

SUPPURATIVE PNEUMONIA IN AN ORGANIZED SHEEP FARM – DIAGNOSIS AND THERAPEUTIC STRATEGIES

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ABSTRACT

A disease outbreak in lambs occurred in an organized sheep farm located in Siddarampuram village, Anantapur district, Andhra Pradesh, during the winter season (November 2022 to February 2023). Out of a total of 68 lambs born, 12 lambs (17.64%) succumbed within a week, exhibiting clinical manifestations including sudden death, nasal discharges, frothy mouth discharges, fever, shivering, inability to walk, weakness, prostration, and respiratory distress. Gross and post-mortem examinations revealed the lungs as the major affected organs, displaying vascular changes and severe pneumonic alterations with pus discharge, indicative of a septicemic nature of the disease. Escherichia coli was isolated from the collected pus and tissues during the post-mortem examination. The study postulates that a sudden environmental change, coupled with cold stress, frost, and poor ventilation, likely exposed the lambs to E. coli septicemia, predominantly affecting the respiratory system. To address the mortality, amikacin was administered following antibiotic sensitivity tests. This approach successfully checked the spread of the disease. The findings highlighted the significance of environmental factors in disease outbreaks and emphasize the importance of targeted antibiotic treatments for effective control of an outbreak.

Keywords: Antibiotic sensitivity, pneumonia, septicemia, sheep

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INTRODUCTION

Sheep farming faces significant challenges, with lamb mortality being a primary contributor to lowered production and economic losses. A comprehensive

study by Ajoy Mandal *et al.*, (2007) identified various factors responsible for lamb mortality, with pneumonia (31.4%), digestive disturbances (14.6%), endoparasitism (0.5%), starvation (9.6%), septicemia and toxemia (10.1%), accidental causes (2.1%) and undetermined causes (27.2%) playing significant roles.

Notably, septicemia associated with pneumonia emerges as a recurrent concern, particularly during the winter season, as highlighted by Radostits *et al.*

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(2007). The susceptibility of newborn lambs to *Escherichia coli* underscores the multifaceted nature of this challenge. Factors such as high temperature, humidity, overcrowding, dust, contaminated bedding and the licking of perineum and udder by lambs expose them to this organism (Goodwin-Ray *et al.*, 2008; Taylor *et al.*, 2010; Scott, 2011).

This study delves into an outbreak of *E. coli* in lambs during the winter season within an organized sheep farm in Anantapur district, Andhra Pradesh. The research aims to elucidate the dynamics of an outbreak and controlled the infection through the implementation of an effective therapeutic measures. Such investigations are crucial for developing targeted strategies to mitigate lamb mortality and enhance overall sheep farming resilience.

MATERIALS AND METHODS

a) Characteristics of the study area

The study was conducted in Anantapur district, situated in the Rayalaseema region of the Indian state of Andhra Pradesh. As of the 2011 census, it ranked as the largest district in the state with the highest sheep population. Anantapur is known for its arid climate, receiving minimal rainfall of 400 mm until the year 2021. The southern portion of the district features elevated terrain, with plateaus rising up to 2000 ft (610 m). The climate exhibits significant diversity between summer and winter seasons. The mortality rate observed in the Nellore brown lambs during the present outbreak was recorded at 17.64%.

Clinical symptoms included shivering, high fever, nasal discharge, frothy mouth discharge, difficult movement, prostration and sudden death.

b) Post-mortem examination

A meticulous necropsy examination was performed on eight lambs that succumbed during the outbreak. Gross lesions in various organs were documented, and tissue pieces, impression smears and lung pus were collected for bacteriological examination. The samples were forwarded to the Animal Disease Diagnostic Laboratory (ADDL) in Anantapur. Grossly, the lungs exhibited a red to grey color, consolidated consistency and caseous characteristics upon incision. Lesions predominantly affected the cranioventral aspects of the lungs (Fig.1). Histopathologically, suppurative areas were characterized by the infiltration of polymorphonuclear cells, primarily neutrophils, along with a few mononuclear cells in the alveoli, bronchi, and bronchioles (Fig.2). Sloughed epithelial cells and necrotic debris were observed in the bronchi and bronchioles, and bacterial colonies were identified in the alveoli in some cases.

c) Bacterial isolation

Tissue homogenates (20% w/v) were prepared in sterile PBS and inoculated into enriched bovine heart infusion (BHI) broth at 37°C for 48 hours, followed by streaking onto sheep blood agar. The bacterial colonies were further streaked on MacConkey's and eosin methylene blue (EMB) agar for the identification of *E. coli* (Cruickshank *et al.*, 1975).

d) Antibiotic sensitivity assay

Antibiotic sensitivity testing involved the use of antibiotic disks, including cephalosporins (CS), cefalexin (CL), ceftriaxone (CT), cefotaxime (CF), amoxicillin (AM), and amikacin (AK). Disks were placed on the agar after uniformly spreading a suspension of the isolate on the EMB agar plate. The zone of inhibition around the disks was measured using a compact zone scale (Hi media). Results were recorded, indicating whether the organism was susceptible (S), intermediately susceptible (I), or resistant (R) to a particular antibiotic based on the reference values.

