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Resynchronization of ovulation protocols for dairy cows including or not including gonadotropin-releasing hormone to induce a new follicular wave: Effects on re-insemination pattern, ovarian responses, and pregnancy outcomes

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ABSTRACT

Our objectives were to evaluate the pattern of re-insemination, ovarian responses, and pregnancy per artificial insemination (P/AI) of cows submitted to different resynchronization of ovulation protocols. The base protocol started at 25 ± 3 d after artificial insemination (AI) and was as follows: GnRH, 7 and 8 d later $PGF_{2\alpha}$, GnRH 32 h after second $PGF_{2\alpha}$, and fixed timed AI (TAI) 16 to 18 h after GnRH. At 18 ± 3 d after AI, cows were randomly assigned to the G25 (n = 1,100) or NoG25 (n = 1,098) treatments. The protocol for G25 and NoG25 was the same, except that cows in NoG25 did not receive GnRH 25 ± 3 d after AI. At nonpregnancy diagnosis (NPD), 32 ± 3 d after AI, cows from G25 and NoG25 with a corpus luteum (CL) ≥15 mm in diameter and a follicle ≥10 mm completed the protocol (G25 CL = 272, NoG25 CL = 194), whereas cows from both treatments that did not meet these criteria received a modified Ovsynch protocol with P4 supplementation [controlled internal drug release insert plus GnRH, controlled internal drug release insert removal, and $PGF_{2\alpha}$ 7 and 8 d later, GnRH 32 h after second $PGF_{2\alpha}$, and TAI 16 to 18 h after GnRH (G25 NoCL = 53, NoG25 NoCL = 78)]. Serum concentrations of progesterone (P4) were determined and ovarian ultrasonography was performed thrice weekly from 18 ± 3 d after AI until 1 d after TAI (G25 = 46, NoG25 = 44 cows). A greater percentage of NoG25 cows were re-inseminated at detected estrus (NoG25 = 53.5%, G25 = 44.6%), whereas more cows had a CL at NPD in G25 than NoG25 (83.7 and 71.3%). At 32 d after AI, P/AI was similar for G25 and NoG25 for inseminations at detected estrus (38.4 and 42.9%), TAI services for cows with no CL (40.4 and 36.7%), and for all services combined (39.6 and 39.0%). However, P/AI were greater for cows with a CL in G25 than NoG25 (40.6 and 32.8%) that received TAI. More cows ovulated spontaneously or in response to GnRH for the G25 than the NoG25 treatment (70 and 36%) but a similar proportion had an active follicle at NPD (G25 = 91% and NoG25 = 96%). The largest follicle diameter at NPD (G25 = 15.0 ± 0.4 mm, NoG25 = 16.5 ± 0.6 mm) and days since it reached ≥10 mm (G25 = 4.0 ± 0.3 d, NoG25 = 5.8 ± 0.6 d) were greater for the NoG25 than G25 treatment. For cows with a CL at NPD, CL regression after NPD, ovulation after TAI, and ovulatory follicle diameter did not differ. In conclusion, removing the first GnRH of a modified Resynch-25 protocol for cows with a CL at NPD and a modified Ovsynch protocol with P4 supplementation for cows without a CL at NPD resulted in a greater percentage of cows re-inseminated at detected estrus and a similar proportion of cows pregnant in spite of reduced P/AI for cows with a CL at NPD.
Key words: resynchronization, estrus detection, gonadotropin-releasing hormone, dairy cow

INTRODUCTION

An ideal strategy for submitting cows for re-insemination minimizes the interbreeding interval and maximizes pregnancy per AI (**P/AI**). Many dairy farms reduce the interbreeding interval by combining re-insemination of cows after a detected estrus and submission to resynchronization of ovulation for timed AI (**TAI**; Caraviello et al., 2006; Ferguson and Skidmore, 2013; Scott, 2016). Re-insemination of cows at estrus with resulting P/AI similar to or better than that observed after re-insemination at fixed time AI benefits herd profitability by reducing the overall interbreeding interval and reproductive program cost (Giordano et al., 2012b, 2013; Galvão et al., 2013). On the other hand, incorporating a resynchronization of ovulation protocol for TAI is essential because it ensures timely re-insemination of nonpregnant cows not detected in

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estrus. Therefore, Ovsynch-type protocols are usually initiated at the time of or 7 d before nonpregnancy diagnosis (**NPD**) to ensure that nonpregnant cows receive TAI as soon as possible (Chebel et al., 2003; Fricke et al., 2003; Lopes et al., 2013).

