Lipid Peroxidation during Cardiac Remodeling in 12-Month-Old Rats with Experimental Infarction

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Blood serum was from 12-month-old Wistar rats with experimental myocardial infarction caused by occlusion of the upper third of the left coronary artery was analyzed. The content of conjugated dienes by the 45th day after primary experimental myocardial infarction returned to normal and did not differ from that in intact animals of the same age group. MDA concentration in rats of the treatment group was lower compared to normal. It was demonstrated that normalization of LPO was accompanied by significant exhaustion of the endogenous antioxidant system (SOD and catalase). Our results suggest that special therapy is required for correction of the endogenous antioxidant defense system.

Key Words: *lipid peroxidation; postinfarction cardiosclerosis; age*

LPO is a pathogenetically important mechanism of cell damage under conditions of ischemia and reperfusion. These data substantiate the use of antioxidants, the agents trapping free radicals and inhibiting LPO processes, in clinical cardiology. Antioxidants are potent in preventing the development of ischemic/reperfusion myocardial injury after surgical treatment for cardiac arrest [1-3].

Published data [6,8,9] show that uncontrolled LPO activation leads to exhaustion of the endogenous defense system of the myocardium and the whole body. In this case, treatment with antioxidants is most justified [1,3]. Our previous experiments on 4-month-old animals showed that hyperactivity of LPO due to myocardial infarction is observed even after scar formation at the site of dead cardiomyocytes [11]. These data suggest that intensive LPO contributes to delayed consequences of postinfarction remodeling.

Since LPO is considered to be a mechanism of aging, it can be expected that the intensity of LPO and activity of the endogenous antioxidant system in the delayed period after myocardial infarction have the age-related characteristics.

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Here we studied the intensity of LPO and activity of the endogenous antioxidant system in 12-month-old animals during the delayed period after acute myocardial infarction.

MATERIALS AND METHODS

Experiments were performed on 12-month-old male Wistar rats weighing 400-450 g. The rats were divided into 2 groups of 10 specimens each. Myocardial infarction in animals of the experimental group was induced by occlusion of the upper third of the left coronary artery. Postinfarction cardiosclerosis (PICS) was shown to develop over 45 days after treatment [11,12]. Therefore, further experiments on these animals were performed after 45 days. Our previous experiments showed that young (4-months-old) animals are characterized by increased intensity of LPO in this period after experimental myocardial infarction [11]. The control group consisted of intact animals.

After decapitation, the blood was collected in a cold tube and centrifuged at 3000 rpm for 15 min. Serum aliquots were stored in liquid nitrogen.

The intensity of LPO in blood serum was estimated spectrophotometrically from the contents of malonic dialdehyde (reaction with thiobarbituric acid [7])

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TABLE 1. Content of LPO Products and Activity of Antioxidant Enzymes in Blood Serum from 12-Month-Old Wistar Rats ($X \pm x$)

Group	MDA, μmol/liter	CD, ΔE_{232}/ml	Catalase, μcat/liter	SOD, mmol/liter/min
Intact animals	25.32±5.44	0.82±0.11	41.30±2.95	0.153±0.039
PICS rats	12.53±1.92*	0.85±0.19	26.70±3.33*	0.087±0.031*

Note. *$p<0.05$ compared to intact animals.

and conjugated dienes (CD) in hexane extracts [9]. The function of the antioxidant system was evaluated from activities of antioxidant enzymes catalase [5] and SOD [4].

The significance of differences was estimated by Mann–Whitney rank test.

RESULTS

The contents of MDA and CD in blood serum from 4-month-old intact rats were 20.5±4.1 μmol/liter and 1.020±0.002 ΔE_{232}/ml. Activities of SOD and catalase were 0.820±0.002 mmol/liter/min and 19.50±5.38 μcat/liter, respectively [11]. We compared the intensity of free radical processes in young and old animals. Endogenous antioxidant defense in 12-month-old animals of the control group was provided by high activity of catalase (Table 1). Analysis of blood samples from animals of the treatment group revealed no differences in the concentration of CD and 2-fold decrease in the content of MDA (Table 1). These data suggest that the inducing effect of myocardial ischemia on LPO in 12-month-old animals is not observed by the 45th day after coronary artery occlusion. The myocardial response in young animals differed from that in old specimens. During this period, the contents of MDA and CD in young rats were much higher than in control specimens of the same age group [11]. Age-related changes in the antioxidant system of old animals probably contribute to their adaptation to myocardial ischemic injury. However, analysis of antioxidant enzyme activity showed that this state was achieved via significant exhaustion of the endogenous antioxidant system. Activities of SOD and catalase were decreased by 43 and 35%, respectively (Table 1). Our findings suggest that the reserves of antioxidant enzymes SOD and catalase in old animals are exhausted during the delayed period after myocardial infarction. Hence, long time is required for the recovery of these enzymes.

We conclude that aging is accompanied by an increase in the contribution of LPO and endogenous antioxidant defense in the process of postinfarction remodeling. Recovery of these systems occurs for a longer period and requires a special therapeutic treatment.

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