CELL COMPOSITION OF THE THYMUS AFTER IMMUNIZATION WITH BACTERIAL AND VIRAL ANTIGENS

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Single or repeated injections of various vaccines (heated typhoid, typhoid vaccine, adsorbed tissue vaccine against tick-borne encephalitis) into guinea pigs induces the development of a cell response in the thymus that affects the whole cell population. Changes in the number of certain cell forms, such as thymoblasts, are of short duration and correspond to the acute phase of the response. The response of other cells, for example basofils, can be detected in the tissue for many days. Most of the changes taking place in the tissue of the thymus after immunization are nonspecific in character. The view that morphological changes in the thymus do not occur in response to ordinary immunization requires closer examination.

KEY WORDS: vaccination; thymus – cell composition.

The literature on the role of the thymus in immunity is extensive but the changes in the cell composition of the gland during immunization have been inadequately studied. Hitherto the morphology of the thymus of the immunized animal has been judged on the basis of investigations of histological sections. However, this method does not reflect the fine changes in cell composition of the lymphoid tissue [3]. For that reason the view frequently expressed in the literature [2] that changes in the course of immunization are not found in the thymus requires closer examination.

The object of this investigation was to study the total cell count of the thymus in animals immunized with bacterial and viral antigens.

EXPERIMENTAL METHOD

Experiments were carried out on 221 guinea pigs. The animals were divided into the following groups: 1) 72 animals immunized twice at weakly intervals subcutaneously in the right hind limb with adsorbed tissue vaccine against tick-borne encephalitis in doses of 1 ml at the first and 2 ml at the second injection; 2) 41 guinea pigs immunized by the same scheme intraperitoneally with heated typhoid vaccine in a dose of 0.5 ml of a suspension containing 2×10^9 bacterial cells/ml; 3) 71 animals immunized with supernatant of a suspension of chick embryonic fibroblasts, a constituent of the tissue vaccine, in doses comparable with group 1 and by a similar scheme (control to group 1); 4) 16 animals injected with physiological saline by the same scheme and in the same doses as above (control to group 2); 5) intact animals (21). Material for investigation was taken 6 h and 1, 3, and 7 days after each injection. Squash preparations were fixed in methanol and stained with azure-II–eosin. Altogether 1000 cells were counted. Besides the percentages of the various types of cells, in the first two groups their absolute number, the number of karyocytes was counted and the thymic index calculated. The numerical results were subjected to statistical analysis with the use of Student's criterion.

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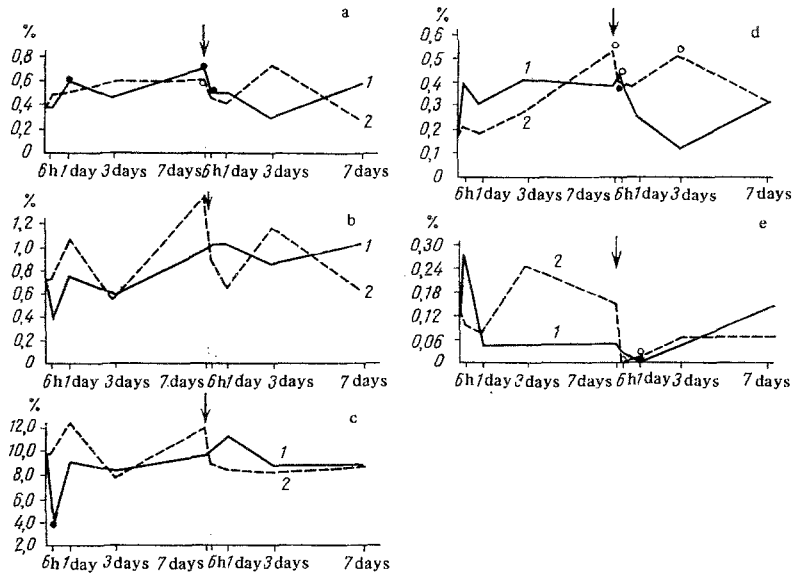

Fig. 1. Dynamics of number of various cell forms in the thymus after immunization of guinea pigs with adsorbed tissue vaccine against tick-borne encephalitis: a) reticulum cells; b) thymoblasts; c) medium-sized lymphocytes; d) cells of the myeloid series; e) cells of the plasma series; 1) experiment; 2) control. Arrow indicates injection of the vaccine; filled circles represent statistically significant changes; empty circles changes close to statistically significant. Abscissa, time after immunization; ordinate, percentage of cells in thymus.

