POSTPARTUM ANOESTRUS IN HIGH YIELDING DAIRY COWS

Postpartum anoestrus bij hoogproductief melkvee

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ABSTRACT

Worldwide dairy herd fertility has been stated to decline drastically during the latest decades leading to significantly increased calving intervals. The principal likely component of an increased calving interval is the prolongation of the interval parturition-insemination. The latter might be caused by problems related to the modern high yielding dairy cow herself (postpartum endocrinopathies leading to ovarian disturbances), or may reflect serious shortcomings in the management (inadequate heat detection). While bovine practitioners are frequently faced with this problem nowadays, they should be fully aware of the underlying causes of this problem in order to be able to help their clients to attain economically optimal calving intervals. As modern herd health control programs mainly focus on the adjustment of management practices on the herd instead of advising a widespread use of drugs, practitioners should be fully aware of the management practices which influence overall fertility and resumption of ovarian activity in peculiar. The present article reviews the current state of knowledge about the postpartum anoestrus problem in high yielding dairy cows, and hence may serve as a practical guide for the practitioners who want to advice their clients on how to tackle this major fertility problem.

SAMENVATTING

Wereldwijd wordt melding gemaakt van een duidelijke daling van de vruchtbaarheid op moderne, hoogproductieve melkveebedrijven. Dit wordt vooral veruiterlijkt in een significante verlenging van de tussenkalftijd. De belangrijkste oorzaak van deze verlengde tussenkalftijd blijkt een verlenging van het interval partus-eerste inseminatie te zijn. Dit laatste kan te wijten zijn aan problemen eigen aan de hoogproductieve koe (endocrinopathieën die leiden tot ovariële stoornissen) of aan tekortkomingen in het management van het bedrijf (ontoereikende bronstdetectie). Aangezien hedendaagse rundveepractici op melkveebedrijven vaak met anoestrusproblemen worden geconfronteerd, dienen zij zich terdege bewust te zijn van de onderliggende oorzaken van dit probleem teneinde hun klanten advies te kunnen geven over hoe het probleem kan worden verholpen. Hierbij dient in het kader van de diergeneeskundige bedrijfsbegeleiding vooral de nadruk te worden gelegd op het bijsturen van het management in plaats van een oplossing te zoeken in een overdreven gebruik van diergeneesmiddelen. Dit artikel geeft een overzicht van de huidige kennis omtrent anoestrusproblemen op hoogproductieve melkveebedrijven en heeft als dusdanig de bedoeling te fungeren als een leidraad voor de rundveepractici die samen met hun klanten streven naar een optimale fertiliteit op het melkveebedrijf.

INTRODUCTION

The failure of the modern-day dairy herds to achieve the optimal level of fertility is a major cause of reduced production efficiency for all various production systems. Worldwide, high producing dairy cows are reported to have an increased interval from calving to conception. It has generally been accepted that for the majority of the dairy herds where artificial insemination is practiced, the limiting factor toward obtaining efficient reproductive performance is the failure to detect oestrus in a timely and accurate manner. Per definition this means that anoestrus is

ranked the number one fertility problem in our dairy herds nowadays. Therefore, the most productive approach to improve dairy herd reproductive performance, is by working to increase heat detection or AI submission rates. As 'anoestrus' is in fact a very broad term indicating the lack of typical oestrus symptoms near the time of ovulation, it can not be seen as a disease but it rather reflects the presence of some suboptimal (e.g. management or nutrition) or pathological (e.g. chronic debilitating diseases or uterine and ovarian diseases) conditions. Bovine practitioners should be fully aware of this in order to be able to serve their clients by helping them to optimise overall (re)production efficiency.

Based on the introduction of more efficient investigation tools, such as progesterone profile analysis and ultrasonography, much progress has recently been made in uncovering the pathophysiology of the anoestrus problem. The latter has led to the recent emergence of a lot of both curative as well as preventive treatment protocols. For the practising veterinarian it is however difficult to keep himself posted of the often large amount of knowledge lying behind the advice he is giving to his clients and the treatment protocols he is using. Hence, it is the aim of this manuscript to review the current state of knowledge of the postpartal anoestrus problem in the dairy cow relevant to the practitioner, and to clarify the appropriate scientific rationale for the advice he is giving to his clients in order to overcome this paramount fertility problem.

