SDSU Extension

BEEF

Chapter 27

Post-Insemination Management of Cattle

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Introduction

Fertility level of the herd may be the hardest factor to evaluate. Herd fertility includes cycling status, compliance with protocols, embryonic mortality, body condition (nutrition level), and disease. Several of these topics are discussed in greater detail in other chapters of this book. This chapter will focus on embryonic loss and the management factors that can increase or reduce embryonic mortality after insemination occurs.

Fertilization rates are reported to be between 89% and 100% when animals are detected in estrus and semen is present at the time ovulation occurs (Bearden et al., 1956; Diskin and Sreenan, 1980; Gayerie de Abreu et al., 1984; Kidder et al., 1954; Maurer and Chenault, 1983). While fertilization usually takes place, conception rates (number of animals that conceive divided by number of animals inseminated) are usually around 60% to 70% for natural service or artificial insemination. Although nature (poor oocyte quality, disease, chromosomal abnormalities, etc.) contributes to much of this loss, management practices can also increase embryonic mortality. Stress, in particular, can be detrimental to embryos and decrease pregnancy rates.

In order to understand how stress may increase embryonic mortality, one must first understand the development of the embryo (Table 1). Just like the estrous cycle, embryo development begins on day 0, or the day of standing estrus. This is the day the female is receptive to the male and insemination occurs. Ovulation occurs on day 1 or about 30 hours after the first standing mount (Pursley et al., 1995; Vasconcelos et al., 1999; Wiltbank et al., 2000). If viable sperm is present, fertilization occurs inside the oviduct shortly after ovulation. The first cell division occurs on day 2, and by day 3 the embryo has reached the 8-cell stage (Shea, 1981). Between days 5 and 6 the embryo migrates into the uterine horn and by day 7 to 8 it forms into a blastocyst (Shea, 1981, Flechon and Renard, 1978, Peters, 1996). At this stage two distinct parts of the embryo

Key Points

- There are several management factors that can increase or reduce embryonic mortality after insemination occurs.
- Many types of stress (handling, nutritional, temperature, etc.) can impact embryo survival.
- There are critical time points in embryo development that can impact embryo survival.

can be seen: 1) the inner cell mass, which will form into the fetus and 2) the trophoblast, which will form into the placenta. Between days 9 and 11 the embryo hatches from the zona pellucida, a protective shell that has surrounded the embryo to this point (Shea, 1981, Peters, 1996). Then, on days 15 to 17, the embryo produces a chemical signal to prevent corpora lutea destruction and allow the cow to remain pregnant (Peters, 1996). The embryo attaches to the uterus beginning on day 19, and around day 25, placentation, an intricate cellular interface between the cow and the calf, begins. By day 42 the embryo has fully attached to the uterus of the cow (Peters, 1996).

Table 1: Time course of early bovine embryo development. *Data adapted from: Shea, 1981, Flechon and Renard, 1978, Peters, 1996, Telford et al., 1990.*

Event	**Day**
Estrus	0
Ovulation	1
Fertilization	1
First cell division	2
8-cell stage	3
Migration to uterus	5-6
Blastocyst	7-8
Hatching	9-11
Maternal recognition of pregnancy	15-17
Attachment to the uterus	19
Adhesion to uterus	21-22
Placentation	25
Definitive attachment of the embryo to the uterus	42
Birth	285

Shipping Stress and Embryonic Mortality

With the knowledge of the critical time points in embryonic development, it is possible to understand how stress from shipping can result in increased embryonic mortality. When animals are loaded on a trailer and hauled to a new location, they become stressed and release hormones related to stress. These hormones lead to a release of different hormones that change the uterine environment in which the embryo is developing. During blastocyst formation, hatching, maternal recognition of pregnancy, and attachment to the uterus, the embryo is vulnerable to these changes. The most critical time points are between days 5 and 42 after insemination. Before day 5, the embryo is in the oviduct and is not subject to changes in the uterine environment. Therefore, stress does not influence embryo survivability at this time. The greater the length of time after day 42, the less severe the influence of shipping stress on embryonic loss appears to be. At the time of complete attachment of the embryo to the uterus the embryo is supported by the dam and appears to be less affected by changes in its environment. On the other hand, in between these time points (5 – 42 days), the embryo is at greatest risk. Shipping during this time can cause detrimental changes to the uterine environment and may result in embryonic mortality. Administration of the prostaglandin inhibitor flunixin meglumine to cows and heifers 10 to 13 days after AI (when they were transported) reduced pregnancy losses about 9% (Merrill et al., 2007). However, administration of flunixin meglumine 10 to 15 d after breeding did not increase pregnancy establishment in cows. In another study, handling heifers to administer flunixin meglumine (compared to leaving them in the pasture) reduced pregnancy rates by 6% (Geary

