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Detection of Anovulation by Heatmount Detectors and Transrectal Ultrasonography Before Treatment with Progesterone in a Timed Insemination Protocol[1]

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ABSTRACT

Our objective was to determine the accuracy of identifying noncycling lactating dairy cows before the application of a timed artificial insemination (AI) protocol [with or without progesterone supplementation via a controlled internal drug-release (CIDR) insert and 2 different timings of AI] by using heatmount detectors and a single ovarian ultrasound examination. At 6 locations in the Midwest, 1,072 cows were enrolled in a Presynch protocol (2 injections of $PGF_{2\alpha}$ 14 d apart), with the second injection administered 14 d before initiating the Ovsynch protocol (injection of GnRH 7 d before and 48 h after $PGF_{2\alpha}$ injection, with timed AI at 0 or 24 h after the second GnRH injection). Heatmount detectors were applied to cows just before the first Presynch injection, assessed 14 d later at the second Presynch injection (replaced when activated or missing), and reassessed at initiation of the Ovsynch protocol. Ovaries were examined for the presence of a corpus luteum (CL) by ultrasound before the initiation of treatment. Treatments were assigned to cows based on the presence or absence of a CL detected by ultrasound: 1) no CL + no CIDR; 2) no CL + CIDR insert for 7 d; and 3) CL present. Further, alternate cows within the 3 treatments were assigned to be inseminated concurrent with the second GnRH injection of Ovsynch (0 h) or 24 h later. Pregnancy was diagnosed at 33 and 61 d after the second GnRH injection. By using low (<1 ng/mL) concentrations of progesterone in serum as the standard for noncycling status, heatmount detectors were activated on a large percentage of noncycling cows (>60%), whereas the single ultrasound examination incorrectly classified noncycling cows only 21% of the time. Conversely, cycling cows (progesterone ≥1 ng/mL) were correctly identified 70 to 78% of the time by heatmount detectors, but 85 to 92% were correctly identified by ultrasound. Overall accuracy of heatmount detectors and ultrasound was 71 and 84%, respectively. Application of progesterone to cows without a CL at the time of the first injection of GnRH reduced the incidence of ovulation but increased the proportions of pregnancies per AI at d 33 or 61 compared with nontreated cows without a CL at the onset of the Ovsynch protocol. Percentages of cows pregnant and pregnancy survival did not differ for cows having a CL before treatment compared with those not having a CL and treated with progesterone. Compared with no response, when a follicle ovulated in response to the first GnRH injection, percentage of cows becoming pregnant after the timed AI increased from 33.3 to 41.6%. Timing of AI at 0 or 24 h after the second GnRH injection did not alter pregnancies per AI, but cows having luteal activity before treatment had improved pregnancies per AI compared with noncycling cows. We conclude that identifying noncycling cows by ultrasound was more accurate than by heatmount detectors. Subsequent progesterone treatment of previously cycling cows not having a CL at the onset of Ovsynch increased the proportion of pregnant cows, equal to that of cows having a CL but not treated with progesterone.

Key words: anovulation, controlled internal drug release, Ovsynch, pregnancy per artificial insemination

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INTRODUCTION

Reproductive efficiency has fundamental economic importance for dairy operations. Nevertheless, reproductive efficiency of lactating dairy cows is less than optimal, with more than a 50% decline in pregnancies per AI (**P/AI**) since 1970 (Butler and Smith, 1989; Washburn et al., 2002). Adequate circulating progesterone concentrations are critical for the normal estrous cycle and for maintenance of pregnancy. In addition, circulating progesterone concentrations before AI seem to be important for optimal fertility, as demonstrated by a positive correlation between serum progesterone before AI and subsequent conception rates (Fonseca et al., 1983; Folman et al., 1990). Circulating progesterone concentrations are determined by the balance between rates of progesterone production, primarily by the corpus luteum (**CL**), and rates of progesterone clearance or metabolism. Lactating dairy cows have much lower circulating progesterone concentrations than would be expected from the size of the CL (Sartori et al., 2002, 2004; Wolfenson et al., 2004). Increased DMI and milk yield seem to increase progesterone metabolism, producing reduced circulating progesterone concentrations in lactating dairy cows (Sangsritavong et al., 2002; Wiltbank et al., 2006). Thus, reducing progesterone metabolism or supplementation of progesterone during reproductive management protocols holds promise for improving dairy cattle fertility.

