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Reproductive performance of dairy cows managed with a program aimed at increasing insemination of cows in estrus based on increased physical activity and fertility of timed artificial inseminations

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ABSTRACT

The objective of this study was to compare the reproductive performance of lactating dairy cows using a treatment (TRT) program for second and subsequent artificial insemination (AI) services aimed at (1) increasing AI upon estrus detection based on increased physical activity (AIAct) and (2) increasing fertility of timed AI (TAI) services for cows not AIAct through presynchronization of the estrous cycle and improved physiological milieu before TAI. Cows in the control (CON) group were managed with a program that combined AIAct and TAI after the Ovsynch protocol. After nonpregnancy diagnosis (NPD) by transrectal ultrasonography at 31 ± 3 d after AI, cows received the following treatments: (1) CON (n = 634), AIAct any time after a previous AI and resynchronization with the Ovsynch-56 protocol (GnRH-7 d-$PGF_{2\alpha}$-56 h-GnRH-16 h-TAI) 1 d after NPD, or (2) TRT (n = 616): cows with a corpus luteum (CL) ≥20 mm (TRT-CL) received a $PGF_{2\alpha}$ injection 1 d after NPD, whereas cows with no CL or a CL <20 mm (TRT-NoCL) received a GnRH injection 3 d after NPD. Cows in TRT-CL and TRT-NoCL not AIAct were enrolled in a 5-d Ovsynch + progesterone protocol (GnRH + controlled internal drug release-5 d-$PGF_{2\alpha}$ + controlled internal drug release removal-24 h-$PGF_{2\alpha}$ -32 h-GnRH-16 h-TAI) 9 and 7 d after the $PGF_{2\alpha}$ or GnRH injection, respectively, to receive TAI. The hazard of pregnancy up to 270 DIM was similar for cows in the CON and TRT group (hazard ratio = 1.07, 95% CI = 0.95 to 1.21), but it was affected by parity (primiparous greater than multiparous cows). Median days to pregnancy for the CON and TRT group were 111 and 110 d, respectively. When evaluated after 104 DIM (first time point at which cows were affected by the treatments), the hazard of pregnancy was similar for the CON and TRT group (hazard ratio = 1.15, 95% CI = 0.95 to 1.39). Based on this analysis, median days to pregnancy for the CON and TRT group were 161 and 178 d, respectively. Thus, in spite of increasing the proportion of cows AIAct (29 and 10% for TRT and CON), median days to insemination after NPD were greater for cows in the TRT (17 d) than the CON (10 d) group, which coupled with similar fertility to AIAct, and TAI failed to improve overall reproductive performance. A low proportion of cows with a CL at NPD (65.2%) and a poor response to $PGF_{2\alpha}$ may explain the poor estrus detection efficiency in the TRT group. We concluded that, when compared with a typical estrus detection and TAI program for cows failing to conceive to previous AI services, a program aimed at increasing the proportion of cows AIAct after NPD and fertility of TAI services increased the proportion of cows AIAct but failed to reduce days to pregnancy during lactation because of greater days to AI after NPD.

Key words: resynchronization, activity monitor, ovarian status, dairy cow

INTRODUCTION

Optimizing reproductive performance of lactating dairy cows is paramount to dairy farms because reproductive efficiency has a major effect on farm profitability (Britt, 1985; Giordano et al., 2012a, 2013a). Because up to 70% of cows may fail to conceive after previous AI services, maximizing fertility (Giordano et al., 2012b,c; Lopes et al., 2013) and minimizing the interval between inseminations (Fricke et al., 2003; Giordano et al., 2012b; Bruno et al., 2013; Chebel et al., 2013) for second and subsequent AI services remains a main objective of reproductive management programs (Giordano et al., 2011, 2013a). In this regard, initiating the Ovsynch protocol (Pursley et al., 1995) either before or after nonpregnancy diagnosis (**NPD**) is a common strategy used to resynchronize ovulation for timed AI (**TAI**) in lactating dairy cows (Fricke et al., 2003). This approach has been widely successful because it ensures the insemination of cows not detected

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in estrus after a previous AI service within a reasonable time frame. Nevertheless, the fertility of resynchronized services after Ovsynch is usually similar to that of cows AI after a detected estrus (Pursley et al., 1997a,b), precluding major improvements to overall reproductive performance. Also, most cows enrolled in Ovsynch receive TAI despite the fact that a high proportion of them are expected to be in the diestrus phase of the estrous cycle (Wijma et al., 2014) and could be induced to display estrus with a luteolytic dose of $PGF_{2\alpha}$. Such a strategy may be appealing to dairy farms that either prioritize insemination of cows based on a detected estrus or to farms that intend to maximize the use of technologies for estrus detection, such as automated activity monitoring (**AAM**) systems.

