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# Myoelectric Duodenogastric Dyskinesia during Pentagastric Ulceration

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**Key Words:** *pentagastrin; ulcer; duodenogastric dyskinesia; myoelectric activity*

It is known that gastrin is one of the main stimulating agents of the gastric secretory function [1, 3-5] and that pentagastrin administered in high doses [4, 7] may cause gastric ulceration . It is also known that ulceration is found in various types of hypergastrinemia, including the Zollinger-Ellison syndrome. It has been demonstrated that pentagastrin may both stimulate and inhibit motor and myoelectric gastrin and intestinal activity. However, the role of gastric in the coordinated activity of the stomach, pyloric sphincter, and duodenum remains obscure.

The purpose of this presentation was to study the relationship between the myoelectric activity of the stomach, pyloric sphincter, and duodenum for the ulcerogenic effect of pentagastrin.

**TABLE 1.** Frequency of Gastroduodenal Action Potential Series at the Beginning and End of Pentagastrin Effect (M±m)

| Area studied | Frequency of action potential series, 1/min | | |
|---|---|---|---|
| | Background | Beginning | End |
| Gastric fundus | 2,9±0,3 | 3,2±0,8 (+10%) | 1,7±0,5* (-41%) |
| Pyloric sphincter | 2,0±0,3 | 3,0±0,9* (+50%) | 1,5±0,5* (-25%) |
| Duodenum | 13,2±1,9 | 21,0±1,0 (+59%) | 20,8±1,0* (+57%) |

**NOTE:** * - the difference is reliable ($p<0,05$) as compared to the background.

## MATERIAL AND METHODS

Chronic experiments were conducted on 5 male rabbits weighing from 2.5 to 3.3 kg. Silver loop electrodes were implanted in the smooth muscles of the stomach, pyloric sphincter, and duodenum according to the method described earlier [8] one to two weeks before the experiments. The gastropyloduodenal activity was recorded by myoelectrography at the rate of 7.5 mm per second, the time constant being 0.3. The rabbits were on the conventional diet (oats, vegetables, hay). The experiments were conducted in the morning; no preliminary dietary restrictions were used. Pentagastrin (Sanitas) was injected subcutaneously during 5 days in ulcerogenic doses [4,7] of 0.2 mg/kg daily. Gastropyloduodenal electromyoelectrography was used to evaluate both the sequence of action potential series one hour before and after injection. The myoelectric activity of the duodenum was compared with that of the stomach before and after pentagastrin administration. Macroscopic evaluation of the destructive lesions of

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the gastric mucosa was done 5 days following pentagastrin administration [7, 9]. The statistical significance of the mean differences was evaluated at the 95% confidence level.

## RESULTS

Subcutaneous pentagastrin administration caused a three-phase gastroduodenal myoelectric response in each animal (see Fig. 1). The first phase of the response was marked by short-term (1 to 3 min) disappearance of the action potentials in the three electromyograms. During the second and third phases the proximodistal action potentials were reversed to distoproximal ones. The second phase (tachymetric) was marked by more rapid gastropyloduodenal action potential series during 4 to 15 minutes.

The third phase (dyskinetic) was manifested in decreased gastropyloric activity and and simultaneously increased duodenal activity (compared the background activity) during 40 to 50 min.

Thus, the effect of pentagastrin was eventually manifested in more pronounced duodenal activity compared to gastropyloric activity; in other words, pylogastroduodenal dyskinesia was observed.

The data presented in Table 1 indicate that during the first phase of pentagastrin effect (the first 10 min), activation of all three sites of the gastropyloduodenal area was observed, the duodenal activity being more pronounced compared to the gastropyloric activity. During the last 10 min of pentagastrin effect, decreased gastropyloric activity was associated with increased duodenal activity. Thus, the final pentagastrin effect was manifested in increased duodenal activity on the one hand and decreased gastropyloric activity on the other. Such a disproportionate bilateral increase of the duodenal activity (up to 100% of the maximum value) and decrease of the gastric activity is a sign of bilateral doudenogastral dyskinesia.

The analysis of the number of action potential series one hour before and after pentagastrin injection demonstrated that gastric and pylorical activity was not changed: the former tended to decrease (from 2.9±0.3 to 2.4±0.3 $min^{-1}$) and the latter remained practically unchanged (2.0±0.3 and 2.0±0.4 $min^{-1}$). On the other hand duodenal activity significantly increased (from 13.2±1.9 to 19.6±1.2 $min^{-1}$), that is, almost 1.5 times.

At the end of the experiment 5 days following pentagastrin administration all the animals showed venostasis areas on the top of the gastric folds of the fundus mucosa and marked duodenal hyperemia. The pale mucosa of the pyloric sphincter showed 3 to 4 ulcers with a diameter of 1 to 2 mm in 4 out of 5 rabbits.

