Review Article

CAPRIPOXVIRUS DISEASES IN INDIA

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ABSTRACT

The genus Capripoxvirus (CaPV) comprises three members namely, sheep pox virus (SPPV), goat pox virus (GTPV) and lumpy skin disease virus (LSDV) affecting sheep, goats and cattle, respectively. Capripoxvirus infections produce similar symptoms in sheep and goats, and the three viruses cannot be distinguished serologically. The Capri pox virus disease is an economically important notifiable disease of cattle, sheep and goats (OIE, 2018). This article reviews about the current scenario of Capri pox disease and the better opportunities for prevention and control of disease. Recent outbreaks of the disease have caused the major economic loss in most of the countries including India.

Key words: Capripoxvirus, economic impact,

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INTRODUCTION

Pox viruses are the largest and most complex of viruses that infect vertebrates. They are large enough to be seen under the light microscope. Small pox, the great success story in the fight against infectious disease provides at least three 'firsts': The first vaccine, the first disease to be totally eradicated by immunization, and the first virus infection against which chemotherapy was clinically effective. *Poxviridae* contains two subfamilies. Entomopoxvirinae, which are the poxviruses that infect insects and Chordopoxvirinae, which infect vertebrates. Ten genera are used to classify the chordopoxvirinae. Capri pox virus is one of the ten genera that causes three economically important disease in cattle, sheep and goats namely lumpy skin disease, sheep pox, and goat pox, respectively. The three Capripoxviruses are antigenically and genetically, linked to each other by 96% (Bhanuprakash, 2006b).

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Economic impact

Capripox disease is an emerging disease in the world in cattle, sheep and goat

causing more economic loss to small scale farmers (Babiuk *et al.,* 2008b). SPPV and GTPV, which are extremely contagious, can result in severe morbidity (70–90%) and mortality (up to 50%). Young animals exhibit more severe illness, and death rates in lambs and young animals may reach 100% (Rao and Bandyopadhyay, 2000).

Cattle are particularly susceptible to LSD during peak lactation, which together with secondary mastitis and prolonged high fever, affect milk production. Animals with the infection have abortions and either temporary or permanent infertility (Weiss, 1968). Skin and hides used in the leather business are less valuable because deep pock sores in the skin leave behind lasting scars (Green, 1959). As per a report, the losses due to capripox in Maharashtra (India) state alone are estimated to be over INR 105 million (US$2.3million) with an average morbidity and mortality of 63.5 % and 49.5 %, respectively, and it took nearly six years for a flock to recover from outbreak (Garner *et al*., 2000). Total estimated annual loss at the national level amounts to be INR 1250 million (US$ 27.47 million) (Bhanot *et al.,* 2009).

Virion properties of Poxviruses

Poxviridae has two lateral bodies with a center that resembles a dumbbell shaped core, and complicated symmetry. The virions of the poxvirus are pleomorphic, often brick-shaped, and measure 220-450 nm × 140-260 nm in size. They have an uneven surface covered in protruding tubular or globular features. They have lengthy surface tubules that resemble thread and are covered in an arrangement that resembles a ball of yarn. Poxviruses are resistant to the environment at room temperature, but they can persist for a long time in dried scabs or other material that is virus-rich.

Capripoxvirus

Capripoxvirus (Capv) is a genus of viruses in the subfamily Chordopoxvirinae and the family *Poxviridae*. Capripoxviruses are among the most serious of all animal poxviruses. All capripoxvirus diseases are notifiable diseases to the OIE (World Organization for Animal Health). Sheep, goat, and cattle serve as natural hosts. The family *Poxiviridae* comprises three closely related viruses, namely lumpy skin disease (LSD), sheeppox (SPP) and goatpox (GTP) viruses.

Goat pox and sheep pox are contagious viral diseases that cause serious economic loss in small ruminants due to high morbidity, mortality and trade restriction. Incubation period is 4-14 days. Depending on the host and virus strain, the infection's acuteness and severity can vary. India has documented several such outbreaks in most of the states (Gomes *et al*., 2023).

