Within-herd spread and clinical observations of contagious bovine pleuropneumonia in Ethiopian Highlands (Boji district, West Wellega): methodology and epidemiological results.

M. Lesnoff[1,*], G. Laval[1], S. Abicho[2], A. Workalemahu[3], D. Kifle[3], A. Peyraud[1], P. Bonnet[1], R. Lancelot[1], F. Thiaucourt[1]. [1] Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), Campus International de Baillarguet, 34398 Montpellier Cedex 5, France. [2] National Animal Health Research Centre, P.O. Box 4, Sebeta, Ethiopia. [3] International Livestock Research Institute (ILRI), P.O. Box 5689, Addis Ababa, Ethiopia.

Summary

A research programme was set up in a CBPP-infected zone in Ethiopian highlands (Boji district in West Wellega Province) and a follow-up survey was implemented in 71 sampled herds. Fifteen of them were classified as newly infected and used in a serological and clinical incidence study. The overall 8-month and 16-month cumulative sero-incidence risks were 26% and 34% of the herd, respectively. The late sero-conversions might have resulted from secondary CBPP introductions. Clinical cases were recorded for 39% of the seropositive cattle. The case-fatality rate was 13% of clinical cases.

Introduction

Contagious bovine pleuropneumonia (CBPP) is a disease caused by the small-colony type of *Mycoplasma mycoides subspecies mycoides* [6]. Transmission occurs from direct and repeated contacts between sick and healthy animals. It is a major threat for cattle health and production in Africa, where it was reported from 17 countries in 2001 [2]. Few field data, however, were reported in the literature on within-herd spread of CBPP during outbreaks. A research programme was set up in a CBPP-infected zone in Ethiopian highlands (Boji district in West Wellega Zone) to estimate the epidemiological parameters of the disease and to assess the effects of different disease management strategies naturally implemented by the local farmers.

Material and methods

Boji district is characterized by a mixed crop-livestock farming system, in which herds are sedentary and small. Cattle are mostly of the Horro breed, an intermediate Sanga-zebu type. Animals are used for agricultural activities, milk, meat production and manure. Cattle exchanges (e.g. for loaning contracts) between farmers are frequent [4, 5].

Fifteen newly and naturally CBPP-infected herds (mean herd size = 17 animals) were sampled and followed for 16 months between June 2000 and January 2002. Each animal was ear-tagged. Trained enumerators visited the herds every 2 weeks to record demographic events (entry, birth, mortality, offtake), the symptoms of CBPP clinical cases and the type and cost of veterinary care applied. In case of death, a post-mortem diagnosis was established by the veterinary supervisors according to the clinical signs reported by the farmers and enumerators, and a necropsy (whenever possible) was realized. Blood samples were collected every 3 months from all animals to assess their serological CBPP status. Sera were tested with a competitive enzyme-linked

Proceedings of the 10th International Symposium on Veterinary Epidemiology and Economics, 2003
Available at www.sciquest.org.nz

immuno-sorbent assay (cELISA) test.

For each infected herd, a retrospective survey was conducted at the end of the follow-up period to determine the control measures implemented by the farmers to manage CBPP clinical cases. Two measures were identified: treatment of clinical cases with antibiotics and isolation from the rest of the herd. Two CBPP-control strategies were defined according to these practices: herds with complete antibiotic treatment or isolation (coded “C”), herds with no antibiotic treatment and partial or null isolation (coded “P/N”). Herds for which the strategy was unknown were coded “UNK”.

Logistic-binomial regression models were used to analyse the serological incidence data from the 15 newly CBPP-infected herds. The follow-up was divided into successive 4-month periods starting at the CBPP-onset date. The response was the sero-incidence risk, i.e. the number of positive sero-conversions during each period, over the number of sero-negative cattle at the beginning of the period. Three statistical models were used to take into account for possible within-herd data correlation [8]. The first model was the ordinary logistic regression adjusted with the variance inflation factor (OLR + VIF). The other 2 models were generalized linear mixed-effect models (GLMM) in which herd was the random effect. Parameters of the GLMM were fitted either with the adaptative gaussian quadrature (AGQ) or a Monte-Carlo Markov chain (MCMC) algorithm.

Results

The statistical analysis of the serological incidence provided similar results with the different logistic-regression models (Table 1). The 95% confidence interval of the herd-effect variance in the MCMC model was [0.12; 1.42] and the estimated VIF was 2.2 (H_0: VIF = 1, $P < 10^{-3}$), which both confirmed the necessity to account for disease clustering. The sero-incidence risk decreased significantly with time ($P < 0.01$ at the most). For example, sero-incidence risks decreased from 20% in period 1 ($t < 4$ mo after CBPP onset) to 5% in period 4 (MCMC estimates). Risks in period 3 and 4 (i.e. $8 \leq t < 12$ mo and $12 \leq t < 16$ after CBPP onset) were > 0. The 16-month cumulative risk was 34% (25; 48) (95% confidence interval in brackets).