Thus, pentagastrin administration in ulcerogenic doses resulted in duodenogastral dyskinesia and was associated with pyloric mucosa ulceration. The available data support the concept that duodenogastral reflux is one of the main factors causing gastric ulceration [1, 9, 15].

The failure to find duodenal mucosa lesions (usually characteristicc for hypersecretion) following pentagastrin administration suggests that myogenic pentagastrin effects (duodenogastral dyskinesia) were more pronounced than secretory effects. This hypothesis is consistent with the available data on true

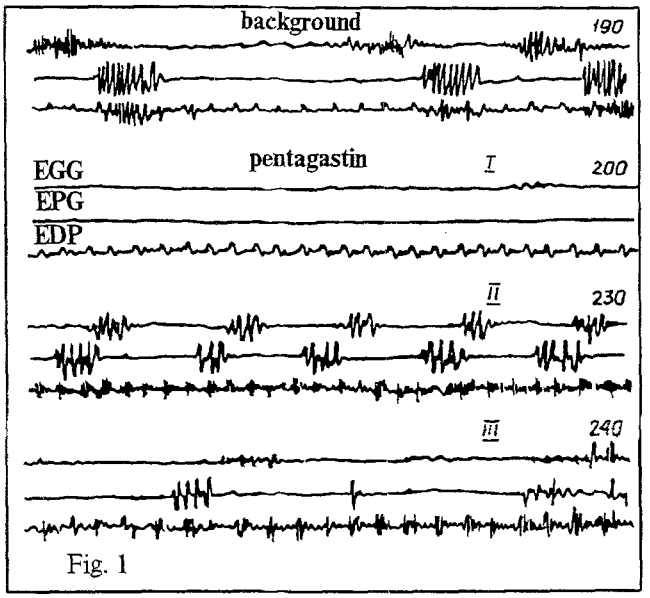


**Fig. 1.** Myoelectric duodenogastric activity before and after pentagastrin administration. Above: background activity 1, 2, 3) phases of pentagastrin effect (0.2 mg/kg injected simultaneously) 1, 5, and 50 min following injection. EGG: electrogastrogram; EPG: electropylorogram; EDP: electroduodenogram. Time mark: 1 sec; calibration: 500 μV; numbers on the right: heart rate by ECG.

hypersecretion being found only in 15% of patients suffering from ulcers [15].

Thus, the findings suggest that one of the possible mechanisms involved in ulceration following pentagastrin administration is bilateral duodenogastral dyskinesia as established by the retrograde spreading of myoelectric duodenogastric activity in response to pentagastrin [1, 9, 15].

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# Study of Frequency Potentiation Mechanisms of cAMP-Dependent Responses of Snail Neurons

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Cyclic adenosine monophosphate (cAMP) is the intracellular mediator of various physiological responses of the nerve cell. The cAMP influence on the neuron electrical activity is studied by cAMP injection into the cytoplasm through an intracellular microelectrode. It has been found on mollusks that intracellular injection of cAMP by microionophoresis or under pressure causes a short-term membrane depolarization, the mechanism of which in different neurons are connected with conductivity changes for ion channels of various types [6].

The effect of frequency potentiation of cAMP-dependent responses developing in some snail neurons has been shown during frequent multiple cAMP injections [2]. It was taken into account that this effect depends on the microionophoresis technique peculiarities, namely that the quantity of substance released from the micropipette depends not only on the injection current strength and duration, but also on the "blocking" current strength and duration commonly used between injections [1, 4]. Our experiments with switching off the "blocking" current have not yielded, however, a clear answer to the question of the interrelations of the latter with the studied effect. This led us to assume that the effect of the frequency potentiation of the cAMP responses might depend on physiological factors, notably on the stimulation of the Ca-mediated cAMP responses [3, 7], in addition to the microelectrode factor.

The present paper demonstrates the analysis of the participation of the physiological and microelectrode factors in the development of the effect of the cAMP responses frequency potentiation.

## MATERIAL AND METHODS

Experiments were carried out on the $B_4$ and F neurons [5] of snail isolated nerve ganglia in a circulating solution: NaCl 120 mM, KCl 5 mM, $CaCl_2$ 6 mM, $MgCl_2$ 3.5 mM; pH 7.5-7.9. Recording of intracellular potentials, transmission of the polarizing current, and cAMP intracellular injection were carried out with a multibarreled microelectrode. The microelectrodes were assembled from semi-finished seven-barreled products of the WPI firm (USA). The recording barrel was filled with a 2 M sodium citrate solution. The resistance was 5-15 mOhm. The same solution was in the barrel for the polarizing current and the barrel serving as an indifferent electrode during the intracellular microionophoresis. The barrels were filled with a 0.1 M

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