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Association Between Uterine Secretions (Metritis/Endometritis) and Fecal Consistency in Dairy Cows

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Association Between Uterine Secretions (Metritis/Endometritis) and Fecal Consistency in Dairy Cows

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Simple Summary

Metritis and endometritis are the most relevant diseases impacting reproductive health in bovine dairy farms. Several indicators are used in dairy farms to monitor animal health and performance. In this study, parity at calving, day of evaluation, and scores of body condition, ketosis, and FC were obtained and modulated through a multivariate logistic regression, regarding metritis outcome, during the first two months of lactation. It was observed that scoring FC is the most significant ($p < 0.001$) indicator associated with metritis. This health indicator is inexpensive, easy, and quick for veterinarians and producers to apply, and should be incorporated into the health management of bovine dairy farms.

Abstract

This study mainly aimed to evaluate the relationship between metritis/endometritis, diagnosed through the uterine secretions, and fecal consistency (FC) during the first two months post-partum in lactating dairy cows. A 9-point scale was used and regrouped into score 1 – 4 (too firm/dry), score 5 (normal), and score 6 – 9 (too liquid/loose). A metritis prevalence of 9.7% (273/2974; 95% CI: 8.2 – 10.3%) was observed from 2974 calving records obtained between December 2023 and July 2025 in 14 Danish dairy farms. The association between metritis/endometritis and parity at calving, day of evaluation, FC, ketosis and body condition scores was tested through multivariable logistic models. 81.0% (221/273) of uterine disorders were diagnosed until day 17 post-partum. In the final model, FC ($p < 0.0001$) was the most relevant factor associated with metritis, followed by ketosis ($p = 0.0001$), body condition ($p < 0.001$), and the day of evaluation ($p < 0.001$). FC score 6 – 9 (soft or diarrheic feces) was two times more likely (odds ratio = 2.1; 95% CI: 1.6 – 2.7) to be related to metritis than score 5 (normal FC). Although FC is generally scored for gut health and nutritional management purposes, this study evidence that it can also be used to predict uterine disorders in early post-partum period of dairy cows. Scoring FC is a simple and low-cost procedure that can serve as indicator of reproductive health in early post-partum period of dairy cows. Further studies are required to evaluate the impact of this indicator on the reproductive performance of the dairy farms.

Keywords: reproductive health; uterine disorders; feces; cattle

1. Introduction

Metritis (first three weeks postpartum) and endometritis (> 21 days) are one of the most relevant and challenging reproductive diseases in dairy cattle herds [1]. A prevalence of approximately 10% to 40% has been reported during the postpartum period [1,2]. Subsequently, they have a relevant impact on reproductive targets such as open days and pregnancy rate [2–4]. Parity, dystocia, retained

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placenta, lameness, and metabolic diseases, among others, are relevant risk factors of uterine inflammation and infection [1].

Currently, several indicators are evaluated during the postpartum period of dairy cows as part of a herd health management program. Body condition, ketonemia, fecal consistency (FC), and uterine secretions are the most widely used indicators to determine the metabolic, digestive, and reproductive health at low cost [2,5–7].

Liaisons between uterine and gut health have been evidenced in recent years. Hematogenous transmission of uterine pathogens from the gut to the uterus was also observed [8]. Also, direct bacterial pathogen contamination from feces to the uterus through the vagina can occur [9,10]. A change in gut microbiota from cows presenting metritis was observed [11]. Also, bacteria and bacterial toxins can disseminate to the bloodstream, reaching the digestive system [12]. These studies highlight a bidirectional flow between the uterus and gut.

FC has been assessed in dairy farms as an indicator of gut and general health [6], but its association with reproductive health status was not evaluated to our knowledge. The objective of this study was to evaluate the association between FC and uterine infections through uterine secretions. We hypothesized that the scored feces consistency, as a health indicator, can be a predictor of metritis/endometritis.

