

**EFFECT OF PREVIOUS ULTRAVIOLET IRRADIATION
ON STABILIZING PROPERTIES OF THE BLOOD
AND THEIR RELATIONSHIP TO PROTEIN COMPLEXES
IN EXPERIMENTAL ATHEROSCLEROSIS**

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Experiments on rabbits have shown that ultraviolet irradiation preceding experimentally induced alimentary hypercholesteremia increases the stabilizing properties of the serum proteins and reduces the coagulating power of γ -globulin. The total serum cholesterol concentration falls and fewer atheromatous plaques are formed in the wall of the aorta.

* * *

One of the factors lowering the blood cholesterol concentration in atherosclerosis is radiant energy [2, 10, 15], especially ultraviolet radiation [4, 13, 17, 18].

The results of experiments performed by one of the authors [5, 6, 16] showed that the albumin fraction and carbohydrate-protein complexes isolated from it, and also serum glycoproteins have the ability to prevent coagulation of a cholesterol solution (stabilization). The γ -globulin fraction and its carbohydrate-protein complexes facilitate precipitation of cholesterol (sensitization).

The object of the present investigation was to study the stabilizing properties of the blood with respect to cholesterol and their connection with changes in the protein, carbohydrate-protein, and lipid-protein complexes of the serum under the influence of ultraviolet irradiation given before induction of experimental hypercholesteremia [3].

EXPERIMENTAL METHOD

Experiments were carried out on 24 male rabbits divided into two groups. The rabbits of group 1 (13) received ultraviolet irradiation of between 1/8 and 5 biodoses (measured by Gorbachev's biodosimeter) from a PRK-2 lamp for 30 days. After irradiation the stabilizing and certain biochemical properties of the blood were investigated. These results were compared with the original data. After the end of irradiation the rabbits were fed for 3 months daily with cholesterol at the rate of 0.4 g/kg body weight and again investigated. The rabbits (11) of group 2 served as controls. These animals were not irradiated but simply fed with cholesterol for 3 months. The results of investigation of the stabilizing and biochemical properties of the serum of the control and experimental (irradiated) animals were compared. At autopsy the severity of atherosclerotic lesions of the aorta was assessed in accordance with a 4-point system (11 animals) and the cholesterol content was determined in the wall of the thoracic aorta.

The stabilizing properties of the blood serum and its individual fractions and glycoproteins (stabilizing and sensitizing power) were determined by G. V. Kobozev's method [7]. The protein [16], lipoprotein [16], and glycoprotein [8] fractions were investigated by electrophoresis on paper [19], and the total glycoproteins by the modification of Weimer and Moschin [1, 19], and the total cholesterol by Bloor's method [9].

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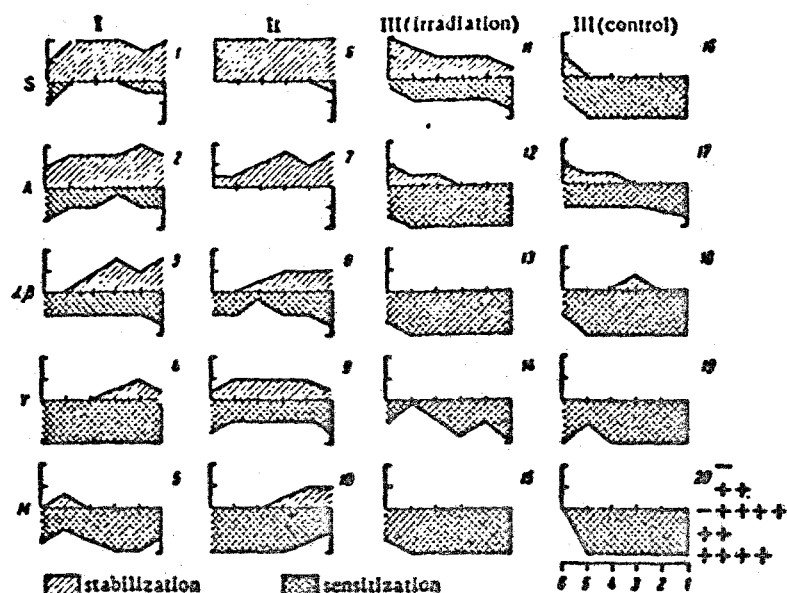


Fig. 1. Graph showing stabilizing and sensitizing properties of blood serum proteins (S), serum fractions (A, α , β , γ), and carbohydrate-protein complexes isolated from serum (M) (mean results of 160 tests). I) original data; II) one month after ultraviolet irradiation (before cholesterol feeding); III) (irradiation) 3 months after beginning of cholesterol feeding (animals irradiated with ultraviolet rays before cholesterol feeding); III) (control) cholesterol feeding for 3 months without ultraviolet irradiation. In each graph stabilizing (protective) properties plotted above zero line, proportional to area below curve; sensitizing (coagulating) properties plotted below zero line, proportional to area above curve. Abscissa, concentration (degree of dilution) of investigated substance in each of six tubes; ordinate, degree of coagulation of cholesterol sol in each tube; - absence of sol compared with original; ++ considerable turbidity; +++ complete coagulation.

