

Risk factors for retained placenta and the effect of retained placenta on the occurrence of postpartum diseases and subsequent reproductive performance in dairy cows

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The objectives of this study were to determine the risk factors for retained placenta by evaluating several reproductive factors in individual cows, and to determine the effects of retained placenta on the occurrence of postpartum diseases and subsequent reproductive performance in dairy herds. The health status, cow parity, calving, and breeding dates were recorded from 805 calvings in nine dairy herds from October 2000 to March 2004. We used logistic regression to evaluate the effects of these factors on the incidence of retained placenta. A stepwise procedure, used to obtain the appropriate model with $\alpha = 0.05$, revealed that abnormal partus and gestation length were important risk factors for retained placenta. The occurrence of endometritis and metabolic disorders was greater ($p < 0.01$) in the group with retained placentas than in the control group. The mean intervals from calving to first service and conception were prolonged ($p < 0.05$) by 7 and 18 days, respectively, in the group with retained placentas compared to the control group. These results suggest that abnormal partus and gestation length are strongly correlated with the development of retained placenta, which increases the occurrence of postpartum diseases and subsequently decreases reproductive performance in dairy herds.

Key words: Retained placenta, risk factors, postpartum diseases, reproductive performance, dairy cows

Introduction

Expulsion of the placenta usually takes less than 6 to 8 hr after parturition in cows [52,53]. In practice, the most commonly used definition of retained placenta is the presence of fetal membranes 24 hr or longer postpartum

[45]. The condition of retained placenta occurs in 4 to 18% of calvings [17,18,23,45]. Retained placenta, one of the main causes of endometritis in cattle, causes economic loss [31,34]. Kossaibati and Esslemont [37] calculated the direct cost of a case of retained placenta to be about £ 83, with an over-all cost of £ 298.29 (1995 prices). Many, often interrelated, factors have been implicated in the occurrence of retained placenta [39]. Thus, various risk factors related to development of retained placenta in individual cows have been identified, although some are controversial. Calving problems including dystocia [8,14,17,25], stillbirths [8,45], and multiple births [1,8,43,47,48,51] are associated with an increased incidence of retained placenta. In addition to these problems, abnormalities in partus, parity [43,61], gestation length [43,47], calving season [43,47], and nutrition [39] are also considered risk factors for retained placenta. However, some researchers have found no association between dystocia [9,10,17], cow parity [47], or calving season [25,38] and the incidence of retained placenta.

Retained placenta is a direct risk factor for postpartum reproductive and metabolic disorders [5,24,38], which may affect subsequent reproductive capability of dairy cows. In fact, a negative impact of retained placenta on reproductive performance of dairy cows has been widely documented [2,21,27,31,40,46,60]. However, others have reported that retained placenta does not significantly alter fertility [28,35,54,57].

Risk factors for retained placenta vary among different regions or countries because of differences in general management, environment, and herd health control conditions [20,22]. In addition, effects of retained placenta on reproductive performance have varied. Our first objective was to determine the risk factors for retained placenta by evaluating several factors: calving condition, parity, gestation length, and calving season in dairy herds in Chungbuk province, Korea. The second objective was to determine the effect of retained placenta on the occurrence of postpartum metabolic and reproductive diseases and on subsequent reproductive performance.

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Materials and Methods

Herds

This study was performed using Holstein dairy farms located in Boeun county, Chungbuk province, Korea. All herds contained 50 or more cows and received regular reproductive health checkups every 4 weeks from veterinarians at the College of Veterinary Medicine at Chungbuk National University. The regular reproductive health checkups included diagnosis and treatment of reproductive disturbances, pregnancy diagnosis, and measurement of body condition score [13]. The cows were maintained in free-stall facilities and fed a total mixed ration. The ration was based on brewers grain, alfalfa hay, cotton seed, beet pulp, sweet sorghum, tall fescue, oat hay, and additives. They were milked twice daily and were observed for estrus behavior twice a day.

