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Risk factors for infertility in nursing cows linked to calving

C Ducrot *, I Cimarosti, F Bugnard, A Van de Wiele, JM Philipot

Centre d'Écopathologie Animale, 26, rue de la Baisse, 69100 Villeurbanne, France

Summary — An ecopathological survey was conducted between 1987 and 1989 in 116 French herds with 3 590 cows in order to study the risk factors for infertility linked to calving. Based upon an analysis model of etiological interactions, the complementary use of a logistic model and factorial analysis followed by classification allowed demonstration of the direct and indirects, effects upon infertility, breed factors, parity, fattening, comfort, calf characteristics (number, sex, weight, presentation), as well as the difficulty and complications which may have been associated with calving. By association, these factors determine the profile of the cows at risk.

fertility / calving / beef cattle / ecopathology / epidemiology

Résumé — **Facteurs de risque d'infécondité des vaches allaitantes liés au vêlage.** *Une enquête d'écopathologie a été menée de 1987 à 1989, dans 116 élevages allaitants français, sur 3 590 vaches, afin d'étudier les facteurs de risque d'infécondité liés au vêlage. Au sein d'un modèle d'analyse des interactions étiologiques, l'utilisation complémentaire du modèle logistique et de l'analyse factorielle suivie de classification a permis de montrer les effets directs et indirects, sur l'infécondité, des facteurs race, parité, engraissement, confort, caractéristiques du veau (nombre, sexe, poids, présentation), ainsi que difficulté et complications du vêlage. Par leurs associations, ces facteurs déterminent des profils de vaches à risque.*

fécondité / vêlage / bovin / écopathologie / épidémiologie

INTRODUCTION

In nursing herds, infertility has considerable economic consequences. This is because it occurs very frequently and has a serious effect upon the number of calves produced globally as well as their market value, particularly in relation to birth dates (Grenet, 1991). Our knowledge of the causes of infertility, obtained from experimental work and

clinical histopathological and physio-pathological research, leads us to believe that there are a number of parameters involved; these are related to both the animal itself and its environment in the widest sense (Grenet, 1982; Espinasse, 1985). An ecopathological survey has been performed in order to study the effects of the conditions associated with calving and breeding management before calving, upon fertility.

* Correspondence and reprints

MATERIALS AND METHODS

This study was devised and performed by a multidisciplinary and multiprofessional working party (Rosner, 1983) led by the person responsible for the study, whose role consisted of formulating study hypotheses, planning the study protocol, and interpreting the statistical results. It consisted of a prospective observation study conducted on herds over a period of 2 yr, the first year allowing information to be collected about farm practices and breeding management, and the second, the reproduction results for the cows over the following season.

The study involved 116 volunteer farmers situated in the Rhône-Alpes and Centre regions, as well as in the administrative region of the Yonne. The main characteristics of the farms monitored were as follows:

- 90% of the herds were Charolais purebred or crossbred, the rest were Limousin or Salers;
- the average size of a nursing herd was 29 cows, 15% having more than 40 cows;
- some of the farms were specialized in beef cattle, which represented more than 90% of the operating turnover in a third of cases, while the others practiced mixed farming, cereal and oil-seed production in association with beef production or other types of breeding (there was some dairy production in a third of the farms monitored);
- the average age of the farmer was 41 yr, one third of the breeders were less than 35 yr old;
- 11% of the farms were *Groupements Agricoles d'Exploitations en Commun* (GAEC).

All of the cows from the farms monitored, ie 3 590 cows, were monitored during the first year; only 2 993 cows were monitored during the second year as a result of culling that was performed between the 2 years. Apart from the information recorded daily by the farmers, data were collected over 5 visits by 33 investigators (veterinarians, technicians, researchers). Each investigator conducted the monitoring at farms which were normally a part of their practice. This involved noting the characteristics of the cows, calving conditions, housing, feeding and breeding management.

