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# Effects of dam and calf risk factors on the incidence of retained placenta in lactating dairy cows

**Hatef Karimi[1], Mojtaba Goli[2*]**

*[1]Faculty of Veterinary Medicine, Razi University, Kermanshah, Iran.*
*[2]Department of Clinical Science, Faculty of Veterinary Medicine, Razi University, Kermanshah, Iran.*

*(*) Corresponding Author: mojtabagoli45@gmail.com*

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## Abstract

Effects of dam and calf risk factors on incidence of retained placenta (RP) in lactating dairy cows were investigated in a retrospective study. Data from 3250 cows including herd (1, 2, 3), date of the last calving, parity (1, 2, 3, 4, ≥ 5), average daily milk yield (≤ 30, 31-39, > 39 kg), gestation length (≤ 275, 276-280, ≥ 281 days), calf sex (male/female), calf birth weight (≤ 36, 37-42, ≥ 43 kg), stillbirth, caesarean section, fetotomy, milk fever, labor (assisted/unassisted), and incidence of RP were collected from three farms and analyzed using a logistic regression method. The overall incidence of RP was 22.7%, which was within the range of 1.3–39.2% reported in previous studies. The greatest incidence of RP occurred in primiparous cows, cows with 31-39 kg milk yield, cows with gestational length of 276-280 days, cows that gave birth to male calves, cows with stillbirth, and cows with assisted calving ($p < 0.05$). Cows producing calves with ≤ 36 kg birth weights developed higher incidence of RP than cows produced calves with 37-42 kg or ≥ 43 kg birth weights ($p < 0.05$), but the difference between the latter two groups was not significant. The results showed that farm managerial quality has a significant effect on the incidence of RP and that cows that are primiparous, give birth to male or dead calves, or need assistance at calving are more prone to suffer from RP.

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## Introduction

Postpartum reproductive diseases are serious problems in dairy cattle, which not only lower productivity and fertility but also bring economic loss. Therefore, it is important to detect them as early as possible, and to develop prophylactic measures (Ganaie *et al.,* 2018; Mahnani *et al*, 2021a). A common reproductive disorder of dairy cows is the retained placenta (RP), which is usually defined as a condition where cows fail to expel their fetal membranes within 12-24 hours of calving (Meira *et al.,* 2013; Cui *et al.,* 2014a; Qu *et al.,* 2014; Rokde *et al*, 2017; Zheng *et al.,* 2018; Mahnani *et al.,* 2021a; Mahnani *et al.,* 2022). RP is a common postpartum disorder in dairy cows (Oliveira *et al.,* 2026) that impacts the dairy cow industry. The frequent occurrence of metritis and delayed involution of uterus after RP was identified as the main reason for reduced fertility in cows having RP (Drillich *et al.,* 2006; Beagley *et al.,* 2010). In dairy cows, normal expulsion of fetal membranes occurs within 8 hours after calf delivery (Qu *et al.,* 2014; Mahnani *et al.,* 2021a), but if they are not expelled within 12-24 hours of calf delivery it is considered as RP. However, the most commonly used diagnostic definition of RP is the absence of fetal membranes delivery 24 hours or longer after calving (Mahnani *et al.,* 2021b), which is due to the failure of timely breakdown of the cotyledon-caruncle attachment (Mahnani *et al.,* 2021a). RP has a reported incidence between 1.3% and 39.2% with a median value of 8.6% (Melendez *et al.,* 2006).

In dairy cattle, RP can be considered as a puerperal syndrome, which has a potentially multifactorial etiology and poses a substantial risk factor for postpartum uterine diseases such as metritis and endometritis. Consequently, RP is often associated with delayed uterine involution and subsequent impaired fertility (Cui *et al.,* 2014b). Moreover, RP is a costly disease in multiparous dairy cows that has been linked to immune suppression, infections, elevated lipid mobilization, and depleted status of antioxidants including α-tocopherol (Qu *et al.,* 2014), that not only increases the risk of uterine diseases, but also other metabolic disorders (Nelli *et al.,* 2019). Predisposing factors that have been mentioned for RP are complex metabolic disturbances during the pre-partum period (Michal *et al.,* 2006), an imbalance or insufficiency of hormones near term, resulting in delayed placental maturation (Bo *et al.,* 1992), hypocalcemia, induction of parturition, placentitis, (Cui *et al.,* 2014a), genetics (Kamemori *et al*. 2011), fetotomy (Ganaie *et al.,* 2018), inflammation, infection, stress (Shixin *et al.,* 2011), shortened gestation, abortion, twinning, dystocia, cesarean section, nutritional deficiencies such as vitamin E, selenium, and carotene, and immunosuppression (Beagley *et al.,* 2010). It has been documented that sex and weight of calves born had pronounced effects on incidence of RP (Gaafar *et al.,* 2010). In addition, parity, calving season, stillbirth, duration of the dry period, gestation length, and higher milk yield can influence the occurrence of RP. These variables significantly affect the likelihood of RP, highlighting the complexity of its management and prevention (Rahimi Hosseinabadi *et al.,* 2025). On the other hand, RP is often categorized as a metabolic disorder because it occurs during the transition period and negatively impacts the reproductive performance of dairy cows in subsequent lactations (Rahimi Hosseinabadi *et al.,* 2025).

