

An Outbreak of Mixed Sheep Pox, Pulmonary Adenomatosis and Worm Infections in an Organized Sheep Farm of Andhra Pradesh

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Abstract

Sheep pox is a highly contagious viral disease of sheep and caused by sheep pox virus. In present outbreak, more than 100 sheep out of 250 sized flock in the farm started showing symptoms of anorexia, dull, and depression, conjunctivitis, lacrimation, and nasal secretion. Young lambs exhibited severe pneumonic symptoms. A total of fifty-one sheep of different age groups died with a mortality of 19.9% and a morbidity of 32.4%. Grossly the affected sheep showed small circumscribed necrotic lesions and scabs surrounded by areas of edema and congestion under the abdomen, perineum and back of the body. Lungs in all the cases were congested, having pale whitish pock nodules on the surface and cranial lobes were hard with meaty appearance upon cut section in few cases. Bronchioles were dilated and contained frothy fluid. Histopathologically, pulmonary lesions showed characteristic sheep pox lesions with sheep pox cells in all the cases and in few cases it is mixed with lesions of pulmonary adenomatosis. Rumen and caecum revealed flukes and caecal worms, respectively. Based on the findings, the outbreak was confirmed as systemic sheep pox disease mixed with pulmonary adenomatosis and worm infections.

Keywords: Andhra Pradesh, Outbreak, Pulmonary Adenomatosis, Sheep Farm, Sheep Pox, Worm Infections

Introduction

Among various infectious diseases affecting sheep, sheep pox (SP) considered to be economically more important due to massive mortality, abortions and loss of market value of affected animals (Saminathan *et al.*, 2016; OIE, 2018). The SP is a malignant contagious viral disease of sheep caused by a sheep pox virus, belongs to the genus *Capri poxvirus* in the family Poxviridae. Prevalence of sheep pox in India ranges between 0-22.2% based on various agro-climatic zones (Hota *et al.*, 2018). Severity of the disease depends on the species susceptibility, breed, age, virulence, and strain (Dharanisha *et al.*, 2020; Sumana *et al.*, 2020). It affects all the age groups of sheep, but more severe in lambs with mortality reaching 50-100%. The disease has been continuously recorded every year in some pockets of India despite of the availability of good vaccines to control (Dharanisha *et al.*, 2020; Sumana *et al.*, 2020). Clinically, the disease is characterized by generalized cutaneous vesicles and pocks (hard nodules) on the head, neck, chest, legs, hocks, and in the lungs in case of systemic infections (Dharanisha *et al.*, 2020). In addition to pock lesions, abortion and mastitis are the other symptoms in the adult ewes were reported (Jones *et al.*, 1997; Bhanuprakash *et al.*, 2005). The most prominent pathological changes are accumulation of sheep pox cells (SPCs) or Cellules Claveleuses of borrel, and inflammatory cells in the affected parts of the skin, respiratory tract and other sites. The SPCs had a distinctly vacuolated nucleus, marginated chromatin and occasionally showed granular intracytoplasmic inclusions (Gulbahar *et al.*, 2006; Chanie, 2011). The present study describes an outbreak of sheep pox and pulmonary adenomatosis in a private organized sheep farm in the Rayalaseema region of Andhra Pradesh, India.

Materials and Methods

History of the Farm

The private sheep farm is located nearly five kilometers away to the Livestock Research Station, Mahanandi, Andhra Pradesh. The farm maintains 250 Nellore brown and Jodipi breeds in an elevated sheep shed with complete intensive system of rearing. They were following regular deworming and vaccination schedule for the year as suggested by the local Veterinarian except sheep pox, even though it is due of the season. Authors invited to visit the farm for investigating the cause of morbidity and mortality. Farm premises and management practices were relatively good and following mixed feeding practices with the available silage, groundnut hay and concentrate feed. Ailing animals were dull, depressed, anorectic with nasal discharges, and lying down on the floor of the elevated shed. All the sick animals were kept in a separate compartment of the same shed.

