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Risk factors for delayed conception in Korean dairy herds

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Delayed conception is defined as an interval of greater than 90 days postpartum before a cow becomes pregnant again. In this study, the risk factors for delayed conception in Korean dairy herds were determined by evaluating several reproductive factors in individual cows. The following data was recorded from 1,012 pregnancies in eight dairy herds (designated A-H) from July 2001 to June 2006: herd, cow parity, repeated animal (cows included 2, 3, or more times), calving season, calving condition (abnormal partus), postpartum disorders (retained placenta, metabolic disorders, metritis and ovarian cysts) and conception. Logistic regression was used to evaluate the effects of these factors on delayed conception. A stepwise procedure was used to obtain the appropriate model ($\alpha = 0.05$), which revealed the herd, metritis and ovarian cysts to be significant risk factors for delayed conception. The odds ratio showed that the likelihood of delayed conception increased by 3.3 and 2.0 fold for each incidence of metritis and ovarian cysts, respectively. Delayed conception was significantly more likely in 2 herds, in herd A by 2.0 fold and in herd B by 2.4 fold, compared with herd H. These results suggest that the prevention of postpartum metritis and ovarian cysts, as well as improved herd management, will be needed to maintain a short interval between calving and conception in Korean dairy herds.

Key words: dairy cow, delayed conception, diseases, herd, risk factors

Introduction

Poor reproductive performance is an important limiting factor in the productivity of dairy herds, and the reproductive performance of a cow plays an important role in the culling decisions made by farmers [2]. In order to attain a recommended calving interval of 12-13 months, cows need conceive within 85-110 days after parturition. A decline in fertility has generally been associated with genetic selection as well as improvements in nutrition and management practices, which have led to a continuous increase in milk yield [11,20]. The shift toward a larger herd size, as well as greater milk production, predisposes cows to severe reproductive disorders, resulting in decreased reproductive performance [26]. The large energy requirement at the onset of lactation in high-producing dairy cows has a severe negative impact on the energy balance during the early lactation period [3,5], which might adversely impact the postpartum health and fertility [7]. The retention of the placenta, metritis, and ovarian cysts are common reproductive disorders that decrease the reproductive performance causing economic loss [1,4,15,17]. In addition to these diseases, herd management, the calving season, and cow parity are also considered to be risk factors for low fertility [14,24]. Similarly, many factors might influence the reproductive performance in dairy cows. The interval from calving to subsequent conception is a useful measure of the reproductive performance in dairy herds [23]. There are many reports of the reproductive performance of dairy cows [12,25,28]. However, few have determined the possible risk factors influencing delayed conception [18,22]. Knowledge of these risk factors would enable the development of more efficient herd management regimens. Therefore, the aims of this study were to identify the risk factors associated with delayed conception by evaluating several reproductive factors in individual cows in Korean dairy herds.

Materials and Methods

Herds

This study used eight dairy farms (designated A-H) located in the Chungbuk Province of Korea. All the farms contained 50 or more cows. The cows were maintained in free-stall facilities and were fed a total mixed ration diet based on brewer's grain, alfalfa hay, cottonseed, beet pulp, sweet sorghum, tall fescue, oat hay, and vitamin and mineral additives. The mean annual milk production (mean ± SD) of herds A, B, C, D, E, F, G and H were 8,897.7 ± 1,810.9, 10,274.9 ± 1,848.8, 8,958.7 ± 1,632.3, 9,453.8 ± 1,821.0, 10,184.5 ± 1,837.8, 9,027.4 ± 1,762.3, 9,170.7 ± 2,003.2

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and 9,235.2 ± 1,853.1 kg per cow, respectively. The cows were milked twice daily and observed for the estrus condition twice daily.

Definitions of calving and postpartum disorders, and reproductive health checkups

All the procedures were performed with the approval of the Animal Ethics Committee of the Chungbuk National University. Calving was defined as an abnormal partus if any of the following conditions were present: dystocia (veterinary-assisted calving or pulling with extreme force), caesarean section, twins, or stillbirth [13,19]. The definitions of postpartum reproductive and metabolic disorder used in this study are similar those used in previous studies [6,10,21,29]. Retention of the fetal membrane for >24 h was defined as a retained placenta [6,19]. Metabolic disorders (abomasal displacement, milk fever, or ketosis) were diagnosed by the clinical signs observed by the veterinarian and/or farmer within 4 weeks postpartum. Metritis was diagnosed 4 weeks postpartum by the presence of the following clinical signs: a cloudy discharge and enlarged uterus observed by a rectal examination, alone or in combination with other clinical signs. Therefore, metritis included those cases with endometritis and pyometra as well as metritis [11,16]. Ovarian cysts were diagnosed from 4 to 16 weeks postpartum using ultrasonography (Sonoace 600 with 5.0 MHz linear-array transducer; Medison, Korea). The ovarian cysts were defined as any ovarian structure >25 mm internal diameter with a wall <3 mm thick (follicular cyst), or with a wall >3 mm thick (luteal cyst) in the absence of a normal corpus luteum that was present for more than 10 days [29].

