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Clinicopathological Manifestations of Contagious Bovine Pleuro-Pneumonia in a Herd of Sokoto Gudali Heifers

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ABSTRACT

Contagious bovine pleuro-pneumonia (CBPP) is an endemic disease in Nigeria, mostly affecting cattle. Despite the endemic status of CBPP in Nigeria, there is a dearth of information on the clinicopathological manifestations of the disease in Sokoto Gudali breed of cattle, hence the need to highlight our findings in this report. The carcass of 11-month-old Sokoto Gudali heifer was presented for necropsy with a history of respiratory distress amongst the herd. A detailed postmortem examination was conducted, and representative tissue sections collected for histopathologic tissue processing. Swabs of the lung tissue and pleural effusion were also collected for bacteriology. A farm visit to assess and manage the disease within the herd was also carried out. Nasal swabs and blood samples were also collected for bacteriological and haematological analyses. Necropsy revealed marked fibrinous effusion in the pleural cavity, fibrinous consolidation of the left lung, and chronic pneumonia of the right lung. Clinical observations of the herd made on farm visit included emaciation, cough, nasal discharge, anorexia and fever in some of the heifers. Haematological analysis of the blood samples revealed anaemia and leukopenia due to neutropenia. Histopathological analysis of samples from the left lung revealed acute fibrinous pleuro-pneumonia whereas analysis of the right lung revealed chronic interstitial pneumonia. Microbial culture of the pleural effusion and nasal swab yielded growths of *Mycoplasma mycoides* subspecies *mycoides* (*Mmm*) colonies. Consequently, the sick heifers were culled while others were treated with enrofloxacin and tetracycline injections. The burden of CBPP in cattle in Nigeria is enormous and discourages investments in the livestock sector thereby thwarting efforts to meet the protein requirements of the growing population.

Keywords: Cattle; CBPP; Fibrinous pneumonia; Hydrothorax

INTRODUCTION

Contagious Bovine Pleuropneumonia (CBPP) is an endemic disease in Nigeria, caused by Mycoplasma mycoides subspecies mycoides (*Mmm*) and mostly affects cattle (Musa *et al*., 2016). The disease manifests clinically as respiratory distress and pathologically as fibrinous pleuropneumonia (Anjum *et al*., 2020; Di-Teodoro *et al*., 2020), which are highly suggestive of the disease. However, confirmation of CBPP is based on isolation and identification of the causative agent, and molecular detection of CBPP antigen in tissues of affected cattle (Gull *et al*., 2013; Ikpa *et al*., 2020). Treatment of the disease, especially in endemic regions is mostly with the use of Tylosin whereas prevention is by vaccination (Alhaji *et al*., 2020).

Despite the crippling economic losses experienced by cattle owners due to CBPP in Nigeria (Anyika *et al*., 2021) and the disease being one of the reportable diseases of cattle (WOAH, 2020), it is grossly underreported, especially in the Federal Capital Territory (FCT) and therefore the impact of the disease in cattle is not fully understood. Also, the clinicopathological manifestations of the disease in Nigerian indigenous breeds of cattle are not well documented, hence the need for this report. Therefore, this report describes the clinicopathological manifestations of CBPP in a herd of Sokoto Gudali Heifers in an integrated farm in Kwali Area Council, Federal Capital Territory (FCT), Nigeria.

Description of the Case

History of the case

The manager of an integrated cattle farm in Kwali, FCT, Nigeria, presented a carcass of 11-month-old Sokoto Gudali heifer to the Necropsy Unit of the Veterinary Teaching Hospital (VTH), University of Abuja. The chief complaint was persistent respiratory distress for about two months before death, which was also observed in some other members of the herd.

The heifers were bought into the farm in two batches between June and July, 2023, and sourced from different cattle markets in Northern Nigeria with no health or vaccination records. A week after they were introduced into the farm, one of the heifers showed signs of respiratory distress which culminated in death. Postmortem examination of the carcass revealed lesions suggestive of CBPP such as hydrothorax, fibrinous covering of parts of the lungs, marbling, red and grey hepatization (Figure 1a), and petechiation and echymosis of the coronary fat (Figure 1b). Consequently, the client was advised to cull the herd based on a tentative diagnosis of CBPP. However, the client opted to treat the herd with Tylosin.

