RAPID DISRUPTION OF SPERM TRANSPORT MECHANISMS BY INTRA-UTERINE DEVICES IN THE EWE

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Summary. A plastic spiral IUD was inserted at laparotomy into one uterine horn of ewes in oestrus; in control ewes in oestrus, an IUD was inserted and removed immediately. In ewes mated 1 to 2 hr and again 5 hr after insertion of the IUD, sperm transport into the uterine horns and oviducts on both sides of the reproductive tract was inhibited and ovum fertilization prevented. The majority of uterine contractions were seen to be moving towards the oviduct in control ewes but towards the cervix in ewes with the IUD 5 hr after its insertion. This may account for the inhibition of sperm transport.

An intra-uterine device in the ewe inhibits sperm transport and ovum fertilization, apparently by causing a reversal in the direction of uterine contractions (Hawk, 1965, 1967; Brinsfield & Hawk, 1969; Mann, 1969). These effects were found weeks or months after the devices had been inserted. Three experiments were designed to determine whether an IUD inserted during oestrus could alter the normal operation of sperm transport mechanisms within a few hours. An additional experiment was designed to determine whether sperm transport would return to normal within a few hr after an IUD was removed.

Each IUD was a plastic spiral made from polyethylene rods, as described previously (Hawk, 1967). Each spiral was 5 cm long and 8 mm in outside diameter, with about 5 mm between the turns of the spiral. The ewes were parous 8-year-old Rambouillets, used on the 1st day of oestrus. Mid-ventral laparotomies were carried out under sodium pentobarbital anaesthesia, the uterine wall was incised with sharp-pointed scissors, and the IUD was inserted into the uterine lumen, the incision being closed by a single stitch. An IUD was inserted and removed immediately from the control ewes at laparotomy. In each ewe, the spiral was inserted into the uterine horn opposite to the ovary containing the largest follicle so that the spiral would not interfere physically with sperm transport on the side of ovulation.

In Exp. 1, fifteen ewes were mated 1 to 2 hr and again 5 hr after laparotomy and were killed 3 days later (Table 1). A higher proportion of ova were cleaving

in the control ewes than in the ewes with an IUD ($P < 0.01$). Accessory spermatozoa were found in each cleaving ovum but not in any of the uncleaved ova, suggesting that sperm transport had been inhibited in the ewes with an IUD.

In Exp. 2, eight ewes were killed 24 hr after mating and the oviducts and uterine horns were flushed with saline solution. Spermatozoa in the flushings were counted in a haemocytometer under a phase contrast microscope. The presence of the spiral effectively inhibited sperm transport into the uterine horns and oviducts (Table 2).

TABLE 1
INHIBITION OF OVUM FERTILIZATION BY INSERTING
AN IUD INTO THE OESTROUS EWE

<i>Treatment of ewes</i>	<i>No. of ewes</i>	<i>No. of ewes from which ova were recovered*</i>	<i>No. of ewes with cleaving ova*</i>
Sham-operated	8	8 (10)	6 (7)†
IUD inserted	7	7 (8)	0

* The numbers in parentheses are the total numbers of ova or the total number of cleaving ova recovered. Each ovum was recovered from the side contralateral to the uterine horn with an IUD.

† The number of accessory spermatozoa ranged from 6 to more than 200.

TABLE 2
INHIBITION OF SPERM TRANSPORT BY INSERTING AN
IUD INTO THE OESTROUS EWE

<i>Treatment of ewes</i>	<i>No. of ewes</i>	<i>No. of oviducts containing spermatozoa</i>	<i>No. of uterine horns containing spermatozoa</i>
Sham-operated	4	7*	7†
IUD inserted	4	0	1‡

* Geometric mean of 1150 spermatozoa/oviduct.

† Geometric mean of 58,900 spermatozoa/uterine horn.

‡ 225 spermatozoa.

In Exp. 3, 5 hr after the spirals were inserted or sham operations performed, ten ewes were re-anaesthetized, their uteri were displayed, and the contractions were observed for 10 min. The number of contractions observed per ewe varied between twenty-four and thirty-six. Nine to twenty-three contractions were seen in the IUD-bearing or sham-operated horn and nine to twenty-one in the contralateral horn. The total numbers of contractions for both horns of the ten ewes are given in Table 3. In the sham-operated ewes, most of the contractions originated in the cervical portion of the uterine horns and moved towards the oviducts. In the ewes with an IUD, the majority of the contractions originated in the tubal ends of the horns and moved towards the cervix, as if to expel the

IUD. In each ewe, both of the uterine horns reacted similarly to the presence of the IUD in one horn. It seems likely that the reversed contractions prevented sperm transport into the uterine horns and oviducts.

The effect of the IUD on the direction of contractions was similar to that found in ewes with an IUD in place for several weeks or months (Brinsfield & Hawk, 1969; Mann, 1969). In the study by Mann (1969), catheters were inserted into the sheep uterus at two points and intraluminal pressures were

TABLE 3
REVERSAL OF UTERINE CONTRACTIONS FOLLOWING
THE INSERTION OF AN IUD INTO THE OESTROUS EWE

Treatment of ewes	No. of ewes	Total no. of contractions		
		Moving towards oviduct	Not moving	Moving towards cervix
Sham-operated	5	107	41	26
IUD inserted*	5	12	36	113

* Sham-operated versus IUD ewes in the proportion of contractions moving towards the oviduct or towards the cervix, $P < 0.01$.

TABLE 4
FERTILIZATION OF OVA IN THE EWE AFTER THE
REMOVAL OF AN IUD

No. of days from removal of the IUD until oestrus	No. of ewes	No. of ewes from which ova were recovered*	No. of ewes with cleaving ova*
0 to 1	5	5 (8)	1 (1)†
6 to 13	5	5 (8)	4 (6)‡

* The numbers in parentheses are the total numbers of ova or the total numbers of cleaving ova recovered.

† No accessory spermatozoa were found in the cleaving ovum or in the seven uncleaved ova.

‡ An average of forty-six accessory spermatozoa were counted in the six cleaving ova.

recorded. Contractions in the control ewes moved predominantly towards the oviduct for about $1\frac{1}{2}$ hr and then tended to become more like those of IUD ewes, which probably indicated a reaction by the uterus to the presence of the catheters.

In the fourth experiment, an IUD was inserted into each of ten ewes, then removed about 1 month later. The ewes came into oestrus and were mated the day the IUD was removed 1 day later, or 6 to 13 days later. The ewes were killed 3 days after mating and one or two ova were recovered from each ewe (Table 4). No accessory spermatozoa were found in the ova recovered from ewes that were mated within a day after removal of the IUD, indicating that a period of time greater than 1 day had to elapse before sperm transport mechanisms could regain normal function.

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