various factors viz geographic location, climate, management conditions, nutritional status of the animal, general condition of the animal, breed of cattle affected, immune status, population levels and dissemination of insect vectors in the various habitats and virus virulence. In general, mortality ranges from 1% to 3%, but it can reach upto 40% in extreme cases (Gari *et al.*, 2011). LSD's emergence is more rapid with disastrous consequences and its current outbreak in India is posing a serious threat to the livestock industry (Abera *et al.*, 2015). LSD is classified as a notifiable disease by the World Organization for Animal Health (OIE) due to its rapid spread and significant economic effect.

Causative Organism

The genus Capripoxvirus of the family Poxviridae is the causative agent of Lumpy skin disease. Lumpy skin disease virus is closely related antigenically to sheep and goat poxviruses (Woods 1988). LSD virus is susceptible to temperature of 55°C for 2 hours and 65°C for 30 minutes. It can be recovered from cutaneous nodules and nasal swabs. The LSD virus is susceptible to highly alkaline or acidic pH. LSD virus is susceptible to ether, chloroform, formalin and some detergents e.g. sodium dodecyl sulphate. In addition to this, it is also susceptible to phenol, sodium hypochlorite, iodine compounds, virkon and quarternary ammonium compounds (QAC). LSD virus is highly stable, surviving for long periods at ambient temperature especially in dried scabs.

LSD virus is very resistant to inactivation. The LSD virus is susceptible to sunlight and detergents containing lipid solvents however it persists for many months in contaminated animal sheds in dark environmental conditions. The genomic sequence of LSD virus is also identified (Tulman *et al.*, 2001). The LSD virus genome (151-kbp) consists of a central coding region bounded by identical 2.4 kbp-inverted terminal repeats and contains 156 putative genes. The complete genome sequences of several capripoxviruses including LSD virus (Tulman *et al.*, 2001), sheep poxvirus and goat poxvirus (Tulman *et al.*, 2002) have been published.

Susceptible animals

LSD virus has a very narrow host range. Cattle and Buffalo are the species, which become infected naturally during field outbreaks. Five clinical cases of LSD in *Bubalus bubalis* (Asian water buffalo) have been reported (Ali *et al.*, 1990). No other domestic ruminant species have been infected naturally during LSD outbreaks. All cattle breeds appear to be equally susceptible to the disease. However, exotic breeds with thin skin are more susceptible than indigenous breeds with thicker skin. Young calves are more susceptible to the disease and may develop the characteristic nodular lesion within 24 to 48 hours, although all ages groups of animals are susceptible. Experimental inoculation of virus in giraffe (*Giraffa camelopardalis*) has led to the development of LSD lesions in the skin (Young *et al.*, 1968).

Transmission

The transmission of lumpy skin disease virus has not been fully understood (Carn and Kitching *et al.*, 1995). However, the mechanical spread of the LSD virus occurs by flying insects. Most cases are believed to be resulted from the transmission by an arthropod vector (MacDonald 1931).

There are variations in the attack rates in different areas due to the differences in the active vector species that are found in that particular area. *Culicoides*, *stomoxys*, *tabanids* and tsetse flies are responsible for the transmission of LSD virus. However, mosquitos also play very significant role in transmission of disease especially after rain. Lubinga (2014), has found three blood sucking hard tick species involved in the transmission of LSD virus in Africa.

The three tick species identified as vectors of the disease are the *Rhipicephalus decoloratus* (blue tick), *R. appendiculatus* (brown ear tick) and *Amblyomma hebraeum* (bont tick). The ticks also act as 'reservoirs' for the LSD virus. The virus has been found in their saliva and organs. Similar mode of

