EFFECT OF INFLAMMATION IN LATE PERIODS AFTER IRRADIATION ON THE SERUM PROTEIN COMPOSITION

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Aseptic inflammation in previously irradiated rats was accompanied by the slower development of changes in the serum protein composition than in control animals. Some of the compensatory changes in the serum protein composition during inflammation were completely absent in the irradiated rats.

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Since restoration of many of the processes disturbed in acute radiation sickness is not always complete, but the residual defects become apparent only when the animal is exposed to additional factors [12], in the course of an investigation to study the age dynamics of the serum protein composition in the late periods after irradiation [5], a simultaneous study was carried out of changes in the protein pattern during functional loading in the form of aseptic inflammation.

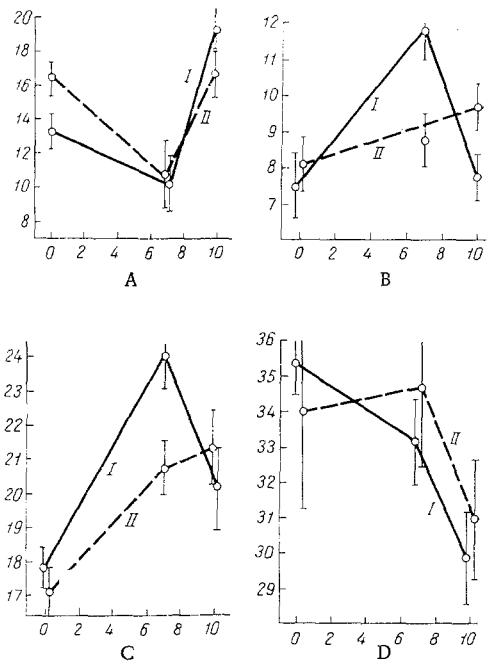

Fig. 1. Changes in serum protein composition during aseptic inflammation in control rats (I) and irradiated rats (II) 10 months after the beginning of the experiment. Points on the graph denote mean values for groups of 6-7 animals, confidence limits for a level of significance of 0.05. Abscissa: time after injection of turpentine (in days); ordinate, concentration: a) of γ-globulin (in %), b) α_1-globulin (in %), c) α-Σ-globulins (in %), d) prealbumin-albumins (in mg/ml).

EXPERIMENTAL METHOD

Experiments were carried out on male Wistar rats surviving 10-17 months after irradiation in a dose of 400 rad. Unirradiated rats of the same age and sex acted as controls. Aseptic inflammation was produced by injecting turpentine in a dose of 0.4 ml subcutaneously into the abdominal wall. In experiments carried out during the 10th month of observation, blood was taken for analysis from the abdominal aorta by exsanguination from animals not receiving injections of turpentine and also from rats on the 7th or 10th day after such injection, corresponding to the phases of formation and opening of the abscess. During the 17th month, blood samples for determination of the initial indices were taken from the rats during cardiac puncture 2 weeks before injection of the turpentine. On the 10th day of inflammation blood was taken from the abdominal aorta of the same animals. Analysis of the serum protein composition was carried out by electrophoresis in an agar gel [15] make up in buffer, pH 8.8, of the following composition: 29.8 g H_3BO_3, 13.6 g KH_2PO_4, 6.5 g NaOH, 37.5 g glycocoll, and distilled water to 2.5 liters. To prepare a gel with ionic strength of 0.015 the buffer was diluted 1:5 with water and mixed with an equal volume of 2% agar. The electrode cells were filled with buffer of the same composition, diluted 1:7 with water. Total serum protein was determined by Waddel's method [16]. Values were obtained for the relative and absolute contents of the prealbumin-albumin fraction, consisting of 15-20% of the 2

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TABLE 1. Changes in Absolute Concentrations of Serum Protein Fractions during Aseptic Inflammation in Rats Surviving 17 Months after Irradiation and in Control Animals of the Same Age