2. Materials and Methods

2.1. Farms and Animal Management

The retrospective reproductive and health records of 14 Danish dairy farms were used between December 2023 and July 2025. These farms were selected by convenience from a Danish veterinarian service (Vestjyske Dyrlaeger ApS; Nørre Nebel, Denmark) located in the region of the Cimbrian Peninsula.

All cows were housed in free-stall barns and milked twice a day in conventional farms. Animals were fed with TMR (total mixed ration). Basal ingredients included maize silage (up to 60%), grass silage (up to 30%), concentrate (usually, grain up to 10%), and minerals. Rapeseed and soy were also periodically incorporated in TMR.

The mean size farm was 694 (95% CI: 510 – 789) heifers and cows. The culling and replacement rates varied between 20 and 25%.

According to the programmed veterinarian visits to farms, each cow was assessed at a single time during the first two months of postpartum. All relevant productive, reproductive, and health parameters were evaluated, and decisions on further procedures were made by agreement between the veterinarian and producer. The respective treatment was implemented when appropriate, and voluntary or involuntary culling, including death and euthanasia, occurred on time, considering production purposes and health status.

Therefore, the farms were under strict control of an overall health management program.

2.2. Study Design, Records, and Health and Reproductive Indicators

Inclusion criteria are 1) cows calving during this period; 2) submitted to a reproductive examination during the first two months postpartum, and 3) monitored during the first 6 months after calving for AI. A total of 2977 calving records from 2075 cows were assessed. The mean number of calvings per farm, during the studied period, was 213 (95% CI: 163 – 263). The parity varied from 1(primiparous) to 10.

The evaluation day was considered an independent variable and categorized according to the quantiles 10 and 90% observed in the present study. Class D0–4 (first four days postpartum; prevailed placenta and lochia), class D5–17 (most morphological uterine involution), and class D18+ (completion of uterine involution) were defined.

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Metritis/Endometritis Definition

The uterine score was classified, according to Elkjær et al. [2] (Danish system), considering a 10-point scale (0 to 9). This scale is based on the amount, color, and odor of uterine secretions assessed by expulsion and visualization through uterine retraction during transrectal palpation. Scores 3+, i.e., a large amount of yellow/gray/purulent uterine secretions with or without foul-smelling, were defined as metritis/endometritis.

Fecal Score

A proper 1-9 scale for FC was used by the Danish clinic as reported in Table 1. These scores were subsequently grouped into score 1 – 4 (too firm/dry), score 5 (normal), and score 5 – 9 (too liquid/loose).

Table 1. 1-9-point scale for fecal consistency in dairy cows, used in the Danish veterinary clinic.

Score	Description	Visualization
1	Dry briquettes.	
2	Marked top formation. No "cow box" closer to "manure pile".	
3	Clear, persistent fractional deposition. Peak formation in the "coke box".	
4	"Silage structure." Greater fragmentation during fecal expulsion. The "coke box" still "flows" together.	
5	Normal consistency. It remains continuously attached to the rectal glove. It forms a kind of "cow's box" with well-defined boundaries.	
6	Poorly cohesive. Allows the rectal glove to adhere. Forms a kind of "cow's box" in the lower layer.	
7	Thin. Completely liquid and difficult to collect from the substrate.	

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8	Homogeneous diarrhea with recognizable stool structures. Difficult to collect.	
9	Watery diarrhea – No structural content or scant content. Cannot be collected.	

Parity at Calving

Cows were grouped into three classes: class 1 (primiparous cows), class 2-4 (adult productive cows), and class 5+ (senior productive cows).

BCS

A 1-5 scale for BCS with 0.25 increments [13] was used. Animals were subsequently grouped and scored into score 1 – 2.75 (lean), score 3 – 3.75 (adequate), and score 4+ (obese).

Ketosis Score

Ketostix strips (Bayer Corporation), a semiquantitative colorimetric test, are used to measure acetoacetate in urine [14]. A 1-6 scale strip indicates acetoacetate levels of 0, 5, 15, 40, 80, and 160 mg/dL. Ketosis was defined as ≥15 mg/dL acetoacetate [15], and a score of 0-1(normal) and score 3+ (ketosis) was considered.