The complexity of the hypotheses tested, organized in accordance with a logical scheme (Legay, 1973) integrating the chronological order of the effect of factors and the existence of indirect effects, was analyzed using a model of analysis of etiological factors (path analysis) (Curtis *et al*,

1985). This method consists of breaking up the general scheme of the hypotheses into sub-groups in order to test them.

Thus, 3 sub-analyses were performed in order to study the risk factors associated with calving difficulty, placental retention and infertility. These were conducted in accordance with 2 complementary approaches: modelling, from the logistic regression model in accordance with methods proposed by Hosmer and Lemeshow (1988); and factor analysis from a multiple correspondence analysis, followed by ascending hierarchical clustering (Lebart *et al*, 1977).

Calvings that were considered to be difficult were those that necessitated the use of a calf-puller, the intervention of several people, or when a caesarean section was performed. The cows that were considered to be infertile were those that were not fertilized during the period under consideration or those cows having with a period longer than 1 year between calvings.

RESULTS

Of the 3 583 cows that were monitored for calving 47% calved without the intervention of the farmer; 23% required easy assistance; and calving was difficult in 30% of cases which included 3% by caesarean section, 8% by forcible extraction and 19% with the assistance of a calf-puller. Furthermore, it was reported that 5.1% involved placental retention, 1.7% acute puerperal endometritis and 1.4% uterine prolapse. As far as the reproduction results are concerned, 49% of the 2 993 cows that were monitored for 2 consecutive years did not achieve the zootechnical objective of a calving interval of less than 370 d (fig 1): 8% were not fertilized and 41% presented with a calving interval greater than 370 d.

The results of the logistic regressions are presented in figure 2. They demonstrate the direct and indirect effects (placental retention being the intermediate of calving difficulty upon infertility as well as farm practices at the time of calving (absence of lubrication, late intervention). Moreover, many factors

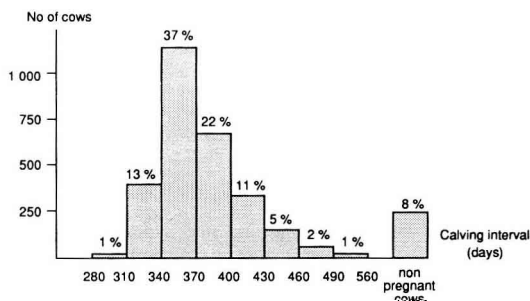


Fig 1. Frequency of calving intervals for 2 993 nursing cows.

had an indirect effect upon infertility because they were the risk factors for calving difficulty, and placental retention. They were relative to the nature of the cow (primiparous, Charolais breed), the calf (male, high birth weight, posterior or abnormal presentation at the time of calving), and the body condition of the cow (excessive or insufficient) and its housing (insufficient available space).

Multiple correspondence analysis has demonstrated that there was no strong typological link between the factors studied; they appeared to be relatively independent of one another apart from the relationships demonstrated in the path analysis model (for example, parity-calving difficulty and complications). The classes of cows resulting from ascending hierarchical clustering presented frequencies of calving difficulty and infertility which were very variable (from 11% to 60% of difficult calvings and 40% to 65% of unfertilized cows according to class), and which were linked directly to a number of risk factors which were strongly represented (table I). By means of the association of factors that they presented, certain classes illustrated the different causes of calving difficulties (classes F, G and H in table I): abnormal presentation and the presence of twins, excess calf volume, and slow delivery linked to excessive fattening.

DISCUSSION

The reproduction results observed in the study as well as the frequency of assisted calvings, forcible extractions, caesarean sections and calving complications were very similar to those observed by other authors, notably those involving Charolais breed (Mc Dermott *et al*, 1991; Vallet and Manière, 1988).

The relationship observed between calving difficulty and infertility, not adjusted for the other factors, agrees with the observations reported by Grenet (1982).

The multivariate study furthermore allowed measurement of the real effects of each of the factors under study. In this case it appeared that calving difficulty exerted both a direct and an indirect effect upon fertility, because of the calving complications it may induce.

