



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(7): 2468-2472
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www.thepharmajournal.com

Received: 20-04-2023

Accepted: 24-05-2023

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Study of an epidemic of sheep pox and foot rot in indigenous sheep of Karnataka

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Abstract

Sheep pox, caused by a poxvirus, is an extremely contagious illness that affects sheep. Among all the animal pox diseases, it is considered the most severe. The disease carries substantial economic implications as it can lead to reduced quality of wool and leather, impacting the financial aspects of sheep farming. It is prevalent in various regions across the globe, including India, where it is considered endemic. An epidemic of sheep pox, accompanied by foot rot, was detected in indigenous sheep of Karnataka, resulting in the infection of a significant number of animals. Upon the observation of high mortality rates, accompanied by symptoms such as nasal discharge, ocular discharge, dyspnea, lameness, and widespread skin lesions throughout multiple villages in the district, an investigation team was promptly dispatched to investigate the situation. The investigation was conducted with the objective of assessing the severity of the infection, determining its causative factors and risk elements, and recommending control and preventive measures to halt the further transmission of the disease. The infected animals showed high fever, anorexia, mucopurulent ocular and nasal discharges, swollen eyelids, papules and necrotic skin lesions. During the post-mortem examination, pock lesions were observed, which were found to be distributed uniformly and in a focal manner throughout the lungs. The lameness observed was attributed to the acute inflammation affecting the skin and surrounding soft tissues of the interdigital space. In addition to lameness, there was swelling and, in the majority of cases, a malodorous necrotic lesion present on the interdigital skin. In the current study, the morbidity rate was recorded at 28%, indicating the proportion of individuals affected by the disease. The mortality rate stood at 8%, representing the proportion of individuals who succumbed to the illness. Furthermore, the case fatality rate was determined to be 30%, denoting the percentage of fatal incidences of the total number of diagnosed cases. Incidence of morbidity and mortality was found to be higher in lambs compared to adult sheep. The possible sources of transmission of the epidemic infection were attributed to mixing of animals from different flocks or villages during grazing activities, as well as through direct contact with sick or deceased animals. The indirect transmission of the infection could have occurred because of the open-air disposal of dead animals. Additionally, the lack of vaccination as a preventive measure served as a contributing factor to the severity of the outbreak.

Keywords: Sheep pox, foot rot, outbreak, Karnataka

Introduction

Sheep pox is an acute disease affecting mainly sheep and also goats. It is characterized by symptoms such as high temperature, the presence of generalized papules or nodules on the skin, occasional development of vesicles, internal lesions (especially in the lungs), and a high risk of mortality leading to death. (WOAH). This highly contagious and devastating viral disease is prevalent in various regions around the world (Aiello and Moses, 2016) [1]. India has also experienced several outbreaks of sheep pox in the recent times. (Roy *et al.*, 2008; Bhanuprakash *et al.*, 2010; Manjunath reddy *et al.*, 2017; Rather *et al.* 2020) [13, 5, 9 11]. The disease is caused by the sheep pox virus, which belongs to the Capripox genus within the Poxviridae family. Among all the animal pox diseases, sheep pox virus (SPV) is the most severe and can have substantial economic consequences due to its adverse effects on wool and leather quality. (Tulman *et al.*, 2002) [14]. In recent years, sheep pox has been primarily reported from regions in Asia and Africa. The transmission of the sheep pox virus occurs through various routes, including close contact between infected and susceptible animals, through aerosols (airborne particles containing the virus), or indirectly through contaminated feed and water sources. (Yune and Abdela, 2017) [15]. The sheep pox virus can remain viable for extended periods, even up to several months, on wool or dried scabs.

This ability to persist on such surfaces contributes to its potential for transmission and poses a risk for disease spread in susceptible populations. The incubation period of sheep pox typically ranges from 8 to 13 days, although it can extend up to a maximum of 21 days. During this period, the infected animals may not show any visible signs of the disease, making it challenging to detect and control its spread. (Qurat *et al.*, 2019) [12]. It is one of the major viral diseases of sheep and goats, with high morbidity (Bhanuprakash *et al.*, 2010) [5] and considerable mortality of 70-90% (Manjunathreddy *et al.*, 2017) [9], which can also approach 100% (Haegeman *et al.*, 2016) [7]. Sheep are the primary host of the sheep pox virus, and all age groups are equally susceptible to the disease. However, young lambs are particularly at a higher risk of death compared to older animals. This increased vulnerability in young lambs may be attributed to their developing immune systems and reduced ability to cope with the severe effects of the infection. (Kamran Mirzaie *et al.*, 2015) [8].