Geographical distribution

The geographic range of Capripoxviruses are bound within Asia and Africa. SPPV and GTPV are limited to northern Africa, the Middle East and continental Asia. In contrast, LSDV is only found in Sub-Saharan Africa (Kitching *et al.,* 1989).

Transmission

All Capripoxvirus species tend to be spread by means of insect vector. Sheep pox and goat pox are also transmissible by aerosol or by close contact with infected animals. Contamination of open cuts or wounds may also contribute to the spread of SPPV and GTPV. However, there is little to no susceptibility of lumpy skin disease when in close contact with an animal infected with LSDV (Babiuk *et al.,* 2008a). While sheep pox and goat pox viruses tend to enter animals through respiratory routes and abraded skin, biting insects are considered the major driving force for the spread and infection of LSDV.

The disease is transmitted by direct contact, fomites, contaminated water, transmucosal/transcutaneous routes, and skin abrasions. Arthropods and the inhalation of nasal and ocular secretions are the mechanical means of transmission. The virus is secreted by infected sheep and goats in their oral, nasal, and ocular secretions, and it is spread by aerosols and direct contact (Bowden *et al*., 2008). Insect vectors may be responsible for mechanical transmission. Experimental evidence suggests that SPPV and GTPV are transmitted by the stable fly, *Stomoxys calcitrans*. Although the SPPV virus was isolated from *Hydrotaea irritans* after the parasite consumed by affected sheep, *Mallophaga* species, *Damalinia* species, *Hydrotaea irritans*, and *Culicoides nubeculosus* were unable to transmit the disease (Kitching and Mellor, 1986).

Experimentally, the female *Aedes aegypti* mosquito has been shown to transmit LSDV from infected to susceptible cattle (Chihota *et al.,* 2001). Direct contact between sick and vulnerable animals is thought to be an ineffective method of LSDV transmission (Weiss, 1968; Carn and Kitching, 1995).

The outbreak of disease in India

Sheep pox outbreaks occurred in an organized sheep breeding farm at Makhdoom (Uttar Pradesh), India, during 2007 and in goats at the Central Institute of Research on Goats, Makhdoom (Uttar Pradesh), India during 2008 (Bhanuprakash *et al.,* 2010). The sheep pox outbreak was noticed in flocks of Khilakaraisal in an organized government farm of Tirunelveli (Tamil Nadu) district during 2013. Mortality and morbidity rates were 4.17% and 80.00%, respectively (Manimaran *et al.,* 2017). A recent outbreak was reported in Himalayan goats during April-May 2018 in the Tawang district of Arunachal Pradesh**.** For a period of about 2–3 years since its introduction into India in 2019, incidences of LSD were mainly observed in the Eastern part of the country without any significant mortality. As of 30 September 2022, LSD had expanded to 251 districts in 15 states, harmed over 2 million animals, and resulted in 100,000 animal deaths, according to the Department of Animal Husbandry and Dairy, Government of India (Kumar and Tripathi, 2022). Gujarat and Rajasthan states in western India were the origin of the highly hazardous LSD outbreak that began in 2023.

Clinical signs

The sheep and goat pox disease is characterized by the clinical symptoms such as lacrimation, salivation, serous nasal discharge, swelling of the eye lids, high fever, pock lesions on the eye lids, lips, nostrils, ears, cheeks, inner side of the thigh, scrotum, prepuce, vulva, buccal mucosa which can be ulcerative and necrotic and enlarged lymph nodes.

Lumpy skin disease is characterized by generalized nodules may be few hundred. Yellowish-grey lesions can occur on the tongue, the hard palate, gums and in the nostrils. The nodules form a "sit fast" which further turns into an ulcerative nodule.

Postmortem findings

The postmortem lesions vary considerably with breed of host and strain of capripoxvirus. Post mortem lesions in sheep and goat pox include nodular or pock lesions in the lungs and intestine (Gomes *et al*., 2023). In lumpy skin disease lesions may also be found in the mucous membranes of the oral and nasal cavities as well as the gastrointestinal tract, lungs, testicles, and urinary bladder. Bronchopneumonia may be present, and enlarged superficial lymph nodes are common. Synovitis and tenosynovitis may be seen with fibrin in the synovial fluid (Center for Food Security and Public Health, Iowa State University, 2011).