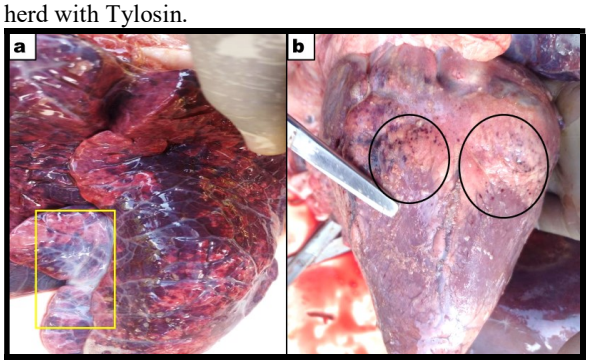

Figure 1: Lungs of a heifer from a herd of cattle diagnosed of contagious bovine pleuro-pneumonia. **a.** Note the fibrinous covering of the affected part of the right cranial and diaphragmatic lobes (rectangle) with typical marbling, and red and grey hepatization. **b.** Note the petechiation and ecchymosis of the coronary fat (circles).

Three weeks prior, the heifer showed severe signs of respiratory distress, emaciation, diarrhea and was first treated with Tylosin for 3 days and switched to Enrofloxacin for 5 days, yet there was no favourable response to treatment. The heifer appeared weak which necessitated infusion with lactated ringer's solution. However, the heifer died during treatment. A few other heifers were reported to be anorexic and had respiratory distress.

Postmortem Evaluation

Postmortem examination of the carcass was conducted as described by Gull *et al*. (2013). The carcass was fresh and in fair body condition. The ocular and oral mucous membranes were pale. The eyeballs were sunken. The subcutaneous fat of the thoracic and abdominal regions was dark yellow and gelatinous.

The thoracic cavity was filled with straw-coloured fibrinous effusion (7.5 L) while the thoracic lymph nodes were enlarged, congested and oedematous. The entire length of the tracheal mucosa was yellow while the mucosa of the posterior end of the trachea (close to the bifurcation of the bronchi) showed petechial haemorrhages. The left lung revealed yellowish fibrinous thickening of its pleura which was loosely adherent to the parietal surface of the left thoracic cage and diaphragm (Figure 2a). The cut surface of the left lung showed red to grey discolouration with widespread tan pitted foci (Figure 2b). The middle, caudal and accessory lobes of the right lung were pale and firm while the cranial lobe was congested and had prominent interlobular septa. The peri-renal fat was dark yellow and gelatinous. The pericardial sac was opaque while the heart chambers contained currant jelly clots.

Tissue samples taken from both lungs were fixed in 10% neutral buffered formalin and processed for histopathological evaluation. Also, swabs of the effusion and lung were taken and sent to the Mycoplasma Laboratory of the National Veterinary Research Institute (NVRI), Vom, Plateau State for culture and isolation of the causative agent as described by Ikpa *et al*. (2020).

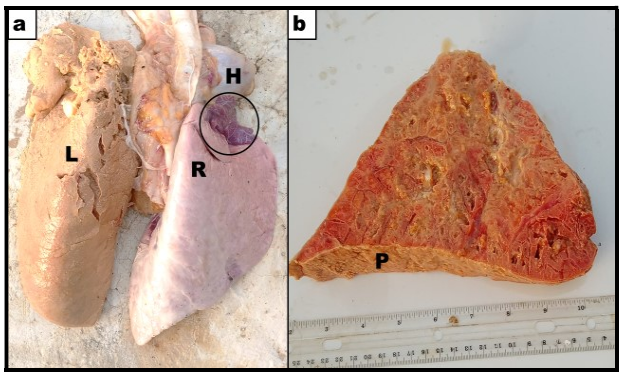

Figure 2: Lungs of a heifer from a herd of cattle diagnosed of contagious bovine pleuro-pneumonia. a. Note the thick yellowish fibrinous membrane which covered the left lung (**L**). The caudal and middle lobes of the right lung (**R**) was pale while the frontal lobe was congested and had prominent interlobular septa (circle). the pericardial sac was opaque (**H**). b. Note the thickened pleura (**P**) and hepatization

Histopathological Findings

Left lung: The pleura was thickened and due to oedema and fibrin (Figure 3a). There was clear to pinkish proteinaceous material (oedema) and wavy strands within the alveolar spaces, lumen of the bronchioles and interlobular septa, which was thickened. There were red blood cells and inflammatory cellular infiltrates (neutrophils and macrophages) within the alveolar spaces and bronchioles. There was necrosis of the smooth muscles of blood vessels and perivascular infiltration of macrophages (Figure 3b).

