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Long range effects of MPOA lesion on mating behavior in the male rat

AVITAL GINTON and ARIEL MERARI

Psychobiology Unit, Department of Psychology, Tel-Aviv University, Tel-Aviv (Israel)

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Several times during the last decade it has been reported that bilateral medial preoptic area (MPOA) lesions in male rats eliminate male sexual behavior[1,2,4–6]. This effect seems to be permanent within the time course allowed in the experiments, which in one case continued up to 95 days after lesioning[4]. However, it was also reported in that study that when there were small lesions in this area, resulting in a marked decrease in the number of ejaculating rats, a slow recovery of function occurred over a few weeks.

In light of this finding, one may raise the question whether it is possible that a functional recovery may also appear in the case of a larger MPOA lesion, providing that more time were allowed.

Another question which arose from that study is whether the recovery was simply a function of post-lesioning time course, or whether it was also a function of post-lesioning mating tests, i.e., the opportunities to be with receptive females. The present experiment seems to answer these two questions.

Twenty-two male rats of a local Wistar strain, 100–120 days of age at the onset of the experiment, served as subjects. They were housed 4 to a cage before surgery and one to a cage thereafter. The temperature in the animal room was maintained at 23 °C, and the light–dark cycle was reversed, with light given from 7 p.m. to 7 a.m. Mating tests were conducted during the dark phase, in semicircular plywood cages, with a transparent front, 40 cm high and 80 cm in diameter. Illumination in the mating room was very diffuse and dim. Ten minutes before the beginning of each test the male was placed in the test cage for adaptation, then a female in estrus was introduced (ovariectomized female, injected with 25 μg estradiol benzoate and 400 μg progesterone, 72 and 4 h before introduction to the male, respectively).

Two sorts of mating tests were conducted: (1) ad libitum tests, in which the male was allowed to copulate until there was a 30 min period without an intromission, or a 60 min period without an ejaculation; (2) tests which continued until one intromission following the first ejaculation occurred, or 30 min following the first ejaculation elapsed without any intromission. The tests were also terminated in the case that no intromission occurred within the first 30 min, or if 30 min passed after the first intromission, and ejaculation was not achieved. The timing and frequency of mounts,

intromissions and ejaculations were recorded on a Monsanto model 512A counter-printer, with an attached electronic timer.

After acquiring sexual experience in 3 weekly mating sessions of 30 min each, the subjects' sexual performance was tested and recorded during a fourth session which was an ad libitum test. One week later they were electrolytically lesioned in the MPOA. Surgery was performed under Nembutal anesthesia and anodic lesions were made through stainless steel electrodes of 0.01 in. in diameter, insulated except for the cross-section of the tip, by passing current of 0.5 mA for 25 sec, with a rectal cathode.

Postoperative mating tests were conducted on the 7th, 14th, 21st, 35th, 70th, 150th and 250th days after lesioning. On the 35th and 70th postoperative day the mating tests were ad libitum, while on other occasions the tests were of the second type. The tests were started for 10 rats on the 7th postoperative day ("immediately tested group"), and for 12 other rats only on the 35th postoperative day ("delayed tested group"). One half of each group was tested up to 150 days postoperatively, while the second half was tested up to 250 days postoperatively.

Of the 22 rats, 10 did not achieve any intromission postoperatively, and 5 achieved intromission at least on one test, but did not ejaculate at all. The other 7 rats ejaculated either on each test (4 rats) or only sporadically (3 rats). The number of intromitting and ejaculating rats on each postoperative test is given in Table I.

The differences in the percentage of rats ejaculating or intromitting postoperatively between the immediately and delayed tested groups were not significant.

Of the 7 ejaculating rats, 5 did so already on their first test (2 from the immediate group and 3 from the delayed group), while the other 2 rats which were from the immediate group achieved their first ejaculation either on the 3rd or on the 4th test (21 and 35 days postoperatively). Thus, it seems that whenever there is a sparing of the function after lesioning, it reveals itself within a month after the lesion was made, or not at all. Also, it seems, from the lack of differences between the two groups, that within the time limits tested, the recovery is a function of time course only and does not depend on the opportunity to stay with estrous females.

TABLE I

Number of intromitting (I) and ejaculating (E) rats on each mating test

Group	*N*	*Post-lesioning days*													
		7		*14*		*21*		*35*		*70*		*150*		*250**	
		I	*E*	*I*	*E*	*I*	*E*	*I*	*E*	*I*	*E*	*I*	*E*	*I*	*E*
Immediately tested	10	2	2	2	2	3	3	5	3	5	3	3	2	2	2
Tested with delay	12	—	—	—	—	—	—	3	3	4	2	4	3	0	0
Total	22	2	2	2	2	3	3	8	6	9	5	7	5	2	2

* Only 5 rats of the immediately tested group, and 6 of the tested with delay group were on this mating test.

Whenever there is a complete abolition of mating behavior, it is impossible to know whether the defect lies only in the initiation of copulation or also in the copulation process itself, once started. This kind of information can be derived from those rats whose mating activity was not impaired completely.