History of the Outbreak

Eight adult ewes were died suddenly, followed by twelve, thirteen, and eighteen sheep of different age groups in subsequent days. A total of fifty-one sheep died within 7 days after appearance of first clinical sign in the farm. Out of these, twelve sheep were received for postmortem examination to the Livestock Research Station, Mahanandi, Andhra Pradesh. Detailed necropsy was conducted with a prior collection of the full history of the farm, rearing methods, and pattern of mortality.

Sample Collection and Processing

The carcasses were carefully examined, the gross changes in various organs were recorded, and representative tissue samples were collected in 10% formalin for histopathological examination. Samples were processed by routine paraffin embedding technique, sections of 4-5 micron thickness were cut and stained as per the standard method (Luna, 1968). Caecal contents were filtered and collected the *Trichuris* spp. worms, washed several times in water, and preserved in 70% alcohol. Caecal contents were observed under the microscope for the presence of whipworm eggs.

Results and Discussion

Clinical history revealed that more than 100 sheep out of 250-sized flock in the farm started showing symptoms of anorexia, dull, depression, conjunctivitis, lacrimation, and nasal secretion. Young lambs exhibited severe pneumonic symptoms.

A total of fifty-one sheep of different age groups died with a mortality of 19.9% and a morbidity of 32.4% (Table 1). Out of these, twelve sheep were received for postmortem examination to the Livestock Research Station, Mahanandi, Andhra Pradesh (Table 2). Gross appearances of the carcasses were emaciated, and skin under the abdomen, perineum, ears and back of the body showed small circumscribed necrotic lesions and scabs surrounded by areas of edema and congestion (Figs.1&2).

Table 1: The percentage of morbidity and mortality among different age groups

S. No.	Category of the sheep	Total number	Morbidity	Mortality
1	Adult ewes	110	38 (34.5%)	21(19.0%)
2	Breeding rams	14	9 (64.2%)	5(35.7%)
3	Male young stock	66	13 (19.7%)	10(15.1%)
4	Female young stock	28	16(57.1%)	11(39.2%)
5	Lambs	38	7(18.4%)	4(10.5%)
	Total	256	83(32.4%)	51(19.9%)

Table 2: Various infections occurred during post mortem examination

S. No.	Type of infection	Total number of cases
1	Total number of sheep received for post mortem examination	12
2	Sheep pox lesions observed	12
3	Pulmonary adenomatosis along with sheep pox lesions	5
4	Mature <i>Paramphistomes</i>	7
5	<i>Trichuris</i> worms	6



Figure 1 and 2: Skin showed small whitish circumscribed scab lesions under the abdomen, surrounded by the areas of oedema and congestion

The lungs were severely congested with whitish pock nodules on the surfaces of all the lobes of both lungs in the majority of the cases (Chanie, 2011; Dharanesh *et al.*, 2020) (Figs. 3&4).



Figure 3 and 4: Lungs showed consolidated grayish small pock nodules on the gross and cut surfaces.

Both the sexes of age between six months to three years were equally affected (Manimaran *et al.*, 2016). Bronchioles were dilated and contained frothy fluid, and it is extended up to the trachea. Mature *Paramphistome* spp. flukes were observed in rumen of few adult sheep (Fig. 5). Mesentery in the majority of the cases were congested.



Figure 5: Rumen showed the presence of *Paramphistome* spp. on the mucosa.

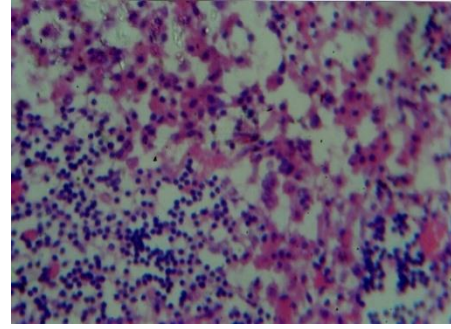


Figure 6: Lung showed infiltration of inflammatory cells and lymphocytes in the inter alveolar space along with sheep pox cells. H&E X100.

