Dairy Cow Postpartum Disease: Definitions, Decisions, and Dilemmas

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Introduction

Reproductive efficiency is the backbone of successful dairy production. The need to maximize the time a cow spends near peak milk production necessitates the production of a calf in each calendar year. Because gestation length is essentially fixed, cows must be rebred as quickly as possible to assure financial success. Inefficient reproductive performance is one of the most frequent and economically significant problems in dairy production.[1,2] Consequently, the decision whether to breed, treat, or cull a dairy cow with reproductive disease is paramount to the success of a dairy. Considerable controversy exists concerning the impact of reproductive disease on cow performance and the benefits of various management interventions, especially the use of therapeutic agents, in combatting these diseases.

Diagnosing Postpartum Disease

Numerous terms have been used to describe pathology associated with the reproductive tract of the postpartum cow. Four of the most commonly described conditions are: retained placenta, endometritis, metritis, and pyometra. Retained placenta is defined as retention of all or parts of the fetal membranes for periods longer than 12 hours post delivery. Endometritis is defined as inflammation of the lining (endometrium) of the uterus. Metritis is defined as inflammation of the entire wall of the uterus. Pyometra is defined as the accumulation of mucopurulent material in the uterus in the presence of a retained corpus luteum.[3] All these definitions, with the possible exception of retained placenta, are based on histologic findings that are impossible to assess by clinical examination. If we accept that uterine biopsy for histologic examination is the gold standard for defining uterine pathology, there is significant potential for disagreement in the interpretation of biopsy findings as it has been suggested that the same histologic finding should be interpreted differently at different stages postpartum.[4]

Three techniques, in addition to uterine biopsy, are currently available to the clinician for the diagnosis of uterine disease: rectal palpation, vaginal speculum examination, and uterine culture. Correlation of findings among these diagnostic techniques (including uterine biopsy) and subsequent performance are extremely poor.[5-7] Rectal palpation is by far the most commonly used diagnostic tool; but it is also the most subjective as disagreement exists as to the criteria to make a positive diagnosis. In one study, abnormal discharge was associated with delayed interval to first estrus and enlarged cervix size was associated with reduced conception rate and longer days open.[8] In a second study, gross genital tract condition (a combined score for vagina, cervix, pus, and uterus) was not associated with conception rate, but had a weak, but significant, correlation to days open.[5] In our laboratory, none of five clinical signs evaluated (uterine size, presence of uterine fluid, vaginal discharge, palpation score, or vaginal speculum score) were significantly associated with days open.[9] Vaginal speculum examination permits evaluation of discharge that may be present at the cervical os or in the anterior vagina and, although not as widely used as rectal palpation, it has been shown to be more highly correlated with bacterial isolation from the uterus.[6] Uterine culture is generally not considered a beneficial technique in the diagnosis of uterine infection because organisms commonly cultured do not differ from the flora identified in "normal" animals[10] and these agents have not been shown to be associated with reduced fertility.[5,6] Thus, the difficulty to diagnose postpartum disease presents the first dilemma: **the clinical examination findings of postpartum diseases are poorly correlated with the criteria used to define the disease.**

Postpartum Disease Effects

For a "disease" to require veterinary intervention, it must impact performance in at least one of three different ways: 1) reduction of milk production, 2)

disruption of the productive cycle, and/or 3) reduction of (productive) life expectancy.[11] A second important question in evaluating the decision to treat or cull a cow is: do uterine infections lead to impaired performance? Studies evaluating the impact of postpartum disease on subsequent milk production have found marginal, if any, impact.[12-14] Although cows that have uterine infections with normal calving to conception intervals may be more likely to be culled,[15,16] the most significant potential impact of postpartum disease is by disruption of the reproductive cycle through delayed conception and consequent increases in culling rate. Studies evaluating the association of postpartum disease with reproductive efficiency have had conflicting results. Some early studies have found that cows with postpartum disease have delayed conception and reduced fertility,[8,17] but recent studies have not been able to find a significant difference in performance compared to "normal" cows.[18-20] This difference in results is most likely explained by the finding that the impact of postpartum disease on subsequent performance is associated with severity of disease.[5,6,9,18] In these studies, significant differences in performance existed only for animals classified as having "severe" infections based on clinical signs. This poses our second dilemma: **a case of postpartum disease, as currently defined, may not be associated with impaired performance.**

A further explanation for why these conflicting results may occur is shown in figure 1. In this figure, our current diagnostic approach is represented by the vertical axis while the pathogenesis of the disease is represented by the horizontal axis. The diagnostic process involves examining the cow, identifying clinical signs consistent with our definition of metritis, then based on the identification of a "significant" number of positive findings, declaring the cow to have metritis, and treating the "metritis" case as we would other cases that we have declared having metritis. A better approach would be to identify the clinical signs associated with impaired performance and devise treatments that correct or prevent these particular signs.

