DEPENDENCE OF PHAGOCYTIC ACTIVITY OF LEUCOCYTES ON RESPIRATORY PHOSPHORYLATION

O.S. Sherstneva

Chair of Normal Physiology (Dir. – Prof. A.A. Zubkov), Kishnev Medical Institute
(Presented by Active Member of AMN SSSR V.V. Parin)
Translated from Byulleten' Eksperimental'noi Biologii i Meditsiny, Vol. 50,
No. 7, pp. 64-65, July, 1960
Original article submitted April 16, 1959

Glycogen contained in leucocytes plays a basic role in assuring their physiological function. Proofs of the dependence of leucocyte mobility on the presence of glycogen in them were given by K. Voskresenskii [2] and Avice [7]. In relation to the leucocyte phagocytic activity it has been established that one of the ways in which this function is guranteed with energy is glycolysis; this was evident from the experiments of N.V. Puchkova [4] and O.S. Sherstneva [6] who have observed a lowering of phagocytic activity following elimination of leucocyte glycolysis with monoiodoacetic acid, and also from the experiments of Fleischmann [8], who obtained the same result by eliminating leucocytic glycolysis by means of sodium flouride. Cleavage of glycogen within the leucocytes, according to data of I.F. Seitz and coworkers [5], takes place also via amylolysis with a subsequent respiratory phosphorylation of the glucose formed. Investigations by Fleischmann have shown that elimination of leucocytic respiration by means of cyanides lowered their phagocytic activity. These facts let one suppose that energy for phagocytic function is assured not only by glycolysis, but also by respiratory phosphorylation; however, direct proofs of respiratory phosphorylation's participation in this process are absent.

EXPERIMENTAL METHODS AND RESULTS

There was investigated, in in vitro experiments, the influence of eliminating the respiratory phosphorylation by means of 2,4-dinitrophenol (DNP), dissolved in Ringer's solution for warm-blooded animals, on the human leucoctye phagocytic activity. Phagocytic activity was determined by the method of G.E. Platonova [3]. There were conducted eight experiments, each accompanied by a control. The experiments have shown that DNP in the concentration of $1:10^{-3}$ sharply decreased the leucocyte phagocytic activity - on the average from 39 to 8% (Fig. 1a).

In the authors' previous experiments on the exclusion of glycolysis by monoiodoacetic acid, the leucocyte phagocytic activity was lowered from 44 to 25%, i.e., to a considerably lesser extent than following exclusion of respiratory phosphorylation. This one to suppose that under aerobic conditions respiratory phosphorylation plays a more essential role in assuring energy for leucocyte phagocytic activity than does glycolysis.

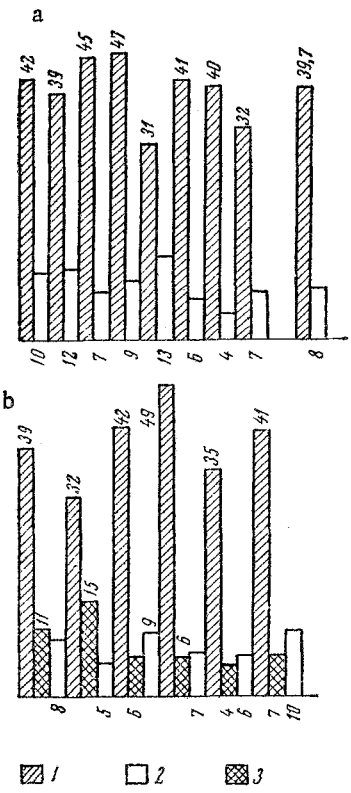

Fig. 1. Influence of 2,4-dinitrophenol on phagocytic activity of leucocytes (a) and the influence of ATP on phagocytic activity of leucocytes previously subjected to exclusion of respiratory phosphorylation (b). 1) Control 2) DNP ($1:10^{-3}$) 3) ATP($1:10^{-3}$).