2.3. Statistical Analysis

Initially, an univariable logistic regression was used to primarily evaluate the isolated effect of each indicator on the prevalence of metritis/endometritis.

A step-by-step ($p < 0.25$) multivariable logistic regression was used, and confounders were identified [16]. The final model only incorporated significant independent variables ($p < 0.05$). Additionally, the Wald test was used to test the significance of the odds ratio (OR).

A $\alpha = 0.05$ level was considered. JMP® version 19 software was used.

3. Results

The mean prevalence of metritis/endometritis was 9.2% (273/2974; 95% CI: 8.2 – 10.3%). 81.0% (221/273) of these uterine disorders were diagnosed up to day 17 post-partum (Figure 1). The distribution of this prevalence according to the scores of significant indicators is reported in Table 2. In the univariate logistic models, all indicators ($p < 0.001$), including parity ($p = 0.04$), affected the prevalence of metritis/endometritis.

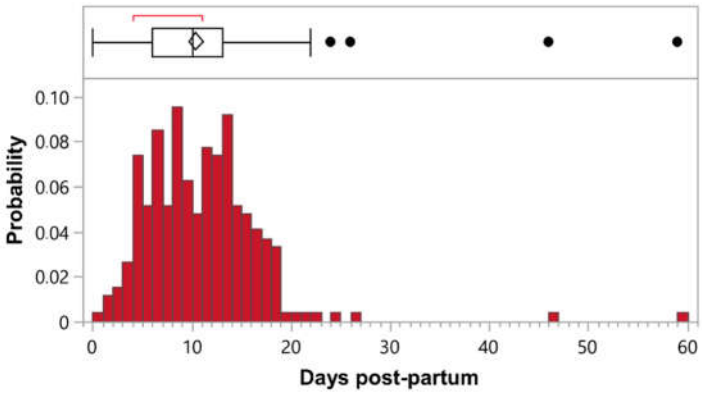

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Figure 1. Distribution of metritis/endometritis throughout the post-partum period.

Table 2. Descriptive analysis of the prevalence of metritis/endometritis according to the category of each relevant indicator.

Indicator	Proportion (n/N)	95% CI
Feces		
Score 1 – 4	6.7% (8/120)	3.4 – 12.6%
Score 5	7.0% (138/1963)	6.0 – 8.3%
Score 6 – 9	14.3% (127/891)	12.1 – 16.7%
Ketonuria		
Class 1 – 2	8.5% (230/2719)	7.5 – 9.6%
Class 3 – 6	16.9% (43/255)	12.8 – 21.9%
BCS		
Score 1 – 2.75	16.5% (52/310)	12.7 – 21.0%
Score 2.75 – 3.75	8.5% (209/2470)	7.4 – 9.6%
Score 4+	6.7% (13/194)	4.0 – 11.1%
Evaluation day		
Class 0 – 4	10.1% (35/336)	7.8 – 14.1%
Class 5 – 17	10.0% (221/2241)	8.7 – 12.2%
Class 18+	4.3% (17/397)	2.7 – 6.8%
Parity		
Class1 (primiparous)	6.9% (50/728)	5.3 – 8.9%
Class 2 – 4	9.8% (190/1934)	8.6 – 11.2%
Class 5+	10.6% (33/312)	7.6 – 14.5%

The FC score was the most significant factor ($p < 0.0001$) associated with metritis/endometritis, followed by ketosis ($p = 0.0001$), BCS ($p = 0.001$), and evaluation day ($p = 0.001$) (Table 3). Additionally, feces consistency with a score of 6 – 9 was more likely (OR = 2.2; 95% CI: 1.1 – 4.6; $p < 0.05$) to display metritis/endometritis than with a score of 1 – 4; BCS 4+ had a higher chance (OR = 2.9; 95% CI: 1.66 – 5.4; $p < 0.001$) to display metritis/endometritis than score 1 – 2.75, and the evaluation day Class D18+ was approximately 3 times less probable (OR = 0.4; 95% CI: 0.2 – 0.7; $p < 0.001$) to display metritis/endometritis than class 0 – 4.

