Austin Journal of Veterinary Science & Animal Husbandry

Open Access

Austin Publishing Group

Review Article

Review Onepidemiology of Contagious Bovine Pleuoro Pneumonia and Its Economic Impacts in Ethiopia

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Received: July 11, 2022; **Accepted:** August 05, 2022; **Published:** August 12, 2022

Abstract

Mycoplasma Mycoides subsp. Mycoides "Small Colony" (MmmSC) causes the infectious and contagious respiratory disease known as Contagious Bovine Pleuropneumonia (CBPP), which has a significant negative effect on livestock output and the propensity to spread quickly. The aim of this paper is to review the epidemiology and economic impacts of CBPP in Ethiopia. Contagious Bovine pleuropneumonia is an endemic disease in Africa, Asia, Eastern Europe, and the Iberian Peninsula. Contagious Bovine pleuropneumonia is mainly transmitted from animal to animal in respiratory aerosols. The clinical manifestations of CBPP in cattle range from hyper acute, acute, sub acute and chronic forms. Diagnosis CBPP based on a history of contact with infected animals, clinical findings, Immuno-diagnosis tests, necropsy findings and cultural examination. Thrombosis in the pulmonary arteries is a hallmark of the CBPP pathogenesis in susceptible animals. The impact that Contagious Bovine Pleuropneumonia (CBPP) can impart in an economy of a given country is so vast and tremendous that it is not advisable to overlook like any of the ordinary routine diseases of livestock that can be easily removed by treatment or self-cure. Movement control, vaccination, and treatment are essential tools in CBPP control and eradication. Regular program of mass vaccination and best treatment regime. Moreover, effective vaccination policy needs to be considered as it is the only realistic method of choice for control of CBPP in Ethiopia.

Keywords: CBPP; Economic impact; Epidemiology; Ethiopial mycoplasma

Introduction

Mycoplasma Mycoides subsp. Mycoides "Small Colony" (MmmSC) causes the infectious and contagious respiratory disease known as Contagious Bovine Pleuropneumonia (CBPP), which has a significant negative effect on livestock output and the propensity to spread quickly. Contagious bovine pleuropneumonia is endemic to parts of Africa, parts of India and China; with minor outbreaks in the Middle East. Countries free of CBPP include the US, UK, and Australia. In almost all African countries CBPP is a notifiable disease with official controls on the import of cattle [18].

Although its clinical effects of CBPP on animals are far more severe than those of Foot and Mouth Disease (FMD), it is now one of the most significant transboundary diseases. In many countries, there are nomadic people who move from one country to the next, such as the Fulani in West Africa and the Maasai in East Africa. Wars, famine as well as inadequate financing of veterinary services have resulted in CBPP spreading widely in East and Central Africa [22].

Although its origin is not documented, from a historical perspective CBPP was a disease of Europe and Asia. It became popular in the nineteenth century through the commerce in cattle after becoming known in Europe in 1773. CBPP has been eliminated from Australia, Europe, Asia, and America by the implementation of limits on the transportation of cattle, as well as test and slaughter procedures paired with compensation for livestock keepers. However, such policies are difficult to apply in most African countries because of pastoralism, lack of economic resources, and fragmented veterinary services [10].

The contribution of livestock to the national economy particularly with regard to foreign currency earnings is through exportation of live animals, meat, skin, and hides. However, a number of obstacles prevent the growth of this industry. The most important constraints are widespread endemic diseases including viral, bacterial, and parasitic infestation. The other important bottleneck for the development of this sector include lack of appropriate disease control policy, lack of appropriate veterinary services, and lack of attention from government [15]. In Ethiopia the average physical losses from CBPP in terms cattle deaths are 25,115 heads (8,372 in endemic areas and 16,743 in epidemic, 1,852 and 13,396 metric tons of beef and milk respectively).

Average 3,135,000 oxen (agricultural) days are lost in terms of animal power. In comparison to other African nations, Ethiopia sees the greatest number of cow mortality and decline in cattle products under both endemic and epidemic situations due to CBPP [27].

Among the health constraints, infectious disease like Contagious Bovine Pleuro Pneumonia (CBPP) is considered to be one of the most economically important and major problem for Ethiopian livestock development [2]. Therefore, the aim of this paper is to review the epidemiology and economic impacts of CBPP in Ethiopia.

Citation: Girma A, Bekele A and Girma G. Review Onepidemiology of Contagious Bovine Pleuoro Pneumonia and Its Economic Impacts in Ethiopia. Austin J Vet Sci & Anim Husb. 2022; 9(2): 1094.

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Epidemiology of Contagoius Bovine Pleuoro Pneumonia

Contagious bovine pleuropneumonia is also one of the diseases that are revealed to be the risk factor of livestock production in Ethiopia as it was seen to be one of the emerging and economically most important diseases in the country. The disease is at an increasing rate in that it is harming the socio-economy of the country in general and of the individual farmer in particular decreasing the export standard and potential of the country [1].

