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Factors associated with early cyclicity in postpartum dairy cows

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ABSTRACT

The objective of this study was to evaluate factors associated with resumption of ovarian cyclicity within 21 days in milk (DIM) in dairy cows. Cows (n = 768) from 2 herds in north Florida had their ovaries scanned at 17 ± 3, 21 ± 3, and 24 ± 3 DIM. Cows that had a corpus luteum ≥20 mm at 17 ± 3 or at 21 ± 3 DIM or that had a corpus luteum <20 mm in 2 consecutive examinations were determined to be cyclic by 21 ± 3 DIM. The following information was collected for up to 14 DIM: calving season, parity, calving problems, metabolic problems, metritis, mastitis, digestive problems, lameness, body weight loss, dry period length, and average daily milk yield. Body condition was scored at 17 ± 3 DIM. Multivariable mixed logistic regression analysis was performed using the GLIMMIX procedure of SAS. Variables with $P \leq 0.2$ were considered in each model. Herd was included as a random variable. Three models were constructed: model 1 included all cows, model 2 included only cows from dairy 1 that had daily body weights available, and model 3 included only multiparous cows with a previous dry period length recorded. In model 1, variables associated with greater cyclicity by 21 ± 3 DIM were calving in the summer and fall rather than in the winter or spring, being multiparous rather than primiparous, and not having metabolic or digestive problems. In model 2, variables associated with greater cyclicity by 21 ± 3 DIM were calving in the summer and fall, not having metritis or digestive problems and not losing >28 kg of BW within 14 DIM. In model 3, variables associated with greater cyclicity by 21 ± 3 DIM were absence of metabolic problems and dry period ≤76 d. In summary, cyclicity by 21 ± 3 DIM was negatively associated with calving in winter or spring, primiparity, metritis, metabolic or digestive problems, loss of >28 kg of body weight, and a dry period >76 d. Strategies preventing extended dry period length and loss of BW, together with reductions in the incidence of metritis as well as metabolic and digestive problems should improve early cyclicity postpartum.
Key words: risk factor, early cyclicity, dairy cow

INTRODUCTION

Reproductive performance is one of the main determinants of profitability in dairy farms (De Vries, 2006; Galvão et al., 2013). Resumption of ovarian cyclicity before the first AI (Galvão et al., 2004; Chebel et al., 2006; Santos et al., 2009), but especially cyclicity earlier in lactation (Darwash et al., 1997; McCoy, 2006), is associated with improved reproductive performance. Two recent studies in North America found that Holstein cows that were cyclic by 21 DIM had improved reproductive performance compared with cows that cycled later in lactation or cows that were not cyclic by 50 to 60 DIM (Galvão et al., 2010a; Dubuc et al., 2012).

Virtually all Holstein cows have the first wave of follicle growth starting 2 wk postpartum, with approximately 30 to 40% of these cows ovulating between 16 and 20 DIM; another 30 to 40% of the cows will ovulate follicles from subsequent follicular waves from 30 to 50 DIM and approximately 20 to 40% remain anovulatory by 50 to 60 DIM (Butler, 2003; Santos et al., 2009; Galvão et al., 2010a). Few studies have evaluated risk factors that affect cyclicity early postpartum. A recent study focused on the effect of indicators of energy balance (i.e., BHBA and NEFA) and indicators of inflammation (i.e., haptoglobin) on cyclicity at 21 ± 3 DIM (Dubuc et al., 2012). Those authors reported that cows with increased NEFA pre- and postpartum had decreased cyclicity at 21 ± 3 DIM. The association between negative energy balance and resumption of ovarian cyclicity has been well described (Butler, 2003). Deep negative energy balance affects LH pulsatility and

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blood glucose, insulin, and IGF-1 concentrations, which ultimately affect follicle development, estradiol production, and ovulation (Canfield and Butler, 1990; Beam and Butler, 1999; Butler, 2003).

