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Lumpy Skin Disease Virus Infection: A Mini-review of Transmission, Diagnosis, and Control

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Abstract:
Lumpy skin disease (LSD) belonging to a Capripoxvirus genus and is one form of viral infection affected by the lumpy skin disease virus (LSDV). In particular, the population of cattle and buffalo are vulnerable to the virus. The illness is typically characterized by the presence of a nodule in the eyelid, muzzle, limb, and udder. Presently, like an emerging disease, this pathogen is spreading to various areas, including Asia, Africa, and the Middle East. LSDV is responsible for reducing milk production, disruption to the hide and skin, abortion, mastitis, etc. Additament, in cattle and buffalo pathogens, its seriousness often causes death, suggesting the greater economic effect of this disease on the farmers and livestock industry. However, the key pillars for reducing the outbreak of this disease are adequate diagnosis, control, strict quarantine initiatives, and vaccination. There have been several studies to assess the prevalence of disease outbreaks, but few studies have been performed to present the current methods of diagnosis, control, and transmission. This mini-review is, therefore, aimed at providing the latest diagnostic and control measures for development. It will also address the propagation and economic significance of this disease to avoid further outbreaks.

INTRODUCTION

Lumpy skin disease (LSD) is a virus-related infectious infection that is transmitted via lumpy skin disease virus (LSDV) of the genus Capripoxvirus, Chordopoxvirniae subfamily, Poxviridae family. Different terms such as "LSD," "Pseudo-urticaria," "Neethling virus sickness," "exanthema nodularis bovis," and "knopvelsiekte" are classified for the disease (Al-Salihi, 2014; Tuppurainen *et al.*, 2017). This disease is linked with elevated economic losses due to trade restrictions on livestock and related goods, reduced weight gain, irreversible disability to hides and skins, reduced milk production and sterility (Carn and Kitching, 1995; Babiuk *et al.*, 2008a; Tuppurainen *et al.*, 2015; Bedeković *et al.*, 2018). Zambia registered the first case of LSD in 1929. In African nations, the disease is widespread, but the infection has rarely been reviewed from novel terrains everywhere in the world. It is already spreading to Israel, Kuwait, Oman, and Yemen (Gupta *et al.*, 2020). Conferring to OIE, this infection is generally accessible in regions, namely diverse countries in Africa, Europe and Asia (Tuppurainen *et al.*, 2015).

In recent times, countries including India, China, and Bangladesh, have registered LSD. The LSDV-induced disease may vary from subclinical to acute and serious, and fever, lymphadenopathy with skin nodules do seem to be clinical indications (Gupta *et al.*, 2020). The importance of adequate diagnostic equipment for LSD relies on responsible and innovative LSD management, since the failure to recognize infected communities is a significant problem in the implementation of successful and cost-effective disease control strategies (Tomita *et al.*, 2008; Mwanandota *et al.*, 2018).

In modern days, several studies have been performed to explain the prevalence of this disease, but there is certain research on the knowledge of latest diagnostic procedure, control, and transmission. The purpose of this research, therefore, is to not only reflect an efficient method of diagnosis, control and transmission, but rather to explain the financial consequences of this disease outbreak. This paper may create awareness among the veterinarian, policy makers and farmers with providing such information to reduce further outbreaks of this disease.

Mode of transmission

A recent study showed that the disease outbreak increases at the time of summer season (according to the top action of the vectors) in rampant republics, including sub-Saharan Africa, Egypt, and Ethiopia (Mulatu and Feyisa, 2018; Gupta *et al.*, 2020). “African Union – Interafrican Bureau for Animal Resources” also detected that the infection dispersed 80 to 200 kilometers apart from infected place through air movement of biting insects. *Aedes aegypti* mosquitoes and *Stomoxys calcitrans* flies are known types of blood-sucking hard tick species have been appeared for acting and transmitting the disease. The *Rhipicephalus decoloratus* (blue tick), *Rhipicephalus appendiculatus* (brown ear tick), and *Amblyomma hebraeum* act as a reservoir host (Lubinga *et al.*, 2013; Gumbe and Ahmed, 2018).