Right lung: There was proliferation of fibrous connective tissue mostly around the bronchioles and blood vessels. The interstitium was thickened due to fibrous connective tissue proliferation making the lobules distinctly prominent (Figure 3c). The alveolar walls were thickened whereas most of the alveolar spaces and bronchiolar lumen were obliterated (Figure 3d).

Farm Visit

Many of the heifers appeared emaciated and dehydrated, had pale mucous membranes, swollen lymph nodes (prescapular and mandibular), rough hair coat, and serous to mucoid nasal discharge, with the presence of ticks mostly attached to the skin of the mammary glands. Two of the heifers were self-isolated, dull and off feed, while another stood still facing the direction of the wind with raised head and extended neck.

Laboratory Analysis

Samples (nasal swabs, blood, feaces and ticks) were collected from the four heifers for analyses. *Mycoplasma*

mycoides subspecies *mycoides* was each isolated from the thoracic fluid and nasal swab samples taken at postmortem and clinically during farm visit, respectively (Figure 4). The erythrograms of all the heifers were characterized by normocytic normochromic anaemia with higher severity in heifers 1 and 4.

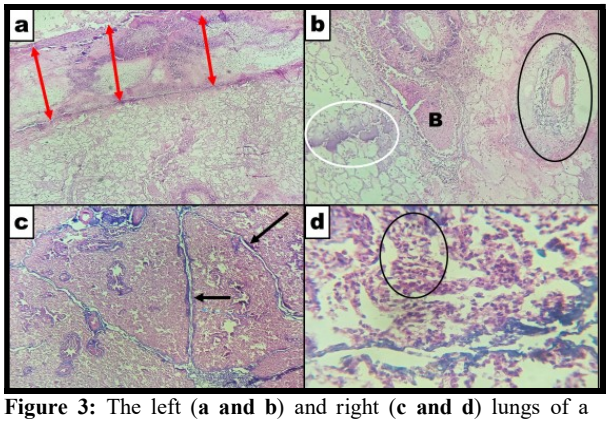

Figure 3: The left (**a and b**) and right (**c and d**) lungs of a heifer from a herd of cattle diagnosed of contagious bovine pleuro-pneumonia. H & E stain. **a.** Note the thickened pleura filled with fibrin and oedema (double arrows). ×100. **b**. Note the fibrin and oedema within the alveolar spaces (white circle), bronchiolitis (**B**) and vasculitis (black circle). ×100. **c.** Note the compartmentalization of the lung into lobules by fibrous connective tissue (arrows). ×100. **d.** Note the thickened alveolar septa (circle) and smaller alveolar spaces. ×400.

The leukograms of all the heifers were characterized by neutropenia with higher severity in heifers 3 and 4, which corresponded with their marked leukopenia (Table 1). The results of faecal analysis of all the heifers revealed low egg count of *Toxocara* sp. while the ticks were identified as *Rhipicephalus* sp. but no haemoparasites were seen in thin blood smears.

Diagnosis

The confirmatory diagnosis was CBPP based on the clinical history of respiratory distress, pathognomonic lesions characterized by fibrinous pleuropneumonia, as well as microbiological isolation of the causative *Mmm*. Other associated problems (acariasis and helminthosis) were mild and couldn't have been the main problem with the herd.

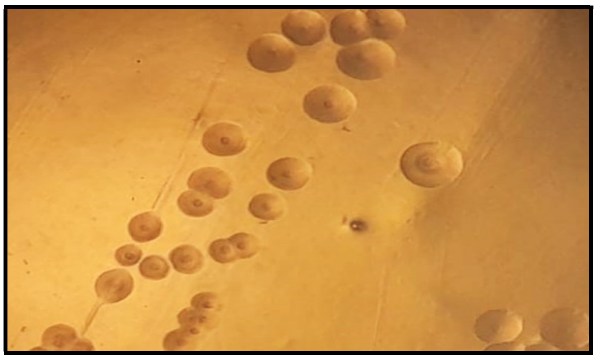

Figure 4: Colonies of *Mmm* from pleural effusion collected during postmortem examination of the carcass of Sokoto Gudali heifer diagnosed of contagious bovine pleuro-pneumonia. Note the characteristic 'nipple-like' appearance of the colonies.

Management

The sick heifers were isolated from the rest of the herd and culled. The remaining heifers were treated with Enrofloxacin (5 mg/Kg IM QD 5/7) and Oxytetracycline LA (20 mg/Kg IM STAT and repeated after three days). Amitraz (12.5%) was used as acaricide to control ticks. The heifers were vaccinated against CBPP after two months of being apparently healthy following treatment.

