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Influence of Salivary Glands Extirpation on Procreation in Rats

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ARCIERI, R.M. and MARTINELLI, C. *Influence of Salivary Glands Extirpation on Procreation in Rats.* Tohoku J. exp. Med., 1977, **121** (2), 105–110 —— The influence of extirpation of the submandibular and sublingual, parotid and all major salivary glands on pregnancy of rats was studied. The statistic analysis of the results indicated that there are statistically significant differences in the number of offsprings between before and after extirpation of the salivary glands. The parotidectomized female rats presented the smallest number of offsprings as compared with other groups and presented some progressive sterility after the gland extirpation. ——— salivary gland extirpation; procreation

A proteinic substance called parotin was isolated by Ogata et al. (1944) and Ito and Mizutani (1952) from the bovine parotid. This fact called attention to comparison between actions of the parotid and pancreas glands (Takizawa 1954; Ogata 1955; Demetriou et al. 1970), suprarenal glands (Katagiri and Higashijo 1940; Bixler et al. 1955, 1956), pituitary gland (Takizawa 1954; Ogata 1955; Lucas et al. 1970), thyroid gland (Takizawa 1954; Ogata 1955), and sexual glands (Lacassagne and Chamorro 1940; Bixler et al. 1955; Raynaud 1960; Berkman and Kronman 1970). However, with respect to the relation between the salivary glands and the female reproductive organs, there are only a few reports in the literature.

Remotion of the submandibular glands and tying of the parotid ducts in young female rats resulted in a hypertrophy of the uterus (Higashijo 1940), and remotion of the major salivary glands in female rats resulted in some disturbances related to the vitamin B complex and to the sexual hormones (Unna 1940; Ginn and Volker 1941).

Bixler et al. (1957), removing the salivary glands from a female rat in its growing period, found a delay in the development of the reproductive organs, characterized by an atrophy of their follicles, but at the same time, they found the retention of the hormones from the pituitary, FSH and LH.

Remotion of the major salivary glands caused a decrease in the fecundation capacity in rats (Afonsky 1958), and Suddick (1960) reported that the salivary glands have a substance that interferes with the normal activity of the reproductive organs.

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Lourides et al. (1970), studying the effect of sialoadenectomy on the uterus and ovary of albino female rats, showed that the uteri of these animals were smaller with a tendency to be atrophic, and the ovaries were smaller with a delay in the maturation of the ovum. Recently, Matheus et al. (1974) reported that the remotion of the parotid glands interferes with the composition of the ovum pellucid membrane of female rats, causing an increase in the quantity of hialuronic acid and sialic acid in their levels. In the present paper we studied the effects of salivary gland extirpation on procreation.

Materials and Methods

48 female and 12 male albino rats, approximately 120 days old, were used. These animals were divided into four groups, each one composing 3 males and 12 females, and these four groups were divided further into 3 subgroups each, composed of 1 male and 4 females.

To test their fertility, they were mated until having three pregnancies completed. For statistic analysis all the three litters were used.

The submandibular and sublingual glands of the female rats of group I, the parotid glands of group II, and all the major salivary glands of group III were removed, but the female rats of group IV did not receive any salivary glands remotion and their salivary glands were just manipulated by anatomic forceps.

Seven days after the glands extirpation when the rats perfectly recovered, a new series of three crossings were started, using the same male rats tested priorly.

After completing the 6th crossing, the statistic analysis of the results was done. For this statistic analysis, only the female rats that had procreated offspring in 6 successive crossings were used, except those which died before completing 6 procreations. And, according to Siegel (1956), the Kruskal Wallis test (H), Wilcoxon test (T), Sinal test (X) and Man Whitney U test (U) were used for the statistic analysis of the results. All these tests were done at 5% significance level.

Results

As mentioned above, the rats were divided into the following four groups: *Group I, rats extirpated the submandibular and sublingual glands; Group II,* parotidectomized rats; Group III, sialoadenectomized rats; Group IV, sham-operated rats.

The number of offsprings in the first three crossings and the subsequent three crossings after remotion of the salivary glands is shown in Table 1.

In the statistic analysis by Kruskal Wallis test for the first three crossings, the result obtained was 0.429937, which is insignificant at 5% level.

The results of the statistic analysis for the three crossings after extirpation of

Table 1. *The number of offsprings before and after surgery*

Group	Before	After
I ($n=8$)	227	137
II ($n=11$)	301	81
III ($n=5$)	147	88
IV ($n=8$)	219	188

the salivary glands are shown in Tables 2 and 3, and the mean and median of the number of offsprings in the four groups before and after extirpation of the salivary glands are presented in Table 3.