Foot rot, also known as infectious pododermatitis, is a hoof infection frequently observed in sheep, goats, and cattle. This condition primarily affects the area between the two toes of the affected animal, causing decay or rotting of the foot. It is highly painful and easily transmissible between animals. Treatment typically involves a series of medications; however, if left untreated, the entire herd can become infected. The present paper deals with an epidemic of sheep pox with foot rot in native sheep in Karnataka, which has caused a heavy death toll of 35 animals in a district in Karnataka.

Methods

During February 2018, several villages of Sira taluk, Tumkur district, Karnataka State reported the epidemic of sheep pox in indigenous breeds along with lameness. The investigation team had a discussion with the farmers and the administrators at the Veterinary Hospital before visiting the flocks. Later the team visited the affected areas of the district to chalk out the contributing risk determinants associated with the present outbreak. Flock to flock investigation was carried out in several affected villages of the district by a team of veterinarians from Institute of Animal Health and Veterinary Biologicals. A detailed discussions were held with the animal owners to collect the data as there were no written records maintained. After the initial descriptive investigation, a case-control study was conducted to determine the causal factors involved with the disease. In this study, a case was defined as a sheep exhibiting any symptom of sheep pox, such as a high temperature exceeding 104 °F, necrotic skin lesions, the presence of papules, vesicles or nodules on the body, mucopurulent nasal or ocular discharges, and swollen eyelids. The flock owners were interviewed and questioned about various factors, including the number, age, and gender of the animals, vaccination history, feeding patterns, as well as any history of animal introduction or migration. This information aimed to identify potential factors that may have contributed to the spread and severity of the disease.

Data Collection

To identify the causal factors involved with sheep pox, clinical examinations were conducted on the affected animals. A total of six flocks from four villages in the affected areas were investigated. The attack rate (AR), mortality rate (MR), and case fatality rate (CFR) were computed for each flock. The attack rate represents the risk of contracting the disease

during a specific period, typically the duration of an outbreak. It is calculated as the proportion of animals that develop the disease among the total number of animals at risk.

The mortality rate is the proportion of animals that died from sheep pox among the total number of animals at risk.

The case fatality rate is the proportion of animals that died due to sheep pox among the animals that developed pox symptoms, as defined in the case definition.

By calculating these rates for each flock, valuable insights can be gained regarding the spread and impact of the disease, helping to identify potential contributing causal factors associated with sheep pox.

Results and Discussion

Clinical observations and post mortem findings

The clinical manifestations in affected animals were high temperature (105 to 106 °F), nasal discharge, ocular discharge, swollen eyelids, coughing, dyspnea/abdominal respiration and pock lesions on the face (Fig. 1), ears, axillary region, groin, tail, inguinal region and all over the body (Fig. 2). A few animals were also showing pock lesions inside the oral cavity (Fig. 3). Most of the animals were limping on one or more feet. On examination, the legs were swollen and there were severe inflammation and open wounds between the toes with maggots (Fig. 4). The nasal discharge, skin scabs/swabs and hoof swabs were collected for further analysis. In most of the flocks farmer had got the animals vaccinated with live attenuated sheep pox vaccine after the disease outbreak. The affected animals were managed with Enrofloxacin/Amoxicillin and cloxacillin combinations, Anti histamines and liver tonics. The skin scabs and foot lesions were collected for laboratory analysis. In one village owner had segregated the affected animals. Necropsy of the dead animal showed pock lesions in the lungs (Fig. 5). Similar observations were also reported by Roy *et al.* (2008) [13] in sheep pox who found high fever, off feed, respiratory discomfort, mucopurulent nasal discharge in most of the cases. They had also observed diarrhea in few cases. They also observed skin lesions mainly around nostrils, eyes, lips, ears and in the abdomen. Their observations on necropsy were severe nodular lesions in the lungs and intestine. Rather *et al.* (2020) [11] observed skin lesions which included erythematous macules which progressed to hard papules in most of the animals. In their study erythematous macules were observed all over the body. However they noticed skin lesions centralized in wool less parts like ears, eyelids, muzzle, axillae, vulva, mammary gland, inguinal area and anus. They also noticed oral and nasal lesions leading to anorexia, rhinitis and pneumonia.



Fig 1: Pox lesions on the face



Fig 2: Pox lesions all over the body



Fig 3: Pox lesions inside the oral cavity



Fig 4: Inflammation and open wounds between the toes



Fig 5: Pox lesions on the lungs observed during post mortem

Morbidity, Mortality and case fatality rates

A total of six flocks from four villages having 590 animals were investigated from the affected areas. It was learnt that the animals in the affected area were not vaccinated against sheep pox earlier. The morbidity, mortality and case fatality rates in the present study were 28%, 8% and 30%, respectively and are presented in Table 1. The morbidity, mortality and case fatality rates were higher in young animals than adult animals. Rather *et al.* (2020) [11] reported a

morbidity, mortality and case fatality rate of 35.50, 4.31 and 13.26%, respectively among cross bred sheep of Kashmir valley due to sheep pox. Bhanuprakash *et al* (2010) [5] reported morbidity and mortality rates, respectively, of 100% and 53.9% in local Muzaffarnagari sheep breed during 2008. Similarly, Roy *et al* (2008) [13] recorded adult mortality rate ranging from 2.66% to 37.5% and lamb mortality rate ranging from 10% to 17.33% in Madras Red and Mechery breeds of indigenous sheep on three farms in Tamil Nadu.

