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The effects of vaccination on serum hormone concentrations and conception rates in synchronized naive beef heifers

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ABSTRACT

Crossbred beef heifers (N = 59) were vaccinated at the time of synchronization/breeding with either a commercially available bovine herpesvirus type 1 modified live virus (MLV) (one dose) or inactivated virus vaccine (one or two doses). The estrus cycle was synchronized at vaccination and heifers were artificially inseminated 8 days (one dose) or 36 days (two dose) after initial vaccination. Pregnancy rates were greater for control heifers (90%; $P = 0.02$) and heifers given the inactivated virus vaccine (one dose: 86%; $P = 0.08$; or two: 90%; $P < 0.01$) than those given the MLV vaccine (48%). No control heifers experienced an abnormal estrous cycle, whereas only two (two dose; 2/21) and one (one dose; 1/7) heifers in the inactive virus groups had abnormal estrous cycles and were similar to control ($P > 0.10$). Heifers given the MLV vaccine had a greater ($P = 0.02$) percentage of abnormal estrous cycles (38%; 8/21) compared with the control and inactivated groups. Of the heifers with an abnormal estrous cycle, 100% of heifers given the inactivated vaccine (one or two dose) conceived at their return estrus, whereas only 38% of heifers given the MLV vaccine conceived at their return estrus ($P > 0.10$). During the synchronization period, concentrations of estrogen were greater ($P < 0.01$) in the control and the two-dose inactivated group compared with the MLV group. After AI, progesterone concentrations were greater ($P < 0.01$) in control heifers compared with the inactivated and MLV groups, but were similar ($P \geq 0.18$) between the inactivated and MLV groups. Therefore, naïve heifers vaccinated with the inactivated vaccine were less likely to have an abnormal estrous cycle and had significantly higher pregnancy rates compared with heifers vaccinated with the MLV vaccine. In summary, vaccination of naïve heifers with an MLV vaccine at the start of a fixed-time AI protocol had a negative effect on pregnancy success.

1. Introduction

Infectious bovine rhinotracheitis, a clinically and economically important disease of cattle, is endemic in cattle populations throughout the world. Infectious bovine rhinotracheitis caused by bovine herpesvirus type 1 (BHV-1) is associated with a variety of clinical signs, and can cause respiratory as well as reproductive diseases. Bovine herpesvirus type 1 is often associated with the bovine respiratory disease complex, predisposing animals to secondary bacterial infections. Bovine herpesvirus type 1 is spread through nasal secretions, droplets, genital secretions, serum, and fetal fluids [1].

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Vaccination with either a modified live virus (MLV) or inactivated virus vaccine is the most effective way to control the spread of BHV-1. Modified live virus BHV-1 vaccines are administered parenterally (sc or im) or intranasally, whereas inactivated vaccines are administered sc or im. However there have been adverse effects associated with MLV BHV-1 vaccines, including abortion in pregnant animals with unknown or questionable vaccine history [2–4].

Vaccination of naïve heifers at approximately the onset of standing estrus has been shown to have negative effects on CL function [5,6] and pregnancy success [7]. However, vaccination of heifers before synchronization requires additional time and labor. Many current synchronization protocols for heifers and cows use an injection of gonadotropin releasing hormone (GnRH) at the start of the synchronization process to induce ovulation and control follicular growth [8].

AI with proven genetically superior sires with economically important traits is the most efficient method producers can use to improve the genetics of their herd, and is the most important and widely applicable reproductive biotechnology available for beef producers [9]. However, adoption of this technology by beef producers has been slow [10], and the primary reason cited by producers for not using the reproductive technologies of AI and estrous synchronization are time and labor [11]. Therefore the question is often asked; can the time and labor involved in heifer development be reduced by vaccinating heifers at the start of the synchronization protocol?

