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Contagious Bovine Pleuropneumonia: Serological Prevalence in Derashe District, Southern Ethiopia

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Abstract: Contagious Bovine Pleuropneumonia (CBPP) is one of the most economically important transboundary animal diseases in Ethiopia. A cross-sectional study was conducted in August 2015 in extensive farming systems of Derashe district, southern Ethiopia aiming at the determination of the seroprevalence of CBPP and associated risk factors. A total of 545 serum samples were examined for the presence of specific antibodies against *Mycoplasma mycoides sub species mycoides* small colony *(Mmm*SC*)* using competitive Enzyme Linked Immunosorbent Assay (c-ELISA). The overall seroprevalence of CBPP was 55.05% (300/545). There was a statistically significant variation of seroprevalence among different examined kebeles ($p< 0.05$). Similarly, herd size was significantly associated with CBPP seroprevalence ($p<0.05$). However, other risk factors such as age and sex were not significantly associated ($p>0.05$) with sero status of the animals. In conclusion, the present study indicated the high seroprevalence in the studied area. Therefore, proper intervention strategies should be designed and implemented to minimize the burden of the disease.

Key words: Seroprevalence · CBPP · Risk Factors · C-ELISA · Derashe · Ethiopia

INTRODUCTION

Contagious bovine pleuropneumonia is an infectious and highly contagious pulmonary disease of cattle [1] caused by *Mycoplasma mycoides* subspecies *mycoides* small colonies (*Mmm*SC). The disease is characterized by fever, symptoms of respiratory problems, high morbidity and mortality rates [2]. It is economically serious disease resulting in direct loss like high mortality, reduced milk yield, high cost of treatments and vaccinations and indirect loss due to impulsion of trade restrictions [3]. It also retards genetic improvement and limits working ability of draught animals. Transmission is through the direct contact of susceptible animal with clinical cases or chronic carriers [4].

Even though, eradicated from many countries by the beginning of the 20th century through stamping-out policies, contagious bovine pleuropneumonia is still challenging cattle rearing in many parts of Africa. It is one of the most important transboundary animal diseases in Africa. It affects 27 countries in this continent with an estimated annual loss of US$2 billion [5]. In Ethiopia, it accounts for annual loss of over 205.60 million Ethiopian birrs. In addition to mortality and morbidity inflicted by the disease, the country has lost a substantial market share and foreign exchange earnings due to frequent bans by the Middle East countries [6, 7]. This huge loss is resulted from lack of effective control policy; mainly due to irregular and low coverage of vaccination and unrestricted movement of livestock and insufficient systematic disease surveillance [8, 9].

The disease mainly occurs in pastoral herds and in cattle derived from these areas [10, 11]. The main methods of CBPP control include movement control, stamping out by slaughter and vaccination [12]. In Ethiopia, movement control is logically difficult to apply due to socio-cultural and trade practices, stamping out is too costly to apply therefore; vaccinations remain the only practical means of combating CBPP in the country [13].

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The vaccines practiced in Ethiopia are exclusively monovalent live attenuated freeze-dried products derived from broth culture of T1SR (Streptomycin resistant variant) or T1/44 seed strain of *Mycoplasma mycoides* subspecies *mycoides* small colony seed strains that gives protection for 6 months. The other vaccines are V5 and KH3J that give protection for 2 and 6 months, respectively [14].

Ethiopia has a substantial informal livestock trade with Kenya and Somalia [15, 16]. This could pose regular reintroduction of infected cattle from neighboring countries or herds where the disease remains endemic. This strongly suggests the need of strengthening regional integrated transboundary disease control in east Africa to gain economic benefit from the livestock sector [17].

Despite the fact that CBPP represents one of the most severe animal diseases responsible for marked economic losses, there is scarcity of information the epidemiology of the disease in the area. Therefore, this study was conducted to determine the seroprevalence of CBPP and assess associated risk factors.

MATERIALS AND METHODS

Study Design and Sampling: Across-sectional study was conducted in August 2015 in Derashe district to estimate the prevalence of CBPP. Four (4) kebeles were purposively selected based on cattle population, farmers' complaints of the problem and accessibility of the roads. The list of herds was obtained from animal health office and community leaders. The herd was categorized in to two groups based on the prevailing herd size in the study area as small (<20) and large (≥20). Twenty seven (27) herds were randomly selected from the list; from each herd, cattle aged over 6 months were randomly selected. Simple random sampling technique was employed to select the individual study cattle from the population. The sample size was determined based on the formula described by Thrusfield [18] considering 50% expected prevalence (P_{exp}) and 0.05 desired absolute precision (d).

$$N = \frac{1.96^2.(P_{\exp}.(1-P_{\exp}))}{d^2}$$

Accordingly, a total of 384 animals were needed to be sampled. However, 545 animals were sampled to increase the precision of the study. Age and sex of the studied animals were recorded during sampling. The age was estimated by means of their dentition as described by Pasquini *et al.* [19].

Sample Collection and Testing: Animals were restrained and10 ml of blood was drawn from the jugular vein using sterile plain vacutainer tubes, which was labeled with herd and animal identification numbers. The tubes containing the blood were slightly inclined and placed at room temperature for 24 hours and serum was collected in serum tubes. The samples were labeled, placed in icebox and transported to the National Animal Health Diagnostic and Investigation Center. Serum samples were examined for antibodies against CBPP using a c-ELISA [20] following the manufacturer's instruction (Pourquier Institute, France). Test Serum samples were premixed with a specific monoclonal antibody (Mab 117/5) in a dilution plate and incubated at 37°C after being gently agitated. Antibody specific to MmmSC in the serum forms an immune complex with MmmSC antigen coated on the microplate, competing with Mab 117/5 for the specific epitopes. An anti-mouse antibody enzyme conjugate was added. After washing unbound conjugate away, enzyme substrate (TMB) was added. In the presence of the enzyme, the substrate is oxidized and develops a blue compound becoming yellow after the reaction ended. The result was expressed in "percentage of inhibition (PI)'' by comparing the optical density in the test well with the optical densities in the Mab control wells. All sera with PI>50% were considered positive [21].

