Theriogenology 85 (2016) 1343–1347

Contents lists available at ScienceDirect

Theriogenology

journal homepage: www.theriojournal.com

Progesterone supplementation during the time of pregnancy recognition after artificial insemination improves conception rates in high-producing dairy cows

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ARTICLE INFO

Article history:
Received 14 September 2015
Received in revised form 19 December 2015
Accepted 23 December 2015

Keywords:
Preimplantation period
Fertility
Bovine

ABSTRACT

This study examines the possible effects of progesterone (P4) supplementation during the time of pregnancy recognition, from Days 15 to 17 post-artificial insemination (AI), on reproductive performance in high-producing dairy cows. Cows in their 15th day post-AI were alternately assigned to a control, no-treatment group (C: n = 257) or treatment group (P4: n = 287) on a weekly rotational basis according to the chronologic order of their gynecologic visit. On the basis of the odds ratio, the interaction treatment × previous placenta retention had a significant effect (P = 0.02) on conception rate. Thus, cows in P4 that had not suffered a retained placenta were 1.6 times more likely to conceive 28 to 34 days post-AI than the remaining cows. In nonpregnant cows, treatment had no effect on subsequent return to estrus or AI interval and neither were any effects of treatment observed on twin pregnancy and early fetal loss rates. The results of this study demonstrate the efficacy of P4 supplementations during the time of pregnancy recognition after AI in cows without a clinical history of placenta retention.

1. Introduction

Worldwide dairy herds are today experiencing a rising trend in infertility besides increased milk production [1–3]. Especially in high-producing dairy cows, such impacts on fertility seem to be the outcome of a multifactorial complex process [4,5]. An example of the complexity of the problem is that irrespective of the conception rate after artificial insemination (AI), early embryonic losses because of the incapacity of cows to successfully establish pregnancy may be the main limiting factor for the efficiency of dairy production systems [6]. Approximately 40% of conception losses in dairy cows are produced from Days 8 to 16 of pregnancy [7–9]. Some studies have shown that cows with lower progesterone (P4) concentrations during the diestrus subsequent to AI have lower conception rates [10–12]. Consistently, poorly developed 16-day-old embryos and embryonic losses have been associated with a delayed increase in systemic P4 concentrations and with lower P4 concentrations during Days 7 to 16 post-AI [11,12]. Hence, to reduce embryonic losses, many investigators have explored benefits of supplementing cows with P4 early post-AI [13–18]. However, P4 supplementation early post-AI does improve fertility in some animals, treatment is not successful in many cases. It seems that P4 supplementation only benefits fertility when P4 levels are low [15], which is a common situation in high-producing dairy cows [19,20]. The interval between Days 15 and 17 of early pregnancy has been described as the time of pregnancy recognition in the estrous cycle of the cow [21]. During this critical period, the cow has to change from a cyclic to a pregnant state blocking luteolysis. High P4 during the time of pregnancy recognition

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http://dx.doi.org/10.1016/j.theriogenology.2015.12.021

seems to play a key role in maintaining pregnancy [21,22]. However, to the best of our knowledge, the effects of P4 supplementation during the critical period in high-producing dairy cows have not yet been addressed. This study was designed to establish the effects of P4 supplementation from Days 15 to 17 post-AI on the reproductive performance of high-producing dairy cows.

2. Material and methods

2.1. Cattle and herd management

This study was performed on a commercial Holstein–Friesian dairy herd in northeastern Spain. During the study period (March to October 2014), the mean number of lactating cows in the herd was 825. Mean annual milk production for the herd was 11,915 kg per cow. The mean annual culling rate was 28%. Cows were grouped according to age (primiparous vs. multiparous), milked three times daily, and fed complete rations. Dry cows were kept in a separate group and transferred to a "parturition group" 7 to 25 days before parturition depending on their body condition score [23,24] and on whether they were carrying twins [25]. An early postpartum, or "fresh cow," group was established for postpartum daily checks and nutrition controls 7 to 20 days postpartum. All cows were artificially inseminated, and the herd was maintained on a weekly reproductive health program previously described [4,26].

