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Treatment of clinical endometritis in dairy cows by previously used controlled internal drug release devices

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ABSTRACT

Postpartum endometritis is considered as one of the diseases that lead to a potential profit reduction in dairy cows. The aims of the present study were to promote follicle growth by a previously used controlled internal drug release (CIDR) device and to evaluate its effect on the likelihood of recovery and the reproductive performance of clinical endometritis (CE) cows. Endometritis was diagnosed using ultrasonographic examination at 31 ± 3 (Day 0 of the experiment) days in milk, and CE cows were included in one of the three experimental groups according to the presence of a CL on their ovaries. Cows without CL on their ovaries received a reused CIDR device, which was previously used for 14 days (CIDR-14, n = 108), or PGF2α (PG-1, n = 112) on Day 0. In the third group, those with CL on their ovaries received PGF2α (PG-2, n = 107) at the same time. Ovarian structures, serum estradiol and progesterone concentrations were measured on Days 0, 7, and 14. Controlled internal drug release devices were removed, and response to treatment was evaluated in all treated cows on Day 14. Diameters of ovarian follicles were 11.61 ± 0.50, 12.46 ± 0.25, and 18.36 ± 0.60 mm on Day 7 and 11.63 ± 0.58, 14.35 ± 0.40, and 21.96 ± 0.77 mm on Day 14 in PG-1, PG-2, and CIDR-14 cows, respectively ($P < 0.05$). Serum estradiol concentrations were higher in CIDR-14 cows (141.17 ± 1.04 pg/mL) than in PG-1 (116.85 ± 1.05 pg/mL) and PG-2 (119.10 ± 1.05 pg/mL) cows on Day 7 ($P < 0.05$). Higher progesterone concentrations were observed in PG-2 cows than in PG-1 and CIDR-14 cows on Days 0, 7, and 14 ($P < 0.001$). The likelihood of clinical cure was 54.46%, 62.61%, and 64.81% in PG-1, PG-2, and CIDR-14 cows, respectively ($P = 0.11$). First-service conception risk, days to the first service, calving to conception interval, proportion of cows bred and pregnant by 120 days in milk did not differ among the treated groups ($P > 0.05$). The cumulative pregnancy risk was lower in PG-1 (77.67%) cows than in CIDR-14 (87.07%) and PG-2 (87.85%) cows ($P = 0.02$). In conclusion, reused CIDR would be contributed to the treatment of CE by promotion of follicle growth and induction of sustainable sources of endogenic estrogen secreted by the dominant follicle.

1. Introduction

Endometritis is a highly prevalent disorder in high-producing dairy cows [1,2] leading to economic losses due to decreased pregnancy per insemination, increased feed intake per lactation, reduced milk yield, extended interval to pregnancy and increased culling rate [1–4].

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Furthermore, the subfertility associated with endometritis persists even after clinical resolution of the disease. In typical studies of the cows treated successfully for clinical endometritis (CE), conception rates are approximately 20% lower compared with healthy cows and an extra 3% of cows remain infertile [2,3,5].

A variety of therapeutic methods for CE has been reported, including systemic [6] or local [3,7–10] antibiotics, as well as PGF2α or estradiol administration [5,6,9,11]. The results of the antibiotic application for treatment of endometritis are controversial. Leblanc et al. [5] reported that the intrauterine infusion of cephapirin benzathine at 27 to 33 days in milk (DIM) significantly decreased time to pregnancy compared to the untreated control. On the other hand, intrauterine infusion of ceftiofur, oxytetracycline, or penicillin did not affect the reproductive performance compared with control cows [7,10]. Moreover, most antibiotics have not been approved for the intrauterine application in dairy cows, and the residue of them after intrauterine or systemic application in food animal products is another concern.

Controlled internal drug release (CIDR) insert is a T-shaped vaginal device containing 1.9 g (Canada, Mexico, Japan, Australia, New Zealand) or 1.38 g (United States, other countries) of progesterone in silicone molded over a nylon spine [12,13] have been approved to be used in dairy cows. The flexible wings of the CIDR collapse for facilitated insertion and expand once placed appropriately within the vagina [12]. The expansion of the wings retains its position; a thin nylon tail remains exterior and is used for removal [12]. The progesterone content after 9-day [14] and 15-day [15] insertion of 1.9-g CIDR was 1.14 and 1.07 g, respectively. Thus, it has the potential for usage.

