Contagious bovine pleuropneumonia (lungsickness) in Africa

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ABSTRACT

AMANFU, W. 2009. Contagious bovine pleuropneumonia (lungsickness) in Africa. *Onderstepoort Journal of Veterinary Research*, 76:13–17

Contagious bovine pleuropneumonia (CBPP) or lung sickness, is an insidious pneumonic disease of cattle caused by *Mycoplasma mycoides* subspecies *mycoides* small colony variant (MmmSC) and it is one of the major diseases affecting cattle in Africa. With the imminent eradication of rinderpest from Africa (Somali ecosystem) CBPP has become the disease of prime concern in terms of epizootics that affect cattle on the continent. The control and/or eradication of the disease have suffered from unsustained control actions due to lack of operational funds to support such actions and deterioration in the quality of veterinary services in many countries affected by the disease. Stamping out procedures which were adopted by Botswana to control the disease (1995–1997) cannot be carried out by many countries currently affected by CBPP due to the high financial cost, the widespread nature of disease, animal welfare considerations and the potential loss of a valuable genetic resource base. The current scenario of CBPP disease epidemiology in sub-Saharan Africa requires that proactive measures are taken to safeguard countries in southern Africa which are currently free from CBPP from being contaminated by the disease thus affecting the beef industry and people's livelihoods; and to progressively control the disease in endemic zones of Western and Central Africa.

This presentation discusses the epidemiology of CBPP in Africa, diagnosis of the disease, regional strategies that could be deployed to prevent and control the spread of the disease on the continent and research thrusts on CBPP.

INTRODUCTION

Contagious bovine pleuropneumonia (CBPP), caused by *Mycoplasma mycoides* subspecies *mycoides* small colony variant (MmmSC) is present in West, Central, East and parts of Southern Africa. CBPP has not been reported in North Africa. The disease has serious implications for food security and peoples' livelihoods in affected countries and is a major constraint to cattle production in Africa. A decline in reports of outbreaks of CBPP in affected countries does not augur well for the implementation of internationally coordinated control actions due to absence of science based evidence for disease prevalence which underpins control and preventive actions.

According to Provost, Perreau, Breard, Le Goff, Martell & Cottew (1987), the first description of CBPP was in 1550 by Gallo. In the early 1800s, the disease was widespread over most of Europe. In 1843, it was introduced into the United States via a dairy cow that was purchased off a ship from England. By 1884, CBPP had become so widespread and destructive in the United States that the Federal Government established the Bureau of Animal Industry to combat the disease. In1887, the first intensive campaign to control an animal disease by quarantine and slaughter began in the United States. The MmmSC bacteria was first isolated and propagated in artificial media in France by Nocard & Roux in 1898. In 1854, CBPP was introduced into South

Africa by a Friesian bull imported from Holland. The disease spread rapidly in Africa and within 2 years, caused the death of over 100 000 cattle in South Africa (Thiaucourt, Van der Lugt & Provost 2004). The disease was eradicated from South Africa in 1924, Zimbabwe in 1904, Botswana in 1939 and Australia in 1972. After virtual elimination of CBPP from Europe in the 19th century, the disease reappeared in Portugal and Spain in 1951 and 1957, respectively. Outbreaks have been reported in southern France on a few occasions, the latest being in 1984. In Italy the disease reappeared in 1990 but was eliminated by 1993.

EPIDEMIOLOGICAL CONSIDERATIONS OF CBPP IN AFRICA

CBPP represents a major constraint to cattle production in Africa and is regarded as the most serious infectious animal disease affecting cattle now that rinderpest is almost eradicated from the continent. In the 1970s, the disease situation seemed to be under control. As such, the interest of veterinary authorities, regional and international animal health organisations shifted towards priorities other than CBPP. However, after almost 20 years of respite, CBPP made a dramatic come back on two major fronts–one in the east of the continent and the other in the south. Almost at the same time, there was a resurgence of the disease in previously known endemic areas of the continent (West Africa) probably as a result of cessation of rinderpest vaccination and with it, the waning of the state of immunity in cattle population to CBPP that used to be conferred through the use of the combined rinderpest/CBPP vaccine. The chronology of events on CBPP outbreaks in Africa shows two distinct epidemiological trends:

- Epidemic outbreaks of disease in previously disease-free areas
- Increased incidence of disease in endemically infected areas.

In the early 1960s and 1970s, sustained research in Africa, notably Muguga (Kenya), Farcha (Chad), Vom (Nigeria) and elsewhere in Africa on CBPP, coupled with a massive international campaign code named Joint Project 16, resulted in the disappearance of clinical disease from most parts of Africa. However, as a result of economic decline, poorly resourced veterinary services and civil conflicts, the disease made a spectacular come back in the late 1980s and early 1990s.

