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Effects of assisted calving on reproductive efficiency in dairy cows without retained placenta

[Efeitos do parto assistido na eficiência reprodutiva de vacas leiteiras que não apresentaram retenção de placenta]

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Abstract: This study evaluated the effects of assisted calving on the occurrence of retained placenta (RP) and reproductive efficiency, as well as the effects of assisted calving on the reproductive efficiency of dairy cows without RP. Calvings were classified as normal (single live calf), assisted (human intervention required, single live calf), abortion, stillbirth, or twin. The interval from calving to first artificial insemination (AI), conception rate at first AI, and days open were analyzed. Statistical analyses were performed using analysis of variance and chi-square tests with R Core Team software. In total, 6,808 calvings were analyzed: 85.56 % normal, 4.36 % assisted, 4.77 % abortions, 3.44 % stillbirths, and 1.87 % twin calvings. Calving type affected the occurrence of RP (P = 0.0001). Cows with assisted calving had longer days open (151.00 ± 101.70 days; P = 0.004) than did cows with normal calving (124.08 ± 87.56 days), as well as a tendency toward a longer interval from calving to first AI (P = 0.093). A subgroup of 2,422 cows without RP was analyzed. Cows with assisted calving and without RP had longer days open (144.00 ± 102.60 days; P = 0.035) than did cows with normal calving (123.23 ± 87.18 days). No effect of assisted calving was detected on the interval from calving to first AI or on conception rate at first AI. It is concluded that assisted calving is associated with a higher incidence of RP, and that calving assistance negatively affects the reproductive efficiency of dairy cows, regardless of RP occurrence.

Keywords: cattle; reproductive performance; dystocia; days open.

Resumo: Objetivou-se avaliar os efeitos do parto assistido na ocorrência de retenção de placenta (RP) e eficiência reprodutiva e os efeitos do parto assistido na eficiência reprodutiva de vacas leiteiras que não apresentaram RP. Os partos foram classificados, como: normal (bezerro único e vivo), assistido (necessidade de alguma interferência humana, bezerro único e vivo), aborto, natimorto ou gemelar. Foi analisado o intervalo do parto à primeira inseminação artificial (IA), taxa de concepção na primeira IA e período de serviço. As análises estatísticas foram realizadas pelo teste de Anova e qui-quadrado pelo programa R Core Team. Foram analisados 6808 partos, sendo 85,56 % partos normais; 4,36 % partos assistidos; 4,77 % abortos; 3,44 % natimortos e 1,87 % gemelares. Houve efeito do tipo de parto sobre a ocorrência de RP (P = 0,0001). Vacas com parto assistido tiveram maior período de serviço (151,00 ± 101,70; P=0,004) comparado as vacas com parto normal (124,08 ± 87,56 dias). E uma tendência (P = 0,093) de terem maior intervalo do parto à primeira IA. Foi analisado um subgrupo de 2422 vacas que não apresentaram RP. Vacas com parto assistido e

sem RP, tiveram maior período de serviço (144,00 ± 102,60 dias; P=0,035) comparado com parto normal (123,23 ± 87,18 dias). Não houve efeito do parto assistido no intervalo do parto e na taxa de concepção na primeira IA. Conclui-se que o parto assistido está associado a maior incidência de RP, e a assistência ao parto afeta a eficiência reprodutiva de vacas leiteiras, independente da ocorrência de RP.

Palavras-chave: bovino; desempenho reprodutivo; distocia; período de serviço.

1. Introduction

Reproductive efficiency is one of the most impactful factors influencing the productivity of dairy herds [1]. Dairy farms should aim for a calving interval of approximately 12 months [2]. To achieve this, it is necessary to ensure adequate conditions related to management, nutrition, genetics, health, and environment, among other factors. In this individual assessment, it is important to consider information related to calving history, the occurrence of dystocia, and other factors that affect the reproductive efficiency of the bovine female.

The time of calving is a critical period for the dairy cow, and any alteration may impact the health of both the dam and the offspring. The occurrence of dystocia affects health and milk production, in addition to impairing reproductive indices [3], such as an increased probability of reproductive tract injuries in females, lower conception rates, and a longer calving-to-conception interval [4]. Furthermore, the type of calving directly influences the development of possible puerperal diseases. Cows that require assistance at calving show a greater predisposition to disorders during the immediate postpartum period [4].

Reproductive diseases affecting dairy cows during the postpartum period negatively influence the productive and reproductive efficiency of herds [5–7]. Several factors are associated with economic losses, particularly reduced dry matter intake and the consequent decrease in body condition score (BCS), reduced milk production, prolonged calving intervals, and premature culling of animals. In addition, the occurrence of such disorders significantly compromises animal welfare, which directly and indirectly impacts herd productivity [8,9].