All the cows received regular reproductive health checkups every 2 to 4 weeks by veterinarians from the College of Veterinary Medicine at Chungbuk National University. This involved the diagnosis and treatment of reproductive diseases, pregnancy diagnosis and an evaluation of the body condition of the cows. Cows with metritis were treated with one intrauterine infusion of either a 1,500 mg oxytetracycline hydrochloride solution (Metrijet 1500; Intervet, UK) or a 2% povidone-iodine solution (Korea Pharma, Korea), and were retreated when deemed necessary. Cows diagnosed with ovarian follicular cysts beyond 8 weeks postpartum were treated with either 100 μg fertirelin acetate (GnRH, Conceral; Dongbang, Korea) or 250 μg gonadorelin (GnRH, Fertagyl; Intervet, Netherlands), and cows diagnosed with luteal cysts were treated with 25 mg $PGF_{2\alpha}$ (Lutalyse; Pharmacia & Upjohn, Belgium). The voluntary waiting period from calving to the first artificial insemination (AI) in this study was 50 days. AI was performed according to the a.m.-p.m. rule. The conception was determined rectally 60 to 70 days after AI by both ultrasonography and manual palpation.

Data collection and analysis

Data were collected from 1,012 pregnancies from eight dairy herds from July 2001 to June 2006. During this period, the average monthly air temperatures ranged from 3.9-16.1°C in spring (March to May), 20.6-24.0°C in summer (June to August), 5.0-18.5°C in autumn (September to November), and –3.8-1.2°C in winter (December to February).

Normal conception was defined as conception occurring during an interval from 50 to 90 days postpartum, and delayed conception was defined as conception occurring after 90 days postpartum. The following data was recorded for each cow: herd, cow parity, repeated animal, calving season, reproductive disorders, metabolic disorders, and interval from calving to conception. The parity in these herds was categorized as 1, 2, and 3 or higher.

Logistic regression was used to determine the relative contribution from each factor to the probability of delayed conception. Delayed conception was considered the dependent variable. Abnormal partus, retained placenta, metabolic disorders, metritis and ovarian cysts were considered independent factors, and were coded as dichotomous variables (where yes indicates the presence these factors and no indicates the absence). Herd, cow parity, repeated animal and calving season were considered as class variables. Table 1 lists the independent variables described above. The influence of these variables on delayed conception was assessed using logistic regression analysis with SAS software [27]. Initially, simple logistic regression was applied to each independent variable separately to determine which of these independent variables influenced delayed conception. Later, a stepwise procedure was used to obtain the appropriate model ($\alpha = 0.05$). For all tests, $p < 0.05$ was considered significant.

Results

The mean interval from calving to conception in 1,012 pregnancies was 147.4 ± 89.6 (mean ± SD) days. Delayed conception was recorded in 687/1012 (67.9%) pregnancies. The final model identified the herd, metritis and ovarian cysts as risk factors for delayed conception (Table 2). Cow parity, repeated animal, calving season, abnormal partus, retained placenta, and metabolic disorders were not found to be significant risk factors for delayed conception. Based on the odds ratio, the likelihood of delayed conception increased by 3.3 and 2.0 fold for each incidence of metritis and ovarian cysts, respectively. Delayed conception was more likely in two herds, in herd A by 2.0 fold and in herd B by 2.4 fold compared with herd H.

Discussion

This study examined the risk factors for delayed conception (>90 days postpartum) by evaluating the herd,

Table 1. Descriptive statistics of the data included in the analysis of the risk factors for delayed conception in 1,012 pregnancies in eight Korean dairy herds

Variables	Level	Total pregnancies (n = 1,012)	Cows without delayed conception[a] (n = 325)	Cows with delayed conception[b] (n = 687)
Herd	A	92	25	67
	B	155	32	123
	C	81	27	54
	D	176	62	114
	E	226	81	145
	F	133	39	94
	G	53	19	34
	H	96	40	56
Parity	1	366	123	243
	2	266	84	182
	3≤	380	118	262
Repeated animal[c]	1	569	175	394
	2	278	96	182
	3≤	165	54	111
Calving season[d]	Spring	221	63	158
	Summer	253	72	181
	Autumn	274	93	181
	Winter	264	97	167
Abnormal partus[e]	No	930	301	629
	Yes	82	24	58
Retained placenta	No	850	285	565
	Yes	162	40	122
Metabolic disorders[f]	No	978	318	660
	Yes	34	7	27
Metritis	No	726	280	446
	Yes	286	45	241
Ovarian cysts	No	827	291	536
	Yes	185	34	151

