Overview and epidemiology of contagious bovine pleuropneumonia in Africa *

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Summary: Contagious bovine pleuropneumonia (CBPP) is widespread in Africa and in other regions of the world. This disease is particularly important in the semi-arid, sub-humid and arid zones of tropical Africa, but CBPP incidence seems to be increasing in some parts of East Africa. The epidemiology of CBPP is characterised by the occurrence of sub-acute and symptomless infections, and the persistence of chronic carriers. Spread of the disease is associated with cattle movement.

The major obstacles to eradication of CBPP are the difficulties in controlling cattle movement and applying quarantine and slaughter policies. Other difficulties arise due to the absence of a field test for diagnosis, the relatively short duration of post-vaccinal immunity and the lack of data on the economic impact of the disease.

The Pan-African Rinderpest Campaign strategy for CBPP control and eradication conforms with national control programmes, which include cost/benefit analysis. It is planned to perform blanket vaccination against the disease for three to five years, depending on the economic situation of each country. Stringent control of cattle movement will complement vaccination campaigns. The eradication phase, including slaughter measures, will be instituted following reduction of CBPP incidence.

Regional and international coordination will be instituted to control international cattle movement and harmonise control strategies.

KEYWORDS: Africa – Bovines – Contagious bovine pleuropneumonia – Diagnosis – Disease control – Epidemiology – Mycoplasma mycoides subsp. mycoides SC.

INTRODUCTION

The causative agent of contagious bovine pleuropneumonia (CBPP) is Mycoplasma mycoides subsp. mycoides SC (bovine biotype). This disease is widespread in Africa and is also present in other regions of the world, including Southern Europe, the Middle East and parts of Asia.

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PRESENT SITUATION IN AFRICA

In 1993, according to information published by the Office International des Epizooties (OIE) and the Food and Agriculture Organisation of the United Nations (FAO) (10, 19), various reports and personal communications, CBPP was present in 23 countries in Africa, as follows: Angola, Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Eritrea, Ethiopia, Ghana, Guinea, Kenya, Mali, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tanzania, Uganda and Zaire.

This list confirms that CBPP is absent from North Africa and most of Southern Africa, and that the disease is of greater importance in semi-arid, sub-humid and arid climates than in the humid regions of tropical Africa, where the cattle population is relatively small.

It is worth noting that the incidence of CBPP seems to have increased in some Eastern African countries, and to have recently been moving southwards (southern Uganda, Rwanda, southern Tanzania).

ECONOMIC IMPORTANCE

The economic importance of 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 programmes (i.e. due to vaccination campaigns, quarantine and restrictions on cattle trade).

It should be noted that economic evaluation of losses due to CBPP has not been performed systematically throughout Africa. Priority should therefore be given to the cost/benefit analysis of control or eradication campaigns.

DIAGNOSIS

CBPP may occur in acute, sub-acute and chronic forms (3, 13). Symptomless infections have also been recorded.

Clinical diagnosis of CBPP is difficult. The disease must therefore be confirmed by serological means. The complement fixation test (CFT), the agglutination of both blood and serum, immunofluorescence, agar gel (14) and skin tests have all been used for the diagnosis of CBPP. The most reliable of these tests is the CFT, which detects approximately 70% of cases (as the process of sequestration takes place, the CFT becomes less sensitive and can fail to detect up to 30% of cases). The allergic skin test, developed at laboratory level, has not been adapted for general field use (23), and enzyme-linked immunosorbent assay is currently under evaluation. Laboratory isolation and identification of \textit{M. mycoides} usually confirm the disease (8, 13). The development of a simple, rapid and reliable diagnostic test is therefore essential.
CBPP is a lobar pneumonia (3, 13). The typical pathology of the acute disease is manifested in the marbling appearance. Sequestration may start as early as two weeks after the onset of the disease. Sequestra vary from the size of a tiny pea to a whole lobe or even the entire lung.

CONTROL OF CONTAGIOUS BOVINE PLEUROPNEUMONIA

Cattle movement control

The control of cattle movement is the most efficient means of limiting the spread of CBPP (2).

Nomadism and transhumance are necessary due to 'agro-pastoral' conditions (a combination of agriculture and pastoral activity), which are often impossible to avoid in Africa. This is particularly true in the semi-arid and sub-humid zones of Central and West Africa. Cattle owners may also deliberately avoid legal livestock movement control measures as, in some countries, many associate these with taxation. In addition, for socio-economic reasons, cattle trade routes and livestock movements are even more difficult to define and control. Stock movement control should therefore be enforced by the police or the army. Unfortunately, some central government authorities are not strong enough to enforce this requirement.

