



精管運動の研究：  
III. 精管の運動性ならびに薬物に対する感受性の動物  
種間の比較について

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## Studies on the Movement of Vas Deferens

### III. Comparison of its Motility and Sensitivity to some Drugs among Animal Species

By

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Ejection of sperms and seminal fluid into the urethra is performed by rhythmical contractions of vas deferens and other accessory genitals which are controlled by the autonomic nerves. In fact, an intense contraction of vas deferens followed by the flow of its contents has been obtained by the electrical stimulation of the hypogastric nerve in rabbits and guinea-pigs.<sup>1)</sup>

In mating, the duration necessary to complete an ejaculation varies depending on the species of animals. With regard to the causes of this difference, two factors may be expected. Namely, one is the difference of impulses from the ejaculatory center which exists in the lumbar part of spinal cord and another is the difference in sensitivities of the accessory genital organs to the stimulus.

The authors have taken up the latter problem and studied, first of all, on the motility of the vas deferens and its sensitivity to some drugs *in vitro*.<sup>2)</sup>

This paper was designed to compare the motilities of the isolated vasa deferentia of several animal species and their sensitivities to some muscle-stimulating agents.

#### Materials and Methods

Vasa deferentia of 24 rats, 10 mice, 12 guinea-pigs, 5 rabbits, 2 dogs, one cat and 3 goats were used in this experiment. All animals were killed by a blow on the head and bleeding from the carotid artery. Intra-abdominal segments of the vas deferens were immediately excised and kept in a Petri dish filled with Locke solution. A segment about two cm. long of a preparation was stripped of all the surrounding tissues as far as possible and then suspended in a Magnus tube which contained 10 or 20 ml. of aircured Locke solution kept at a constant temperature of 37.5°C. Longitudinal contractions were registered with an amplification index of 5 to 8 on a smoke drum.

Each sample was kept in the bath for 30 to 60 minutes to find an appearance of spontaneous contractions before the addition of drug.

The drugs used in the present experiment were acetylcholine chloride (Ach), adrenaline chloride (Adr) and barium chloride (Ba). They were added into the bath as aqueous solutions in a volume of 0.1 to 0.5 ml. The sensitivity of the vas deferens to each drug was expressed by the lowest concentration of a drug needed to induce recognizable contractions.

### Results

In the vasa deferentia of the rat, mouse and dog, no spontaneous contraction was observed during the experimental period. In the vasa of the guinea-pigs, two out of the twelve samples exhibited spontaneous movements soon after they were suspended in the bath, one of which showed active rhythmical contractions (Fig. 1, upper curve) and the other faint oscillations (Fig. 1, lower curve). The vasa deferentia of the rabbits, in all cases, showed active movements. The types of these movements were shown in Fig. 2.

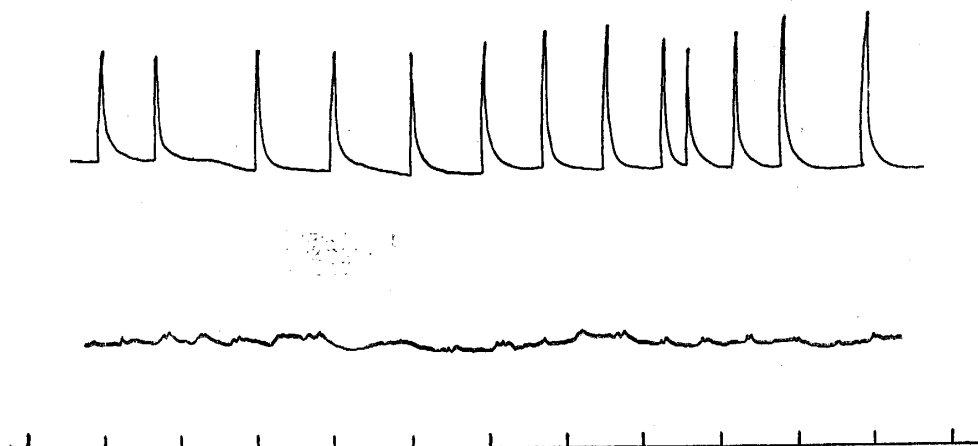


Fig. 1. Spontaneous movements of the isolated vasa deferentia of guinea-pigs. Time in minutes.