transmission of LSD virus by hard ticks (Tuppurainen *et al.*, 2012). The study showed molecular evidence of transstadial and transovarian transmission of LSD virus by *Rhipicephalus decoloratus* ticks and mechanical or intrastadial transmission by *Rhipicephalus appendiculatus* and *Amblyomma hebraeum* ticks. LSD virus has been isolated from *Stomoxys calcitrans* and *Musca* spp. The virus has been also isolated from mosquitoes (*Anopheles* and *Culex*), stable fly and biting midge (*Culicoides* spp). Cattle can be infected by drinking water, although ingestion and direct contact transmission are not the common routes of transmission. The virus is present in nasal and lacrimal secretions, semen and milk of infected animals. Transmission of LSD virus through semen (natural mating or artificial insemination) has also been reported. Intra-uterine infection also occurs, which is very evident by the presence of skin lesions in the aborted calves (Weiss 1968). Some wild species (giraffe and gazelle) have been infected by parenteral inoculation with LSD virus and have developed characteristic nodular skin lesions.

Sheep and goats do not become infected during LSD outbreaks even when kept in close contact with the infected cattle. Infection by contact can also occur at a low rate but it is not considered as major route of transmission. The movement of animals from infected areas, even months after recovery, has regularly resulted in the introduction of infection. The source of the virus is considered to be from old skin lesions. In most of the areas LSD shows seasonal pattern usually after seasonal rains. There is always an increase in the population of different arthropod species after seasonal rains. Local movement of the disease in presence of strict quarantines has been attributed to the aerial movement of insect vectors. The onset of winter season has resulted in reduction in the number of LSD cases, which virtually disappears over the winter season and reappears again in the spring and summer season. The imposition of quarantines does prevent the spread of infection by recovered animals but not by the aerial movement of vectors (Fayez and Ahmed, 2011).

Pathogenesis and Clinical signs

LSD virus replicates inside the host cells such as macrophages, fibroblasts, pericytes and endothelial cell in the lymphatics and blood vessels walls leading to vasculitis and lymphangitis. Thrombosis and infarction may get developed in severe cases. Viraemia occurred after the onset of fever and persists for almost 1-2 weeks. In natural infection, very young calves, pregnant cows and malnourished animals seem to develop more severe form of LSD disease. A lifelong cell-mediated immunity is developed in most of the recovered animals. Calves born from the infected cows acquire maternal antibodies that may protect them from LSD for upto six months. Intravenous, intradermal and subcutaneous routes of inoculation were used in experimental infection. The intravenous route develops severe generalized infection, while the intraepidermal inoculation developed localized lesions or no apparent disease. A localized swelling at the site of inoculation after four to seven days and enlargement of the regional lymph nodes, develop after subcutaneous or intradermal inoculation of cattle with LSD virus (Vorster and Mapham, 2008). However, generalized eruption of skin nodules usually occurs after 7 to 15 days after inoculation.

The incubation period of LSD varies from 4-12 days (usually 7 days). The temperature of the infected animals raises to 40-41°C, which may persist for 6-72 hrs or more and may rarely be up to 10 days. The infected animals shows lacrimation, increased nasal discharge and pharyngeal secretions, anorexia, dysgalactia, general depression and a disinclination to move usually due to the hygroma of joints (Figure 6,8). Various cutaneous nodules develop in the skin of the affected animals (Figure 1, 3, 5). These nodules are suddenly erupted within 1-2 days. The erupted nodules may be widespread or restricted to just a few lesions. The head, neck, the perineum, the genitalia, udder, and the limbs are the predilection sites. The whole skin of the infected animal is covered with lesions in frequent cases (Figure 1). The affected skin is hyperaemic especially external

genitalia (Figure 12). The lesions are of full skin thickness and involve epidermis, dermis and subcutis, often with some edema. The regional lymph nodes are easily palpable (Figure 14) and enlarged to 3-5 times their normal size (Diesel 1949). The disease lesions are also developed on the muzzle in the nares and the oropharynx. The muzzle shows a typical ring-like lesion due to sloughing of the necrotic lesions from the healthy surrounding epithelium. Keratitis is a common complication. Mucopurulent discharges appear from the nares, persistent dribbling from the mouth (Figure 7), coughing and often stertorous and distressed respiration (Ayre-Smith, 1960).