[a]Conception from 50 to 90 days postpartum. [b]Conception after 90 days postpartum. [c]Cows included once (n = 569), twice (n = 278), three (n = 104) or more (n = 61) times within this study. [d]Spring = March through May; Summer = June through August; Autumn = September through November; Winter = December through February. [e]Abnormal partus includes dystocia, caesarean section, twins and stillbirth. [f] Metabolic disorder includes abomasal displacement, milk fever and ketosis.

cow parity, repeated animal, calving season, and several reproductive factors in individual cows in Korean dairy herds. Delayed conception occurred in 68% of cows. Logistic regression analysis indicated that herd, as well as the incidence of metritis and ovarian cysts were significant risk factors for delayed conception.

The reproductive performance of a dairy herd affects the profitability of a farm. Poor reproductive efficiency reduces the milk yield and the number of calves born (i.e., replacements produced), and might increase the cost of veterinary services and culling. The interval from calving to conception is a useful measure of the reproductive performance in herds where calving is spread throughout the year and there is no defined breeding season [23]. The mean interval from calving to conception in this study (147 days) was longer than the previously reported intervals of 118-126 days [8,9,18]. The longer interval measured in this study might be due to differences in the characteristics of the cows, the environment, nutritional management and herd health control conditions. However, the finding that 68% of cows experienced delayed conception is similar to the rate (64%) reported by López-Gatius *et al.* [22].

Reproductive performance is influenced by many factors, including management practices, environmental and nutritional factors, and breeding for milk production [24]. The aim of this study was to determine the important risk factors for delayed conception in Korean dairy herds. These findings that the herd, incidence of metritis, and ovarian cysts are the

Table 2. Risk factors for delayed conception analyzed by a stepwise selection procedure using the data from 1,012 pregnancies in eight Korean dairy herds

Independent variables		Odds ratio	95% confidence interval	*p*-values
Metritis	Yes or No	3.3	[2.273, 4.666]	<0.0001
Ovarian cysts	Yes or No	2.0	[1.306, 2.987]	0.0013
Herd	A vs. H	2.0	[1.005, 3.582]	0.1920
	B vs. H	2.4	[1.324, 4.229]	0.0090
	C vs. H	1.6	[0.864, 3.048]	0.5639
	D vs. H	1.2	[0.734, 2.108]	0.3931
	E vs. H	1.2	[0.713,1.959]	0.1981
	F vs. H	1.6	[0.896, 2.798]	0.5808
	G vs. H	1.0	[0.490, 2.088]	0.2060

risk factors for delayed conception is consistent with the results reported by Gröhn and Rajala-Schultz [14]. However, another study reported that cows with ovarian cysts had a longer interval from calving to conception than the cows without cysts, while the cows with metritis had a shorter interval from calving to conception than the cows without metritis [18]. In contrast to the present study and the results reported by Gröhn and Rajala-Schultz [14], López-Gatius *et al.* [22] did not find any significant effect of reproductive disorders, such as metritis and ovarian cysts on delayed conception, while they found that high milk production at day 50 postpartum, advanced parity and retained placenta were associated with delayed conception. In this study, the herd was also correlated with delayed conception, which consistent with a previous report [24]. Delayed conception may be also due to management practices that have a negative influence on the energy balance in early lactation, which is associated with a higher milk yield and inadequate nutrient intake. In addition, the heat detection rate and a short postpartum interval prior to the first insemination might be associated with fertility, as indicated by Mayne *et al*. [24].

The cow parity, repeated animal, calving season, abnormal partus, retained placenta and metabolic disorders were eliminated from the final model because these factors had no influence on delayed conception. The finding that cow parity is not related to an increased risk of delayed conception is not consistent with previous studies [14,22]. However, the relationship between parity and fertility is difficult to determine because of the confounding effect of culling under farm conditions. The correlation between fertility and parity might be explained by the observation that the culling rates increased with increasing parity (data not shown). In agreement with a previous report [22], the calving season was not associated with delayed conception in this study. However, calving during the spring (March-May) has been associated with an increased risk for delayed conception [14]. The finding that a retained placenta is not correlated with an increased risk of delayed conception is not consistent with a previous study [14] that reported that delayed conception was likely in cows suffering from a retained placenta. Overall, these results suggest that the possible risk factors for delayed conception in dairy cows is highly variable and might be the result of differences in the characteristics of the cows, differences in the location of the herds, or climate and general herd management including nutrition and health control conditions.

In conclusion, the herd, metritis and ovarian cysts were found to be risk factors for delayed conception in dairy herds in Korea. Therefore, the prevention of, and efficient treatment for metritis and ovarian cysts as well as improvements in herd management, will be necessary to shorten the interval from calving to conception in Korean dairy herds.

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