The effects of vaccination on estrus synchronization and conception are variable. A study in which the vaccination history was not reported and titer concentrations were not determined indicated that vaccination at time of the start of a synchronization protocol (Day −9, with AI on Days 1 to 5) did not affect estrous response or pregnancy success [12]. In another study, animals were vaccinated with a MLV vaccine at least twice before synchronization protocol (the second dose given 90 days before peak breeding day). The heifers were then revaccinated either at 40 or 3 days before peak breeding (three doses total) and there were no differences in conception rates [13]. However, several studies have reported negative effects on pregnancy success by vaccinating naïve heifers with a MLV at the approximate time of breeding [7,14,15]. Recently developed estrous synchronization or fixed-time AI protocols in heifers try to control follicular development by inducing ovulation at the start of the synchronization protocol; therefore, insemination should occur on the second ovulation after the start of the protocol [8,16]. A review of the literature did not find a study that evaluated the effect of vaccination on estrus synchronization and/or conception on these newly optimized protocols.

The objective of the present study was to determine the effect that vaccinating naïve heifers with either a MLV or inactivated virus vaccine at the time of the first induced ovulation of a fixed-time AI synchronization protocol has on plasma hormone concentrations, estrous cycle length, and pregnancy success.

2. Materials and methods

2.1. Animals

Protocols were reviewed and approved by both Novartis Animal Health and Rural Technologies Inc. institutional animal care and use committees. Fifty-nine heifers (1 to 2 years of age) which were seronegative (<1:2) for BHV-1, bovine viral diarrhea virus (BVDV) type 1, and BVDV2 were enrolled. In addition, heifers were evaluated to ensure there were no BVDV- and BHV-1-specific T cell responses before vaccination [17]. Before study initiation, all heifers were randomly assigned to one of four treatment groups at enrollment using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA).

Heifers in group 1 (N = 21) were given two doses of inactivated virus vaccine (36 and 8 days before AI), heifers in group 2 (N = 7) were given one dose of inactivated virus vaccine (8 days before AI), heifers in group 3 (N = 21) were given one dose of MLV vaccine (8 days before AI), and heifers in group 4 (N = 10) were given two doses of placebo (inactivated sterile water; 36 and 8 days before AI; Fig. 1). All heifers were synchronized and bred by AI 8 days after vaccination (Fig. 1). Pregnancy rates were determined by transrectal ultrasonography 47 and 61 days after AI (31 and 45 days after removal of bulls). Presence of a fetal heartbeat was used to determine fetal viability and crown-rump length was used to determine fetal age.

Heifers were managed according to routine animal husbandry procedures and fed an age-appropriate grain and hay ration *ad libitum* for the duration of the study.

2.2. Vaccination

Twenty-one heifers (group 1) were subcutaneously vaccinated 36 days before AI (Day 36) with a commercially available adjuvanted inactivated combination vaccine (ViraShield 6VL5HB, Novartis Animal Health US, Inc., Larchwood, IA, USA; Fig. 1). The inactivated vaccine contained the following viral fractions: BHV-1, BVDV (types 1 and 2), bovine parainfluenza-3, and bovine respiratory syncytial virus, and the following bacterial fractions: *Campylobacter fetus, Leptospira canicola, L. grippotyphosa, L. hardjo, L. pomona,* and *L. icterohaemorrhagiae*. Ten heifers (control; group 4) were subcutaneously vaccinated 36 days before AI (Day 36) with sterile diluent (Inactivated Sterile Water Placebo, Novartis Animal Health US, Inc.) and served as controls. Heifers in groups 1 and 4 were booster vaccinated with the appropriate vaccine/placebo 28 days later

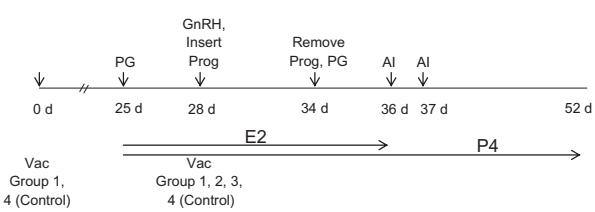

Fig. 1. Timeline for synchronization events and vaccination. E2, estradiol; P4, progesterone; PG, prostaglandin F2-α (Lutalyse); Prog, progesterone (EAZI-BREED CIDR implants); Vac, vaccination.