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Risk factors for clinical endometritis and its effects on reproductive performance in dairy cattle

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Abstract
Endometritis is one of the most prevalent uterine infection in dairy cattle that affects reproductive performance by decreasing fertility and leading to high economic losses. The objectives of this study were to assess the risk factors for clinical endometritis and its subsequent effects on reproductive performance in Holstein Friesian cows. The study was conducted in two dairy farms from Belgium, where 682 animals were enrolled, during two years of study. All data were processed using IBM SPSS Statistics version 17. The Pearson correlation revealed positive correlations between endometrits and postpartum disorders like dystocia, placental retention, milk fever, metritis and ovarian pathologies (persistent corpus luteum) ($p<0.01$). As expected, a moderate positive correlation was found between endometritis and voluntary waiting period ($p<0.05$). Regarding the analyzed reproductive indices, endometritis was positively correlated with reproduction period, service period, calving interval and inseminations number/pregnancy ($p<0.01$). A negative correlation was found between endometritis and pregnancy rate ($p<0.05$) as well as other weak correlations between this pathology and other parameters taken under study. We conclude that the risk factors for clinical endometritis in cattle are mainly caused by postpartum disorders with detrimental effects on reproductive performance, as the affected cows take longer to become pregnant by extending calving to conception intervals and increasing the risk for culling.
Key words: *endometritis, cows, postpartum disorders, reproduction.*

Introduction

Endometrial bacterial infections which causes uterine diseases are common in the first two weeks after parturition, their occurrence being encountered in 80–90% of dairy cattle, leading thus to a decreased productivity and subfertility (Sheldon I.M. et al., 2009, Potter T.J. et al., 2010).

The isolated bacteria from the uterine lumen of cows during the first weeks after calving (Sheldon I.M. et al., 2009) are responsible for five "classifications" of uterine infections: puerperal metritis, clinical metritis, clinical endometritis, subclinical endometritis and pyometra (Adnane M. et al., 2017). According to Sheldon I.M. et al. (2017), clinical endometritis is defined as the presence of a purulent discharge detectable in the vagina 21 days postpartum or more, or a mucopurulent discharge detectable in the vagina after day 26 postpartum.

The global incidence of endometritis in cattle is highly variable, ranging from 3.4% to 40% and is associated with a delayed conception and an increased culling rate (Sheldon I.M. et al., 2006).

Although many cows eliminate these bacteria during the first 5 weeks after parturition, in 10 – 17% of animals, persistence of bacterial infection causes uterine diseases detectable by physical examination (Cheong S.H. et al., 2011; Williams E.J. et al., 2005). Thus, the presence of pathogenic bacteria in the uterus causes inflammation, histological lesions of the endometrium, delays uterine involution and perturbs embryo survival (Prunner I. et al., 2014; Kim I.H. et al., 2003).

Furthermore, uterine infection and associated inflammation bacterial products, suppress pituitary LH secretion and perturbs postpartum ovarian follicular development and function, which

disrupts ovulation in cattle (Gilbert R.O. et al., 2005; Potter T.J. et al., 2010; Salasel B. et al., 2010). Thus, uterine disease is associated with lower conception rates, increased intervals from calving to first service or conception and more cattle culled for failure to conceive (Cheong S.H. et al., 2011; Williams E.J. et al., 2005; Bacha B. et al., 2010).

Risk factors most commonly associated with uterine infection are those that are likely to cause endometrial trauma, including stillbirth, twins, male and beef-sire calves, dystocia, caesarean section surgery, and retained fetal membranes (Dubuc J.T.F. et al., 2010; Potter T.J. et al., 2010).

Material and methods

This study was conducted during two years on a total number of 682 (163 primiparous and 465 multiparous) Holstein Friesian cows from two commercial dairy farms, from the eastern region of Belgium. All the animals enrolled in this study were housed in free stall barns and were fed according to their physiological status.

