Role of Functional Activity of Phagocytic Mononuclear System in the Formation of Autoprostheses for Angioplasty

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The possibility of formation of connective-tissue vascular prostheses on subcutaneously implanted polychlorovynil base was demonstrated in experiments on rats. Suppression of the function of phagocytic cell with carrageenan decelerates, while its stimulation with tamerit accelerates the formation of connective-tissue autoprostheses.

Key Words: *vascular autoprostheses; phagocytic mononuclear system; tamerite; carrageenan*

Plastic repair of damaged vessels is one of the most important problems of modern theoretical and practical medicine. Improvement of methods of angioplasty led to creation of autoprostheses from host cells [7-9]. However, the mechanisms of their formation remain poorly studied, for example, the impact of the system of phagocytic mononuclears playing an important role in defense and reparative processes [3-5].

We investigated the role of functional activity of phagocytic mononuclear system in the formation of vascular autoprostheses.

MATERIALS AND METHODS

The study was carried out on 40 outbred albino rats (200-250 g). Polychlorovynil tubes (2 mm in diameter, 20 mm long) serving as the base for the formation of connective-tissue prostheses were subcutaneously implanted on the back to rats under ether narcosis. The prostheses were removed from the base after 2, 3, 4, 5, and 6 weeks and fixed in 10% neutral formalin. The sections were stained with hematoxylin and eosin and with picrofuchsin by Van-Gieson method. Morphometrical studies of the prostheses were carried out: vascular wall thickness was measured using an ocular micrometer (MOB-1-15^{x}), the number of cells per area unit (0.01 mm^2) was counted, and their qualitative composition was evaluated.

In order to evaluate the relationship between functional and metabolic activity of macrophages and the formation of autoprostheses, the animals were intramuscularly injected with tamerit (0.4 mg) and intraperitoneally with carrageenan (1.5 mg) for 4 weeks.

Tamerit is an immunomodulator selectively regulating functional and metabolic activity of macrophages [1,6]. Carrageenan is an algel polysaccharide captured by macrophages of the host and reversibly inhibiting the function of phagocytic cells [2].

In order to evaluate the possibility of using the resultant prostheses for plastic repair of vessels, 5-week autoprostheses were sutured (under ether narcosis) "end-to-end" into the dissected carotid artery of rats in which they were formed.

RESULTS

The inner surface of autoprostheses was smooth, without thickenings or ruptures, necrotic areas, or suppurative infiltration at all terms of the study. Wall thick-

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TABLE 1. Formation of Autoprostheses after Treatment with Tamerit and Carrageenan (4 Weeks; *M*±*m*)

Parameter	Control	Tamerit	Carrageenan
Wall thickness, mm	0.14±0.02	0.020±0.001***	0.30±0.02***
Cell count	62.33±1.95	48.93±1.68***	65.46±2.41
Fibroblasts	17.9±3.7	7.3±1.5	31.3±2.9*
Fibrocytes	37.2±4.4	41.6±1.5	26.8±4.3
Fibroblasts+fibrocytes	55.06±0.75	48.930±0.001***	58.13±1.70
Lymphocytes	4.6±0.9	0	2.5±1.0
Segments	1.5±1.2	0	4.8±2.0
Macrophages	1.2±0.7	0	0

Note. *p<0.05, **p<0.01, ***p<0.001 compared to the control.

ness decreased from 0.18±0.02 mm (after 2 weeks) to 0.09±0.05 mm (after 5 weeks; p<0.001).

After 2 weeks the wall of the prosthesis consisted mainly of loose connective tissue. Prostheses of later terms were characterized by more ordered morphostructural organization (collagen fibers appeared, prosthesis wall thinned, number of cells per unit of area decreased, and the count of more mature fibrocytes increased).

The time course of autoprostheses formation depended on functional and metabolic activity of monocytic macrophages. For instance, 4-week autoprostheses from carrageenan-treated animals differed from the control prostheses, which had fibrous connective tissue with longitudinally oriented collagen fibers of different degree of maturation and loose rough connective tissue with predominating cell component, which is typical of early period of prosthesis formation.

After treatment with carrageenan the autoprosthesis wall was remarkably thicker than in control animals (Table 1). Cell count in the prosthetic wall in the experimental group and qualitative composition of cells virtually did not differ from that in the control, but there were no macrophages, while fibroblasts were more numerous.

The autoprosthesis wall formed in animals treated with tamerit was characterized by fibrous connective tissue with collagen fibers of different degree of maturation, with longitudinal orientation. Treatment with tamerit accelerated differentiation and maturation of connective-tissue elements. This is also confirmed by decreased total cell count, decreased count of fibroblast cells, accelerated maturiation of fibroblasts into fibrocytes, and an appreciable thinning of the prostheses walls. In addition, there were no lymphocytes, macrophages, or segmented granulocytes in the autoprosthesis wall (Table 1).

Hence, the structure of autoprostheses formed during tamerit treatment is typical of prostheses formed at later terms.

Prostheses used for plastic repair of the carotid arteries of rats in which they were formed remained patent and normally functioned within 3 months without signs of thrombosis, sclerosis, or growth inside the vessel, which was confirmed by histological studies. No suppuration, aneurysm of the prosthesis, hemorrhages through the transplant wall or from the anastomosed area were observed.

Our findings suggest that the system of phagocytic mononuclears plays an important role in the formation of autoprostheses. Inhibition of the function of phagocytic cells with carrageenan decelerated the formation of connective tissue autoprostheses, while its stimulation with tamerit accelerated this process.

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