

Effects of bovine somatotropin and timed embryo transfer on pregnancy rates in non-lactating cattle

J. BLOCK, R. M. RIVERA, M. DROST,
F. D. JOUSAN, C. R. LOONEY, F. T. SILVESTRE,
F. F. PAULA-LOPES, O. M. OCON, H. ROSSON,
T. R. BILBY, R. L. MONSON, J. J. RUTLEDGE,
P. J. HANSEN

THE success of embryo transfer in cattle can be compromised by low pregnancy rates, especially when embryos produced in vitro are used (Farin and Farin 1995, Hasler and others 1995), and by poor oestrus detection. One approach to improve embryo survival is to treat the recipient animal with appropriate hormones. For example, the use of recombinant bovine somatotropin (bST) in lactating dairy cows increased pregnancy rates following the transfer of frozen-thawed embryos (Moreira and others 2002). This effect may be mediated directly by bST or indirectly by insulin-like growth factor I (IGF-I) (de la Sota and others 1993). It is unclear whether this beneficial effect of bST on fertility can be achieved in non-lactating cows, since they have higher plasma concentrations of IGF-I (de la Sota and others 1993). Poor detection of oestrus can be overcome by performing timed embryo transfer (TET): ovulation synchronisation protocols are used, and embryo transfer can then be carried out at a fixed time without the need to detect oestrus (Ambrose and others 1999, Al-Katanani and others 2002, Bo and others 2002). This short communication describes a study with two aims: first, to determine whether the administration of bST to non-lactating cows would improve the post-transfer survival of in vitro produced (IVP) embryos, and secondly to determine whether pregnancy rates achieved following TET using either IVP or superovulated embryos were similar to those achieved by timed artificial insemination (TAI).

In the first experiment, embryos produced in vitro as described by Block and others (2003) were transferred into a total of 47 non-lactating cows and heifers (11 Aberdeen Angus and 36 Holstein), over six separate occasions, with six to 12 recipients on each transfer date. Oocytes for fertilisation were obtained from ovaries collected in an abattoir. They were matured for 21 to 24 hours in vitro and then fertilised with sperm prepared from a mixture of semen from two Jersey bulls during an incubation period of eight to 10 hours. Seven days after fertilisation, 33 grade 1 and seven grade 2 blastocysts (Robertson and Nelson 1998) and five grade 1 morulae were harvested for transfer. The procedure for production of the embryos was the same for each transfer date except that a different pair of bulls was used for each fertilisation procedure.

The recipients were synchronised for TET using 25 mg prostaglandin F_{2α} (Lutalyse; Pfizer Animal Health) administered intramuscularly, twice, 14 days apart, followed 12 days later by the OvSynch protocol, which involves 100 µg gonadotrophin-releasing hormone (GnRH) (Cystorelin), 25 mg PGF seven days later, and 100 µg GnRH 48 hours after the PGF. On the day of synchronised ovulation, 24 hours after the second GnRH injection, the cattle were randomly assigned either to receive 500 mg bST (Monsanto) or to be used as untreated controls. On day 7 after the synchronised ovulation, the ovaries of all the cattle were examined per rectum to

TABLE 1: Effects of the breed of recipient cattle and bovine somatotropin (bST) treatment on pregnancy rates at day 42 to 49 of pregnancy

	Pregnancy rate (number pregnant/ total [%])	Odds ratio	95 per cent CI	P
Breed				
Holstein	8/35 (22.9)	0.45	0.10-2.00	0.29
Angus	4/10 (40.0)			
Treatment				
bST	5/10 (25)	0.89	0.23-3.40	0.89
Control	7/25 (28)			

CI Confidence interval

determine the presence of a corpus luteum. If one was present, a single, fresh IVP embryo, produced and harvested as described above, was transferred to the horn ipsilateral to the ovary with a corpus luteum. Animals without a palpable corpus luteum did not receive an embryo and were excluded from the experiment. Pregnancy was diagnosed at 42 to 49 days of gestation by palpation per rectum. The data were analysed by logistic regression using the PROC LOGISTIC procedure of SAS statistical software (SAS 1989).

The pregnancy rate was not significantly affected by the bST treatment and was similar in the two groups (Table 1). While there was a numerically higher pregnancy rate in Aberdeen Angus recipients, breed had no significant effect.

In a second experiment, a total of 85 non-lactating Holstein cows and heifers were subjected to either TAI, TET using fresh IVP embryos, or TET using frozen-thawed superovulated embryos, over three separate occasions. In vitro production of the embryos was as described above except that fertilisation was carried out with sperm pooled from two Angus bulls (with a different pair of bulls used each time) and the embryo culture medium contained 100 ng/ml human recombinant IGF-I (Upstate Biotechnology), as described by Block and others (2003). The IVP embryos used for transfer were all grade 1 blastocysts collected on day 7 after fertilisation. Grade 1 morulae and blastocysts from superovulated cows were recovered, on day 7 after oestrus, from five donor cattle. These embryos were frozen in 1.5M ethylene glycol for direct transfer.

Ovulation in the recipients was synchronised using the OvSynch protocol, as described for the first experiment. Cattle assigned to TAI were inseminated at day 0 of synchronised ovulation, 16 to 18 hours after the second GnRH injection of the OvSynch protocol, with semen from one of the six Angus bulls used to produce the IVP embryos. The procedures for TET were the same as those described for the first experiment. Pregnancy was diagnosed by ultrasonographic examination on day 30 and day 51 of gestation.

The pregnancy rates were identical on day 30 and day 51 of gestation. The proportions and percentages of cows that became pregnant were 11 of 27 cows (40.7 per cent) for TAI, six of 14 cows (42.9 per cent) for TET with a frozen-thawed superovulated embryo, and six of 15 cows (40 per cent) for TET with an IVP embryo. There was no significant difference between the three treatments on the pregnancy rate achieved.

The administration of bST to non-lactating recipient cattle did not increase embryo survival following TET with IVP embryos. Moreover, the results of the second experiment indicate that the transfer of IVP embryos in a TET scheme can result in similar pregnancy rates to those achieved by TAI and TET with frozen-thawed embryos produced by superovulation. The failure of bST to increase pregnancy rates in non-lactating recipients is in contrast to the positive effects seen in lactating recipients (Moreira and others 2002). The authors

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J. Block, MS,
R. M. Rivera, PhD,
F. D. Jousan, MS,
F. T. Silvestre, BS,
F. F. Paula-Lopes, PhD,
O. M. Ocon, BS,
H. Rosson, MAg,
T. R. Bilby, MS,
P. J. Hansen, PhD,
Department of Animal
Sciences,
M. Drost, DVM,
Department of Large
Animal Clinical Sciences,
University of Florida,
Gainesville, FL 32611, USA
R. L. Monson, MS,
J. J. Rutledge, PhD,
Department of Animal
Sciences, University of
Wisconsin-Madison,
Madison, WI 53706, USA
C. R. Looney, PhD,
Ovagenix, Bryan,
TX 77868, USA

Correspondence to
Professor Hansen, PO Box
11090, Gainesville,
FL 32611-0910, USA

speculate that bST causes increased embryonic survival by increasing IGF-I secretion, and is ineffective in non-lactating cows because these animals have higher blood concentrations of IGF-I than lactating cows do (de la Sota and others 1993, Bilby and others 1999).

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