No evidence of farmer CBPP-control strategy effect was shown. The difference of the mean random-herd effects between strategies “P/N” and “C” was 0.271 on the logit scale (which represented a variation of 6% in the cumulative sero-incidence risk) and was not significant (randomisation test, B = 2,000 permutations, P = 0.432).

Period	OLR + VIF [a]		GLMM – AGQ [b]		GLMM - MCMC [c]	
	Inc. [d]	Cum. Inc. [d]	Inc.	Cum. Inc.	Inc.	Cum. Inc.
$0 \leq t < 4$ mo	22 (16, 30) [a]	22 (16, 30)	20 (13, 29)	20 (13, 29)	20 (13, 28)	20 (13, 28)
$4 \leq t < 8$ mo	8 (4, 15)	28 (21, 37)	8 (5, 14)	27 (19, 37)	8 (4, 14)	26 (18, 37)
$8 \leq t < 12$ mo	7 (3, 15)	33 (26, 43)	7 (4, 12)	32 (23, 43)	7 (4, 13)	31 (22, 44)
$12 \leq t < 16$ mo	5 (2, 13)	36 (29, 47)	5 (3, 8)	36 (26, 47)	5 (2, 10)	34 (25, 48)

Table 1. CBPP sero-incidence and cumulative sero-incidence risks (%) estimated from 3 logistic-regression models for zebu cattle in 15 CBPP newly infected herds from West Wellega (Ethiopia). Sample sizes were 278, 212, 197 and 155 cattle during the first, second, third and fourth 4-month periods after CBPP introduction.

[a] Estimated population mean and 95% confidence interval.

Clinical cases were recorded for 39% of the sero-positive cattle. Only 13% of these clinical cases died from CBPP and no antibiotic treatment effect was observed

Proceedings of the 10th International Symposium on Veterinary Epidemiology and Economics, 2003
Available at www.sciquest.org.nz

(3/20 untreated animals and 2/19 treated animals, Fisher's exact test P = 1). For animals surviving to the disease, the mean duration of the clinical signs was 4 weeks (median = 3, range = [1, 11]). The difference in the clinical-phase duration between untreated and treated animals was 1.2 weeks and not significant (Kolmogorov-Smirnof test, P = 0.73).

Discussion

The CBPP cumulative incidence and mortality risks observed in Boji district were lower than those reported from experimental challenges or from field outbreak in pastoral herd (incidence risk higher than 80% and mortality risks from 10% to 80%) [3, 1, 6]. The animal confinement conditions, the virulence variability in *MmmSC* strains or an effect due to the small herd size (cattle management and disease control may be easier than in large herds) might be involved. A number of recovered or vaccinated animals could also have been introduced in Boji district through commercial or loaning flows, thus reducing the proportion of susceptible cattle. Further longitudinal studies are necessary to validate the observed low incidence and mortality in mixed-crop farming systems.

Incidence risks in periods 3 and 4 were not in agreement with the outbreak durations reported in literature [3, 1, 7]: in the absence of re-infection, most of the new CBPP sero-conversions should occur within 6-7 months after the initial introduction. The late sero-conversions observed during the present survey might have resulted from secondary CBPP introduction, occurring through unreported cattle importation or unobserved contacts with neighbouring and non-monitored infected herds.

The between-herd variability in CBPP incidence risks observed in the study was difficult to interpret. Antibiotics treatments associated with isolation of sick animals can reduce both incidence and mortalities. However, no effect of the CBPP-control measures, as implemented by the farmers, was observed. This might be related to a lack of power in the statistical analyses due to the small number of infected herds in the sample or to confounding factors (for example, the priority given by the farmers to the treatment of the most severely affected animals). On the other hand, it could reflect a quality problem for the medications used, and more generally, for health-care delivery in the Boji district. Most of the treated cattle during the follow-up survey received a single injection of a 10% oxytetracycline suspension (purchased on the informal market), and administered intra-muscularly at a dose of 10 ml per cattle by the farmers themselves. Such a treatment protocol was probably not appropriate to ensure CBPP recovery.

References

- [1] Bygrave A.C. et al., 1968. Bull. epiz. Dis. Afr., 16, 21-46.
- [2] Handistatus OIE, 2002.
- [3] Hudson J.R., Turner A.W., 196. Aust. Vet. J., 39, 373-385.
- [4] Laval G., Workalemahu A., 2002. Eth. J. Anim. Prod., 2, 97-114.
- [5] Lesnoff M. et al., 2002. Rev. Elev. Méd. vét. Pays trop., 55,139-147.
- [6] Masiga W.N. and Domenech J., 1995. Rev. Sci. tech. Off. int. Epiz., 14, 611-630.
- [7] Provost A. et al., 1987. Rev. Sci. tech. Off. int. Epiz., 6 (3), 625-679.
- [8] Schukken Y.H. et al., 2003. Prev. Vet. Med., 59, 223-240.