J. Dairy Sci. 99:1–12
http://dx.doi.org/10.3168/jds.2015-10223

Reproductive management strategies to improve the fertility of cows with a suboptimal response to resynchronization of ovulation

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ABSTRACT

The objective was to compare the reproductive performance of lactating Holstein cows managed with a strategy that included the Ovsynch protocol with exogenous progesterone (P4) supplementation or presynchronization with GnRH 7 d before Ovsynch to treat cows without a corpus luteum (CL), a CL <15 mm, or cystic at the time of the $PGF_{2\alpha}$ injection of Resynch (GnRH-7 d-$PGF_{2\alpha}$-56 h-GnRH-16 to 20 h-TAI). In a preliminary study, blood collection and transrectal ovarian ultrasonography were conducted (n = 555) at the $PGF_{2\alpha}$ of Resynch [coincident with nonpregnancy diagnosis (NPD)] to define a cutoff value for CL size that better predicted fertility after timed artificial insemination (TAI). A CL size of 15 mm was selected based on statistical differences in pregnancies per AI (P/AI) [33.2 vs. 10.3 P/AI for CL ≥15 mm (n = 497) vs. no CL ≥15 mm (n = 58; no CL, CL <15 mm, or cystic)]. Subsequently, in a completely randomized experiment, cows were enrolled in a management strategy that used Ovsynch with P4 supplementation [Ovsynch+P4; GnRH and controlled internal drug release device (CIDR)-7 d-$PGF_{2\alpha}$ and CIDR removal-56 h-GnRH-16 to 20 h-TAI] or a PreG-Ovsynch protocol [PreG-Ovsynch; GnRH-7 d-GnRH-7 d-$PGF_{2\alpha}$-56 h-GnRH-16 to 20 h-TAI] to treat cows without a CL, a CL <15 mm, or cystic at NPD and the $PGF_{2\alpha}$ of Resynch. Cows with a CL ≥15 mm at the $PGF_{2\alpha}$ of Resynch completed the protocol and received TAI. Data were available from 212, 192, and 1,797 AI services after Ovsynch+P4, PreG-Ovsynch, and Resynch, respectively. At 39 d after AI, P/AI tended to be greater for Ovsynch+P4 and PreG-Ovsynch combined (35.1%) than for Resynch cows (31.1%), whereas P/AI were similar for Ovsynch+P4 (34.4%) and PreG-Ovsynch (35.9%). The hazard of pregnancy for cows that received the experimental treatments at least once was similar for cows in the Ovsynch+P4 (n = 124) and the PreG-Ovsynch (n = 132) group (hazard ratio 1.15; 95% confidence interval: 0.87 to 1.53). Median days to pregnancy were 52 and 59 for cows in the Ovsynch+P4 and the PreG-Ovsynch groups, respectively. The presynchronizing GnRH injection of PreG-Ovsynch induced ovulation in 86.0% of the cows. At the first GnRH of Ovsynch, the proportion of cows with a CL based on ultrasound (86.6 vs. 15.0%), P4 >1 ng/mL (82.8 vs. 31.8%), a follicle ≥10 mm (98.0 vs. 84.4%), and P4 concentrations (3.7 vs. 1.1 ng/mL) was greater in PreG-Ovsynch than in Ovsynch+P4. Conversely, more cows ovulated in response to the first GnRH of Ovsynch in Ovsynch+P4 (71.9%) than PreG-Ovsynch (58.3%). At the $PGF_{2\alpha}$ before TAI, more cows had a CL based on ultrasound (92.1 vs. 77.0%) and P4 concentrations were greater in PreG-Ovsynch than in Ovsynch+P4 (4.1 vs. 2.6 ng/mL); however, a similar proportion of cows had P4 >1 ng/mL (79.1 vs. 82.7%). We conclude that the Ovsynch+P4 and PreG-Ovsynch treatments for cows without a CL, a CL <15 mm, or cystic at the $PGF_{2\alpha}$ injection of Resynch led to P/AI similar to that of cows with a CL ≥15 mm, and that both management strategies resulted in similar time to pregnancy.

Key words: resynchronization, corpus luteum, management strategy, dairy cow

INTRODUCTION

Because up to 65 to 70% of lactating dairy cows may remain not pregnant after an AI service, implementing an efficient strategy to identify and reinseminate nonpregnant cows is critical to achieve optimal reproductive performance of dairy herds. In general, well-managed dairy farms with efficient estrus detection programs consistently inseminate 50% or more of the nonpregnant cows after detection of behavioral estrus (Chebel et al., 2006; Galvão et al., 2007; Giordano et al., 2015). Additionally, to avoid a prolonged interbreeding interval, cows not detected in estrus are enrolled in a resyn-

Received August 6, 2015.
Accepted December 14, 2015.
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chronization of ovulation protocol to receive a timed AI (**TAI**) service. A widely adopted program in US dairy herds consists of the initiation of the Ovsynch protocol (GnRH-7 d-$PGF_{2\alpha}$-56 h-GnRH-16 to 20 h-AI) 32 ± 3 d after a previous AI, regardless of pregnancy status (Fricke et al., 2003). Seven days later, nonpregnancy diagnosis (**NPD**) is conducted so that only nonpregnant cows continue in the protocol to receive their next TAI. This program, usually referred to as D32 Resynch, guarantees an interbreeding interval of no more than 45 d in all cows (for herds that enroll cows weekly).