In this regard, some recent studies were conducted to explore strategies that promote insemination of cows in estrus through the use of a $PGF_{2\alpha}$ injection at or immediately after NPD (McArt et al., 2010; Bruno et al., 2013; Chebel et al., 2013). Assuming that fertility of AI services after induction of estrus with a $PGF_{2\alpha}$ injection is at least similar to that of cows receiving TAI after resynchronization with the Ovsynch protocol, such strategies have the potential to improve reproductive performance by reducing the interval between inseminations. Obviously, the success of the program is highly dependent on the ability of cows to display estrus and of farm personnel to identify cows in estrus. Indeed, some of the recent studies that compared $PGF_{2\alpha}$-based programs for induction of estrus reported that if $\geq$60% of cows treated with $PGF_{2\alpha}$ were inseminated in estrus and pregnancy per AI (**P/AI**) were ~35%, reproductive performance improved when compared with other resynchronization of ovulation strategies (Bruno et al., 2013; Chebel et al., 2013). A caveat of these studies was that rather than monitoring reproductive performance during an entire lactation, cows were only monitored from the time of NPD until their next AI (Bruno et al., 2013; Chebel et al., 2013) or from the time of enrollment at various stages of lactation until conception (McArt et al., 2010). This is relevant because to truly evaluate reproductive management programs that affect the interval between inseminations and P/AI, cows must be monitored during an entire lactation and remain in the same treatment during that lactation.

In addition, despite the benefit observed for the programs that increased insemination of cows in estrus in some of the previous studies (Bruno et al., 2013; Chebel et al., 2013), the potential benefits of $PGF_{2\alpha}$-based programs in combination with TAI protocols for cows not detected in estrus may have not been fully realized because the ovarian status of cows at the time of the $PGF_{2\alpha}$ treatment or at the beginning of the synchronization of ovulation protocol for TAI were not considered (Bruno et al., 2013; Chebel et al., 2013). Indeed, all cows received a $PGF_{2\alpha}$ injection after NPD and initiated the TAI protocol if not detected in estrus, regardless of the presence or absence of a corpus luteum (**CL**). This is important because cows without a functional CL do not respond to $PGF_{2\alpha}$ injections, whereas cows that lack a CL at the initiation of the Ovsynch protocol for resynchronization of ovulation present suboptimal fertility after TAI (Silva et al., 2007; Giordano et al., 2012c; Lopes et al., 2013). Therefore, the use of a $PGF_{2\alpha}$ injection only for cows with a functional CL and the use of presynchronization of the estrous cycle before the TAI protocol for cows without a functional CL would be expected to improve the efficacy and success of the program. In addition, cows that proceed to receive a TAI service despite having ample time and opportunities to be inseminated in estrus are likely to be anovular or present physiological limitations that preclude them for displaying estrus. For these problem cows the use of alternative synchronization of ovulation protocols that optimize the physiological milieu before TAI through reduced duration of the period of dominance of the ovulatory follicle (Bisinotto et al., 2010; Santos et al., 2010) and exogenous progesterone supplementation (Chebel et al., 2006; Bisinotto et al., 2010; Bilby et al., 2013) may be a viable strategy to improve P/AI.

Thus, the objective of our study was to evaluate a reproductive management strategy for nonpregnant cows after previous AI services aimed at increasing the proportion of cows inseminated upon estrus detection based on increased physical activity and P/AI of cows receiving TAI. To maximize the efficacy of this program, nonpregnant cows were assigned to treatments according to their ovarian status at the time of NPD. Furthermore, presynchronization of the estrous cycle and the 5-d Ovsynch protocol with progesterone (**P4**) supplementation was used to maximize the fertility of TAI services. This management approach was compared with a typical estrus detection and Ovsynch-based resynchronization program for cows not AI upon estrus detection based on increased physical activity (**AIAct**). We hypothesized that immediate insemination of cows after NPD combined with increased fertility to TAI services for cows not inseminated in estrus would result in improved reproductive performance of lactating dairy cows. Because reproductive efficiency of dairy herds is affected by the rate at which cows are inseminated and the fertility of AI services, our study was designed to evaluate the reproductive performance of cows during an entire lactation rather than the immediate period after NPD.