Histopathologically, lungs showed proliferative bronchiolitis and alveolitis giving the appearance of gland like structure. Alveoli, peribronchial and perivascular spaces contained eosinophilic material with neutrophils, mononuclear cells especially macrophages, sheep pox cells and karyorrhectic cellular debris (Figs. 6 and 7). The similar findings were also reported in earlier studies (Gulbahar *et al.*, 2006, Parimol *et al.*, 2008, Sary *et al.*, 2009; Chanie, 2011). The sheep pox cells had a vacuolated nucleus and marginated chromatin with occasional granular intracytoplasmic eosinophilic inclusions. The cytoplasm of bronchiolar epithelial cells also has eosinophilic inclusion bodies (Parimol *et al.*, 2008; Sary *et al.*, 2009). The inflammatory nodules revealed coagulative necrosis of the lobular tissue and serous exudates in alveolar spaces. Mild hyperplasia and degeneration of the epithelium of the trachea were also observed. In two cases, bronchi and bronchioles revealed the desquamation of epithelial cells with various inflammatory cells (Parimol *et al.*, 2008) (Fig. 8).

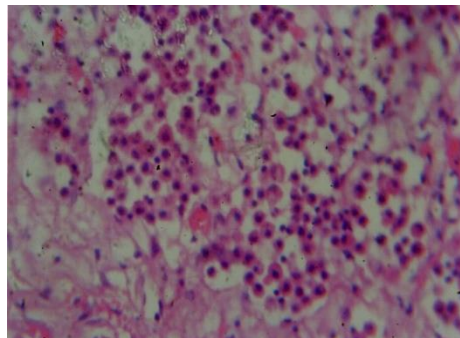


Figure 7: Lung showed severe infiltration of sheep pox cells in alveolar spaces and focal areas of congestion. H&E X100.

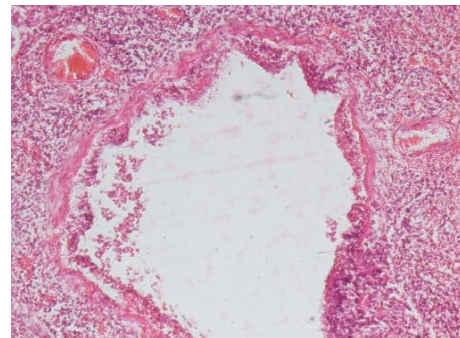


Figure 8: Lung showed dilatation of bronchiole with proliferation of bronchiolar epithelial cells, peribronchial infiltration of inflammatory cells and congestion of alveolar vessels. H&E X100.

In two adult ewes, apical lobes were enlarged with consolidation and appear darker than the adjacent healthy tissue. On cut section, small granular and coalescing firm grey nodular lesions giving rise to the characteristic meaty appearance of pulmonary adenocarcinoma was observed and it usually seen in the aged sheep (Hera *et al.*, 2003; Summers *et al.*, 2012; Naik *et al.*, 2015; OIE, 2018) (Fig. 10).



Figure 9 and 10: Cut surface of apical lobe of lungs showed dark, gray and whitish small coalescing granular lesion with meaty appearance.

Histopathologically, terminal bronchioles and alveoli of apical lobes revealed a characteristic diffuse transformation of thin, normal alveolar epithelium into cuboidal to columnar type and formed a papillary projection with distinctive connective tissue cores giving adenomatous appearance (Figs.11 and 12).

