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Modifying the double-Ovsynch protocol to include human chorionic gonadotropin to synchronize ovulation in dairy cattle

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Abstract

The objectives were to determine whether rates of conception, ovulation, presynchronization, or follicle and CL characteristics were altered after modifying the Double-Ovsynch (DO) protocol to include hCG compared with the DO protocol. Primiparous and multiparous lactating dairy cows (N = 183), and nulliparous dairy heifers (N = 51) were used. Cows were blocked by parity and heifers were stratified by age and breed before being randomly assigned to one of two treatments. All females received either 100 μg GnRH or 2000 IU hCG im, at initiation of the Pre-Ovsynch (PO) portion of the DO protocol (PO: *GnRH/hCG*, 7 days $PGF_{2\alpha}$ and 3 days GnRH). After 7 days, females started the Breeding-Ovsynch portion of the DO protocol (Breeding-Ovsynch: GnRH, 7 days, $PGF_{2\alpha}$, 48 or 56 h and GnRH 16 hours timed artificial insemination with sex-sorted semen). Transrectal ultrasonography and blood samples were used to assess ovarian structures, ovulation, pregnancy diagnosis, and concentration of progesterone in plasma. Conception rates were similar in females treated with GnRH or hCG in cows (32.2 and 25.0%) and in heifers (30.8 and 36.0%). Ovulation rates in cows at the onset of PO were increased with hCG compared to GnRH (77.2 vs. 62.2%, $P < 0.05$). Concentrations of progesterone 7 days post-hCG or GnRH were greater in cows treated with hCG compared with GnRH (least significant mean ± SEM; 4.3 ± 0.3 and 3.0 ± 0.3 ng/mL, $P < 0.01$), but did not differ in heifers (4.5 ± 0.9 and 2.9 ± 0.9 ng/mL). More cows ovulated within 7 days post-hCG and a greater proportion of these cows tended to have failed luteal regression by Day 3 post-$PGF_{2\alpha}$ compared with cows that had ovulated to GnRH (29.6 vs. 16.1%, $P \leq 0.10$). The overall percentage of females which were synchronized to PO did not differ between GnRH- or hCG-treated cows (61.5% and 52.2%) and heifers (42.3% and 40.0%). In conclusion, no overall improvement in fertility was achieved by replacing the first injection of GnRH in the DO protocol with hCG.

Keywords: Double-Ovsynch; hCG; Presynchronization; Timed artificial insemination; TAI

1. Introduction

In the United States, most dairy herds have an estrus detection efficiency of < 50% [1,2], resulting in substantial economic losses for dairy producers [1]. Estrus synchronization protocols, such as Ovsynch, that allow for timed artificial insemination (TAI) have been developed to alleviate this problem and increase reproductive efficiency [3–5]. Conception rates are greatest when Ovsynch is initiated on Days 5 to 12 of the estrous cycle [6], because of increased rates of ovulation following the first injection of GnRH of Ovsynch [6,7]. Inclusion of a presynchronization stage to the protocol improved fertility in dairy cattle [7–9]. Cattle that respond to presynchronization protocols have increased likelihood of ovulating to the first treatment of

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GnRH of Ovsynch and subsequently have better conception rates [6,7]. Continued improvements in methods of presynchronization may result in further increases in fertility. For example, Souza et al. [10] introduced the novel idea of combining two Ovsynch protocols to form what is known as Double-Ovsynch. The first Ovsynch is referred to as Pre-Ovsynch (PO) and is used for presynchronizing follicular growth. After the PO, the Breeding-Ovsynch (BO), is initiated 7 days later and the cow is inseminated after this Ovsynch.

Human chorionic gonadotropin has similar activity to LH [11], inducing ovulation by binding to LH receptors on the follicle [12]. Therefore, ovulation of a follicle using hCG is no longer dependent upon a surge of LH produced from an injection of GnRH [13]. Administration of hCG resulted in greater ovulatory responses compared to GnRH in some [14,15] but not all [16,17] experiments.

Heifers subjected to the Ovsynch protocol have significantly decreased conception rates compared with breeding after detected estrus [5]. It is thought that this decrease is predominantly caused by failure of ovulation after the initial injection of GnRH of Ovsynch [18,19]. However, induction of ovulation with hCG in dairy heifers has been reported to be significantly increased compared with GnRH [20].

We hypothesized that replacing the first treatment of GnRH in the Double-Ovsynch protocol with hCG would increase the percentage of females that ovulate, thus improving the overall presynchronization rate and increasing conception rates. The objectives of this study were to determine whether rates of conception, ovulation, presynchronization, or follicle and CL characteristics were altered by using hCG in lieu of the initial treatment of GnRH in the Double-Ovsynch protocol.

2. Materials and methods

2.1. Herd management practices

All procedures in this study were approved by the Institutional Animal Care and Use Committee of Mississippi State University. Experiment 1 was conducted in lactating dairy cows, and Experiment 2 was conducted in dairy heifers. Animals were housed in three free-stall barns at the Bearden Dairy Research Center, Mississippi State, MS, USA. All cattle had access to water ad libitum and twice daily were fed a total mixed ration formulated to meet or exceed dietary requirements of lactating dairy cows or heifers [21]. Experiment 1 consisted of Holstein (N = 146) and Jersey (N = 37) cows. Experiment 2 consisted of Holstein (N = 41) and Jersey (N = 10) heifers ranging in age from 13 to 16 mo at the time of AI (mid-December). Because of negative effects of heat stress in Mississippi during summer months, this herd was managed with a seasonal breeding season with no females being inseminated from the end of May to mid-November.

2.1.1. Animals

During the fall 2009 and 2010 breeding seasons, primiparous (N = 67) and multiparous (N = 116) dairy cows were used for Experiment 1. Cows were grouped into three replicates in Years 1 and 2, with enrollment beginning in late October and ending in early December. The first group enrolled each year consisted of cows held over from the previous breeding season that failed to initiate or maintain a pregnancy (239 to 458 days in milk [DIM] at TAI; N = 64). Groups 2 and 3 of both years consisted of early lactation cows (60 to 116 DIM at TAI; N = 119) receiving their first postpartum insemination. Cows were blocked by parity and randomly assigned to one of two treatments, although groups were checked for balance in milk production and DIM. In Experiment 2, heifers were grouped in two replicates with enrollment of both groups in early November 2009. Heifers were stratified by age and breed and then randomly assigned to one of two treatments.

2.2. Treatments

After assignment to treatments, all cattle received either treatment of 100 μg (2 mL) GnRH im (Cystorelin; Merial, Ltd., Duluth, GA, USA) or 2000 IU (2 mL) hCG im (Chorulon; Intervet, Inc., Millsboro, DE, USA) at initiation of the PO portion of the Double-Ovsynch protocol (Day 0). Seven days later, all cattle received 25 mg (5 mL) $PGF_{2\alpha}$ intramuscular (Lutalyse; Pfizer Animal Health, New York, NY, USA) followed 3 days later (Day 10) with GnRH im (PO: *hCG/GnRH*; 7 days, $PGF_{2\alpha}$, 3 days GnRH). After 7 days, females started the BO portion of the Double-Ovsynch protocol (BO: GnRH, 7 days, $PGF_{2\alpha}$ 48 h [heifers]/56 h [cows]; GnRH 16 h; TAI). All females received TAI with sex-sorted (female) semen.

2.3. Milk production and body condition scores

Body condition scores (BCS) [22] of all females were assessed by a single trained observer at the time of the first treatment (Day 0). Milk production was recorded monthly on individual cows and the test-day milk yield nearest to the initiation of the trial was used