Dubuc et al. (2012) also showed that cows with increased haptoglobin postpartum had decreased cyclicity at 21 ± 3 DIM. Metritis is the most common disease associated with increased haptoglobin early postpartum (Huzzey et al., 2009; Galvão et al., 2010b). In a previous study, it was observed that cows that were cyclic at 21 ± 3 DIM had decreased prevalence of cytological endometritis at 49 ± 3 DIM compared with cows that were not cyclic by 49 ± 3 DIM (Galvão et al. 2010a). Metritis is a major risk factor for endometritis (Benzaquen et al., 2007; Cheong et al., 2011). These findings indicate that metritis might be an important factor associated with early ovulation. Gram-negative bacterial LPS concentrations are increased in the uterine fluid (Mateus et al., 2003), plasma (Herath et al., 2009), and follicular fluid (Herath et al., 2007) when cows have a uterine infection. Large quantities of LPS are also released during coliform mastitis (Carroll et al., 1964; Hill et al., 1979) and SARA (Khafipour et al., 2009), which are common conditions in early postpartum. Lipopolysaccharide has been shown to impair the release of both GnRH and LH (Peter et al., 1989; Rivest et al., 1993; Battaglia et al., 1999) and to decrease aromatase activity (Herath et al., 2009), which ultimately may affect follicular growth, estradiol production (Williams et al., 2007, 2008), and decrease ovulation rate (Peter et al., 1989). Dubuc et al. (2012) also observed that calving season and parity were associated with early cyclicity postpartum; however, other postpartum conditions such as calving problems (e.g., dystocia, twins, stillbirths or retained placenta), infectious diseases such as mastitis or lameness, and metabolic diseases such as hypocalcemia and ketosis may also directly, through inflammation, or indirectly, through negative energy balance, affect cyclicity early postpartum. Other factors that may be important for early ovulation because of their association with negative energy balance are BW loss and dry period length (Opsomer et al., 2000; Shrestha et al., 2005). Therefore, the objective of our study was to identify risk factors associated with resumption of ovarian cyclicity early postpartum (cyclicity by 21 ± 3 DIM).

MATERIALS AND METHODS

Cows, Housing, and Feeding

Seven hundred sixty-eight cows (280 primiparous and 488 multiparous; 461 cows from dairy 1 and 307 cows from dairy 2) from 2 freestall dairies located in north-central Florida were used for the current study. Cows calving from December 2010 through August 2012 were enrolled at 17 ± 3 DIM. Our study included control cows (n = 245) from a previous study (Bittar et al., 2014). All animal procedures were approved by the University of Florida Institutional Animal Care and Use Committee.

Dairy 1, the University of Florida Dairy Unit (Gainesville), milked approximately 500 Holstein cows twice daily with a rolling herd average of approximately 10,000 kg/cow. The freestall beds and walking alleys were cleaned twice daily. Twice weekly, clean and dry sand was added on the top of the freestall beds. Fans with misters and sprinklers over the feed line were present in the barns and activated when environmental temperatures rose above 18°C. Dairy 2, a privately owned dairy, milked approximately 4,800 Holstein cows thrice daily with a rolling herd average of approximately 10,500 kg/cow. The freestall beds and walking alleys were cleaned thrice daily. Twice weekly, clean and dry sand was added on the top of the freestall beds. Cows were housed in tunnel-ventilated freestall barns equipped with misters that were activated when environmental temperatures increased above 18°C. In both dairies, cows were fed twice daily a TMR to meet or exceed the requirements of a second lactation Holstein cow weighing 680 kg of BW and producing 45 kg of 3.5% FCM per day. Fresh water was available ad libitum. In both dairies primiparous and multiparous were housed separately. Cows were vaccinated and treated for common diseases according to standard operating procedures developed with participation of the veterinarians from University of Florida, College of Veterinary Medicine, Food Animal Reproduction, and Medicine Service.

Study Design, Sample Size, and Data Collection

This was a longitudinal cohort study. The data was conveniently collected from December 2010 to August 2012 or selected (control cows; n = 245) from a previous study as previously mentioned (Bittar et al., 2014). Because the data was sampled by convenience, no a priori calculation of sample size occurred. Therefore, to address this shortfall, power was calculated and presented in the statistical analysis. All cows had their ovaries examined by ultrasonography (**US**) at 17 ± 3, 21 ± 3, and 24 ± 3 DIM using a portable ultrasound scanner (Easi-Scan, 4.5- to 8.5-MHz linear transducer, BCF Technology Ltd., Livingston, UK). Cows that had a corpus luteum (**CL**) ≥20 mm at its longest diameter (McArt et al., 2010) at 17 ± 3 or at 21 ± 3 DIM were determined to be cyclic by 21 ± 3 DIM. Cows that had a CL <20 mm at 17 ± 3 DIM were scanned again at