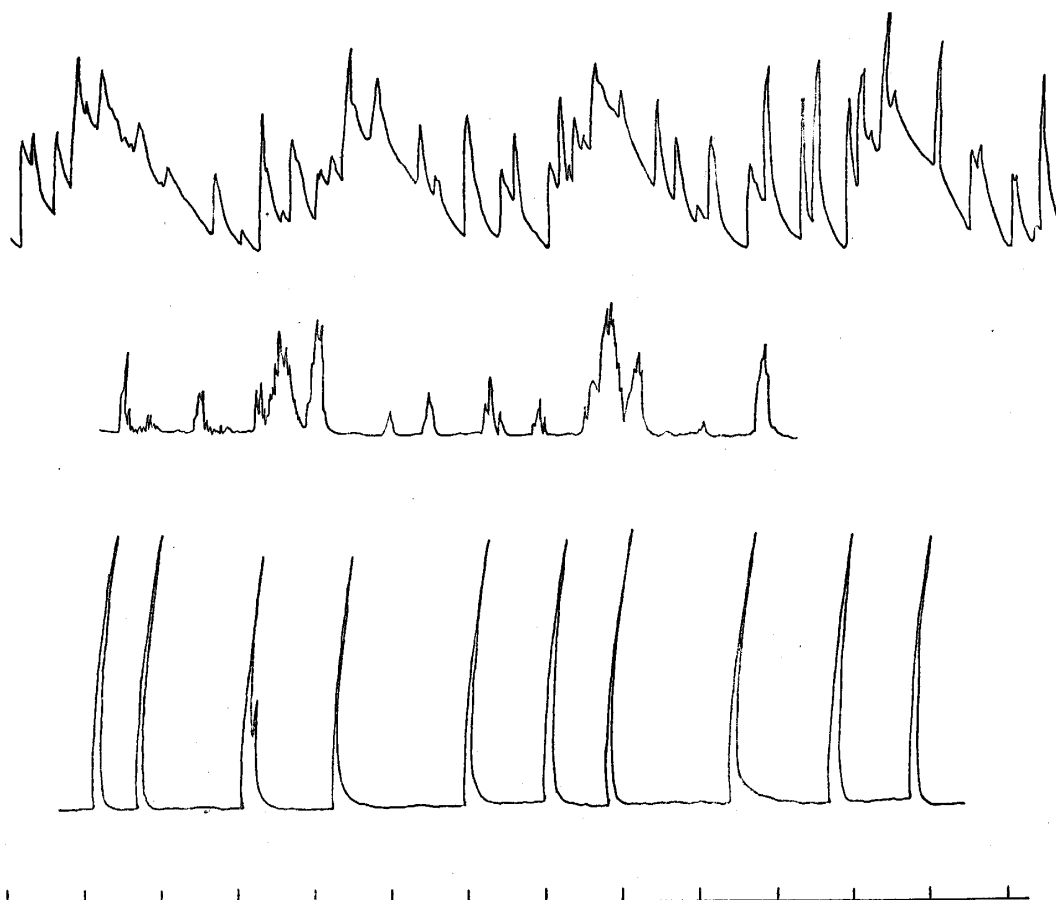


Fig. 2. Spontaneous movements of the isolated vasa deferentia of rabbits. Time in minutes.

One sample from the guinea-pigs, two from the three goats and one from the cat, though they had not shown any movement during the first 30 to 60 minutes, began to contract spontaneously after the first contact with a drug (Fig. 3). These contractions remained even after the removal of the drug.

