A DESCRIPTIVE STUDY OF POSTPARTUM ANOESTRUS IN NINE HIGH-YIELDING DAIRY HERDS IN FLANDERS

Descriptief onderzoek naar postpartum anoestrus in negen hoogproductieve Vlaamse melkveebedrijven

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ABSTRACT

Fertility data derived from 3,108 lactation periods in nine high-yielding dairy herds in Flanders were analyzed to determine the incidence and importance of preservice postpartum anoestrus. In 1,291 (42%) of all lactation periods studied, no heat was observed within 60 days after calving. Of the cows observed to be in heat within the first 60 days after calving (n=1,817), 622 (34%) had to be examined during regular herd health visits because they had not been observed to be in heat at the time insemination should be performed. Hence, in total, 1,913 (62%) of all lactation periods were identified as having suffered from one or another kind of preservice postpartum anoestrus. Cows not observed in heat within 60 days after calving as well as cows suffering from cessation of cyclicity, both had a significant (P<0.001) increase in days open (26 and 24 days respectively) and a significantly (P<0.05) increased risk of being culled as compared with their normal herdmates (Odds Ratio: 1.41 and 1.44 respectively). There was a significant (P<0.001) variation among the herds in the lactational incidence rate (LIR) both for cows not observed in heat during the first 60 days after calving and for cows with cessation of cyclicity, the former ranging from 21% to 67%, and the latter from 14 to 48% among the herds. Besides significant herd influences, the season of calving was also of major importance. The LIR for cows not observed in heat in the first 60 days after calving was highest for cows calving in April and lowest for cows calving in September (P<0.001). In conclusion, the authors stress the importance of the preservice postpartum anoestrus problem in dairy herds, and explain the need for further investigation of this problem with a view to taking preventive measures.

Keywords: dairy cow – anoestrus – descriptive epidemiology

SAMENVATTING

In dit artikel worden door middel van een retrospectief onderzoek op 9 hoogproductieve melkveebedrijven het voorkomen en het belang van anoestrus postpartum onderzocht. Hiertoe werden, uitgaand van de vruchtbaarheidsziektekaarten, de vruchtbaarheidsgegevens van in totaal 3.108 lactaties geanalyseerd. Bij 1.291 (42%) van de onderzochte lactaties was er geen bronst waargenomen gedurende de eerste 60 dagen na het afkalven. Van de koeien die wel binnen de 60 dagen na het afkalven tochtig waren gezien, dienden er naderhand nog eens 622 (34%) te worden onderzocht, omdat zij door de veehouder niet meer tochtig werden gezien op het moment dat ze geïnsemineerd moesten worden. Zowel de koeien die niet tochtig werden binnen de 60 dagen na het afkalven als de koeien die in deze periode wel tochtig werden maar daarna niet meer, hadden een significant (P<0.001) langer interval partus-conceptie (26 en 24 dagen respectievelijk) en een significant (P<0.05) grotere kans om tijdens de lactatie te worden opgeruimd (odds ratio (OR)= 1,41 en 1,44 respectievelijk). Tussen de bedrijven bestonden er significante (P<0.001) verschillen in voorkomen, zowel wat betreft de groep koeien met anoestrus gedurende de eerste 60 dagen na het afkalven, als de groep koeien die naderhand geen oestrus meer vertoonden. Wat de eerste groep betreft, lag het voorkomen op de verschillende bedrijven tussen 21% en 67%, terwijl dit voor de tweede groep tussen 14% en 48% lag. Ook het seizoen van afkalven bleek invloed te hebben. Niet tochtig worden gezien binnen de eerste 60 dagen na het afkalven kwam vooral voor bij koeien die in april hadden afgekalfd, terwijl dit veel minder het geval was bij koeien die dit in september hadden gedaan. Concluderend kan worden gesteld dat met de resultaten van het hier beschreven onderzoek is aangetoond dat het niet tochtig worden van melkkoeien een vaak voorkomend probleem is op hoogproductieve bedrijven en er kan zorgen voor een duidelijke daling van de opbrengsten.