The virus can transmit indirectly via milk, nasal discharges, saliva, blood, and lachrymal secretions (Ali *et al.*, 2012). The contemporary study reported that transmission through the intrauterine route could be a possible route. Figure 1 shows the transmission cycle at a glance.

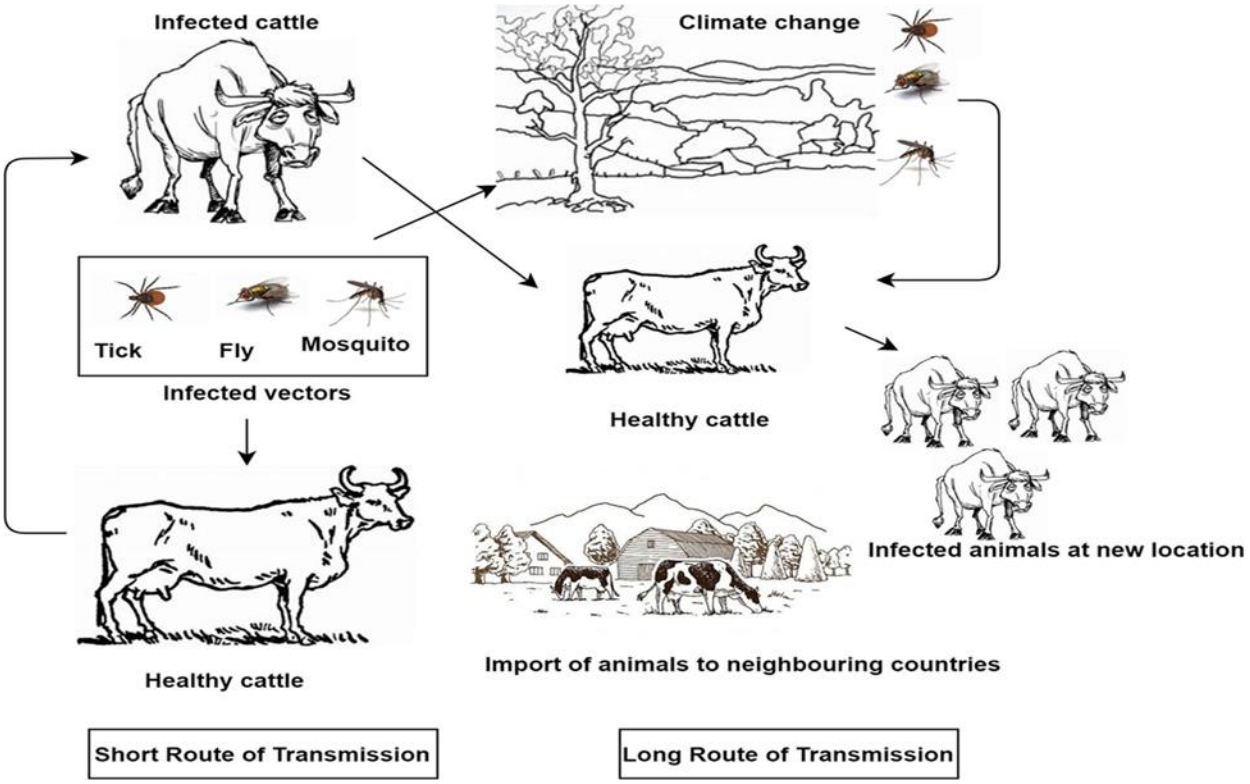

Fig. 1. Transmission of LSD virus at a glance (Gupta *et al.*, 2020).

Clinical diagnosis

Skin nodules observed on the forehead, eyelids, ears, muzzles, nostrils, udder, limbs could be tentatively diagnosed. It is possible to gather a skin biopsy sample for further disease confirmation. Specimens should be transported through 20% to 50% glycerol in phosphate buffer saline in a protective covering. Skin samples can be analyzed to determine viruses by electron microscopy (Davies *et al.*, 1971).