Diagnosis

Capripoxvirus diseases can be diagnosed by virus isolation in foetal bovine/ lamb testicle, foetal bovine/lamb kidney, vero, MDBK cells or by chorioallontoic membrane route in embryonated eggs (Binepal, 2001). Apart, virus neutralization, indirect fluorescent antibody test (Gari *et al*., 2008), capripox antibody ELISA can also be used. Molecular diagnosis can be done using techniques like PCR (Ireland and Binepal, 1998; Tuppurainen *et al*., 2005) and real time PCR (Lamien *et al*., 2011)

Prevention and control

A viral illness does not have a specific therapy but secondary bacterial infections are treated with antibiotics, and careful nursing care is advised to minimize morbidity and other problems (Hajer *et al.,* 1988). It would be possible to effectively control and eliminate small ruminants with CaPV in countries that were previously free of CaPV by slaughter all infected and *in-situ* animals (Tuppurainen and Galon, 2016).

Capripox-free countries maintain their disease-free status by the restriction of imports of livestock and animal products from affected areas. In the case of countries remote from enzootic areas, the swift implementation of a radical slaughter policy and severe movement restrictions, coupled with a ring vaccination of radius 25-50 km should result in elimination of disease (Carn, 1993). Antibiotic coverage should be given to all diseased animals to control the secondary bacterial infection. To

reduce respiratory symptoms, nostrils can be cleaned and washed with a mild solution of potassium permanganate (1:10,000). Respiratory symptoms can be relieved by inhalation of oleum, eucalyptus, or by taking coramine. Antibiotic ointment or powder topically can be effective to the skin lesions (Nandi *et al*., 1999).

Pox virus/vaccines induce strong immunity that may last quite longer as compared to some pathogens through involvement of both cellular and humoral immune effectors (Panchanathan *et al.,* 2008).

Antibody responses to highly pathogenic SPP or highly pathogenic GTP viruses are elicited by the attenuated KS-1 vaccine. However, the attenuated vaccine does not always produce detectable neutralizing antibody responses in ovine and caprine (Bowden *et al.,* 2009). Live attenuated vaccine manufacturers recommend an annual vaccination schedule as the recommended duration of protection is 22 months (Kitching, 2003).

An attenuated live goatpox vaccine has been developed by the Indian Veterinary Research Institute (IVRI) and the vaccine is currently undergoing extensive field validation in different parts of the country after successful in-house trials. Laboratory studies have shown that the vaccine provides complete protection against high dose of challenge goat pox virus (GTPV) (Hosamani *et al.,* 2004). Several sheep pox vaccine virus strains are available in India including Roumanian Fanar (RF strain), Srinagar, Jaipur and Ranipet strains. These strains are also used for vaccine production and their subsequent field application (Bhanuprakash *et al.,* 2006a). The Government of India also authorized the use of a heterologous vaccine (GPV-based) against LSD in cattle (Abutarbush *et al.,* 2018). The National Centre for Veterinary Type Cultures in Hisar (India), in collaboration with the Indian Veterinary Research Institute in Izatnagar (India) has developed a homologous live-attenuated LSD vaccine, named Lumpi-ProVacInd. The virus used for developing the vaccine was isolated from skin scab collected from naturally LSDV-infected cattle from Ranchi (India) in 2019 (Kenyan-type LSDV strain). The virus was attenuated by continuous cell culture passaging in Vero cells (Kumar and Tripathi, 2022).

CONCLUSION

Healthy Livestock is one of the most affordable and sustainable ways to improve the lives of smallholders and poor rural communities. The outbreak of these disease causes economic devastation in livestock industry. These diseases are of important concern as most of the countries have agriculture based economy and small ruminants are particularly important for bringing up in gender equality. Hence there is a need for prevention and control of these disease.

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