INTRODUCTION

Because cows have to calve before milk production can start, fertility remains a major item of interest for dairy farmers. The failure to achieve the expected level of fertility is a major cause of reduced production efficiency in the dairy cattle industry nowadays. Since milk production peaks after each calving, farmers want to attain as many peaks and hence as frequent calving as possible during the cows' herd life. In general, a calving interval of 1 year is considered to be economically optimal (Esslemont, 1982; Schmidt, 1989; Dijkhuizen *et al.*, 1997). In order to reach this optimum, cows must regain full reproductive capacity within the first 85 days after calving. Within this time frame the uterus has to involute to its pregravid size and constitution, and ovarian cyclicity has to resume, resulting in the exhibition of oestrus symptoms by the cow and in the observation of these symptoms by the farmer. Furthermore, cows must be bred, they must conceive, and they must be able to maintain pregnancy to full term. In high-yielding dairy cows these events clearly coincide with the time of top production, which makes fertility a weak point in many high producing herds nowadays.

It is now known that the ability of the farmer to efficiently detect oestrus both in cows and heifers has a profound influence on reproductive performance and, hence, on the profitability of dairy herds (Heersche and Nebel, 1994). Researchers in the United States have concluded that the poor detection of oestrus is the single most important problem limiting high reproductive efficiency in dairy herds nationally (Senger, 1994). The failure to detect oestrus or the erroneous diagnosis of oestrus results in an annual loss of over $300 million to the dairy industry in the US (Senger, 1994). Many of these losses are caused by a prolongation of the calving interval, due to the inability of the farmer to observe his cows in heat and then to inseminate them at the optimal time after calving. Likewise in Europe, the reproductive performance of dairy herds has been reported to be declining over the past decades. These reports point to the anoestrus problem as the major reason for this decline (Schopper *et al.*, 1993; Van Vliet and Van Eerdenburg, 1996). In Belgium, as well, many farmers are complaining of not observing their cows in heat at the desired time after calving, a situation which leads to inferior fertility results. Furthermore, herdsmen often complain of having observed their cows in heat shortly after calving, while at the time insemination should be performed, oestrus symptoms are no longer discernible.

The aim of this study was to analyze an overall picture of the problem of preservice postpartum anoestrus in dairy cows in Flanders (Belgium) by carrying out an epidemiological field study in which attention was focused on the cows not observed to be in heat at the time insemination should be performed. Special interest was given to the importance of this problem in relation to future fertility.

MATERIALS AND METHODS

Study Design

A retrospective epidemiological study was carried out under field conditions. Its aim was to analyze the incidence and overall importance of preservice postpartum anoestrus in well-managed, high-yielding dairy herds in the Flemish part of Belgium. For the analysis, data from the herd health charts of nine dairy herds taking part in the herd health programme of the Faculty of Veterinary Medicine of the Ghent University (Belgium) were investigated. This programme was started in 1987. Over time, the number of herds taking part in the study has gradually risen. In the analysis, reproductive data were studied for all births taking place since the herd health programme started up in each of the respective herds. This implies that different herds were followed during different periods of time and for different lengths of time, and that some cows were followed during several consecutive lactation periods.

Animals and herds

Data from 3,108 lactation periods of nine well-managed dairy herds were analyzed in this study. The main criteria for herd selection were a high production level (Table 1) and excellent management, as well as the willingness of the farmer to cooperate and his reliability in writing down all observations.

Each of the nine herds was closely managed by the farmer and was a participant in a monthly herd health control programme in which reproduction management was a point of major interest. Fertility levels in the different herds were normal: none of the herds had complaints of fertility problems when the study started. Tests for detecting cows in heat were performed by the farmer at least three times a day at regular time intervals. Cows observed to be in heat, along with all other observations concerning health and fertility were carefully noted on a herd health chart. The animals were generally inseminated at the first oestrus occurring after 50 to 60 days postpartum. In cows that had experienced puerperal disorders, insemination was postponed until complete recovery. All cows were inseminated artificially by an experienced AI -veterinarian during the second half of standing heat. All herds had a year-round calving pattern, as is usual in Belgium.