Outbreaks of CBPP in previously disease-free countries or parts of countries

Over more than a decade, outbreaks of CBPP in previously uninfected areas have occurred in Tanzania (1990, 1992 and 1994), Democratic Republic of Congo (1991), Rwanda (1994), Botswana (1995), North-western Zambia (1997 and still continuing) and Burundi (1997). The underlying common factor to these outbreaks in previously free areas were uncontrolled or illegal movement of cattle from known infected cattle populations and represent a failure of surveillance systems, emergency preparedness and early reaction to these outbreaks. The Botswana outbreak occurred after over half a century of freedom from the disease (Amanfu, Masupu, Adom, Raborokgwe & Bashiruddin 1998a). This outbreak was eradicated by the slaughter of about 320 000 infected and in-contact cattle and restocking with about 70 000 cattle (Amanfu, Sediadie, Masupu, Benkirane, Geiger & Thiaucourt 1998b). International cooperation in the eradication of CBPP in Botswana was fostered between South Africa, Namibia and others. The technical expertise of Onderstepoort Veterinary Institute, coupled with technical assistance from the Food and Agriculture Organization of the United Nations (FAO) and the deep commitment of the government of Botswana to eradicate the disease, ensured that the eradication of CBPP from Botswana was a success.

In Zambia, CBPP appears to be confined to the Western Province but the influx of CBPP infected cattle from Angola has contributed to the maintenance of this infected zone with spread to the rest of the country and further southwards to Sesheke. Elsewhere in East and Central Africa, the outbreaks were not effectively controlled with the result that CBPP is now endemic in Rwanda, Burundi, Kenya, Central African Republic and Tanzania from where the disease threatens Malawi, Mozambique and northern Zambia.

Increased incidence in endemically infected countries

Most countries within the previously infected zones of West, Central and East Africa have over the years reported an increase in the incidence of the disease. The reasons behind this increase are decreased surveillance and control due to a variety of factors among which are:

- Changing ecological/environmental factors such as availability of water and grazing areas leading to increased movement of cattle over long dis-

tances in search of water and feed. Stress factors may contribute to exacerbation of the disease.

- Cattle movement control which was easily enforceable during the colonial era appears unenforceable in recent times. The deterioration and decrease in mobility of field veterinary staff that are expected to enforce cattle movement regulations, has also been a contributory factor. In most countries the implementation of structural adjustment programmes (withdrawal of most government services, vehicles, sudden and poorly implemented shift of responsibilities from public to private, etc.), and changes in chain of command within veterinary services, led to rapid decline in the activities of veterinary departments and with that, disease control in general.
- Lack or insufficient resources allocated to CBPP control activities in particular reduced funding for vaccination, possibly associated with the cessation of externally funded vaccination campaigns against rinderpest whereby vaccination against CBPP was carried out simultaneously.
- Cost recovery for CBPP vaccination and farmers' unwillingness to pay because of association of vaccines with tissue reactions after administration of vaccines in some cases.
- Potency and field performance of CBPP vaccines (T1-44 and T1-SR).
- Reduced disease surveillance in the field, abattoir and the laboratory.
- Recently, over-concentration on the prevention and control of highly pathogenic avian influenza has led to decreased efforts in CBPP surveillance and reporting.

CBPP DIAGNOSIS

An overview of the current state of techniques available for the diagnosis of CBPP clearly demonstrates that recent advances in the study of immunology and molecular biology have and will continue to open up avenues for improved CBPP diagnosis. The tools currently available for CBPP diagnosis include clinical signs (Fig. 1), pathologic lesions (pleurisy, lung hepatisation and interlobular thickening) (Fig. 2), isolation and identification of the causative agent, immunoblotting, serology and PCR techniques. Details of standard diagnostic tools for CBPP have been well documented by Thiaucourt *et al.* (2004).

Recent advances in molecular biology have allowed accurate characterization of MmmSC strains at a molecular level and insertion sequence analysis has permitted the differentiation of CBPP agents of African, European or Australian origin.

A PAN-AFRICAN LABORATORY NETWORK FOR CBPP

One of the major developments in the past was the establishment of the FAO/IAEA Coordinated Research Programme through which national veterinary laboratories were provided with tools to diagnose CBPP, including further validation of CBPP c-ELISA

FIG. 1 Acute clinical form of CBPP. Note the extended neck and abducted fore limbs indicative of respiratory distress

Source: M. Niang; FAO Project (2008)-LCV, Bamako-Mali

FIG. 2 Acute gross lung lesion of CBPP. Note the pronounced interlobular thickening with marbled appearance

Source: M. Niang; FAO Project (2008)-LCV, Bamako-Mali

and a pen-side test in the field. The advantages of having a CBPP network included easier management of information through electronic messaging systems and the provision of an ideal forum for research and development of regional strategies for the progressive control of CBPP. In addition, this facilitated standardization of reagents, protocols, data analysis and interpretation of results of CBPP tests. A network arrangement offered opportunities to facilitate dissemination of knowledge and technologies in a uniform manner. The network system needs to be revived and the international support to improvements in functional capacity of laboratories for avian influenza diagnostics could be adapted to support CBPP diagnostics as well.