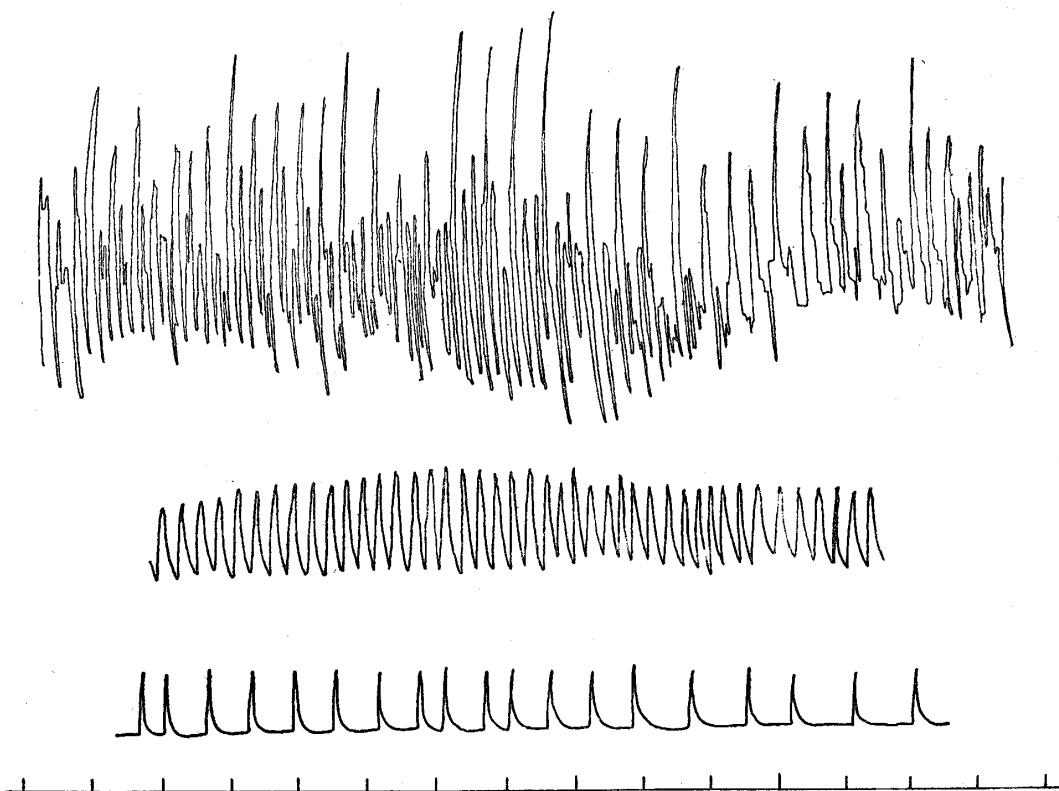


Fig. 3. Spontaneous movements of the isolated vasa deferentia of guinea-pig (upper curve), goats (middle curve) and cat (lower curve). Time in minutes.

The addition of Ach or Adr in a concentration causing the contraction always increased the tone of the quiescent and the rhythmically active preparations. In the latter cases these drugs also increased both the amplitude and the frequency. The addition of Ba, however, induced the rhythmical contractions, without increasing of the tone, after a longer latent period than the cases of Ach and Adr.

Sensitivities of vasa deferentia to these three stimulating agents were shown in Fig. 4 (Ach), 5 (Adr) and 6 (Ba) respectively. The isolated vas deferens of the rat seemed to have a lower sensitivity to Ach, and those of the guinea-pig, rabbit and goat showed relatively higher sensitivities. The sensitivity of the vas deferens of the mouse to Ach was observed to be higher than that of the rat and lower than those of the guinea-pig, rabbit and goat. One of the two samples from the dogs reacted in a concentration more than  $5 \times 10^{-7}$  g./ml. of Ach, but the reaction of the other was negative even in the concentration of  $5 \times 10^{-4}$  g./ml. of Ach.

The preparations from the rat, mouse, guinea-pig, rabbit and dog seemed to have similar sensitivities to Adr. Only the preparations from the goat seemed to be more sensitive than those of the others.

The sensitivity to Ba showed a similar tendency to that to Ach, though it was not so conspicuous as in the results obtained with Ach. The sensitivity of the preparations from mice to Ba seemed to be similar or rather lower compared with that of the rat.