Therefore, several studies have highlighted the effects of calving-related events, such as calving assistance, dystocia, and retained placenta (RP), which are correlated with various negative consequences for the health and reproduction of dairy cows [6,8,10]. However, the scientific literature does not describe the effects of calving assistance on reproductive efficiency in cows that do not develop RP. Thus, the present study aimed to evaluate the effects of assisted calving on the occurrence of RP and reproductive efficiency, as well as the effect of assisted calving on the reproductive efficiency of dairy cows that did not present RP.

2. Material and methods

All procedures in this study were conducted in accordance with the Ethical Principles of Animal Experimentation and were approved by the Animal Use Ethics Committee (CEUA) under protocol number 003/17.

The present study consisted of an analysis of data from a commercial dairy farm located in the city of Lagoa Santa, Minas Gerais State, Brazil. The farm maintained a herd of 670 crossbred dairy cows (Holstein × Gir) in lactation. The cows were milked three times per day, with an average milk yield of 25.0 kg of milk per cow per day. The animals' diet consisted of corn silage, whole

cottonseed, concentrate, minerals, and ad libitum access to water. Diets were adjusted according to milk production, following the guidelines of the Nutrient Requirements of Dairy Cattle (NASEM, 2021) [11]. Cows in the prepartum period (approximately 30 days before the expected calving date) were housed in shaded grazing paddocks with Tifton-85 forage, received a total mixed ration, and had ad libitum access to water. Herd health management included vaccination against foot-and-mouth disease, brucellosis, bovine viral diarrhea, infectious bovine rhinotracheitis, leptospirosis, and clostridial diseases. All adult animals received anthelmintic treatment twice a year, with alternating drugs. In addition, bovine somatotropin (Lactotropin®; Agener União, Brazil) was administered from 60 days postpartum until 190 days of gestation, at 14-day intervals between applications.

Data from 6,808 calvings were collected between January 2015 and January 2024. Calvings were observed and classified according to the degree of difficulty proposed by Lombard et al. [12]: 1 – eutocia (normal calving) without assistance; 2 – mild assistance, defined as prolonged duration of normal calving (more than 2 hours from the appearance of the limbs to delivery) or assisted calving by one person without mechanical traction, using moderate force; 3 – moderate assistance, requiring traction by two people; 4 – major assistance, involving considerable traction force or mechanical extraction, usually performed by a veterinarian; and 5 – extreme difficulty, requiring surgical procedures such as cesarean section or fetotomy. After the initial classification, calvings were grouped as normal (score 1 – no human intervention required, resulting in a single live calf), assisted (scores 2 and 3 – requiring mild or moderate human intervention, resulting in a single live calf), abortion, twin calving, or calvings resulting in stillborn calves. Abortions were defined as calvings occurring between 42 and 260 days of gestation. Stillbirths were defined as cases in which calf death occurred before, during, or shortly after calving. Calvings classified as difficulty scores 4 and 5 (cesarean section or fetotomy) did not occur during the analyzed period.

RP was characterized when the cow did not completely expel the fetal membranes within the first 12 hours after expulsion of the fetus. After classification of calving type and occurrence of RP, a subgroup was formed containing only cows that did not present RP in order to analyze the effect of calving assistance on reproductive efficiency. BCS was evaluated according to the scale proposed by Edmonson et al. [13], which classifies animals from 1 to 5 in 0.25-point increments, with cows scoring 1 considered very thin and cows scoring 5 considered obese.

The farm adopted a voluntary waiting period of 40 days postpartum. At the end of this period, all cows underwent ultrasonographic examination using a 7.5-MHz linear rectal transducer (DP3300vet®; Mindray) for evaluation of the uterus and ovaries. Subsequently, cows with a BCS greater than 2.5 and without uterine disorders were enrolled in a fixed-time artificial insemination (FTAI) protocol as follows: Day 0, insertion of a 1.9-g intravaginal progesterone device (CIDR®; Zoetis), intramuscular administration of 2.0 mg estradiol benzoate (Gonadiol®; Zoetis), and 25.0 µg lecirelin (Dalmarelin®; MSD); Day 7, intramuscular administration of 25.0 mg PGF2α (Lutalyse®; Zoetis); Day 9, removal of the intravaginal device and intramuscular administration of 1.0 mg estradiol cypionate (ECP®; Zoetis) and 25.0 mg PGF2α; and Day 11, AI performed in all animals.

Pregnancy diagnosis was performed by ultrasonographic examination approximately 35 days after FTAI, confirmed by visualization of the embryo with the presence of a heartbeat. Cows that exhibited estrus before 35 days after AI were inseminated 12 hours after estrus detection. Cows that did not return to estrus and were not diagnosed as pregnant on Day 35 were resynchronized using the same hormonal protocol described previously.

