EVALUATING ELECTRONIC ESTRUS DETECTION IN A CONTRACT RECIPIENT BOVINE EMBRYO TRANSFER PROGRAM

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INTRODUCTION

The recent introduction of electronic estrus detection of recipients has the potential of affecting the efficiency of embryo transfer. The use of electronic estrus detection may improve the accuracy and precision of estrus detection in embryo transfer recipients and facilitate a program for repeated use of recipients that fail to become pregnant following initial embryo transfer. As part of a large contract recipient bovine embryo transfer project, the effects of an electronic estrus detection system were evaluated.

METHODS AND PROCEDURES

Embryo freezing, transfer and pregnancy rate: A total of 1058 bovine embryos were transferred in three transfer episodes over 8 weeks. A portion of the embryos were transferred within 6 hr after collection (fresh, n=74). The remaining embryos were frozen and thawed for direct transfer using ethylene glycol as a cryoprotectant (direct, n=783) or were thawed and rehydrated after being frozen in 10% glycerol (glycerol, n=201). The fresh embryos were collected by a single practitioner. The frozen embryos were supplied by 13 different embryo transfer companies. Five companies supplied embryos frozen in ethylene glycol and 11 companies provided embryos frozen in glycerol. Therefore, the effects of the source of embryos and the freezing method cannot be determined separately in this project.

Regardless of embryo type (fresh, direct or glycerol), the embryos were all transferred to synchronous recipients by a single practitioner. Thawing and rehydration of embryos frozen in 10% glycerol were conducted by a single practitioner and all the embryos were loaded into side-delivery embryo transfer gun by one technician.

Pregnancy rates were determined by ultrasound detection of a viable embryo at approximately 28 d of gestation (range 25 to 32 d). Differences in pregnancy rates due to embryo type, embryo quality or recipient factors were analyzed using procedures appropriate for analysis of categorical data (CATMOD, Statistical Analysis System).

Recipients and estrus detection: The contract recipient embryo transfer program was conducted at the Virginia Beef Corporation, Virginia's largest commercial beef producer. Embryos supplied by the embryo owner were transferred to recipient cows or heifers owned by Virginia Beef. Virginia Beef assumed all costs associated with embryo transfer and production of a weaned calf. The embryo owner received a weaned, pre-conditioned calf at a price negotiated prior to transfer.

Estrus was synchronized in 851 crossbred cows or heifers using Syncro-Mate B. Estrus was detected exclusively using an electronic heat detection system manufactured by DDx Inc. (Boulder, CO). The HeatWatch™ system consisted of a battery-powered, reusable, pressure-sensing radio frequency transmitter contained in a pouch glued to the tailhead of the animal. The transmitter signal was emitted when the device was activated by pressure from mounting activity. A signal receiver (.4 mi. range) was hard-wired to a buffer which received and stored mounting activity data until it could be downloaded using HeatWatch™ software. The animal identification number, time of mounting and duration of each mount were recorded. Designation of a "heat" was defined by the operator as three mounts during a 4-hr period. A data file containing all mounting activity was created and exported as a print file. The print file was imported to a spreadsheet program and manipulated with database functions to facilitate the assignment of embryos to recipients based on the stage of the embryo and synchrony of the embryo and recipient.

To avoid loss of the transmitters, a method was devised to secure the pouches containing the transmitters to each animal. A 6-mm plastic electrical tie was placed subcutaneously just lateral to the tailhead with a Buhner needle. A pig tail attached to the pouch containing the transmitter was connected in a loop through the electrical tie. If the pouch came free from the tailhead, it hung from the electrical tie via the pig tail and could be recovered. It became apparent that pig tails made of flexible fabric rather than wire remained in place better and caused less irritation to the tail.. Ties placed adjacent to the tailhead 30 days prior to administration of the transmitters caused the least trauma to the animal. Glue was applied to the pouch, the Velcro seal on the pouch and to the pig tail to prevent loss of the transmitters. Four receivers were required in the area to be monitored by the HeatWatch™ system during this project.

RESULTS

The overall pregnancy rate following the transfer of fresh and frozen bovine embryos was 59% (Table 1). There was no significant difference among pregnancy rates due to embryo type (fresh, direct or glycerol). Furthermore the difference in pregnancy rate following the direct transfer of embryos frozen in ethylene glycol and the transfer of embryos frozen in 10% glycerol was not significant.