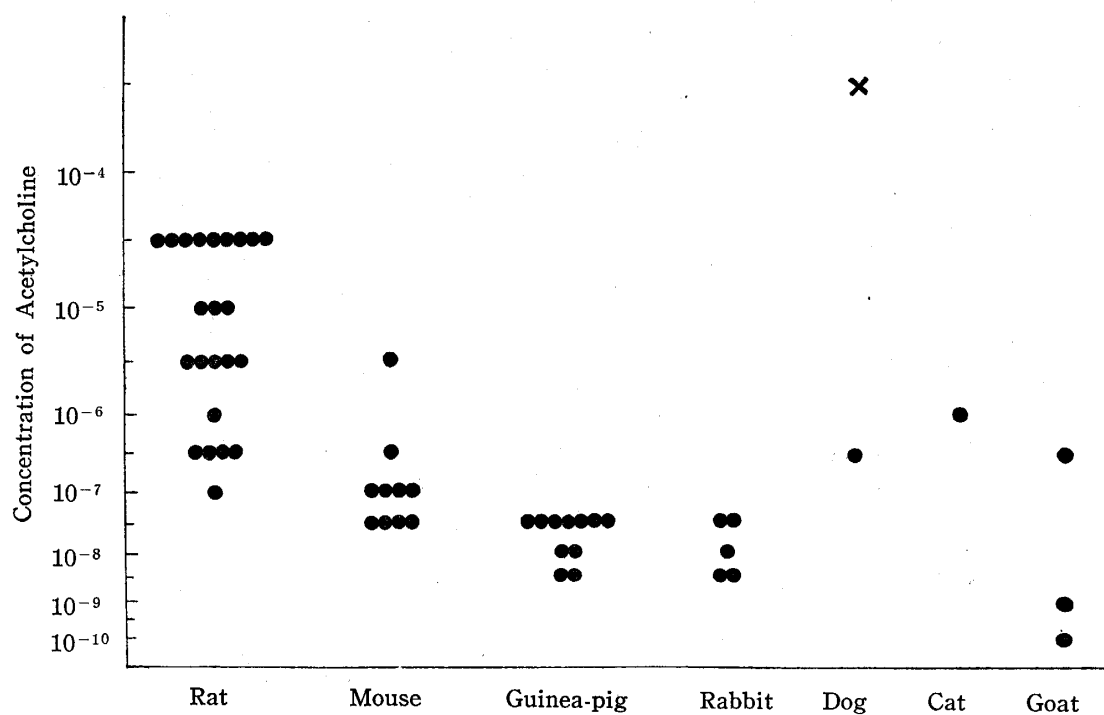


Fig. 4. Comparison of sensitivities of isolated vasa deferentia to acetylcholine among the animal species. x, presents a negative result.