As was already mentioned, 5 rats which achieved intromission at least in one test did not achieve ejaculation postoperatively at all. One other rat which ejaculated sporadically had one test in which it achieved intromission but did not ejaculate. Thus, there were altogether 6 rats that had mating tests in which they started to copulate but failed to carry on copulation successfully. It therefore seems that MPOA lesions interfere not only with the initiation of copulation but also with its execution, once started. For purposes of analysis, the 12 rats that achieved intromissions with or without ejaculations were divided into two groups, according to the severity of their difficulties to initiate copulation. One group consists of rats that achieved intromission on each postoperative test (5 rats), and the other consists of rats that achieved intromission only on occasional tests (7 rats). It was found that all the rats of the first group achieved ejaculation, while only 2 of 7 rats of the second group did so. This difference is significant at the 0.05 level (Fisher Exact Probability Test; one-tail).

Thus, rats which were more severely defective in their ability to start copulation were also more severely defective in their ability to carry it on, once started. That the lesions had deleterious effects on the copulation process itself and not only on its initiation can be seen also from Table II which presents data for sexual behavior of the 7 rats which ejaculated postoperatively. The 4 measures presented in the table are measures for sexual performance after the initiation of copulation took place. The postoperative tests were divided into two sections. Early tests (7–35 days postoperatively) and later tests (70–250 days postoperatively). Comparison of the pre- to postoperative performance indicates that the lesion resulted in slowing the copulation process. Postoperatively, the inter-intromission interval (III) increased by hundreds of percents. This high increase was probably a main factor in the increase of ejaculation latency (EL). The resumption of mating activity after ejaculation was also affected by the lesion, as indicated by the increased postejaculatory interval (PEI). The fourth measure, namely, the number of ejaculations in the ad libitum tests, was also adversely affected by the lesion in each rat. This impairment of copulatory performance is incongruent with the conclusions of other researchers, regarding the effect of MPOA lesion on male rat sexual behavior[1,4]. According to their view, the lesion has deleterious effects only on the initiation of copulation, and not on the copulation performance, once started. However, significant increases of III were found also in their experiments. Those increases were of a much smaller magnitude, compared to the increases found in the present experiment, which might be the reason for not attaining significant increases in EL. A decreased number of ejaculations in ad libitum tests, resulting from MPOA lesions, were found also by Giantonio et al.[2], although only in 3 out of 6 rats. Thus, it is suggested that the MPOA is involved not only in the mechanism for initiating sexual behavior but also in the copulatory mechanism itself.

Comparing the ejaculating rats' performances in early vs. late postoperative

TABLE II

*Mean scores of sexual performance in preoperative, early postoperative (7–35 days) and late postoperative (70–250 days) tests, for the 7 rats that ejaculated after lesioning**

Rat no.	*Inter-introm.-interval (sec)*			*Ejaculation latency (sec)*			*Post-ejacul.-interval (sec)*			*Ejaculation frequency*		
	Preop. test	*Early postop. tests*	*Late postop. tests*	*Preop. test*	*Early postop. tests*	*Late postop. tests*	*Preop. test*	*Early postop. tests*	*Late postop. tests*	*Preop. test*	*Early postop. test*	*Late postop. test*
2	25	230	220	200	1610	1650	359	861	915	6	5	0
3	31	121	50	246	121	166	357	728	320	6	4	3
4	19	81	79	130	487	570	299	349	380	8	5	5
7	96	131	169	575	919	845	429	490	486	7	0	2
35	24	43	103	71	150	698	346	412	525	9	4	3
70	22	54	94	112	363	986	282	419	437	5	3	3
87	23	199	256	228	1594	1790	458	643	497	6	1	0
Mean	34.28	122.71	138.71	223.14	749.14	957.85	361.42	557.42	508.57	6.71	3.14	2.28
Significance of differences (randomization test, two-tailed)	preop. vs. early postop. $P = 0.016$ preop. vs. late postop. $P = 0.016$ early postop. vs. late postop. $P > 0.1$			preop. vs. early postop. $P = 0.047$ preop. vs. late postop. $P = 0.031$ early postop. vs. late postop. $P = 0.094$			preop. vs. early postop. $P = 0.016$ preop. vs. late postop. $P = 0.031$ early postop. vs. late postop. $P > 0.1$			preop. vs. early postop. $P = 0.016$ preop. vs. late postop. $P = 0.016$ early postop. vs. late postop. $P > 0.1$		

* Except for ejaculation frequency, all scores are based on the first ejaculatory series in each mating test. Ejaculation frequency scores are based on ad libitum mating tests.

