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CONCENTRATION OF BIOGENIC AMINES IN STOMACH TISSUES OF RATS WITH REDUCED GASTRIC CIRCULATION

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Clinical experience shows that a reduction in the blood flow in the celiac artery as a result of stenosing diseases is the cause of ischemic changes in the stomach and duodenum: atrophic gastritis and duodenitis, gastroduodenal ulcers [6, 8, 11]. After surgical removal of the cause of ischemia these changes do not always regress, and accordingly additional pharmacological correction of these states is required. Under these circumstances the complex mechanisms of development of structural and functional lesions of the gastric (GM) and duodenal mucosa must be taken into account. Biogenic amines – histamine, serotonin, catecholamines – are of great importance in the metabolic organization of gastric function and in the development of gastric pathology [1, 4, 12].

The object of this investigation was to study the concentrations of biogenic amines in the stomach tissues of rats with chronic reduction of the gastric circulation.

EXPERIMENTAL METHOD

Experiments were carried out on 300 male rats weighing 250-300 g deprived of food for 2 days. Under ether anesthesia stenosis of the celiac artery was produced by constricting its lumen by 50% of its initial diameter (0.8 ± 0.007 mm). The control group consisted of animals in which the stenosis was discontinued immediately after its creation. The animals were removed from the experiment after 3 h and 1, 2, and 7 days. A macroscopic study of GM was undertaken. The concentrations of histamine [14], serotonin [15], and adrenalin and noradrenalin [5] in the stomach wall were determined.

EXPERIMENTAL RESULTS

Chronic ischemia of the gastric wall was found to cause marked degenerative changes in GM. In all cases erosive gastroduodenitis and ulcers were found in the fundal part of the stomach. The ulcers after 3 h of the experiment were punctate, and the mucosa was edematous with venous congestion. On the 1st day the ulcers increased in size on account of necrotic areas of mucosa and a very small quantity of hemorrhagic contents was present in the lumen of the stomach. On the 2nd day these changes progressed further: The ulcers penetrated as far as the serous membrane, they often perforated, and the mucosa was ischemic. By the 7th day the

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TABLE 1. Concentration of Biogenic Amines (in μg/g tissue) in Tissues of Stomach Wall of Rats with Reduced Gastric Circulation (M ± m)

Time of investigation	Group of animals	Histamine	Serotonin	Noradrenalin
	Normal	39,3±2,5	7,4±0,5	0,25±0,03
3 h	Control	28,9±1,5*	9,5±0,6*	0,12±0,04*
	Experiments	61,8±3,1*	10,6±0,6*	0,06±0,01*
1 day	Control	42,7±1,5	7,8±0,6	0,18±0,02
	Experiments	64,9±6,1*	10,2±0,7*	0,13±0,02*
2 days	Control	38,8±7,1	9,3±0,3*	0,21±0,02
	Experiments	88,6±6,4*	14,4±1,2*	0,12±0,01*
7 days	Control	37,9±2,9	7,1±1,2	0,25±0,02
	Experiments	57,1±2,9*	7,4±0,6	0,21±0,02

Legend. *P < 0.05 compared with normal. Each group consisted of 10 animals.

mucosa had become dull and atrophic, the superficial ulcers were epithelized with the formation of pale, easily wounded scars. The gastric contents, with pH from 1.5 to 3.5, were always abundant. In animals of the control group the changes described above were not observed.

Besides destructive changes in GM, a considerable increase in the endogenous histamine level was found in the stomach tissues, reaching a maximum by the 2nd day (Table 1). By the 7th day the level of this parameter showed a gradual fall. Similar changes were noted in the serotonin concentration. The endogenous noradrenalin concentration 3 h after stenosis of the celiac artery was much lower than normally. By the 7th day its original level had been regained. Changes in the adrenalin concentration at all times were not significant.

Activation of the production of endogenous histamine and serotonin in the gastric tissues was thus observed in rats with a reduced gastric circulation. Initially this response was probably adaptive in character and aimed at increasing the blood flow in different parts of the stomach [13]. Meanwhile the ulcerogenic effects of these amines are known [2, 7]. Excessive accumulation of histamine and serotonin in the tissues evidently leads to a disturbance of the microcirculation, which favors the development of trophic disturbances. The action of these amines probably takes place through activation of the adenylate cyclase system, as a result of elevation of the cAMP level and of disturbances of energy metabolism [9], and also on account of a disturbance of equilibrium between acid-peptic factor and the physiological resistance of GM. As the results of the present investigations [3] show, under conditions of reduced gastric circulation pepsin is released into the lumen of the stomach and its content in the tissues falls; reflex diffusion of H^+ into the mucosa also is intensified. A parallel fall in the level of sulfur-containing mucoproteins also took place in the stomach wall. The decrease in the endogenous nonradrenalin concentration can be explained by the increased release of the mediator from the cells at a time when its restoration from the depots is impossible. It can be tentatively suggested that dystrophic damage to the tissue of the vessel wall itself, which as a rule is abundantly supplied with adrenergic nerve fibers, plays an essential role in the genesis of chronic ischemia of the stomach wall due to stenosis of the celiac artery. This hypothesis is supported by data on the role of endogenous catecholamines in ischemia and reflex trophic disturbances [1, 7].

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