EFFECT OF NEONATAL THYMECTOMY ON PHAGOCYTIC ACTIVITY OF NEUTROPHILS AND MACROPHAGES OF THE PERITONEAL EXUDATE IN RATS

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Experiments on rats showed that neonatal thymectomy depresses the ability of peritoneal exudate phagocytes to ingest, and still more to digest, bacteria. The phagocytic activity of the macrophages is disturbed to a much greater degree under these conditions than the phagocytic activity of the neutrophils.

The role of the thymus in the development of nonspecific reactivity to infections has received very little investigation. An important aspect of this problem is the study of the possible effect of the thymus on phagocytosis, which, besides being one of the main nonspecific cellular defensive mechanisms, is also the first stage in the identification and analysis of antigenic information. The few reports in the literature on this problem deal mainly with the study of the rate of removal of colloidal particles from the blood stream, and they are conflicting in character [3-8]. In an investigation conducted on thymectomized lambs, Meshkov [2] showed that the phases of attraction and ingestion of microorganisms by phagocytes are disturbed. No information could be found on the state of the digestive function of the neutrophils and macrophages after neonatal thymectomy.

The object of the present investigation was to study the effect of neonatal thymectomy on the ingestive and digestive power of peritoneal exudate cells of rats with respect to Salmonella paratyphi B.

EXPERIMENTAL METHOD

Experiments were carried out on 65 thymectomized Wistar rats and 62 rats of the same line undergoing a mock operation. Thymectomy was performed during the first 12-24 h of the animal's life by the writer's own method. Completeness of the thymectomy was verified by autopsy at the time of the experiment, and the site of the thymus in 17 rats was investigated histologically. Animals with remnants of the thymus were not included in the experiment. Indirect evidence of the reliability of the method of thymectomy used was given by the characteristic histological picture of the lymphoid organs in 15 animals examined, and also by development of an exhaustion syndrome in 16 of the 36 rats not exposed to bacterial infection and attaining the age of 1.5-3 months.

To study the phagocytic activity of the exudate cells, animals aged 2, 4, and 8 weeks (with no signs of an exhaustion syndrome) were inoculated intraperitoneally with a 3-h living culture of S. paratyphi B 43 411 in doses of 200 million and 1 and 2 billion bacterial cells respectively. To obtain a sufficient quantity of peritoneal exudate, 24 h before infection the rats received an injection of 10% sterile peptone solution (0.2, 0.5, and 1 ml depending on age). Autopsy was carried out 30 min after injection. Phagocytic activity of the neutrophils and macrophages was investigated by the method of Berman and Slavskaya [1]. To estimate

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TABLE 1. Effect of Neonatal Thymectomy of Phagocytic Activity of Peritoneal Exudate Cells (mean values for rats of each group)

Parameter	Age (in weeks)	No. of animals	Neutrophils			Macrophages		
			control	experiment	P	control	experiment	P
Phagocytic index (in %)	2	22/21	35	37	>0,05	34	16	<0,01
	4	20/20	39	42	>0,05	33	16	<0,01
	8	23/21	38	33	<0,01	34	17	<0,01
Phagocytic number	2	22/21	3,2	3,8	<0,05	2,6	2,8	>0,05
	4	20/20	5,6	5,1	>0,05	4,9	3,5	<0,01
	8	23/21	3,6	4,4	>0,05	3,2	2,8	=0,05
Index of completeness (in %)	2	22/21	50	15	<0,01	52	12	<0,01
№ 1	4	20/20	47	41	>0,05	49	15	<0,01
	8	23/21	50	42	<0,01	49	16	<0,01
№ 2	2	22/21	44	9	<0,01	44	6	<0,01
	4	20/20	46	36	<0,01	44	9	<0,01
	8	23/21	44	31	<0,01	46	13	<0,01
№ 3	2	22/21	15	7	<0,01	15	2	<0,01
	4	20/20	15	12	>0,05	15	2	<0,01
	8	23/21	16	5	<0,01	15	1	<0,01

Note. Numerator gives number of control rats, denominator number of thymectomized rats.

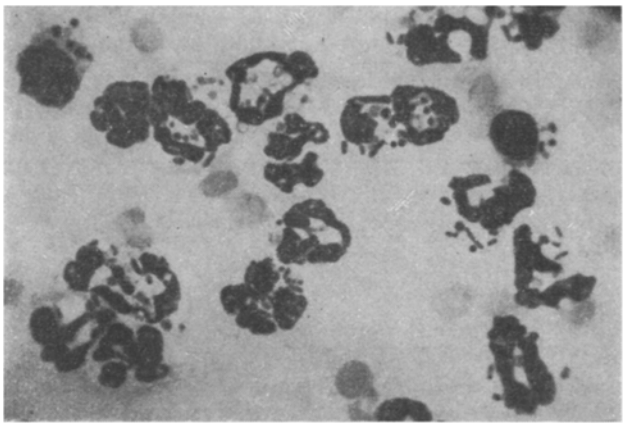

Fig. 1. Peritoneal exudate cells of control rat. Active ingestion of bacteria by phagocytes. Many ingested microorganisms in a stage of advanced digestion. Romanowsky–Giemsa, 450 ×.