For farms that enroll cohorts of cows in a resynchronization of ovulation protocol on a weekly basis, an effective strategy to minimize the interbreeding interval of TAI services is to initiate the Ovsynch protocol (GnRH, 7 d later $PGF_{2\alpha}$, 56 h later GnRH, and 16 to 20 h later TAI) 25 ± 3 d after AI (hereafter referred to as Resynch-25), which results in an interbreeding interval of 35 ± 3 d. A caveat of this protocol is that the GnRH treatment 25 ± 3 d after AI may reduce estrus expression because many cows are expected to receive the treatment when a follicle capable of ovulating in response to a GnRH-induced LH surge is present on the ovaries. In cattle, a GnRH-induced LH surge causes an immediate reduction in estradiol production by the dominant follicle (Berndtson et al., 1995; Komar et al., 2001; Jo and Fortune, 2003), which can prevent the estradiol surge responsible for estrus behavior. Indeed, previous research has shown that fewer cows are detected in estrus when GnRH is given to cows 17 to 32 d after AI (Chebel et al., 2003; Mendonça et al., 2012; Bruno et al., 2014). Another inconvenience associated with the Resynch-25 protocol is that because the pregnancy status of cows is unknown 25 ± 3 d after AI, a substantial proportion of the cows that receive the first GnRH treatment are pregnant. These unnecessary treatments increase the cost and burden (i.e., labor and cow disruption) of the reproductive management program. Thus, removing the first GnRH treatment of the protocol may be an alternative strategy to reduce the interbreeding interval without disrupting re-insemination at estrus and eliminating the treatment of pregnant cows.

The first GnRH of the Resynch-25 protocol is meant to induce the emergence of a new follicular wave that will give rise to the ovulatory follicle and the formation of a new corpus luteum (**CL**) after ovulation (Pursley et al., 1995). Therefore, removing the first GnRH of the Resynch-25 protocol may reduce the synchrony of ovulation, fail to promote a proper endocrine environment for follicle growth, and result in poorer oocyte quality because of an extended period of dominance of the ovulatory follicle. Indeed, P/AI of cows that ovulate to the first GnRH treatment of Ovsynch-like protocols is greater than that of cows that fail to ovulate (Chebel et al., 2003; Galvão et al., 2007; Rutigliano et al., 2008; Bisinotto et al., 2010; Keskin et al., 2010; Giordano et al., 2012d). Nonetheless, the detrimental effects of lack of ovulation may be less relevant when initiating Resynch 25 ± 3 d after AI than when initiating the protocol at other intervals after AI (e.g., 32 ± 3 or 39 ± 3 d) or when a group of cows is initiated in the protocol at a wider range of days after AI. This is because at 32 ± 3 d after AI, when cows would receive the $PGF_{2\alpha}$ treatment of the Resynch-25 protocol, 60 to 85% of the nonpregnant cows present a functional CL (Giordano et al., 2012d, 2015; Bruno et al., 2014; Wijma et al., 2015) and almost all cows present an active follicle with potential to continue growing after a $PGF_{2\alpha}$ treatment (Wijma et al., 2015). Moreover, the ovulatory response to the first GnRH of the Resynch-25 protocol rarely exceeds ~40 to 60% (Giordano et al., 2012c; Lopes et al., 2013; Bruno et al., 2014), resulting in not all cows being properly synchronized 7 d later.

Another advantage of management strategies aimed at reducing the interbreeding interval of TAI services is that NPD is usually conducted through transrectal ultrasonography (Chebel et al., 2003; Fricke et al., 2003; Giordano et al., 2015). This method of pregnancy testing allows the determination of the ovarian status of cows with minimal effort. Anticipating that the use of the Resynch-25 protocol without the GnRH treatment 25 ± 3 d after AI could result in fewer cows at the appropriate stage of the estrous cycle at NPD; using treatments tailored to the ovarian status of cows could help maximize P/AI to TAI services (Giordano et al., 2016). For example, completing the Resynch-25 protocol only in cows that present a CL and a putative ovulatory follicle at NPD could result in reasonable P/AI. Conversely, cows without a CL or a putative ovulatory follicle (or both) may benefit from re-enrollment in a synchronization of ovulation treatment including progesterone (**P4**) supplementation (Bisinotto et al., 2015; Giordano et al., 2016) through improved synchrony of ovulation and a better endocrine environment before TAI.

Thus, our objectives were to evaluate the effect of removing the first GnRH of the Resynch-25 protocol on the pattern of re-insemination, ovarian responses before and after the protocol, and P/AI. We hypothesized that removing the GnRH treatment 25 ± 3 d after AI would result in re-insemination of more cows upon detection of estrus. A secondary hypothesis was that the expected reduction in P/AI for TAI services in cows that did not receive the GnRH treatment would not reduce the overall proportion of pregnant cows. We expected that cows pregnant after insemination at detected estrus would compensate for the reduced fertility to TAI services.

MATERIALS AND METHODS

This experiment was conducted from March 2015 to December of 2016 at the Dairy Unit of the Cornell Uni-