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ScienceDirect
Theriogenology 71 (2009) 920–929
Theriogenology
www.theriojournal.com

Pregnancy patterns during the early fetal period in high producing dairy cows treated with GnRH or progesterone

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Received 14 August 2008; received in revised form 18 October 2008; accepted 18 October 2008

Abstract

In order to explore pregnancy patterns in high producing dairy cows treated with GnRH or progesterone at pregnancy diagnosis (Days 28–34), two consecutive experiments were designed. In Experiment 1, cows bearing a single embryo were randomly assigned to a PRID ($n = 40$; cows fitted with a progesterone releasing intra-vaginal device for 28 days), GnRH ($n = 40$; cows receiving GnRH) or Control ($n = 26$; untreated cows) group. PRID treatment led to a rise in plasma progesterone concentrations in the 7 days following the onset of treatment compared to the other two groups. In Experiment 2, in which we also examined twin pregnancies, animals were randomly assigned to PRID ($n = 312$) or GnRH ($n = 294$) treatment groups. Treatments were the same as described for Experiment 1. Logistic regression procedures revealed that in cows with a single corpus luteum, the probability of pregnancy loss between the first (Days 28–34) and second (Days 65–62) pregnancy diagnosis decreased by a factor of 0.51 in the PRID group compared to the GnRH group. However, in cows with two or more corpora lutea, PRID treatment increased the likelihood of pregnancy loss by a factor of three, compared to GnRH treatment. In cows carrying twins, the conceptus reduction rate was higher ($P = 0.02$) for the GnRH (36%) than for the PRID (16.4%) group. Formation of a new corpus luteum was recorded in 17.7% of cows in the GnRH group. Our results indicate that compared to GnRH treatment, progesterone treatment given at pregnancy diagnosis in high producing dairy cows, reduced by a factor of 0.51 and increased by a factor of 3 the probability of pregnancy loss in cows with a single or with two or more corpora lutea, respectively, and reduced the conceptus reduction rate in cows carrying twins. The practical implications of our findings are that in herds with a high incidence of early fetal loss of a non-infectious nature, treatment at the time of pregnancy diagnosis with PRID in cows with one corpus luteum and with GnRH in cows with two or more corpora lutea should offer considerable benefits.

Keywords: Early fetal loss; Progesterone supplementation; GnRH; Twins; Dairy cattle

1. Introduction

During the past few decades, dairy herds have been under ever-increasing pressure to improve their productive efficiency, yet many aspects of the reproductive process remain inefficient [1–3]. Getting the cow pregnant in a reasonable time is an important issue, but it is also essential that pregnancy progresses safely to term. The embryonic period of gestation extends from conception to the end of the differentiation stage (about 42 days), and the fetal period runs from Day 42 to parturition [4]. Most pregnancy losses occur during the

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doi:10.1016/j.theriogenology.2008.10.013

early embryonic period [5–7]. However, under the intensive management systems used today, the incidence of early fetal loss is increasing [8], and rates may exceed 12% [9–11].

Early fetal loss peaks between 45 and 60 days of gestation [12], when the association between mother and conceptus is still not fully developed [13,14]. Several cow and management factors of a non-infectious nature have been related to pregnancy loss during this period in our area [15,16] and elsewhere [11,17–19]. The presence of an additional corpus luteum (number of corpora lutea exceeding number of embryos) has been identified as a main preventive cow factor for pregnancy loss [12,16,20–22]. In the cow, the corpus luteum is the main source of progesterone, at least during the first 200 days of pregnancy [23,24]. Progesterone, the key hormone of gestation, is required for maternal support of conceptus survival and development [25]. Pregnancy maintenance has been positively correlated with plasma concentrations of progesterone on Week 5 of gestation [26], and progesterone concentrations have been reported to affect the secretory functions of the trophoblast and pituitary during the first trimester of gestation [27]. However, one of the consequences of high milk production is an increased metabolic rate linked to a greater intake of dry matter. This process reduces plasma concentrations of steroid hormones such as progesterone [28]. In effect, milk production can negatively affect plasma progesterone concentrations at the onset of the fetal period [21]. Twenty-eight days of intra-vaginal progesterone supplementation starting from Days 36 to 42 of gestation reduces the incidence of losses in high producing dairy cows [29]. Therefore, it seems reasonable to suppose that one of the causes of early fetal loss in high producing dairy cows could be suboptimal concentrations of progesterone, either due to increased progesterone catabolism, reduced luteal function, or both. Thus, strategies that induce the formation of an additional corpus luteum may help to increase progesterone concentrations and are hypothesized to result in a more prolonged action on maintenance of gestation than a progesterone-based treatment regimen. For example, treatment with GnRH at AI and 12 days later has been found to increase the likelihood of a cow producing an additional corpus luteum by a factor of 3.7 [30], whereas GnRH treatment on Day 27 of gestation significantly increases the chances of an accessory corpus luteum on Day 45 of gestation [22]. In both these studies the presence of an additional corpus luteum reduced the risk of fetal loss [22,30], however treatment did not promote pregnancy maintenance. Probably, the number of cows in each treatment group (89 [22] and 152 [30] pregnancies) was too small to establish a clear positive effect of GnRH treatment in reducing early fetal loss. Because progesterone treatment is more expensive and laborious at the farm level than GnRH we compared the two treatments to gain further insight into some of the problems related to early fetal loss and information on possible differences in response levels to each treatment. The aim of the present study was to determine plasma progesterone concentrations, early fetal loss and GnRH-induced corpus luteum formation in high producing dairy cows treated with GnRH or progesterone at the time of pregnancy diagnosis (Days 28–34). Cow and management factors previously found to be related to early fetal loss were also assessed.

2. Materials and methods

2.1. Cattle and herd management

Two consecutive experiments were performed on two commercial dairy herds in northeastern Spain, selected because of their high incidence of early fetal loss over a 13-month period (February 2007 to February 2008). The herds comprised a mean of 88 (Herd 1) and 585 (Herd 2) mature Holstein–Friesian cows, with a mean annual milk production for this period of 9260 and 11,250 kg per cow, respectively. The cows, reared within the herds, calved all year round, were milked two (Herd 1) or three (Herd 2) times per day and fed complete rations. Feeds consisted of cotton-seed hulls, barley, corn, soybean and bran, and roughage, primarily corn, barley and alfalfa silages and alfalfa hay. Rations were in line with NRC recommendations [31]. All the animals were tested free of tuberculosis and brucellosis and bred by artificial insemination using semen from 35 bulls of proven fertility. Mean annual culling rates for the study period were 20% for Herd 1 and 31% for Herd 2.

The herds were maintained on a weekly reproductive health program. The reproductive tract of each animal was examined by palpation per rectum 30–36 days post-partum to check for normal uterine involution and the morphology of ovarian structures. Reproductive disorders diagnosed at this time were treated until resolved or until culling. The voluntary waiting period from calving to first AI established for these herds was 45 days post-partum. Only cows free of detectable reproductive disorders were inseminated.