Case definition

An abnormal partus included dystocia (veterinary-assisted calving or pulling with extreme force), caesarean section, twins, or stillbirth [21,36]. The postpartum reproductive and metabolic disorder definitions used in this study are similar to the definitions used in previous studies [8,11,41,59]. Retained placenta was defined as the retention of the fetal membrane for > 24 hr [8,36]. Metabolic disorders (abomasal displacement, milk fever, or ketosis) were diagnosed by clinical signs observed by the veterinarian and/or farmer within 4 weeks postpartum. Abomasal displacement was diagnosed by a pinging sound upon abdominal auscultation by a veterinarian, and all cases were corrected by surgery. Milk fever was diagnosed by the presence of the following clinical signs: weakness, cold skin, and favorable response

to calcium therapy. Ketosis was defined as the presence of the following clinical signs: anorexia, depression, and odor of acetone on the breath. Endometritis was diagnosed 4 weeks postpartum by examination by the authors and diagnosed by the presence of the following clinical signs: cloudy discharge and enlarged uterus observed by rectal examination with or without other clinical signs. Therefore, endometritis included cases of metritis and pyometra as well as endometritis [15,29]. At the same time, the presence of ovarian cysts was diagnosed by ultrasound examination (Sonoace 600 with 5.0 MHz linear-array transducer; Medison, Korea) based on ovarian structures present: an ovarian structure of greater than 25 mm internal diameter with a wall less than 3 mm thick (follicular cyst) and with a wall more than 3 mm thick (luteal cyst) in the absence of a normal corpus luteum [59]. Repeat occurrences of these conditions in a single cow were included.

Data collection and processing for determination of the risk factors for retained placenta

Data were collected from 805 calvings from nine dairy herds from October 2000 to March 2004. Table 1 lists independent variables that describe calving condition, parity, gestation length, and calving season. In order to evaluate the influence on development of retained placenta of abnormal partus (total cases of dystocia, caesarean section, twins and stillbirth), parity, gestation length, and calving season, we used logistic regression with the SAS program [55]. Initially, to determine which independent variables influence development of retained placenta, simple logistic regression was applied to each independent variable separately. Later, a stepwise procedure was used to obtain the appropriate model with $\alpha = 0.05$. Data about the occurrence of retained

Table 1. Descriptive statistics of data included in the analysis of risk factors for retained placenta in 805 calvings in nine dairy herds

Variables	Level	No. of calvings	
		Retained placenta +	Retained placenta -
Abnormal partus ¹⁾	Yes	26	42
	No	121	616
Gestation length	< 271	24	19
	271 - 280	65	332
	> 280	58	307
Cow parity	1	27	172
	2	41	209
	3	35	138
	≥ 4	44	139
Calving season ²⁾	Spring	27	153
	Summer	36	187
	Autumn	50	154
	Winter	34	164

¹⁾Abnormal partus included dystocia, caesarean section, twins, and stillbirth.

²⁾Spring = March to May; Summer = June to August; Autumn = September to November; Winter = December to February.

placenta among individual farms were compared using the chi-square test.

Evaluation of the effect of retained placenta on the occurrence of reproductive and metabolic disorders

Cows were grouped based on the occurrence of retained placenta 24 hr postpartum into the retained placenta group ($n = 147$) or the control group ($n = 658$). Data about the occurrence of reproductive disorders (endometritis or ovarian cyst) or metabolic disorders (abomasal displacement, milk fever, or ketosis) were compared between the two groups using the chi-square test, or Fishers exact test when frequencies were too low (< 5) to use the chi-square. Statistics were performed the SAS program.

Evaluation of the effect of retained placenta on reproductive performance

The cows were bred at observed estrus more than 50 days after calving. Artificial insemination (AI) was done according to the a.m.-p.m. rule. The conception to AI ratio was determined per rectum 60 to 70 days after AI by both ultrasonographical observation and manual palpation. Reproductive performance data were collected for a minimum of 7 months postpartum or until pregnancy or culling. Data on the intervals from calving to first service and conception between the retained placenta and control groups were analyzed by t -test using the SAS program. For all tests, a value of $p < 0.05$ was considered significant.