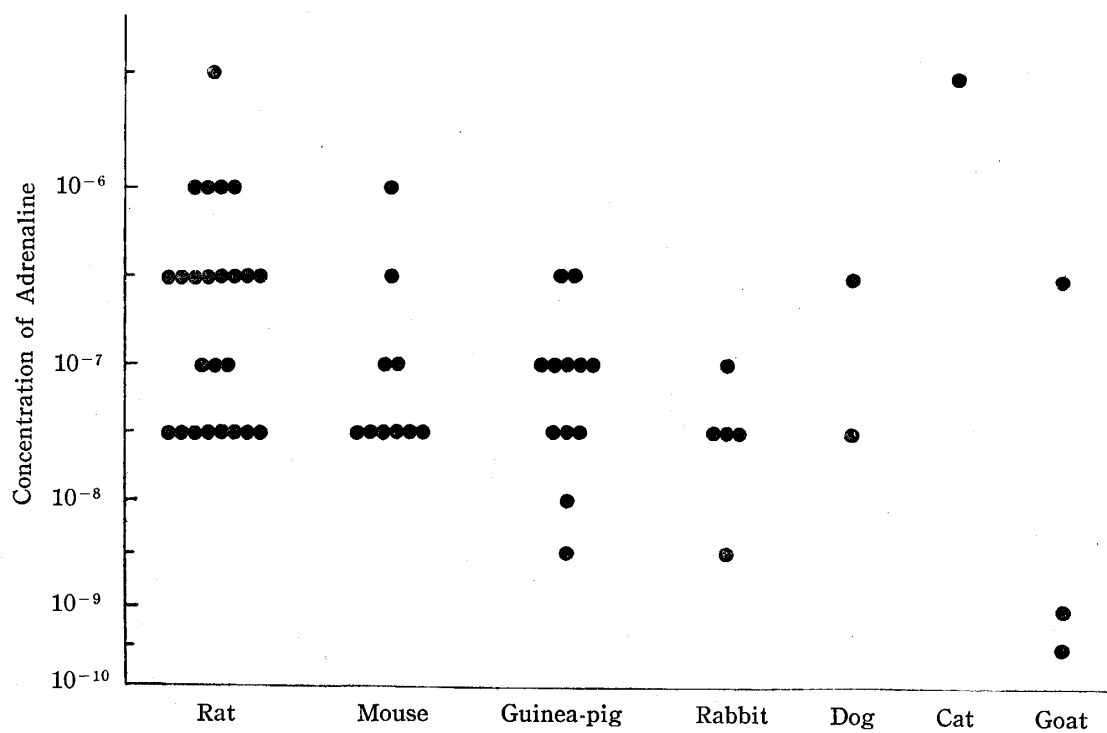


Fig. 5. Comparison of sensitivities of isolated vasa deferentia to adrenaline among the animal species.

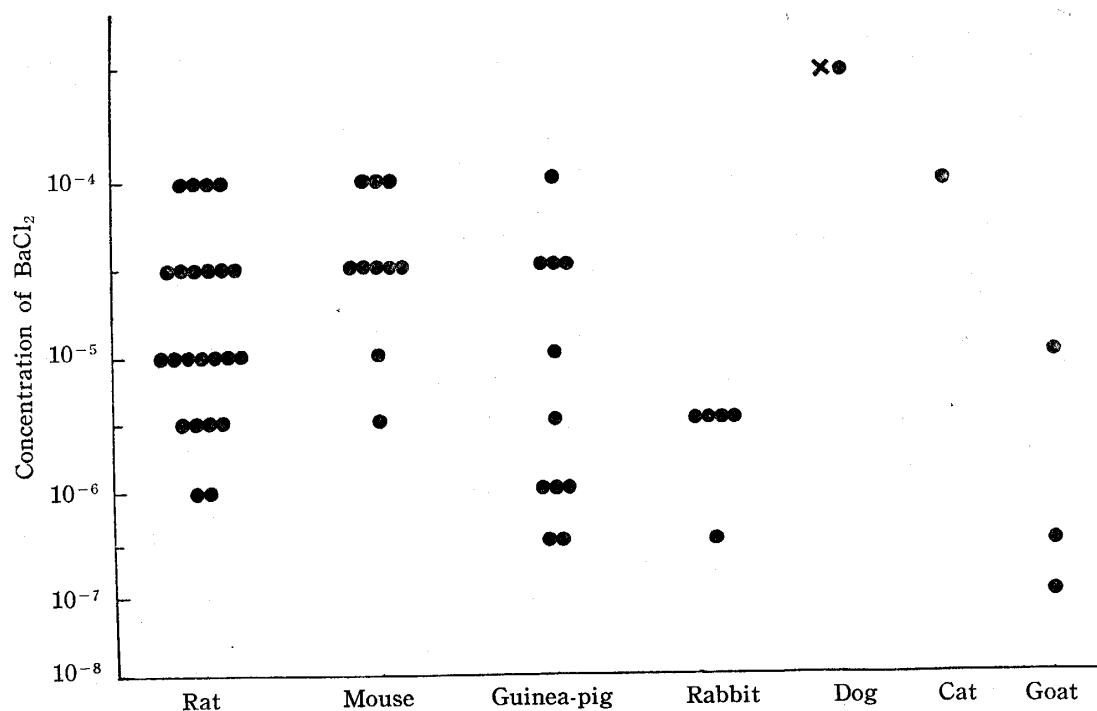


Fig. 6. Comparison of sensitivities of isolated vasa deferentia to barium chloride among the animal species.  $\times$ , presents a negative result.