Table 2: Effect of time of transport after insemination on pregnancy rates. *Data adapted from Harrington et al., 1995, and T. W. Geary unpublished data.*

	Days after insemination that transportation occurred			
	1 to 4	**8 to 12**	**29 to 33**	**45 to 60***
Synchronized pregnancy rate	74%	62%	65%	---
% pregnancy loss compared to transportation on days 1 to 4	---	12%	9%	6%*
Breeding season pregnancy rate	95%	94%	94%	---
*Loss in heifers compared to percentage pregnant prior to transportation (pregnancy determined by transrectal ultrasonography)				

et al., 2010). Taken together, these studies provide evidence that some heifers are more susceptible to the stress of handling.

When should I not ship cows?

Shipping cows between days 5 and 42 can be detrimental to embryo survival and cause around a 10% decrease in pregnancy rates (Table 2). Critical time points such as blastocyst formation, hatching, maternal recognition of pregnancy, and adhesion to the uterus take place during this early time of pregnancy. If any of these time points are disturbed, then the result would lead to increased embryonic mortality and decreased pregnancy rates. Research has also demonstrated that shipping cattle 45 to 60 days after insemination can result in 6% of embryos being lost. Therefore, it is important to plan on transporting cattle before the breeding season or immediately after insemination.

When can I ship cows?

Shipping between days 1 – 4 is best. The embryo is still in the oviduct during this time; therefore, it is likely not subjected to uterine changes. Also after day 45, the embryo is well established and fully attached with the placenta; therefore it is less susceptible to the changes resulting from stress. Shipping at this point is less risky. However, embryonic loss from shipping has been reported up to 60 days after insemination. Care should always be taken to try to reduce the stress involved when animals are shipped. Do not overcrowd trailers and handle cattle as gently and calmly as possible.

Heat Stress and Embryonic Mortality

The best time to ship cattle is during early stages of development. However, this is also the time point when the embryo is most susceptible to increased temperatures. Temperature, humidity, radiant heat, and wind all affect heat stress in cows. The rectal temperature of cattle is normally 102.2°F, and an increase in rectal temperature by as little as 2°F can result in decreased embryonic development (Ulberg and Burfening, 1967). When rectal temperatures reach 105.8°F for as little as 9 hours on the day of insemination, embryonic development can be compromised (Rivera and Hansen, 2001). Heat stress has also been reported to change follicular waves, resulting in reduced oocyte quality (Wolfenson et al., 1995). Researchers have reported that heat stress 42 days prior to breeding (Al-Katanani et al., 2001) and up to 40 days after breeding can affect pregnancy rates (Cartmill et al., 2001). This illustrates how important it is to plan ahead for the breeding season.

Several methods have been researched to reduce the effects of heat stress. Shade, fans, and misters can all reduce the effects of heat stress in natural service or AI programs. These methods allow animals to stay cooler during the hottest parts of the day. In humid areas, misters may not actually benefit the animals. If the water cannot evaporate, it will not be effective at cooling the animal.

Producers that utilize AI can also implement fixed-time AI (TAI) protocols to increase pregnancy rates during the hot summer months. Fixed-time AI has increased pregnancy rates over animals inseminated 12 hours after estrous detection in conditions of heat stress (Aréchiga et al., 1998; de la Sota et al., 1998). This is most likely due to fewer animals showing signs of estrus when under heat stress. When the weather is too hot, animals tend not to move around as much and do not show signs of standing estrus. Heat detection is a vital part of getting more animals pregnant. Since fewer animals are seen in heat, fewer animals can be inseminated. In this case, TAI protocols that synchronize ovulation would be the best choice because no heat detection is necessary.

Using embryo transfer during times of heat stress can also increase pregnancy rates. High quality, fresh embryos have been proven to increase pregnancy rates over AI in heat stressed cows (Putney et al., 1989). Embryos at time of embryo transfer can adapt to the elevated temperatures. Therefore, use of embryo transfer during times of heat stress can improve pregnancy success.