Table 3. Odds ratio of the main factors to display a metritis/endometritis association.

Indicator	Odds ratio (95% CI)	p-value
Feces		
Score 5	Reference	
Score 1 – 4	1.1 (0.6 – 2.4)	0.71
Score 6 – 9	2.1 (1.5 – 2.6)	< 0.001
Ketonuria		
Score 1 – 2	Reference	
Score 3 – 6	2.0 (1.4 – 2.9)	< 0.0001

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Body condition score		
Score 3 – 3.75	Reference	
Score 1 – 2.75	1.8 (1.3 – 2.5)	0.001
Score 4+	0.7 (0.4 – 1.2)	0.12
Evaluation day		
Class D5-17	Reference	
Class D0-4	1.2 (0.8– 1.88)	0.31
Class D18+	0.4 (0.3 – 0.7)	< 0.001

4. Discussion

In dairy cows, the classification between metritis and endometritis is largely defined by the threshold of 21 days post-partum, although this limit is not absolute. In both situations, uterine secretion (mucus, pus, and even lochia) occurs to a greater or lesser extent, according to the severity of the inflammation and infection, and through the cervical opening [17]. The pyometra (chronic endometritis with corpus luteum persistence) is an exception due to the closed cervix. Uterine secretions can be visualized and scored by vaginal discharge and are mostly identified, e.g., by vaginoscopy [18]. Using the Denmark 0 -9 scale, Elkjær et al. [2] defined metritis for ≥ 5 points, i.e., the presence of purulent red-brown, abnormal-smelling vaginal discharge, which requires treatment. Using this threshold, these authors found a metritis prevalence of 14.6% (58,063 cases/ 398,237 lactations) during the first 19 days post-partum. In our study, a 9.2% prevalence of metritis/endometritis was observed within the first two months post-partum. Most of them (81.0%) were diagnosed up to day 17, i.e., as metritis. Since metritis was treated, this procedure can justify the residual diagnosis of endometritis. In recent years, a similar prevalence of metritis (up to 10%) was reported in a Vietnamese farm monitored using sensors and software for health alerts [4]. In contrast, a 21.4% prevalence of metritis, using a uterine scoring methodology, has been reported in Florida, US [19]. Although the prevalence of metritis is associated with several risk factors linked to animals, pathogens, and the environment, effective herd health management, with an emphasis on proactive disease diagnosis, plays a key role.

FC can predict exchange on fecal dry matter or diarrhea (frequency and consistency) in calves [20] and cows [6]. Osmotic or water secretory/absorption patterns regulate FC. An increase in osmolarity by non-absorbable nutrients or other substances draws and retains water into the gut. On the other hand, secretory activity of enterocytes is mediated by chloride secretion mechanisms, whose cellular and molecular mechanisms can be challenged by toxins or other noxious substances [21]. Despite the influence of nutrition, soft feces or diarrhea can surge due to bacteria (endotoxins and exotoxins) or other pathogens, which infection is primarily linked, or not, with the digestive tract. Our hypothesis linking the FC to the occurrence of metritis was confirmed. Cows with soft feces (score 6 -5) were two times more likely to be associated with metritis than those with normal feces (score 5). Even if a cause-and-effect relationship cannot be established, this association supports the evidence that endotoxins enter the bloodstream from a bacterial pool in the uterus.

Furthermore, metritis [22] and diet transition [23] were associated with systemic inflammation and metabolic changes, which relationship can be bidirectional. Additionally, gut disorders, infectious (e.g., parasitism) or non-infectious (e.g., sub-acute ruminal acidosis), induce alterations in FC [6]. Depending on the control and prevalence of each disease, as well as the metabolic and immunological status of the cow, the associations between different diseases and FC can increase significantly.

