SPERM MIGRATION IN RATS WITH EXPERIMENTAL DIABETES INSIPIDUS

Y. MANABE*

Department of Human Anatomy, University of Oxford

(Received 28th September, accepted 30th October 1968)

Summary. The presence of spermatozoa in the uterus and oviducts at 15, 30 and 60 min after copulation was studied in rats after denervation of the neurohypophysis. Sperm migration occurred at the same rate as in normal rats.

It is known that the distance covered by spermatozoa between copulation and fertilization is too large to be interpreted by their own flagellation speed (Bishop, 1961). Since there is some evidence that oxytocin is reflexly secreted in response to uterine stimulation at the time of copulation in women (Harris & Pickles, 1953) and in some animals (Bishop, 1961) it is possible that this oxytocin aids rapid sperm transport. However, the amount of oxytocin thus secreted is considered very small and its definite physiological role in this process is still a matter for speculation. There is also evidence that normal fertilization is not impaired in the absence of oxytocin, at least in the rat (Cross, 1959; Gale & McCann, 1961). Since there is no report concerning sperm migration rate as assessed by actual time and numbers in the oxytocin-free condition, this study was undertaken in an attempt to clarify this point. In order to make oxytocin-free animals the experimental diabetes insipidus was induced by the destruction of the median eminence since it is proved that such a condition abolishes the milk ejection responses both to electrical stimulation (Cross & Harris, 1952) and to normal suckling (Gale & McCann, 1961).

Forty-six normal rats (150 to 200 g) of Lister strain were used. Bilateral electrolytic lesions were made in the median eminence using a stereotaxic instrument and de Groot (1959) forebrain coordinates. Cathodal current of 3.0 mA for 30 sec was passed through a glass-insulated platinum electrode left bare at its tip. Daily vaginal smear and urine output were assessed in a metabolic cage after operation. Out of forty-six rats, thirteen operations proved satisfactory, giving a daily urine output of more than 150 ml and only these were used for the study. Since copulation in rats usually takes place at midnight, for the convenience of the experiment the rats were placed in a chamber in which the day and night schedule was entirely reversed—12 hr each. Since the normal oestrous cycle is considerably impaired in most cases after brain operation, hormones were given to the animals some 3 weeks post-operatively so as to

* Postdoctoral Research Fellow of the Population Council. Present address: Department of Obstetrics and Gynecology, Kyoto University School of Medicine, Kyoto, Japan.

elicit natural copulation. Oestradiol benzoate (0.1 mg) was given on the 1st and 3rd days, and 1 mg of progesterone at approximately 10.00 hours on the 4th day, each by the subcutaneous route. Four to six hours after the injection of progesterone, each rat was put in a mating chamber with a fertile male, and several copulations were directly observed under a dim red lamp. The mated rats were left undisturbed in the chamber until they were taken out and decapitated at 15, 30 and 60 min after copulation, and the uterus and oviduct were dissected out. These organs were then independently flushed out by saline under a dissecting microscope. Normal intact rats were similarly treated and used as controls. Assessment of the accurate sperm number in the washings proved extremely difficult in most cases. Although some uteri and tubes contained

TABLE 1
THE RELATIVE RATES AT WHICH SPERMATOZOA REACH
THE UTERUS AND OVIDUCTS IN NORMAL AND OXYTOCIN-
FREE RATS

Time after copulation (min)	No. of uteri in which any sperm. were found		No. of oviducts in which any sperm. were found	
	Lesioned	Control	Lesioned	Control
15	3 (4)	4 (6)	2 (8)	4 (12)
30	3 (4)	4 (7)	4 (8)	3 (14)
60	5 (5)	5 (6)	10 (10)	11 (12)

Numbers in parentheses indicate total uteri and oviducts studied.

spermatozoa, they were present in minimal numbers. Therefore, only the presence or absence of any spermatozoa in these organs was checked. The results are summarized in Table 1.

It was learned that spermatozoa migrate in the uterus and oviducts even in the oxytocin-free condition, and the time sequence of this seems not to differ significantly compared with that of the control group. The speed of sperm ascent observed in this experiment is in agreement with the results of other investigators (Hartman & Ball, 1930; Rossman, 1937; Blandau & Money, 1944). They found spermatozoa in the uterus and oviducts several minutes after copulation and a larger number as time passed. Although the amount of oxytocin secreted physiologically on copulation has not been assessed quantitatively in any animal it is considered comparatively small, if any. In the case of the monkey, it was reported that sperm migration cannot be accelerated even by a considerable amount of exogenous oxytocin (Manabe & Mastroianni, unpublished data). In the light of these findings there is a possibility that some other factors such as spinal reflex initiated by vaginal stimulation, hypothalamic influences mediated by sympathetic outflows (Cross, 1959), or the activation of the intrinsic autonomic nature of the uterus are involved in this process.

The author wishes to express appreciation to Professor G. W. Harris for his invaluable suggestions in the course of this study.

REFERENCES

- BISHOP, D. W. (1961) *Biology of spermatozoa*. In: Sex and Internal Secretion, p. 729. Ed. W. C. Young. Williams & Wilkins, Baltimore.
- BLANDAU, R. J. & MONEY, W. L. (1944) Observations on the rate of transport of spermatozoa in the female genital tract of the rat. *Anat. Rec.* **90**, 255.
- CROSS, B. A. (1959) *Hypothalamic influences on sperm transport in the male and female genital tract*. In: Endocrinology of Reproduction, p. 167. Ed. C. W. Lloyd. Academic Press, New York.
- CROSS, B. A. & HARRIS, G. W. (1952) The role of the neurohypophysis in the milk-ejection reflex. *J. Endocr.* **8**, 148.
- GALE, G. C. & MCCANN, S. M. (1961) Impairment in gestation, parturition and milk ejection following hypothalamic lesion. *J. Endocr.* **22**, 107.
- GROOT, J. DE (1959) The rat forebrain in stereotaxic coordinates. *Trans. R. Soc. Can.* **28**, 312 (translated from *Verh. K. ned. Akad. Wet.*).
- HARRIS, G. W. & PICKLES, V. R. (1953) Reflex stimulation of the neurohypophysis (posterior pituitary gland) and the nature of posterior pituitary hormones. *Nature, Lond.* **172**, 1049.
- HARTMAN, C. G. & BALL, J. (1930) On the almost instantaneous transport of spermatozoa through the cervix and the uterus of the rat. *Proc. Soc. exp. Biol. Med.* **28**, 312.
- ROSSMAN, I. (1937) Uterine contractions and the transport of sperm in the rat. *Am. J. Anat.* **77**, 253.