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Presynchronization of lactating dairy cows with $PGF_{2\alpha}$ and GnRH simultaneously, 7 days before Ovsynch have similar outcomes compared to G6G

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ABSTRACT

The overarching objective of this study was to develop an alternative strategy for first and greater services that will improve fertility in lactating dairy cows for dairy operations limited by labor or other logistical constraints that make it difficult to use Presynch-11, G6G, or Double-Ovsynch. Our overall hypothesis was that simplification of a Presynch program through the combination of $PGF_{2\alpha}$ and GnRH on the same day (PG + G), 7 days before the first GnRH of Ovsynch, would allow for similar ovulation and luteolysis rate and pregnancies per AI (P/AI) compared with G6G. Lactating dairy cows 58 to 64 days in milk (first service; n = 114), and cows diagnosed not pregnant 39 days after previous AI (second + service; n = 122) were blocked by parity and service and randomly assigned to control or PG + G. Control cows received G6G (n = 116) that consisted of $PGF_{2\alpha}$, 2-day GnRH, 6-day GnRH, 7-day $PGF_{2\alpha}$, 56-hour GnRH, and 16-hour AI. Treated cows (PG + G; n = 121) received $PGF_{2\alpha}$ and GnRH, 7-day GnRH, 7-day $PGF_{2\alpha}$, 56-hour GnRH, and 16-hour AI. All cows received a second $PGF_{2\alpha}$ 24 hours after the $PGF_{2\alpha}$ of Ovsynch. First service cows received AI between 76 and 82 days in milk and second + service received AI 57 days after previous AI. Pregnancies/AI (n = 230) were similar in controls compared with treated cows on Day 35 (57 vs. 50%; P = 0.27) and Day 49 (54 vs. 47%; P = 0.33), respectively. Percent of cows ovulating after GnRH of the presynchronization was greater (P = 0.002) for controls vs. treated (80 vs. 58%); however, ovulation after first GnRH of Ovsynch was similar (67 vs. 68%; P = 0.86). Serum concentrations of progesterone were similar (P = 0.78) at the time of first GnRH of Ovsynch for control and treated cows (2.22 vs. 2.14 ng/mL). However, serum progesterone at the time of $PGF_{2\alpha}$ of Ovsynch was greater (P = 0.002) for control cows compared with treated cows (5.75 vs. 4.64 ng/mL). In summary, administering both $PGF_{2\alpha}$ and GnRH on the same day, 7 days before the start of Ovsynch, appears to be a simple alternative that results in acceptable P/AI but potentially less progesterone during the growth of the ovulatory follicle.

1. Introduction

Fertility of lactating dairy cows treated with Ovsynch was enhanced when the first GnRH of the program induced ovulation [1]. This injection caused ovulation in approximately 60% of the lactating dairy cows when administered

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during random stages of the estrous cycle [1,2]. In comparison, ovulatory response was 80% or more when the first GnRH of Ovsynch was administered on Day 6 or 7 of the estrous cycle [1,2]. Administering GnRH on Day 6 or 7 of the estrous cycle compared with random stages resulted in greater percentages of cows with a new follicular wave, a new accessory CL, a functional CL at the $PGF_{2\alpha}$ of Ovsynch, and subsequent control of luteolysis [3]. In addition, initiating Ovsynch near Day 6 or 7 of the estrous cycle increases the chances for pregnancy after Ovsynch [1,2]. Three presynchronization strategies increased the chances for Ovsynch to be initiated near Day 6 or 7 of the estrous cycle (e.g., G6G [2,4,5], Double-Ovsynch [6–8], and Presynch-11 [9]) and increased pregnancy per artificial insemination (P/AI) compared with only Ovsynch or Presynch-14 or -12 and are now referred to as "fertility programs" [2,6–9].

Although fertility programs successfully improve reproductive performance, they are logistically challenging due the number of injections and the possibility for compliance problems. Farms that are restricted to administering injections on 2 days of the week due to labor constraints are limited to strategies that limit fertility outcomes (e.g., Ovsynch [10–12] and Presynch-14 or -12/Ovsynch [13,14]). Creating a presynchronization strategy that can be administered on 2 days of the week with fertility outcomes greater that Ovsynch or Presynch-14/Ovsynch would be advantageous for dairy producers.

