CHANGES IN HIGHER NERVOUS ACTIVITY FOUND IN EXPERIMENTAL GASTRIC PATHOLOGY

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According to reports published during the past few years conditioned reflex activity exhibits considerable changes during development and healing of experimentally induced gastric ulcer in dogs [1, 3]. In this paper we present the results of a study of higher nervous activity in dogs with experimentally produced inflammatory lesions of the stomach (localized and diffuse burns of the mucosa).

EXPERIMENTAL METHODS

The experiments were carried out on 4 dogs with fistulae of the fundus of the stomach and of the parotid glands, and with a Pavlov pouch. A system of positive and negative conditioned acid-defense reflexes was developed (to the sound of a bell, to a 75-watt light bulb and to the tone of a sound generator with differentiation of response). A 0.25% solution of hydrochloric acid was taken as an unconditioned stimulus. The work was done in a sound-proof chamber.

Localized lesions of the gastric mucosa were produced by the application of a tube, through which hot water (70-90°) was being passed for 2-3 minutes [2]. The application was usually made to the posterior wall of the fundus, opposite the fistula tube, and resulted in development of a hemorrhagic erosion of the mucosa, about 2 cm in diameter (confirmed by gastroscopy). About 3-4 minutes after the operation we observed vomiting, panting, salivation, and general excitation. A small amount of bloodstained mucinous fluid flowed out of the fistula, and the gastric juice contained a small admixture of blood during the succeeding 5-7 days. The volume of gastric secretion (in response to meat and to histamine), and its acidity, were lower on the day the cautery was applied than the pre-cauterization levels. The impairment of secretory function persisted for about 2 weeks, after which normal response was obtained. Anorexia was not observed; the dogs ate the food given them as eagerly as before operation.

EXPERIMENTAL RESULTS

Our experiments showed that circumscribed lesions of the gastric mucosa caused definite disturbances in higher nervous activity (Fig. 1). The strength of the conditioned positive reflexes was lowered by 29-46%, while that of the unconditioned reflexes either remained unchanged, or slightly increased (by 8-24%). The weakening of conditioned reflexes was evident during the first days following the operation, with weak, medium, and strong stimuli. The latent period of conditioned reflexes was somewhat lengthened. Following cauterization discrimination became more marked in the dogs Lis and Tsygan (it became absolute or approached a zero value); in the dog Volk the response to a differentiated stimulus was even somewhat higher on the 5th and 6th days after burning than it was initially. Subsequent inhibition after application of a differentiated stimulus was strengthened.

In a series of experiments weak and strong stimuli gave the same response (equalizing phase), or a weak stimulus (light) gave rise to a bigger response than did a strong one (paradoxic phase). It should be noted that the incidence of these phases was of short duration, and alternated irregularly with periods of virtually normal conditioned reflex activity. Further evidence of changes in cortical activity was afforded by the listless and drowsy behavior of the dogs.

It thus appears that causation of circumscribed lesions of the gastric mucosa provokes perceptible changes in the conditioned reflex activity of the animals, lasting for 6 to 9 days after the operation.

In the second series of experiments acute generalized inflammation of the gastric mucosa was provoked by single or repeated washing with 10% silver nitrate solution for periods of 5 minutes. This was followed by copious production of mucinous secretion from the stomach, accompanied by vomiting and hypersalivation, together with restlessness and whining. Gastroscopy showed a hyperemic state of the mucosa, with copious production of viscid mucus, lasting for several days after the operation. The secretory response to meat and histamine was lowered, and the acidity of the secretion (particularly that due to free hydrochloric acid) fell markedly.

The strength of the conditioned positive reflexes was much lower during this period (by 41-56%) than initially (Figs. 2 and 3).

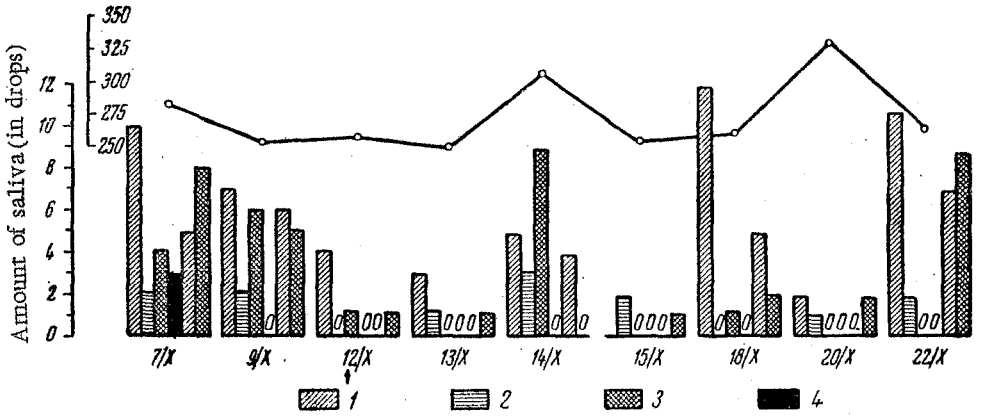

Fig. 1. Changes in higher nervous activity with circumscribed lesions of the gastric mucosa of the dog Lis. The columns show the amount of saliva secreted in response to conditioned reflex stimuli, while the curve refers to undonditioned reflex response. The arrow indicates the date of operation. Conditioned reflex secretion of saliva: 1) to the sound of a bell, 2) to light, 3) to the tone of a sound generator, 4) to differentiation.

