Estrual Behavioral Patterns in Prostaglandin-induced and Naturally Cycling Recipient Females from a Commercial Embryo Transfer Center

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Findings

- Prostaglandin-induced recipients exhibited a longer, more intense estrus than naturally cycling recipients.
- Synchronization with prostaglandin does not affect time of onset or end of estrus in potential embryo recipient females.
- The length of standing estrus can be used to identify a portion of the prostaglandin-induced female recipient pool for improved pregnancy rates following embryo transfer.

Introduction

The success of any embryo transfer operation ultimately resides in the reproductive performance of the recipient females. Several factors, including the type of synchronization and degree of synchrony, have been implicated in reduced pregnancy rates often found in recipient females. Manipulation of the estrous cycle in cattle to increase the number of suitable candidates to be used as embryo recipients typically involves the use of hormonal agents (for example, prostaglandins, progestins). Several reports indicate that the use of prostaglandins (Lutalyse®) increases pregnancy rates after embryo transfer, but it is not clear whether the increase is caused by the properties of the prostaglandin administered or increased accuracy of estrous detection following the prostaglandin treatment. The degree of synchrony (defined as the difference in hours between the onset of estrus of the recipient and the onset of estrus of the donor) certainly plays a role in transfer pregnancy rates. Researchers agree that as the degree of synchrony increases, pregnancy rates of recipients increase. Some reports have suggested that asynchrony of +24 to -48 hours did not affect overall pregnancy rates; others indicate that asynchrony of as little as ±24 hours can result in lower recipient pregnancy rates.

The purpose of this study was to determine if the behavioral patterns exhibited by potential recipients during estrus could be used as an indicator of subsequent pregnancy rates following embryo transfer. The behavioral responses (measured by an electronic estrous detection system) could give the embryologist another tool to make decisions at the time of transfer based on estrual behavioral patterns of the recipient recorded 6 to 8 days earlier.

Experimental Approach

A total of 1,812 embryos were nonsurgically transferred to recipient females from April 15 through September 15 at TransOva Genetics, Sioux Center, Iowa. Primarily beef cross cattle were used as embryo recipients for mixed breed donor females. Body condition scores of these recipients ranged between 7 and 8 (1=thin and 9=obese). All cattle were fitted with HeatWatch™ (DDx Inc., Denver, Colorado) transponders and assigned to one of two treatments as follows: naturally cycling (n=816) or prostaglandin-induced (n=996). Cows in the prostaglandin-induced treatment group received a single intramuscular 25 mg dose of Lutalyse®, and any female that exhibited standing estrus was considered a potential embryo recipient. Cows in the untreated treatment group were allowed to cycle naturally, and likewise any animal that exhibited standing estrus was classified as a potential embryo recipient. Data from the recipient pool were retrospectively retrieved from the HeatWatch™ computer system of TransOva Genetics at the Sioux Center, Iowa, facilities. The electronic system was used to determine the time of estrus onset and the cessation (end) of estrus for transplantation of fresh or frozen embryos on days 6 to 8 following the onset of estrus. Recipients that did not have a CL at rectal palpation did not receive an embryo and were returned to the recipient pool.

The criterion used to determine the onset of estrus was 4 mounts by herd mates within a 6-hour period. Any animal that did not meet this criterion was not included in the data set. Concurrently, cessation of estrus was determined by the absence of at least 4 mounts within a 6-hour period. Based on the distribution of the length of estrus from 1,812 recipients, a distribution category was assigned to each recipient

female. These categories were: 1) estrus length of less than 11 hours, 2) estrus length of between 11 and 17 hours and 3) estrus length longer than 17 hours. Pregnancy rates were compared for recipients across various behavioral parameters as well as those receiving either fresh or frozen-thawed embryos.

Fresh, frozen-thawed and in vitro fertilized (IVF) derived embryos were stratified across treatment groups. Embryos were graded on the standard industry scale (grade 1 - excellent, no granulation; grade 2 - good, slight granulation and little cellular debris; grade 3 - fair to poor, with granulation, cellular debris and irregular cell size).

Results and Discussion

In this study, whether potential recipient females exhibited natural or induced estrus, approximately 50% of the females exhibited estrus longer than 11 hours but less than 17 hours (Figure 1). As expected, fewer females exhibited estrus longer than 17 hours. Prostaglandin-induced recipients had significantly more mounts per female per estrus, more total number of seconds stood per estrus and a longer estrus length than naturally cycling recipients (Table 1). Many characteristics of the estrual response exhibited by these females, however, were similar between the prostaglandin-induced and naturally cycling recipients, such as the number of mounts per hour, number of seconds stood per mount and number of seconds stood per hour (data not shown). The total number of mounts per recipient per estrus for both naturally cycling and prostaglandin-induced recipients in our study was somewhat lower than total mounts per female per estrus reported by others for either naturally cycling dairy heifers or prostaglandin-induced beef heifers.

Prostaglandin treatment did not affect the pattern of onset and the cessation of estrus across the 24-hour day when 6-hour time frames were compared (Table 2). Length of estrus did not affect pregnancy rates for naturally cycling recipients receiving fresh grade-1 or -2 embryos (Table 3). Prostaglandin-induced recipients, however, receiving fresh grade-1 or -2 embryos with a length of estrus longer than 17 hours had higher ($P<.05$) pregnancy rates (78%) when compared with similarly induced recipients with an estrus length of between 11 and 17 hours (42%).

Furthermore, the length of estrus did not affect the pregnancy rates of recipients receiving grade-3 embryos. The length of estrus had no effect on pregnancy rate for recipients receiving frozen-thawed or IVF-derived embryos (Table 3).