Results

The overall incidence of retained placenta among the 805 calvings was 18.3%, and ranged from 8.3 to 28.1% among nine dairy herds (Fig. 1). The final model identified abnormal partus and gestation length as risk factors, while cow parity and calving season were not identified by the model (Table 2). Comparison of the occurrence of postpartum reproductive or metabolic diseases between cows with and without retained placenta is shown in Table 3. The occurrence of endometritis or metabolic disorders was greater ($p < 0.01$) in the retained placenta group than in the control group. However, the occurrence of ovarian cyst was not different ($p > 0.05$) between the two groups. The effect of retained placenta on reproductive performance is shown

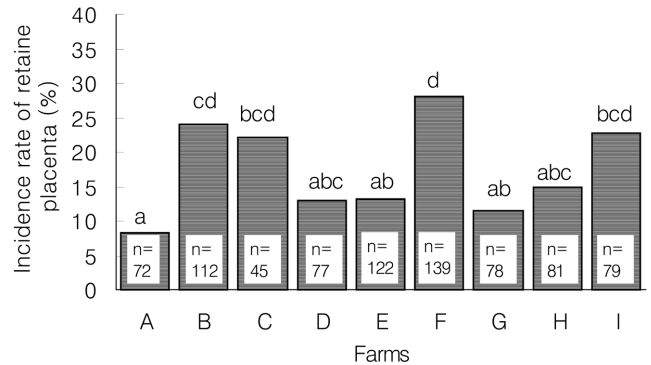


Fig. 1. Incidence of retained placenta in 805 calvings on nine dairy farms. Different letters (a-d) denote significant difference ($p < 0.05$).

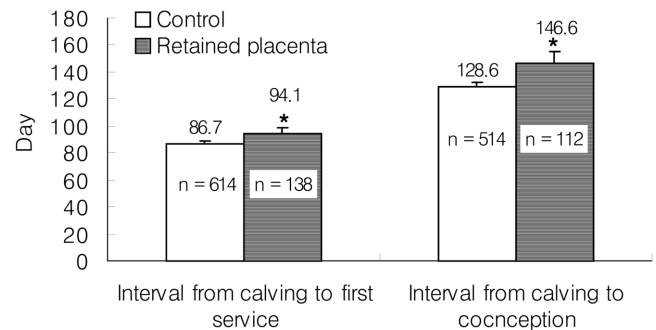


Fig. 2. Effect of retained placenta on the intervals from calving to first service and conception. Values are means \pm SEM.

* $p < 0.05$ compared with controls.

in Fig. 2. The intervals from calving to first service (7 days) and conception (18 days) were more prolonged ($p < 0.05$) in the retained placenta group than in the control group.

Discussion

The data presented here show that abnormal partus and gestation length are important risk factors for retained placenta, which increases the occurrence of postpartum endometritis and metabolic disorders, resulting in decreased reproductive performance in dairy herds.

The incidence of retained placenta in this study (18.3%) was similar to that reported by Markusfeld (17.8%) [45], but the incidence was higher than some previously reported

Table 2. Risk factors for retained placenta analyzed by a stepwise selection procedure on data from 805 calvings in nine dairy herds

Parameter	Estimate	SEM	<i>p</i>	Odds ratio	95% Confidence interval
Intercept	-0.84	0.15	< 0.001	-	-
Abnormal partus yes vs no	-0.33	0.15	0.0327	1.92	[1.055, 3.501]
Gestation length of cows > 280 vs 271-280	-0.55	0.15	< 0.001	0.97	[0.660, 1.433]
< 271 vs 271-280	1.07	0.23	< 0.001	4.89	[2.412, 9.928]

Table 3. Comparison of the occurrence of postpartum reproductive and metabolic diseases between cows with and without retained placenta

Postpartum disorder	Retained placenta		
	Yes (n = 147)	No (n = 658)	<i>p</i>
Reproductive disorder			
Endometritis (%)	116 (78.9)	208 (31.6)	$p < 0.01$
Ovarian cyst (%)	13 (8.8)	37 (5.6)	$p > 0.05$
Metabolic disorder			
Abomasal displacement (%)	11 (7.5)	13 (2.0)	$p < 0.01$
Milk fever (%)	3 (2.0)	1 (0.2)	$p < 0.05$
Ketosis (%)	7 (4.8)	8 (1.2)	$p < 0.01$
Metabolic subtotal (%)	20 (13.6)	21 (3.2)	$p < 0.01$

rates (4-14%) [8,18,36,50]. The higher rate in this study may have resulted from factors related to management, such as overcrowding resulting in limited exercise [1] and/or inadequate nutrition [7,9,33].

