Animal Reproduction Science 144 (2014) 14–21

Contents lists available at ScienceDirect

Animal Reproduction Science

journal homepage: www.elsevier.com/locate/anireprosci

Effects of administration of gonadotropin-releasing hormone at artificial insemination on conception rates in dairy cows

R.W. Shephard[a,c,*], J.M. Morton[b], S.T. Norman[c]

[a] Herd Health Pty Ltd, 65 Beet Road, Maffra, VIC 3860, Australia
[b] Jemora Pty Ltd, Geelong, VIC 3220, Australia
[c] Charles Sturt University School of Animal and Veterinary Sciences, Graham Centre for Agricultural Innovation, Wagga Wagga, NSW 2678, Australia

ARTICLE INFO

Article history:
Received 9 August 2013
Received in revised form 5 November 2013
Accepted 8 November 2013
Available online 21 November 2013

Keywords:
Artificial insemination
Conception
Dairy
Gonadotropin-releasing hormone
Luteinizing hormone

ABSTRACT

A controlled trial investigating the effect on conception of administration of 250 μg of gonadotropin-releasing hormone (GnRH) at artificial insemination (AI) in dairy cows in seasonal or split calving herds was conducted. Time of detection of estrus, body condition, extent of estrous expression, treatment, breed, age and milk production from the most recent herd test of the current lactation was recorded. Cows were tested for pregnancy with fetal aging between 35 and 135 days after AI. Sixteen herds provided 2344 spring-calved cows and 3007 inseminations. Logistic regression adjusting for clustering at herd level was used to examine the effect of treatment for first (2344) and second (579) inseminations separately. For first AI, treatment significantly improved conception rate in cows with milk protein concentrations of 3.75% or greater and for cows with milk protein concentrations between 3.00% and 3.50% and less than 40 days calved; increased conception rate from 41.2% to 53.4%. Treatment reduced conception rates in cows with milk protein concentrations of 2.75% or less. Treating only cows identified as responding positively to treatment (11% of all study cows) was estimated to increase first service conception rate in herds from 48.1% to 49.4%. There was no significant effect of treatment on conception to second AI, nor any significant interactions. These findings indicate that GnRH at AI should be limited to the sub-group cows most likely to respond. The positive effect of GnRH at AI may be mediated through improved oocyte maturation and/or improved luteal function, rather than by reducing AI-to-ovulation intervals.

1. Introduction

Conception rates in dairy cows have decreased over the last three decades associated with physiological and endocrine changes (Butler, 2000; Wiltbank et al., 2006), and with increases in genetic merit, altered management practices and increased milk yields. The uncoupling of the somatotropic axis from the gonadotropic axis in high-producing dairy cows, especially in early lactation, allows the cow to partition nutrients and mobilize body tissue for milk production; this partitioning, however, can be to the detriment of reproduction (Chagas et al., 2007; Lucy, 2001). In addition, hypothalamo-pituitary-gonadal axis functions may be directly suppressed in the postpartum period by negative energy balance (Butler, 2000) and endogenous opioids (Williams, 1990). Importantly, high-producing cows can metabolize sex-steroids more rapidly in comparison to cows operating at a lesser metabolic rate (Wiltbank et al., 2006). All of these influences can result in reduced gonadotropin release during the pre-ovulatory

* Corresponding author at: Herd Health Pty Ltd, 65 Beet Road, Maffra, VIC 3860, Australia. Tel.: +61 3 5147 0307.
E-mail address: richard@herdhealth.com.au (R.W. Shephard).

0378-4320/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.anireprosci.2013.11.004

period, providing a mechanism for reduced estrous expression, delayed ovarian follicle maturation, delayed oocyte maturation, delayed ovulation relative to onset of estrus and compromised corpus luteum function.

GnRH analogs have been administered around the time of insemination to enhance oocyte maturation and induce ovulation (Mee et al., 1990; Thatcher et al., 1993), but effects on conception rates are inconsistent. A meta-analysis conducted about two decades ago of 40 trials reported in 27 papers, GnRH or analogs at the time of insemination on average increased conception rate. Across all studies, pooled treatment resulted in a 12.5% increase in probability of pregnancy and this increased to 22.5% for repeat-breeder cows (cows with three or more AIs). Responses to GnRH were greater with larger doses (>250 μg rather than <125 μg) (Morgan and Lean, 1993). The authors recommended further research to better characterize the population of cows likely to respond favorably to GnRH administration at AI. If the subset of cows most likely to respond positively to GnRH administration could be identified at AI, treatment could be restricted to these cows, potentially increasing the cost-benefit ratio of GnRH treatment.