Contagious bovine pleuropneumonia is an endemic disease in Africa, Asia, Eastern Europe, and the Iberian Peninsula. Cattle moving on foot are the one estimated to be at risk hence suitable for extension of outbreaks to happen thereby facilitate the disease to spread at ease [8]. The origin of CBPP in Central, West and East Africa is obscure and it has been suggested that zebu cattle introduced the infection when they first migrated to the African continent. There is speculation that when Field Marshal Napier's army invaded Ethiopia in 1867–1868, they brought CBPP from India into East Africa [19].

Mycoplasma mycoides subspecies mycoides small Colony type, the aetiological agent of CBPP, can be grouped into two major, epidemiologically distinct, clusters. A one cluster, made up of strains gathered over the past 50 years from Africa and Australia, is composed of second strains separated from various European nations since 1980.Epidemiological and clinical observations indicate that the European outbreaks of CBPP are less virulent than the disease encountered in Africa [33].

Geographical distribution: Due to annual combined vaccination programs from the efforts to eradicate Rinderpest, the geographical distribution of CBPP was constrained in the 1980s and nearly no outbreaks were noted. Contagious bovine pleuropneumonia is yet present in other regions of the world including the Middle East, parts of Asia and, until very recently, Southern Europe. Eradication policies are difficult to apply in most developing countries because of pastoralism, lack of economic resources and fragmented veterinary services [21]. contagious bovine pleuropneumonia is dominant in the arid and semi-arid areas in the eastern, northeastern and southeastern parts of the country [29].

Hostfactors: Bosindicus and Bos taurus cattle are susceptible to Mmm Under natural conditions, while there is variability in breed susceptibility in cattle, with disease tolerant breeds more susceptible. Also, water buffaloes are susceptible to Mmm, but it does not affect domestic buffaloes. Contagious bovine pleuropneumonia has been reported in Asian yaks and American bison, but not in African buffaloes (Syncerus caffer). Sheep and goats are resistant to the disease [7].

Transmission: *Mycoplasma mycoidessub. sppmycoides* Small colony is mainly transmitted from animal to animal in respiratory aerosols. Saliva, urine, fetal membranes, and uterine secretions all contain this bacterium. Trans-placental transmission is also possible. Although there are a few subjective reports of transmission on fomites, mycoplasmas do not survive for more than a few days in the environment, hence indirect transmission is thought to be unimportant in the epidemiology of this disease [9]. Moreover, in other report confirmed that the disease is transmitted almost exclusively by direct contact between infected and susceptible cattle, by means of infected aerosols from exhaled air. Airborne spread up to 200 meters is to be possible and conditions under which cattle are herded closely together is favored the rapid spread of the disease [11].

Clinical Signs

Incubation period of the disease is usually 1-4 months, but can be longer. After experimental in oculation into the trachea, clinical signs may appear in2-3 weeks. The clinical manifestations of CBPP in cattle range from hyper acute, acute, subacute and chronic forms. The hyper acute form is most often seen at the start of an outbreak and involves up to 10% of the infected animals. Death is sudden, within a week of respiratory signs or without prior signs at all [24].

The early stages of acute CBPP are indistinguishable from any severe pneumonia with pleuritis and acute CBPP affects approximately 20% of infected animals. Clinical signs start with fever, dullness, anorexia, irregular rumination and only slight respiratory distress [14]. It's common to see frothy saliva around the mouth and nasal discharge. Sub-acute CBPP is the most common form (40-50%) and is a less severe form of the acute disease with only slight respiratory symptoms and intermittent fever [14].

Pathogenesis

The development of thrombosis in the pulmonary arteries, which may take place before the onset of pneumonic lesions, is a hallmark of the pathogenesis of CBPP in susceptible animals. The process of thrombosis formation is not well known, but partly believed to be mediated by induction of cytokines [26].

An essential part of the pathogenesis of the disease is thrombosis in the pulmonary vessels, probably prior to the development of pneumoniclesions. The mechanism of development of the thrombosis is not well understood, but is considered, at least in part, mediated through induction of cytokines. Contagious bovine pleuropeumonia is lobar variety of pneumonia in which the inter-lobular septa are dilated and prominent due to a great out pouring of plasma and fibrin in to them and it this dilated septa that give the "marbling" effect to the lung in these areas [18].

Diagnosis

Contagious bovine pleuropneumonia is difficult to diagnose based on clinical signs alone as therecan be many causes of severe pneumonia in cattle. But, we can diagnosis CBPP based on a history of contact with infected animals, clinical findings, Immuno-diagnosis tests, necropsy findings and cultural examination. Contagious bovine pleuropneumonia frequently results in disease in only one lung as compared with other types of pneumonia in which both lungs are affected. CBPP should be taken into account in a herd that exhibits pneumonia in adults and polyarthritis in calves. Post mortem lesions may be more useful in the diagnosis. Confirmatory diagnosis is based on the isolation of Mccfrom clinical samples of lung [23].

