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Comparison of artificial insemination versus embryo transfer in lactating dairy cows

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Abstract

Conception rates (CR) are low in dairy cows and previous research suggests that this could be due to impaired early embryonic development. Therefore, we hypothesized that CR could be improved by embryo transfer (ET) compared with AI. During 365 days, 550 potential breedings were used from 243 lactating Holstein cows (average milk production, 35 kg/day). Cows had their ovulation synchronized (GnRH-7d-$PGF_{2\alpha}$-3d-GnRH) and they were randomly assigned for AI immediately after the second GnRH injection (Day 0) or for transfer of one embryo 7 days later. Circulating progesterone concentrations and follicular and luteal size were determined on Days 0 and 7. Pregnancy diagnosis was performed on Days 25 or 32 and pregnant cows were reevaluated on Days 60–66. Single-ovulating cows with synchronized ovarian status had similar CR on Days 25–32 with ET ($n = 176$; 40.3%) and AI ($n = 160$; 35.6%). Pregnancy loss between Days 25–32 and 60–66 also did not differ ($P = 0.38$) between ET (26.2%) and AI (18.6%). When single ($n = 334$) and multiple ($n = 57$) ovulators were compared, independent of treatment, multiple ovulators had greater ($P < 0.001$) circulating progesterone concentrations on Day 7 (2.7 ng/ml versus 1.9 ng/ml) and there was a tendency ($P = 0.10$) for a greater CR in multiple ovulators (50.9% versus 38.1%). However, there was no difference in CR between AI and ET cows with multiple ovulations (50.0% versus 51.7%). In single-ovulating cows, CR tended to be lower for AI than ET in cows ovulating smaller follicles (diameter $\leq$ 15 mm; 23.7% versus 42.3%; $P = 0.06$) but not average-diameter follicles (16–19 mm; 41.2% versus 37.3%; $P = 0.81$) or larger ($\geq$20 mm; 34.3 versus 51.0%; $P = 0.36$) follicles.

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Thus, although ET did not improve overall CR in lactating cows, follicle diameter and number of ovulating follicles may determine success with these procedures.

Keywords: Embryo transfer; Dairy cattle; Pregnancy; Artificial insemination; Synchronization

1. Introduction

Several reports have described an association between high milk production and low reproductive efficiency in dairy cows [1–4]. At least three studies [5–7] have shown that lactating dairy cows have poor early embryonic development. Sartori et al. [6] reported a very high percentage of non-viable embryos (∼70% during summer and ∼50% during winter) by Day 6 after estrus, as compared to heifers during summer (∼30% non-viable embryos) and non-lactating cows during winter (∼20% non-viable embryos). Moreover, although fertilization of the oocyte in lactating cows appeared to be decreased by summer heat stress, fertilization rate for lactating cows during winter was very high (∼90%). Therefore, low conception rates (CR) in lactating dairy cows appear to be at least partly due to compromised early embryonic development, which can be augmented by fertilization failure and more profoundly impaired early embryonic development during heat stress.

A number of studies from Florida compared embryo transfer (ET) to AI in order to improve CR of lactating dairy cows during summer heat stress [8–11]. In all these studies, CR was greater for ET than AI when fresh or frozen in vivo produced embryos were transferred, or when fresh in vitro produced embryos were used. To the best of our knowledge, there is no published study in which ET was compared to AI in dairy cows during cooler times of the year. Therefore, it is not known whether transfer of an embryo would improve CR and reduce pregnancy loss in lactating dairy cows during non-heat stress times of the year. The present experiment tested the hypothesis that CR can be improved by ET compared with AI, not only during summer (as demonstrated by other studies), but also during other seasons of the year. In addition, we hypothesized that the high pregnancy loss (Day 25 and later) after AI of lactating dairy cows could be overcome by ET, consistent with the idea that events in the oocyte or during early embryonic development are responsible problems in pregnancy.

2. Materials and methods

During a 1-year interval, (December 2001–December 2002), 550 potential breedings from 243 lactating Holstein cows were used. Every week, cows that were $\geq$60 days postpartum, or cows detected non-pregnant after breeding were assigned to the experiment. At the time of assignment, cows averaged 142.1 $\pm$ 3.3 days postpartum, yielding 34.9 $\pm$ 0.3 kg of milk/day, with an average lactation number of 2.4 $\pm$ 0.1 and had been bred 1.7 $\pm$ 0.1 times. Cows were housed in stanchion barns or free-stalls at the University of Wisconsin–Madison, Madison, WI, USA. They were milked twice daily and fed a TMR