After 2-3 weeks, the skin lesions gradually become harder and necrotic. Later on, the "sitfast" of LSD are developed from harder lesions (core of necrotic tissue forms a plug). There is a distinct ring of living tissue around the lesions. Some of "sitfast" may peel off, leaving a full skin thickness hole in the skin, which heals by granulation. Bacteria may invade the hole. The limbs are swelled to several times their normal size due to inflammation and may develop edema (Figure 9, 10). Hard skin over chronically oedematous limbs may peel off, leaving large areas that can become infected or susceptible to myiasis. The common sequel of LSD is the pneumonia which may prove fatal. Abortion is a common sequel in acute phase of the disease. Infertility is a problem following LSD infection, females remain in anoestrous for several months and most infected cows suffer from cessation of ovarian activity mainly due to poor body condition. The infected bulls, which suffer from lesions on the genitalia, may also become infertile. Deterioration in the general condition occurs in the severely affected animals and under range conditions the mortality can be high. The recovered animals suffered from weakness and debility for upto 6 months (Gezahegn *et al.*, 2013). Severely infected animals may show secondary bacterial pneumonia, tracheal stenosis, acute and chronic orchitis, mastitis with secondary bacterial infection, and similar lesions in the female reproductive tract (Davies *et al.*, 1971).

Fig.1



Fig.2



Fig.3



Fig.4



Fig.1, 3 & 5 Characteristic Nodular Skin Lesions of Lumpy Skin Disease affecting all age groups (Cow, Pregnant Heifer and Suckling Calf).

Fig.2 & 4 Recovered animals after 15 days of treatment.

Fig.5



Fig.6



Fig.7

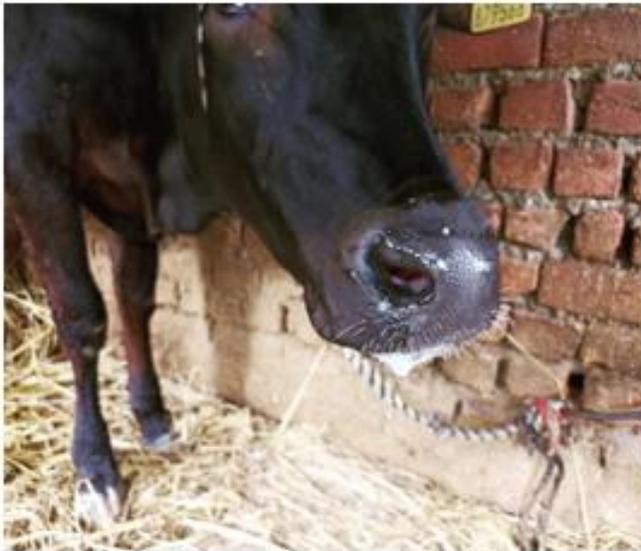


Fig.8



Fig.6 Edematous and inflammatory swelling of foot.

Fig.7 Nasal Discharge and Profuse Salivation.

Fig.8, 9, 10 & 14 Edematous forelimb, Brisket region, Lower Abdomen and Pre-Scapular Lymph Node respectively.

Fig.9



Fig.10



Fig.11



Fig.12



Fig.12 Small nodular and hypermic external genitalia.
Fig.11 & 13 Ulcerated Skin Lesions.

Fig.13



Fig.14



Diagnosis

The diagnosis of LSD is based on typical clinical signs combined with laboratory confirmation of presence of the virus or antigen. A field presumptive diagnosis of LSD can be done on the basis of presence of skin nodules, enlargement of lymph nodes draining the affected areas, pox lesions on the mucous membrane of the mouth, pharynx, epiglottis, tongue, mucous membranes of the nasal cavity, edematous brisket region (Figure 9). Preliminary diagnosis of LSD can also be done by palpation of enlarged Pre-Scapular lymph node (Figure 14), small nodules on labia majora with hypermia (Figure 12), enlargement of knee joint (Figure 8). Polymerase chain reaction (PCR) and loop-mediated isothermal amplification (LAMP) assay have been used for detection of capripoxviruses with higher sensitivity (Bowden *et al.*, 2009).

