

Amylolytic Activity of Small Intestinal Brush-Border Membrane in the Late Postresuscitation Period

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Functional changes in the small intestinal brush-border membrane were studied in the late recovery period after acute fatal blood loss. Delayed recovery of enzyme activity in the small intestinal brush-border membrane was due to impaired functional topography of the digestive transport system. It was manifested in a shift of the proximodistal gradient toward reserve zones of the ileum.

Key Words: *acute fatal blood loss; resuscitation; parietal digestion*

Long-term persistence of catabolic processes in the resuscitated organism attests to profound changes in the digestive system making impossible adequate carbohydrate supply satisfying metabolic demands of the organism [2,3,5,6]. This primarily results from digestion disorders in the small intestine (SI). Here we studied functional changes in the SI brush-border membrane during the late postresuscitation period after acute fatal blood loss.

MATERIALS AND METHODS

Experiments were performed on 30 male outbred albino rats weighing 200-220 g. The animals were bred in a vivarium of the Omsk State Medical Academy. The rats had free access to water, but were deprived of food over 10-12 h before the experiment. They were intraperitoneally narcotized with 100 mg/kg calipsol (Gedeon Richter). The left common carotid artery was catheterized. Heparin in a dose of 500 U/kg (Biochemie) was administered through a catheter 15 min before blood loss to prevent blood coagulation. Clinical death in 30 animals was produced by bloodletting from the catheterized vessel. Resuscitation was performed 5 min after clinical death and included centripetal infusion of the withdrawn blood, ar-

tificial ventilation (moderate hyperventilation, 20 min), and external cardiac massage [2]. Enzyme activity of SI mucosa was *in vitro* estimated by stepwise desorption of enzymes at various terms after resuscitation [3].

The control group included 10 intact rats. They were narcotized with calipsol, intubated, heparinized, and subjected to left common carotid artery ligation.

The results were analyzed by Student's *t* test and Wilcoxon *U* test [1].

RESULTS

One day after resuscitation activity of different amylase fractions in the SI brush-border membrane sharply decreased (Table 1). In the duodenum and jejunum activity of intestinal amylase, total activity of desorbed fractions, and activity of the intracellular enzyme decreased by 34, 53, and 64%, respectively, compared to the control. In the ileum activity of intestinal amylase, total activity of desorbed fractions, and activity of the intracellular enzyme decreased by 80, 57, and 60%, respectively.

In parallel to this decrease in amylase activity, adsorption capacity and efficiency of parietal digestion in the brush-border membrane decreased in the proximal portion, but increased 2-fold in the distal portion of SI. The decrease in the effectiveness of these processes in the proximal portion reflects a shift in the

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proximodistal gradient of enzyme activity toward the ileum.

The progressive decrease in activity of amylase fractions was observed 7 days after resuscitation. In the duodenum and jejunum activities of intestinal amylase (readily desorbed fraction) and intracellular amylase (slowly desorbed fraction) decreased by 52 and 38%, respectively, compared to the control. In the ileum activities of intestinal and readily desorbed amylase fractions were 83 and 75% of the control, respectively. Activities of slowly desorbed and intracellular amylase progressively decreased and were 59 and 35% of the control, respectively. During this period adsorption capacity and effectiveness of parietal digestion increased in various portions of SI. In the proximal portion of SI the adsorption coefficient and effectiveness of parietal digestion increased by 27 and 38%, respectively. In the distal portion of SI these indexes surpassed the normal. The adsorption coef-

ficient and effectiveness of parietal digestion increased by 41 and 92%, respectively. The observed changes reflect a compensatory activation of parietal digestion in the proximal portion of SI that accompanies the decrease in pancreatic amylase activity.

Amylolytic activity of intestinal and readily adsorbed fractions of amylase was low in the proximal portion of SI 14 days after resuscitation. Activities of slowly adsorbed and intracellular amylase were stabilized in this period. In the duodenum activities of intestinal and readily adsorbed amylase decreased by 76 and 73%, respectively, compared to the control. Activities of slowly desorbed and intracellular amylase decreased by 65 and 66%, respectively, compared to the control. Activity of amylase fractions in the ileum underwent similar changes.

A sharp decrease in activity of pancreatic amylase was accompanied by improvement of adsorption and parietal digestion. The coefficient of parietal digestion in

TABLE 1. *In Vitro* Amylolytic Activity of the SI Brush-Border Membrane during the Late Postresuscitation Period ($\mu\text{g}/\text{mg}/\text{min}$, $M \pm m$)

Index		Control	Postresuscitation period, days		
			1	7	14
Duodenum	IN	27.40 \pm 0.03	18.2 \pm 0.02*	9.1 \pm 0.03*	6.6 \pm 0.11*
	Σ A	20.80 \pm 0.04	9.80 \pm 0.03*	7.70 \pm 0.02*	6.10 \pm 0.08*
	IC	15.60 \pm 0.04	5.60 \pm 0.02*	6.10 \pm 0.01*	5.40 \pm 0.12*
Jejunum	IN	26.10 \pm 0.04	16.70 \pm 0.02*	7.90 \pm 0.01*	7.10 \pm 0.11*
	Σ A	20.60 \pm 0.05	10.30 \pm 0.03*	6.10 \pm 0.01*	6.40 \pm 0.08*
	IC	16.70 \pm 0.04	6.40 \pm 0.01*	6.10 \pm 0.02*	5.10 \pm 0.07*
Ileum	IN	26.90 \pm 0.05	5.40 \pm 0.01*	4.60 \pm 0.02*	6.40 \pm 0.13*
	Σ A	18.10 \pm 0.04	7.90 \pm 0.03*	4.30 \pm 0.01*	5.30 \pm 0.07*
	IC	12.20 \pm 0.03	5.70 \pm 0.01*	4.30 \pm 0.03*	5.20 \pm 0.09*

Note. IN, intestinal fraction of amylase; Σ A, total activity of desorbed amylase fractions; IC, intracellular amylase fraction. Here and in Table 2: $p < 0.001$ compared to the control.

TABLE 2. Adsorption Capacity and Parietal Digestion in the SI Brush-Border Membrane of Rats during the Late Postresuscitation Period ($M \pm m$)

Index		Control	Postresuscitation period, days		
			1	7	14
Adsorption coefficient					
Duodenum		0.70 \pm 0.02	0.50 \pm 0.01*	0.90 \pm 0.02*	0.90 \pm 0.02*
Jejunum		0.80 \pm 0.01	0.60 \pm 0.01*	0.80 \pm 0.02	0.70 \pm 0.02*
Ileum		0.6 \pm 0.1	1.4 \pm 0.1*	0.90 \pm 0.02*	0.80 \pm 0.01
Coefficient of parietal digestion					
Duodenum		1.30 \pm 0.01	0.80 \pm 0.05*	1.80 \pm 0.02*	1.70 \pm 0.01*
Jejunum		1.30 \pm 0.02	0.90 \pm 0.03*	1.50 \pm 0.07*	1.60 \pm 0.02*
Ileum		0.90 \pm 0.01	2.50 \pm 0.03*	1.80 \pm 0.03*	1.60 \pm 0.01*

the proximal and distal portion of SI increased by 25 and 70%, respectively, compared to the control (Table 2).

Morphofunctional changes in the pancreas and SI wall during the late postresuscitation period involve the reserve pool of enzymes (slowly desorbed and intracellular fractions of amylase) to compensate disturbances in intestinal digestion. Delayed recovery of enzyme activity in the SI brush-border membrane can be explained by impairment of functional topography in the digestive conveyor, manifested in a shift of the proximodistal gradient toward reserve zones of the ileum.

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