EFFECT OF PROCAINE BLOCK OF THE SYMPATHETIC TRUNKS AND SPLANCHNIC NERVES ON THE SECRETORY ACTIVITY OF THE GLANDS OF THE STOMACH

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Procaine block has been widely applied of recent years to the treatment, diagnosis, and prevention of a number of morbid conditions.

V. V. Mosin [4] has proposed the method of retropleural procaine block of the sympathetic trunks and splanchnic nerves, which has been found to be extraordinarily effective in the treatment of diseases of the abdominal viscera, both in humans [3, and others] and in animals [V. V. Mosin and others].

It was thought to be of interest to elucidate experimentally the effect of retropleural procaine block of the sympathetic trunks and splanchnic nerves on the secretory activity of the gastric glands which is closely involved with processes taking place in the organism as a whole.

EXPERIMENTAL METHODS

Our experiments were made on dogs previously subjected to the following operations: gastric and esophageal fistulae in 3 dogs; Pavlov stomach pouch in 11 dogs; and Klemensiewicz-Heidenhain stomach pouch in 2 dogs.

I. P. Pavlov's usual experimental technique was used. The reaction of the gastric secretion was alkaline or neutral at the start of the experiments. The latent period of secretion was noted in all experiments, and the amount of secretion produced was registered. Total acidity and free hydrochloric acid content of the secretion were determined in one-hour amounts by titration with 0.1 N alkali, and its proteolytic activity was determined by Mett's method.

Normal values for gastric secretion were first determined in response to the following stimuli: 200 g of meat, 100 g of bread, histamine solution (1 ml of 0.1% solution), meat extract (10 g in 150 ml water).

Procaine block was performed by Mosin's method, at the point of intersection of the posterior margin of the last rib with the dorsal group of intervertebral muscles, on both sides of the body. We used 0.25 and 0.5% procaine solutions, at dosage rates of 2 ml per kg body weight. The solution spreads retropleurally to the VII-IX thoracic vertebrae, and caudally to the crura of the diaphragm, and then spreads retropertitoneally to the II-IV lumbar vertebrae, making contact with the sympathetic trunks along the last thoracic and the first lumbar segments, as well as with the splanchnic nerves.

EXPERIMENTAL RESULTS

We began our study with the examination of the effect of sympathetic block on the secretory activity of a Pavlov pouch, which is known to reflect both the first, complex reflex, and the second, neurochemical, phases of the gastric secretory process.

It was found that procaine block lowers secretory response to alimentary stimuli during the complex reflex phase, but raises it in the neurochemical phase. As duration of secretion is increased its total amount is greatly augmented (from 1.5 to 3 times) and the secretion curve changes accordingly.

Feeding the dogs 200 g of meat or 100 g of bread under conditions usually considered as normal, results, after a lapse of 6-10 minutes, in secretion of gastric fluid which attains a maximum during the first hour and then falls markedly during the second hour for bread feeding and in the third hour for meat, remaining during the second hour at a low level for a long time. After sympathetic block (20, 30, 60, 120, 300 minutes and more) only a small amount of secretion was obtained during the first hour, after which it rose during the next 4-5 hours, to a maximum at the 5th to 7th hour, and then fell gradually until the 10th to 12th hour, in most cases. The duration of the latent period of secretion was very little affected by sympathetic block (see table).

Simultaneous block of the sympathetic trunks and splanchnic and vagus nerves (in the neck) led to abolition of the complex reflex phase of secretion, and to a considerable (2.5-5 fold) fall in secretion in the neurochemical phase.

Block of the sympathetic trunks and splanchnic nerves resulted in increase (2-2.5 fold) of the total amount of secretion from a Pavlov pouch after introduction of meat extract (through a fistula) into the main stomach, as well as after subcutaneous histamine injection. At the same time the rate of secretion rose, giving a corresponding rise in the secretion curve.

Further experiments were performed, with the object of confirming these results, on dogs with gastric and esophageal fistulae, and on dogs with a Klemensiewicz-Heidenhain gastric pouch.