The current study evaluated the effect of administration of GnRH at AI on conception rate in commercial dairy herds, and hypothesized interactions between treatment and potential risk factors for uncoupling of the somatotropic and gonadotropic axes.

2. Materials and methods

2.1. Cattle management

A controlled trial was undertaken in spring 2012 in 16 seasonal or split calving dairy herds in the Macalister Irrigation Area, East Gippsland, Victoria, Australia. Seasonal and split calving systems predominate in south-eastern Australia. Seasonal systems use a restricted breeding period characterized by set dates for the start and cessation of matings for all cows in the herd. Inseminations and natural services are withheld from all cows until the start of mating (the mating start date). From mating start date onwards all estrus cows are inseminated regardless of their time since calving. Thus, each cow's calving to mating start date interval is her voluntary waiting period. Accordingly, voluntary waiting periods vary between cows within herds. The mating period typically begins in most herds with a period in which only AI is used, followed by a period when bulls are run with the milking herd. All cows detected in estrus during the AI period are inseminated. To ensure sufficient AI-sired heifer replacement calves are born each year approximately half of the cows must become pregnant to AI. This requires an AI period of between 4 and 8 weeks in most herds. Split-calving systems have more than one calving and mating periods (typically two calving periods, one each in spring and autumn). Cows calving in each group are managed as described above for seasonal calving herds, except that cows failing to conceive during the first mating period after their calving may be inseminated at observed estrus or mated by bulls during the next breeding period.

Herds were selected by convenience sampling from those that were seasonal (spring) calving or split calving with a spring calving group, had a numerical cow identification system, used computerized herd records, and, for the spring mating period, planned to use professional AI technicians with all inseminations each day performed at one time immediately after either the morning or afternoon milking, to undertake milk recording, and to use early pregnancy diagnosis with fetal aging, and the farm manager was willing to monitor the herd at least twice daily for cows in estrus and record time of first detection of estrus.

To be eligible, cows were required to have clear and unique numerical identification, to have calved either during the spring calving period in 2012 or, in split calving herds, during the previous autumn calving period in 2012 but not have conceived during the autumn mating period, and have no recorded reproductive disease or treatment in the 60 days preceding mating start date in spring 2012. Cows treated with either progesterone and/or GnRH between calving and first AI were ineligible for enrolment. All eligible cows within study herds were enrolled in the study.

Inseminations at estrus events where the cow received AI on consecutive days were ineligible for enrolment. Estrus periods induced using prostaglandin alone were eligible. All other inseminations of study cows within each herd's AI period were eligible and enrolled for the study.

The unit of allocation was the individual cow. Each cow was allocated into one of two groups based on whether the last digit of their identification number was an odd or even number. One of these groups was then randomly selected to receive treatment, the remaining group was the control group; cows with odd identification numbers were assigned to the treatment group. Assignment to treatment was at the cow level to ensure that any cow failing to conceive to first AI and subsequently returning to estrus would receive the same treatment for all subsequent AIs.

From each herd's mating start date, farm staff recorded the time of first detection of estrus for each insemination. Cows first detected in estrus at or immediately before the milking preceding insemination were categorized as "early AI". Cows first detected in estrus at or before the preceding milking were categorized as "late AI". The extent of estrous expression was recorded at the time of AI using a 1–3 scale (1 – weak, 2 – normal, 3 – strong) based on the farm staff's assessment of the cow's estrous behavior. Four experienced professional technicians performed all artificial inseminations across the 16 herds.

Cows in the treatment group received 250 μg gonadorelin (Ovurelin; Bayer Australia Ltd. (Animal Health); Pymble NSW) by deep intramuscular injection administered at the time of AI. Cows in the control group were not treated; no placebo treatment was used. Treatment status of all cows at each insemination was individually recorded. The AI technician classified the body condition of each cow as either below average for the district, or at or above average for the district. Herd, cow, and AI technician identities, and date and time of the insemination visit were also recorded. Cow breed, date of birth, most recent calving date, AI number for each cow for the study mating period, and milk production data (24-h milk volume and fat and protein