CONTROL OPTIONS, CONTAINMENT AND ERADICATION OF CBPP IN AFRICA

The epidemiological nature of CBPP, where there is persistence of infection and transmission of the disease (often over long distances) through sub-acute and chronic cases, dictates that control and eradication programmes must be both comprehensive and consistently applied over about 15–20 years to be successful. On the other hand, a 'piece-meal' approach to CBPP control and eradication is almost certainly doomed to failure. It will predispose countries to CBPP endemicity, discourage both animal health officials and farmers and will make control/eradication both difficult and costly. In many areas where CBPP currently occurs or which are at high risk of the disease, the potential natural epidemiological range of the disease extends over territory which may encompass more than any one country and may indeed include several countries. This may occur where there are traditional cattle trading, herding, nomadic or transhumance patterns that cover a large region. Examples of this are to be found in the well-recognized ecological zones for CBPP in West/Central Africa, East Africa and northern parts of southern Africa. The best method to control CBPP is by stamping out, but this is beyond the means of most African countries affected by the disease. Significant progress towards CBPP control in these ecological zones will only be possible if there is a high degree of cooperation between neighbouring countries in the development and implementation of regionally coordinated CBPP prevention, preparedness and control/eradication programmes. Risk of infection can be minimised by the prevention of contact between infected and healthy herds together with active disease surveillance. Emergency preparedness, including early warning and early reaction based on contingency planning and establishment of the necessary infrastructure must therefore be the cornerstone of CBPP management in Africa. Community involvement based on education and training is essential to ensure early warning and early reaction. A regional programme must have the capacity for innovation and flexibility. CBPP control, like many transboundary animal diseases, must be regarded as a public good.

Control strategies for CBPP in different ecological and epidemiological zones have been discussed and published in joint FAO/IAEA/AU-IBAR/OIE Consultative Group Meetings (FAO 1998, FAO 2001, FAO 2004 and FAO 2007). Musisi, Bamhare, Belemu, Chisembele, Chitate, Kabilika, Kimera, Kitalyi, Munsimbwe & Njau (2007) described the evolution of CBPP in SADC countries following the acknowledgement by the Chief Veterinary Officers (CVOs) of SADC countries at their workshop in Pretoria 2003 of the threat CBPP poses to the cattle industry in the region and counter epizootic measures that have to be instituted following the recognition by the CVOs to tackle CBPP control in the region with all seriousness. This was done in phases, namely emergency and recovery phases. Control actions in SADC countries have been implemented by the FAO supported by the government of South Africa. Success is limited, but in Tanzania, Zanzibar still remains free of CBPP. The spread of CBPP southwards has been arrested such that to date there has been no spread of CBPP disease to Malawi, as indicated through sustained surveillance in that country.

RESEARCH THRUST

The FAO/OIE/AU-IBAR/IAEA joint Consultative Group Meeting on CBPP has afforded these organizations and the international scientific community an excellent technical platform for exchange of ideas and synthesis of strategic initiatives aimed at the progressive control and prevention of CBPP. Earlier meetings of the CBPP Consultative Group have identified the need for development and validation of new strategies, vaccines, diagnostic tests and the potential use of antibiotics for control of CBPP in Africa (FAO 2001, 2004 and 2007). In view of the epidemiological situation of CBPP in Africa, most countries use vaccination, usually carried out by official veterinary services, as a form of control. The T1-44 vaccine, an attenuated live MmmSC vaccine strain, has been in use since 1956. Safety and efficacy of the vaccine has been questioned at different fora by Rweyemamu, Litamoi, Palya & Sylla (1995),

Thiaucourt, Yaya, Wesonga, Huebschle, Tulasne & Provost (2000) and March (2004). The live attenuated vaccines currently in use are a compromise between virulence, immunogenicity and safety. It has been argued in certain quarters that improving the quality of existing CBPP vaccines is more likely to deliver significant beneficial effects than developing a new generation of vaccines, which will be an expensive and time consuming process. With the support of the Wellcome Trust, the Moredun Institute, University of Edinburgh, UK has proposed or is currently working on the following research themes on vaccines and diagnostics in collaboration with various partners (Schnier & McKeever 2007):

- Comparison of safety and efficacy of buffered CBPP vaccine with conventional T1-44 vaccine
- Estimation of the social and economic impact of vaccination
- Evaluation of different vaccine distribution systems
- Evaluation of different diagnostic tests, e.g. latex agglutination test (LAT antigen) LppQ-ELISA, TaqM-PCR
- Development of a new generation vaccine
- Evaluation of immunological responses to vaccination.

Research on molecular epidemiology and improvements in the diagnostics of CBPP amongst other initiatives by the CIRAD group in Montpellier, France in collaboration with partners, is ongoing.

THE FUTURE

The control of CBPP by affected countries appears uncertain, partly owing to missing gaps in the pathogenesis of the disease, lack of plausible epidemiological data from which sustained control actions could be based, weak veterinary services and poor economic standing of most countries affected by the disease in Africa. The feasibility of the use of currently available tools for diagnosis and control coupled with reinforcement of awareness creation, disease search using community based animal health workers must be strengthened to bring hope to cattle farmers in Africa. The control of CBPP in Angola is pivotal to the mitigation of risk of CBPP spread to SADC countries. A template for prevention and control was presented by Windsor (2000).

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