Quarantine

Quarantine of endemic areas is one effective method of controlling the spread of CBPP. The quarantine should be for a minimum of three months, and clinical and serological examinations should be performed during this period: all animals showing positive results should be slaughtered and the remaining animals vaccinated.

Regional and international coordination

Regional and international coordination of stock movement is important in the control of CBPP (13). This practice should emphasise the exchange of disease outbreak information, cattle movement data and border harmonisation of vaccination campaigns. The establishment of livestock markets on both sides of the borders would greatly facilitate stock movement control.

Vaccination

Vaccines which have been used against CBPP are the KH\textsubscript{3}J, F, V5 and T\textsubscript{1} strains. The latter has been used extensively in Africa (3, 13, 20, 21).

In 1971, the FAO/OIE/Organisation of African Unity (OAU) Expert Panel recommended that the T\textsubscript{1} strain should be preferred, but that the KH\textsubscript{3}J strain should be used where animals are over-sensitive (1). The T\textsubscript{44} or T\textsubscript{1}-SR strains are currently used throughout the continent.

Annual vaccination is effective when using the T\textsubscript{1} strain (3, 7, 11, 15, 22), or bi-annual vaccination when using KH\textsubscript{3}J. The recommended minimum vaccinating dose of the T\textsubscript{1} strain is $10^7$ organisms (12, 18).
Annual mass vaccination should be performed for three to five years before genuine control of CBPP is achieved. This type of vaccination has been used with good results in East Africa and much of West Africa. More recently, this vaccination strategy has been successfully applied in Côte d'Ivoire.

In outbreak areas, more intensive vaccination strategies can be instituted (1, 3).

Following vaccination, only one-third of the animals respond serologically, as measured by CFT. Nevertheless, the majority of cattle are well protected for up to two years (7, 11, 22).

Combination of slaughter policy and movement control

Slaughter of sick and contaminated animals is useful in the control of the disease. This may necessitate compensation, however, and a fund should always be established for this purpose.

CBPP was eradicated in the United Kingdom in the 19th century, through the slaughter of all animals in the outbreak area. Southern Africa eradicated the disease in the early 20th century by implementing strict movement control, quarantine and slaughter.

Combination of vaccination, slaughter policy and movement control

Australia succeeded in eradicating CBPP using a combination of the three control methods (17), and this combination has also been used in many countries in Africa. In the 1960s and 1970s, the countries of East Africa practised all three methods; these countries were followed by the Central African Republic, Cameroon and Nigeria in 1970s and 1980s, and Guinea (Conakry) in 1992-1993.

Slaughter policy alone

Eradication through the slaughter of all animals yielding positive results by CFT is difficult to implement and cannot succeed alone.

Surveillance

Clinical diagnosis, serological surveillance, and post-mortem examination of lesions at abattoirs are essential in the detection of CBPP (4, 5, 13). A country intending to provide evidence of freedom from the disease should form a strong surveillance network. The standard procedures recommended by the OIE for the declaration of freedom from CBPP include the following (6):

- a system of reporting active disease, supported by efficient laboratory and field services
- an active programme of examination of statistically-selected samples from the cattle population, to detect clinical disease or other indications of occurrence of CBPP.

EPIDEMIOLOGY

Hosts

CBPP affects only cattle and water buffalo, although serological response may occur in other animal species.
Transmission

Transmission from infected to healthy animals generally occurs through inhalation of infected droplets (13).

Droplets can be carried on the wind for 200 m or more (13). Transmission can also occur through fomites and contaminated fodder (24, 26). Transmission from the acute, sub-acute and chronic forms of the disease may occur. However, the majority of sequestra are sterile by 36 months, and therefore non-infectious. Animals may recover from CBPP provided that the lesions are small; such lesions may resolve completely, although possibly leaving scarring on the lungs. Animals which recover from CBPP are resistant to further challenge (25).

Age susceptibility

Young animals are more susceptible to articular forms of CBPP than adult cattle (13, 16). Old cattle are more susceptible to pleuropneumonia (3).

Pathogenesis

It is known that inhaled droplets containing M. mycoides lodge in small bronchioles, where the organism becomes established and starts to form the lesion. Lesion formation is understood to proceed through the direct multiplication of mycoplasma and immunological reactions.

Problems associated with CBPP control

As stated above, the most important problem is that cattle movements are very difficult (and sometimes impossible) to stop or control (9). Moreover, CBPP is generally chronic and insidious, and some time is required before the disease becomes manifest. Morbidity is approximately 30%, while mortality is low (13). CBPP is therefore less alarming than rinderpest, and farmers may be slow to recognise the presence of the disease and accept control measures. For these reasons, it is often difficult to achieve high vaccination coverage.