Fractions	Control		Irradiated		P_{c-e}
	M_1-M_2	P	M_1-M_2	P	
Prealbumin-albumins	−3,5	<0,02	+0,8	>0,05	<0,01
α_1-globulins	+1,0	<0,05	−0,02	>0,05	<0,05
α_2-globulins	−0,2	>0,05	−0,02	>0,05	>0,05
α_3-globulins	+1,1	<0,02	+0,1	>0,05	<0,05
α-globulins	+2,1	<0,05	−0,02	>0,05	<0,05
β-globulins	−0,8	>0,05	+0,02	>0,05	>0,05
γ-globulins	+1,8	<0,02	−0,02	>0,05	<0,02

Note. Since in this series of the experiment the indices of the protein fractions obtained initially and on the 10th day of inflammation were obtained by analysis of the sera of the same animals, deviations from the initial values are given in the table and their significance is determined by the method of two-sample comparisons. M_1-M_2 represents deviations from initial values by 10th day after injection of turpentine, P represents significance of deviation from initial values, and P_c-P_e significance of differences between control and experiment.

prealbumins and 80-85% of albumin, the concentrations of α_1-, α_2-, α_3-, β-, and γ-globulins, and also the total content of all three α-globulins (α-Σ-globulins).

EXPERIMENTAL RESULTS

The response of the experimental animals surviving 10 months after irradiation to development of a focus of aseptic inflammation differed from the control in the character of the changes in relative concentrations of α_1-, α-Σ-, and γ-globulins. Calculation of the absolute concentrations showed that, besides significant differences in the dynamics of the various components listed above, the content of the prealbumin-albumin fraction in the control animals fell significantly whereas in the experimental animals no significant change in the index took place (Fig. 1). The differences between the intact and irradiated rats at the 17th month of the observation (Table 1) were that in the former the same changes in the protein fractions could be observed as in the preceding series of the experiment, while in the animals undergoing irradiation no significant changes were present whatsoever.

Comparison of these results with those obtained by other workers [7, 9, 10, 17, 18] shows that in the control rats in both series of the experiment inflammation was accompanied by typical and definite disproteinemic changes.

The lowering of the level of γ-globulins by the 7th day was evidently due to inhibition of synthesis of these proteins under the influence of an increase in the blood glucocorticoid concentration [4, 14], their utilization being either unchanged or speeded up. However, adrenal cortical activity in rats in the late periods after irradiation does not differ from the control level [2, 8]. Consequently, the more sudden decrease in concentration of γ-globulins in the irradiated rats than in the controls cannot be explained by more marked inhibition of their synthesis. It can only be assumed that this difference reflects the utilization of these proteins at a faster rate than normal. Evidently in the irradiated animal inflammatory processes are accompanied by increased consumption of γ-globulins, so that their level falls more sharply against the background of inhibited synthesis, while when synthesis is activated (7th-10th days) it rises more slowly. Possibly the increased consumption of γ-globulins during inflammation in irradiated animals is one cause of the persistent increase in the content of these proteins in the blood serum [5]. This hypothesis is in agreement with the view [3] that in the late period after irradiation the effectiveness of cellular mechanisms of immunity falls while that of its humoral components remains relatively intact. From this

point of view the elevation of the level of γ-globulins can be regarded as an attempt by the body to compensate for certain defects in the defensive mechanisms.

It is considered that the decrease in the serum albumin concentration during inflammation is associated with increased exudation of albumin and a reduction in its half-breakdown time [1, 7, 10, 18]. The possibility of a decrease in mobility of the albumin molecules as a result of adsorption of transportable metabolites on them likewise cannot be ruled out [11], as a result of which the value of the albumin concentration obtained by electrophoretic analysis is too low while that of the α-globulins is too high. Besides this process, an increase in the α-globulin level during inflammation may be due to the more rapid formation of proteins of this group [10, 13, 17], some components of which possess the properties of antibodies [6]. There are thus grounds for considering that changes in the concentrations of albumins and α-globulins during inflammation are connected with the development of protective and adaptive reactions in the body.

The protracted increase in the concentration of α-globulins, with no tendency for their restoration to normal, the absence of any significant change in the level of the prealbumin-albumins, and likewise the absence of changes in the serum of the rats 17 months after irradiation can be regarded as evidence of the imperfection of protective and adaptive mechanisms in irradiated animals.

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