### Discussion

The movement of the isolated vas deferens has been studied by several workers since WADDELL.<sup>3)</sup> In the experiment with the vas deferens suspended in Ringer or Tyrode solution of the rat, guinea-pig, rabbit, dog and sheep, WADDELL observed the spontaneous movements only in a small number of the organs of the rat and the rabbit. MACHT<sup>4)</sup> reported that the vasa deferentia of dogs, cats, sheep and bulls had exhibited no spontaneous movement, but the movements had been observed in almost all preparations from rabbits and sometimes in those from guinea-pigs. Later the occurrence of the spontaneous movement has been reported on the isolated vas deferens of rats (PERUTZ and TAIGNER<sup>5)</sup>) and rabbits (UMEDA<sup>6)</sup>; OHASHI<sup>7)</sup>). IWAKI<sup>8)</sup> reported that the spontaneous movement appeared in the several samples from the rabbit and the guinea-pig, but it rarely occurred in those from dogs and cats. According to the studies of MARTINS and others,<sup>9-13)</sup> only the vas deferens of guinea-pig had automatism, among the matured normal rat, guinea-pig, monkey, cat and dog. GOHARA<sup>14,15)</sup> reported that the isolated vasa deferentia of the rabbits had not shown any spontaneous movement. RABBENO<sup>16)</sup> observed the spontaneous contractions only in two cases out of fifty preparations from dogs.

In our present experiment we observed the spontaneous movements in the vasa deferentia of all the rabbits. Some preparations of guinea-pigs and goats also exhibited the automatisms. Although the motility of isolated vas deferens may be influenced by the degree of sexual maturation, the hormonal pattern in the animal body (especially in rats)<sup>2)</sup> and the experimental conditions after the excision of the organs, it may be admitted to say that the vasa deferentia of guinea-pigs, rabbits and goats have a higher motility than those of the other animals examined.

This is interesting in connection with the sensitivity of vas deferens to acetylcholine. Namely, the sensitivities of the organs of guinea-pigs, rabbits and goats to acetylcholine were higher than those of rats, mice, and dogs. In this experiment, though one sample

of the dogs responded to  $5 \times 10^{-7}$  g./ml. of acetylcholine, another was insensitive even to a high concentration such as  $5 \times 10^{-4}$  g./ml. According to VALLE and PORTO,<sup>13)</sup> the two out of fourteen vasa deferentia from the dogs responded to the concentration of  $1.25 \times 10^{-5}$  to  $5 \times 10^{-5}$  g./ml. of acetylcholine. Therefore, sensitivity of the vas deferens of dogs to acetylcholine may be relatively low in spite of our one exceptional result in this experiment.

The difference in sensitivity to adrenaline among these animal species was not clear. We previously reported that in the castrated rat the spontaneous movements of the vas deferens, which had never been recognized in the organs of normal rats, were observed and moreover the sensitivity to acetylcholine was increased over the normal one, but that to adrenaline was not altered.<sup>2)</sup> This suggests that the variances of excitability of male accessory genitals are influenced mainly by cholinergic and not by adrenergic factor.

VALLE and PORTO<sup>13)</sup> stated that the excitability of the vas deferens of a normal dog was weaker than that of the rat, for instance, under the same conditions and that perhaps this hypoexcitability was a phenomenon connected with the ejaculation types of the two species. If a connection between the hypoexcitability and the ejaculation types of the species does exist, the present results suggest that acetylcholine may have a main influence on the difference of the ejaculation types.

### Summary

1. Motilities and sensitivities to the acetylcholine, adrenaline and barium chloride of isolated vasa deferentia of rats, mice, guinea-pigs, rabbits, dogs, cats and goats were studied in usual way by the Magnus method.

2. Spontaneous movements of the vasa deferentia were observed in three out of the twelve guinea-pigs, all five rabbits, two of the three goats and one cat, but not in the other preparations.

3. The sensitivity of the vasa deferentia of guinea-pigs, rabbits and goats to acetylcholine was higher than that of the others and followed by mice and rats in the order. The organs of dogs seemed to be less sensitive to acetylcholine.

4. Differences in sensitivity to adrenaline were not clear among the species examined, except the preparations of goats. Only the preparations of the goat seemed to be more sensitive than those of the other species.

5. The sensitivity to barium chloride showed a similar tendency to that to acetylcholine, though it was not so conspicuous as in the results with acetylcholine.

6. A possible relationship between the difference of ejaculation types among animal species and the motility of isolated vasa deferentia, especially the sensitivity to acetylcholine, was suggested.

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