Evaluation of a needle-free injection system for administration of cloprostenol for luteolysis in lactating dairy cows

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Introduction

Luteolytic drugs are critical for managing reproductive success in dairy cows. Currently prostaglandin analogs are only approved for intramuscular injection. The utilization of a needle and syringe for administration of any drug can result in needle-stick injuries to workers. Furthermore, needle-free injection systems have been shown to eliminate transmission of blood-borne pathogens, such as anaplasmosis, in cattle. Data on the efficacy of needle-free injection systems and their application in an estrous synchronization protocol has not been reported. The objective of the present study was to evaluate the effectiveness of utilizing a needle-free injection system (Pulse Needle-Free Systems, Lenexa, KS) for the intramuscular delivery of cloprostenol (Estrumate®, Merck Animal Health, Madison, NJ) for the purpose of estrous synchronization in lactating dairy cows.

Materials and methods

Lactating Holstein dairy cows (n = 26) were randomly assigned to treatment groups utilizing a simple randomized controlled trial study design. Treatment groups consisted of: 1) needle-free injection of 2 mL (0.5 mg) cloprostenol IM (NFREE-PG; n = 10); 2) traditional needle injection of 2 mL (0.5 mg) cloprostenol IM (NDL-PG; n = 10); 3) needle-free injection of 2 mL physiological saline IM (CNTL; n = 6). All cows were synchronized to achieve an active corpus luteum (CL) at time of treatment (60 +/- 3 DIM). A CL was deemed active if the diameter was greater than 13 mm and blood flow was > 25%, these measurements were determined via ovarian ultrasound. Biomarkers were evaluated at 1 h prior to treatment administration and for 92 h after treatment administration and included ovarian ultrasound measurements of corpus luteum blood flow and diameter (cm), plasma for cortisol analysis, plasma for progesterone analysis, and plasma for cloprostenol concentration. Data were analyzed using a mixed model with the cow serving as the experimental unit, utilizing commercially available software.

Results

Not all results are presented. Results with significant effects are presented as least squares means ± SE. There was no difference between the NFREE-PG and NDL-PG groups between 0H to 92H for percent change in CL diameter, however the CNTL group observed a smaller percent change in CL diameter between 0H to 92H (-40.7 +/- 7.3, -39.0 +/- 4.2 vs. 5.8 +/- 8.0; $P < 0.0001$). There was no difference between the NFREE-PG and NDL-PG between 0H to 92H for percent change in CL volume, however the CNTL observed smaller percent change in CL volume between 0H to 92H (-76.3 +/- 5.2, -72.7 +/- 5.4 vs. 3.2 +/- 10.2; $P < 0.0001$). There was no difference between the NFREE-PG and NDL-PG groups between 0H to 92H for percent change in CL blood flow, however the CNTL observed a smaller change in CL blood flow between 0H to 92H (-93.1 +/- 2.8, -97.1 +/- 2.2 vs. -0.7 +/- 6.2; $P < 0.0001$). The NFREE-PG cows had lower cortisol levels (9.8 +/- 1.2 ng/mL) compared to the NDL-PG (17.8 +/- 1.2 ng/mL) and CNTL (19.2 +/- 1.3 ng/mL; $P = 0.04$).

Significance

Similar regression of the CL was observed in both cloprostenol treatment groups from 20H to 92H. This indicates an effective dose of cloprostenol for luteolysis was administered via the needle-free system. For animals in the CNTL group, CL regression was not observed. These data support the use of a needle-free injection system as a low-stress alternative to needle and syringe to deliver cloprostenol for reproductive management in lactating dairy cows. Further research is warranted to evaluate the replacement of a tradition needle injection with needle-free delivery of luteolytic drugs used in estrous synchronization protocols.