Diets for pre- and postpartum transition cows were designed to meet or to exceed the requirements of lactating dairy cows according to NRC guidelines (2001). Lactating dairy cows were milked twice daily and the established voluntary waiting period was set at 50 days postpartum. The first postpartum examinations were performed in order to identify disorders that frequently occur in the early postpartum period (retained fetal membranes, milk fever, metritis, endometritis). Cows were examined between day 20 and day 51 postpartum for uterine involution and ovarian function assessment (follicles, persistent corpus luteum, cystic ovarian disease and ovarian inactivity). Cows that calved during the two years of study were gynecologically examined (transrectal examination/ vaginoscopy), supplemented by complementary examinations as required (ultrasonography/ bacteriological examination of vaginal secretions).

Information for each individual including parity number, calving season, dystocia, retained fetal membranes, milk fever, metritis, endometritis, calving season and cow's parity, were the selected risk factors for clinical endometritis in the present analysis.

Parity numbers were divided into four categories (1 - $\geq$ 4) and calving seasons in four categories (spring, summer, autumn, winter). All statistical analyses from 682 cows were performed using the IBM SPSS Statistics version 17.

Results and Discussion

Thus, taking into consideration the risk factors emphasized in Table 1, following statistical data analysis, we observed that during the studied period, cows with dystocia ($r = 0.211$; $P < 0.01$), retained fetal membranes ($r = 0.198$; $P < 0.01$), milk fever ($r = 0.211$; $P < 0.01$) and metritis ($r = 0.398$; $P < 0.01$) were significantly associated with a higher risk to develop clinical endometritis than herdmates with normal parturitions (Table 2).

In a study published by Adnane M. et al. (2017), he claims that abnormal calving and dystocia can lead to endometrial trauma; also, calving assistance favors the introduction of pathogenic bacteria into the uterus and increases the potential for clinical and subclinical endometritis to develop.

Furthermore, the incidence of both clinical and subclinical endometritis is significantly increased by calving assistance encountered in case of dystocia (Prunner I. et al., 2014).

Our positive correlations in this study are similar to other findings in which dystocia is often associated with several postpartum disorders, such as retained fetal membranes and delayed uterine involution, both of which clearly favor development of endometritis (Markusfeld O., 1984; Correa M.T., 1993).

Regarding the retained fetal membranes, they tended to have an important effect on the risk of endometritis occurrence ($r = 0.198$; $P < 0.01$); specifically, cows with retained fetal membranes (11.6%) were more likely to develop the disease than herdmates with normal parturition (Table 1, 2).

Table 1. Potential risk factors for clinical endometritis in dairy cattle

Variables	Yes / No	Endometritis	
		Yes	No
Dystocia	Yes – 230 (33.7) No – 452 (66.3%)	Yes – 116 (17%) No – 71 (10.4%)	Yes – 114 (16.7%) No – 381 (55.9%)
Retained Fetal Membranes	Yes – 79 (11.6%) No – 603 (88.4%)	Yes – 48 (7%) No – 122 (17.9%)	Yes – 31 (4.5%) No – 481 (70.6%)
Milk Fever	Yes – 87 (12.8%) No – 595 (87.2%)	Yes – 44 (6.5%) No – 27 (3.9%)	Yes – 43 (6.3%) No – 568 (83.3%)
Metritis	Yes – 122 (17.9%) No – 560 (82.1%)	Yes – 97 (14.2%) No – 95 (13.9%)	Yes – 25 (3.7%) No – 465 (83.4%)
Calving season			
Spring	177 (25.6%)	47 (6.9%)	130 (19.1%)
Summer	210 (30.8%)	50 (7.3%)	160 (23.5%)
Autumn	172 (25.1%)	42 (6.2%)	130 (19.1%)
Winter	123 (18.5%)	31 (4.5%)	92 (13.4%)
Cow's parity			
1	163 (23.9%)	48 (7%)	115 (16.8%)
2	150 (22%)	31 (4.5%)	119 (17.4%)
3	123 (18%)	23 (3.4%)	100 (14.7%)
≥4	246 (36.1%)	68 (10%)	178 (26.2%)