Various diseases can be induced by RP, such as pyometra, metritis, mastitis, and laminitis, resulting in large economic losses in dairy farming, particularly affecting milk production and reproductive performance (Lu *et al.,* 2020). RP significantly extends the time from parturition to first estrus, the service period, days open, and increases the number of services per conception. RP is also an economically significant issue due to the direct costs of treatment and its detrimental impact on productive performance (Rahimi Hosseinabadi *et al.,* 2025). This disorder also impairs myometrial contractility, which prevents a complete elimination of uterine contents and inhibits uterine defense mechanisms, thus favoring the establishment of infections (Martins *et al.,* 2016). RP is associated with the presence of uncontrolled elevated levels of reactive oxygen species (ROS), which may disturb physiological processes leading to expulsion of the placenta (Kankofer, 2001). ROS such as hydrogen peroxide, superoxide, peroxynitrite, and nitric oxide, which are commonly present in the environment, cause oxidative stress by oxidizing mitochondrial membranes, cellular lipids, proteins, and DNA, leading to cellular dysfunction (Zolfaghari *et al.,* 2025). There is some evidence that ROS imbalance may be one of the reasons for improper release of the fetal membranes. Activities of antioxidative enzymes, representing enzymatic antioxidative defense against ROS in bovine placental tissues differed between spontaneously released and

retained membranes (Kankofer *et al.,* 2010). Nevertheless, the exact etiology behind RP is not fully understood to date. However, improvement in the management and introduction of new remedial and precautionary strategies can help in reducing the incidence of RP and thereby will help in mitigating the associated losses with RP (Ganaie *et al.,* 2018).

For effective management of RP cases in dairy cattle, understanding of pathophysiology and causes are of critical importance (Ganaie *et al.,* 2018). Therefore, the objective of the present retrospective study was to address some of the predisposing causes, which lead to the RP.

## Materials and Methods

All the procedures of the present study were conducted according to the guidelines of the Research Ethics Committee of Razi University, Kermanshah Iran.

### Animals and location

Three commercial dairy farms with a total of more than 7000 animals located in Kermanshah vicinity, west of Iran, were used for the present study. The animals were housed in free-stall barns with free access to water, fed a total mixed ration with nutrient content being adjusted to meet their requirements according to NRC and milked three times daily with an average 8-hour intervals and average daily milk yield of 30-35 kg.

### Data collection

Data including herd (1, 2, 3), date of the last calving, dam parity (1, 2, 3, 4, ≤ 5), average daily milk yield (≤ 30, 31-39, > 39 kg), gestation length (≤ 275, 276-280, ≥ 281 days), calf sex (male or female), calf birth weight (≤ 36, 37-42, ≥ 43 kg), stillbirth, caesarean operation, fetotomy, milk fever, labor (assisted or unassisted), and incidence of RP were collected based on the records of the farms. A cow was considered to be affected by RP if had failed to expel the placenta within 24 hours after completion of calf delivery. Stillbirth was defined as a calf that was born dead or died within 48 hours after birth. Assisted calving was defined as births that were required considerable force or were extremely difficult. The data relating to the cows and their calves were evaluated initially and those cows with missing information at least in one of the variables were excluded from further evaluation. Since there had happened no milk fever, caesarian section or fetotomy and since there were data of only a few numbers of cows affected by abortion very close to term, data relating to such cows were removed from further analyses. Finally, information of 3250 cows and their calves that were fully available were used for final analyses.

### Statistical analysis

Data were analyzed using SAS® software (SAS System, Release 9.4. Cary, NC, USA: SAS Inst. Inc.) by Logistic Regression method using Proc Genmod and $\chi^2$ square statistics for determining the probability and degree of significant differences in the incidence of RP in relation to the variables. The following statistic model was used to evaluate the effect of each variable on the incidence of RP:

$$Y=\mu+H+P+MY+GL+CS+CBW+SB+AC$$

where $Y$ = RP, $H$ = herd, $P$ = parity, $MY$ = milk yield, $GL$ = gestation length, $CS$ = calf sex, $CBW$ = calf birth weight, $SB$ = stillbirth, and $AC$ = assisted calving. The level of significance was set at $p < 0.05$.