The majority of the cows were Holstein-Friesian, except in two herds where crosses between Red Holstein (RH) and the local East-Flemish Red and White (Table 1) were present. Generally, cows were housed during the period from October to April, while for the rest of the year they were on pasture. Cows in all herds were housed in loose stables with cubicles. In the summertime, cows were on pasture day and night, while in the transition periods (spring and autumn) they were on pasture during the day and stabled at night.

Milking was performed twice daily with an 11-hour interval between morning and evening milking. All herds participated in the official milk recording system and in artificial insemination (AI) service programmes. Individual milk production was determined for all cows on the basis of monthly production tests, during which both milk yield and protein and fat content were measured.

Table 1. Main characteristics of the nine participating herds.

Herd	*1*	*2*	3	4	5	6	7	8	9
Period followed	July 1990-Feb. 1996	Oct. 1993-Nov. 1994	March 1991-March 1995	Aug. 1989-June 1996	Feb. 1990-Feb. 1996	Dec. 1987-Aug. 1996	Aug. 1987-Dec. 1996	Aug. 1987-June 1996	Nov. 1991-Aug. 1996
Average number of cows in the herd	35	55	65	45	55	60	60	80	80
Number of lactation periods followed	175	52	237	222	300	490	519	763	350
Breed	Holstein x East-Flemish (<50% Holstein)	Holstein Friesian	Holstein Friesian	Holstein Friesian	Red Holstein x East-Flemish (>50% RH)	Holstein Friesian	Holstein Friesian	Holstein Friesian	Holstein Friesian
Average 305-day FCM production at the end of the study (kg)	6,500	9,600	8,700	9,200	8,900	9,300	9,600	9,750	9,350

Cows were fed according to their requirements for maintenance and production, based on the results of the monthly production tests. The ration consisted of high quality roughage (corn silage, grass silage, sugar beet pulp or fodder beets) supplemented with concentrates according to need for maintenance and production of energy and protein.

Data analysis

Data was gathered from the herd health charts on the farms. On these charts all observations concerning health and fertility had been carefully noted by the farmers. During monthly herd health visits, all data were carefully controlled by a veterinarian. All fertility data of the herd health charts were entered into the computer using a spread sheet programme (Excel). Only cows that had been inseminated at least once were included in the analysis.

Fertility indices were calculated for each herd separately and for the nine herds together. These included: interval between calving and first observed heat (geometric mean), interval between calving and first insemination (geometric mean), interval between calving and conception (geometric mean), first service pregnancy rate, number of inseminations per conception, the culling rate for fertility reasons, the lactational incidence rate (LIR) of anoestrous cows (i.e. the proportion of cows not observed to be in heat during the first 60 days of lactation), and the LIR of cows suffering from cessation of cyclicity (i.e. the proportion of cows that were observed to be in heat during the first 60 days after calving but not during the next 30 days, and that therefore needed to be examined with a view to avoiding a prolonged calving interval). The conception to calving interval was calculated based on pregnancy diagnosis by rectal palpation carried out during regular herd health visits, starting 42 days after insemination.

'Generalized linear mixed models (GLMM)' (Blouin and Saxton, 1991) were used to find differences in the $\log_e$-transformed interval between first observed heat and calving, the interval between first insemination and calving, and the interval between conception and calving for the cows with different cyclicity patterns, i.e. normal cows, anoestrus cows, and cows with cessation of cyclicity. The first service pregnancy rate and culling rate per group were analysed with logistic regression (Glimmix macro, SAS 6.12, SAS Institute Inc., SAS Campus Drive, Cary, NC, USA). The number of inseminations per conception was analysed with Poisson regression (Glimmix). In order to investigate seasonal effects, the LIR of anoestrous cows and of cows with cessation of cyclicity was calculated for lactation periods initiated per month with logistic regression analysis (Glimmix). In all analyses, herd was used as a random effect. The attributable risk for culling was calculated according to Kelsey *et al.* (1996).

RESULTS

Table 2 presents the fertility parameters of the nine herds in the study.

Table 2. Main fertility indices of the nine herds taking part in the study.