DEFINITION OF POSTPARTUM ANOESTRUS AND SKETCHING THE PROBLEM

Anoestrus post partum can be defined as the lack of oestrus symptoms at the time inseminations should be started once cows have calved. In order to reach optimal calving intervals, inseminations should be started at 50 to 60 days after calving. Hence, there is a general agreement that in dairy cows the anoestrus period after calving should not exceed 60 days (Farin and Slenning 2001). Cows not seen in heat during the first two months after calving are considered to be problem cows and need to be examined during regular herd health visits (Brand and Varner 1996; Farin and Slenning 2001).

In a recent study Opsomer et al.,(2000b) highlighted both the high incidence as well as the economic consequences of the problem of anoestrus post partum in modern high yielding dairy cows. In their study (n=3.108) 62% of the cows were anoestrous during the first two months after calving. They furthermore subdivided these preservice anoestrous cows into two groups, namely cows not seen in heat within 60 days after calving, and cows which were seen in heat early after calving but which became anoestrous at the time they should be inseminated. The latter were defined as suffering from 'cessation of observed heat symptoms' (Opsomer *et al.,*2000b). Both groups of anoestrous cows had prolonged days open and were significantly more at risk of being culled in the current lactation. Although it is very difficult to compare the results of this study with the results of comparable studies because of differences in defining oestrus as well as anoestrus, and in reporting the results, earlier studies generally reported lower rates of preservice anoestrus. In earlier studies, the lactational incidence rate generally ranged from 16 to 20% (de Kruif 1977; Mayer *et al.,*1987). All authors however agree in mentioning a wide spread in occurrence among different herds, suggesting a strong influence of management factors such as heat detection. Hence, although farmers have been alerted for the importance of oestrus detection during a number of years, and although a lot of energy has been put in testing aids to improve oestrus detection (Lehrer *et al.,*1992; Senger 1994; Van Eerdenburg *et al.,1*996), the number of cows not seen in heat at the time they should be inseminated has still been increasing.

Consequently the question arises whether this increase is merely due to shortcomings in the management (e.g. failure to detect oestrus) or whether it is peculiar to the modern high-yielding dairy cow herself. Furthermore, when problems could indeed be designated as being inherent to the high-yielding dairy cow, the next question arises as whether the anoestrus problems are caused by a lack of expressing heat symptoms by the cow, or are caused by ovarian/uterine disorders leading to the symptom of anoestrus. In order to investigate this into more detail, it is obvious that a clear and detailed method of investigation, based on clear-cut and objective definitions is necessary. Hence, to objectively monitor postpartum ovarian activity in the field, researchers have been using milk progesterone monitoring usually based on twice weekly progesterone assays (Bulman and Lamming 1978; Van de Wiel *et al.,*1979; Bulman and Wood 1980; Ball 1982; Fagan and Roche 1986; Butterfield and Lishman 1992; Lamming and Darwash1998; Opsomer *et al.,*1998).

Anoestrus post partum due to ovarian abnormalities

The widespread use of milk progesterone monitoring in field studies has led to a clear and objective illustration of the postpartal ovarian activity and the oc-

currence of deviations hereon. Furthermore, due to the use of this research tool for almost 25 years, it can be used as the basis for historical comparisons of the reproductive health and performance in a sample of dairy cows (Roche *et al.,* 2000; Royal *et al.,* 2000a,b), and help to more objectively determine the influence of the introduction of genetics for high productivity into a dairy cow population on a larger scale (Royal *et al., 2*000a,b; Veerkamp *et al.,* 2000).