Laboratory diagnosis

"The World Organization for Animal Health" (OIE) suggests many tests for the laboratory diagnosis, including the virus neutralization test, the indirect fluorescence test, the agar gel immunodiffusion test, the enzyme immunosorbent test (ELISA) and the western blot test (Milena *et al.*, 2019). The gold standard test, which has the potential to detect particular antibodies against LSDV, is the alternative name of the virus neutralization test (European Food Safety Authority, 2019). Additional study recommends that the infection of LSDV is principally cell mediated and the development of low-level neutralizing antibody is responsible for plummeting the effectiveness of the viral neutralization test (Abdulqa *et al.*, 2016). Moreover, a recent research in Ethiopian region has made an otherness between serologically positive and negative animals through the use of indirect fluorescent antibody tests (Woods, 1988).

Therefore, OIE recommends to use standard titer (100 TCID/50 and a range of 1:5 to 1:500 dilution of test sera) of capripox in the lamb testis cells or supplementary susceptible cells for titrating the virus (Milena *et al.*, 2019). In contrast, detecting antibody against LSDV, the immunodiffusion and immunofluorescence tests are less sensitive. Western blot test is very sensitive but the main disadvantages are the set-up procedure and expenses (Bowden *et al.*, 2009; Milena *et al.*, 2019). Another test (ELISA) also use for detecting the antibody against this virus. This method can distinguish antibodies in

contrast to Capri poxviruses, including LSDV, sheep pox and goat pox virus from almost twenty days until seven months post-vaccination. For investigating comparatively new outbursts, caring out consistent intermissions, and serological assays are suggested in a current study (Krešic *et al.*, 2020). In the contemporary, for the diagnosis procedure, Polymerase Chain Reaction (PCR) is the utmost effective and speedy test. There are many types of PCR methods being used for LSD rapid diagnosis, including conventional PCR, real-time PCR, nested PCR, etc. (Heine *et al.*, 1999; Tuppurainen *et al.*, 2005; Bowden *et al.*, 2008, 2009; Gupta *et al.*, 2020). In the current research, a newfangled method (DIVA TaqMan probe-based real-time PCR) was recommended to detect the wild type strain and vaccine strain of LSDV. This PCR method is superior because it provides advanced specificity that is essential for LSD abolition plans. This method is extremely subtle (LOD: 8 DNA copies/ reaction), precise, repeatable, and fast (entire period: 2 h) (Agianniotaki *et al.*, 2017). Moreover, to determine the viral genome, targeting the open reading frame (ORF 074) of capripoxvirus that encrypts the intracellular matured virion protein (P32) is the principle of the real-time PCR TaqMan assay (Babiuk *et al.*, 2008b; Bedeković *et al.*, 2018). (95°C for 10 min; 45 cycles at 95°C for 15 s and 60°C for 1 min) is the intensification program giving the manufacturer's instructions (Bedeković *et al.*, 2018). Furthermore, an alternative recent addition is the loop-mediated isothermal amplification (LAMP) assay. It is a unique kind of gene intensification process with continuous temperature (60–65°C) consisting of a single enzyme (Tuppurainen *et al.*, 2005). The strategy of LAMP assays needs minimum four to maximum six oligonucleotides with a least of four obligatory positions and the outcome could be recited through the stark-naked eye, when turbidity read out is normally used (Notomi *et al.*, 2000). The attribution of rapidity and effortlessness makes it different from another prevailing process (Tuppurainen *et al.*, 2005). Moreover, another recent study shows that LAMP assay has virtuous specificity and sensitivity to the identification of individuals with subclinical contaminations (Mwanandota *et al.*, 2018).

Differential diagnosis

A serious type of LSD is highly characteristic and detectable; other diseases, including bovine herpesvirus (pseudo lumpy skin disease), vaccine virus, bovine papular stomatitis, cowpox virus, and pseudo cowpox virus, may occur through uncertainty in diagnosis (Davies, 1991; Abdulqa *et al.*, 2016). Moreover, the contagion of dermatophilosis (wide blowout skin disease) is common among the cattle population, and the lesion can be confused with LSD virus infection. The only differential diagnosis can be done for the dermatophilosis by demonstrating the superficial (soggy and seem as coatings of keratinized substantial) scabs of (0.5- 2) cm (Gumbe and Ahmed, 2018). The mild infection can also be conflicted with insect or tick bites, rinderpest, photosensitization, urticaria, onchocerciasis, and cutaneous tuberculosis (Davies, 1991).

