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Follicular wave emergence, luteal function and synchrony of ovulation following GnRH or estradiol benzoate in a CIDR-treated, lactating Holstein cows

Ui-Hyung Kim[a], Guk-Hyun Suh[b], Hyun-Wook Nam[a], Hyun-Gu Kang[a], Ill-Hwa Kim[a,*]

[a]*Laboratory of Theriogenology, College of Veterinary Medicine, Chungbuk National University, Cheongju, Chungbuk 361-763, South Korea*
[b]*National Livestock Research Institute, RDA, Cheonan, Chungnam 330-800, South Korea*

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Abstract

This study evaluated the effect of GnRH or estradiol benzoate (EB) on follicular wave emergence and progesterone concentrations, and following a second injection of GnRH, synchrony of ovulation, and pregnancy rates in a controlled internal drug release (CIDR)-based timed AI (TAI) protocol in lactating Holstein cows. Cows received a CIDR device without hormone (controls), with an injection of 100 μg GnRH or with an injection of 4 mg EB. Thereafter, all received $PGF_{2\alpha}$ at the time of CIDR removal on Day 7, GnRH on Day 9, and TAI 16 h later. Follicular wave emergence occurred within 7 days in 19/20 GnRH-treated, 14/20 EB-treated and 5/20 control cows ($P < 0.05$). The interval to wave emergence was the shorter and less variable ($P < 0.01$) in the GnRH group (2.9 ± 0.2 days) than in the EB (4.7 ± 0.5 days) or control (4.8 ± 1.0 days) groups. Serum progesterone concentrations from Days 4 to 7 were higher ($P < 0.01$) in the GnRH-treated cows that ovulated than in those that did not ovulate, or in control and EB-treated cows. The diameters of dominant follicle on Day 7 differed among groups ($P < 0.01$), and the diameters of the preovulatory follicle on Day 9 were larger ($P < 0.01$) in the control and GnRH groups than in the EB group. The proportion of cows with synchronized ovulations did not differ among groups, but pregnancy rate to TAI was higher ($P < 0.05$) in the GnRH group (65%; 13/20) than in the control (30%; 6/20) or EB (35%; 7/20) groups. Results suggest that GnRH treatment of CIDR-treated lactating Holstein cows will result in synchronous follicular

* Corresponding author. Tel.: +82 43 2612571; fax: +82 43 2673150.
E-mail address: illhwa@cbu.ac.kr (I.-H. Kim).

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wave emergence, large preovulatory follicles and synchronous ovulation, resulting in an acceptable pregnancy rates to TAI.
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Keywords: CIDR; Timed AI; GnRH; Estradiol; Follicular waves; Holstein cows

1. Introduction

The lack of an efficient and accurate method of estrus detection severely limits the reproductive performance of lactating dairy cattle [1]. The estrus periods in nearly half of normal cycling dairy cows may not be detected [2,3]. The Ovsynch protocol, which combines GnRH–$PGF_{2\alpha}$–GnRH treatments, has made planned breeding programs more effective [4]. However, ovulation failure in response to the initial GnRH injection in the Ovsynch protocol may result in reduced pregnancy rates following timed AI (TAI) due to asynchronous ovulation [5]. For example, premature estrus between the first GnRH and the injection of $PGF_{2\alpha}$ has been reported in 5–11.8% of cows [6,7]. Therefore, various procedures have been employed to improve the Ovsynch protocol [8–10].

An alternative is to utilize a progestin-based regimen [11–13]. However, the induction of a new follicular wave is important in progestin-based synchronization regimens, in order to prevent the development of a persistent follicle, which will result in reduced fertility following AI [14,15]. Thompson et al. [12] reported that treatment with GnRH in a norgestomet-based protocol improved pregnancy rates to TAI in beef cows. Similarly, Martinez et al. [10,11,16] found that treatment with GnRH or estradiol in a melengestrol acetate (MGA)-based synchronization regimen resulted in acceptable pregnancy rates after TAI in crossbred beef heifers. However, the incorporation of GnRH or estradiol into CIDR-based TAI protocol has not been evaluated in lactating Holstein cows. Therefore, we examined the effects of GnRH or estradiol benzoate (EB) in a CIDR-based protocol on follicular dynamics, progesterone concentrations and pregnancy rates following TAI in lactating Holstein cows.

2. Materials and methods

2.1. Animals and treatment

This study was performed on three Holstein dairy farms located in Chungbuk province in central Korea. Lactating Holstein cows were maintained in free-stall facilities, fed a total mixed ration, and milked twice daily. Four replicates of this experiment were conducted with 60 cows, ranging from 2 to 5 lactations and averaging 71 days postpartum (range of 62–85 days). The cows were allocated to one of three treatment groups with balancing by lactation number and days postpartum. All cows received a controlled, internal drug-release device containing 1.9 g of progesterone (CIDR^{TM}, InterAg, Hamilton, New Zealand) at random stages of the estrous cycle (Day 0). Cows in the control group ($n = 20$) received no further treatment, while those in the GnRH group ($n = 20$) received

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