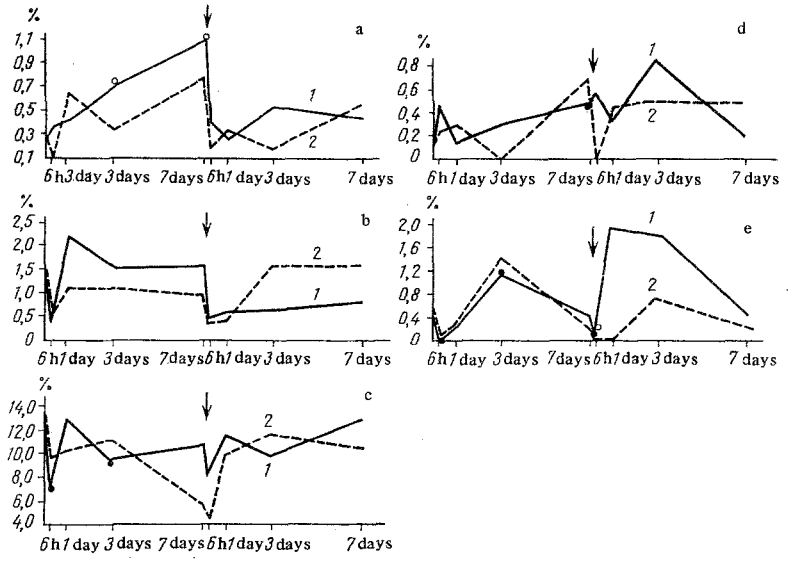

Fig. 2. Dynamics of number of various cell forms in the thymus after immunization of guinea pigs with heated typhoid vaccine. Legend as in Fig. 1.

EXPERIMENTAL RESULTS

All cell forms represented in the thymus were found to respond to injection of both viral and bacterial antigen (Figs. 1 and 2). Since the dynamics of the absolute number of cells as a rule coincided with the dynamics of their relative percentage, only the latter data were taken into consideration.

The number of reticulum cells increased by a statistically significant degree after the first injection of both the viral and the bacterial vaccines. The second injection of both antigens reduced the relative

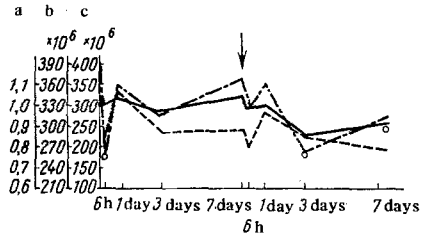

Fig. 3. Dynamics of thymic index (a) and the number of karyocytes (b) and small lymphocytes (c) in the thymus of guinea pigs immunized with adsorbed tissue vaccine against tick-borne encephalitis.

percentage of these cells to the original level or even a little below. The response of these cells to injection of physiological saline or supernatant of the fibroblast suspensions (CEF) was much weaker, although its direction was similar to that in the experimental groups. The macrophages responded with an increase in their relative percentage after each injection of either antigen, except the second injection of the vaccine against tick-borne encephalitis.

The number of cells of the myeloid series in the thymus tissue increased appreciably after the injection of the antigens; the maximum in the case of typhoid vaccination was observed after the second immunization, whereas in the case of vaccination against tick-borne encephalitis the maximum was observed after the first injection. Injection of physiological saline likewise was followed by a small increase in the number of cells of the myeloid series, but this was not statistically significant. Cells of the myeloid series responded very actively to injection of CEF cells; by contrast with vaccination against tick-borne encephalitis, in this case a second maximum was observed on the third day after the second injection of the antigen.

The number of lymphoblasts also changed during immunization. The first injection of typhoid vaccine led to a marked, statistically significant decrease in this parameter 6 h after immunization. Later, by the end of the first day, it rose again and was back to normal on the third day of the experiment. A second injection of this same vaccine led to a fresh decrease in the number of lymphoblasts, and this change persisted until the end of the period of observation.

Primary immunization with vaccine against tick-borne encephalitis reduced the number of lymphoblasts in the thymus for a short time, but later the number of these cells increased gradually. The dynamics of the number of prolymphocytes was similar to that of the lymphoblasts.

It is significant that after injection of the typhoid vaccine an increase in the relative percentage of cells of the plasma-cell series was observed by the third day after each injection of antigen, but by contrast, after immunization with vaccine against tick-borne encephalitis, the relative percentage of these cells was lower than initially. The second wave of the response of the plasma-cell series was evidently specific in character, for it could not be induced by the use of a nonantigenic stimulus (injection of physiological saline). Nor could it be observed after repeated injection of the extract of CEF cells.

The dynamics of the thymic index, the number of karyocytes, and the absolute number of small lymphocytes in guinea pigs immunized with vaccine against tick-borne encephalitis is illustrated in Fig. 3. Clearly the thymic index was higher after immunization than initially, especially in the case of the second immunization. Paradoxically the number of karyocytes and the absolute number of small lymphocytes in the thymus fell steadily during this period. A parallel investigation of histological sections [1] suggests that this contradiction can be attributed to changes in the blood volume of the organ, and another contributory factor could be edema.

Injection of extract of CEF cells in most cases led to smaller changes in these parameters, although the direction of the changes remained the same.

The cell composition of the thymus thus varies regularly in response to injection of both bacterial and viral antigens. Consequently, the view that the thymus remains morphologically intact during immunization is premature. The reticulum cells of the thymus and the small lymphocytes respond most clearly, but regular changes are also observed in the cells of the myeloid series. The direction of these changes is largely dependent on the type of antigen given. This is clear from the example of the medium-sized lymphocytes and also of the cells of the myeloid series. Changes observed after injection of the viral preparation cannot be reduced simply to the responses evoked by injection of extract of CEF cells, for as a rule these responses were weaker.

Immunization with different antigens thus leads to the development of complex psychological changes in the thymus affecting all types of cells represented in the organ. Some of these changes may be nonspecific in character, possibly in response to the stressor action of the antigen.

LITERATURE CITED

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