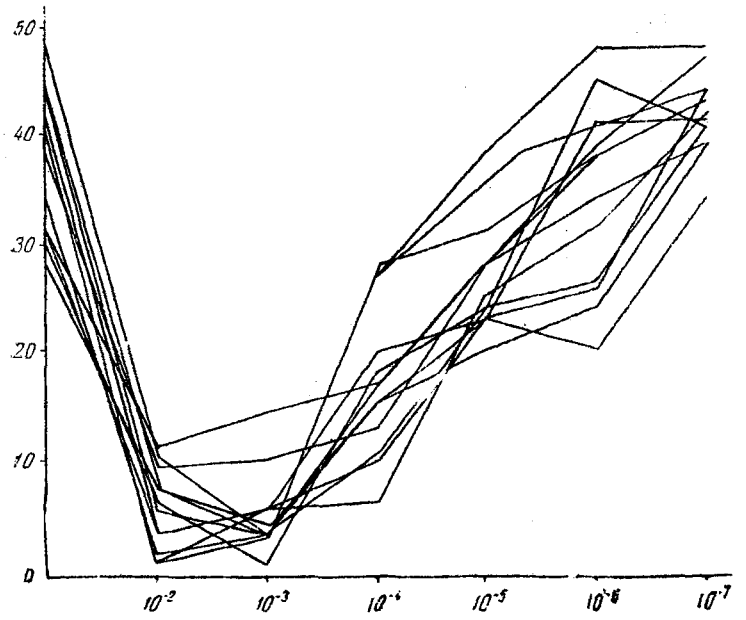

Fig. 2. The influence of ATP on the phagocytic activity of leucocytes (abscissa concentration of the sodium salt of ATP, ordinate-percent of phagocytizing leucocytes).

The attempt to restore leucocyte phagocytic activity which was previously lowered by exclusion of respiratory phosphorylation, by adding a sodium salt of ATP, was unsuccessful; even a large concentration of ATP ($1:10^{-3}$) produced only an insignificant increase in phagocytic activity of leucocytes poisoned with 2,4-DNP, this increase was within the accuracy limits of the method (Fig. 1b).

The influence of various ATP concentrations on phagocytic activity of leucocytes not previously subjected to the exclusion of respiratory phosphorylation was investigated in 12 experiments. These experiments have shown that during intact leucocytic metabolism concentrations of ATP from $1:10^{-2}$ to $1:10^{-4}$ lowered phagocytosis (Fig. 2). From this follows that the phagocytic process is slowed down by the surplus of phosphate macroergs, which was created by the addition of ATP to the medium. The stimulatory action of ATP in the quantities which were noticed in the work of D.N. Alpern and R.U. Lipshitz [1], were not observed in the present study; this is possibly due to the fact that these authors experimented with exudate leucocytes, whereas the present experiments were conducted on blood leucocytes.

SUMMARY

As shown experimentally (in vitro), exclusion of respiratory phosphorylation in the leucocytes considerably reduces their phagocytic activity. Addition of ATP to the medium results in restoration of this function. The addition of ATP to the medium in a concentration not under $1:10^{-4}$ tends to depress phagocytosis, if leucocyte metabolism remains intact.

LITERATURE CITED

1. D.N. Alpern and R.U. Lipshitz, Arkhiv. Patologii No. 3, 69(1951).
2. K. Voskresenskii, Leucocytic Glycogen and Its Clinical Significance [in Russian] (Moscow, 1907).
3. G.E. Platonov, Fiziol. Zhur. No. 8, 129(1938).
4. N.V. Puchkov, Biokhimiya, 20, 123 (1958).*
5. I.F. Seitz, Byull. Eksp. Biol. i Med. 43, No. 2, 719(1957).*
6. O.S. Sherstneva, Byull. Eksp. Biol. i Med. 44, No. 3, 67 (1958).*
7. C.M. Avice, Annales de l'Université de Paris (Sorbonne, Paris, 1955) No. 4
8. W. Fleischmann, Biochem. Z. 184, 385(1927).

*Original Russian pagination. See C.B. Translation.