## Results

### Effect of herd

Table 1 showed the total number of cows and the incidence of RP in each studied herd. The results showed that the overall incidence of RP among the herds was 22.7%. Also, the highest and lowest incidence of RP occurred in the herds 2 and 3, respectively. The differences in the incidence of RP among the three herds were significant statistically ($p < 0.0001$).

**Table 1.** Incidence of retained placenta (RP) in cows in different herds.

| Herd | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| 1 | 1768 (263) | 14.9[a] |
| 2 | 933 (461) | 49.4[b] |
| 3 | 549 (15) | 2.7[c] |
| Overall | 3250 (739) | 22.7 |

* Different superscript letters within a column denote significant difference ($p < 0.05$).

**Effect of dam parity**

The incidence of RP in cows with different parity has been shown in Table 2. The results showed that the highest and lowest incidence of RP occurred in cows in parities 1 and ≥ 5, respectively. The differences in the incidence of RP between cows in parities 1 and 2, and between these two groups and the cows in parities 3, 4, and ≥ 5 were significant statistically ($p$ < 0.0001). However, the differences in the incidence of RP between cows in parities 3, 4, and ≥ 5 were not significant statistically ($p$ ≥ 0.05).

**Table 2.** Incidence of retained placenta (RP) in cows with different parities.

| Parity | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| 1 | 1015 (411) | 40.5[a] |
| 2 | 741 (150) | 20.3[b] |
| 3 | 620 (73) | 11.9[c] |
| 4 | 506 (66) | 13.0[c] |
| ≥5 | 368 (39) | 10.8[c] |

* Different superscript letters within a column denote significant difference (P < 0.05).

**Effect of milk yield**

Table 3 showed the incidence of RP in cows with different average daily milk yield. The results showed that the highest and lowest incidence of RP occurred in cows with average daily milk yields of 31-39 and ≤ 36 kg, respectively, which was statistically significant ($p$ < 0.05). However, the difference in the incidence of RP between these two groups of cows and the cows with an average daily milk yield of > 39 kg was not statistically significant ($p$ = 0.2478).

**Table 3.** Incidence of retained placenta (RP) in cows with ~~a~~ different average daily milk yields.

| Average daily milk yield (kg) | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| ≤ 30 | 796 (162) | 20.3[a] |
| 31-39 | 1559 (485) | 31.1[b] |
| > 39 | 900 (194) | 21.6[ab] |

* Different superscript letters within a column denote significant difference ($p$ < 0.05).

**Effect of gestation length**

The incidence of RP in cows with different gestation lengths has been presented in Table 4. The results showed that the highest and lowest incidence of RP occurred in cows with a gestation length of 276-280 and ≥ 281 days, respectively, which was significant statistically ($p$ < 0.05). The incidence of RP between the cows with a gestation length of 276-280 days and those with a gestation length of ≤ 275 days differed significantly, too. However, the difference between the cows with a gestation length of ≤ 275 days and those with a gestation length of ≥ 281 days was not significant statistically ($p$ = 0.7420).

**Table 4.** Incidence of retained placenta (RP) in cows with different gestation lengths.

| Gestation length (day) | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| ≤ 275 | 1273 (328) | 25.8[a] |
| 276-280 | 1467 (659) | 44.9[b] |
| ≥ 281 | 510 (123) | 24.1[a] |

* Different superscript letters within a column denote significant difference ($p$ < 0.05).

**Effect of calf sex**

Table 5 showed the incidence of RP in cows that gave birth to male or female calves. According to the results of the present study, the cows that gave birth to male calves suffered from higher incidence of RP than those that gave birth to female calves, which was significant statistically ($p$ = 0.0490).

**Table 5.** Incidence of retained placenta (RP) in cows that gave birth to male or female calves.

| Calf sex | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| Male | 584 (203) | 34.7[a] |
| Female | 2666 (536) | 20.1[b] |

* Different superscript letters within a column denote significant difference ($p$ < 0.05).

**Effect of calf birth weight**

The incidence of RP in cows in relation to the birth weights of their calves has been shown in Table 6. According to the results, the highest and lowest incidence of RP occurred in cows with calf birth weight of ≤ 36 kg and 37-42 kg, respectively. The incidence of RP between the cows with calf birth weight of ≤ 36 kg and those with calf birth weight of 37-42 kg or the cows with calf birth weight of ≥ 43 kg differed significantly ($p$ < 0.05). However, the difference between the latter two groups was not significant statistically ($p$ = 0.7680).