Treatment

Lumpy skin disease is a viral disease hence there is no specific treatment for the disease. However, supportive treatment including antibiotics, analgesics, anti-inflammatory drugs, multivitamins should be given to infected animals to relieve

clinical signs and to control all secondary complications and improvement of the animal's general body condition and appetite. Following medicines were used in treatment of the affected animals. Flunixin Meglumine @ 0.4 to 0.5 mg/Kg BW (Unizif), Chlorpheniramine maleate @ 0.4 to 0.5 mg/Kg BW (Anistamin), Ivermectin @ 0.2 mg/Kg BW (Neomec L.A), Intavita-H (Vit. A, D₃, E & H) @ 5 ml/200 Kg BW.

Bolus Melonex z plus and Boviheal 2 boli daily for 4 days and susp. Intavita NH 20 ml daily for 5-10 days. This treatment were used in affected cases and showed tremendous efficacy and efficiency in combating LSD.

Control and Vaccination

Control of Lumpy skin disease by quarantine and control on movement of animals is not very effective because biting flies and certain tick species are the most important mode of transmission of the disease. Although, the control of insects was not effective in preventing the spread of LSD, but use of insecticides together with fly repellents can be used in prevention of the spread of Lumpy skin disease. LSD outbreaks can be eradicated by quarantines,

depopulation of infected and exposed animals, proper disposal of carcasses, cleaning and disinfection of the premises and insect control.

LSD control can be done only by vaccination or immunoprophylaxis. According to OIE, four live attenuated strains of capripoxvirus have been used as vaccines specifically for the control of LSD (Brenner *et al.*, 2006). However in India Live Goat Pox Vaccine Uttarkashi strain has been used to mass vaccinate the animals against LSD disease. The vaccine is recommended for use as early as 4 months or above. Recently indigenous vaccine Lumpi-ProVac^{Ind} against LSD has been developed by the National Equine Research Center, Hisar Haryana in collaboration with the Indian Veterinary Research Institute, Izatnagar Bareilly Uttar Pradesh for the vaccination of livestock animals against LSD disease.

Lump Skin Disease causes huge economic losses in livestock industry due to the weakness of the affected animal, decrease in the milk production, loss of hide values and delayed response to the daily clinical treatment. Bites from the biting flies are believed to be the primary cause of the entry of the virus into the animal. To prevent the spread/occurrence of LSD disease animals should not be left for grazing in the vector borne areas, complete restriction on movement of the animals at village or district or state level. The affected animals should be kept in separate insect proof paddocks and fed separately. Use of fly repellents at the farms to prevent entry of insects. Proper disposal of farm manure and urine on regular basis. Any stagnation of water in nearby places should be avoided. Smoking of farm with raw leaves especially during evening hours would help to reduce the nuisance. In conclusion the animal should be stall fed and should not be left open for grazing. Cow sheds should be made mosquito/insect proof to prevent the occurrence of disease. And at last mass vaccination/immunization of the susceptible livestock animals seems to be the best strategy to prevent occurrence of the LSD disease.

Clinical Observation

In general from the clinical observation the young and healthy animals has responded to the treatment very well and recovered in a quick period of time than old ones (Figure 2,4). Pregnant animals show very poor response to the treatment and resulted in delayed recovery. Healthier animals recovered quickly as compared to the debilitated ones. Feeding of balanced ration having abundant minerals, immunomodulators and vitamins can directly reduce the recovery period in affected animals. Stress to the livestock animals in the dairy farms should be also minimised. And at the end dairy farmers/entrepreneurs must seek immediate professional veterinary intervention and timely vaccination of livestock can only reduce the menace of this Lumpy Skin Disease.

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