This study has confirmed the complexity of the mechanisms of infertility, involving a large number of factors, each having a limited effect. These factors occurred in a variety of areas, and included the characteristics of the cow and its calf, the circumstances surrounding calving (presentation, calving difficulty), calving period (which is a consequence of the reproduction management of previous years) as well as a number of parameters that depend partly upon the farmer: housing conditions, feeding, and intervention techniques during calving. A factorial analysis has demonstrated the relative independence of these factors, indicating that they probably did not have a common determinism.

These results also confirmed the role of the calving and pre-calving periods in the risk of later infertility. They confirmed the idea that the prevention of infertility must begin before calving. The reproduction programmes followed currently include the rapid resolution of any problems arising after calving (Jactel, 1985); this approach is indis-

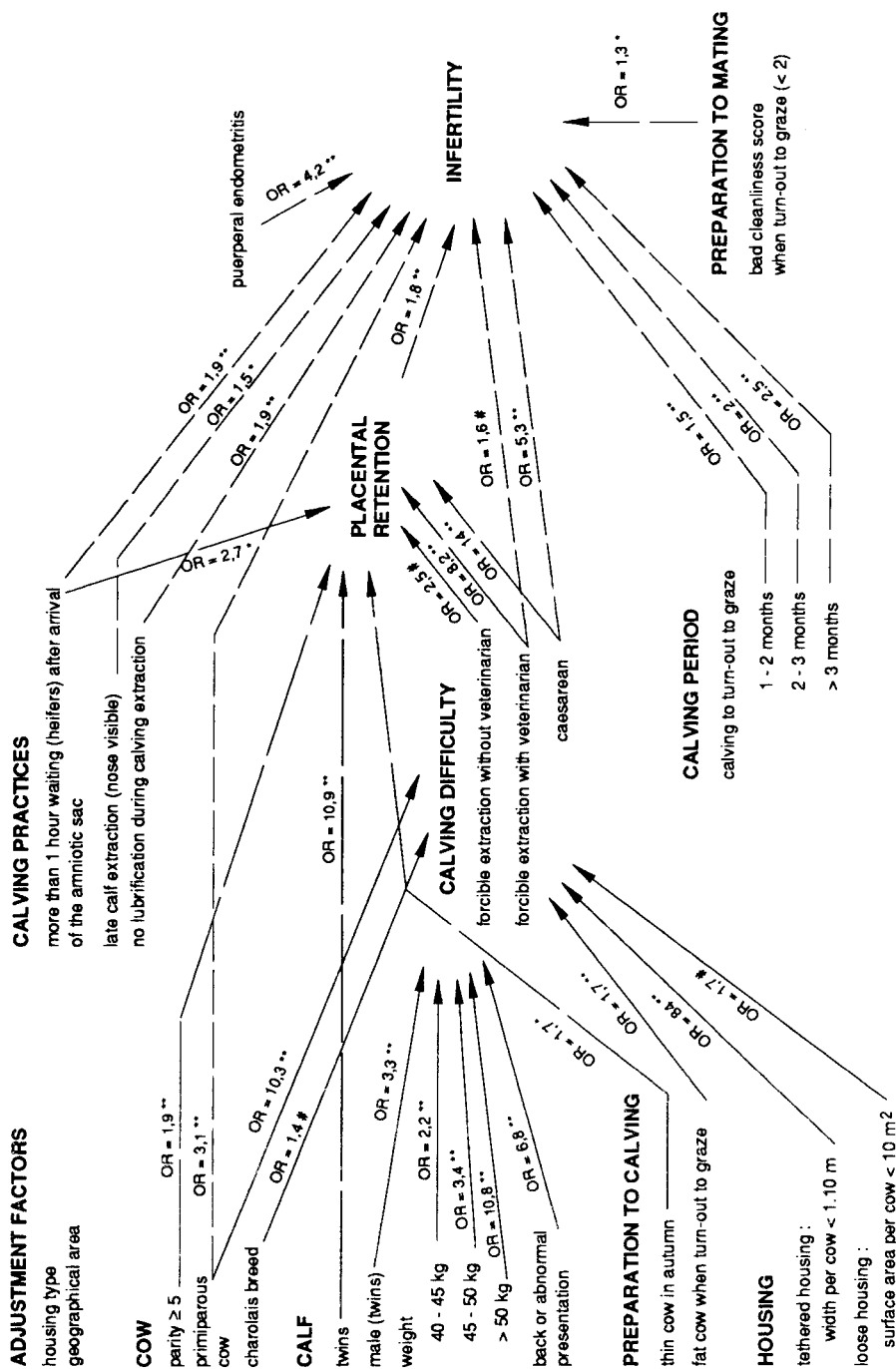


Fig 2. Final path analysis scheme for infertility (OR = conditional odds ratio; ** $P \leq 0.01$; * $P \leq 0.05$; # $P \leq 0.2$).

Table 1. Calving difficulty–risk factor profiles for the 8 groups from a hierarchical ascending clustering of 1 743 nursing cows (■ $P < 0.001$; □ $0.001 < P \leq 0.05$).

Groups	A	B	C	D	E	F	G	H
Sample size (cows)	228	175	175	528	185	176	172	104
Main variables								
parity								
1						■		
2 - 3 - 4							□	
≥ 5								
breed								
charolais				■		■	■	
limousin, salers, cross-bred		■						
calf sex and number								
1 male							■	
1 female			□					
twins								■
calf weight								
≤ 40 kg		■			■			
40 - 45		□		■				
45 - 50			■			□		
≥ 50 kg							■	
calf presentation								
unknown	■	■	■					
front and normal				■	■	■	■	
back or abnormal								■
fattening score in autumn								
low					■			
medium	■	■		■				
high						■		
fattening variation during winter								
high loss						■		
loss			□	■				
medium	□	■						
gain					■			
feeding at the end of pregnancy								
hay						■		
corn, sorghum or crucifers silage				□	□			
grass silage		□						

Table I. Cont.

Groups	A	B	C	D	E	F	G	H
Sample size (cows)	228	175	175	528	185	176	172	104
Main variables								
concentrate at the end of pregnancy								