Table 1. The Effects of Embryo Type and Embryo Quality on Pregnancy Rate[a] Following Bovine Embryo Transfer

	Embryo Quality			
Embryo Type	**Grade 1**	**Grade 2**	**Grade 3**	**Total**
Fresh	66.7% (20/30)	61.3% (19/31)	0% (0/5)	62.2% (46/74)
Direct	64.1% (321/501)	51.6% (144/279)	100% (3/3)	59.8% (468/783)
Glycerol	60.6% (63/104)	51.9% (42/81)	31.3% (5/16)	54.7% (110/201)
Total	63.6% (404/635)	52.4% (205/391)	33.3% (8/24)	59.0% (624/1058)

[a] Pregnancy rate was determined by ultrasonography at 28 d.

Recipients were continuously monitored for estrus activity using HeatWatch™ over a 60-d period. After the initial embryo transfer, any recipient recording mounting activity was eligible to be reused for another embryo transfer. Any recipient not detected in estrus or rejected for the first transfer was also re-synchronized to be in estrus at the time of non-pregnant recipients from the first transfers. To avoid transferring a second embryo to a pregnant recipient, each recipient identified by HeatWatch™ mounting data to be reused was checked for pregnancy with ultrasonography prior to a second transfer. Of the 438 recipients that became pregnant following the first embryo transfers, 21 (4.8%) exhibited some mounting activity (≥1 mount), but were determined to be pregnant. However, if the threshold for mounting activity used to define a heat period was increased from one to three mounts, the frequency of false identification of heat was reduced to 0.5% (2/438; Table 2).

Combining ultrasonography and HeatWatch™ mounting data allowed for the evaluation of the accuracy of the HeatWatch™ system to detect pregnancy following the first and second episodes of embryo transfer. After the first transfers 496 recipients had no recorded mounting activity, however, ultrasound revealed that of these only 438 were pregnant (438/496; 88.3%). The accuracy of pregnancy detection following the second transfer was 63.3% (145/229).

Table 2. Frequency of False Detection of Estrus in Recipients Following Embryo Transfer

No. of Mounts	**No. of Recipients**	**Frequency of False Detections**	
1	14	14/438	3.2%
2	5	5/438	1.1%
≥3	2[a]	2/438	0.5%
Total	21	21/438	4.8%

[a] These recipients exhibited 3 and 6 mounts each, respectively.

The pregnancy rate decreased 5.5% from the first to the third transfer episode, but this decrease was not statistically significant. Heat detection efficiency was greater ($P<.05$) prior to the first transfer episode (91.9%) than prior to the second. HeatWatch™ indicated that only

272/413 (65.9%) eligible recipients were in estrus prior to the second transfers . The low heat detection rate prior to the second transfers may have been due to severe weather and average temperatures of < 20° F that occurred during that period. Recipients that may have been noncyclic also became a greater proportion of the recipient pool as the number of eligible recipients decreased.

Table 3. Estrus Detection and Pregnancy Rates Following Sequential Use of Recipients for Bovine Embryo Transfer

Item	First Transfers		Second Transfers		Third Transfers	
Eligible recipients	851		413		NA[a]	
Detected in heat	782	(91.9%)	272	(65.9%)	83	
Rejected for transfer	55	(7.0%)	16	(5.9%)	8	(9.6%)
Total transferred	727		256		75	
Pregnant @ 28 d	438	(60.2%)	145	(56.6%)	41	(54.7%)

[a] Eligible recipients were arbitrarily removed following estrus detection for management reasons

The use of HeatWatch™ electronic estrus detection system in this project was mandated by the scope of the project and the availability and experience of the labor force for heat detection. Negotiation of a 60-d lease and ownership of a computer prior to the project were important factors in controlling costs. The large number of recipients over which fixed costs (receivers, supplies) could be spread and the relatively low rate of transmitter loss (5.5%) also helped contain the cost of using the HeatWatch™ system to $20.34 per recipient (Table 4).

Table 4. Economic Analysis of HeatWatch™ Estrus Detection System

Item	Amount
No. transmitters/recipients	851
Cost per transmitter (60-d lease)	$10.00
Cost per receiver (4 required)	$250.00
Cost per pouch	$3.40
Glue and electrical tie material per recipient	$1.90
Cost per transmitter lost (47 lost)	$70.00
Total cost of HeatWatch™ system	$17,310.00
Cost per recipient	$20.34
Cost per embryo transferred	$16.36
Cost per pregnancy	$27.74

CONCLUSION

HeatWatch™ electronic estrus detection reduced the labor required and provided accurate detection of estrus in this project. The HeatWatch™ system, like visual estrus detection, was unable to detect heat in a situation in which the estrous behavior of the animals was influenced by adverse environmental conditions. Data exported from the HeatWatch™ system enabled more precise matching of embryo development and recipient synchrony. The cost of electronic estrus detection per recipient was reduced because large numbers of recipients were synchronized and used repeatedly in this project. The one-time cost of using the system was also reduced by leasing of the equipment. The feasibility of using HeatWatch™ will depend on these and other factors which are unique to each embryo transfer client.