**Table 6.** Incidence of retained placenta (RP) in cows in relation to the birth weights of their calves.

| Calf birth weight (kg) | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| ≤ 36 | 831 (222) | 26.7[a] |
| 37-42 | 1660 (352) | 21.2[b] |
| ≥ 43 | 759 (165) | 21.8[b] |

* Different superscript letters within a column denote significant difference ($p < 0.05$).

### Effect of stillbirth

The incidence of RP in cows with or without stillbirth has been shown in Table 7. The results showed that the incidence of RP in cows with stillbirth was higher than those without stillbirth, which differed significantly ($p = 0.0421$).

**Table 7.** Incidence of retained placenta (RP) in cows after giving birth to a live or dead calf.

| Calf fate | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| Stillbirth | 52 (28) | 53.8[a] |
| Live birth | 3198 (710) | 22.2[b] |

* Different superscript letters within a column denote significant difference ($p < 0.05$).

### Effect of assisted calving

The incidence of RP in cows after assisted or spontaneous calving has been shown in Table 8. Based on the results, the incidence of RP in those cows that needed assistance at calving was higher than those that calved without any assistance, which differed significantly ($p < 0.0001$).

**Table 8.** Incidence of retained placenta (RP) in cows after assisted or spontaneous calving.

| Assisted calving | Total number of cows (RP affected) | RP incidence (%)* |
|---|---|---|
| Yes | 630 (232) | 36.9[a] |
| No | 2620 (506) | 19.3[b] |

* Different superscript letters within a column denote significant difference ($p < 0.05$).

## Discussion

The incidence of RP in the present study was relatively high (22.7%), but was within the range of 1.3–39.2% reported in the literature (Melendez *et al.,* 2003) and differed significantly between the herds.

As the results of the present study showed, the highest (40.5%) and lowest (10.8%) incidence of RP occurred in cows in parities 1 and ≥ 5, respectively. Erb and Martin (1978) reported the effect of parity on the incidence of RP. They suggested that the primiparous cows were more likely to suffer from RP, probably due to more incidence of dystocia and shorter length of their gestation period, which are of the risk factors for the occurrence of RP (Erb and Martin, 1978). Moreover, Melendez *et al*. (2003) reported that older cows were less likely to develop RP, perhaps because they were less likely to experience calving difficulty. On the contrary, Curtis *et al.* (1985) and Gröhn *et al*. (1995) found that older cows are more likely to develop RP than did younger ones. In addition, it was found in other studies that primiparous cows were at lower risk of being affected by RP (Gaafar *et al.,* 2010; Ghavi Hossein-Zadeh and Ardalan, 2011; Montiel-Olguín *et al.,* 2018). Moreover, results of another research showed that the incidence of RP increased from 1.3% in parity 1 to 3.4% in parity 5 in Norwegian Red cows (Haugaard and Heringstad, 2015). Moreover, a recent research reported that the risk of RP increased as parity number increased, but was not statistically significant (Mahnani *et al.,* 2021a). Parturition is a hormonal, metabolic, and immunological process involving the production of ROS. Superoxide dismutases (SODs) are the enzymes involved in the antioxidant system that protects the living organism from the harmful effects of ROS. SOD converts superoxide anion to hydrogen peroxide and oxygen and minimizes the production of hydroxyl radicals. Most dairy cows suffer from excessive production of free radicals, especially during the periparturient period. Any imbalance between the production and neutralization of free radicals causes oxidative stress, which is associated with chronic inflammatory response, immune suppression, and RP (Yazlık *et al.,* 2019). Oxidative stress in cows is a contributory factor to increase disease susceptibility, since metabolic demands associated with late pregnancy, parturition and initiation of lactation would be expected to increase the production of reactive ROS. RP was reported to associate with oxidative stress in dairy cows (Ahmed *et al.,* 2009). It has been observed that younger animals have a better response to oxidative stress, and this could account for the lower prevalence of RP in primiparous cows (Montiel-Olguín *et al.,* 2018).

Cows with an average daily milk yield of 31-39 kg and those with an average daily milk yield of ≤ 30 kg developed the highest (31.1%) and lowest

(20.3%) incidence of RP, respectively, which differed significantly. Moretti *et al*. (2015) reported that RP occurs frequently in high-yielding dairy cows and has been proven to cause negative effects on reproductive performances. Melendez *et al*. (2003) reported that the incidence of RP is high in those cows that are genetically high producers. By contrast, Gröhn *et al*. (1995) reported that there was no effect of milk yield on the risk of retained placenta.