Most of the field studies that are based on the monitoring of postpartal progesterone profiles have two main purposes: to denote the occurrence of the first significant progesterone rise after calving, and to identify postpartal ovarian abnormalities (Lamming and Darwash 1998; Opsomer *et al.,*1998; Royal *et al.,* 2000a). Although it is nearly impossible to compare the results of all these studies in detail, because of the different sampling protocols and the use of different definitions for both normal and abnormal profiles, authors generally came to comparable conclusions. The first significant rise in progesterone is stated to occur on the average at 34 (Lamming and Darwash 1998) to 37 days (Opsomer *et al.,*1998) after calving, indicating that the first postpartum ovulation in the modern-day dairy cow occurs around day 30 after calving. While other authors mentioned a 5 to 10 day shorter period for the postpartal resumption of luteal actvity (Darwash *et al.,*1997; de Vries and Veerkamp 2000), all authors mention a very large range and standard deviation suggesting the presence of a lot of cows with ovarian abnormalities. The latter has been confirmed by the study of Opsomer *et al.,*(1998) in which 47% of the 448 examined progesterone profiles showed an abnormal pattern during the preservice postpartum period. The two most frequently recognized abnormalities being delayed cyclicity or anovulation (defined as 'no significant progesterone rise during the first 50 days after calving'), and prolonged luteal phase (defined as 'a period of at least 20 days of positive progesterone levels without a preceding insemination'). By means of regularly carried out rectal palpations they pointed to inactive ovaries as being the most important reason of delayed cyclicity (90% versus 10% cystic ovaries). Searching for the causes of the prolonged luteal phases, in almost half (48%) of these cows an abnormal uterine content could be palpated, in 3% a cystlike structure on one of the ovaries was discernable, while in 49% no specific reason for this ovarian abnormality could be palpated (Opsomer *et al.,*1998). This clearly illustrated that the prolonged presence of luteal tissue is an obvious cause of anovulation and hence anoestrus, which was confirmed later and is generally accepted nowadays for the high-yielding dairy cow (Wiltbank *et al.,2*002). Other abnormalities such as short luteal phases (first cycle not included), cessation of cyclicity, and irregular profiles were much less important and accounted together for nearly 10% of the encountered abnormalities. Lamming and Darwash (1998) reported similar problems in UK dairy cows, also based on twice weekly progesterone assays. They furthermore illustrated the impact of both most frequently recognized abnormalities by demonstrating that both submission rates to AI and pregnancy rates per cycle are adversely affected in these abnormal cows.

In a recent review Wiltbank *et al.,(*2002) highlighted the fact that postpartum anovulation should be further specified depending on the stage where the follicular wave was arrested. In cows with very small, 'static' ovaries it was demonstrated that follicles only grow to the state of emergence. Although it was stated that this situation is very rare, this could be the explanation for the cows with an extremely prolonged interval towards resumption of luteal activity as encountered in the studies based on progesterone profiles. According to the same manuscript, the most commonly reported and well known cause of anovulation is the one with follicular growth to dominance but not ovulatory size.

Risk factors for ovarian abnormalities leading to anoestrus

Besides the identification of the postpartal ovarian abnormalities leading to the symptom of anoestrus, of equal or even greater importance is the need to identify the etiological factors leading to the occurrence of these disorders, which in turn offers possibilities of disease prevention. Based on a multivariate analysis at farm level taking into account a number of relevant factors, Opsomer *et al.,(*2000a) demonstrated that calving during the stable period, an extended length of the previous dry period, health problems during the first month of lactation and clinical parameters illustrating the appearance of a severe negative energy balance, significantly increase the risk for delayed cyclicity before service. Parity, problem calvings, health problems during the first month of lactation and an early resumption of ovarian cyclicity after calving, significantly increase the risk for prolonged luteal cycles before service.

Hence, this field study clearly confirmed previous carried out clinical trials in which the health status and the negative energy balance (NEB) of the animals shortly after calving were demonstrated to be the most important risk factors leading to delayed cyclicity and

anovulation. Both the degree (Kruip *et al.,*1998) as well as the duration (Beam and Butler 1997) of the NEB have been proven to significantly influence the duration of the postpartum interval to first ovulation. Because the increase in dry matter intake (DMI) significantly lags behind the increase in milk production in recently calved high yielders, most of them experience a period of NEB. It has been stated that the first ovulation does not occur earlier than 10 to 25 days after the moment the NEB reaches his nadir, which normally occurs at about two weeks after calving (Beam and Butler 1997). While the energy balance in postpartum cows depends more on the ingestion of calories than on the production of milk (Staples *et al.,* 1990), it is obvious that the level of DMI and the factors that may influence it are of major importance. Besides the general accepted importance of the energy balance, other authors also mention the effect of the protein metabolism, as problem cows who did not cycle during the first 50 days after calving showed significantly lower plasma urea and albumin levels than did cows who did (Giger *et al.,1*997; Opsomer *et al.,* 1999b).