Control and prevention

The LSD virus disease is an emerging threat for the cattle population, therefore, initial uncovering of outbursts, entire or incomplete earmarking out, mass immunization, and over-all prohibition of individual actions for controlling further outbreaks. Though early detection of LSD sometimes is not probable, it is a requirement for successfully ceased further outbreaks. For controlling the disease, different dynamic observation programs (nursing of the cattle holdings and experimental inspection) by a veterinarian can play an effective role. Moreover, stamping samples and disposal of the carcass can be operative for further control, but the killing procedure should be humanitarian and regarding animal welfare. Furthermore, restrict the movement of the affected animal is essential to avert the additional banquet of this emerging contagious ailment. It is also recommended that pastoralism, related cattle movements with transhumance should be controlled. Besides, the border should be ceased and strictly maintained traffic control (Tuppurainen *et al.*, 2018). Also, vector-like tick control is one of the major steps

for controlling the further outbarks of LSDV. Detect the insects which play a principal role in the LSDV transmission in a specific area and take necessary steps for mitigating its reproduction could be an effective way for controlling this pathogenies outburst (Kayesh *et al.*, 2020). Finally, wearing personal protective equipment (PPE), headgear, protective boots is recommended to all veterinarians during handling and treating animals for lessening the chances of contamination of this pathogen (Kasem *et al.*, 2018).

Vaccination is called the main pillar of controlling the disease. At present-day, solitary live attenuated inoculations are existing commercially in contradiction of LSDV. However, attenuated sheep poxviruses are less effective than homologous LSD vaccines. In contrast, local and occasionally severe responses can be seen as a side effect of using a heterologous live attenuated virus vaccine (Al-Salihi, 2014). A recent study recommends that live attenuated Gorgan goatpox rinsing has upright defense ability in cattle population with almost not at all adjacent consequence (Brenner *et al.*, 2009; Gari *et al.*, 2015; Gupta *et al.*, 2020).

Economic impact

Due to flattering an emergent threat to the whole cattle, sheep, and goat populations in the world, LSDV causes significant economic losses, including emaciation, damage of hiding and skin, momentary or enduring infertility both in males and females, abortion, decrease milk production, mastitis, and up to 40% mortality (Tuppurainen and Oura, 2012; Gumbe and Ahmed, 2018). Devastating viral disease like LSDV causes an extreme financial problem for farmer due to milk loss, abortion, infertility, and occasionally death (Tuppurainen and Oura, 2012; Gumbe and Ahmed, 2018). Another recent study supposed that diseased animals at a low value, defeating, treatment expenditure, and production loss of milk and meat are the main evidence of economic loss (Limon *et al.*, 2020).

CONCLUSION

Lumpy skin disease is an emergent disease in several countries that affects cattle and buffalo. The economy of a nation is partly dependent on the livestock industry; however, this disease has a higher mortality rate and a major economic impact on both countries and farmers. Therefore, after understanding the causes and proper diagnosis, it is important to take potential preventive and control steps to avoid further outbreaks. I propose that more research on the efficient development of vaccines is vital.

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CONFLICT OF INTEREST

The authors declare that this article's content has no conflict of interest.

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REFERENCES

Abdulqa, H.Y., Rahman, H.S., Dyary, H.O., Othman, H.H., 2016. Lumpy Skin Disease. Reprod. Immunol. Open Access., 1(25): 2476–1974.

Agianniotaki, E.I., Tasioudi, K.E., Chaintoutis, S.C., Iliadou, P., Mangana-Vougiouka, O., Kirtzalidou, A., Alexandropoulos, T., Sachpatzidis, A., Plevraki, E., Dovas, C.I., Chondrokouki, E., 2017. Lumpy skin disease outbreaks in Greece during 2015–16, implementation of emergency immunization and genetic differentiation

between field isolates and vaccine virus strains. Vet. Microbiol., 201(March): 78–84.

Al-Salihi, K.A., 2014. Lumpy Skin disease : review of literature. Mirror Res. Vet. Sci. Anim., 3(3): 6–23.

Ali, H., Ali, A.A., Atta, M.S., Cepica, A., 2012. Common, emerging, vector-borne and infrequent abortogenic virus infections of cattle. Transbound. Emerg. Dis., 59(1): 11–25.

