ON THE AGE-INDUCED ANTIGENIC PECULIARITIES OF TISSUES IN OLD ANIMALS

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Many authors studying the development of an individual frequently resort to experimental immunological techniques, since the latter are characterized by high sensitivity, and the immunological phenomena, as is known, hold an extensive and significant position in ontogeny.

It is known that an old organism differs significantly from the young both in the metabolic activity and biochemical structure of tissue components [1,3,5,6].

The above indicated investigators offer many examples of significant and varied alterations with age in tissues of old animals

Considering that aging changes must reflect, in one manner or another, on the antigenic properties of tissues of old animals, we carried out a series of experiments to determine antigenic peculiarities of tissues of old animals. For this purpose, we first used the anaphylactic reaction with desensitization, suggested by L. A. Zil'ber and his coworkers for detection of specific antigens in malignant animal tumors.

EXPERIMENTAL METHOD

Experiments were carried out on clinically healthy guinea pigs, sensitized by subcutaneous injection of antigen. Blood sera and saline extracts of spleen and liver of cows and other animals 3-5 years and over 10 years old served as antigens. A half of the experimental animals were sensitized with the antigens obtained from young animals, and the other half by antigens from the older animals. Desensitization was carried out after 30 days by intravenous injection of the antigen. Guinea pigs sensitized with preparations from the old animals were desensitized with the antigens obtained from the young animals, and vice versa. The shocking dose of the antigen of the kind used for sensitization of the respective guinea pigs was introduced intravenously two hours after desensitization. The degree of response of the animal to the antigen was indicated by the appropriate number of pluses and the absence of reaction by a minus. A more detailed consideration of the method was presented by us at an earlier date[2].

EXPERIMENTAL RESULTS

It is apparent from Table 1 that a single subcutaneous injection of guinea pigs with saline extracts of bovine liver and spleen produces increased sensitivity to these agents. Upon intravenous injection of these agents after 30 days, guinea pigs display, in most instances, a typical anaphylactic reaction.

It can be seen from Table 1 that a marked anaphylactic reaction is observed in all experimental animals sensitized with extracts from organs of old animals after a shocking dose of the same agents. This confirms the inability of extracts of organs of young animals, used to desensitize the guinea pigs in question, to completely remove the sensitizing property of analogous organ extracts of old animals. Consequently, saline extracts of liver and spleen of old animals, in addition to the common antigenic properties characteristic of analogous extracts of the same organs of young animals, evidently also have their own specific antigenic peculiarities which are related to the aging changes of the animal.

A different picture is observed in guinea pigs sensitized by analogous saline extracts of organs of young animals. All these guinea pigs, after injection of a shocking dose of the same preparations, do not, as a rule, show

TABLE 1. Experimental Data with Saline Extracts of Bovine Liver and Spleen

Guinea pig No.	Sensitization			Desensitization				Additional Desensitization			Complete Desensitization			Shocking injection		
	No. of Antigen	Age of the animal donor of the antigen (in years)	Dose of protein (in mg)	No. of Antigen	Age of the animal donor of the antigen (in years)	Dose of protein (in mg)	Degree of guinea pig's reaction	No. of Antigen	Dose of protein (in mg)	Degree of guinea pig's reaction	No. of Antigen	Dose of protein (in mg)	Degree of guinea pig's reaction	No. of Antigen	Dose of protein (in mg)	Degree of guinea pig's reaction
1	10	14	24	13	3	15	±				13	24	–	10	24	++
2	10	14	12	13	3	9	–				13	12	±	10	18	+++
3	27	12	4.68	25	4	4	++				25	5.5	–	27	5.85	++
4	27	12	4.68	25	4	4	++				25	5.5	±	27	5.85	++
5	6	17	6.12	9	5	0.625	+++	9	1.2-6.2	+;++	9	6.25	–	6	7.51	++++
6	6	17	6.12	9	5	0.5	++	9	1.2-6.2	+;++	9	6.25	–	6	7.51	++++
7	7	17	6.55	10	5	0.36	+	10	0.3-6.0	+;±	10	6.1	–	7	6.1	+++
8	7	17	6.55	10	5	0.54	+	10	0.3-3.8	++	10	6.1	±	7	6.6	++
9	11	16	24	12	3	15	++				12	24	±	11	30	++
10	14	15	7.4	16	4	6.36	±				16	6.7	–	14	9.25	+
11	19	15	17.2	21	3	16.7	++				21	19.7	–	19	18.9	+
12	25	4	5	27	12	3	+++				27	5.46	±	25	6	±
13	25	4	5	27	12	3	+++				27	6.24	–	25	6	–
14	9	5	6.25	6	17	0.37	+++	6	1.3-6.8	++; +++	6	6.88	±	9	7.5	–
15	16	4	6.7	14	15	5.74	++				14	7.4	–	16	8.3	–
16	21	3	15.2	19	15	8.6	+				19	12.9	–	21	16.7	–
17	10	5	5.4	7	17	0.44	+++	7	1.4-5.0	+++; ++	7	6.1	–	10	6.3	–
18	10	5	5.4	7	17	0.88	+++	7	1.4-5.0	++; ±	7	6.7	–	10	6.3	–