Stress from Change in Diet

Changes in nutritional status can also have a tremendous influence on embryonic survival through several mechanisms. Heifers fed 85% maintenance requirements of energy and protein had reduced embryo development on day 3 and day 8 compared to heifers fed 100% maintenance (Hill et al., 1970) indicating decreased embryonic growth. Therefore, changes in nutrition can have a large impact on embryo survival and the ability of heifers to conceive during a defined breeding season.

Previous research has indicated that grazing skills are learned (Flores et al., 1989a, b, c) early in life (Provenza and Balph, 1988). This learned behavior resulted in the development of preferences or aversions to plants and in the development of the skills necessary to harvest and ingest forages efficiently (Provenza and Balph, 1987). Heifers that grazed forage from weaning to breeding rather than being placed in drylots appeared to retain better grazing skills and had increased average daily gains into the subsequent summer (Olson et al., 1992: Perry et al., 2013). A decrease in feed intake from 120% of maintenance to 40% of maintenance resulted in a loss of 56.3 lbs over 2 weeks (4.03 lbs/day; Mackey et al., 1999); similar to the losses reported by Perry et al., (Figure 1) when heifers were moved to grass in the spring after being developed in a drylot from weaning to breeding. However, heifers that were developed from weaning until breeding on range with supplementation showed no weight loss the following spring. Furthermore, heifers that were kept in a drylot until AI (n = 214) had decreased pregnancy rates compared to heifers that had previous grazing experience (n = 207; 59.4% vs. 49.1%, respectively). Therefore, post-insemination nutrition may influence embryonic survival. Nutritionally mediated changes to the uterine environment can occur by changing components of uterine secretions or by influencing the circulating concentrations of progesterone that regulate the uterine environment (see review by Foxcroft, 1997).

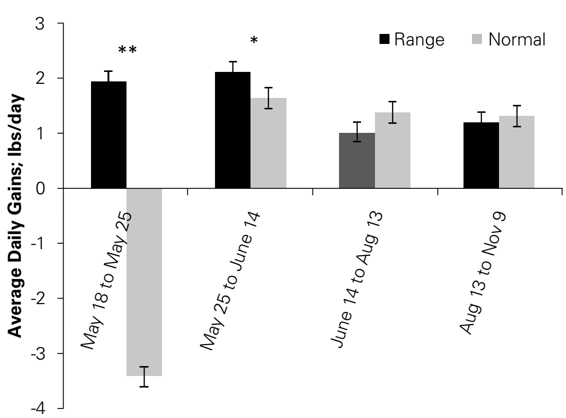

Figure 1: Average daily gain (lbs/day) of heifers weaned and developed on range (Range) compared to heifers weaned and developed in a drylot (Normal). All heifers were moved to the same pasture on May 18th (*P = 0.06; **P < 0.05).

In another recent study, beef heifers (n = 164) were developed in a feedlot from weaning to breeding. At time of insemination heifers were randomly allotted to one of two treatments: 1) heifers were moved from the feedlot to graze spring forage, or 2) heifers were moved to graze spring forage and supplemented with DDGS (5 lbs/hd/day) for 42 days. Pregnancy success was determined 42 days after AI. Heifers that were grazing spring forage alone lost 37 ± 4 lbs, but heifers that were grazing spring forage and were supplemented gained 45 ± 3 lbs from AI to pregnancy determination ($P < 0.01$). Pregnancy success was different between treatments. Heifers that were not supplemented after AI had decreased pregnancy success (61%) compared to heifers that were supplemented (76%). Therefore, when heifers were developed in a feedlot, pregnancy success tended to be influenced by supplementation and subsequent weight gain after moving heifers to grass.