Cows with gestation lengths of 276-280 and those with gestation lengths of ≥ 281 days developed the highest (44.9%) and lowest (24.1%) incidence of RP, respectively, which differed significantly. Previous research on the relationship of gestation length and the incidence of RFM has been conflicting (Muller and Owens, 1973). However, shorter gestation lengths frequently have been associated with a higher incidence of RP (Ottobre and Inskeep, 1983). Premature delivering of calf by caesarean operation and premature induction of calving lead to RP (Bellows *et al.,* 1994; Mansell *et al.,* 2006). Since none of these treatments had been given to the cows of the present study and calving occurred spontaneously, therefore, the shorter length of the gestation period due to caesarean operation or premature induction of calving in cows with a gestation length of ≤ 275 days could not affect the incidence of RP among them. The lower incidence of RP in cows with gestation lengths of ≤ 275 and ≥ 281days in comparison to those with a gestation length of 276-280 days may probably be attributed to the lower calf birth weight, therefore lower incidence of dystocia, and complete placental maturation, respectively.

According to the results of the present study, the incidence of RP in cows that gave birth to a male calf was greater than that in the cows that gave birth to a female calf, which differed significantly (34.1% vs 24.1%). El-Malky *et al*. (2010) reported increased incidence of RP following births of male calves in buffalos. Another research found that the probability of dystocia was higher in dams when giving birth to male calves than giving birth to female calves. This effect may be partly explained by the fact that male calves are in general heavier than female ones (Atashi *et al.,* 2012). Dystocia has been mentioned as a predisposing factor for RP (Drillich *et al.,* 2003). Montiel-Olguín *et al*. (2018) mentioned birth of a male calf as a significant factor for RP. In another study, the percentage of incidence of RP in Friesian cows was insignificantly higher with born male rather than female calves (Gaafar *et al.,* 2010). However, Muller and Owens (1973) reported that sex of calf had no influence on incidence of retention.

Surprisingly, the results of the present study showed that the highest and lowest incidence of RP occurred in cows that produced calves with birth weights of ≤ 36 and 37-42 kg, respectively (26.7% vs 21.2%), which differed significantly. In contrast to these results, it has been reported that larger calves frequently have been associated with a higher incidence of RP primarily because of the relationship of calf size to dystocia and, in turn, the relationship of dystocia to the incidence of RP (Muller and Owens, 1973). Also, in another study by Gaafar *et al*. (2010), it was reported that the percentage of incidence of RP increased significantly with increasing weight of born calves. Calf birth weight was associated with an increase in the occurrence of dystocia in heifers calving as 3-year olds (Micke *et al.,* 2010). This discrepancy may be explained by this fact that in the present study, incidence of RP in primiparous cows was greater than that in multiparous cows, and that primiparous cows produced calves with lower birth weight than multiparous cows.

Stillbirth parturition is defined as calves that are either born dead, and or die within 48 hours after calving (Gundelach *et al.,* 2009). Based on the results of the present study, the incidence of RP in cows with stillbirth was higher than that in cows without stillbirth (53.8% vs 22.2%), which differed significantly. Stillbirth was correlated with increased risk of developing metritis and RP (Emanuelson *et al.,* 1993). Mahnani *et al*. (2021a) reported that there was an increased rate of RP for cows with stillbirth. In the present study, the overall incidence of stillbirth was 1.6% (52 out of 3250 calvings).

The incidence of RP in cows that were assisted at calving was higher than that in cows that calved without any assistance (36.9% vs 19.3%), which differed significantly. Dystocia has been well documented as a predisposing factor for RP in dairy cattle. Cows with dystocia are 2.2 times more likely to experience RP than normal cows (Melendez *et al.,* 2003). Newby *et al*. (2017) reported that assistance at calving doubled the odds of RP in Holstein cows. Moreover, it was found that there was an increased rate of RP for cows with dystocia (Mahnani *et al.,* 2021a). In two

other studies, assisted calving was reported as a main risk factor for RP (Lyons *et al.,* 2013; Montiel-Olguín *et al.,* 2018).

In conclusion, the results showed that farm managerial quality has a significant effect on the incidence of retained placenta in dairy cows and that, cows that are primiparous, give birth to male or dead calves, or need assistance at calving are more prone to suffer from retained placenta, which should be taken into account and require to take necessary action in order to reduce the probability of retained placenta, and therefore, its adverse consequences.

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## Conflict of Interest

The authors declare that they have no conflict of interests.

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