Herd	No. of lactation periods studied	*No. of cows conceived (%)*	*No. of cows culled for fertility reasons (%)*	First service pregnancy rate (%)	*No. of inseminations per conception*	*Interval calving to first observed heat (days)* (95% CI)*	*Interval calving to first insemination (days)* (95% CI)*	Interval calving to conception (days)* (95% CI)	No. of anoestrous cows (LIR)	No. of cows with cessation of obs. heat sympt. (LIR)
1	175	158 (90)	6 (3)	66	1.33	37 (12-108)	71(43-118)	80 (44-146)	36 (21)	30 (22)
2	52	42 (81)	5 (10)	44	1.67	60 (22-167)	74 (38-143)	98 (36-265)	29 (56)	4 (17)
3	237	208 (88)	14 (6)	59	1.99	46 (15-144)	76 (42-137)	100 (44-229)	77 (32)	40 (25)
4	222	191 (86)	12 (5)	45	1.80	51 (18-147)	73 (39-137)	98 (42-228)	79 (36)	20 (14)
5	300	276 (92)	9 (3)	58	1.57	45 (13-156)	81 (52-128)	96 (48-190)	105 (35)	64 (33)
6	490	444 (91)	20 (4)	56	1.62	51(17-156)	81 (45-146)	97 (46-205)	199 (41)	106 (36)
7	519	476 (92)	18 (3.5)	49	1.78	48 (14-161)	90 (57-144)	112 (58-218)	208 (40)	148 (48)
8	763	688 (90)	40 (5)	52	1.75	51 (17-152)	85 (52-138)	104 (52-209)	323 (42)	188 (43)
9	350	317 (91)	7 (2)	52	1.66	74 (30-183)	82 (41-167)	104 (46-235)	235 (67)	22 (19)
Total	**3,108**	**2,800 (90)**	**131 (4)**	**53**	**1.70**	**51 (17-155)**	**82 (47-142)**	**101 (49-211)**	**1,291 (42)**	**622 (34)**

* geometric mean

Table 3. Fertility indices of the normal cows and of both groups of problem cows[1].

	Normal cows	*Anoestrous cows*	*Cows with cessation of obs. heat sympt.*	*All cows*
No. of lactation periods studied	1,195	1,291	622	3,108
Interval calving to 1st observed heat (days)°	37	86***	30***	51
Interval calving to 1st insemination (days)°	66	91***	91***	82
First service pregnancy rate (%)	54	49*	52	53
No. of inseminations per conception	1.68	1.70	1.63	1.7
Interval calving to conception (days)°	85	111***	109***	101

1 In all models, herd was included as a random factor
*P<0.05 **P<0.01 ***P<0.001 significantly different as compared to the normal cows
° geometric mean

Of all 3,108 lactation periods studied, in 1,291 (42%) of them the cows were not observed to be in heat during the first 60 days after calving and could be designated as anoestrous. Of the 1,817 cows that were observed to be in heat during the first two months after calving, 622 (34%) were anoestrous for the period of at least 30 days after the first heat symptoms and needed to be examined with a view to avoiding a prolongation of the calving interval. Hence, in total 1,913 (62%) of the 3,108 cows were found to be anoestrus.

The LIR for anoestrus cows among the nine herds studied varied from a low of 21% to a high of 67%. The LIR for cessation of cyclicity among the cows that were observed to be in heat during the first 60 days after calving varied from 14% to 48% of the lactation periods at risk. LIR for both anoestrus and for cessation of cyclicity differed significantly (P<0.001) between herds.

Fertility indices of the three different classes of cows are given in Table 3.

The odds ratio (OR) for the culling of cows because they have not been observed to be in heat within 60 days after calving was 1.41 (P<0.01), while the OR for the culling of cows suffering from cessation of cyclicity was 1.44 (P<0.05). The attributable risk of being culled, which expresses the percentage of cows that are culled due to anoestrus, was 14% for cows not observed to be in heat within 60 days after calving and 13% for cows suffering from cessation of cyclicity.

The distribution of postpartum anoestrus incidence, according to the month of calving is shown in Figure 1.