It was found from these experiments that sympathetic block leads to a 3-fold diminution of the total amount of gastric secretion, produced during the whole experiment in response to sham feeding for 5 minutes with meat and bread. The secretion rate and the corresponding secretion curves fell, and secretion ceased sooner (during the 2nd to 3rd hour) than in control animals (4th to 5th hour).

There was virtually no secretion of gastric juice when food was displayed but not given.

Experiments on dogs with Klemensiewicz-Heidenhain pouches showed that after sympathetic block the secretory response to feeding was greater, and the duration of secretion increased.

Gastric secretion returned to the initial level after stimulation on the 2-4th day when 0.25% procaine was used, and on the 9-12th day with 0.5% procaine.

The proteolytic power of the gastric juice was in all cases below normal on the first day after block, in both secretory phases, but on subsequent days it was considerably increased (by 50-70%), and returned to normal within 3-8 days.

The question arises as to why secretion was depressed during the reflex phase, and raised during the neurohumoral phase, after sympathetic block.

According to A. A. Vishnevskii and A. D. Speranskii, 0.25% procaine, exerts, apart from its nerve-blocking action, a weak stimulation action on nervous tissue.

After procaine block of the sympathetic trunks and splanchnic nerves we observed a marked inhibition of vasomotor reflexes to stimulation of gastric mechanoceptors, which is evidence of the neurotomic action of procaine block. Afferent impulses from these receptors are conveyed by the splanchnic nerves [2, 8].

It may be supposed that procaine block, by interrupting the reflex path along the sympathetic trunks and splanchnic nerves, prevents the passage to the central nervous system of impulses from the stomach and other viscera, while at the same time weakly stimulating the nerves of this region and thus causing changes in the equilibrium between stimulatory and inhibitory processes, in favor of the latter; this will affect above all the cerebral cortex (and the alimentary center), as being the most reactive part of the nervous system. At the same time, moderate cortical inhibition, or, more exactly, inhibition of individual points in the cortex, does not result in inhibition of subcortical centers.

The amount of gastric juice secreted during the reflex phase is indicative of the functional state of the alimentary center [5, 6, 7], the lowered tonus of which is responsible for diminished secretion.

Secretion of Gastric Juice by the Dog Bobik, with a Pavlov Stomach Pouch, in Response to Feeding with 200 g of Meat, Before and After Sympathetic Block.

Hour	Control experiment			30 minutes after block		
	amount of secretion (ml)	total and free acid contents (%)	proteolytic power (mm)	amount of secretion (ml)	total and free acid contents (%)	proteolytic power (mm)
1	10.7	0.468 0.526	3.8	3.4	0.314 0.367	3.1
2	9.5	0.496 0.532	3.2	7.0	0.471 0.510	2.5
3	6.8	0.441 0.490	3.2	8.6	0.485 0.522	2.0
4	3.2	0.378 0.432	3.0	10.0	0.510 0.546	1.7
5	2.0	0.216 0.280	—	10.2	0.510 0.546	1.2
6	0.4	0 000 0.000	—	12.8	0.527 0.560	1.0
7	0	—	—	9.6	0.462 0.499	1.6
8	—	—	—	5.9	0.398 0.448	2.0
9	—	—	—	3.7	0.359 0.398	2.1
10	—	—	—	1.5	0.250 0.312	—
Total	32.6			72.7		
Latent period (min)		7			8	

In the period immediately following establishment of sympathetic block, abolition of inhibitory effect on the gastric glands appears to occur; this effect is normally exerted through the sympathetic (splanchnic) nerves. It is for this reason that neuroreflex (vagal) and humoral control of the gastric glands during the second secretory phase (after entry of food into the stomach) resulted in their excessive activity.

In order to exclude the possibility that procaine at the dosage levels used in our experiments might have a direct action on the neuroglandular apparatus of the stomach, we performed control experiments, differing from the above only in that the procaine was given subcutaneously, and a further series in which the dogs were subjected to the same manipulations, including insertion of the hypodermic needle, but procaine was not injected. In no case was any effect on the secretory activity of the stomach observed.

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