Table 1: Morbidity, mortality, case fatality rate, sample collected and results of PCR in outbreak of sheep pox.

Flock	Village Name	Age	Total no. of animals	No. infected	Morbidity	Deaths	Mortality	CFR	Samples collected	Result
Flock 1	Gollarahatti village	Adults	30	5	17	2	7	40	Skin scab	Positive
Flock 2	Mudigere Village	Adults	70	23	33	12	17	52	Skin scab Hoof swab Nasal swab	Positive Positive Negative
		Lambs	20	12	60	6	30	50	Skin scab	Positive
Flock 3	Mudigere village	Adults	20	17	85	5	25	29	Skin scab	Positive
		Lambs	15	13	87	10	67	77	Skin scab	Positive
Flock 4	Rangapura Village	Adults	90	5	6	0	0	0	Skin scab	Positive
		Lambs	30	12	40	2	7	17	Skin scab	Positive
Flock 5	Rangapura Village	Adults	65	15	23	3	5	20	Skin scab	Positive
Flock 6	Doddabanagere Village	Adults	250	62	25	10	4	16	Skin scab Hoof swab	Positive Positive
		Total	590	164	28	50	8	30		

*Skin scabs and nasal swab was tested for sheep pox and hoof swabs were tested for *Fusobacterium necrophorum*.

Laboratory findings

The clinical signs were sufficient enough to diagnose the disease as sheep pox. Further skin scabs/swabs collected from all the above flocks during investigation tested positive for sheep pox virus by capripox-specific conventional PCR targeting P32 envelope protein gene. The hoof swabs tested positive for *Fusobacterium necrophorum* by species specific PCR.

Sheep pox being highly contagious farmers were advised to separate the affected/ailing animals from the healthy flock immediately and to take care of ailing animals with respect to feeding. The animals were already under treatment with enrofloxacin/amoxicillin and cloxacillin, antihistamines and liver tonics. The farmers were advised to continue with the treatment. In untreated flocks, treatment of ailing animals with sensitive antibiotics (β lactam antibiotics with metronidazole), antihistamines, antipyretics and other supportive therapy was suggested. It was also suggested to take up ring vaccination of all healthy animals above 3 months of age in the surrounding area (3-5 km radius) with live attenuated sheep pox vaccine using separate sterile needle for each animal by sub cutaneous route and to monitor the vaccinated animals as the vaccine produces thermal and local reactions. It was also advised to maintain the cold chain of the live attenuated sheep pox vaccine to maintain the efficacy of the vaccine. It was also strictly recommended to carry out sheep pox vaccination as a prophylactic measure during the period of Sept-Oct every year as the area was endemic for sheep pox. For the animals suffering from foot rot it was also suggested to dip the feet in copper sulphate solution along with β lactam antibiotics and metronidazole. The farmers were educated to introduce new animals to the flock only after initial quarantine period of at least three weeks. Good management practices such as avoiding overcrowding, maintaining hygienic conditions, providing good nutritious feed and regular de-worming were advised.

In the present investigation, by considering previous studies we concluded that sheep pox remains endemic in the district and cases/epidemics arise mainly during the winter season. Literature also shows that disease is more prevalent during the winter and autumn season (Manjunathreddy *et al.*, 2017; Authie *et al.*, 2014) ^[9, 3]. Mixing of animals from different flocks/villages during grazing/direct contact with sick or dead animals were the probable sources of direct spread of disease. The indirect transmission of disease could have happened through open air disposal of dead carcasses. Similar findings were reported by several other authors in and outside India (Al-shabebi *et al.*, 2014; Yune *et al.*, 2017; Moustafa

Kardjadj, 2017; Ben Chehida *et al.*, 2018) ^[2, 15, 10, 4]. Vaccination on the face of outbreak and no/low vaccine coverage as a prophylactic measure also contributed to the spread of disease.

To conclude, the current study has emphasized the susceptibility of native sheep from Karnataka state to sheep pox and foot rot with different symptoms and lesions emerging during the development of the disease. The disease can effectively be controlled with vaccination and awareness programmes.

Acknowledgements

Authors acknowledge the support provided by Dept. of Animal Husbandry and Veterinary Services, Karnataka, during disease investigation.

Conflict of Interest

The Authors declare that there is no conflict of interest

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