Babiuk, S., Bowden, T.R., Boyle, D.B., Wallace, D.B., Kitching, R.P., 2008a. Capripoxviruses: an emerging worldwide threat to sheep, goats and cattle. Transbound. Emerg. Dis., 55(7): 263–272.

Babiuk, S., Bowden, T.R., Parkyn, G., Dalman, B., Manning, L., Neufeld, J., Embury-Hyatt, C., Copps, J., Boyle, D.B., 2008b. Quantification of lumpy skin disease virus following experimental infection in cattle. Transbound. Emerg. Dis., 55(7): 299–307.

Bedeković, T., Šimić, I., Krešić, N., Lojkić, I., 2018. Detection of lumpy skin disease virus in skin lesions, blood, nasal swabs and milk following preventive vaccination. Transbound. Emerg. Dis., 65(2): 491–496.

Bowden, T.R., Babiuk, S.L., Parkyn, G.R., Copps, J.S., Boyle, D.B., 2008. Capripoxvirus tissue tropism and shedding: a quantitative study in experimentally infected sheep and goats. Virol., 371(2): 380–393.

Bowden, T.R., Coupar, B.E., Babiuk, S.L., White, J.R., Boyd, V., Duch, C.J., Shiell, B.J., Ueda, N., Parkyn, G.R., Copps, J.S., Boyle, D.B., 2009. Detection of antibodies specific for sheeppox and goatpox viruses using recombinant capripoxvirus antigens in an indirect enzyme-linked immunosorbent assay. J. Virol. Methods., 161(1): 19–29.

Brenner, J., Bellaiche, M., Gross, E., Elad, D., Oved, Z., Haimovitz, M., Wasserman, A., Friedgut, O., Stram, Y., Bumbarov, V., Yadin, H., 2009. Appearance of skin lesions in cattle populations vaccinated against lumpy skin disease: statutory challenge. Vaccine., 59(1): 40–48.

Carn, V.M., Kitching, R.P., 1995. An investigation of possible routes of transmission of lumpy skin disease virus (Neethling). Epidemiol. Infect., 144(1): 219–226.

Davies, F.G., 1991. Lumpy skin disease of cattle: a growing problem in Africa and the Near East. Vet. J., 68(3): 37–42.

Davies, F.G., Krauss, H., Lund, J., Taylor, M., 1971. The laboratory diagnosis of lumpy skin disease. Res. Vet. Sci., 12(2): 123–128.

European Food Safety Authority, 2019. Lumpy skin disease: Workshop on risk assessment and data collection for epidemiology, control and surveillance - November 2019. EFSA Support. Publ., 16(11): 1751E.

Gari, G., Abie, G., Gizaw, D., Wubete, A., Kidane, M., Asgedom, H., Bayissa, B., Ayelet, G., Oura, C.A.L., Roger, F., Tuppurainen, E.S.M., 2015. Evaluation of the safety, immunogenicity and efficacy of three capripoxvirus vaccine strains against lumpy skin disease virus. Vaccine., 33(28): 3256–3261.

Gumbe, F., Ahmed, A., 2018. Review on lumpy skin disease and its economic impacts in Ethiopia. J. Dairy, Vet. Anim. Res., 7(2): 39–46.

Gupta, T., Patial, V., Bali, D., Angaria, S., Sharma, M., Chahota, R., 2020. A review: lumpy skin disease and its emergence in India. Vet. Res. Commun., 62(5): 549–554.

Heine, H.G., Stevens, M.P., Foord, A.J., Boyle, D.B., 1999. A capripoxvirus detection

PCR and antibody ELISA based on the major antigen P32, the homolog of the vaccinia virus H3L gene. J. Immunol. Methods., 227(1–2): 187–196.

Kasem, S., Saleh, M., Qasim, I., Hashim, O., Alkarar, A., Abu-Obeida, A., Gaafer, A., Hussien, R., AL-Sahaf, A., Al-Doweriej, A., Bayoumi, F., Hodhood, A., Abdelatif, M., 2018. Outbreak investigation and molecular diagnosis of lumpy skin disease among livestock in Saudi Arabia 2016. Transbound. Emerg. Dis., 65(2): e494-e500.