Statistical analysis revealed a significant (P<0.001) influence of the month of calving on the occurrence of anoestrus within 60 days after calving. The incidence of anoestrus was lowest for cows calving in September (29%) and showed a clearly increasing trend thereafter, reaching a maximum for cows calving in April (61%). The month of calving did not influence the occurrence of cessation of cyclicity (P=0.21).

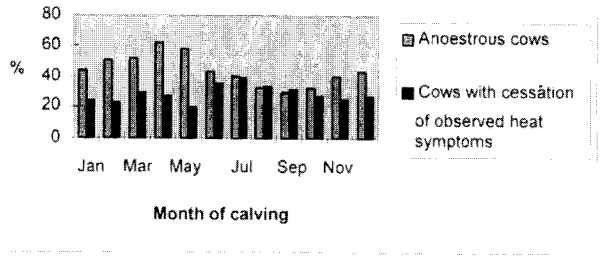

Fig. 1. Incidence distribution (%) of postpartum anoestrus according to the month of calving.

DISCUSSION

This study consists of a retrospective epidemiological investigation, with emphasis on postpartum anoestrus in dairy cows. The fact that herds in this study were not selected randomly means that the study population differed from the average herds in the region. The average milk production rate for the selected herds was higher than the average rate for all herds in the region. The husbandry of the selected herds was better as well, due to their participation in a veterinary herd health programme, which was focused on reproduction and nutrition. Although the results cannot be extrapolated to typify the situation of all farms in this region, they are representative for the high quality, well-managed herds that are the wave of the future.

The negative effects of anoestrus on overall fertility in dairy herds using AI was already demonstrated in 1961 by Zemjanis, who noted a 30-day delay in fertility in anoestrus cows. In the same study the author proposed a system for classifying postpartum anoestrus for the purpose of further investigating the importance of this reproductive failure. In his system, anoestrus was classified as either "preservice" or "postservice", and was further subclassified as either "organic" or "functional" on the basis of clinical examination. Preservice anoestrus was defined as the absence of observed oestrus in the immediate postpartum period, while postservice anoestrus was defined as the absence of observed oestrus following an unsuccessful insemination. In our study, we only investigated the incidence and importance of preservice anoestrus. However, we did mention the fact that some cows exhibit oestrus symptoms shortly after calving, while they are anoestrus at the time when insemination should be performed, a fact which, to our knowledge, has not been studied until now.

Comparisons of anoestrus incidence found in previous studies are complicated by differences in definitions both of oestrus and anoestrus, as well as by differences in the methods used to report the results. Our results agree completely with the study of Bartlett *et al.* (1987), in which 1,395 (42%) of a total of 3,309 lactating cows were classified as having exhibited preservice anoestrus. However, these authors defined preservice anoestrus as 'no oestrus detected by 70 days after calving'. In a comparable study, Markusfeld (1987) reported that the number of cows presented for examination because of unobserved heat by two months after calving, amounted to 45.3% (n=7,751). Most other researchers generally mention lower rates of preservice anoestrus. de Kruif (1977) reported that 438 out of a total of 2,720 (16%) studied lactation periods had been submitted to examination because oestrus was not observed within 50 to 60 days after calving. Mayer *et al.* (1987) mentioned a comparable percentage in a much larger study. In their investigation of 106 herds in which 61,200 lactation periods were studied over a two-year period, 10,124 (16.5%) cows were examined because they had not been seen in heat during the first 60 days after calving. All of the above mentioned studies emphasize the highly variable incidence of occurrence among the different herds. Generally, authors consider this as the best proof that management factors are of major importance in the occurrence of anoestrus. Although it must be stressed that comparisons with other studies are questionable because of differences in definitions and in reporting results, an increasing trend in the incidence rate of preservice anoestrus is remarkable. Hence, despite the fact that during the last several years farmers have been alerted to the importance of oestrus detection, more and more cows seem to be suffering from preservice anoestrus. This clearly illustrates the need to further investigate this problem in order to clarify whether this rising incidence rate is due to shortcomings in herd management or whether it can be attributed to real ovarian or uterine disturbances. On this point, the study of milk progesterone profiles can be of great value (Bulman and Wood, 1980; Munro *et al.*, 1982; Opsomer *et al.*, 1998).