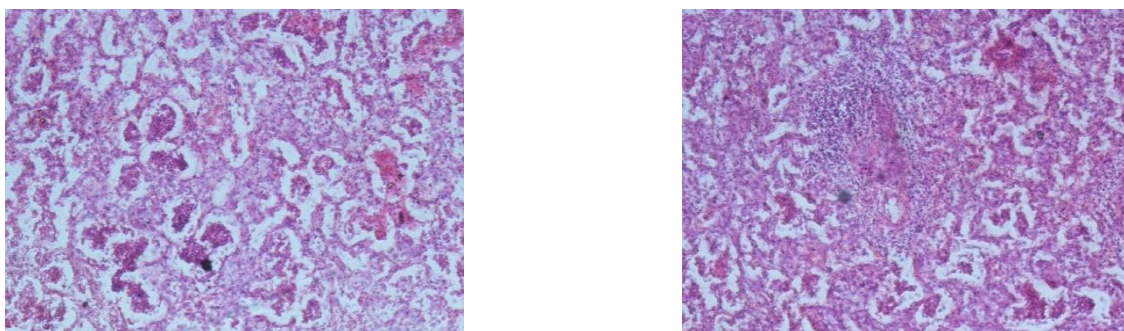


Figure 11 and 12: Lungs showed proliferating alveolar squamous epithelium forming papillary projections into the lumen of alveoli giving the appearance of adenomatosis. Note the infiltration of inflammatory cells in between the alveolar spaces. H&EX100.

Bronchial and bronchiolar epithelial cells were also revealed hyperplastic changes leading to partial obstruction of the lumen. Infiltration of few inflammatory cells in the interalveolar septa was observed. Congestion of alveolar vessels was also observed. No metastatic lesions were observed in the bronchial lymph nodes (Hera *et al.*, 2003; Naik *et al.*, 2015; Summers *et al.*, 2012; OIE, 2018). Even though all the sheep were maintained in an elevated shed, some of the sheep on postmortem examination revealed *Trichuris* spp. worms in the cecum and proximal part of the colon (Fig.13). Cecal contents were watery with congested mucosa. Fecal contents were found positive for whipworm eggs under microscopic examination (Saminathan *et al.*, 2015; Nazima and Hidayatullah, 2016) (Fig.14).

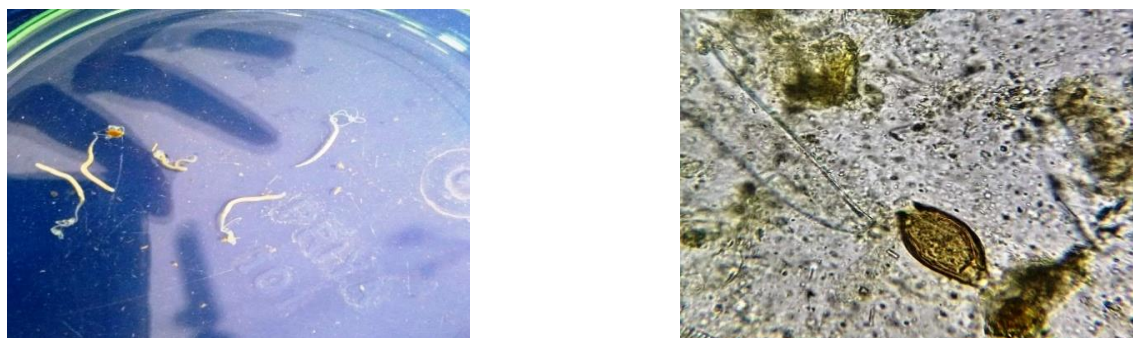


Figure 13 and 14: Note the adult whip worms and whip worm eggs (Barrel-shaped yellowish –brown egg with two polar plugs on either ends).

Farm organizers conveyed that the recent addition of these sheep from the outside farmer flocks as to increase the breeding stock might be the reason for the worm infestation. All these were dewormed with fenbedazole at a dose rate of 10 mg/kg b. wt before they were mixed into the farm stock. Irrespective of deworming, the infection was not completely removed, and it might be due to failure of deworming or might be due to resistance of worms to the drug (Ramandeep *et al.*, 2017).

The present report described the detailed clinical and histopathological changes of mixed infection of systemic sheep pox and pulmonary adenomatosis. The outbreak might be due to non-immunization against the sheep pox in the season and indicates the importance of regular vaccination against the sheep pox in any organized or unorganized field flocks for effective control of the disease. Regular screening of fecal samples is required to know the type of worm burden for the selection of deworming drugs for effective control of worm burden in the flocks.

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Conflict of Interests

There is no conflict of interest.

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