the ingestive function of the phagocytes, the percentage of cells actually ingesting microorganisms (the phagocytic index) and the mean number of bacteria ingested by one phagocyte (the phagocytic number) were calculated. The digestive function of the phagocytes was estimated by determining three parameters of the completeness of phagocytosis, 1) the ratio (in%) between the number of microorganisms in a stage of advanced digestion and the total number of microorganisms ingested; 2) the ratio between the number of phagocytes in which more than 50% of the bacteria were in a state of advanced digestion and the total number of active phagocytes of that type; 3) the difference between the phagocytic index before and after cultivation of a suspension of leukocytes and microorganisms for 2 h on agar, expressing the percentage of phagocytes digesting all the ingested microorganisms. The level of disintegration of the ingested bacteria was estimated from the change in their morphological and staining properties.

EXPERIMENTAL RESULTS

Analysis of the cell composition of the peritoneal exudate revealed no significant differences in the relative percentages of neutrophils and macrophages in the animals undergoing thymectomy and the mock operation, in all investigated age groups.

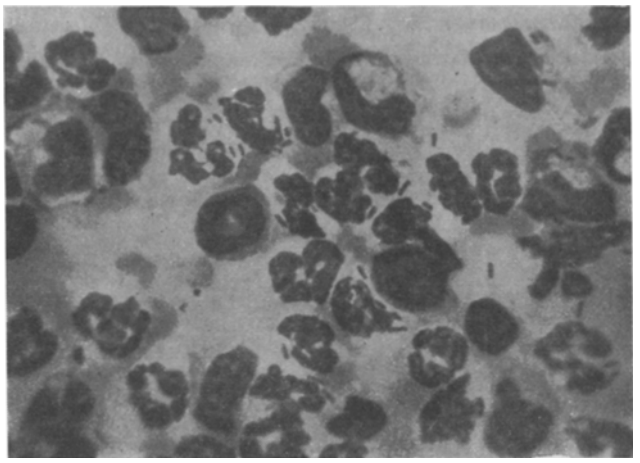

Fig. 2. Peritoneal exudate cells of thymectomized rat. Fewer cells engaged in phagocytosis. Ingested bacteria appear unchanged. Romanowsky–Giemsa, 450 ×.

Neonatal thymectomy in rats definitely disturbs both the ingestive and the digestive functions of the phagocytes (Table 1). A significant decrease in the number of phagocytes of the neutrophil series ingesting bacteria did not take place until 8 weeks after thymectomy. The ingestive power of the macrophages, estimated from their phagocytic index, was reduced by about half as a result of neonatal thymectomy. This effect was clearly seen in the animals aged 2 weeks, and it persisted throughout the subsequent periods of investigation. No significant variations in the degree of these changes could be found in rats of different ages.

No regular and consistent changes in the value of the phagocytic number could be found in the thymectomized rats. The decrease in the phagocytic index following neonatal thymectomy was probably the result of a disturbance of a diagnostic function, although this hypothesis requires further study.

The results of calculating all the indices of completeness of phagocytosis in rats undergoing thymectomy and the mock operation are given in Table 1. Comparison of the mean values of these indices in the thymectomized and control animals shows that the digestive power of both neutrophils and macrophages is appreciably disturbed in neonatally thymectomized rats (Figs. 1 and 2). Neutrophils of the 4-week old animals were the exception, for the decrease in digestive power, as reflected by the two indices of completeness of phagocytosis, was not significant.

The capacity of the macrophages to carry out intracellular digestion of the bacteria was inhibited to a much greater degree than that of the neutrophils.

Disturbance of the digestive function of the phagocytes after neonatal thymectomy was confirmed by comparing the above indices after cultivation of a suspension of leukocytes and microorganisms on agar. The rate of digestion of ingested microoganisms by neutrophilic phagocytes of the experimental rats was reduced by 2-3 times during cultivation, while that of the macrophages was reduced by about 10-15 times compared with the corresponding phagocytes of the control rats. Macrophages of the thymectomized animals showed minimum activity at the age of 8 weeks.

The decrease in digestive power of the phagocytes in neonatally thymectomized rats can possibly be explained by some defect in the lysosomal structures of the cells.

The unequal degree of inhibition of phagocytic activity of the neutrophils and macrophages by neonatal thymectomy, in the writer's opinion, emphasizes the different roles of these cells in immunogenesis.

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