Kayesh, M.E.H., Hussan, M.T., Hashem, M.A., Eliyas, M., Anower, A.K.M.M., 2020. Lumpy skin disease virus infection: an emerging threat to cattle health in Bangladesh. Hosts and Viruses., 7(4): 97–108.

Krešic, N., Šimic, I., Bedekovic, T., Acinger-Rogic, Ž., Lojkic, I., 2020. Evaluation of serological tests for detection of antibodies against lumpy skin disease virus. J. Clin. Microbiol., 1–20.

Limon, G., Gamawa, A.A., Ahmed, A.I., Lyons, N.A., Beard, P.M., 2020. Epidemiological characteristics and economic impact of lumpy skin disease, sheeppox and goatpox among subsistence farmers in northeast Nigeria. Front. Vet. Sci., 7(8): 1–13.

Lubinga, J.C., Tuppurainen, E.S.M., Stoltsz, W.H., Ebersohn, K., Coetzer, J.A.W., Venter, E.H., 2013. Detection of lumpy skin disease virus in saliva of ticks fed on lumpy skin disease virus-infected cattle. Exp. Appl. Acarol., 5(2): 113–120.

Milena, S., Vladimir, P., Vladimir, G., Diana, L., Gospava, L., Tamaš, P., Sava, L., 2019. Detection of antibodies against lumpy skin disease virus by virus neutralization test and ELISA methods. Acta Vet. Brno., 69(1): 47–60.

Mulatu, E., Feyisa, A., 2018. Review: Lumpy Skin Disease. J. Vet. Sci. Technol., 09(03): 1–8.

Mwanandota, J.J., Macharia, M., Ngeleja, C.M., Sallu, R.S., Yongolo, M.G., Mayenga, C., Holton, T.A., 2018. Validation of a diagnostic tool for the diagnosis of lumpy skin disease. Vet. Dermatol., 29(6): 532-e178.

Notomi, T., Okayama, H., Masubuchi, H., Yonekawa, T., Watanabe, K., Amino, N., Hase, T., 2000. Loop-mediated isothermal amplification of DNA. Nucleic Acids Res., 28(12): e63–e63.

Tomita, N., Mori, Y., Kanda, H., Notomi, T., 2008. Loop-mediated isothermal amplification (LAMP) of gene sequences and simple visual detection of products. Nat. Protoc., 3(5): 877–882.

Tuppurainen, E., Alexandrov, T., Beltrán-Alcrudo, D., 2017. Lumpy skin disease: a field manual for veterinarians. FAO Anim. Prod. Heal. Man., 20.

Tuppurainen, E.S.M., Oura, C.A.L., 2012. Review: lumpy skin disease: an emerging threat to Europe, the Middle East and Asia. Transbound. Emerg. Dis., 59(1): 40–48.

Tuppurainen, E.S.M., Venter, E.H., Coetzer, J.A.W., 2005. The detection of lumpy skin disease virus in samples of experimentally infected cattle using different diagnostic techniques. Onderstepoort J. Vet. Res., 72(2): 153–164.

Tuppurainen, E.S.M., Venter, E.H., Coetzer, J.A.W., Bell-Sakyi, L., 2015. Lumpy skin disease: Attempted propagation in tick cell lines and presence of viral DNA in field ticks collected from naturally-infected cattle. Ticks Tick. Borne. Dis., 6(2): 134–140.

Tuppurainen, E.S.M., Antoniou, S.E., Tsiamadis, E., Topkaridou, M., Labus, T., Debeljak,

Z., Plavšić, B., Miteva, A., Alexandrov, T., Pite, L., Boci, J., Marojevic, D., Kondratenko, V., Atanasov, Z., Murati, B., Acinger-Rogic, Z., Kohnle, L., Calistri, P., Broglia, A., 2018. Field observations and experiences gained from the implementation of control measures against lumpy skin disease in South-East Europe between 2015 and 2017. Prev. Vet. Med., 181.

Woods, J.A., 1988. Lumpy skin disease-a review. Trop. Anim. Health Prod., 20(1): 11–17.