RESULTS AND DISCUSSION

Necropsy findings

Upon post-mortem examination, the carcasses displayed weakness, accompanied by mucinous discharges from the nose. The oral cavity exhibited wetness with watery, frothy contents. The lungs were notably congested, presenting severe hemorrhages on both diaphragmatic lobes and filled with fibrinous exudate in the alveoli, as depicted in Fig 1. The trachea exhibited severe congestion with linear hemorrhages, while the bronchi were filled with blood-tinged frothy exudate. The liver appeared congested and slightly enlarged, with highly congested kidneys. The heart and spleen displayed petechial hemorrhages, and the small intestinal mucosa exhibited mild congestion with yellowish mucous mixed contents.

Bacterial isolation

Enriched tissue homogenates and pus discharges were inoculated on to blood agar, revealing medium-sized round, smooth, and whitish-grey colonies. Some of these colonies exhibited partial hemolysis. On EMB agar, the colonies appeared dark greenish with a metallic sheen, as shown in Fig 3. Biochemical tests indicated that the isolates were methyl red positive, indole positive, and citrate negative, tentatively identifying them as *E. coli*.

Antibiotic sensitivity assay

In the antibiotic sensitivity assay, *E. coli* displayed a high susceptibility to amikacin, as depicted in Fig 4. Additionally, it showed intermediate susceptibility to amoxicillin, while demonstrating resistance to cephalosporins, cefalexin, ceftriaxone, and cefotaxime. These results provide valuable insights into the antibiotic profile of the isolated *E. coli* strain, aiding in the formulation of targeted therapeutic interventions.

Respiratory diseases, notably pneumonia, contribute significantly to economic losses in small ruminants, following diarrhoea (Dohare *et al.*, 2013). The vulnerability of lungs to various aggressions is attributed to their anatomical and histological characteristics (Caswell *et al.*, 2007; Belkhiri *et al.*, 2009; Dar *et al.*, 2013). The extensive surface area and delicate vascular bed make the lungs susceptible to infections by diverse pathogens (Caswell *et al.*, 2007). Despite

advancements, pneumonia remains a major limiting factor in animal production in tropical regions (Attoh-Kotoku *et al.*, 2018). In our study, 12 out of 68 lambs (17.64%) succumbed within a week, exhibiting clinical signs such as sudden death, frothy mouth and mucinous nasal discharges, pyrexia, shivering, inability to walk, and prostration. Stress, poor air quality, and adverse weather conditions were identified as potential contributors to the development of the disease (Wassmuth, 2003; Turkson and Sualisu, 2005). Lungs and the trachea emerged as the primarily affected organs, resulting in substantial mortality. Subsequently, antibiotics including cephalosporins, cefalexin, ceftriaxone, and cefotaxime were attempted but yielded unsatisfactory results. Based on antibiotic sensitivity tests, amikacin at 15 mg/kg/day, administered intramuscularly, in combination with amoxicillin at 10 mg/kg body weight, intramuscularly, every 12 hours for 5 to 7 days, demonstrated significant progress, complemented by supportive treatment with normal saline, Ringer's lactate, B-complex injections, and oral antioxidants.

Pneumonia is acknowledged as a disease complex, involving interactions between host factors (immunological, physiological), multiple etiological agents (viral, bacterial, mycoplasmal, parasitic, etc.), and environmental factors such as temperature, humidity, and dust levels (Taylor *et al.*, 2010; Dar *et al.*, 2013). *E. coli* has been identified as a key cause of septicaemia in lambs (Raji *et al.*, 2000; Ertan, 2006; Lacasta *et al.*, 2008). Our study

aligns with previous findings, where *E. coli* was isolated from various pneumonia types, emphasizing its role in lamb health (Ertan, 2006). Septicaemic processes originating in respiratory organs were notably high (44%) in lambs exposed to cold stress and kept in poorly ventilated pens (Sonwane *et al.*, 2012). Recent research also reported *E. coli* isolation from pneumonic lungs and septicemia cases (Lacasta *et al.*, 2008).

Suppurative pneumonia identified in our study was of the acute type, indicating likely exposure to stress factors such as long transportation under poor conditions, overcrowding, sudden climate changes during transit, unrest in the lairage, and insufficient feed and water provision. Predisposing viral infections of the respiratory system, including parainfluenza-3, adenoviruses, and respiratory syncytial virus, are widely accepted as contributing factors to bacterial pneumonia (Caswell *et al.*, 2007; N'jai *et al.*, 2013). The severity of neutrophilic exudates within airspaces, corresponding with the findings of Foggie *et al.* (1976), and enhanced infection due to co-infection with *M. haemolytica* (Glimour *et al.*, 1982; Sheehan *et al.*, 2007), underscores the complexity of pneumonia pathogenesis.