While a lot has recently been elucidated about the influence of the metabolic hormones that regulate the homeorhetic events to sustain high milk yield on the regulation of the ovarian function, it is going behind the scope of this manuscript to describe this into full detail. Recently, excellent review articles on this topic have been published (Lucy 2000; Lucy 2001; Wiltbank *et al.,2*002).

Anoestrus post partum due to a lack of detected heat symptoms

In practice, one of the most frequently heard complaints among managers of high yielding dairy herds, is that they nearly see their cows in heat. Recent field studies confirmed this complaint by demonstrating that in the majority of the oestri after calving, no standing heat could be observed in spite of an excellent heat detection (Schopper *et al.,*1993; Van Eerdenburg *et al.,* 1996). Moreover, Opsomer *et al.,(*2000b) recently described the existence of cows suffering from 'cessation of observed heat symptoms', being cows which were seen in heat shortly after calving, but which were anoestrous at the time they should be inseminated. Hence a frequently asked question nowadays is: do high producing dairy cows show oestrus signs, and if not, why? It is obvious that the intensity with which oestrus symptoms are expressed by the cow and hence can be observed by the herdsman, is a very subjective matter and therefore difficult to scientifically investigate. This is probably the most important explanation for the fact that there is still a lot of debate concerning the above formulated question.

While some stated that high milk production is antagonistic to the expression of oestrus behaviour (Harrison *et al.,*1990), there is no firm experimental evidence that high levels of milk production per se influence mounting or standing activity. Although there is some evidence that the energy balance during the early postpartum period may influence whether a cow is detected in heat at the beginning of the first postpartum cycle (Berghorn *et al.,*1988), others stated that, based on research with heifers, NEB or fat body condition do not reduce detectability of oestrus (Villa-Goddoy et al.,1990). Apparently cows experiencing a severe negative energy balance can produce enough oestrogens to elicit an LH surge and ovulation, but not enough to cause heat, resulting in an ovulation without heat symptoms. Others suggested that the presence of suprabasal progesterone levels, being released by the breakdown of fat during the period of NEB around the moment of ovulation, can seriously depress the expression of heat symptoms (Schopper and Claus 1990). Why some cows clearly exhibit oestrus symptoms at around 30 days after calving but are not seen in heat at the time the farmer wants to inseminate them, remains however difficult to explain.

Whilst a lot of recent research is obviously directed towards the investigation of the influence of the energy balance and the stressed metabolism on heat expression, one may not forget to take into consideration all management changes which took place while moving towards high yielding herds. Studies clearly showed that primary behavioural signs such as mounting and standing, may be seriously depressed by the immediate environmental conditions. It is for example well known that the expression of heat seriously decreased since the overall use of concrete floors. Cows furthermore dislike being mounted by herdmates if the floor surface is either slippery or very coarse (Britt *et al.,*1986). Cows that have foot problems regardless of whether the problem is structural, clinical or subclinical, apparently show less mounting activity. Many of the foot problems that affect mounting activity can be alleviated by proper foot care and trimming. Other often encountered management problems leading to anoestrus in dairy herds are: too few observations for oestrus signs per day, observations at the wrong time of the day or during the wrong phase of the daily routine, too little time spent per observation, lack of knowledge of both primary and secondary signs of oestrus (Van Eerdenburg *et al.,*1996).

CONCLUSIONS AND PRACTICAL RECOMMENDATIONS

Worldwide, the failure to observe cows in heat has been claimed to be the paramount fertility problem in the modern dairy industry (MacMillan *et al.,*1996; Ferguson and Galligan 1999; Opsomer 1999a). Therefore, dairy producers can most effectively improve fertility numbers of their herds by improving AI service rates and practitioners should be able to advise them how to realize this. When dealing with a problem of cows not seen in heat two months after calving, it is the veterinarians' first task to make a diagnosis of the underlying cause of this symptom. Unfortunately it is often difficult to discover the underlying etiology of the problem. This is usually done based on a detailed analysis of the fertility records and a clinical examination of the affected cows, which is usually based on one single rectal palpation. While veterinary medicine and overall herd health control is nowadays far more directed towards the advice of preventive measures instead of curative treatments, the most effective methods for minimizing anoestrous problems on dairy herds are surely preventive measures.