TABLE 1. Severity of Atheromatous Plaques on Thoracic Aorta and Their Total Cholesterol Content (per dry weight) in Rabbits with Experimental Atherosclerosis

Animals	No. of animals	Severity of aortic lesions				Cholesterol cont. per gram aortic wall tissue (in mg.)
		+	++	+++	++++	
Irradiated with ultraviolet light	12	10	1	2	0	4.5
Unirradiated (control)	11	0	3	3	5	7.8

EXPERIMENTAL RESULTS

Changes in the stabilizing properties of the serum proteins and their individual fractions and glycoproteins are illustrated in Fig. 1 and the changes in other biochemical indices in Fig. 2.

It is clear from Fig. 1, 1-5 that the original results of determination of the stabilizing properties of the serum, its individual fractions, and glycoproteins agreed with our earlier findings [3, 5, 6].

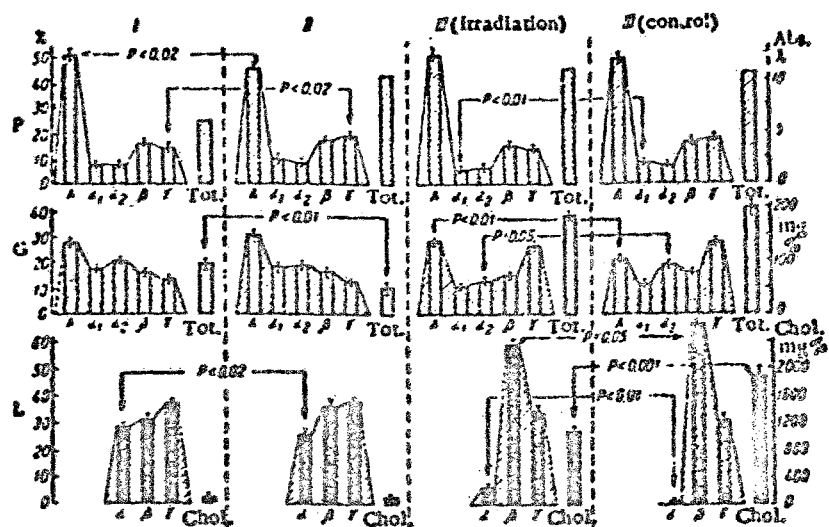


Fig. 2. Dynamics of changes in proteins (P), glucides (G), and lipids (L) during electrophoresis. Ordinate, on the left: relative distribution of protein, glucides, and lipids in serum fractions; on the right: total content of glycoproteins and total cholesterol. Height of the columns corresponds to arithmetic mean data with mean error shown graphically ($M \pm m$) [12]. I, II, III, -see footnote to Fig. 1.

After ultraviolet irradiation of the rabbits a tendency was observed for an increase in the stabilizing properties of the serum and its fractions. A decrease in the concentration of total glycoproteins of 38.2 mg% ($P < 0.01$) can be seen in Fig. 2. A decrease in the level of albumins by 6.8% ($P < 0.02$) and an increase of 3.7% in the γ -globulin ($P < 0.02$) can also be observed.

The rabbits subsequently received cholesterol for 3 months. Analysis of the results obtained in experiments on animals irradiated with ultraviolet light and on unirradiated animals showed that the stabilizing properties of the serum relative to cholesterol were higher in the rabbits of the first group at the end of the experiment than in the control. Relative to the fractions of albumins and α - and β -globulins, no difference was found. Dynamics in the properties of γ -globulin are interesting. In healthy animals and in the control this protein caused coagulation of cholesterol in all dilutions (Fig. 1, 4 and 19), whereas in animals receiving ultraviolet irradiation the ability of the γ -globulin fraction to precipitate cholesterol was sharply reduced (Fig. 1, 14). This pattern was observed only in animals irradiated with ultraviolet light (before cholesterol feeding), as is clear from Fig. 1 (compare 4 and 19 with 9 and 14). The concentration of lipoproteins and total cholesterol (Fig. 2) different significantly in the irradiated and control animals. The relative concentration of γ -lipoproteins was three times higher ($P < 0.01$) in the irradiated animals than in the controls 6 ± 0.7 and 1.9 ± 0.003 . The total cholesterol concentration was 670 mg% less ($P < 0.001$) in rabbits receiving ultraviolet irradiation (1158 ± 4.8 mg% in the irradiated animals, 1828 ± 13.2 mg% in the controls).

The severity of the atherosclerotic plaques in the aorta was assessed by a 4-point system. As Table 1 shows, the lesions in the aorta were less severe in animals irradiated with ultraviolet light than in the controls. Slight involvement of the aorta (solitary plaques) was found in 10 of the 13 rabbits in the experimental group, while no such changes in the aorta were found in the control animals ($P < 0.01$). Severe involvement of the aorta (numerous plaques) was observed in half the unirradiated rabbits, while in the irradiated animals no such lesions were found in the aorta.

The experiments described show a parallel between the severity of the aortic lesions and the cholesterol concentration in the blood and in the aortic wall (Table 1), and also in the relative proportions of lipoprotein fractions of the blood serum. The coagulating properties of the γ -globulin fraction were reduced by ultraviolet irradiation, and this fraction markedly lost its ability to precipitate cholesterol. The changes enumerated indicate the beneficial effect of ultraviolet irradiation on the development of experimental atherosclerosis.

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