Cows with both types of preservice anoestrus in our study had a significantly ($P<0.001$) prolonged calving to conception interval as compared with their normal herdmates. This occurred mainly because these cows had a significantly ($P<0.001$) lengthened calving to first insemination interval, which was almost true by definition. Our results corroborate the results of Bartlett *et al.* (1987), who found a comparable increase of 30 days in the calving to conception interval. From our study it is difficult to conclude whether anoestrus cows are less fertile than normal cows. Although cows that had not been seen in heat within 60 days after calving had a significantly ($P<0.05$) lower first service conception rate, the number of inseminations per conception was not significantly different. Francos and Mayer (1988) stressed that cows that have not been observed in heat within two months after calving are suffering real and serious fertility disturbances that lead to severe economic problems. While these authors concluded that the absolute majority of the anoestrus cows had a delayed return to oestrus because of an impaired reproductive ability and not as a result of an inadequate oestrus detection, this could not be confirmed with the present study. What is remarkable in the present study is the fact that cows suffering from cessation of cyclicity had a significantly ($P<0.001$) shorter calving to first observed heat interval as compared with normal herdmates (30 days vs 37 days). This may suggest that cows

that have their first ovulation earlier are more prone to suffer from any disease (e.g. pyometra or prolonged luteal phase) that may lead to cessation to cyclicity. This topic certainly requires further detailed investigation.

This study also demonstrated that cows suffering from both anoestrus types as defined in our study had greater odds of being culled. The OR for culling was 1.41 ($P<0.01$) for cows not observed in heat within 60 days after calving, and was 1.44 ($P<0.05$) for cows with cessation of cyclicity. The attributable risk of being culled, which expresses the percentage of cows that are culled due to anoestrus problems, was 14% for cows not observed in heat within 60 days after calving, and 13% for cows suffering from cessation of cyclicity. It should however be emphasized that by restricting this study to cows that had received at least one insemination, the most severe cases of preservice anoestrus were excluded from the study. Cows that were anoestrus for an extremely long period of time, and were hence culled because they would otherwise cause an extreme prolongation of the calving interval, were not included in the actual study. From a previous study by Bartlett *et al.* (1986), it is known that most culls occur at more than 200 days after calving and that many of these cows have not been inseminated at the time of culling. This bias in our study caused our findings to somewhat underestimate the real attributable risk for culling.

Although cows calving in April suffered significantly more from anoestrus than cows calving in September, conflicting seasonal effects have been reported in the literature. Our data confirm the results of Bartlett *et al.* (1987), who demonstrated that cows with preservice anoestrus were more likely to have begun their lactation in the spring months. Martinez and Thibier (1984) reported that cows calving between October and May had a higher incidence of anoestrus. On the other hand, Coleman *et al.* (1985) stated that cows calving in the spring had a nine-day shorter calving to first observed heat interval, which suggests that there are fewer anoestrus problems during this time of the year. All these authors mention feeding effects, and effects of daylength and temperature as possible factors in accounting for seasonal differences in anoestrus incidence. In this study it must be noted that although the farmers usually maintain a year-round calving pattern, milk prices are substantially higher in winter months. Hence, higher milk prices in the winter months may be seen as a confounding factor that probably influences oestrus detection by the farmer and finally leads to higher anoestrus incidence rates for cows calving in the spring and summer months. This probable bias clearly illustrates the need for more objective methods for studying the postpartum anoestrus problem in detail.

CONCLUSION

This study clearly demonstrates the importance of postpartum anoestrus in modern high-yielding dairy herds in Flanders (Belgium). Nearly 60% of all lactation periods (n=3,108) followed in this study suffered from one or another form of postpartum anoestrus, which lead to prolonged calving intervals. In this study we were not able, however, to distinguish between problems caused by poor oestrus detection by the farmer, and problems caused by disturbances in ovarian cyclicity in the cows. A further detailed study is needed to clarify this.

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