Retained placenta was significantly associated with abnormal partus and gestation length in this report. Increased risk of retained placenta (odds ratio = 1.9) in cows with abnormal partus was consistent with numerous previous findings [1,5,818,30,38]. In contrast, veterinary-assisted dystocia was not associated with retained placenta in another study [9]. Increased occurrence of retained placenta in cows with abnormal partus might be due to lack of tone and slow involution or damage to the uterus by mechanical stress resulting from calving difficulty [36,43,45]. Previous reports [5,30,43,47] on the relationship between gestation length and the incidence of retained placenta showed that shorter gestation lengths are associated with a higher incidence of retained placenta. Short gestations (< 271 days) were also related to an increased risk of developing retained placenta (odd ratio = 4.9) in this study. On the other hand, Larson *et al.* [38] reported that seasons were associated with development of retained placenta, with a higher incidence rate during the warm season for the first lactation and during the cold season for the second lactation.

Cow parity and calving season were eliminated from the final model since they did not influence the incidence of retained placenta. Our finding that cow parity is not related to increased risk of retained placenta is discordant with previous studies [1,9,17,25], which reported that the incidence of retained placenta increased with advancing parity. On the other hand, increased risk for retained placenta has also been reported in heifers with dystocia [17]. In agreement with other reports [16,25], calving season was not associated with the incidence of retained placenta in this study. Yet, calvings during the summer [32,43] or during periods of heat stress [12] have been associated with higher incidences of retained placenta. Chassagne *et al.* [5] observed a decreased incidence of retained placenta in autumn. Different temperature ranges or management

environments of countries or regions may account for these varied results.

Our data demonstrated that retained placenta was an important predisposing factor for development of postpartum endometritis and metabolic disorder in dairy herds, as previously reported by others [9,10,44]. The occurrence of endometritis was greater in the retained placenta group than in the control group, which is consistent with previous studies [34,36]. The condition of the uterus at parturition or soon after may determine whether potential pathogens cause infections [42]. At this time, retained placenta (a perfect media for bacterial growth), dystocia, or involution characteristics of the cervix and uterus may predispose cows to various infections [4,49]. Thus, the relationship between retained placenta and endometritis should be considered carefully; a large proportion of primary endometritis cases occurred just after the occurrence of retained placenta [43]. The incidence of endometritis after retained placenta in this study was 78.9%, which is between the incidence rates reported by Brooks (92%) [3] and by Borsberry and Dobson (64%) [2]. We assumed that this higher incidence of endometritis in cows with retained placenta might significantly affect subsequent reproductive performance. The occurrence of ovarian cyst was not different between cows with and without retained placenta, which is consistent with previous reports [10,27,57]. However, Erb *et al.* [17] found an indirect association between the occurrence of ovarian cyst and retained placenta mediated by endometritis. The occurrence of ovarian cyst appears to be more closely associated with milk production, cow parity, or calving season than with retained placenta [26,27]. The occurrence of metabolic disorder (abomasal displacement, milk fever, or ketosis) was also greater in the retained placenta group than in the control group. Cows with retained placenta have previously been reported to have a higher incidence of abomasal displacement and ketosis [9,10,45] compared to cows without retained placenta, although one report did not find a relationship between retained placenta and abomasal displacement [8].

The intervals from calving to first service and conception

were higher in the retained placenta group than in the control group, which is consistent with other reports [19,50,56]. In some studies, however, the intervals from calving to first service and/or conception were not related to the occurrence of retained placenta [6,35,47]. The effect of retained placenta was much greater on the interval from calving to conception than the effect on the delay in the interval from calving to first service in this study, consistent with the report of Borsberry and Dobson [2]. Furthermore, the delay of 8 days to first service in cows with retained placenta was similar to the results of Erb *et al.* [17]. On the other hand, the intervals from calving to first service and conception in this study were longer than those (83 to 85 days and 109 to 121 days, respectively) in the reports of Francos and Mayer [23]. Retained placenta has been suggested to reduce fertility in two ways: first, by a direct effect through an unknown mechanism and secondly, by an indirect effect through endometritis [39,58]. Since the interrelationships among retained placenta, postpartum reproductive or metabolic disorder, and reproductive performance have not been determined, the exact route by which retained placenta affects reproductive performance has not been clarified in this study. However, considering the high incidence of endometritis after retained placenta (Table 3), the decreased reproductive performance appears to be due largely to an indirect effect through endometritis.

In conclusion, abnormal partus and short gestation periods are important risk factors for development of retained placenta, which increases the occurrence of endometritis and metabolic diseases, resulting in decreased reproductive performance in dairy herds in Chungbuk province, Korea.

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