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Effect of time interval between prostaglandin $F_{2\alpha}$ and GnRH treatments on occurrence of short estrous cycles in cyclic dairy heifers and cows

M.H. Rantala *, T. Katila, J. Taponen

Department of Production Animal Medicine, Faculty of Veterinary Medicine, University of Helsinki, Pohjoinen pikatie 800, FI-04920 Saarentaus, Finland

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Abstract

Prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) and GnRH treatments, when administered 24 h apart during early diestrus, cause short estrous cycles in some dairy cows and heifers [J. Taponen, M. Kulcsar, T. Katila, L. Katai, G. Huszenicza, H. Rodriguez-Martinez, Short estrous cycles and estrous signs after premature ovulations induced with cloprostenol and gonadotropin-releasing hormone in cyclic dairy cows, Theriogenology 2002; 58, 1291–1302]. We investigated the effect of a time interval between $PGF_{2\alpha}$ and GnRH administration on the appearance of short cycles. Estrus was induced in heifers with dexcloprostenol. A second luteolysis was induced similarly on day 7 after ovulation, and either 0 (T0) or 24 h (T24) later an injection of GnRH (0.1 mg of gonadorelin) was administered. We monitored ovarian activity with progesterone analyses from blood plasma samples and with ultrasonography. Fourteen cases (12 in T0 and 2 in T24) were excluded due to either incomplete luteolysis (2 cases) or unresponsiveness to GnRH (10 in T0 and 2 in T24). Short estrous cycles (7 to 8 d) were detected in 11/11 and 8/17 heifers in groups T0 and T24, respectively, with a significant difference in the incidence of short cycles ($P < 0.01$). In Experiment 2, estrus was induced in cows on day 8 (D8, $n = 18$), 9 (D9, $n = 5$), or 10 (D10, $n = 3$) with cloprostenol and gonadorelin administered simultaneously. Daily milk samples were collected for progesterone analysis until subsequent estrus was detected and ovarian ultrasound examinations were performed. Eight cases had to be excluded due to unresponsiveness to GnRH, leaving 18 cases eligible for the study. Short estrous cycles (7–12 d) were detected in 14/18 cows. In conclusion, shortening the time interval between $PGF_{2\alpha}$ and GnRH treatments increased the incidence of short estrous cycles and appeared to increase the proportion of females unresponsive to GnRH treatment.

Keywords: Short estrous cycle; Bovine; Prostaglandin $F_{2\alpha}$; GnRH; Gonadorelin

1. Introduction

When postpartum cows, or pubertal heifers, begin ovarian cyclicity after an anestrous period, the first luteal phase is often short and is thus known as a physiologic short estrous cycle [for reviews, see [2–4]]. Prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) and gonadotropin-releasing hormone (GnRH) treatments given in sufficiently close succession to cyclic animals during the luteal phase may also lead to short cycles and affect fertility if animals are inseminated during estrus preceding those cycles [1,5,6].

We recently elucidated the mechanisms behind $PGF_{2\alpha}$- and GnRH-induced short estrous cycles. Taponen et al. [7] showed that the release of $PGF_{2\alpha}$

* Corresponding author at: Saari Unit, Pohjoinen pikatie 800, 04920 Saarentaus, Finland. Tel.: +358 19 5295 305; fax: +358 19 6851 181.
E-mail address: mari.h.rantala@helsinki.fi (M.H. Rantala).

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closely resembles the release during normal spontaneous luteolysis and results in premature luteal regression. The GnRH dose used (0.1 mg vs. 0.5 mg of gonadorelin) and the subsequent LH release failed to explain the occurrence of induced short cycles [8], as did the size of the ovulatory follicle in predicting the occurrence of short cycles [8]. In our previous studies, the incidence of induced short cycles was 33% in cyclic dairy cows [1] and 25–76% in cyclic dairy heifers [7,8]. In all the above-mentioned experiments, the time interval between $PGF_{2\alpha}$ and GnRH was 24 h.