Table 1: Haemogram of selected heifers from an integrated farm diagnosed of contagious bovine pleuro-pneumonia in Kwali, FCT, Nigeria.

Parameter	Heifer 1	Heifer 2	Heifer 3	Heifer 4	*Reference range
RBC ($x10^{12}$/L)	3.85	4.93	5.28	3.80	6.41 – 12.59
HGB (g/dL)	5.50	7.40	7.50	5.70	8.08 – 11.96
HCT (%)	17.50	23.40	23.00	17.20	30.35 – 38.25
MCV (fL)	45.50	47.40	43.70	45.20	28.54 – 48.66
MCH (pg)	14.40	15.10	14.30	14.90	8.78 – 15.52
MCHC (g/dL)	31.60	31.90	32.70	33.00	27.51 – 35.65
WBC ($x10^9$/L)	8.49	3.96	3.15	3.10	6.95 – 17.58
Lymphocyte ($x10^9$/L)	7.98	3.48	2.92	3.04	2.63 – 9.21
Neutrophil ($x10^9$/L)	0.12	0.12	0.05	0.01	2.54 – 10.18

*Source: Olayemi *et al*. (2007).

Key: RBC = red blood cell; HGB = haemoglobin; HCT = haematocrit; MCV = mean corpuscular volume; MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration; WBC = white blood cell.

DISCUSSION

Contagious bovine pleuropneumonia is endemic in Nigeria and responsible for high economic losses due to low productivity, mortality and export ban to countries free of the disease. Unfortunately, reputable sources of cattle free of the disease are not readily available, hence intending livestock farmers are compelled to utilize open livestock markets for purchase of their stock without guarantees of freedom from disease or even vaccination history against the disease (Alhaji *et al*., 2020). The clinical signs observed in this case were consistent with those earlier reported (Anjum *et al*., 2020). The respiratory insufficiency observed clinically aligned with the predominantly thoracic lesions at necropsy and substantiated by histopathology. The marked fibrinous effusion that filled the thoracic cavity could have restricted expansion of the lungs thereby hampered efficient respiration (Almaw *et al*., 2016). Furthermore, the diffuse oedema and infiltration of inflammatory cells within the alveolar spaces in the left lung as well as fibrosis, thickened alveolar walls and narrowing of the

bronchiolar lumen/alveolar spaces in the right lung could have decreased the oxygenation of blood, suggestive of why the PCV and haemoglobin were low. Although, the pathological findings of marked hydrothorax and pleuropneumonia observed in this case were consistent with findings of other authors (Markus *et al*., 2022; Otina *et al*., 2022), the unilateral lung involvement mostly reported in CBPP affected cattle was not the presentation in this case. The lesions in the left lung indicated acute pleuropneumonia while in the right lung characteristic of chronic inflammation, suggested that the right lung was first affected and probably undergoing healing before the left lung became affected.

The pathological changes in the acute form of CBPP could sometimes present diagnostic challenge due to their similarity with the lesions of manheimiosis. However, the isolation of *Mmm* from the samples and not *Manheimia haemolytica* confirmed the diagnosis of CBPP. Albeit, only 4.1% of the tested samples were positive for *Mmm*. This finding is like that of Ikpa *et al*. (2020) who reported a detection rate of 4%, which could be attributed to the several attempts at treating the herd with antibiotics. Sometimes, owners of affected cattle resort to unguided use of antibiotics to control CBPP, a phenomenon that increases the risk of antibiotic resistance development by the causative agent to further complicate the control of CBPP in endemic areas (Danbirni *et al*., 2020).

Conclusion

The clinicopathological manifestations of CBPP in Sokoto Gudali breed of heifers in this case were like those reported for other breeds of cattle, characterized clinically by respiratory distress and pathologically by marked pleural effusion and fibrinous pleuro-pneumonia. There is a need for continuous surveillance of the disease in indigenous breeds of cattle to ascertain the true burden of the disease.

Conflict of Interest

The authors have no conflict of interest to declare.

Author Contribution

NAS, SEA, OZT and JES were responsible for the post-mortem examination and interpretation of the histopathology slides and the haemogram. VOK, DOO, JES and JSA were responsible for sample collection and management of the disease. DOO was responsible for parasite identification while JSA was responsible for culture and identification of *Mycoplasma* sp. NAS drafted the initial manuscript while all authors made significant intellectual contributions to the final version of the manuscript. All authors consented to submitting the final version of the manuscript for publication.

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