Theriogenology 81 (2014) 797–804

Contents lists available at ScienceDirect

Theriogenology

journal homepage: www.theriojournal.com

Effect of the first GnRH and two doses of PGF2α in a 5-day progesterone-based CO-Synch protocol on heifer pregnancy

R.K. Kasimanickam [a,*], P. Firth [a], G.M. Schuenemann [b], B.K. Whitlock [c], J.M. Gay [a], D.A. Moore [a], J.B. Hall [d], W.D. Whittier [e]

[a] Department of Veterinary Clinical Sciences, Washington State University, Pullman, Washington, USA
[b] Department of Veterinary Preventive Medicine, The Ohio State University, Columbus, Ohio, USA
[c] Department of Large Animal Clinical Sciences, University of Tennessee, Knoxville, Tennessee, USA
[d] Nancy M. Cummings Research, Extension and Education Center, University of Idaho, Carmen, Idaho, USA
[e] Department of Large Animal Clinical Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA

ARTICLE INFO

Article history:
Received 9 October 2013
Received in revised form 23 December 2013
Accepted 26 December 2013

Keywords:
Beef heifer
Dairy heifer
5-Day CIDR
Estrous synchronization
PGF2α dose
Artificial insemination pregnancy

ABSTRACT

The objectives were (1) to determine the effects of gonadorelin hydrochloride (GnRH) injection at controlled internal drug release (CIDR) insertion on Day 0 and the number of PGF2α doses at CIDR removal on Day 5 in a 5-day CO-Synch + CIDR program on pregnancy rate (PR) to artificial insemination (AI) in heifers; (2) to examine how the effect of systemic concentration of progesterone and size of follicles influenced treatment outcome. Angus cross beef heifers ($n = 1018$) at eight locations and Holstein dairy heifers ($n = 1137$) at 15 locations were included in this study. On Day 0, heifers were body condition scored (BCS), and received a CIDR. Within farms, heifers were randomly divided into two groups: at the time of CIDR insertion, the GnRH group received 100 μg of GnRH and No-GnRH group received none. On Day 5, all heifers received 25 mg of PGF2α at the time of CIDR insert removal. The GnRH and No-GnRH groups were further divided into 1PGF and 2PGF groups. The heifers in 2PGF group received a second dose of PGF2α 6 hours after the administration of the first dose. Beef heifers underwent AI at 56 hours and dairy heifers at 72 hours after CIDR removal and received 100 μg of GnRH at the time of AI. Pregnancy was determined approximately at 35 and/or 70 days after AI. Controlling for herd effect ($P < 0.06$), the treatments had significant effect on AI pregnancy in beef heifers ($P = 0.03$). The AI-PRs were 50.3%, 50.2%, 59.7%, and 58.3% for No-GnRH + PGF + GnRH, No-GnRH + 2PGF + GnRH, GnRH + PGF + GnRH, and GnRH + 2PGF + GnRH groups, respectively. The AI-PRs were ranged from 50% to 62.4% between herds. Controlling for herd effects ($P < 0.01$) and for BCS ($P < 0.05$), the AI pregnancy was not different among the treatment groups in dairy heifers ($P > 0.05$). The AI-PRs were 51.2%, 51.9%, 53.9%, and 54.5% for No-GnRH + PGF + GnRH, No-GnRH + 2PGF + GnRH, GnRH + PGF + GnRH, and GnRH + 2PGF + GnRH groups, respectively. The AI-PR varied among locations from 48.3% to 75.0%. The AI-PR was 43.5%, 50.4%, and 64.2% for 2.5 or less, 2.75 to 3.5, and greater than 3.5 BCS categories. Numerically higher AI-PRs were observed in beef and dairy heifers that exhibited high progesterone concentrations at the time of CIDR insertion (>1 ng/mL, with a CL). In addition, numerically higher AI-PRs were also observed in heifers receiving CIDR + GnRH with both high and low progesterone concentration (<1 ng/mL) initially compared with heifers receiving a CIDR only with low progesterone. In dairy heifers, there were no differences in the pregnancy loss between 35 and 70 days post-AI among the treatment groups ($P > 0.1$). In conclusion, GnRH administration at the time of CIDR insertion is

* Corresponding author. Tel.: +1 509 335 6060; fax: +1 509 335 0880.
E-mail address: ramkasi@vetmed.wsu.edu (R.K. Kasimanickam).

0093-691X/$ – see front matter
http://dx.doi.org/10.1016/j.theriogenology.2013.12.023

advantageous in beef heifers, but not in dairy heifers, to improve AI-PR in the 5-day CIDR + CO-Synch protocol. In addition, in this study, both dairy heifers that received either one or two PGF2α doses at CIDR removal resulted in similar AI-PR in this study regardless of whether they received GnRH at CIDR insertion.