Realizing the importance of this fertility disturbance and supported by the extreme expansion of the scientific knowledge of the regulation of the bovine oestrus cycle, this has led to the emergence of several treatment protocols in order to get the cows bred at the time wanted by the herdsman without the need of heat detection (Pursley *et al.,*1997; Nebel and Jobst 1998; Thatcher *et al.*,2001). While the use of these treatment protocols becomes more and more widespread in the US, their general application remains difficult in Europe. Especially in times where items as food safety, animal welfare and the appropriate use of drugs attract a lot of (often exaggerated) attention, the widespread treatment of healthy cows for merely economical reasons bumps against a lot of criticism in a large part of the world. Although researchers claim optimistic results while applying oestrus synchronization and timed insemination protocols by increasing the overall pregnancy rate of the herd, they realize that its implementation does not fulfil the requirements of a magic formula by solving all the anoestrus problems (Thatcher *et al.,*2001). High yielding cows with small, inactive ovaries for instance, will not respond to regular synchronization protocols and need special attention. This may probably be depending on the stage in which follicular development is arrested (Wiltbank *et al.,2*002). Hence it is important both for producers and their veterinarians to realize that even the implementation of management systems based on the widespread use of drugs, will not solve all reproductive problems per se. Furthermore, both producers and practitioners using these management systems are often tempted to solely trust upon the action of the drugs and often neglect to take care of a lot of other management measures that are at least equally important to guarantee the overall success of the reproductive program. Hence, for all veterinarians worldwide, both the ones who are applying synchronization protocols as well as those who are not, it is important to be aware of the underlying causes of the problem of cows not seen in heat at the time insemination should be started.

Because there is a general agreement that NEB and general health status after calving are the paramount factors influencing the resumption of ovarian activity and the occurrence of ovarian abnormalities, it is apparent that avoiding both is among the most important preventive measures to take. Improvement of the energy status by achieving a high dry matter intake and the provision of optimal and well balanced nutrition during the transition period as well as during early lactation, will reduce the period of anovulation. Because postpartum dry matter intake is significantly influenced by body condition, feeding the cows during late lactation needs to take into consideration regularly scoring of the body condition. Additional nutritional factors influencing fertility postpartum are the dietary ingredients. While research investigating the effect of feeding additional amounts of fats did not unanimously show positive results (Lucy *et al.,*1992; Beam and Butler 1997), optimistic results have recently been demonstrated when feeding a diet to increase circulating insulin concentrations during the early postpartum period (Gong 2001).

In addition, puerperal disease conditions should be minimized or at least effectively and thoroughly treated. This should be one of the cornerstones of the transition cow management program of each high-yielding dairy herd. Having plans for early recognition of puerperal diseases and intervention if necessary, is hence necessary. Careful assessments of fresh cows during the first 10 days after calving should be based on individually carried out examinations such as measuring rectal temperature, checking for vaginal discharge, checking for pings, evaluating rumen fill, and checking for urine ketones. All of these are simple and easy to carry out tasks of the present dairy farmer and his staff.

In herds where oestrus detection is the main problem, further investigations are necessary to elucidate the underlying cause of this. Based on the fertility records of the herd, a detailed investigation towards the

efficacy and accuracy of the oestrus detection carried out by the herdsman and his personnel on the one hand, and towards environmental factors which might negatively influence oestrus expression by the cows on the other hand, should be carried out. When the former is the main problem, the use of oestrus detection aids may be advised. These aids are usually effective if used to enhance the oestrus detection program (Lehrer *et al.* 1992; Senger 1994; Van Eerdenburg *et al.* 1996), but should never fully replace visual detection of oestrus. Obviously new technology is being developed to solve the problem of detection of oestrus, as yet however, the 'perfect' system does not exist. In herds with a robotic milking system, the extra available time should be spent by performing a better oestrus observation (Kruip *et al.* 2000). When the latter seems to be more important, measures should be taken to improve both mounting and standing activities of the cows in heat. In this case, full emphasis should be laid on both foot and claw condition and on the under-foot surface in the stable (Vailes and Britt 1990).

Instead of only advising the widespread use of drugs and hormones in postpartum cows, the practitioner has to stress the predominant role of management factors such as oestrus detection, the plane of nutrition (in late lactation, dry period and shortly after calving), and the hygiene at parturition in order to prevent anoestrus problems. Good fertility in high yielding dairy herds can only be achieved when management is excellent.

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