ATTEMPTS TO DETERMINE THE OPTIMAL TIME OF ARTIFICIAL INSEMINATION IN HEIFERS

J. F. ROCHE

Agricultural Institute, Grange, Dunsany, Co. Meath, Ireland

(Received 2nd May 1974)

To be ultimately successful, techniques used to control the oestrous cycle of the cow will have to embody methods which allow the time of insemination to be arranged without reference to behavioural oestrus. This is particularly important in the case of beef suckler cows as it is difficult to detect heat in these animals probably owing to the suckling stimulus. This means that treatments used to synchronize the oestrous cycle will also have to give precise control of the time of ovulation or that other hormones will have to be given to control ovulation time. The aim of the experiment described in this paper was to obtain hormonal control of the time of ovulation following synchronization of oestrus with implants of progesterone (Roche, 1974a). This would allow all animals to be inseminated on a fixed time basis.

Eighty-four mature Hereford cross heifers fed on grass silage during the winter of 1972 were randomly assigned to different treatments. Twenty-four untreated control heifers were inseminated as they came into oestrus. All the remaining animals received implants of progesterone for 21 days (Roche, 1974a) and twelve were inseminated as they came into oestrus following removal of the implants. Twelve more heifers, given 400 μg oestradiol benzoate intramuscularly in oil 20 hr after removal of the implants, were inseminated at 18 hr and at 24 hr after the oestrogen injection. Twenty-three heifers were given 1500 i.u. HCG intramuscularly 24 hr after removal of the implants and were inseminated at 16 and 22 hr after the HCG. Finally, twenty-five heifers were given 100 μg gonadotrophin-releasing factor (Gn-RH) intramuscularly 30 hr after removal of the implants and were inseminated at 6 and 12 hr after Gn-RH injection. The heifers were inseminated with frozen semen by inseminators from a commercial A.I. station. Inseminations were carried out according to the schedule outlined previously (Roche, 1974b). Twelve of the controls and the heifers which received Gn-RH were inseminated with semen from the same ejaculate (Semen A), while the remainder were inseminated with semen from a different bull (Semen B). All animals were slaughtered 30 to 40 days after insemination and the reproductive tracts were examined to determine the numbers which were pregnant based on the presence of live embryos.

The conception rates obtained following the various treatments are shown in Table 1. Since the conception rate in the control heifers inseminated with semen from different bulls was similar, the conception rates for the different treatments were compared. The fertility obtained following all synchronizing

Table 1. The conception rates of control and treated heifers to A.I. following attempts to control ovulation

Treatment	Time of A.I.	No. of heifers	No. inseminated	Semen used	Heifers pregnant following A.I.	
					No.	%
Control	At oestrus	12	11	B	7	64
		12	12	A	8	66
Progesterone implants for 21 days	At oestrus	12	11	B	4	35
Progesterone implants + 400 µg OB	18 and 24 hr after OB	23	23	B	4	17
Progesterone implants + 1500 i.u. HCG	16 and 22 hr after HCG	12	12	B	2	17
Progesterone implants + 100 µg Gn-RH	6 and 12 hr after Gn-RH	25	25	A	11	44

OB, oestradiol benzoate; HCG, human chorionic gonadotrophin; Gn-RH, gonadotrophin-releasing factor.

treatments was lower than the conception rate in the untreated control animals. Of the different hormones used in attempts to control the time of ovulation, only animals inseminated after the injection of Gn-RH gave promising results based on the time schedules used when progesterone was given for 21 days to control the oestrous cycle.

Injection of synthetic Gn-RH has been shown to cause a release of LH similar in magnitude to the ovulatory surge in sheep (Reeves, Arimura, Schally, Kragt, Beck & Casey, 1972; Rippel, Mauer & White, 1972), in cattle (Mauer & Rippel, 1972; Zolman, Convey, Britt & Hafs, 1973) and in pigs (Chakraborty, Reeves, Arimura & Schally, 1973). The responsiveness of the pituitary to synthetic Gn-RH depends on the endocrine state of the animal at the time of injection (Convey, 1973). The heifers in this experiment were injected during the follicular phase which is the period when maximal release of LH from the pituitary is obtained (Convey, 1973). Oestrogen is also known to cause release of a large surge of LH in cattle at the dose level used in this experiment (Hobson & Hansel, 1972) so that it should be effective in synchronizing the release of LH and presumably ovulation as there is a constant interval between the LH peak and time of ovulation in ewes (Cumming, Buckmaster, Blockey, Goding, Winfield & Baxter, 1973). When given after progestagen administration, HCG is also effective in controlling the time of ovulation in cattle (Graves & Dziuk, 1968; Roche & Crowley, 1972).

