EFFECT OF AN INTRAUTERINE DEVICE ON SPERM TRANSPORT AND UTERINE MOTILITY IN SHEEP AND RABBITS

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Summary. The presence of an IUD in the oestrous ewe inhibited sperm transport into the uterine horns and oviducts and caused reversal of the direction of uterine contractions for as long as 2 years after the insertion of the IUD. In rabbits, an IUD did not prevent sperm transport and ovum fertilization and did not alter the pattern of uterine contractions. The results support the hypothesis that the inhibition of sperm transport in IUD-bearing sheep is caused by reversed uterine contractions.

An IUD inhibits sperm transport and prevents ovum fertilization in the ewe (Hawk, 1965), apparently by reversing the direction of uterine contractions (Brinsfield & Hawk, 1969). In rabbits, the IUD does not prevent fertilization (Marston & Chang, 1964; Adams & Eckstein, 1965). Experiments were conducted (1) to study long-term effects of the IUD on sperm transport and uterine motility in ewes, (2) to determine whether an effect of the IUD on sperm transport in rabbits could be detected when less than a normal ejaculate of semen was used for artificial insemination, and (3) to compare the effect of an IUD on the pattern of uterine contractions in sheep and rabbits.

The IUDs used in ewes were plastic spirals made of polyethylene rods (Hawk, 1965) while those inserted into rabbits were plastic spirals, 4 mm in diameter and 40 mm long, made of polyethylene tubing (P. E. 160, Clay-Adams).

Before IUD insertion, parous Rambouillet ewes 4 to 6 years of age and mature New Zealand White does were anaesthetized with sodium pentobarbital and the uterus was exposed through a mid-ventral incision. The IUD was introduced aseptically through a small incision in the uterine wall and secured by a loop of thread passed through the uterine wall. In control uterine horns, an IUD was inserted and then removed immediately. The uterine incision was closed with a single stitch. Rabbits and ewes were used 8 weeks and 2 years, respectively, after IUDs were inserted or control operations performed.

In Exp. 1, the ewes were each mated three to five times on the 1st day of an oestrous period and killed 24 hr later. The oviducts and uterine horns were flushed with saline solution (0.9% NaCl) and spermatozoa in the flushings were counted in a haemocytometer under a phase contrast microscope. The IUD effectively inhibited sperm transport into the uterine horns and oviducts (Table 1), indicating that the uterus did not adapt over a period of 2 years to the presence of the IUD.

In Exp. 2, twenty-two oestrous rabbits with an IUD in one uterine horn were either mated naturally or inseminated artificially with 1/4, 1/8 or 1/16 of an ejaculate of freshly collected semen (Table 2). Artificially inseminated rabbits were injected just before insemination with 250 i.u. HCG to cause ovulation. The rabbits were killed 30 hr after insemination and the oviducts flushed with saline solution to recover ova. To determine whether sperm transport had occurred, the recovered ova were examined microscopically for cleav-

TABLE 1
INHIBITION OF SPERM TRANSPORT IN EWES HAVING AN IUD
FOR 2 YEARS

<i>Treatment of ewes</i>	<i>No. of ewes</i>	<i>No. of individual oviducts containing spermatozoa*</i>	<i>No. of individual uterine horns containing spermatozoa*</i>
Control IUD†	5 8	10 (162) 3 (3)	10 (34,220) 6 (322)

* The numbers in parentheses are the geometric means of the spermatozoa in oviducts or uterine horns in which at least one spermatozoon was found.

† IUD versus control ewes in the proportion of oviducts or uterine horns containing spermatozoa, $P < 0.01$.

TABLE 2
COMPARISON BETWEEN IUD AND CONTROL SIDES OF THE UTERUS ON OVUM
FERTILIZATION IN THE RABBIT

<i>Type of mating and amount of semen</i>	<i>No. of rabbits</i>	<i>No. of individual oviducts from which cleaving ova were recovered*</i>		<i>Accessory spermatozoa†</i>	
		<i>IUD side</i>	<i>Control side</i>	<i>IUD side</i>	<i>Control side</i>
Natural, 1 ejaculate	3	3 (100)	3 (100)	27 ± 1	24 ± 1
A.I., 1/4 ejaculate	5	5 (88)	5 (100)	10 ± 5	10 ± 5
A.I., 1/8 ejaculate	7	5 (95)	5 (100)	9 ± 5	21 ± 12
A.I., 1/16 ejaculate	7	4 (100)	5 (100)	6 ± 1	10 ± 5

* The numbers in parentheses are the percentages of ova which were cleaving in oviducts from which at least one cleaving ovum was found.

† Mean ± S.E. Each individual observation contributing to the mean was the average number of accessory spermatozoa in cleaving ova from each uterine horn of each rabbit.

age and for the number of accessory spermatozoa in the zonae pellucidae. The IUD did not interfere to any great extent with sperm transport (Table 2). Only one rabbit, inseminated with 1/16 of an ejaculate, had cleaving ova on the control side and uncleaved ova on the IUD side. In rabbits inseminated with 1/8 or 1/16 of an ejaculate, the number of accessory spermatozoa tended to be lower in ova recovered from the IUD than from the control side, but the differences were not statistically significant.

In four other rabbits, spermatozoa were counted in flushings of the oviducts at 6 hr after natural mating; there was no consistent difference in the numbers of sperm cells recovered from the IUD or control sides.

In Exp. 3 (Table 3), sixteen ewes were anaesthetized with sodium pentobarbital on the first day of an oestrous period and the uterus exposed through mid-ventral incision. The direction of movement of uterine contractions was observed for 10 min. Most uterine contractions were moving from the uterine body towards the oviducts in control ewes and from the anterior portion of the uterine horns towards the cervix in IUD-bearing ewes. In ewes with an IUD in only one uterine horn, both horns reacted similarly to the presence of the IUD. Brinsfield & Hawk (1969) and Hawk (1970) have reported that uterine contractions were reversed in IUD ewes at several months and within 5 hr, respectively, after the IUD was inserted.

TABLE 3
EFFECT OF THE IUD ON THE DIRECTION OF UTERINE CONTRACTIONS IN SHEEP
AND RABBITS

Species and treatment of the uterus	No. of animals	Total no. of contractions	Percentage of uterine contractions		
			Moving towards oviducts	Not moving longitudinally	Moving towards cervix
Sheep Control	6	282	60	32	8
IUD one horn	6	194	10	31	59
IUD each horn	4	160	9	38	53
Rabbits					
Control	5	183	48	32	20
IUD one horn	5	176	44	36	19
IUD each horn	5	182	52	32	16

In another phase of Exp. 3, fifteen rabbits were placed under general anaesthesia and the uterine horns exposed. Uterine motility was recorded for 3 min on Kodachrome film with a cine camera. The developed film was viewed at least four times, and the number and direction of uterine contractions were recorded (Table 3). Contractions averaged about six/horn/min. The presence of an IUD in one or both uterine horns did not affect uterine contractions significantly.

The IUD-induced change in the direction of uterine contractions in sheep and the lack of such changes in rabbits, a species in which an IUD does not prevent sperm transport and ovum fertilization, further implies that an IUD inhibits sperm transport and ovum fertilization in sheep by reversing uterine contractions.

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