To investigate the idea that the decrease in AI pregnancy success may be due to grazing behavior and not just a change in diet, an experiment was conducted where heifers were moved from a grazing environment to a drylot following AI. Beef heifers at one location (n= 333) were developed on a forage diet from weaning to breeding. All heifers were brought into a feedlot and synchronized with a 7-d CO-Synch + CIDR protocol. At time of insemination heifers were randomly allotted to one of three treatments: 1) heifers were returned to graze spring forage, 2) heifers were returned to graze spring forage plus supplemented with DDGS (5 lbs/hd/day) for 42 days, or 3) heifers remained in the feed lot after AI for 42 days. Pregnancy success was determined 42 days after AI. Body condition increased from the day synchronization began (day -7; 5.4 ± 0.05) to day 42 in both the heifers that were supplemented on pasture and the heifers that were kept in the feed lot (5.9 ± 0.04 and 5.8 ± 0.04, respectively). Body condition did not change from day -7 to day 42 among the heifers that were on grass alone (5.4 ± 0.05 and 5.4 ± 0.04 for day -7 and day 42, respectively). Pregnancy success did not differ among treatments (59% (65/111), 57% (63/111), and 56% (62/111) for heifers on grass alone, heifers on grass plus supplemented, and heifers in the feed lot, respectively). Therefore, when heifers were developed on grass, there was no effect on pregnancy success whether they were returned to grass with or without supplementation or even kept in the feed lot after breeding.

To further investigate if method of heifer development could impact grazing behavior, an experiment was conducted to measure daily activity between drylot developed heifers that had been moved to grass before AI compared to heifers that were moved to grass on the day of AI. Sixty-nine drylot developed heifers were randomly allotted to one of two treatments: 1) heifers remained in the drylot for 42 days, or 2) heifers were moved to graze spring forage for the 42 day prior to AI. Daily activity was measured by a pedometer. Heifers that were grazing spring forage took more steps per day compared to heifers in the drylot (Figure 2). However; following the 42 day period, heifers that had remained in the drylot and were turned out to grass at AI had increased activity compared to heifers that had previous experience grazing spring forage (Figure 3). When activity is increased energy requirements are also increased. Cows that were forced to walk ~3 miles per day had a greater than 30% increase in energy requirements compared to cows that were held in a drylot (Bellows et al., 1994). Hence, heifers switched from a drylot to pasture are not accustom to grazing, forced to eat a novel diet, and exert increased energy during the period following AI. These factors combined may be the reason some heifers developed in a drylot and moved to forage after insemination have reduced conception rates. Therefore, keeping consistency in management during the breeding season is important to achieving optimum pregnancy success.

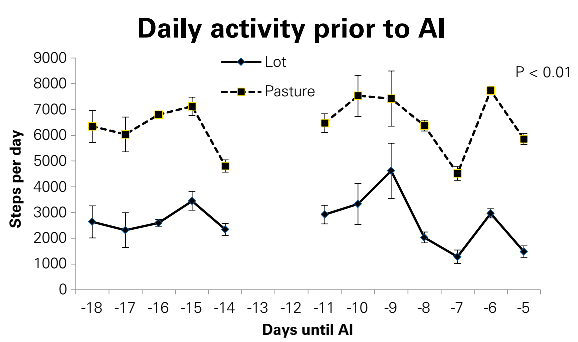

Figure 2: Daily activity for heifers that remained in the drylot until AI (LOT), and heifers that were moved to graze spring forage for the 42 days prior to AI (Pasture).

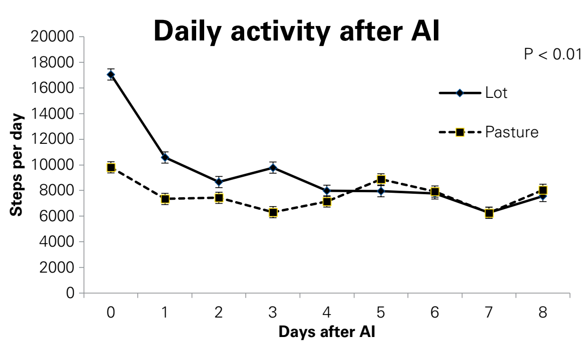

Figure 3: Daily activity for heifers that remained in the drylot until AI (LOT), and heifers that were moved to graze spring forage for the 42 days prior to AI (Pasture).

Summary

Although nature contributes to most embryonic losses, management practices can also increase embryonic mortality. Stress, in particular, can be detrimental to embryos and decrease pregnancy rates. Animals vary in their ability to handle or adapt to changes with heifers being more susceptible to stressors than cows. Following insemination the embryo is most susceptible to heat stress before the maternal to zygotic transition on day 4 or 5. Shipping cattle after the embryo has moved into the uterus can have negative effect possible through 60 days after insemination. While abrupt changes in diet likely have the greatest impact on embryo survival before the embryo attaches to the uterus around day 20 as during this time period the embryo is totally dependent on the secretions from the uterus for survival. Therefore, it is essential to try to minimize stress and/or major changes following insemination to maximize pregnancy success.

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