Previous studies produced inconsistent results after supplementing progesterone via a progesterone-releasing intravaginal controlled internal drug-release (**CIDR**) insert during various timed AI (**TAI**) protocols. For example, our previous regional research project reported numerically greater P/AI measured 28 d after TAI for cows treated with progesterone during the Ovsynch protocol (injection of GnRH 7 d before and 48 h after $PGF_{2\alpha}$ injection, with TAI between 0 and 24 h after the second GnRH injection; Stevenson et al., 2006). In that study, P/AI were greater for both cycling and noncycling cows treated with the CIDR insert compared with no CIDR treatment, but only at 4 of the 6 locations at 28 d and at 3 of 6 locations at 56 d after TAI. This inconsistent response is corroborated by other large-scale studies (El-Zarkouny et al., 2004; Galvão et al., 2004; Moreira et al., 2004a,b).

Estrus-detection aids, including tail paint, chalk, and heatmount detectors, are inexpensive tools that may aid in the detection of noncycling cows before first AI. Likewise, examination of ovaries by transrectal palpation (Morrow et al., 1966) or ultrasonography (Silva et al., 2007) is a means of identifying noncycling cows that may benefit from progesterone supplementation as part of a TAI protocol.

Pregnancies per AI are maximized when the TAI of the Ovsynch protocol is administered at 16 h after the second GnRH injection (Pursley et al., 1998). In practice, this timing is inconvenient and does not correspond to when other management activities occur (e.g., AI, pregnancy diagnosis, vaccinations, and other treatments) while dairy cows are locked up at the feed line after the morning milkings. Further, P/AI was similar when AI occurred concomitant with the second GnRH injection or 24 h later (Nebel and Jobst, 1998; Pursley et al., 1998).

The objectives of the present experiment were to determine 1) the accuracy of detecting potentially noncycling cows by using heatmount detectors applied to cows for 28 d before initiating the Ovsynch protocol or by a single ovarian examination using transrectal ultrasonography at the onset of the Ovsynch protocol; 2) the benefit of applying progesterone (via a CIDR insert) during the first 7 d of the Ovsynch protocol; and 3) P/AI when timing of AI occurred concurrent with the second GnRH injection of the Ovsynch protocol or 24 h later.

MATERIALS AND METHODS

Experimental Locations

This study was a collaborative project of North Central Regional Research Project 1006 of the Cooperative States Research, Education, and Extension Service (CSREES). Similar treatments were applied to lactating Holstein cows at 6 locations (Indiana, Kansas, Michigan, Minnesota, Missouri, and Wisconsin) where the co-authors were located. A total of 1,072 cows were enrolled between April 2003 and October 2005. A similar experimental design was used at each location. New cows were enrolled weekly or biweekly into breeding clusters. Various location characteristics are shown in Table 1.

Experimental Protocol

Sampling, procedures, and design of treatments are illustrated in Figure 1. Cows were enrolled in a Presynch + Ovsynch protocol. Two 25-mg injections of $PGF_{2\alpha}$ (5 mL of Lutalyse, Pfizer, New York, NY, or 5 mL of Prostamate, IVX Animal Health Inc., St. Joseph, MO) were given i.m. 14 d apart. The Ovsynch protocol was then initiated 14 d after the second Presynch injection by injecting GnRH. Prostaglandin $F_{2\alpha}$ (25 mg) was administered 7 d later and was followed in 48 h by a second injection of GnRH. All injections of GnRH (100 μg) were administered i.m., consisting of 2 mL of Ova-Cyst (IVX Animal Health Inc.).