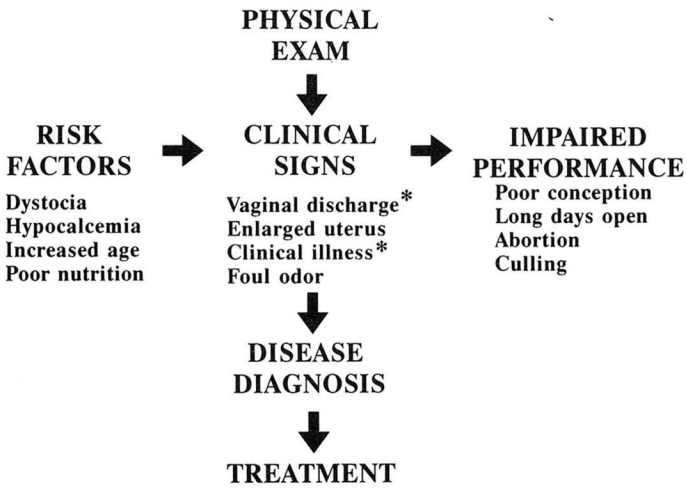

Figure 1. Model showing the intersection of the diagnositc and pathogenic processes.

Risk Factors and Disease Interrelationships

Several risk factors for uterine infections have been described in the literature. Risk factors associated with postpartum disease include: induction of parturition, excessive body condition, selenium/vitamin E deficiency, unsanitary calving conditions, and twinning.[21,22] A number of studies have described the interrelationships of disease.[13,14,24,25] These studies used an epidemiologic technique known as "path analysis" to estimate the degree of interrelationship between diseases during the periparturient period. An example of one path analysis is shown in figure 2. Numbers listed for each pathway represent the increase in odds of developing the disease (odds ratio, or OR) for animals with the risk factor. For example, animals which aborted are 3.7 times more likely to develop early metritis than animals that do not abort. Diseases shown to be associated with metritis are: abortion, dystocia, uterine prolapse, retained placenta, and milk fever.[13,14,24,25] Cows that develop a uterine infection in one lactation are at higher risk (OR=1.4-1.9) of developing a uterine infection in the next lactation.[22,26] Factors shown to be associated with retained placenta include: dystocia, abortion, milk fever, low protein diets prepartum, and deficiencies of selenium, vitamin E, and/or vitamin A.[3] Similar to metritis, cows with retained placenta are at higher risk of a second retained placenta (OR=1.2-1.8) compared to cows which did not retain their placenta the previous calving.[22,26] These findings indicate that improving general health in dairies is an important control point in preventing postpartum disease.

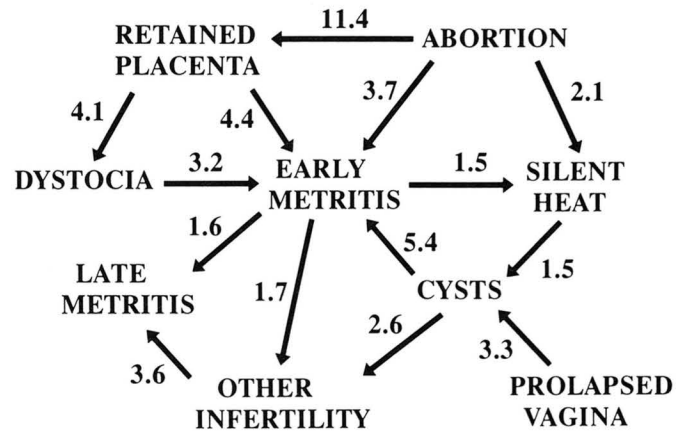

Figure 2. Example path model for reproductive disorders. Adapted from Groehn *et al*, 1990.