TABLE 2. Experimental Data with Cow and Guinea Pig Sera

Sensitization				Desensitization				Additional Desensitization			Complete Desensitization			Shocking injection		
Guinea pig No.	No. of Antigen	Age of the animal donor of the antigen (in years)	Dose of protein (in mg)	No. of Antigen	Age of the animal donor of the antigen (in years)	Dose of protein (in mg)	Degree of guinea pig's reaction	No. of Antigen	Dose of protein (in mg)	Degree of guinea pig's reaction	No. of Antigen	Dose of protein (in mg)	Degree of guinea pig's reaction	No. of Antigen	Dose of protein (in mg)	Degree of guinea pig's reaction
Cow Sera																
1	23	14	7.98	22	4	6.48	+++				22	9.6	–	23	9.57	++
2	23	14	7.98	22	4	6.48	+++				22	9.6	–	23	9.57	±
3	5	17	0.83	8	4	0.27	++	8	0.54	++	8	0.9	±	5	0.99	++
4	5	17	0.83	8	4	0.27	++	8	0.54	++	8	0.9	–	5	0.99	++
5	5	17	2.1	11	4	0.36	+	11	0.7-2.5	+	11	2.5	–	5	2.7	+++
6	5	17	2.2	11	4	0.36	+	11	0.7-2.5	±	11	2.9	–	5	3.1	++++
7	22	4	8.1	23	14	6.4	++				23	9.57	–	22	9.6	–
8	8	4	0.69	5	17	0.33	++	5	0.66	++	5	0.91	–	8	0.95	–
9	11	4	2.17	5	17	0.41	+++	5	0.8-2.4	++	5	2.49	–	11	2.66	±
10	11	4	2.17	5	17	0.41	+++	5	0.8-2.4	+++	5	2.49	–	11	2.66	–
11	8	4	6.87	11	4	0.36	+	11	0.7-7.2	+++	11	7.25	–	8	8.24	–
12	8	4	6.87	11	4	0.36	+	11	0.7-7.2	+++	11	7.25	–	8	8.24	–
13	11	4	7.25	8	4	0.34	+	8	0.6-8.2	++	8	8.24	–	11	8.7	–
14	11	4	7.25	8	4	0.34	+	8	0.6-8.2	++	8	8.25	–	11	8.7	–
15	1	12	3.8	3	13	0.37	++	3	0.7-3.0	++	3	3.75	–	1	3.96	–
16	3	13	3.75	1	12	0.2	++	1	0.6-3.2	++	1	3.8	–	3	3.9	–
Guinea Pig Sera																
1	29	3	6.12	30	11	4.9	–				30	6.75	–	29	6.75	+
2	29	3	6.12	30	11	4.9	–				30	6.75	–	29	6.75	++
3	30	11	6.12	29	3	4.9	+				29	6.75	–	30	6.75	–
4	30	11	6.12	29	3	4.9	++				29	6.75	–	30	6.75	–

Note. Preparation #29 is a mixture of sera from two 3-year old guinea pigs; preparation #30 is a mixture of sera of two 11-month old guinea pigs.

anaphylactic symptoms and only a few show doubtful reaction. Inasmuch as these guinea pigs were desensitized with extracts of organs of old animals, it can be concluded that these extracts completely removed the sensitizing action of analogous preparations from organs of young animals. Therefore, the saline extracts of organs of old animals have both the antigenic properties inherent in analogous preparations of the same organs of young animals and the specific antigenic peculiarities of aging.

Analogous results were obtained by us also in experiments with saline extracts of liver and spleen of white rats, which indicates that species specificity of animal-donors of antigens did not have a significant effect on the outcome of the experiment.

The data in Table 2, depicting the results of experiments with sera of cows and guinea pigs, allows one to make the same conclusions as the data in Table 1. Therefore, not only the organs, but also the sera, of old animals have their own age antigenic specificity differing from sera of young animals.

From Table 2 it is seen that the aging antigenic specificity of sera of old animals are clearly demonstrated also in the experiments with homologous antigens. And, finally, Table 2 shows that guinea pigs sensitized and desensitized with sera of only young or only old animals do not develop symptoms of anaphylactic reaction after a shocking dose of corresponding preparations. This points to the identical antigenic properties of sera of different individuals of the same species of animals of the same age.

On the basis of the above, it may be considered proven that the tissues of old animals contain antigens absent from the tissues of young animals.

SUMMARY

An experimental work was carried out to determine the antigenic properties of blood sera and of the saline extracts from animal tissues (cows and albino rats) of a different age. As established, blood sera and saline extracts from the organs and tissues of old animals, apart from the common antigenic properties to the analogous preparations from the young animals, possessed their own specific antigenic peculiarities, connected with the aging of the organism.

LITERATURE CITED

1. S. E. Bresler, in: Advances in Biological Chemistry[in Russian] 2 (Moscow, 1954), p. 66.
2. I. N. Bulankin and M. A. Blumina, Trudy Nauchno-Issled, In-ta Biologii, 12 (Kharkov, 1947), p. 62.
3. O. E. Vyazov, in: Problems of Modern Embryology [in Russian] (Leningrad, 1956), p. 311.
4. O. E. Vyazov, About Certain Antigenic Properties of Embryonic Tissues, Thesis [in Russian] (Moscow, 1951).
5. N. N. Zhukov-Verezhnikov, Uspehi Sov. Biol., 18, No. 1 (1944), p. 93.
6. V. A. Karev, Bull. Éksper. Biol. i Med., No. 8 (1954), p. 56.
7. P. N. Kosyakov, Antigenic Substances of the Organism and Their Significance in Biology and Medicine [in Russian] (Moscow, 1954).
8. I. N. Maiskii, About Biological Basis of Anticancer Immunity [in Russian] (Moscow, 1955).
9. Zh. A. Medvedev, Priroda, No. 3 (1953), p. 101.
10. N. B. Medvedeva, Transactions of a Conference About the Problem of Genesis of Aging and Prophylaxis of Premature Aging of the Organism, [in Russian] (Kiev, 1939), p. 207.
11. N. B. Medvedeva, Arkh. Pat., No. 3 (1947), p. 28.
12. I. I. Mechnikov, Resistance in Infectious Diseases [in Russian] (Moscow, 1947).
13. A. V. Nagornii, Aging and Prolongation of Life [in Russian] (Moscow, 1950).