As expected, frozen-thawed embryos generally had lower pregnancy rates when compared with recipients receiving similar grade fresh embryos. The overall pregnancy rates for recipients receiving fresh and frozen-thawed embryos were 64% and 50% for naturally cycling and 56% and 52% for prostaglandin-induced recipients, respectively.

Based on the observations from this study, recipient females that were induced to cycle with prostaglandin exhibited a longer, more intense estrus that would allow more opportunities for detection of estrus by an observer. Also, synchronization of recipient females does not affect the time of onset or cessation of estrus; therefore, recipient females as needed for embryo transfer treated with prostaglandin would not have to be managed any differently for estrus detection. Finally, length of estrus did not affect pregnancy rates of any naturally cycling recipients in this study; however, prostaglandin-induced recipients receiving a fresh grade-1 or -2 embryo and having a length of estrus longer than 17 hours had higher pregnancy rates than similarly cycling recipients receiving similar embryos and exhibiting estrus for 11 to 17 hours. The reason for this is unclear. Since 49% of prostaglandin-induced recipients in this management system had an estrus that lasted between 11 and 17 hours, it is not recommended that these animals be excluded from the recipient pool. Further study is needed to verify these findings.

Acknowledgment

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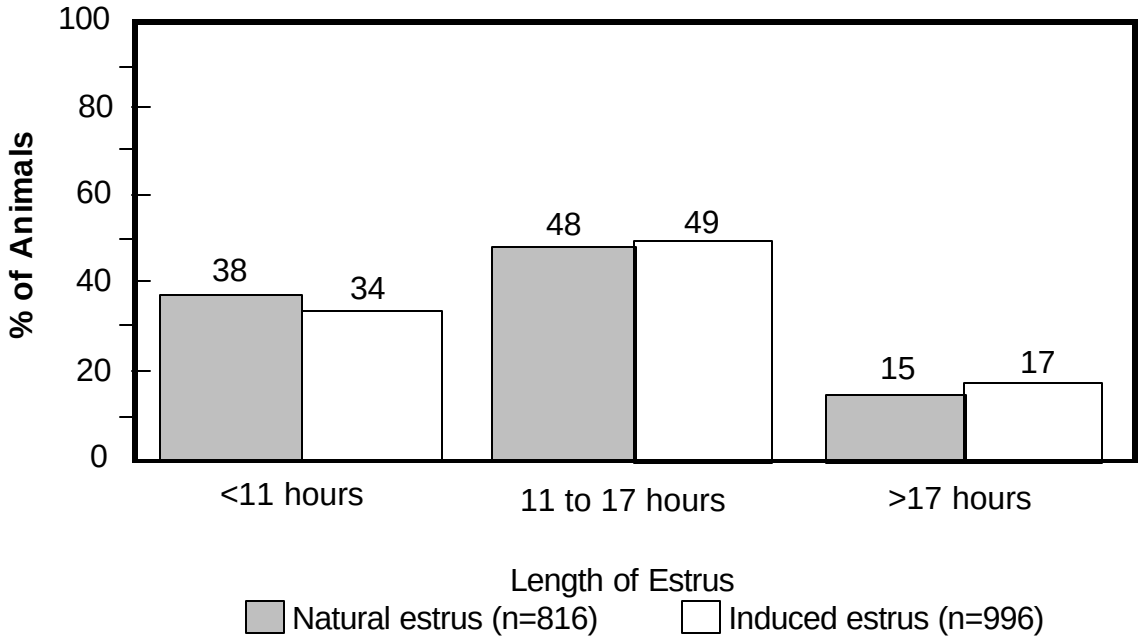

Figure 1. Distribution of estrus periods of naturally cycling and prostaglandin-induced recipient females.

Table 1. Effect of estrous synchronization on the estrual characteristics of recipient females

	Estrual behavior[a,b]	
Characteristic	Natural	Induced
Number of recipients	816	996
Length of estrus/female, (hours)	12.2[c] ± 0.2	12.7[d] ± 0.1
Total number of mounts/female/estrus	42[c] ± 1.1	47[d] ± 1.0
Total number of seconds stood/estrus	145[c] ± 4.2	163[d] ± 3.8

[a] Mean ± standard error of the mean.

[b] Information collected by electronic HeatWatch™ system.

[c,d] Values across rows with different superscripts are different (P<.05).

Table 2. Percent distribution of the time of onset and time of cessation of standing estrus during a 24-hour period for recipient females[a]

Characteristic	0000 to 0559 h	0600 to 1159 h	1200 to 1759 h	1800 to 2359 h
Natural estrus:				
Onset of first standing event	22%	20%	25%	33%
Onset of last standing event	26%	31%	17%	26%
Prostaglandin-induced estrus:				
Onset of first standing event	23%	22%	23%	32%
Onset of last standing event	24%	36%	18%	23%

[a] Information collected using the HeatWatch™ system.

Table 3. Effect of embryo type and grade, type of estrus and length of estrus on the pregnancy rate in recipient females

Embryo type and grade	Treatment (type of estrus)	Length of estrus <11 h	Length of estrus 11 to 17 h	Length of estrus >17 h
			Pregnancy rate, %	
Fresh embryos grades 1 and 2	Prostaglandin-induced	68	42[a]	78[b]
	Naturally cycling	73	63	56
Fresh embryos grade 3	Prostaglandin-induced	54	50	55
	Naturally cycling	46	48	53
Frozen-thawed embryos grades 1 and 2	Prostaglandin-induced	50	51	54
	Naturally cycling	49	49	57
IVF[c] derived embryos grades 1 and 2	Prostaglandin-induced	61	55	55
	Naturally cycling	50	57	54

[a,b] Values across rows with different superscripts are different (P<.05).
[c] IVF = in vitro fertilized.