no		■			■			
yes			■			□		
time of calving								
night	■							
day out of feeding time		■		■				
during feeding time		□		■	■	■		
unknown			■					
Supplementary variables								
fattening score at turn out to graze								
thin					■			
medium		■		■				
fat			□					
calving difficulty								
no assistance	■	■						
easy assistance				■				
assistance with calf puller							□	□
forcible extraction							■	■
caesarean								□
difficult calving (%)								
(calf puller, forcible extraction or caesarean)	11	17	23	23	24	37	51	60

Example: parity. Compared with the overall sample (1 743 cows), primiparous (parity 1) are significantly more numerous in group F ($P < 0.001$) and cows with parity 2, 3 or 4 more numerous in group G ($0.01 < P < 0.05$); in the other groups, the parity distribution does not differ (at $P < 0.05$) from the distribution in the overall sample (Lebart *et al.*, 1988).

pensable but it would be even more useful if it could involve action upon the causes of these problems which are related to the calving and pre-calving periods. The risk factors for infertility are numerous and none of them is preponderant. Thus, a preventive programme must encourage the removal of the greatest number of risk factors, which may

be present. The results indicated that these measures must involve: the choice of reproductive animal, *ie* both cows and bulls in order to work on the conformation of the mother and the weight of the calf at birth; the management, particularly feeding and comfort in housing; and the progress of calving, by improving intervention techniques.

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Contribution de l'approche écopathologique à l'étude des relations nutrition–santé chez la vache laitière

J Barnouin *, M Chassagne

INRA-Theix, laboratoire d'écopathologie, 63122 Saint-Genès-Champanelle, France

Résumé — Une approche écopathologique des relations nutrition–pathologie chez la vache laitière est présentée. Elle est basée sur des enquêtes effectuées pendant 4 ans afin de détecter les facteurs de risque qui discriminent entre élevages à faibles et à fortes incidences pathologiques (rétention placentaire, fièvre de lait, mortalité périnatale, métrite, infertilité, troubles hépatiques). Une nutrition préventive

* Correspondance et tirés à part