Table 2. Correlations between endometritis and risk factors in dairy cattle

	D	RFM	MF	M	E	E 60	PCL/ COD/ OH	(P –1AI)	No. AI/P	P%	No. Treat.
D	1.000	**0.406****	**0.233****	0.110	**0.211****	-0.053	**0.179***	0.034	**0.161***	-0.126	**0.169***
RFM		1.000	**0.323****	0.037	**0.198****	**-0.154***	0.120	**0.215****	0.063	-0.079	**0.171***
MF			1.000	0.018	**0.211****	-0.121	-0.100	0.103	**0.223****	**0.265****	**0.312****
M				1.000	**0.398****	**-0.113***	**0.204***	**0.103***	**0.184****	-0.040	**0.153***
E					1.000	**-0.160***	**0.403****	**0.115***	**0.333****	**-0.155***	**0.310****

D – dystocia; **RFM** – retained fetal membranes; **MF** – milk fever; **M** – metritis; **E** – endometritis; **E 60** – estrus < 60 days postpartum; **PCL/ COD/ OH** – persistent corpus luteum/ cystic ovarian disease/ ovarian hypofunction; **P – 1AI** – parturition – 1st artificial insemination; **No. AI/ P** – number of artificial insemination/ pregnancy; **P%** - pregnancy index; **No. Treat**. – number of treatments.

Similar to our findings, Esslemont E.J. et al. (2002), states that at the herd level, presence of retained fetal membranes is characterized by an extended interval between calving and first artificial insemination, a longer service period and an increase in number of slaughtered cows because they fail to conceive in the first 80 days postpartum.

Retained placental tissue is the main important risk factor for endometritis in dairy cattle (Potter T.J. et al., 2010). Residual tissue observed in case of retained fetal membranes is a suitable medium for bacterial growth in the uterus, delays uterine involution and thus, the endometrium restoration (Adnane M. et al., 2017).

As for milk fever correlations with clinical endometritis, our results are in accordance to several epidemiological studies carried out by van Dorp et al. (1999) and Roche (2006), in which they demonstrated that there is an association between the development of metabolic disease and subsequent development of reproductive disorders like metritis and clinical endometritis.

Following statistical analysis, Pearson correlation revealed for clinical endometritis two negative correlations with estrus < 60 days postpartum ($r = - 0.160$; $P < 0.05$), pregnancy index ($r = - 0.155$; $P < 0.05$) and several positive correlations with ovarian pathologies ($r = 0.403$; $P < 0.01$), parturition – 1st artificial insemination ($r = 0.115$; $P < 0.01$), number of artificial inseminations/ pregnancy ($r = 0.310$; $P < 0.01$) and number of treatments ($r = 0.333$; $P < 0.01$) (Table 2).

According to Sheldon I.M. et al. (2008), postpartum disorders presence delays involution and restoration of the endometrium, as well as maintaining the patency of the cervix, facilitating an entry point and a suitable environment for bacterial overgrowth, influencing thus, all reproductive parameters.

Moreover, in a study published in 2009 by Sheldon I.M. et al., claimed that cows affected by endometritis have a high concentration of bacterial lipopolysaccharide (LPS) and immune-depressant products which subsequently decrease the recruitment of leukocytes into the uterus to clear bacteria involved in the inflammatory process, disturbs fertilization, prevents implantation or can lead to early embryonic death.

As for the clinical endometritis occurrence according to calving season and cows parity for the studied period, we observed that the highest prevalence of clinical endometritis was registered during summer (50%) and spring (47%) seasons, as well as for cows during 1st (48%) and ≥ 4th (68%) parities (Table 1).

Although calving season is mentioned by other authors as having a considerable importance in explaining reproductive disorders in cows, following the statistical analysis, no statistically significant correlations were obtained for the present study. Thus, we can affirm that the occurrence and the magnitude of endometritis in dairy cattle are linked to the livestock status as extrinsic factors as well as to intrinsic factors specific to each animal, indicating that some cows may be more likely to develop and maintain endometritis than other animals in the same herd.

Conclusion

In conclusion, cows with postpartum disorders like dystocia, retained fetal membranes, milk fever and metritis have the highest risk for clinical endometritis occurrence, with detrimental effects on reproductive performance, by economic losses related to delay in the resumption of ovarian activity, by extending the calving - conception interval, by an increased number of services per conception and higher costs for treating postpartum conditions thus contributing, to an increase in culling rates.

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