Previous studies that evaluated ovarian dynamics and fertility of resynchronized cows identified subgroups with low and high fertility after the TAI service (Fricke et al., 2003; Stevenson and Tiffany, 2004; Giordano et al., 2012b,c; Lopes et al., 2013). Interestingly, a major determinant of the success of resynchronized TAI services was the presence or absence of a functional corpus luteum [**CL**; defined as progesterone (**P4**) concentrations ≥1 ng/mL] at the time of the $PGF_{2\alpha}$ injection of the protocol. Cows without a functional CL that received TAI had approximately a 50% reduction in fertility compared with cows with a CL (Stevenson and Tiffany, 2004; Giordano et al., 2012b,c). The poor fertility of cows without a CL was likely the result of lack of synchrony of ovulation, a suboptimal endocrine environment before AI, or both (Vasconcelos et al., 1999; Giordano et al., 2012c). Maximizing the fertility of these cows with a suboptimal response to the resynchronization of ovulation protocol is relevant because nonpregnant cows after a resynchronized TAI service not only incur the expense of completing the protocol and the ensuing AI but they also undergo a major delay until the next AI service, reducing overall cow and herd profitability (Giordano et al., 2013).

A simple treatment alternative for cows not properly resynchronized, as evidenced by lack of a CL at the $PGF_{2\alpha}$ of Resynch, would be to immediately re-enroll them in the Ovsynch protocol. Nevertheless, previous studies have demonstrated that initiating Ovsynch in the absence of a functional CL results in reduced fertility compared with that of cows with a CL present (Stevenson et al., 2008; Giordano et al., 2012c; Lopes et al., 2013; Bisinotto et al., 2015). In this regard, providing supplemental P4 through an intravaginal controlled drug releasing (**CIDR**) insert during Ovsynch or presynchronization of the estrous cycle before Ovsynch may be suitable alternatives for cows without a CL at the $PGF_{2\alpha}$ of Resynch. Exogenous P4 supplementation has been proven effective to increase pregnancies per AI (**P/AI**) of lactating dairy cows without a functional CL at the initiation of Ovsynch (Stevenson et al., 2006, 2008; Bilby et al., 2013), likely through improved synchrony of ovulation and the hormonal milieu before AI (Stevenson et al., 2006, 2008; Lima et al., 2009). Likewise, presynchronization with a GnRH injection has been proven effective to increase the P/AI of resynchronized cows (Dewey et al., 2010; Lopes et al., 2013; Bruno et al., 2014), probably by increasing the proportion of cows with a functional CL and a follicle with ovulatory capacity at the time the initiation of Ovsynch.

Thus, the objective of this research was to evaluate the reproductive performance of cows managed with reproductive programs that included the Ovsynch protocol with P4 supplementation through a CIDR device (Ovsynch+P4) or presynchronization with GnRH (**PreG**) 7 d before Ovsynch (PreG-Ovsynch) for cows without CL or with a CL of suboptimal size at the time of the $PGF_{2\alpha}$ injection of Resynch. We hypothesized that the fertility of cows without a CL or a CL smaller than the expected size needed to optimize fertility after TAI could be improved by re-enrollment in the experimental treatments. We expected the fertility of TAI services after Ovsynch+P4 and PreG-Ovsynch to be similar to that of AI services after completion of Resynch for cows with a CL of a size expected to result in high fertility after TAI. We also hypothesized that time to pregnancy would be earlier for cows enrolled in the management strategy that used the Ovsynch+P4 protocol because of the 7-d-shorter interval to the next insemination.

MATERIALS AND METHODS

Animals and Management

In a preliminary study, lactating Holstein cows from 6 commercial dairy farms in New York State were enrolled from November 2012 to April 2013. Subsequently, in a completely randomized experiment, lactating Holstein cows from 5 commercial dairy farms (4 out the 5 farms participated in experiment 1) in New York State were enrolled from July 2013 to September 2014. The approximate number of milking cows across herds during the period our research was conducted ranged from 470 to 1,770. Cows were housed in freestall barns with 6 rows of stalls with mattresses covered with organic bedding or in barns with 4 rows of stalls and deep sand bedding. Cows were fed a TMR to meet or exceed the nutritional requirements of lactating Holstein cows (NRC, 2001). Feed was delivered at least once or twice daily and cows had free access to feed and water. Cows were milked 3 times daily and received injections of recombinant bST (Posilac, 500 mg; Elanco Animal Health, Indianapolis, IN) at 14-d intervals starting at ~60 to 70 DIM until dry-off.

In all farms, cows were enrolled in the Presynch-Ovsynch protocol ($PGF_{2\alpha}$-14 d-$PGF_{2\alpha}$-12 or 14 d-