In addition, vaccination cover is usually not very high, due to financial and government policy constraints. Cost/benefit analysis of CBPP control would highlight the importance of the disease.

Other problems associated with CBPP control are the lack of a simple, rapid and reliable diagnostic field test, and the relatively short period of immunity conferred by current vaccines.

ROLE OF THE PAN-AFRICAN RINDERPEST CAMPAIGN IN PAST AND FUTURE CONTROL STRATEGIES

During Phase I of the Pan-African Rinderpest Campaign (PARC), the campaign was specifically aimed at rinderpest eradication, integrating this into a general scheme which included the revitalisation and privatisation of veterinary services. But revitalisation of CBPP control was not the priority, and indeed PARC has strengthened state Veterinary Services; in so doing, PARC has backed vaccination campaigns, epidemiological surveillance and laboratory diagnosis for rinderpest as well as CBPP.
The main improvement has consisted of blanket vaccinations performed with mixed rinderpest/CBPP vaccines, and quality control duly certified by the Pan-African Veterinary Vaccine Centre (PANVAC) in Debre-Zeit (Ethiopia).

In countries such as Côte d'Ivoire, for example, vaccination against CBPP was achieved over three consecutive years (1989-1991). General surveys, management of the campaigns and laboratory diagnosis were progressively added to the field service activities. The control of cattle movements at the borders with Mali and Burkina Faso was also strengthened. The number of CBPP outbreaks thus decreased and an eradication scheme could be foreseen in the near future.

Also, the evolution towards privatisation of animal health care should have positive effects in the field as control of CBPP at the village level could be better achieved by private veterinarians, through associations of cattle owners.

During Phase II, the role of PARC in the control of CBPP will be amplified in many ways.

As stated above, technical solutions theoretically exist to control and eradicate CBPP: vaccination, control of cattle movements and slaughter measures. The problem is when and how to apply these measures.

The strategy of PARC will be defined on a country-by-country basis, according to the local and regional situations. The proposed plans will include the following steps:

a) Intensive vaccination schemes may be applied in countries where CBPP outbreaks are rampant and where many active cases threaten non-infected areas, as is the case at present in some East African countries (1, 3). Complementary measures must be instituted, i.e. disease surveillance, strict quarantines and slaughter of sick animals.

b) Epidemiological surveys will be conducted, with economic evaluation of the cost of the disease, and calculation of the cost/benefit ratio of control campaigns involving vaccination and/or mixed vaccination and slaughter policies.

c) The final shape of the plan would be decided on the basis of the results of these surveys. In most cases, the plan would commence with an initial phase of blanket vaccination using T1 vaccine, for three to five years. Communication and sensitisation of cattle owners will be very important at this stage. In fact, intensive and localised campaigns are considered to have more chance of succeeding than widespread campaigns (4, 5).

d) These campaigns would be accompanied by intensification of disease surveillance and control of cattle movement. Quarantine measures will be difficult to impose in many countries, but the control of moving herds will be strengthened: ear notching, re-vaccination, and checking of geographical origin and destination of animals will be compulsory when these herds enter the vaccinated zone. A movement permit mentioning this information will also be compulsory for checking and enforcing controls along the movement routes and, at the final destination, for a final veterinary inspection to be performed. Pre-movement vaccination of animals intended for slaughter remains necessary, as the trade routes are often long and animals can sometimes be sold instead of continuing on to the abattoir.

e) As and when cattle are slaughtered, inspection for CBPP lesions will be carefully conducted.

f) When the number of outbreaks becomes low enough, the compulsory slaughter and compensation phase should commence.
At this stage, control of cattle movement becomes crucial. If a policy of slaughtering infected animals is to be implemented, isolation of the area will be essential, with prohibition of herds entering from infected areas.

Verification of the disease status (i.e. CBPP situation and immunological status of cattle) in the region of origin of the herds must be rigorously applied.

Therefore, regional and international coordination becomes important, as every country which runs a control programme must know the situation of the neighbouring countries. This information will also be necessary for distant countries if cattle herds are transported from such countries.

Regional and international coordination – by organisations such as the OIE, OAU/Inter-African Bureau of Animal Resources (IBAR) and FAO – should extend to various fields, including animal health information, cattle movement data, harmonisation of control strategies, training, research, standardisation of biological products and quality control of diagnostic testing.

The recommendation elaborated at the OAU/IBAR/OIE meeting in December 1991 (2), with the creation of a special CBPP group associating the OAU, OIE, FAO and donors, should be implemented as soon as possible.

With the approval of the funding of a new PARC Phase II programme by the European Development Fund, a set of countries will begin implementing this strategy.