Cultural examination: from Live animals samples such as pleural fluid, bronchoalveolar washings, and nasal swabs can be collected. Samples taken to necropsy are lung lesions, lymph nodes, pleural and synovial fluid from animals with arthritis. The causal organisms can be isolated culturally from animals during febrile phase or shortly

Table 1: Current status of contagious bovine pleuropneumonia disease in some parts of Ethiopia.

No.	Prevalence of CBPP (%)	Place	Year (GC)	References
1	28.5%	Western Oromia	2016	(Mersha, 2016).
2	62.5%	Southern Ethiopia	2014	(Alemayehu, 2014)
3	96.7%	Farm in Ethiopia	2016	(Almawet al., 2016)
4	8.1%	South West Ethiopia	2018	(Mamoet al., 2018)
5	33.77%	West Shoa zone	2020	(Fulaset al ., 2020)
6	14.3%	HorroGuduru	2020	(Tolaet al., 2021)

after postmortem from blood, pleural exudates (chest fluid) and/or affected lung tissue & lymph nodes. Because of 'fastidious' nature of the agent, samples should be submitted to the laboratory as soon as possible after collection [34]**.**

Post Mortem Finding: The post mortem lesions of CBPP include thickening and inflammation of lung tissues include thickening and inflammation of lung tissues the chest cavity. A characteristic marbled appearance of the affected lungs is caused by the presence of both acute and chronic lesions in the connective tissues. Fluid accumulation in the lungs leads to the creation of extra tissue (fibrosis) Encapsulated areas of diseased tissue can be found even in recovered animals [11].

Chest lymph nodes may be swollen and wet (edematous), with minute necrotic foci and pinpoint hemorrhages, making it difficult to tell the difference between the cortex and medulla. Infarcts white areas of dead tissue of varying sizes can occasionally be detected in the cortex of the kidney. Although in the Ethiopian context slaughtering is accomplished in practically all small butcheries at backyard slaughtering, slaughterhouse monitoring is a great tool to utilize in detecting introduction and spread of the disease since the lesions are so distinctive [25].

Pathological lesions commonly affect one lung and are often localized in the diaphragmatic lobe with a characteristic marbling appearance, while the pleural cavity may contain large quantities of clear, yellow-brown fluid with pieces of fibrin [24].

Serology: To detect latency and chronically infected animals, almost all serological tests are suitable. OIE has recommended the Complement Fixation Test (CFT) as a trustworthy test for use in international trade where interpretation can be handled at the herd level. The other is competitive ELISA, which has excellent specificity and equal sensitivity. It was seen to be easy to perform than complement fixation (CF) test but its performance characteristics has not yet been fully assessed [1].

PCR: Identification of Mmm has been problematic because of the close phylogenetic relatedness between it and other members of the M. mycoides cluster that include M. mycoides subsp. Mycoides PCR has provided powerful diagnostic procedures for the specific identification of Mmm strains, as well as robust fast detection, identification, and differentiation of members of the M. mycoides cluster. The use of nested PCR systems that is sensitive for the detection of Mmm in cultures and clinical materials with very low numbers of target organism [3].

Differential Diagnosis

It is important to distinguish CBPP from other disease that may exhibit comparable clinical symptoms or lesions when performing the diagnosis. Some differential diagnosis are Rinderpest, Foot-and Mouth Disease (FMD), Haemorrhagic Septicaemia (HS), Bacterial or viral broncho-pneumonia, Theileriosis (East Coast Fever), Tuberculosis, Actinobacillosis and Echinococcal (hydatid) cysts. Differentials for acute infections include acute Bovine Pasteurellosis, Bronchopneumonia, and pleuropneumonia resulting from mixed infections [11].

Treatment

Treatment is usually undertaken and indicated only in areas where the disease is endemic [25], but in practice farmers are treating their animals when they have no other alternative. Although the Mycoplasmas are susceptible to a number of antibiotics in vitro, treatment failures are common. Commonly used antibiotics include tetracyclines, tylosin, erythromycin, lincomycin, spectinomycin, and tilmicosin. Resistance to some of these antimicrobials has been noted [25].

Control and Prevention

Four essential control approaches that include vaccination, treatment, movement control, and stamping-out through slaughter with compensation have been adopted towards mitigation of CBPP in Africa [28]. Control and elimination of CBPP require four key tools. These include movement control, treating, immunizing, and eradicating. Each control measure acts by reducing the effective reproductive number of the agent in the population. However, not all nations employ these restraints. The current policy advocated by AU-IBAR for the control of CBPP were collection of epidemiological data and information to determine and detect foci of infection, Effective control of animal movements from and towards these foci, Mass vaccination of cattle regularly for at least five consecutive years and repeating vaccination of the same cattle each year.