Previously, Stevens et al. [9] administered $PGF_{2\alpha}$ and GnRH simultaneously to diestrous animals and noticed that all of them exhibited signs of a new estrus 7–13 d after the treatment. Pursley et al. [10] investigated GPG, an estrus synchronization protocol initiated with GnRH and $PGF_{2\alpha}$ treatments administered 7 d apart and followed by another GnRH injection 48 h later. The pregnancy rates declined substantially as the time interval between the $PGF_{2\alpha}$ and the second GnRH injections decreased from 48 h to 24 h or 0 h. In addition, Schmitt et al. [5] shortened the time interval between $PGF_{2\alpha}$ and GnRH administration from 48 h to 24 h. The pregnancy rate was significantly lower with the 24 h interval (25.8%) than with the 48 h one (45.5%) or without the second GnRH treatment in the control group (48%). In a study by Peters and Pursley [6], shortening the time between $PGF_{2\alpha}$ and GnRH treatments from 48 h to 24 h or 0 h lowered fertility. Moreover, a tendency toward increased incidence of short luteal phases emerged when $PGF_{2\alpha}$ and GnRH were given simultaneously.

The aim of this study was to determine whether the timing of GnRH administration (0 h vs. 24 h) after $PGF_{2\alpha}$ injection affects the incidence of induced short estrous cycles in cyclic dairy heifers (Experiment 1), and to estimate this incidence after simultaneous injections of $PGF_{2\alpha}$ and GnRH in cyclic dairy cows (Experiment 2).

2. Materials and methods

2.1. Experiment 1

2.1.1. Animals

Experiment 1 involved 21 healthy and normally cycling dairy heifers of the Finnish Ayrshire (19 animals) and Holstein-Friesian (2 animals) breeds. These heifers were aged 13–18 months at the beginning of the experiment, were fed grass silage, concentrate, and straw according to Finnish standards, and were loose housed. The experiment was carried out in two periods between January and March and between February and June in consecutive years.

2.1.2. Experimental design

At the beginning of the experiment, the cyclic status of each animal was determined by transrectal ultrasound examination. Estruses were synchronized with a single intramuscular (im) injection of PGF (0.15 mg of dexcloproxtenol; Genestran® vet 75 μg/ml, Vetcare Ltd., Salo, Finland). From the day after the treatment, the heifers were examined daily with transrectal ultrasonography to monitor the occurrence of ovulation. A new luteolysis was then similarly induced with PGF on day 7 after ovulation. Either 0 (treatment T0) or 24 h (treatment T24) after the administration of PGF, the heifers received GnRH (0.1 mg of gonadorelin, Fertagyl® 0.1 mg/ml, Intervet International, Boxmeer, The Netherlands) im to induce ovulation. Based on our previous experiments [1,7,11], group T24 served as a control. All treatments were performed at the same time every day. Initially, every heifer was assigned randomly to either of these manipulations. After at least one unmanipulated cycle, the experimental setting was repeated in an attempt to treat every heifer in both groups at least once. Finally, we collected data from 42 manipulation cases, 23 in treatment group T0 and 19 in T24.

Beginning 24 h after the GnRH treatment, transrectal ultrasonographic examinations of the ovaries were repeatedly performed every 6 h until ovulation was detected, and thereafter once daily until the next ovulation. Any possible signs of estrus or metestrous bleeding were also recorded daily.

Blood sampling for plasma progesterone determinations began immediately before the second PGF administration and continued once daily until the second ovulation after the GnRH treatment. The samples were collected by vacuum puncture of a tail blood vessel into heparinized blood tubes (Vacutainer, Becton Dickinson Vacutainer Systems, Plymouth, UK). After immediate centrifugation ($1400 \times g$, 10 min), plasma was harvested, frozen, and stored in plastic tubes at $-20\ ^{\circ}C$ until analyzed.

2.1.3. Ovarian examinations

A real-time B-mode ultrasound scanner (Aloka SSD-210DXII, Aloka, Japan) equipped with a 7.5 MHz rectal linear array transducer served to follow the growth of the corpus luteum (CL) and follicles and to determine the occurrence of ovulation. The same operator performed all examinations.