Research article

JOURNAL OF VETERINARY CLINICAL RESEARCH

Issue 14, Vol 2
Autumn and Winter 2023

Improving Reproductive Performance in Dairy Cattle Herds through Pharmacological Intervention in Estrous Cycles

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Article received: October 29, 2023, final acceptance: December 23, 2023

Home Message:

- GnRH synchronizes new wave emergence only when administered in the presence of a functional dominant follicle.
- Presynchronization protocols that induce the production of a CL before initiation of the Ovsynch protocol are likely to improve fertility in anovular cows.
- Estradiol is usually administered at the initiation of the protocol, concurrent with the insertion of a progestin-releasing device to induce new wave emergence regardless of the phases (i.e. growing, static, or regressing phases)
- Progesterone supplementation between the first GnRH and $PGF2\alpha$ for seven days in Ovsynch protocols enhances estrus/ovulation synchrony and conception in anestrous cows and heifers and in cows with cystic ovaries.
- The utilization of eCG in breeding protocols improves reproductive efficiency in seasonally calving, anestrous cattle.

Keywords: Dairy Cattle, Reproductive Performance, Pharmacological Intervention

Introduction:

Reproductive competence is a major aspect affecting the production and economic success of dairy and beef cattle operations. For herds using

artificial insemination (AI), detection of estrus (submission rate) and calving rate are the two major determinants of inter-calving interval. The economic consequences of low efficiency and poor accuracy in the detection of estrus are the main reasons why cattle reproduction research programs focus on developing practical breeding protocols. The important requirements for any effective estrous synchronization protocol are predictable and high estrus and ovulation responses during a specified interval, followed by a higher pregnancy rate to a single insemination carried out in a predetermined time (1).

Induction of new follicle wave emergence:

The induction of new follicle wave emergence using exogenous hormonal treatments requires (2):

1: consistent termination of an existing follicle wave

2: predictable induction of a transient increase in FSH to induce the emergence of a new wave

3: normal growth of the dominant follicle after selection.

Use of GnRH:

Functional removal of the dominant follicle or cohort follicles by inducing either ovulation or luteinization using exogenously induced gonadotropin release is a practical approach for the induction of a new follicular wave. GnRH synchronizes new wave emergence only when administered in the presence of a functional dominant follicle (3).

Use of estradiol:

In estrous synchronization protocols, estradiol is usually administered at the initiation of the protocol, concurrent with the insertion of a progestin-releasing device. The combination of estradiol and progestin was used to determine if suppression of follicle growth would induce new wave emergence at a consistent interval after treatment regardless of the phases (i.e. growing, static, or regressing phases) of follicle development at which treatment was initiated. The use of estradiol-17β in progestin-implanted cattle was followed consistently by the emergence of a new wave, on average 4.5 days later (3).

Controlling the Lifespan of the Corpus Luteum:

The injection of PGF2α causes immediate regression of the CL after approximately day 5 of the estrous cycle: progesterone concentrations decline rapidly to basal levels within 24 hours, and LH pulse frequency increases, causing a significant increase in estradiol from the dominant follicle and the induction of estrus and ovulation.

Induction of ovulation:

A single injection of GnRH combined with 48-hour calf removal also induces ovulation in beef cows. A single injection of human chorionic gonadotropin (hCG) 500–3000IU induces ovulation in dairy and beef cows. Further, because of its positive feedback effect on the surges of FSH and LH, exogenous estradiol has been used to induce ovulation in cows.

Synchronization of Ovulation:

Synchronization of ovulation involves a combination of GnRH and PGF2α, with or without progesterone supplementation during the course of the treatment. These protocols facilitate insemination at a predetermined (fixed) time without the need for the detection of estrus.

GnRH-PG-GnRH Protocols:

The protocol involves an injection of GnRH at a random stage of the estrous cycle, followed by an injection of PGF2α seven days later. A second injection of GnRH follows the PGF2α injection for 48 hours. The method is designed to be used with timed insemination 16 (range 8–24) hours after the last GnRH injection (2).

Presynch Protocol:

It is evident that the stage of the estrous cycle at initiation of the Ovsynch protocol influences the success of synchrony of the follicular wave. Initiation of the protocol too early (e.g. one to four days after ovulation) or too late (e.g. 13–20 days after ovulation) reduced synchrony. Furthermore, if the first GnRH treatment was given when the dominant follicle was pre- or post-dominance, ovulation may not occur and synchronous emergence of a new follicular wave will not occur. An alternative is to ensure that a viable growing dominant follicle is present at the time of GnRH treatment. Cattle will respond most consistently when GnRH is given between days 5 and 12 of the estrous cycle. Another protocol, designated G6G, starts with an