Gram-negative bacteria, a predominant bacterial group involved in cattle infections, produce endotoxins (lipopolysaccharides) [24]. The presence of these endotoxins is frequent during the puerperal period, mainly by translocation from the rumen (microbiota change and ruminitis) and intestines (primary enteritis), uterus (metritis and endometritis), and mammary gland (mastitis) [25].

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A high plasma level of endotoxin concentrations, up to 9.14 Endotoxin Units/mL, can be observed in cows with heavy metritis during the puerperal period, in the early post-partum period [26,27]. Bacteriemia can occur concomitantly with endotoxemia when local defenses are overlapping. For example, Credille et al. [28] observed a 53% (17/32) prevalence of bacteriemia in cows, up to 9 days post-partum, without differences between healthy and acute puerperal metritis groups.

In our study, ketotic cows (score 3-6 for ketonuria) were twice as prone to display metritis/endometritis as non-ketotic cows (score 1-2). This association seems to be bidirectional. High serum levels of β-Hydroxybutyrate were observed in cows with further puerperal metritis (days 7 and 14 post-partum) than the control group at parturition or days -7 and -14 [29]. On the other hand, cows with metritis were more likely to show high levels of subclinical ketosis (blood β-Hydroxybutyrate ≥1.2mmol/L) [30]. Changes in metabolic and immunological profiles during the transition period, as well as puerperal diseases, have been reported as a key factor [30,31].

Our study observed that cows with a low BCS (score of 1 to 2.75) are twice as likely to develop metritis compared to cows with a normal score (score of 3 to 3.75). In dairy cows, a lower BCS has been reported in uteri with metritis compared to healthy uteri (e.g., [30]). Increasing serum levels of anti- and pro-inflammatory cytokines (adiponectin, leptin, TNF-alpha, IL-1beta, and IL-6 have been associated with low BCS (score 2 and 2.5) and metritis [33]. In the present study, no significant differences in the prevalence of metritis/endometritis were observed between the BCS scores of 3 – 3.75 and 4+. Sun et al. [34] observed that cows that lost > 0.5 BCS during the periparturient period (-21 to 50 days post-partum), but not ($P > 0.05$) those in the $0.25 < \text{BCS loss} \leq 0.5$ group, were more likely ($P < 0.05$) to develop metritis than those that lost ≤ 0.25 BCS. Probably, a low to moderate BCS loss occurred for cows that show a high (>4) BCS during early postpartum. This is also consistent with the differences between scores 1 – 2.75 and 4+ observed in our study. Melendez et al. [35] suggested BCS variation (losses) as a key indicator, better than measurement at a given postpartum time point. In our study, BCS was measured only once, on different days postpartum, and for a relatively small proportion of cows. These conditions represented a limitation of the study and may introduce some degree of bias.

Finally, in our study, no effect ($p > 0.05$) of parity on the prevalence of metritis/endometritis was observed in the final multivariable logistic model, despite a significant univariate analysis. This indicator can be considered a confounder, apparently. Nonetheless, primiparous cows have been associated with metritis, as reported in larger studies (102,060 Danish dairy cows – U-shaped risk [36]; 28,230 cows – multiparous at risk [37]). Most likely, the sample size of our study, although considerable, was insufficient to include three parity categories for a multivariate logistic regression analysis, and may have created bias at that level.

5. Conclusions

Scoring FC during the early postpartum period is a key indicator for predicting metritis. Most of the abnormal uterine secretions occurred during the first 2.5 weeks postpartum. The assessment of BCS at the time of reproductive management was the second most significant indicator of uterine health.

A large study involving these indicators, other diseases during the post-partum period, and their relationship with reproductive outcomes, can provide more information regarding animal health management and farm sustainability.

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Informed Consent Statement: Informed consent was obtained from the board of Vestjyske Dyrlaeger ApS (Denmark) to use their data.

Data Availability Statement: Data is available upon request to Vestjyske Dyrlaeger ApS (Denmark).

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

BCS	Body condition score
FC	Fecal consistence

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