J. Dairy Sci. 98:1–11
http://dx.doi.org/10.3168/jds.2014-9081

Effect of intrauterine dextrose on reproductive performance of lactating dairy cows diagnosed with purulent vaginal discharge under certified organic management

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ABSTRACT

The objectives of the study were to assess responses to treatments (clinical cure and resumption of estrous cycles) of cows with purulent vaginal discharge (PVD) that received intrauterine infusion of a hypertonic solution of 50% dextrose (DEX) or untreated control (CON) cows and the subsequent pregnancy per artificial insemination (PAI) in cows with and without PVD. Cows (n = 2,852) from 2 dairy herds were screened for PVD using the gloved hand technique at exam 1 [26 ± 3 d in milk (DIM)]. Cows with vaginal discharge scores of 2 or 3 (0–3 scale) were stratified by parity and randomly allocated into 1 of 2 treatment groups: (1) intrauterine infusion (~200 mL) of 50% DEX solution (n = 456), or (2) untreated control animals (CON, n = 491). Fourteen days posttherapy (40 ± 3 DIM), cows with PVD were re-examined at exam 2 (40 ± 3 DIM) to assess the response to treatments. All cows were subjected to the same reproductive program, which consisted of estrus detection twice daily (using tail chalking and visual observation) for the first 5 artificial inseminations; then, open lactating cows were turned out with bulls. Cows displaying signs of standing estrus underwent AI and no reproductive hormones were used. Pregnancy diagnosis (PD) was performed via transrectal palpation at 40 ± 3 d post-AI. The risk of culling within 14 d posttherapy was not different among treatment groups. Cows with PVD had greater cervical diameter at exam 1 and decreased PAI compared with cows without PVD. Treatment with DEX increased the proportion of cows with clear vaginal discharge (clinical cure) and cyclicity 14 d posttherapy compared with CON cows. Pregnancy per AI for DEX (29.2 ± 2%) cows was significantly greater than that for CON (22.5 ± 2%) cows. Cows without PVD had a greater proportion of cycling cows (65.6%) and PAI (37%) with reduced pregnancy losses (5.7%) compared with DEX or CON cows. The use of intrauterine DEX alone improved reproductive performance of cows with PVD.
Key words: clinical endometritis, reproductive performance, organic dairy

INTRODUCTION

Postpartum uterine diseases such as metritis and clinical endometritis (**CE**) are common disorders of lactating dairy cows that negatively affect reproductive performance (LeBlanc et al., 2002a; Gilbert et al., 2005; Brick et al., 2012) and thus diminish the profitability of dairy operations (Overton and Fetrow, 2008). Clinical endometritis is defined as the inflammation of the endometrial lining of the uterus characterized clinically by mucopurulent or purulent vaginal discharge (**PVD**), or characterized cytologically by endometrial inflammation occurring 21 to 40 DIM (LeBlanc et al., 2002a; Gilbert et al., 2005; Dubuc et al., 2011a). Risk factors such as hygiene of the perineum at the time of calving (Schuenemann et al., 2011), peripartum metabolic status (Földi et al., 2006; LeBlanc, 2008), parity (Dubuc et al., 2011b), retained fetal membranes (LeBlanc et al., 2002a; Sheldon et al., 2009), delivery of twins (Földi et al., 2006), and dystocia (Földi et al., 2006) have all been associated with CE in lactating dairy cows. Moreover, CE has been shown to contribute to ovarian dysfunction (e.g., smaller follicle size, lower plasma estradiol concentration, and prolonged luteal phase; Sheldon et al., 2009), poor reproductive performance (LeBlanc et al., 2002a; Brick et al., 2012), increased risk of culling due to reproductive failure (LeBlanc et al., 2002a,b), and reduced milk yield (Dubuc et al., 2011b).

Although administration of $PGF_{2\alpha}$ (Heuwieser et al., 2000; Kasimanickam et al., 2005; Dubuc et al., 2011a) is often recommended to treat CE, conflicting data exist in the literature regarding the potential reproductive benefits. Antibiotic therapy, such as treatment with

Received November 6, 2014.
Accepted February 10, 2015.
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cephapirin, is frequently prescribed to treat cows with CE (LeBlanc et al., 2002b) or vulvar discharges >13 d postpartum (McDougall, 2001) in dairy herds. Ceftiofur sodium (Drillich et al., 2001), ceftiofur hydrochloride (Kasimanickam et al., 2010), and ceftiofur crystalline free acid (McLaughlin et al., 2010) have been shown to be effective (resulting in clinical recovery) for treatment of metritis. However, no antimicrobial is approved in the United States for treatment of CE or PVD in dairy cattle.