Economic Impact of Contagious Bovine Pleuropneumonia

Food and Agriculture Organization estimates indicate that animal diseases cause losses of up to 30% of the annual livestock output in developing countries. This has a spectacular financial impact on the economies of emerging nations. Contagious bovine pleuropneumonia is considered a disease of economic significance because of its ability to decrease the economy of country due to mortality and morbidity [28]. The cost of CBPP control by vaccination in ten (10) African countries during the PARC period and found unit costs to vary from 0.27 Euros in Ethiopia to 0.71 Euros in Cote d'Ivoire with an average of 0.42 Euros was estimated [28].

The economic importance of Contagious Bovine Pleuro Pneumonia (CBPP), especially losses due to the chronic disease, is difficult to assess. Losses include mortality, loss of weight, reduced working ability, reduced fertility, reduced growth rate, and losses caused by control program due to vaccination campaigns, quarantine, and restrictions on cattle trade [1].

Mortality and morbidity losses: Contagious bovine pleuropneumonia outbreaks have been associated with various levels of mortality. Due to the debilitating nature of the disease, mortality rates have been relatively lowparticularly in endemic situations. Higher mortality rates are however not uncommon. In its acute form, the mortality rate can reach 50%. Mortality losses were estimated by applying the CBPP specific mortality rate to each class of cattle at risk. Cattle production in each of the countries considered involves large pastoral communities and the effective contact rate for pastoral transhumant production systems in East Africa was estimated Morbidity losses were considered as reductions in the productivity of milk, beef and draft power [18].

Production losses: In cattle and cattle products can be lowered by this disease. The total number of dead cattle in all twelve countries was estimated at about 30,873 head giving an average of 2,573 head per country range from474 in Ghana to 10,112 in Ethiopia [12]. The loss in draft power was estimated as the product of the number of infected oxen and the number of workdays per year. All physical losses in cattle, beef, milk and draft power were valued using market prices [12].

Current Status of CBPP in Ethiopia

Historically, there is no established document as to when and how the disease exactly entered to Ethiopia [5]. From economic view, CBPP is one of the most important diseases in Africa being widespread in West, Central and Eastern parts of the continent [30]. Contagious bovine pleuropneumonia is endemic in Eastern Africa including Rwanda, Burundi, Tanzania, Sudan, Ethiopia and Uganda [16]. According to the OIE (2008), the highest number of outbreaks reported in 20 African countries (2006) were recorded in Ethiopia. An economic loss analysis study conducted by Tambi *et al.* [28] in 10 African countries including Ethiopia has estimated an annual loss of 14,987,000 million Euros attributed to CBPP threat. In Ethiopia, according to reports of various outbreaks, national serosurveillance and research results from 1997 to 2010, CBPP was found to be present in almost all regional states [31]. CBPP has been reported in different regional states of Ethiopia with an overall seroprevalence like 7.13% in Afar, 1.29% in Amhara, 12.05% in Benishangul Gumuz, 19.72% in Gambella, 5.17% in Oromia, 5.44% in Southern Nations Nationalities and People (SNNP), 0.9% in Somali, and 6.11% in Tigray in the year of 2004 (Gulima, 2011). In Ethiopia, CBPP is considered as one of the most important cattle diseases and impediments to livestock development in the country [6].

Conclusion and Recommendations

Contagious bovine Pleuropneumonia is a highly contagious, economically significant infectious illness of cattle that has a varied course and a sneaky nature. The recent seroprevalence studies from different areas of Ethiopia witnessed as this severe respiratory disease is posing a major threat to livestock industry of the country. It was identified as the second most important trans boundary disease in Africa next to render pest which needs a major focus. Contagious bovine pleuropneumonia is a disease that causes high morbidity and mortality losses to cattle. Contagious bovine pleuropneumonia is an endemic disease in Africa including Ethiopia. The financial implications of these losses are of great significance to both cattle owners and to the nation. Moreover, CBPP has potential to be spread in to new areas that have been considered previously as free areas. In order to reduce losses and increasing cattle owners' incomes, it is crucial to control CBPP.

Contagious Bovine Pleuropneumonia constitutes a major disease problem, which justifies a specific internationally coordinated regional control program at least for Africa. In Ethiopia CBPP has major effect by decreasing the economy of the country by high mortality and morbidity. Based on the above conclusion, the following recommendations were forwarded:-

- A regular program of mass vaccination should be conducted
- Quarantine of diseased animal with CBPP from healthy animal should be important
- Movement control of animal with suspected CBPP disease
- Further study on the prevalence and distribution of the disease in the Ethiopia are needed

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