In addition, PARC is also supporting the following projects devoted to or directly linked with CBPP control activities:

- A CBPP research programme, which includes a network of eleven specialised laboratories, six in Europe and five in Africa, and which will be coordinated by the Département d'élevage et de médecine vétérinaire (CIRAD-EMVT, France). This programme covers three main areas, namely the improvement of vaccines and diagnostic tools, and research on CBPP immunology.

- The continuation of the work of PANVAC in the quality control of CBPP vaccines produced in Africa.

- The setting-up of an epidemiological surveillance network for rinderpest-like diseases, which will also help the surveillance of CBPP.

- The development of a communication programme for public participation in PARC, which will actually strengthen all national PARC project components, including CBPP control programmes and epidemiological surveillance.

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SITUATION ET ÉPIDÉMIOLOGIE DE LA PÉRIPNEUMONIE CONTAGIEUSE BOVINE EN AFRIQUE. – W.N. Masiga et J. Domenech.

**Résumé** : La péripneumonie contagieuse bovine est répandue en Afrique et dans d'autres régions du monde. Particulièrement importante dans le Sahel (Afrique tropicale), cette maladie semble avoir une incidence croissante dans certaines régions d'Afrique orientale. L'épidémiologie de la péripneumonie contagieuse bovine se caractérise par l'apparition d'infections subaiguës et
asymptomatiques, ainsi que par la persistance de porteurs chroniques de l'agent pathogène. La propagation de la maladie est liée aux déplacements du bétail.

Les difficultés rencontrées pour contrôler les déplacements de bovins et appliquer des procédures de quarantaine et d'abattage constituent un obstacle majeur à l'éradication de la péripneumonie contagieuse bovine. Mais la lutte contre cette maladie se heurte également à d'autres problèmes : l'absence d'épreuves de diagnostic de terrain, une immunité post-vaccinale relativement courte et le manque de données sur l'impact économique de la maladie.

La stratégie mise en œuvre dans le cadre de la Campagne panafricaine de lutte contre la peste bovine (Pan-African Rinderpest Campaign : PARC) pour le contrôle et l'éradication de la péripneumonie contagieuse bovine répond aux exigences des programmes nationaux dans ce domaine, qui incluent notamment une analyse coûts-bénéfices. Cette stratégie prévoit une vaccination systématique pour une durée de trois à cinq ans selon la situation économique de chaque pays. Un contrôle strict des déplacements du bétail viendra compléter les campagnes de vaccination. La phase d'éradication (y compris les mesures d'abattage) sera mise en place lorsque l'incidence de la péripneumonie contagieuse bovine aura diminué.

Le contrôle des déplacements internationaux de bovins et l'harmonisation des stratégies de prévention feront l'objet d'une coordination à l'échelle régionale et internationale.


SITUACIÓN Y EPIDEMIOLOGÍA DE LA PLEURONEUMONÍA CONTAGIOSA BOVINA EN ÁFRICA. – W.N. Masiga y J. Domenech.

Resumen: La pleuroneumonia contagiosa bovina (contagious bovine pleuropneumonia: CBPP) es una enfermedad muy extendida en África y otras regiones del mundo. Resulta de especial importancia en el Sahel tropical africano, aunque su incidencia parece ir en aumento también en algunas zonas del África oriental. La epidemiología de la CBPP se caracteriza por la existencia de infecciones subagudas y asintomáticas y por la supervivencia de portadores crónicos del agente patógeno. Su propagación está ligada a los movimientos de ganado.

El obstáculo más importante para la erradicación de la CBPP reside en las dificultades de practicar tanto un control de los movimientos de ganado como políticas de sacrificio y de cuarentena. La ausencia de una prueba de campo para el diagnóstico de la enfermedad, la duración relativamente corta de la inmunidad que sigue a la vacunación y la carencia de datos sobre su impacto económico constituyen otros tantos inconvenientes adicionales.

La estrategia para el control y erradicación de la CBPP, definida a raíz de la Campaña Panafricana contra la Peste Bovina (Pan-African Rinderpest Campaign: PARC), se ajusta a los programas nacionales de control, e incluye un análisis de costes y beneficios. Está prevista la realización de vacunaciones generalizadas durante un período de entre tres y cinco años, en función de la
La situación económica de cada país. Las campañas de vacunación se complementarán con un control riguroso de los movimientos de ganado. Cuando haya decrecido la incidencia de la CBPP, se dará comienzo a la fase de erradicación, que incluye el sacrificio sanitario.

A fin de controlar los movimientos internacionales de ganado y de armonizar las estrategias de control se instituirán medidas de coordinación regional e internacional.


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REFERENCES