An examination of the results shows that reduction in strength of conditioned reflexes is encountered mostly with weak and moderate stimulation. Discrimination was sometimes absolute, and in some cases exceeded the initial value. Extinction of conditioned reflexes (to two "zeros") to the tone of the sound generator normally supervened at the 8th or 9th test (dogs Valet and Volk), at 2-minute intervals; after applying silver nitrate extinction took place after the 4th or 5th repetition. The unconditioned reflex response to acid rose by 7-10%. The length of the latent period rose to 12-15 seconds. In some experiments the general picture of conditioned reflex activity resembled the equalizing, paradoxic, or even ultraparadoxic phases (Figs. 2 and 3). These changes persisted for 9 to 26 days, after which higher nervous activity returned to normal.

An interesting feature of the period of restitution of normal cortical function was that days on which inhibition of conditioned reflexes were observed alternated with days on which they were at their normal strength, giving the impression that there was a succession of pathological and normal states of the cortical cells. The cyclic nature of this disturbance of activity of the cerebral cortex suggests that it depends on perturbation of the normal equilibrium between stimulatory and inhibitory processes. It is of interest that changes in gastric secretion during the same period varied in a similar manner – days of hyposecretion alternated with days on which secretion was at the normal level, or even exceeded it.

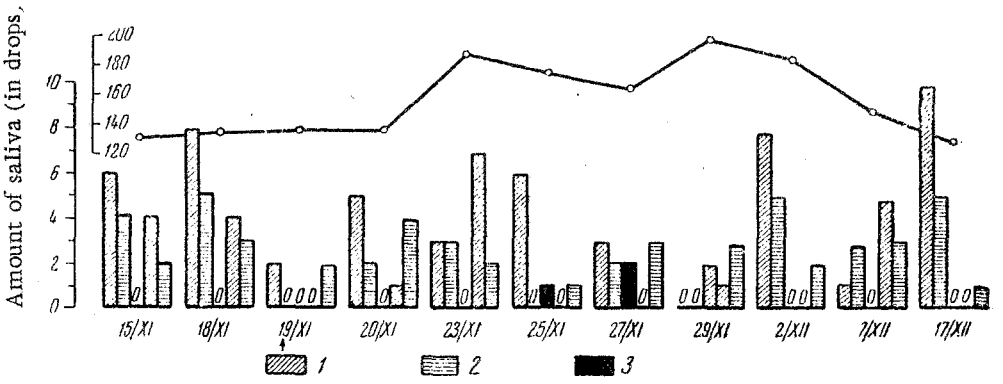

Fig. 2. Changes in higher nervous activity with generalized lesions of the gastric mucosa of the dog Volk. Conditioned secretion of saliva: 1) to the sound of a bell; 2) to the tone of a sound generator; 3) to differentiation. Other explanations as in Fig. 1.

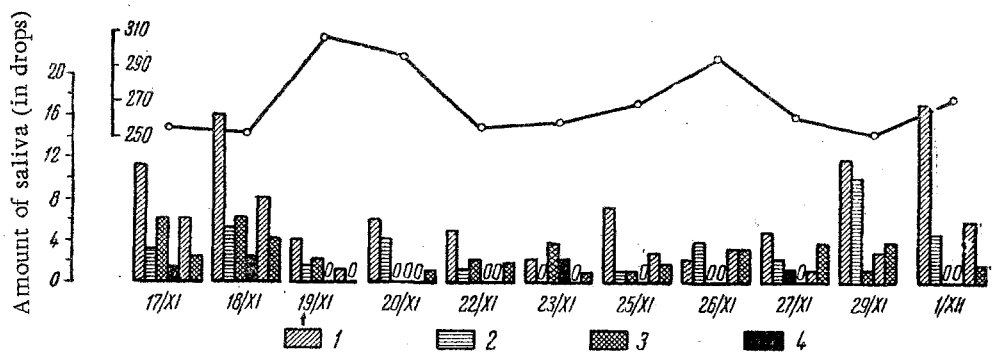

Fig. 3. Changes in higher nervous activity with generalized lesions of the gastric mucosa of the dog Lis. Details as for Fig. 1.

It should also be noted that restoration of normal conditioned reflex activity was achieved before disappearance of gastric secretory function disturbances and of morphological changes in the gastric mucosa.

We were unable to find any significant qualitative differences between the effects of circumscribed and generalized burns of the gastric mucosa on the higher levels of the central nervous system. It follows from this that the changes in higher nervous activity take place in response to the pathological stimuli, by a neuroreflex path.

Our experiments show that, as a result of a pathological process of limited extent and duration in the stomach, definite disturbances of higher nervous activity are observed. These changes consist in lowering of the working efficiency of the cortical cells, and in a disturbance of the normal equilibrium between stimulatory and inhibitory processes, in favor of the latter. It appears that the inhibition of the activity of the cerebral cortex observed by us is of the nature of a defense mechanism, and arises as a result of excessive stimulation of cortical cells due to the action of an "unusual noxious agent" (I. P. Pavlov) on receptors located in the gastric mucosa.

Our experiments provide additional evidence in favor of the view that in an intact animal the development of a pathological process in the stomach cannot proceed in isolation, without involvement of the cerebral cortex, and without changes in cortico-visceral dynamics. From this point of view, our results may be of use in clinical practice, in particular for the analysis of the clinical picture of gastritis, and they should be taken into account in the functional diagnosis of diseases of the stomach.

LITERATURE CITED

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