1. Introduction

Artificial insemination (AI) and estrus synchronization are strategies available for beef producers to integrate superior genetics from AI sires into their herds. Although there are many benefits to exploit, the use of AI in beef herds across the United States still remains low [1]. Estrous synchronization protocols that result in highly synchronized ovulation and increased pregnancy in treated cattle with reduced time and labor costs will make AI a feasible option and may increase the adoption among beef producers [2].

The CO-Synch protocol includes administration of GnRH, followed by one or two doses of PGF2α 5 or 7 days later, and AI at 56 to 72 hours later with a concurrent GnRH treatment. In heifers, the first GnRH injection administered at random stages of cycle increases the probability of ovulation [3]. Such responses improve synchrony of the estrous cycle by initiating of new follicular wave, developing of a follicle under high systemic progesterone concentrations, and limiting the follicle dominance duration and assuring the presence of an ovulatory follicle at the time of AI, all of which are important factors affecting fertility [2]. Addition of progesterone supplementation between GnRH and PGF2α improves synchronization without prolonging a timed-AI (TAI) program. The goal of progesterone supplementation by an intravaginal device between the GnRH and the PGF2α injections is to prevent premature estrus, an LH surge, and ovulation in heifers with no endogenous progesterone. Short-term progestin treatments as a component of 5-day CO-Synch with a controlled internal drug release (CIDR) insert have an acceptable AI pregnancy rate (AI-PR) when inseminated at 56 to 72 hours after CIDR withdrawal [4–7]. Although, reducing the interval from initial GnRH to induction of luteolysis from 7 to 5 days increased AI-PR [4], two injections of PGF2α on Day 5 after the first GnRH were needed to reliably induce CL regression [4–7]. The second PGF2α injection is important because any new CL that forms because of ovulation after the first GnRH injection may not consistently regress after a single PGF2α injection on Day 5 [5–7]. Although the first GnRH injection is required to synchronize new follicular wave initiation, administration of GnRH irrespective of estrous cycle stage resulted in ovulation rate of only 27% to 35% [8]. Although, Stevenson, et al. [9] increased ovulation by using the first GnRH injection in the TAI program in presynchronized heifers, this increase did not influence AI pregnancy or pregnancy loss rates. Eliminating the first GnRH injection may not be affecting the pregnancy rate in a 5-day CO-Synch + CIDR protocol. In addition, eliminating the first GnRH injection may also eliminate the need for the second dose of PGF2α on Day 5 to regress any newly formed CLs. We hypothesize that in heifers, eliminating the first GnRH injection at CIDR insertion on Day 0 will also eliminate the need for the second PGF2α dose at CIDR removal on Day 5 without affecting AI-PR.

The objectives were (1) to determine the effect of GnRH at CIDR insertion on Day 0 and two doses of PGF2α at CIDR removal on Day 5 in a 5-day CO-Synch + CIDR program on AI-PR. The hypothesis is that the administration of GnRH at CIDR insertion will require a second dose of PGF2α at CIDR removal; (2) to examine how the effect of systemic concentration of progesterone and size of follicles influenced treatment outcome.

2. Materials and methods

2.1. Animals and treatments

Angus cross beef heifers (n = 1018) at eight locations and Holstein dairy heifers (n = 1137) at 15 locations were body condition scored [BCS; Beef: from one (emaciated) to nine (obese); Dairy: from one (emaciated) to five (obese)], and received a CIDR (Eazi-Breed CIDR Cattle Insert; Pfizer Animal Health, New York, NY, USA) insert intravaginally. Within farms, heifers were randomly divided (using computer-generated randomization numbers or using odd or even ear-tag numbers) into GnRH and No-GnRH groups. The GnRH group received 100 μg of gonadorelin hydrochloride (GnRH, Factrel, 2 mL, intramuscularly [IM]; Pfizer Animal Health) and the No-GnRH group received no treatment at the time of CIDR insertion. All heifers received 25 mg of dinoprost tromethamine (PGF2α, Lutalyse, 5 mL, IM; Pfizer Animal Health) at the time of CIDR insert removal on Day 5. The GnRH and No-GnRH groups were further divided (using computer-generated randomization numbers or using odd or even ear-tag numbers) into 1PGF and 2PGF groups. The heifers in 2PGF group received a second dose of PGF2α 6 hours after the first dose. The beef heifers were inseminated at 56 hours and the dairy heifers at 72 hours after CIDR removal and received 100 μg of GnRH at the time of insemination. The numbers of dairy and beef heifers assigned to the four treatment groups are given in Table 1.

The AI technicians and AI sires differed among locations. The AI sires were selected and assigned to heifers based on sire traits and to avoid inbreeding. A schematic representation of the synchronization protocol is shown in Figure 1. The timing of CIDR insertion, CIDR insert withdrawal, interval to the second PGF2α injection, and TAI was recorded for each animal. Two weeks later, intact Angus bulls were placed with beef heifers (bull-to-cow ratio, approximately 1:30–1:40) across treatments for the rest of the 60 to 70 days of breeding season. Dairy heifers that were observed in estrus after insemination and/or found as nonpregnant at pregnancy diagnosis were according to that farm's breeding protocols.