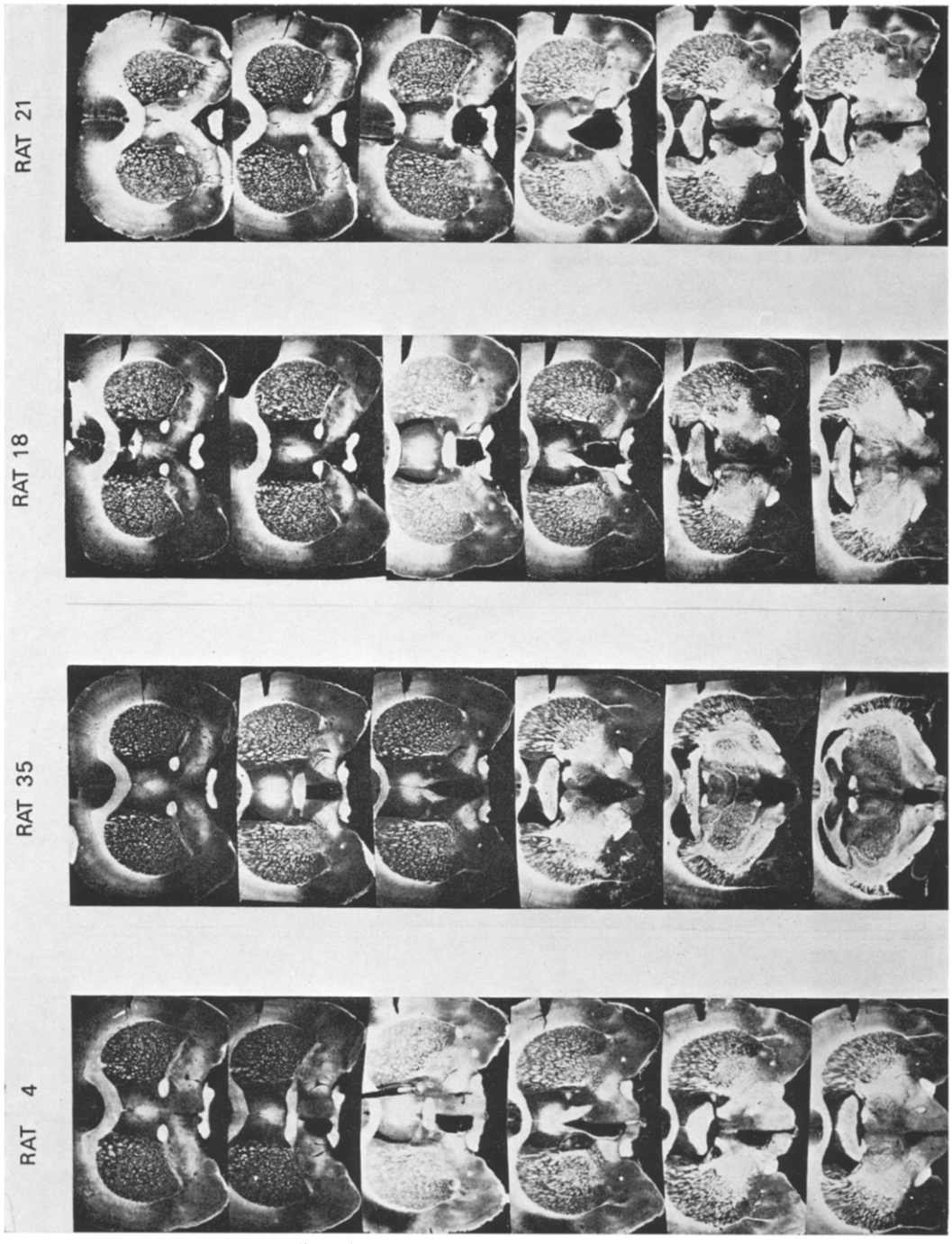

Fig. 1. Extension of lesions in 4 representative rats. Rat 21 did not intromit at all after lesioning, rat 18 intromitted sporadically but did not achieve ejaculation, and rats 4 and 35 ejaculated on each post-operative mating test.

tests (Table II), it is seen that, basically, their performance level did not improve. Thus, the idea mentioned above, that the complete sparing of function reveals itself within one month after lesioning, is strengthened.

Several days after the last mating test, all rats were killed by an overdose of Nembutal and perfused with saline followed by a solution of 10% formaldehyde in saline. The brain was then removed and soaked for a few days in a formaldehyde solution. Coronal sections (50 μm) were cut and every fourth slice was photographed using the technique described by Guzman-Flores et al.[3].

Fig. 1 presents photographed brain slices of 4 representative rats. It was found that the lesions were usually large, almost symmetrical and extended throughout the POA and anterior hypothalamus. Dorsally the lesion usually extended up to the anterior commissures and ventrally reached the suprachiasmatic nuclei. Anatomically, the rats that ejaculated postoperatively differed from the others either by having only unilateral lesions (2 rats), or by having bilateral lesions which spared large portions of the MPOA.

In conclusion, the present study indicated that retention of sexual behavior or its functional recovery following MPOA lesion in male rats could not be detected for as long as 8 months after lesioning, provided that the lesion did not spare large portions of the MPOA. In the latter case, a complete pattern of copulation took place within about one month after lesioning. However, even then, the sexual performance was found to be inferior in comparison to pre-lesioning performance, and it did not improve with time.

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