Stevens et al. (1993) [15] compared the effect of the administering $PGF_{2\alpha}$ and GnRH simultaneously vs. $PGF_{2\alpha}$ with saline in lactating dairy cows on Day 8 or 10 of the estrous cycle to determine the effect of luteolysis. Administration of $PGF_{2\alpha}$ and GnRH simultaneously did not affect the luteolytic actions of $PGF_{2\alpha}$. Peters and Pursley (2003) [16] tested the effect of combining the final GnRH of Ovsynch with the $PGF_{2\alpha}$ of Ovsynch. There was no effect on luteolysis or ovulation rate compared with administering GnRH 36 hours after $PGF_{2\alpha}$. Yet, P/AI was decreased, and there was a trend for greater percentage of short cycles when the final GnRH was combined with the $PGF_{2\alpha}$ of Ovsynch.

The objective of this study was to develop a presynchronization strategy for Ovsynch that would limit treatments of GnRH and $PGF_{2\alpha}$ to 2 days per week that would produce fertility outcomes similar to that of G6G/Ovsynch. The hypothesis was combining $PGF_{2\alpha}$ and GnRH in a presynchronization strategy 1 week before Ovsynch would result in similar luteal and follicular outcomes after Ovsynch treatments, and P/AI compared with G6G/Ovsynch.

2. Materials and methods

2.1. Cows, housing, feeding, and products

This experiment was conducted from May to August 2013 in a commercial dairy farm (Nobis Dairy Farm, St. Johns, MI, USA) that milked approximately 900 dairy cows 3 times daily. Herd milk production during this period averaged approximately 40 kg/cow/d. Cows were housed in free stall barns, fed a total mixed ration once daily, and had free access to feed and water. The total mixed ration consisted of corn, wheat and alfalfa silages, and corn-soybean meal-based concentrates formulated to meet or exceed nutrient recommendations for lactating dairy cows (NRC, 2001).

All treatments of $PGF_{2\alpha}$ (25-mg dinoprost tromethamine, Lutalyse, Zoetis) and GnRH (86-μg gonadorelin acetate, 2 mL of Fertagyl, Merck Animal Health) were administered with single dose syringes in semimembranosus or semitendinosus muscles of cows by trained personnel from our laboratory. The Institutional Animal Care and Use Committee at Michigan State University approved all animal handling and procedures described in this article.

2.2. Experimental design

Healthy Holstein lactating dairy cows between 58 and 64 days in milk (DIM; first service; n = 114) and cows diagnosed not pregnant 39 days after previous AI (second and greater service; n = 122) were blocked by parity and service and randomly assigned to control (G6G [2]; n = 116) or treatment (PG + G; n = 121; see Fig. 1). Controls were treated with $PGF_{2\alpha}$ followed in 2 days with GnRH, then 6 days later Ovsynch [10] (GnRH, 7-day $PGF_{2\alpha}$, 24-hour $PGF_{2\alpha}$, 32-hour-GnRH, and 16-hour AI) was initiated. Treatment cows received $PGF_{2\alpha}$ and GnRH in different sites seconds apart 7 days before the first GnRH of Ovsynch. All cows received timed-AI 16 hours after the final GnRH of Ovsynch at 76 to 82 DIM (first service) or 57 days after previous AI (second or greater services). Artificial insemination was performed by three AI technicians blind to treatments and using commercial semen from multiple sires purchased by the farm. Only one sire was used to inseminate weekly cohorts of cows; therefore, treatments were not confounded by an effect of service sire.

2.3. Ovarian ultrasonography, pregnancy diagnoses, and blood samples

Ovarian structures (follicles and corpora lutea) were mapped and measured at time of the presynchrony GnRH and first GnRH of Ovsynch as previously described by Martins et al. [17] using a MicroMaxx Sonosite ultrasound machine with a linear array transducer using 10-MHz frequency (Sonosite Inc., Bothell, WA, USA). Ovulation to each GnRH injection was determined by the disappearance of one dominant or codominant follicles (≥10 mm) previously visualized at the day of GnRH injection and the presence of a new CL 2 days later. Cows without a CL 2 days after the presynchrony GnRH but had a CL at the time of first GnRH of Ovsynch were considered to have ovulated during the 5-day period before the first GnRH of Ovsynch.

Diagnoses of pregnancy were conducted by farm veterinarians blind to treatment performing transrectal ultrasonography with an Ibex Pro ultrasound machine with a 5 to 8-MHz linear array transducer (E.I. Medical Imaging, Loveland, CO, USA) on Day 35 and 49 after AI. Pregnancy was confirmed by embryo presence and heartbeat.

Blood samples were collected by coccygeal venipuncture using Vacutainer tubes without anticoagulant (BD Vacutainer, Franklin Lakes, NJ, USA) on the day of presynchronization $PGF_{2\alpha}$ (n = 235) and 2 days later (n = 236)