2.2. Detection of estrus, insemination, pregnancy diagnosis, and pregnancy loss

Estrus was detected using a pedometer system (AfiFarm System; SAE Afikim). Walking activity values were recorded at the milking parlor (three times daily) and analyzed automatically using a herd management computer program. A walking activity greater than 80% of the mean activity recorded in the previous 2 days was taken as the lower limit for a cow to be considered in estrus. Because this herd was observed in a previous study to show a very significant positive relationship between increased walking activity and fertility provided, this increase was 80% to 993% [26], and values lower than 80% were not considered as estrus signs. Previous individual information concerning estrus detection was also taken into account. For example, if a cow normally showed a 400% increase in activity but showed an increase of around 120% during its two previous estrus periods, the cow was explored for possible conditions other than estrus, such as acute lameness or a change in location.

Estrus was confirmed by palpation per rectum in cows deemed to be in estrus using the pedometer system described earlier, and the animals were inseminated at this time. Only cows showing estrous signs with strong uterine contractility (determined by uterine tone) and copious transparent vaginal fluid were inseminated. If a cow returned to estrus, its status was confirmed by examination per rectum, and the animal was recorded as nonpregnant. In the remaining cows, pregnancy diagnosis was performed by ultrasound 28 to 34 days post-AI and confirmed 58 to 64 days post-AI. Because management and cow-related factors of a noninfectious nature have been extensively linked to late embryonic or early fetal loss in our geographical area [3,25], pregnancy loss was recorded when the 58- to 64-day diagnosis proved negative.

2.3. Experimental design

All procedures were approved by the Ethics Committee on Animal Experimentation of the University of Lleida (license numbers CEEA 09–01/12 and CEEA 09–01/13).

Cows in their 15th day post-AI were alternately assigned to a control, no-treatment group (C: $n = 257$), or treatment group (P4: $n = 287$) on a weekly rotational basis according to the chronologic order of their gynecologic visit. Animals in P4 were fitted with a progesterone-releasing intravaginal device (PRID DELTA, containing 1.55 g of progesterone; CEVA Salud Animal, Barcelona, Spain) for 3 days. Only healthy cows with no signs of mastitis, lameness, or digestive disorders were included in the study. Cows were included only once in the experiment.

2.4. Data collection and statistical analysis

The following data were recorded for each animal: parturition and AI dates; parity (primiparous vs. multiparous); previous retained placenta (fetal membranes retained longer than 12 hours after parturition) or metritis (diagnosed during the first or second week postpartum in animals with no history pf retained placenta); insemination number; repeat breeding syndrome (cows undergoing more than 3 AI); treatment (control vs. P4); milk production at treatment (mean production during the 3 days before treatment) (low producers $<$40 kg vs. high producers $\geq$40 kg); days in milk at AI (DIM; $<$90 days postpartum vs. $\geq$90 days postpartum); inseminating bull; AI technician; conception 28 to 34 days post-AI; presence of twins; and pregnancy loss 58 to 64 days post-AI. Insemination dates were used to assess the effects of season on subsequent reproductive performance. It should be noted that in our geographical region, there are only two clearly differentiated weather periods: warm (May to September) and cool (October to April) [2,5].

Three binary logistic regression analyses were performed using conception 28 to 34 days post-AI, presence of twins, and pregnancy loss 58 to 64 days post-AI as the dependent variables. The factors entered in the model as independent variables were season (warm period) of AI, parity (multiparous), retained placenta, metritis, repeat breeder syndrome, and treatment as dichotomous variables (where one denotes the presence and 0 denotes absence). Days in milk at AI, milk production at treatment, semen-providing bull, and AI technician (class variables) were considered factors in the analyses. For the dependent variable pregnancy loss, twin pregnancy was added as an independent (dichotomous) variable and only pregnant cows were included in the analysis. Regression analyses were conducted according to the method of Hosmer and Lemeshow [27] using the logistic procedure of PASW Statistics for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA). Basically, this method consists of five steps as follows: preliminary screening of all variables for univariate