

REDUCTION OF DEHYDROASCORBIC ACID BY AORTIC TISSUE OF GUINEA PIGS DURING ACUTE RADIATION SICKNESS

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Among the various kinds of injury that appear in animals after exposure to ionizing radiation at certain doses, hemorrhage into different parts of the organism is a frequent symptom. On the basis of results in the literature [2, 3], one might suppose that damage to the integrity of blood vessel walls is among the principal causes for the development of hemorrhages.

At present there is experimental evidence suggesting that during hemorrhagic conditions in the organism, particularly in vessel walls, the metabolism of the intracellular substance of connective tissue is impaired [6, 7, 9]. Ascorbic acid has considerable significance for maintaining the integrity of the intracellular substance [7, 9].

Earlier we [5] obtained results on guinea pigs, suggesting that in the aortic tissue of animals without the ability to synthesize ascorbic acid (AA), the development of acute radiation sickness leads to significant interference in ascorbic acid metabolism, expressed as a decrease in AA concentration and a sharp increase in the concentration of the product of its reversible oxidation, dehydroascorbic acid (DAA). One of the factors affecting the decrease in AA concentration and rise in DAA content in tissues of the organism might be a lowered ability of tissue to reduce DAA.

It has been proved that the ability of some tissues to reduce DAA decreases during a number of pathological conditions, such as tuberculosis, membranous pneumonia, etc.; this decrease goes in parallel with lowered AA concentration in the organism [1]. At present, numerous experimental results suggest that liver tissue has a lower ability to reduce DAA after exposure to ionizing radiation, and moreover, this decline in liver tissue also goes in parallel with a decrease in ascorbic acid concentration.

In this connection, in order to study the causes leading to lowering of the free AA content and a rise in DAA concentration in vessel tissue during acute radiation sickness, we carried out determinations of the ability of this tissue to reduce DAA.

EXPERIMENTAL METHODS

We used aortic tissue as the experimental system, just as in previous work [5].

Experiments were carried out on male guinea pigs weighing 250-300 g. Before and during experiments animals were kept on a constant diet, consisting of hay, oats, and carrots. Acute radiation sickness was produced by a single external exposure to γ -rays of Co^{60} (dose strength of 500 r/min) at a dosage of 800 r. Animals were killed by decapitation. Animals were deprived of food for 16 hours before being sacrificed. The aorta was extracted from carcasses of slaughtered animals and freed from surrounding tissue and blood. Determinations of the ability of vessel tissue to reduce DAA were carried out by the method perfected by Schultz, Stotz, and King [8]. DAA was obtained by oxidizing crystalline AA with iodine.

Reduction of DAA was determined by the increase in the quantity of ascorbic acid in suspensions of homogenates of vessel tissue, to which DAA had been added. Ascorbic acid was determined by titration with 2,6-dichlorophenylindophenol. A difference in AA content in experimental and control tubes indicates reduction of DAA. Each tube contained 300 mg of aortic tissue, taken from five guinea pigs.

The ability of aortic tissue to reduce DAA was determined at 1, 3, and 5 days after irradiation. At the doses of ionizing radiation used in the experiments, the animals died 5-7 days after irradiation. Thus, studies at these time intervals were carried out during appearance of the acute form of radiation sickness.

EXPERIMENTAL RESULTS

The results are presented in the table. From these results one can conclude that the ability of guinea pig aortic tissue to reduce DAA is still maintained within normal limits one day after irradiation. Three days after irradiation, when the fall in AA content and sharp increase in DAA concentration in aortic tissue of guinea pigs can already be observed [5], the ability of this tissue to reduce DAA has declined by a factor of 2, i.e., accounts for barely $18 \pm 3\%$ of the added DAA. Reduction of DAA returned to normal five days after exposure to ionizing radiation.

Reduction of DAA to Ascorbic Acid by Aortic Tissue of Guinea Pigs during Acute Radiation Sickness

Time after irradiation (in days)	Quantity of DAA reduced, in mg%, after addition of 0.3 mg DAA	Reduction of DAA as compared to amount of DAA added (in percent)
	Normal	
—	11.0 ± 1.2	37 ± 4
	After irradiation	
1	10.9 ± 1.2	36 ± 4
3	5.5 ± 0.8	18 ± 3
5	11.2 ± 0.5	37 ± 2

Thus, the decline in the ability of aortic tissue to reduce DAA in guinea pigs exposed to ionizing radiation may actually be one of the reasons for the fall in AA content and sharp increase in DAA concentration, but this in turn affects the integrity of the intracellular substance of connective tissue, and consequently also the permeability and fragility of the vessel wall. On the other hand, the fall in the ability of tissue from vessel walls to reduce DAA may indicate a general acceleration of oxidative processes in this tissue during exposures to radiation.

The increased rate of DAA reduction five days after irradiation may evidently be regarded as a physiological protective reaction, connected with the increased requirement for ascorbic acid.

SUMMARY

Experiments were performed on guinea pigs. Acute radiation sickness provokes disturbance in the ability of the aortic tissue to reduce dehydroascorbic acid. In three days after irradiation this reducing faculty was halved and reassumed its normal value in 5 days.

Diminution of the reducing faculty of aortic tissue with respect to dehydroascorbic acid in guinea pigs affected by ionizing radiation may serve as one of the causes of the drop of ascorbic acid content and of the sharp rise of the dehydroacetic acid concentration; this, in turn, affects the stability of the interstitial substance of connective tissue, and consequently the permeability and the fragility of the vascular wall.

The rise of the intensity of dehydroascorbic acid reduction in five days after the irradiation, may evidently be regarded as a physiological protective reaction, connected with the increased ascorbic acid requirement.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
