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Body temperature in early postpartum dairy cows

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ABSTRACT

A strategy widely adopted in the modern dairy industry is the introduction of postpartum health monitoring programs by trained farm personnel. Within these fresh cow protocols, various parameters (e.g., rectal temperature, attitude, milk production, uterine discharge, ketones) are evaluated during the first 5 to 14 days in milk (DIMs) to diagnose relevant diseases. It is well documented that 14% to 66% of healthy cows exhibit at least one temperature of 39.5 °C or greater within the first 10 DIM. Although widely adopted, data on diagnostic performance of body temperature (BT) measurement to diagnose infectious diseases (e.g., metritis, mastitis) are lacking. Therefore, the objective of this study was to identify possible factors associated with BT in postpartum dairy cows. A study was conducted on a commercial dairy farm including 251 cows. In a total of 217 cows, a vaginal temperature logger was inserted from DIM 2 to 10, whereas 34 cows did not receive a temperature logger as control. Temperature loggers measured vaginal temperature every 10 minutes. Rectal temperature was measured twice daily in all cows. On DIM 2, 5, and 10, cows underwent a clinical examination. Body temperature was influenced by various parameters. Primiparous cows had 0.2 °C higher BT than multiparous cows. Multiparous cows that calved during June and July had higher BT than those that calved in May. In primiparous cows, this effect was only evident from DIM 7 to 10. Furthermore, abnormal calving conditions (i.e., assisted calving, dead calf, retained placenta, twins) affected BT in cows. This effect was more pronounced in multiparous cows. Abnormal vaginal discharge did increase BT in primiparous and multiparous cows. Primiparous cows suffering from hyperketonemia (beta-hydroxybutyrat $\geq$ 1.4 mmol/L) had higher BT than those not affected. In multiparous cows, there was no association between hyperketonemia and BT. The results of this study clearly demonstrate that BT is influenced by various parameters in dairy cows. Therefore, these parameters have to be considered when interpreting measurements of BT in dairy cows. This information helps to explain the high incidence of type I and II errors when measuring BT and clearly illustrates that measures of BT should not be used as a single criterion to decide whether or not to provide antibiotic treatment to dairy cows. However, research-based test characteristics of other parameters (e.g., vaginal discharge) alone or in combination with BT are still lacking.

1. Introduction

One major goal in transition cow management is to maintain animal health in the early postpartum period. An early recognition of sick cows is essential for an early treatment, which enhances the chance for returning to a normal state [1]. A strategy widely adopted in the modern dairy industry is the introduction of postpartum health monitoring programs by trained farm personnel. As surveyed in Germany, 89% of large dairy farms ($\geq$200 cows) checked fresh cows once or twice daily, whereas only 59% of small dairy farms ($<$100 cows) checked fresh cows with

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Table 1
Association of rectal and vaginal temperature with ambient temperature and temperature–humidity index of dairy cows calving in May, June, and July.

Environmental parameter	Temperature	Month of calving								
		May			June			July		
		n[a]	r	P-value	n[a]	r	P-value	n[a]	r	P-value
Ambient temperature (°C)	Vaginal	16,329	0.04	<0.01	15,472	0.16	<0.01	8838	0.34	<0.01
	Rectal (morning)[b]	771	0.04	0.24	914	0.17	<0.01	565	0.28	<0.01
	Rectal (evening)[c]	771	0.06	0.12	914	0.17	<0.01	565	0.38	<0.01
Temperature–humidity index	Vaginal	16,329	0.04	<0.01	15,472	0.15	<0.01	8838	0.35	<0.01
	Rectal (morning)[b]	771	0.04	0.23	914	0.17	<0.01	565	0.28	<0.01
	Rectal (evening)[c]	771	0.06	0.13	914	0.16	<0.01	565	0.36	<0.01

[a] Number of paired observations.
[b] Rectal temperature in the morning was correlated to ambient temperature and temperature–humidity index at 0700.
[c] Rectal temperature in the evening was correlated to ambient temperature and temperature–humidity index at 1700.

the same frequency [2]. Within these fresh cow protocols, various parameters (e.g., rectal temperature (RT), attitude, milk production, uterine discharge, ketones) are evaluated during the first 5 to 14 days in milk (DIMs) to diagnose relevant diseases (e.g., metritis, ketosis, displaced abomasum, mastitis) and provide treatment [3]. These authors postulated that the combination of the parameters stated above has to be considered when making a decision whether or not a cow is sick and requires treatment.

Based on practical observations, a health monitoring program was developed earlier that included RT and an evaluation of attitude, appetite, and milk production to evaluate the health status during the first 10 DIM [4]. The goal of this protocol was to determine whether or not a cow appeared sick (depressed, off feed, and low milk production) with or without fever (>39.4 °C). The combination of the two different outcomes (fever: yes or no; sick: yes or no) was used to define different treatment strategies based on the assumptions that fever early postpartum is most often related to metritis and that sick cows (with or without fever) have metabolic problems such as ketosis or hypocalcaemia [4]. However, the evaluation whether a cow appears sick or not remains more or less a subjective decision. For uterine diseases, for example, Sheldon, et al. [5] stated that it is not possible to categorize every animal with disease using internationally accepted definitions [6], although the vast majority can be identified.

To overcome subjectivity and to prevent confounding, in several studies on metritis [7–9] or retained placenta [10] in dairy cows, RT was the only criterion for the treatment decision, because it is objectively measurable. Although this approach seems to be more objective, it is well documented that 14% to 66% of healthy cows exhibit at least one temperature of 39.5 °C or greater within the first 10 DIM [11–13] and that RT is influenced by various parameters such as type of thermometer and the method itself [14], age, and climate [11,12], as recently reviewed [15]. Furthermore, in one study, it was demonstrated that 58.5% of cows with metritis did not have fever (>39.4 °C) [16]. Therefore, using an approach with RT as the only parameter used to make treatment decisions leads to an overtreatment of healthy cows (i.e., type I errors).

Table 2
Number of cows with and without temperature logger inserted into the vagina considering parity, risk factors, month of calving, vaginal discharge, and hyperketonemia.

Parameter	Cows with vaginal logger		Cows without vaginal logger	
	Primiparous	Multiparous	Primiparous	Multiparous
n	75	142	15	19
Parity (mean ± SD)	1	3.0 ± 1.2	1	3.2 ± 1.4
Risk for fever[a]				
Retained placenta	5	19	—	3
Twins	2	4	—	1
Stillbirth	5	1	2	—
Assisted calving	43	39	10	3
Total at risk	48	55	10	6
Total not at risk	27	87	5	13
Month of calving				
May	36	53	—	—
June	22	59	7	12
July	17	30	8	7
Vaginal discharge				
Abnormal	68	100	9	11
Normal	7	42	6	8
Hyperketonemia				
≥1.4 mmol/L	12	52	4	7
<1.4 mmol/L	63	90	11	12

Abbreviation: SD, standard deviation.
[a] Cows can have more than 1 risk for fever. Therefore, adding the number of cows in each risk category can be less than the total number of cows at risk.