TABLE 2. *Statistic analysis of the four groups before and after extirpation of the salivary glands*

Group	Values	
	T	X
I	0*	—
II	0*	—
III	—	0*
IV	(−11)	—

* Significant at 5% level.

TABLE 3. *Statistic analysis of the four groups after extirpation of the salivary glands*

Group	Values	
	H	U
I×II×III×IV	12, 15*	—
III×I	—	19, 50
I×II	—	15, 50*
III×IV	—	11, 00

* Significant at 5% level.

TABLE 4. *Mean and median of the number of offsprings in the four groups before and after extirpation of the salivary glands*

	Before				After			
	Group				Group			
	I	II	III	IV	I	II	III	IV
Mean	28, 35	27, 36	29, 40	27, 38	17, 13	7, 36	17, 60	23, 50
Median	28, 00	28, 00	28, 00	28, 50	19, 50	10, 00	21, 00	27, 00

DISCUSSION

In the control group no significant difference was noted in the number of offsprings between before and after the sham-operation, but in all the operated groups a reduction of procreation was found.

Comparing Group I (extirpation of the submandibular and sublingual glands) with Group III (sialoadenectomy), no significant statistic difference was found in the number of offsprings by the Man Whitney U test.

There were not significant statistic changes between the numbers of offsprings from the sialoadenectomized female rats and the control, although the size of

sample of sialoadenectomized group was small. In fact, when comparing the number of offsprings in the group III between before and after extirpation on the salivary glands, a decrease in the reproduction was observed in the animals which had their salivary glands removed, while comparing the number of offsprings of the control groups in the six crossings, any significant difference was not verified. This leads us to consider that there is some difference between the numbers of offsprings of sialoadenectomized female rats and the control ones.

The number of offsprings in parotidectomized group was significantly smaller than that in the sialoadenectomized and control groups. These results are in agreement with Afonsky (1958), who found a decrease in the fecundation capacity in the sialoadenectomized female rats, and with Bixler et al. (1957), Suddick (1960) and Lourides et al. (1970), who reported that extirpation of the salivary glands caused a delay in the maturation and a decrease in number of the immature follicles. Our present work shows that extirpation of the parotid gland caused a decrease in the fecundation capacity and a progressive sterilization of the female rats.

Recently, Matheus et al. (1974) found an increased proportion of hialuronic and sialic acids in the ovum pellucid membrane in the parotidectomized female rats, and it was reported that the mechanism of spermatozoon penetration into the ovum is intimately related to the histochemical composition of the ovular pellucid membrane and the binomial, hialuronic acid-hialuronidase (Sasso 1961) and the sialic acid-sialidase (Matheus et al. 1974). So, the low fecundation capacity and sterility of the parotidectomized female rats may be due to a proportion of increase in the hialuronic and sialic acid, over and above an increase in the polymerization and/or aggregation of glyco- and/or mucoprotein (Matheus et al. 1974). The above changes would make the depolymerization of the membrane insufficient, and make the penetration of spermatozoon into the ovum more difficult owing to the increase in hyaluronidase and sialidase existent normally in the spermatozoon.

An increase of hialuronic acid in parotidectomized animals has been shown in granulation tissue and in neoformed bone (Matheus 1973), and according to the same author, the extirpation of the parotid glands caused an increase in the thyroid activity, increasing the synthesis of acid mucopolysaccharides in these animals. The thyroid gland plays an important role in the reproduction mechanism, stimulating the ovulation and the corpus luteum (Botella 1966), since the remotion of salivary glands causes a hyperplasia of the thyroid follicles and increased production of thyroxin (Takizawa 1954; Ogata 1955), and since the increase in the thyroid activity is associated to the absence of ovulation (Guyton 1969), it would be possible to explain reasonably the decrease in reproduction of the female rats which had the salivary glands removed.

Finally, according to Takizawa (1954) and Ogata (1955), remotion of the salivary causes an increase in the insulin secretion and it stimulates the anterior lobe of the hypophysis to secret a larger amount of gonadotrophic hormone (Herlant

1938); on the other hand, the excess of gonadotrophic hormone causes a shortage of estrogen secretion and as a consequence no formation of new ovarium follicles. This would also explain the sterility of those sialoadenectomized animals.

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