Information on calving dates, artificial inseminations, and pregnancy diagnoses was collected for the analysis of reproductive performance indices. The interval from calving to first AI was evaluated, as well as days open, calculated as the interval between the calving date and the conception date (AI at which the animal became pregnant). In addition, conception rate at the first postpartum AI was assessed and calculated by dividing the number of cows diagnosed pregnant at 35 days after the first AI by the total number of inseminated cows.

For statistical analysis of quantitative variables, such as the interval from calving to first AI and days open, analysis of variance was applied in a completely randomized design, followed by Tukey's test. For binomial variables, such as the occurrence of RP and conception rate at first AI, the chi-square test of independence was used, and multiple comparisons between proportions were also performed, as proposed by Biase and Ferreira [14]. All analyses were conducted using R Core Team software [15]. Statistical differences were considered significant at $P \leq 0.05$ and trends at $0.05 < P < 0.10$.

3. Results and discussion

During the evaluated period, 6,808 calvings were recorded, of which 85.56 % (5,825/6,808) were normal calvings, 4.36 % (297/6,808) assisted calvings, 4.77 % (325/6,808) abortions, 1.87 % (127/6,808) twin calvings, and 3.44 % (234/6,808) stillbirths (Table 1). Considering all calvings, an effect of calving type on the occurrence of RP was detected (P = 0.0001). Only 8.69 % of cows that had normal calving presented RP, whereas 29.29% of cows that had assisted calving developed RP.

In the analysis of the effects of calving type on reproductive efficiency, a subgroup of cows was formed due to the lack of complete reproductive information for all animals (n = 2,696). A trend was detected (P = 0.093) for cows with assisted calving to have a longer interval from calving to first AI (72.41 ± 30.74 days) compared with cows with normal calving (65.10 ± 28.29 days). Another finding was that cows with assisted calving had longer days open (151.00 ± 101.70 days; P = 0.004) than did cows with normal calving (124.08 ± 87.56 days). The conception rate at first AI was not affected by calving type (P = 0.662) (Table 1).

Table 1. Occurrence of RP and reproductive performance according to calving type in dairy cows.

Calving type (n)	RP (%)	Calving to first AI interval (days)	Conception rate at first AI (%)	Days open
Abortion (325)	23.38^{a}	66.75 ± 35.89^{x}	50.00^{a}	105.29 ± 72.86^{a}
Assisted (297)	29.29^{a}	72.41 ± 30.74^{y}	36.54^{a}	151.00 ± 101.70^{b}
Twin (127)	30.71^{a}	67.27 ± 23.15^{x}	41.67^{a}	119.00 ± 69.68^{a}
Stillbirth (234)	25.64^{a}	66.95 ± 24.27^{x}	44.33^{a}	124.08 ± 80.49^{a}
Normal (5825)	08.69^{b}	65.10 ± 28.29^{x}	44.16^{a}	124.08 ± 87.56^{a}
P value	0.0001	0.093	0.662	0.004

Data are presented as mean ± standard deviation unless otherwise indicated. AI = artificial insemination; ^{a,b}Different lowercase letters in the same column indicate a significant difference ($P \leq 0.05$); ^{x,y}Different lowercase letters in the same column indicate a trend ($0.05 < P < 0.10$).

The results demonstrated that calving type affects the occurrence of RP. Cows with twin and assisted calvings had a higher RP rate. The literature describes a relationship between twin calving and an increased risk of dystocia, a higher incidence of RP, and a longer interval from calving to first estrus [16]. Buso et al. [8] demonstrated that 68.42% of cows that had assisted

calvings presented RP, whereas only 12.19 % of cows with normal calving developed RP. Thus, identifying which types of calving are more likely to result in RP allows the implementation of specific preventive strategies to reduce complications.

Regarding reproductive efficiency, RP is correlated with an increase in days open, as demonstrated by Fourichon et al. [17], in which cows that experienced RP tended to have days open extended by 2–3 days. RP is also associated with other negative effects on reproductive efficiency, such as increased service rate and higher culling rates [8]. In agreement with other studies conducted in tropical climate regions, cows that had RP showed days open that were, on average, 27 days longer than those of cows that did not present this condition [18]. In the present study, no effect of calving type on conception rate at first AI was detected; however, Bicalho et al. [19] associated twin calvings with a reduced conception rate.

Analyzing the total recorded calvings, 88.72 % (6,040/6,808) of cows did not present RP. A subgroup of 2,422 calvings from cows without RP and with complete reproductive data was analyzed. Among these, 88.15 % (2,135/2,422) were normal calvings, 2.84 % (69/2,422) assisted calvings, 4.58 % (111/2,422) abortions, 1.65 % (40/2,422) twin calvings, and 2.76 % (67/2,422) stillbirths (Table 2).

