Effect of Vagotomy and Serotonin on Myoelectric Activity and Functional Relationships in Various Subdivisions of the Gastroduodenal Complex

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Serotonin significantly increases the amplitude of smooth muscle electrical activity in the stomach and duodenum and improves their functional coupling disturbed by vagotomy.

Key Words: *stomach; duodenum; electrical activity; serotonin*

The use of vagotomy in surgery largely depends on successful prophylaxis and treatment of postvagotomy motor-evacuatory gastric disorders caused by gastroplegia [1,2,4,7-9]. The contractile activity of smooth muscles in the gastrointestinal tract (GIT) is regulated by biological amine serotonin, which directly stimulates GIT smooth muscles bypassing synaptic transmission in the autonomic nervous system [6].

Our aim was to study electrical activity of smooth muscles in various subdivisions of the stomach and duodenum after vagotomy and against the background of serotonin adipinate (SA) treatment. We also evaluated the possibility of using SA for restoration of the motor-evacuatory function in GIT in the early postoperation period and studied the role of serotonin-reactive structures in various parts of the gastroduodenal complex (GDC) for its coordinated activity.

MATERIALS AND METHODS

Experiments were carried out on 30 mature cats weighing 2-3 kg. Baseline myoelectric activity of the gastric body, cardia and pylorus and duodenal bulb was recorded. Then the vagosympathetic trunks were transected at the level of the thyroid cartilage, and 15-20 min later the myoelectric activity was recorded again. SA (1%, 0.4-0.5 mg/kg) was injected into a small subcutaneous vein in the hind limb.

In all fragments of the study the myoelectric activity was recorded during 18 min. The experiments were carried out under standard conditions 12-14 h after the last feeding.

Multichannel electrogastrography with analog data processing yielded an amplitude-frequency characteristic and provided a quantitative estimate of myoelectric (and hence, motor) activity in the examined GTI subdivisions [3,5].

RESULTS

Serotonin increased the mean amplitude of myoelectric activity in all examined GDC subdivisions in comparison with that observed after vagotomy (Table 1), which indicated a principal possibility of applying the drug to restore gastric motility postvagotomy.

Correlation analysis demonstrated different degree of functional coupling between the examined structures (Table 2). The highest correlation coefficients characterized the relationships between myoelectric activities in the body of the stomach and that in the cardia, pylorus, and duodenal bulb. The total correlation coefficient r for the body of the stomach was 1.514 (or 42% of the general total r). The weakest correlation was observed in the relationships of duo-

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TABLE 1. Amplitude (mV) of Myoelectric Activity of GDC Subdivisions after Vagotomy and Intravenous Injection of CA ($M\pm m$)

GDC subdivisions	Amplitude of myoelectric activity		
	initial	postvagotomy	after intravenous CA injection
Cardia	3.445±0.664	1.824±0.289*	6.570±0.891*
Body of the stomach	1.849±0.342	1.888±0.334	5.198±0.498*
Pylorus	5.865±1.194	1.748±0.292*	2.737±0.441
Duodenal bulb	4.420±0.707	3.040±0.852	6.798±1.456*

Note. Here and in Table 2: *$p<0.05$ compared to the initial values.

TABLE 2. Correlation of Myoelectric Activity in GDC Subdivisions ($M\pm m$)

Parameters	Correlation coefficients		
	before vagotomy	postvagotomy	after intravenous CA injection
Cardia — body of the stomach	0.661±0.097	0.896±0.031*	0.968±0.008*
Cardia — pylorus	0.115±0.019	0.034±0.008*	0.164±0.036*
Cardia — duodenal bulb	0.091±0.020	0.070±0.009	0.099±0.017
Body of the stomach — pylorus	0.401±0.092	0.178±0.019*	0.368±0.078*
Body of the stomach — duodenal bulb	0.452±0.095	0.271±0.062	0.294±0.035
Pylorus — duodenal bulb	0.084±0.013	0.156±0.039*	0.059±0.012*

denal bulb with the cardia and pylorus, and also between the cardia and pylorus. The total r values for the pylorus and duodenal bulb were 16.6 and 17.4% of the general total r, respectively. These data indicate the initial functional heterogeneity of the studied complex system, in which body of the stomach plays the system-forming role, while the pylorus is the most autonomic component.

After vagotomy gastric body retained the major system-forming role (42% of the general total r), while the pylorus became even more functionally isolated (11.5% of the total general r).

The system-forming role of the gastric body and cardia remained at the same level (42.0 and 31.1% of general total r, respectively). Duodenal bulb became the most autonomic part of the GDC: the total r decreased to 0.452 (11.6% of the general total r).

Thus, intravenous injection of SA to vagotomized cats not only significantly increased the amplitude of myoelectric activity of GDC parts, but considerably enhanced their correlation and changed the gradient of their functional coupling. It suggests that relationships between motor activity in the stomach and duodenum deprived of vagal influences are mainly determined by the state of serotonin receptors in these organs.

Profound effect of SA on restoration of stomach motor function during the first few hours postvagotomy attests to a stimulating effect of serotonin on gastric and duodenal smooth muscles via the corresponding receptor apparatus. These data indicate the possibility of using SA for restoration of the motor-evacuatory function of the GIT after vagotomy in the first few hours and days after the surgical intervention.

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