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Short Commentary

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The Serotonin Role in the Vagal Activation Development of the Motor Function of the Apex of the Rabbit Bladder: *In Vivo* Study

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Abstract

The structure and electrophysiology of the urinary bladder are presented. The smooth muscles of the bladder's top contraction electromyogram were recorded by the multichannel Nihon-Kohdenencelograph. The effect of serotonin enhancement of cholinergic effects on smooth muscle contractions was studied by electric field stimulation of the vagus and the serotonergic (as part of the sympathetic trunk) nerve fibers. The serotonin influence on contractile activities of bladder through the 5-HT2 receptors by the relevant inhibitor introduction was studied.It was found that in the bladder top serotonin contribution to cholinergic influence on contractile activity mediated by the effector 5-HT2 receptors.

Keywords: Pelvic organs; Serotonin Role; Urinary bladder; Uterus;

Introduction

The importance of the problem of vagal regulation of the pelvic organs is that during the operation of stem vagotomy (HIRGI), the functional state of these organs may suffer. It is known that the bladder, consisting of the top, body and triangle and which is the pelvic organ, according to classical ideas, is not innervated by the vagus nerve [1]. However, electrophysiological studies have shown that irritation of the vagus nerve leads to increased motor function of the bladder Serotonin enhances the motility of the bladder and ureters, uterus and vas deferens [2].

When the vagus nerve is irritated, acetylcholine, a vasoactive intestinal peptide, purines and serotonin are released from the terminals. The introduction of exogenous serotonin, which does not have an independent effect on the motility of the bladder, can lower the threshold of excitation of parasympathetic nerve fibers and increase the vagal stimulatory effect.

However, the regulation of the bladder by the vagus nerve and its mechanisms are not well understood. The aim is to investigate the possibility of vagal innervation of the apex of the bladder and the role of serotonin in the development of vagal effects.

Materials and Methods

The experiments were performed on 12 chinchilla rabbits of both sexes (6 animal females and males each) in accordance with the recommendations of the 1982 Helsinki Convention, confirmed in 2000, on the sparing attitude to experimental animals in an acute experiment. Rabbits underwent a lower mid-laparotomy, a bladder was isolated, electrodes for recording an electromyogram (EMG) were placed on the top of the bladder, measures were taken to prevent drying of tissues, and bipolar platinum electrodes were used. On the EMG curve, the amplitude-frequency characteristics of slow waves and spikes, the power of phase and tonic contractions, propulsive activity were determined using a Conan-M hardware-

software complex with a passband of 0.1-10 Hz, a noise level of less than 1-5 μV.

Next, a midline incision was made on the neck, at the level of CIV - CVI, the trunks of both vagus nerves were prepared, they were intersected, and the distal segment of the right vagus was irritated with electric current with parameters of 1.5-7.0 V, 10 Hz and 2 ms. The experimental plan was:

- Control irritation of the vagus nerve,
- The introduction of serotonin in a dose of 50-80 mcg / kg to test its effect on motility,
- The introduction of serotonin against irritation of the vagus nerve,
- Blockade of 5-HT2 receptors and vagus nerve irritation,
- The introduction of serotonin on the background of vagus nerve irritation in the conditions of blockade of 5-HT2 receptors.

The control group consisted of 5 animals that were recorded with EMG for 3.5-5 hours (the duration of the experiment in the main group).

Statistical processing of the material was carried out using Microsoft Office Excel. Relative (P), average values (M), and their errors (+t) were calculated. The reliability of the differences in the indicators was assessed using parametric (Student t-test). And nonparametric criteria (U-Wilcoxon-Mann-Whitney test, % 2-Pearson's consent criterion). The differences were considered significant at a significance level of $p < 0.05$. To determine the degree of correlation of the studied parameters, the Pearson pair correlation coefficients (g) were calculated.

Results

Irritation of the vagus nerve in the experimental group of animals leads to a change in the frequency of slow EMG waves from 8.0 ± 0.5 to 12.0 ± 0.8 / min (an increase of 50.1% $p < 0.05$), amplitude from 0, 05 ± 0.003 to 0.1 ±0.025 mV (an increase of 99.8% $p < 0.01$), the power of tonic contractions from 0.40 ± 0.02 to 1.2 ± 0.3 (an increase of 200.1 % $p < 0.01$). The frequency of spikes varies from 0.8±0.015 to 1.3 ± 0.11 (an increase of 62.5% $p < 0.05$), the amplitude of spikes changes from 0.02 ± 0.004 to 0.05 ± 0.005 mV (increase by 150% $p < 0.01$, the power of phase contractions from 0.016 ± 0.003 to 0.065 ± 9.004 (an increase of 306.3% $p < 0.01$), propulsive activity changes from 25.0 ± 1.6 to 18.0 ± 0.11 (decrease by 18.0% $p < 0.05$). That is, vagus nerve irritation has a stimulating effect on the motility of the apex of the bladder, moreover, the vagus has a predominant effect on the circular muscles of the apex, ensuring its spastic activity.