Data Analysis: The data collected were entered in to Microsoft Excel Data base system. The entered data were analyzed using STATA version 12.0 statistical software program. The seroprevalence was calculated by dividing the proportion of sample found to be positive for the test by the total number of sample examined multiplied by 100. The association between the sero status of the CBPP and associated risk factors were assessed using Chi-square (□2) test. A statistically significant association between variables was said to exist if the calculated P<0.05 at 95% confidence level.

RESULTS

In the present study, an overall seroprevalence of 55.05% (300/545) was recorded. A seroprevalence of 21.2, 39, 79 and 50.9% was recorded in Kolla mashile, Gato, Hayibena and Bussa kila kebeles, respectively. There was statistically significant variation ($p<0.05$, $\chi 2 = 60.95$) among the four kebeles. A mean seroprevalence of 61.70 and 49.00 % was recorded in large herds and small herds respectively (Table 1). Seroprevalence in males (58.6%) was slightly higher than that of females (50.6 %) though

Table 1: Serological prevalence of CBPP in relation to kebeles and herd size in Derashe district

Variables	Category	Number of tested animals (N)	Number of positive animals	Prevalence (%)	Chi-square (□2) (P-value)
Kebeles	Kolla mashile	33	7	21.20	60.95(p=0.00)
	Gato	200	78	39.00	
	Hayibena	200	158	79.00	
	Bussa kila	112	57	50.90	
Herd Size	Small	286	140	49.00	14.97(.001)
	Large	259	160	61.70	

Table 2: Seroprevalence of CBPP according to host demographics

Variables	Category	Number of tested	Number of positive	% positive sample	χ^2(P-value)
Sex	Male	302	177	58.6%	0.073(0.787)
	Female	243	123	50.6%	
Age	Young	212	103	48.6%	0.625(0.429)
	Adult	333	197	59.1%	

the difference was not statistically different (P > 0.05). Higher seropositivity (48.9%) was recorded in young animals than in old animals (59.1%). The difference was statistically significant among the age groups (Table 2).

DISCUSSION

Contagious bovine pleuropneumonia is a major cattle health problem in the studied area evidenced with a high seroprevalence (55.05%). This is in agreement with a previous report by Dejene [22] in which he documented a CBPP seroprevalence of 56% in North Omo zone. However, this finding is much higher than most of the previous reports in Ethiopia; including the reports of Gedlu [23], Ebisa *et al*. [24], Regassa [25] and Issa [26] in which seroprevalence of 39, 31.8, 28 and 5.1% were recorded, respectively. Such a wide variation in the prevalence of CBPP reported from different parts of Ethiopia could be due to difference in agro ecology, management system, population density and the types of tests employed to evaluate the prevalence [27-29].

In the present study, a 100% herd level prevalence was recorded; showing the wide spread of the disease in the studied area. The average seropositivity was 61.7 % and 49 % in large herds and small herds, respectively. The variation among herd sizes was statistically significant. This is in line with previous studies in Ethiopia [30]. This might be explained by the fact that the infection needs proximity to source of infection and increasing number of susceptible population. The aggregation of animals during watering, grazing and rest times might favor the spread of the disease in large herds compared to small herds [31].

A seroprevalence of 79.00, 50.90, 39.00 and 21.20% was recorded in Hayibena, Bussa kila, Gato and Kolla mashile kebeles, respectively. The variation was significantly different among the study sites. The higher prevalence reported in Hayibena, could be due to large herd size owned by individual farmers.

The seroprevalence in male (58.6%) was slightly higher than that of females (50.6 %) even though the difference was not statistically significant (P > 0.05). Daniel *et al.* [32] also reported insignificant difference in prevalence of CBPP between sex groups. A seroprevalence of 48.60 and 59.60 % was recorded in young and adult age groups, respectively. The seroprevalence was not statistically different among age groups, although, lower infection rate was recorded in younger animals. This is in agreement with previous reports by Swai *et al*. [33] and Sori [34] in which seropositivity in adults was slightly higher than that of younger animals. In the studied area, calves tethered within the homestead when other animals were taken to grazing fields. This is because of the fact that calves cannot move long distances in search of pasture and water as adult animals do. Therefore, calves have less likely to have direct contact with other herds, which could potentially reduce the likely hood of getting the infection [35].

The higher individual and herd level seroprevalence recorded in this study might be attributed to lack of control schemes in the studied area. Alemayehu *et al*. [36] also reported higher CBPP seroprevalence in larger herds than the smaller herds.

The farmers in the study areas complained that, vaccination and treatment was not given for their animals for the last few years. This significantly influenced productivity of their animals and threatened their livelihood. This suggests the need of integrated control approach not only in pastoral areas but also in highlands.

CONCLUSIONS

This study shows a high seroprevalence of CBPP (55.05%), indicated this disease is the major cattle rearing constraint in the area. All the examined herds were infected and the prevalence was higher in larger herd showing the wide spread of the disease, warranting proper prevention and control strategies to be designed and implemented to minimize the burden of the disease.

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