Hatler et al. [16] evaluated the surge of the LH and ovulation in lactating dairy cows received a previously used 14-day CIDR device. The average follicle diameter after 14-day insertion of reused CIDR devices was more than 25 mm, and none of the cows showed ovulation during the study period [16]. According to their study, reused CIDR devices (which previously used for 14 days) prevented the ovulation of the dominant follicle but did not regress the dominant follicle. In this situation, the dominant follicle would grow and probably produce more estradiol. In the estrogenic phase of the estrous cycle, the uterine defense mechanism is up regulated [17] and the local uterine infection such as endometritis will probably be cured.

The objectives of the present study were to investigate the ability of the previously used CIDR devices to support follicle growth in CE cows and to evaluate this method for the treatment of CE compared to the PGF2α-treated group. In order for that, concentrations of estradiol and progesterone were measured. To the best of the authors' knowledge, this is the first report of CE treatment by the reused CIDR devices with the approach of prolongation of follicular dominance in lactating dairy cows.

2. Materials and methods

2.1. Experimental location and animals

The study was conducted on a commercial dairy herd in Alborz Province, Iran. A total of 1983 dairy cows and pregnant heifers were housed in open-shed and free-stall groups. Cows were fed with mixed ration and additional concentrates according to their current milk yield. Average milk yield was 10,750 kg per cow per 305 days, with 3.26% fat and 3.43% protein.

2.2. Experimental design

All cows were examined by external inspection and palpation of the genital tract per rectum at 31 ± 3 (Day 0 of the experiment) DIM. Next, the entire reproductive tract was examined by ultrasonography (Easi-Scan; BCF Technology Ltd., Livingston, Scotland, UK) using a real-time B-mode scanner equipped with a 7.5-MHz linear-array transrectal transducer (active array length: 65 mm, power: 5V @ 250 mA max). Presence and diameter of the ovarian follicles and CL were recorded on individual case report forms for each cow. If the pathologic fluids, i.e., the accumulation of nonuniformly echogenic liquid or multiple hyperechoic particles, were observed in the lumen of the uterus, the cow(s) was assumed to be affected by CE. Then, the rectal palpation of the genital tract continued to exclude the uterine discharge. Endometritis severity was classified by visualization of the discharge (if present) according to Gautam et al. [18] with some modifications: clear mucus with flakes of pus (mild endometritis), mucopurulent discharge with less than 50% pus (moderate endometritis), and the exudates containing more than 50% white or yellow pus in the discharge (severe endometritis). After ultrasonographic examination and visualization of the excluded uterine discharge, the uterine lavage technique was used in 15 to 20 cows of each treated group to obtain an endometrial cytology sample.

Cows received one of the three treatments according to their ovarian structures. If no CL was present on the ovaries, cows (n = 108) received a reused CIDR device which was previously used for 14 days (CIDR-14 group; EAZI-BREED CIDR; InterAg; Hamilton, New Zealand) or an intramuscular injection of PGF2α analog (n = 112; PGF-1 group; 150 μg, VETEGLAN; Calier, Barcelona, Spain). If the CL was present on the ovaries, an intramuscular PGF2α analog was injected (n = 107; PGF-2 group; 150 μg, VETEGLAN; Calier). Ovaries were scanned and the diameter of ovarian structures was measured on Day 0, and this process was repeated on Days 7 (38 ± 3 DIM) and 14 (45 ± 3 DIM) after treatment. Controlled internal drug release devices were removed on Day 14 of the experiment.

All CIDR devices to be reused had been obtained from the cows involved in a previous synchronization of ovulation experiment and had been inserted initially for 14 days. Immediately after removal, they were placed in an empty bucket, washed thoroughly with soap and water, then soaked in a chlorhexidine gluconate solution (0.03%) for 2 hours, rinsed thoroughly with water, allowed to air-dry, and placed in bags for storage.

All cows were reexamined by ultrasonographic inspection of uterine lumen, rectal palpation, and by taking endometrial cytology samples (15–20 cows of each treated group) on Day 14 to evaluate response to therapy. The cure from CE was described as the absence of pathologic fluids in the lumen of the endometrium in the ultrasonographic