injection of PGF2α, which is intended to induce luteolysis of functional corpora lutea, and a GnRH injection two days later, intended to induce an ovulation. Collectively, the two injections of G6G are intended to initiate a new estrous cycle. The Ovsynch is scheduled to start six days after the GnRH injection in order for the cow to be on day 6 of a new estrous cycle and very likely to have a functional dominant follicle, capable of ovulating in response to the first GnRH of Ovsynch. Further, the use of two injections of PGF2α to presynchronize estrous cycles was not effective for anovular cows Presynchronization protocols that induce the production of a CL before initiation of the Ovsynch protocol are likely to improve fertility in anovular cows. A protocol that involves induction of cyclicity in anovular dairy cows is the use of an Ovsynch protocol to presynchronize and induce cyclicity in cows before the use of a breeding Ovsynch protocol, termed Double-Ovsynch (4).

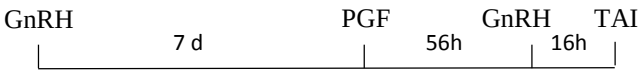
Addition of Progesterone in GnRH-PG-GnRH Protocol:

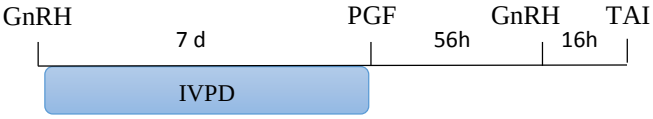
Progesterone supplementation between the first GnRH and PGF2α for seven days in Ovsynch (Figure 1) and CO-Synch protocols enhance estrus/ovulation synchrony and conception in cows and heifers. These protocols are advantageous in anestrous cows and heifers and in cows with cystic ovaries.

Addition of Equine Chorionic Gonadotrophin:

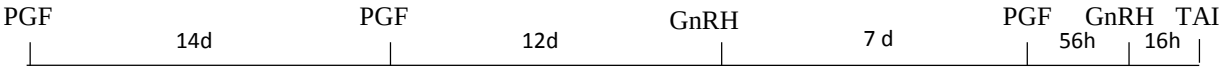
Equine chorionic gonadotropin (eCG) is added to the synchronization treatment protocols as a means of increasing follicular development. The utilization of eCG in breeding protocols improves reproductive efficiency in seasonally calving, anestrous cattle. The addition of 400IU eCG at progesterone device removal resulted in 74% pregnancy in a 49-day breeding season. The inclusion of eCG in 6 or 7 days of the GPG/P4 protocol increased pregnancy in 28-day breeding (58.6 vs 52.3%) and decreased median days to conception in anestrous dairy cows (5).

Ovsynch protocols with or without progesterone





Presynchronization with PGF, no progesterone



Presynchronization with GnRH + PGF, no progesterone

Conclusion:

Estrous and ovulation synchronization protocols now exist to successfully

achieve acceptable fertility after applying insemination at observed estrus or at a predetermined time without estrus detection. Further, success is achieved in females that may not be cycling at the onset of treatment. Initiation of fertile ovulation in peripubertal heifers and acyclic cows is likely the primary manner in which producers may improve fertility in response to estrous synchronization and timed AI protocols. The use of IVPD-based synchronization before the insemination of cows and heifers enhances fertility more effectively than other hormonal synchronization interventions. The development of synchronization protocols that reduce the factors associated with reducing synchrony of estrus and/or ovulation will provide cattle producers with efficient and effective tools for improving genetics in their operations. Since location, pasture difference, diet, breed composition, body condition, postpartum interval, climate, and geographic location may affect the success of synchronization protocols, these variables should be kept in mind to enhance the success of synchronization.

References:

1.Kasimanickam, R. (2021) Pharmacological Intervention of Estrous Cycles. In: Bovine Reproduction, 2e. Richard M. Hopper: Wiley

2.Twagiramungu, H., Guilbault, L., and Dufour, J. (1995). Synchronization of ovarian follicular waves with gonadotrophin-releasing hormone agonist to increase the precision of estrus in cattle: a review. *J. Anim. Sci.* 73: 3141–3151.

3.Bo, G., Adams, G., Caccia, M. et al. (1995). Ovarian follicular wave emergence after treatment with progestogen and estradiol in cattle. *Anim. Reprod. Sci.* 39: 193–204.

4. Herlihy, M., Giordano, J., Souza, A. et al. (2012). Presynchronization with double-Ovsynch improves fertility at first postpartum artificial insemination in lactating dairy cows. *J. Dairy Sci.* 95: 7003–7014.

5.Bryan, M., Bó, G., Mapletoft, R., and Emslie, F. (2013). The use of equine chorionic gonadotropin in the treatment of anestrous dairy cows in gonadotropin-releasing hormone/progesterone protocols of 6 or 7 days. *J. Dairy Sci.* 96: 122–131.