

# DIFFERENCES IN ACTIVITY OF PERITONEAL PHAGOCYTES IN FEMALE AND MALE SWR/J MICE

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The object of the investigation was to compare macrophagal and neutrophilic reactions in female and male SWR/J mice. Differences in the activity of the peritoneal phagocytes of the females and males relative to a pathogenic strain of Salmonella typhimurium were found. The results indicate that when animals are chosen for experimental purposes and the results of investigations assessed consideration must be paid to sex, for the intensity of immune reactions differs in males and females and this affects the experimental results.

Key words: immune response; sex; phagocytosis.

The reactions of males and females to the same stimulus are known not to be identical. For example, the mean diurnal level of mitotic activity in the zona glomerulosa of the adrenals is 1.5 times higher in male than in female rats [1]. The mortality among males from all types of anoxia is higher than in females [11]. Experimental tumors appear sooner and grow faster in female hamsters than in males [8]. The frequency of onset of induced leukemia is higher in male than in female mice [12]. In a previous investigation the writers showed that the peritoneal exudate of female CBA, C57BL/6, and CC57W mice contains fewer macrophages than in males [2]. The outcome of the reaction or disease also may differ in males and females [5, 13]. Meanwhile other workers have found no differences in the immune response of females and males [7, 10].

It was therefore decided to make a comparative study of macrophagal and neutrophilic responses in female and male SWR/J mice.

## EXPERIMENTAL METHOD

Male and female SWR/J mice aged 2-2.5 months were used. To compare the characteristics of the phagocytic activity of their cells peritoneal cultures of macrophages and neutrophils were studied in the phagocytic reaction to Salmonella typhimurium (strain No. 506 from the Museum of the Research Laboratory of Experimental Biological Models, Academy of Medical Sciences of the USSR) in vitro. A culture of neutrophils was obtained after injecting 3 ml nutrient broth intraperitoneally [3]. A macrophagal culture was obtained after injecting 3 ml of a thioglycollate medium [4]. The phagocytic response was studied in vitro by a test-tube method. The ratio between the numbers of microorganisms and phagocytes was approximately 1:16 [6]. The percentage of phagocytes in the exudate and the percentage of active phagocytes (f) were determined after counting the cells in films stained by the Romanowsky-Giemsa method. The digestive power of the phagocytes was studied by the method of Pelletier and Delaunay [9] with slight modification. The nutrient agar suggested by these workers for growing the salmonellas was replaced in this case by Ploskirev's medium, being more selective. The ratio between the number of growing colonies in the control (serum + culture of Salmonella) and the number growing in the experimental series (serum + Salmonella culture + phagocytes), designated K, reflected the degree of digestion of the bacteria by phagocytes. The numerical results were subjected to statistical analysis.

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TABLE 1. Neutrophilic and Macrophagal Responses in SWR/J Mice (M with confidence limits for  $P = 0.05$ )

Phagocytes investigated	Sex	Number of mice	Percentage of phagocytes in exudate	f	K
Neutrophils	Males	25	60,1 (55,8—64,4)	65,7 (60,2—71,2)	1,20 (0,93—1,47)
	Females	25	23,5 (16,9—30,1)	87,1 (84,8—89,4)	1,82 (1,69—1,95)
Macrophages	Males	25	56,1 (42,3—69,9)	5,3 (4,2—6,4)	0,74 (0,64—0,84)
	Females	25	61,6 (59,2—64,0)	4,9 (2,5—7,3)	1,64 (1,24—2,04)

## EXPERIMENTAL RESULTS

As Table 1 shows, the relative percentage of neutrophils in the exudate of the males was much higher than in that from the females ( $P < 0.001$ ).

The males and females also differed in the ability of their neutrophils to ingest S. typhimurium ( $P < 0.001$ ). Differences also were observed in the digestive power of the neutrophils: neutrophils of male SWR/J mice caused significantly less destruction to ingested microorganisms ( $P < 0.01$ ). The lower activity of the neutrophils in male SWR/J mice was thus apparently compensated by their larger relative number in the exudate; this could indicate either a larger number of them in the peripheral blood or their higher positive chemotaxis.

When macrophages were investigated differences between males and females were found only in the digestive power of these phagocytes: macrophages from females destroyed S. typhimurium cells twice as actively as macrophages of the males ( $P < 0.001$ ).

The SWR/J mice used were sensitive to salmonellosis. Their neutrophils were moderately active against the strain used, but the macrophages showed little ability to ingest the pathogen, which was still able to multiply freely outside the phagocytes. Not only was the ability of the males to ingest salmonellas low, but their K value was below 1. These facts evidently explain the sensitivity of SWR/J mice to infection.

Comparison of the activity of the two types of phagocytes shows that neutrophils were most active against the strain used. The reason for this is probably a difference in the functions performed by the two types of phagocytes during infection. Neutrophils, especially at the beginning of an infection, destroy antigen and, at the same time, deprive it of its immunogenic properties whereas macrophages, although they digest the antigen, do not deprive it of its immunogenic properties but may even enhance them. This is essential for the induction of the corresponding antibodies.

The results thus indicate that when an animal is chosen for experimental purposes and when the results of investigations are assessed consideration must be paid to sex, for immune responses in males and females differ in their level of intensity and this is reflected in the outcome of the experiment.

## LITERATURE CITED

1. R. I. Bogatova-Nikiforova, in: Proceedings of a Conference of Junior Research Workers of the Institute of Experimental Biology [in Russian], Moscow (1966), p. 21.
2. V. A. Dushkin and I. N. Emel'yanenko, in: The Biology of Laboratory Animals [in Russian], No. 3, Moscow (1971), p. 164.
3. G. I. Il'in and A. A. Kyazimova, Lab. Delo, No. 6, 361 (1968).
4. B. F. Argyris, J. Exp. Med., 128, 459 (1968).
5. G. Bouley and M. Stupfel, Bull. Inst. Nat. Sante, 25, 1249 (1970).
6. H. S. Hsu and A. S. Radcliffe, J. Bact., 96, 191 (1968).
7. J. F. Kenny and J. Gray, Pediat. Res., 5, 246 (1971).
8. G. Lipkin, Cancer Res., 30, 1928 (1970).
9. M. Pelletier and A. Delaunay, C. R. Acad. Sci., 261, 2989 (1965).
10. B. Skarova and I. Riha, Folia Microbiol. (Prague), 14, 364 (1969).
11. M. Stupfel and A. Roussel, C. R. Soc. Biol., 163, 310 (1969).
12. T. Tanaka and A. W. Craig, Europ. J. Cancer, 6, 329 (1970).
13. G. Terres, S. L. Morrison, and G. S. Habicht, Proc. Soc. Exp. Biol. (New York), 127, 664 (1968).