The reasons for the low fertility in the animals inseminated on a fixed time basis are not clear. Failure to control the time of ovulation, insemination of heifers at the wrong time in relation to ovulation or an abnormal pattern of secretion of steroid hormones at this time would all affect the conception rate.

It is apparent from the results that the use of Gn-RH holds out the most promise when used in heifers synchronized with implants of progesterone for 21 days. It has been shown that the apparent key to achieving high conception

rates in heifers synchronized with implants of progesterone is to reduce the period of administration from 18 days to 9 or 12 days (Roche, 1974c). Some of the hormones used in this experiment to control ovulation following short-term progesterone treatments may allow heifers to be inseminated on a fixed time basis and achieve normal conception rates.

The author wishes to thank Dr Myron Brown of Abbott Labs for supply of Gn-RH, Dr F. J. Harte for facilities provided, Mr D. Prendiville for excellent technical help and the Dublin District Milk Board for semen used.

REFERENCES

- CHAKRABORTY, P. K., REEVES, J. J., ARIMURA, A. & SCHALLY, A. V. (1973) Serum LH levels in prepubertal female pigs chronically treated with synthetic luteinizing hormone-releasing hormone/follicle stimulating hormone-releasing hormone (LH-RH/FSH-RH). *Endocrinology*, **95**, 52.
- CONVEY, E. M. (1973) Neuroendocrine relationships in farm animals: a review. *J. Anim. Sci.* **37**, 745.
- CUMMING, I. A., BUCKMASTER, J. M., BLOCKEY, M. A. DE B., GODING, J. R., WINFIELD, C. G. & BAXTER, R. W. (1973) Constancy of interval between luteinizing hormone release and ovulation in the ewe. *Biol. Reprod.* **9**, 24.
- GRAVES, C. N. & DZIUK, P. J. (1968) Control of ovulation in dairy cattle with human chorionic gonadotrophin after treatment with 6 α -methyl-17 α -acetoxy-progesterone. *J. Reprod. Fert.* **17**, 169.
- HOBSON, W. C. & HANSEL, W. (1972) Plasma LH levels after ovariectomy, corpus luteum removal and estradiol administration in cattle. *Endocrinology*, **91**, 185.
- MAUER, R. E. & RIPPEL, R. H. (1972) Response of cattle to synthetic gonadotropin releasing hormone. *J. Anim. Sci.* **35**, 249.
- REEVES, J. J., ARIMURA, A., SCHALLY, A. V., KRAGT, C. L., BECK, T. W. & CASEY, J. M. (1972) Effect of synthetic luteinizing hormone-releasing hormone/follicle stimulating hormone-releasing hormone (LH-RH/FSH-RH) on serum LH, serum FSH and ovulation in anestrus ewes. *J. Anim. Sci.* **35**, 84.
- RIPPEL, R. H., MAUER, R. E. & WHITE, W. F. (1972) Response of the prepubertal ewe to gonadotropin releasing hormone. *J. Anim. Sci.* **35**, 252.
- ROCHE, J. F. (1974a) Synchronization of oestrus in heifers with implants of progesterone. *J. Reprod. Fert.* **41**, 337.
- ROCHE, J. F. (1974b) Synchronization of oestrus and fertility following artificial insemination in heifers given prostaglandin F_{2 α} . *J. Reprod. Fert.* **37**, 135.
- ROCHE, J. F. (1974c) Effect of short-term progesterone treatment on oestrous response and fertility in heifers. *J. Reprod. Fert.* **40**, 433.
- ROCHE, J. F. & CROWLEY, J. P. (1972) Control of oestrus and ovulation in heifers. *Proc. 7th Int. Congr. Anim. Reprod. & A.I., Munich*, **2**, 859.
- ZOLMAN, J., CONVEY, E. M., BRITT, J. & HAFS, H. D. (1973) Release of bovine luteinizing hormone by purified porcine and synthetic gonadotrophin releasing hormone. *Proc. Soc. exp. Biol. Med.* **142**, 189.