Table 2. Reproductive performance according to calving type in dairy cows without RP.

Calving type (n)	Calving to first AI interval (days)	Conception rate at first AI (%)	Days open
Abortion (111)	65.81 ± 34.03[a]	50.77[a]	105.88 ± 72.83[a]
Assisted (69)	67.25 ± 21.03[a]	36.99[a]	144.00 ± 102.60[b]
Twin (40)	68.16 ± 25.57[a]	47.73[a]	105.30 ± 55.41[a]
Stillbirth (67)	65.09 ± 25.59[a]	46.38[a]	128.70 ± 87.40[ab]
Normal (2135)	64.44 ± 27.59[a]	44.81[a]	123.23 ± 87.18[ab]
P value	0.79	0.53	0.035

Data are presented as mean ± standard deviation unless otherwise indicated. AI = artificial insemination; [a,b]Different lowercase letters in the same column indicate a significant difference (P ≤ 0.05).

In this subgroup of cows that did not present RP, an effect of calving type on days open was detected (P = 0.035). Cows without RP that had assisted calvings showed longer days open (144.00 ± 102.60 days) than did cows that had normal calving (123.23 ± 87.18 days). No effect of calving type on the interval from calving to first AI was detected (P = 0.79), which ranged from 64.44 ± 27.59 to 68.16 ± 25.57 days. This finding was likely due to the use of FTAI, in which all cows received the first AI within the same postpartum period.

These results demonstrate that even among cows that did not present RP, days open were longer in cows with assisted calving than with other calving types. In this subgroup of cows without RP, cows receiving calving assistance showed an increase of 21 days in days open compared with cows that did not require assistance. This indicates that assisted calving may be associated with long-term detrimental effects that reduce reproductive performance in dairy herds, even when cows do not develop RP.

Considering this, it can be inferred that calving assistance may be one of the causes of reduced reproductive efficiency, even when cows have no history of RP and appear visually to be in adequate health condition. However, in the present study, other diseases that commonly affect dairy cows in the postpartum period, such as puerperal metritis and endometritis, were not evaluated.

A study conducted by Coury et al. [20] evaluated the effects of assisted calving on the occurrence of puerperal uterine disorders in crossbred dairy cows kept under conditions similar to those of the present study. The results showed that among cows requiring calving assistance, 74.29 % presented at least one uterine disorder (RP, metritis, and/or clinical endometritis).

In addition, during the experimental period, no calvings were classified as difficulty scores 4 or 5 (cesarean section or fetotomy cases); consequently, no high-intensity calving assistance was performed. Other factors associated with cow production and health, such as BCS at calving, milk production throughout lactation, and seasonality, were not analyzed in the present study. However, Coury et al. [20] highlighted that cows healthy during the puerperium had a higher pregnancy rate at 150 days postpartum than did cows that experienced uterine disorders in early lactation (51.65 % vs. 42.92 %).

When analyzing the effect of abortion occurrence on days open, an unexpected finding was observed. Cows that experienced abortion had shorter days open than did cows with other calving types. This result is difficult to interpret because the gestational stage at which the abortion occurred was not evaluated.

One way to reduce the negative effects of assisted calving is to perform intervention only when necessary and in an appropriate manner. For this to occur on farms, it is essential that workers receive continuous training on the signs of calving progression, the appropriate timing of intervention, hygiene practices, and other related aspects [21].

4. Conclusion

Crossbred dairy cows with assisted calving have a higher likelihood of presenting retained placenta. The service period is longer with assisted calving, regardless of the occurrence of retained placenta.

Conflict of interest statement

The authors declare no conflict of interest.

Data availability statement

Data will be provided upon request to the corresponding author.

Author contributions

Conceptualization: dos Santos, R. M.; Data curation: Borges, A. S., Resende, N. R., Coury, L. F. F., dos Santos, R. M.; Formal analysis: Borges, A. S., Resende, N. R., dos Santos, R. M.; Funding acquisition: dos Santos, R. M.; Project administration: dos Santos, R. M.; Methodology: Coury, L. F. F., dos Santos, R. M.; Supervision: dos Santos, R. M.; Investigation: Borges, A. S., Resende, N. R., Coury, L. F. F., dos Santos, R. M.; Visualization: Reis, N. S., Nascimento Neto, J. P., dos Santos, R. M.; Writing—original draft: Borges, A. S., Resende, N. R., Coury, L. F. F.; Writing—review and editing: Reis, N. S., Nascimento Neto, J. P., dos Santos, R. M.

Generative AI use statement

The authors did not use generative artificial intelligence tools or technologies in the creation or editing of any part of this manuscript.

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