Retention rate in cows and heifers of intravaginal silastic coils impregnated with progesterone

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The widespread application of control of oestrus in cattle using progesterone requires a simple practical method of administering the steroid. The retention rate of intravaginal pessaries in cows and heifers has been variable (Carrick & Shelton, 1967; Wishart & Hoskin, 1968; Scanlon, Sreenan & Gordon, 1972; Sreenan, 1974) and is, therefore, an unacceptable method at present for routine administration. Since the demonstration that steroids can be eluted from silastic rubber (Dziuk & Cook, 1966), silastic implants containing progesterone or progestagens have been used to control oestrus in cattle (Scanlon & Burgess, 1971; Roche & Crowley, 1973; Roche, 1974), but the large surface area required to release sufficient progesterone to block oestrus in cattle does not favour their widespread use. However, silastic vaginal rings containing a progestagen have been shown to suppress the mid-cycle peak of LH and ovulation in women (Mishell, Talas, Parlow & Moyer, 1970; Mishell & Lumkin, 1970). For the present study, a number of different types of silastic rings and coils were made and, after intravaginal insertion, were tested for retention rate and ability to synchronize oestrus in heifers and cows.

Rings of silastic tubing (Dow Corning, Michigan, U.S.A.) containing springs of unknown tension were made with a diameter of 3.5 or 5.0 cm. A ring of each type was inserted into the vagina of ten mature Hereford-cross heifers, five in each group, but none was present 3 days later. Coils 2.5 cm wide and with an approximate diameter of 4 cm were made entirely from silastic rubber (Silcoset 105: I.C.I. Ltd, U.K.) and inserted into the vagina of each of four mature Hereford cross heifers, but again none was present 3 days later.

In order to increase the tension on the walls of the vagina, strips of stainless steel (EN 58A 400/450 VPN: Knight Strip Metal, Herefordshire, U.K.) 30 cm long, 3.2 cm wide and 0.0203 mm thick were coated with silastic rubber to a final thickness of 3 mm. They were coiled by hand to a final diameter of approximately 5.5 cm and a piece of nylon cord was attached to one end. Following steam sterilization, the coils were placed into the anterior vagina of 25 heifers with the aid of a plastic speculum; all were removed 18 days later.

Similar coils were coated with silastic rubber containing 10% progesterone, by weight, and were inserted into 20 cyclic heifers and 32 Friesian cows that were at least 50 days *post partum*. The retention rate after 18 days was high in heifers (20/20) and dairy cows (31/32) and none of the animals was observed in oestrus while the coils were in the vagina; 42/51 animals were detected in oestrus on the 2nd and 3rd day after removal of the coils (15/20 heifers and 27/31 cows). Fourteen of the cows were inseminated with frozen semen at this oestrus and 7 subsequently calved to this insemination.

Similar 10% progesterone-impregnated coils were used in experiments, at the Research Station and on farms, to determine the retention rate of the coils for periods from 7 to 18 days in Hereford or Friesian heifers, Friesian dairy cows and Hereford-cross nursing beef cows. The interval from calving to insertion of coils varied from 10 to 100 days for the cows. The retention rate is shown in Table 1 and, with the exception of dairy cows housed in winter, it was over 90%.

Stainless-steel coils with 6.6% progesterone by weight incorporated into the silastic rubber were inserted into the vagina of each of four Hereford-cross heifers on Days 1 or 2 of the oestrous cycle (Day 0 = oestrus) for 12 days. Three animals received an injection of 5 mg oestradiol benzoate + 200 mg progesterone in 10 ml corn oil and the fourth (No. 223) received 5 mg oestradiol benzoate only at the time of insertion of the coils in order to shorten the life-span of the CL (Roche, 1974) and hence give a synchronized oestrus after treatment. The heifers were bled before insertion of the coils and then daily until removal. Plasma was obtained by centrifugation at 4°C and was stored at –20°C

Table 1. The retention rates of the progesterone-impregnated silastic coils in cattle

	Period of insertion of coils (days)	No. of animals treated	No. of coils removed	Retention rate (%)
At pasture				
Dairy cows	12	670	620	92.5
	18	70	67	95.7
Suckling cows	12	114	104	91.2
	7	88	86	97.7
Heifers	18	60	58	96.6
	12	499	480	96.2
	7	37	34	92.0
Total		1538	1449	94.2
Housed				
Dairy cows	12	309	271	87.7
Suckling cows	12	167	160	95.8
	7	65	64	98.5
Heifers	12	128	117	91.4
	7	19	19	100.0
Total		688	631	91.7

until measurement of progesterone (Table 2) by radioimmunoassay (Gosling, Parker & Fottrell, 1975). After removal of the coils, the heifers were checked for oestrus with a vasectomized bull. The levels the day after insertion increased 4- to 8-fold and remained high in 3/4 animals until Day 4 and the levels then fluctuated between 0.3 and 3.8 ng/ml plasma until the coils were removed. In animal No. 16, progesterone declined after the initial rise and fluctuated between 1.4 and 2.5 ng/ml. Heifers 223, 149 and 16 were in oestrus on the 2nd day after removal of the coils but oestrus was not detected in Heifer 147 within 6 days of removal of the coil.

Table 2. Progesterone levels (ng/ml) in heifers before and after insertion of the coils

Heifer No.	Before insertion	Days after insertion											
		1	2	3	4	5	6	7	8	9	10	11	12
16	1.0	4.6	1.7	2.1	2.3	2.6	1.9	1.4	1.7	2.6	1.9	1.2	2.8
147	1.1	5.8	5.9	8.7	4.0	2.3	2.0	3.7	3.2	3.0	3.3	3.4	3.4
149	0.2	8.3	6.4	6.9	3.2	2.6	2.4	1.6	2.3	2.0	1.6	1.5	1.5
223	3.1	8.5	7.2	5.7	4.6	0.8	0.8	0.9	0.4	0.8	0.2	1.2	0.8

The insertion into the vagina of a coiled stainless steel strip coated with silastic rubber containing 10% progesterone is a practical method of administering progesterone continuously to heifers or cows for periods of up to 18 days. The coils were easily inserted and removed, and the only adverse physical sign noted was a slight uneasiness in heifers (less in cows) for a few days after insertion. The retention rate was slightly higher in heifers than in dairy cows, particularly during the winter when animals were housed. The progesterone released from the coils was sufficient to block oestrus and presumably ovulation, and there was a precise onset of oestrus after removal of the coils from cows and heifers treated for 18 days.

The limited data on plasma levels of progesterone indicate that the levels are similar to those found during the luteal phase of the cycle (Hansel, Concannon & Lukaszewska, 1973). Steroids administered continuously from silastic implants provide biological effects at lower dose rates than once-a-day oral administration (Kincl & Rudel, 1971). The larger oral dose of melengestrol acetate required in rats to give the same biological response as a lower daily dose from silastic implants resulted in an increased accumulation in various body tissues, indicating that the liver and kidney degradative functions for metabolizing the steroid may have been stressed (Kincl & Rudel, 1971).

The slow continuous release rate from silastic rubber, with the consequent better chance of normal clearance rates from body tissues, appears to simulate more closely the normal endogenous release rate of steroids from endocrine glands.

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