Amikacin sulphate injection, an aminoglycoside antibiotic, demonstrated efficacy in the short-term treatment of serious infections caused by Gram-negative bacterial septicaemia, including *Pseudomonas sp.*, *Escherichia coli sp* and indole-positive *Proteus sp.* (Safdar *et al.*, 2004). Amikacin is an aminoglycoside antibiotic that exerts its antimicrobial activity

by binding to the 16S rRNA of the 30S ribosome, leading to the inhibition of protein synthesis in bacterial cells. It primarily acts on aerobic Gram-negative bacteria, including *Escherichia coli* particularly against multidrug-resistant *E. coli* strains that may be resistant to other antibiotics (Prescott *et al.*, 2020). When administered intravenously or intramuscularly, amikacin is rapidly absorbed and distributed throughout the body. It penetrates well into various tissues and fluids, including the pleural and peritoneal cavities, and achieves therapeutic concentrations in the lungs (Giguère *et al.*, 2006). The dosage and administration of amikacin in lambs with *E. coli* infection depend on the severity of the infection, the weight of the lamb, and the individual response to the medication. Typically, amikacin is administered intravenously or intramuscularly at a dose of 10 to 15 mg/kg body weight, administered every

8 to 12 hours (Plumb, 2018). Amikacin has been shown to be effective in treating *E. coli* infections in lambs. Studies have demonstrated significant improvement in clinical signs, decreased mortality rates, and reduced bacterial shedding in lambs treated with amikacin compared to untreated lambs or lambs receiving other antibiotics (O'Brien and Hinchliffe, 2001; Gupta and Datta, 2004).

CONCLUSION

Our findings highlight the importance of a comprehensive understanding of the multifactorial nature of pneumonia in lambs and underscore the significance of targeted therapeutic approaches for effective management. It was concluded that antibiotic amikacin successfully reduced the mortality rate in suppurative pneumonia affected sheep.

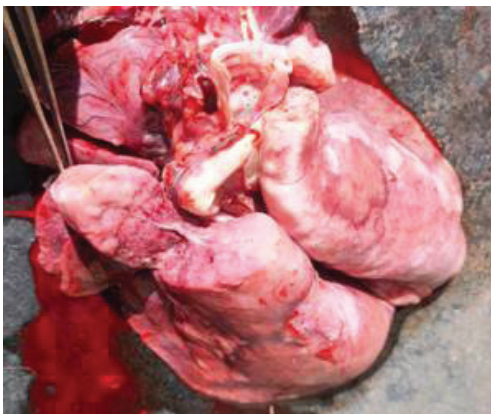


Fig.1. Oozing of pus from the cranioventral aspects of the affected lungs

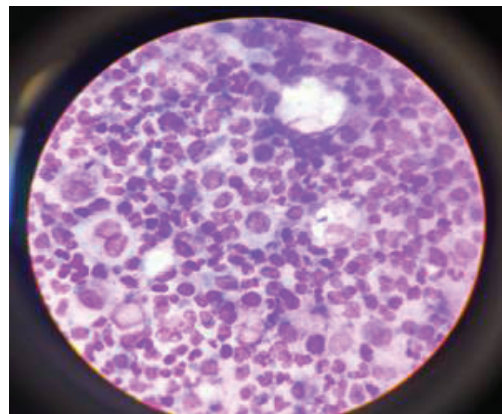


Fig.2. Polymorphonuclear cells in the smear taken from affected alveoli

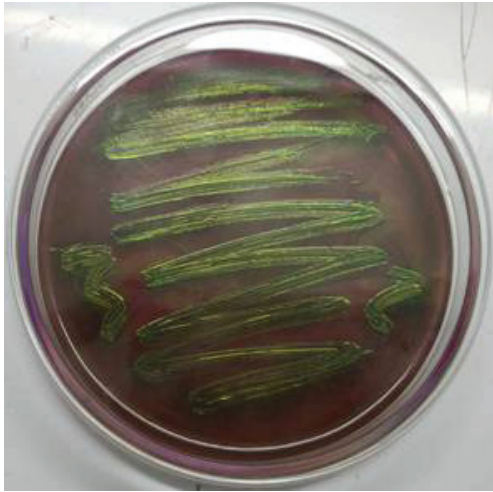


Fig.3. The colonies appeared dark greenish with a metallic sheen on EMB agar

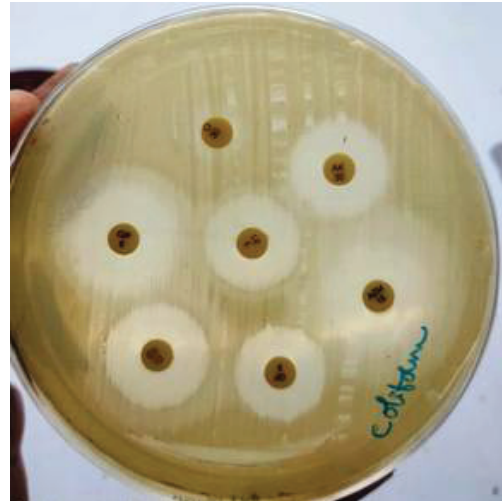


Fig.4. Antibiotic sensitivity assay

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