Treatment Strategies

Strategies used to treat cows with postpartum uterine infections fall into two major classes: hormonal therapy and antibiotic therapy. Clinical trials have evaluated numerous combinations of outcome measures, treatment groups, therapeutic agents, dosages, and timing of treatments with conflicting results. A good example of conflicting results are studies evaluating the benefit of treatment with prostaglandin $F_{2\alpha}$ in the postpartum cow. This hormone has been shown to decrease conception rate in some reports,[27-29] enhance conception rate in others,[30,31] and produce no detectable difference in the majority of studies.[32-37] In a metanalysis of studies prior to 1984, McIntosh and colleagues found effects of cloprostenol treatment (an analogue of $PGF_{2\alpha}$) on conception rate ranged from a 10% decrease to a 20% increase with the overall effect a 7% increase.[38]

Why the Conflicting Results of Intervention Trials?

Several factors may contribute to the apparent discrepancies in these studies. First and foremost, the lack of agreement on clinical criteria for the diagnosis of postpartum diseases makes comparison of studies nearly impossible. Second, substantial disagreement exists on the performance measure(s) chosen to evaluate the success of treatment. Reproductive measures reported include: calving to first estrus interval, calving to first service interval, calving to conception interval, service period length, first service conception rate, overall conception rate, services per conception, pregnancy rate, and proportion of cow conceiving by various stages of lactation. Third, differences exist in the assignment of cows to treatment groups. Several studies consider cows with reproductive disease separately,[34,35,39] other studies restrict sampling to clinically normal animals,[27,29,37] while the majority assign cows to treatment groups at calving without respect to disease status.[30-33,36,40-42] Discrepancies in these studies are due to differences in treatment protocols. By far, the largest discrepancy in treatment protocol is in the timing of treatments with protocols encompassing distinctly different physiologic periods of uterine involution and fertility. The vast majority of treatments occur in the postpartum period (first 30 days post calving); however, several studies have evaluated reproductive treatments during the early breeding period.[27,37,43] The last factor that could contribute to the apparent discrepancies of these studies is the univariate approach to analysis. Statistical analyses have been based on comparisons involving one and sometimes two covariates, necessitating examination for potential confounding associated with small sample sizes, poorly defined treatment groups, and loosely defined time frames. Some studies have attempted to control for confounding by randomly allocating animals to treatment groups.[29-32,41-43] This approach limits some cow factors as potential confounders, but still has the potential confounder of subsequent disease status. A better approach has been the use of matched analysis in a few studies.[35,36,40]

Conclusions

With all the difficulties and conflicting findings in studies concerning the management of cows with postpartum disease, the challenge is to arrive at practical recommendations and strategies for dealing with dairy cow postpartum diseases. The following are three important concepts that I believe will help clinicians successfully manage cows in the postpartum period:

1) Be more selective in cows you diagnose with and treat for postpartum disease.

As mentioned above, impairment of performance in several studies is associated with disease severity with "mild to moderate" cases not significantly different from controls. This suggests that animals are being treated that would not have impaired performance and practitioners should focus on clinically ill or "severe" cases in their treatment program. An important corollary to this recommendation is that monitoring reproductive performance for animals that have "mild or moderate" disease and have not been treated is an important aspect for fine tuning the reproductive program.

2) Emphasize prevention and control of risk factors over therapy.

Herd level programs aimed at controlling risk factors for postpartum disease are likely to have the greatest impact on reproductive health. The interrelationship of postpartum diseases suggests that strategies must start during the dry period. Care must be taken to provide a clean environment and balanced nutrition during this transition period. Animals that have difficulties during the periparturient period should be watched carefully for the potential to develop subsequent postpartum problems.

3) Invest your effort in the bottleneck (rate-limiting problem) of the reproductive program for that specific farm.

The importance of postpartum disease varies according to underlying conditions on the farm. It is important to remember that the choice of an intervention is based on three factors: 1) the size of the deviation

from optimal performance, 2) the per unit impact of improving the deficiency, and 3) the cost or ability to make the change. Due to the multifactorial nature of reproductive problems, it is important to determine what the rate-limiting factor is for the individual farm. Results of a current study suggest that for the typical dairy operation, management factors such as poor heat detection or factors leading to poor conception rates (nutritional imbalances, poor inseminator technique, improper semen handling, etc.), play a much greater role in reproductive inefficiency than does postpartum disease.[19] This finding is even more important when coupled with the early timing of postpartum disease in the lactation. In other words, eliminating postpartum disease in a herd with a significant heat detection problem does little to improve calving to conception interval as the effects of poor heat detection occur later in lactation when the influence of postpartum disease has passed. Thus, the underlying conditions on a given farm play an important role in our decision process and must be considered when evaluating alternatives to improve reproductive performance.

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