An in vitro study showed that mannose (a sugar monomer) inhibits the adhesion of bacteria such as *Escherichia coli* to cultured equine endometrial epithelial cells (King et al., 2000). In addition, the use of hypertonic sucrose solutions inhibits bacterial growth such as *E. coli* from infected human wounds (Chirife et al., 1983). The emergence of multidrug resistance in *Arcanobacterium pyogenes* (reclassified as *Trueperella pyogenes*) and *E. coli*, important pathogens associated with uterine infections (Sheldon and Dobson, 2004; Williams et al., 2005), has been reported in dairy cows suffering from metritis (Santos et al., 2010). A recent study showed that the use of a hypertonic solution (e.g., 50% dextrose in water) improves clinical cure of lactating dairy cows with CE compared with untreated control cows under conventional management (Brick et al., 2012).

The first objective of this study was to determine the effect of PVD on reproductive performance of lactating dairy cows under certified organic management. The hypothesis was that PVD would be detrimental to pregnancies per AI (**PAI**) compared with cows without PVD. The second objective was to compare the response to treatments (clinical cure and resumption of the postpartum estrous cycles 14 d posttherapy) in lactating dairy cows diagnosed with PVD and treated with an intrauterine infusion of a hypertonic solution of 50% dextrose (**DEX**) compared with untreated control (**CON**) cows. The hypothesis was that the administration of intrauterine DEX infusion would improve clinical cure and resumption of the postpartum estrous cycles in lactating dairy cows with PVD. The third objective was to determine the effect of intrauterine DEX in cows with PVD on PAI compared with CON cows or cows without PVD. The hypothesis was that PVD would be detrimental to PAI but that treatment with DEX would improve PAI in lactating dairy cows.

MATERIALS AND METHODS

Facilities, Animals, and Feeding Management

A total of 3,181 lactating dairy cows (1,544 primiparous and 1,637 multiparous) from 2 certified organic dairy farms in Colorado were used in the present study. The breed distribution was Holstein (n = 2,493), Jersey (n = 61), and Holstein × Jersey cross (n = 298). Briefly, cows were housed in freestall barns with open access to a contiguous dry lot. All cows were milked thrice daily at approximately 8-h intervals, and the rolling herd average milk production was 8,800 kg with a reported voluntary waiting period of 45 d. From May to September, all cows had access to pasture (mixture of alfalfa, ryegrass, and orchardgrass, as well as triticale, wheat, and sorghum). Additionally, cows were fed twice daily, in the morning and afternoon, with a TMR formulated to meet or exceed dietary nutritional requirements for lactating dairy cows (NRC, 2001). This study was conducted from January through December 2012. The procedures described below were reviewed by The Ohio State University Institutional Animal Care and Use Committee.

Diagnosis of PVD, Ovarian Structures, and Treatments

Weekly, a list of cows was obtained based on their calving dates using on-farm computer records (PCD-ART, Dairy Record Management Systems, Raleigh, NC). Briefly, cows at 26 ± 3 DIM were restrained using headlocks within the pen immediately after milking for the diagnosis of PVD using the gloved hand technique (Williams et al., 2005), measurement of cervix diameters, and recording of ovarian structures by ultrasonography (Brick et al., 2012). Once the cow was in the headlock, the uterus was massaged via transrectal palpation, the perineal area was cleaned, and vulva was wiped off with paper towel. Then, a lubricated gloved hand was introduced through the vulva to the vaginal vault and cervical os, and the vaginal content was withdrawn manually for assessment at first gynecological examination (exam 1; Figure 1). The vaginal discharge was scored using a 0–3 scale (0 = normal uterine discharge, 1 = flakes of purulent exudates in the uterine discharge, 2 = >50% of the uterine discharge is made up of purulent exudates, 3 = hemorrhagic uterine discharge mixed with purulent exudates; adapted from Williams et al., 2005; Sheldon et al., 2006). Purulent vaginal discharge was defined as a score of 2 or 3 (mucopurulent or worse vaginal discharge) at the time of exam 1. Cervix diameters at exam 1 (26 ± 3 DIM) were classified as <3.0 or >3.1 cm (Table 1).

Immediately before the PVD examination, rectal temperatures (ReliOn, Waukegan, IL) were recorded. The presence or absence of ovarian structures, such as corpus luteum (**CL**), follicles (>3 mm), or cysts, was recorded via transrectal ultrasonography (Easi-Scan, BCF Technology, Rochester, MN) at exam 1 and at the