Administration of serotonin at a dose of 50-80 mcg/kg does not affect motor function. The frequency of slow waves was 8.0 ± 0.3/min, the amplitude was 0.06 ± 0.003 mV, the spike frequency was 0.9 ± 0.07, and the amplitude of spikes 0.03 ± 0.0015 remained unchanged.

The administration of serotonin against the background of vagus nerve irritation changed the frequency of slow waves from 12.0 ± 0.8 to 16.0 ± 0.25 / min (an increase of 33.5%$p < 0.05$), amplitude from 0.1 ± 0.025 up to 0.25 ± 0.05 mV (an increase of 150% $p < 0.01$), the power of tonic contractions - from 1.2 ± 0.25 to 4.0 ± 0.08 (an increase of 233% $p < 0, 01$). The frequency of spikes varies from 1.3 ± 0.11 to 3.0 ± 0.2 (an increase of 130.8% $p < 0.05$), the amplitude of spikes changes from 0.05 ± 0.005 to 0.1 ± 0.03 mV (increase by 99.8% $p < 0.01$, the power of phase contractions from 0.65 ± 0.004 to 0.3 ± 0.02 (increase by 361% $p < 0.01$), propulsive activity changes from 18, 3 ± 0.9 to 13.0 ± 0.7 (a decrease of 18.0% $p < 0.05$), that is, administration of serotonin against the background of vagus nerve irritation increases both tonic and phase contractile activity of the apex of the bladder.

The introduction of spiperone slightly changes the frequency of the slow waves of the apex of the bubble from 0.05 ± 0.003 to 0.07 ± 0.0035 / min (an increase of 40% $p < 0.05$), with a stable amplitude of 8.0 ± 0.4 mV, power tonic contractions - from 0.4 ± 0.09 to 0.56 ± 0.007 (an increase of 40% $p < 0.01$). The frequency of spikes varies from 0.8 ± 0.004 to 0.7 ± 0.0015 (a decrease of 12.5% $p < 0.05$), the amplitude of spikes remained unchanged (0.05 ± 0.005), and the power of phase contractions from 0.016 ± 0.003 to 0.014 ± 0.004 (a decrease of 12.5% $p < 0.05$), propulsive activity changes from 25 ± 0.3 to 40.0 ± 0.34 (an increase of 60.0% $p < 0.05$). Those. the introduction of spiperone promotes an increase in propulsive motility by reducing phase activity. Apparently, the phase component of the vagus nerve influence is provided by the serotonin of the trunk itself, that is, endogenous serotonin.

The introduction of exogenous serotonin against the background of vagus nerve irritation when the 5HT2 receptor is turned off leads to a change in the amplitude of the slow waves of EMG of the bladder from 0.1 ± 0.03 to 0.09 ± 0.004 mV (decrease by 10% $p < 0.05$) with stable frequency (11.0 ± 0.13/min), the power of tonic contractions - from 1.1 ± 0.02 to 0.19 ± 0.003 (a decrease of 11.2% $p < 0.05$). The frequency of the spikes varies from 1.3 ± 0.12 to 1.2 ± 0.09 (a decrease of 7.6% $p < 0.05$), the amplitude of the spikes remained unchanged (0.05 ± 0.002 mV), the power of phase contractions is from 0.065 ± 0.005 to 0.06 ± 0.004 (decrease by 2.4% $p < 0.05$), propulsive activity changes from 16.9 ± 1.3 to 16.5 ± 1.3 (decrease by 6.0% $p < 0.05$). Those. administration of spiperone blocks an increase in propulsive motility due to a decrease in phase activity. Apparently, the phase component of the vagus nerve influence is provided by the serotonin of the trunk itself, that is, endogenous serotonin.

Conclusion

The study showed that the vagus nerve innervates the apex of the bladder and strengthens both the phase and tonic components of the contractile process. Thus, with stem vagotomy, not only intestinal atony and gastrostasis will be observed, but also hypotension of the apex of the bladder.

Endogenous serotonin released during vagus nerve

stimulation exerts a predominant effect on the phase component of the contractile process, activating 5-HT2 receptors.

The release of exogenous serotonin against the background of vagal irritation also creates phase and tonic activity with a predominant decrease in propulsive activity due to an increase in spastic contractions.

Exogenous and endogenous serotonin helps to reduce the propulsive activity of the smooth muscles of the apex of the bladder.

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