

MODIFICATION OF THE DIRECTION OF UTERINE CONTRACTIONS BY INTRA-UTERINE DEVICES IN THE EWE

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Summary. The direction of uterine contractions *in vivo* was studied in oestrous ewes by recording the motility of exteriorized uteri on cine film. In eight control ewes, 58% of 1156 contractions moved towards the oviduct, while 16% moved towards the cervix. In eight ewes with a plastic spiral in the lumen of one horn, only 17% of 927 contractions moved towards the oviduct; 70% of the contractions moved towards the cervix. The effect of the IUD on the direction of uterine contractions may explain inhibition of sperm transport and ovum fertilization in 'IUD' ewes.

A plastic spiral placed in one uterine horn of the ewe inhibits sperm transport and ovum fertilization (Hawk, 1967). Inhibition of sperm transport is probably not due to suppression of uterine motility because the *in vitro* motility of strips of myometrium taken from ewes with a spiral in one uterine horn was greater than that of strips taken from control ewes (Brinsfield & Hawk, 1968). Also, attempts to overcome the antifertility effect of the spiral with various compounds which stimulate uterine contractions were unsuccessful (Warren & Hawk, 1968). The possibility remained that a spiral might inhibit sperm transport by altering some qualitative aspect of uterine motility. The present experiment was conducted to determine whether the presence of a spiral in one uterine horn would alter the direction of uterine contractions *in vivo*.

Sixteen mature, parous ewes were checked twice daily for oestrus by the use of aproned rams. Ewes were laparotomized on Day 10 or 11 of an oestrous cycle (Day of oestrus = Day 0), a small puncture was made in the wall of one uterine horn near its anterior end and a plastic spiral measuring 32 mm in length and 10 mm in diameter was screwed in a posterior direction into the lumen through the puncture so that the spiral lay in the lengthwise centre of the horn. In eight ewes, the spiral was anchored in place by one suture through the uterine wall. The spiral was removed immediately from the remaining eight ewes; these animals served as sham-operated controls. Ewes were assigned to each group at random and the horn to be operated upon within each ewe was also selected at random.

At the first oestrus of each ewe that occurred more than 2 weeks after insertion of the spiral, the ewe was anaesthetized with sodium pentobarbital and the uterus was carefully exteriorized through a mid-ventral incision.

Motility of the exteriorized uterus was photographed on Kodachrome film with a Super 8 mm Nikon cine camera equipped with a No. 2 close-up lens. Auxiliary lighting was supplied by a Sylvania Sun-gun positioned approximately 4 ft from the exposed uterus. Each uterus was photographed for 21 min, composed of three 7-min periods. Between these periods, the uterus was placed back into the body cavity for 3 min to prevent dehydration.

Each developed cine film was viewed several times and the frequency and direction of uterine contractions were recorded. Each contraction represents a movement in the uterine wall that could definitely be classified as a

TABLE 1
EFFECT OF INTRA-UTERINE DEVICES ON UTERINE MOTILITY *in vivo*

Observation	Type of ewe			
	Oestrous control ewes		Oestrous IUD ewes	
	Sham-operated horn	Unoperated horn	IUD horn	Unoperated horn
Total no. of contractions	570	586	455	472
Mean no. of contractions/horn/ewe	71.2 ± 5.7*	73.2 ± 4.7	56.9 ± 6.8	59.0 ± 7.5
Frequency (contractions/min)	3.4 ± 0.9	3.5 ± 0.2	2.7 ± 0.3	2.8 ± 0.4
Mean percentage of contractions:				
Moving towards oviduct	60.5 ± 5.1	55.4 ± 5.2	19.5 ± 8.6	14.7 ± 5.6
Moving in both directions	17.2 ± 4.7	14.3 ± 3.3	3.0 ± 1.1	3.5 ± 1.3
Not moving	8.0 ± 2.9	13.0 ± 3.0	11.9 ± 4.8	7.6 ± 3.2
Moving towards cervix	14.3 ± 2.4	17.3 ± 2.8	65.6 ± 7.6	74.2 ± 5.4

* Mean ± standard error.

constriction, the initial constriction usually being followed by its movement lengthwise along the uterine horn. Individual contractions were classified as those moving towards the oviduct, towards the cervix, in both directions from the initial point of constriction, or not moving from the point of constriction.

About two-thirds of the length of the uterine horns was exteriorized. However, the observed contractions can be considered to represent only those of the anterior half of each exteriorized uterine horn.

The presence of an IUD in one uterine horn had a pronounced effect on the direction of uterine contractions (Table 1). In control ewes, 58% of the contractions moved towards the oviduct and another 16% moved in both directions. In IUD ewes, only 17% of the total contractions moved towards the oviduct and 3% moved in both directions. Contractions which moved in both directions in ewes of each group were generally of short duration and frequently travelled less than 2 cm in either direction. Analysis of variance of the percentages of contractions in the four classifications showed a significant interaction between direction of contractions and type of ewe ($P < 0.001$). There were no significant differences between the two horns within ewes of either group.

In addition to modifying the direction of uterine contractions, the IUD also altered the origin, intensity and duration of contractions. In control ewes, the initial point of contraction occurred anywhere along the observed portion of uterine horn. In IUD ewes, the majority of the contractions originated near the tubo-uterine junction. Both the intensity and duration of contractions were noticeably greater in IUD ewes than in control ewes.

Uterine contractions tended to be more frequent in control than in IUD ewes (Table 1), but the difference was not statistically significant. The lower frequency of contractions in IUD ewes was probably caused by the increased intensity and duration of contractions induced by the presence of the IUD. The frequencies of contractions measured *in vivo* in the present study were similar to those measured in strips of myometrium *in vitro* (Brinsfield & Hawk, 1968); in the previous study the frequency of contractions was also somewhat greater for control than for IUD ewes.

Since the direction of a high proportion of uterine contractions was reversed in both horns of IUD ewes, it seems reasonable to suspect that altered patterns of uterine motility may account for the failure of sperm transport in either uterine horn of ewes with an IUD in one horn. This reversal of contractions probably represents an attempt on the part of the uterus to expel the device.

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