

CHANGE IN THE REFLEXES OF THE CHEMORECEPTORS OF THE INTESTINES AND SPLEEN UPON TRAUMATIC SHOCK

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The character of the change in the reflexes of the mechanoreceptors and chemoreceptors of the carotid reflex area upon the infliction of trauma and development of traumatic shock has been studied in detail in the laboratories of A. N. Gordienko and I. R. Petrov [1, 2, 3].

M. G. Danilov [1] found in the torpid phase of the shock a weakening of the depressor reflex and then its distortion upon stimulation of the baroreceptors of the small intestine.

As is clear from the literature devoted to the question of interoception, the general property of the reflex reactions of the receptors of the internal organs (connected with the vessels) is a constant tonic influence of a pressor nature on the part of their receptors. In connection with this, of definite interest is the study of the reflexes of the chemoreceptors of the internal organs upon the infliction of trauma and development of traumatic shock, since the tonic influences of a pressor nature depend on the functional state of the reflex arcs, with their origins in the chemoreceptor apparatus of the internal organs. In the literature in our possession we have not found any information on this question.

In the present communication, study of the changes of the reflex influences of the chemoreceptors of the intestines and spleen in the process of development of traumatic shock is described.

EXPERIMENTAL METHODS

The study of the reflexes of the chemoreceptors of the intestines and spleen was conducted according to the method proposed and devised by V. N. Chernigovsky.

Traumatic shock was induced by a local lesion of the bones and soft tissues of the hind limbs of the dog. Reflex changes in blood and respiratory pressure on introduction of acetylcholine (0.8-1.0 ml, 10^{-6}), nicotine (0.5-0.8 ml, 10^{-4}) and in a number of experiments potassium chloride (1.0 ml, 5%) were recorded by the usual means.

The animals were subjected to hexanal anaesthesia (10% solution of hexanal gradually introduced in the period of preparation, until the necessary degree of narcosis was obtained).

EXPERIMENTAL RESULTS

The first series of experiments (12 experiments) was devoted to study of the reflex changes of the chemoreceptors of the intestines in the course of development of traumatic shock.

The experiments showed that while before the shock in the weakly anaesthetized dogs, introduction into the perfusate of acetylcholine, nicotine and potassium chloride produced a clearly marked reaction in the form of a distinct increase in the arterial pressure, an increase in the tonus of respiratory expiration, increased frequency of respiration, and slowing down of the perfusion, during the shock a reaction of such a type was absent.

The reaction upon introduction of the chemical stimuli applied by us was usually absent in the torpid phase of severe shock when the blood pressure equalled 40-60 mm Hg.

We considered it also necessary to clarify how the reflexes of the intestinal interoceptors change during the erectile phase of the shock. It was shown that introduction of the same chemical stimuli after insignificant trauma produced a sharper reaction as compared with the original one.

The above is vividly illustrated by Fig. 1 and also the record of Experiment No. 6 of November 21, 1953.

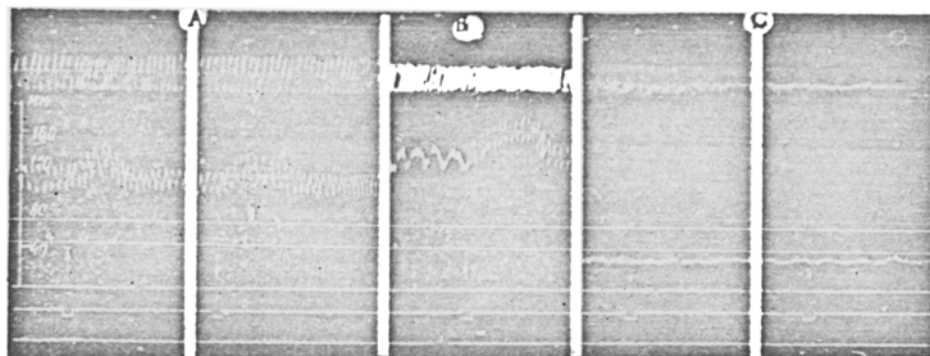


Fig. 1. Change of the reflexes of the intestinal chemoreceptors upon traumatic shock. A) Reflexes before infliction of trauma; B) Reflexes after infliction of slight trauma; C) Reflexes during torpid phase of traumatic shock. Weak narcosis. Significance of tracings (from top to bottom): respiration, blood pressure, zero line, indication of stimulation, indication of time (2 seconds).

Dog-mongrel bitch, color black, average nourishment, weight 7.2 kg.

Original blood pressure - 123 mm Hg.

Blood pressure reflexes of the chemoreceptors of the intestines: to acetylcholine + 17 mm, to nicotine + 13 mm.

Infliction of slight trauma.

Blood pressure - 156 mm.

Blood pressure reflexes of the chemoreceptors to acetylcholine + 24 mm Hg, to nicotine + 15 mm.

During the torpid phase of the shock, blood pressure = 36 mm.

Pressor reaction of the chemoreceptors of the intestines to introduction of chemical stimuli is absent.

Analysis of the findings presented testifies to the phase character of the change in the intensity of the reflexes of the interoceptors of the intestines in the course of development of traumatic shock.

Taking into account the numerous data at the disposal of the laboratory of V. N. Chernigovsky, we confined ourselves to arranging two controlled experiments. In these experiments, it was established that for the interval of time, in the course of which the basic experiment lasted (50-70 minutes), the reflexes of the intestinal interoceptors did not undergo any essential changes.

It is necessary to note that generally the initial traumatization caused an increase in blood pressure in the animals which were not in deep narcosis.

In five experiments of the given series, we obtained traumatic shock in the animals which were in deep narcosis. Study of the reflexes in such animals is of special interest in connection with the fact that there are many communications from clinicians to the effect that in persons under deep narcosis, operational trauma is not accompanied by a sharp increase in blood pressure.

The findings of our experiments showed that blood pressure did not increase at the moment of trauma in the animals under deep narcosis. The introduction of the same doses of chemical stimuli in the same condition led to a rise in pressure not exceeding the magnitude of the original reaction. In these cases we observed an

increase in the time of the reaction without an increase in the minimum blood pressure, i. e., there took place an increase in the pulse pressure.

Thus, the character of the changes in the reactions of the interoceptors, after an initial slight trauma, like the character of the change in the blood pressure at the very moment of infliction of the trauma, depended on the degree of narcosis, i. e., on the functional state of the central nervous system.

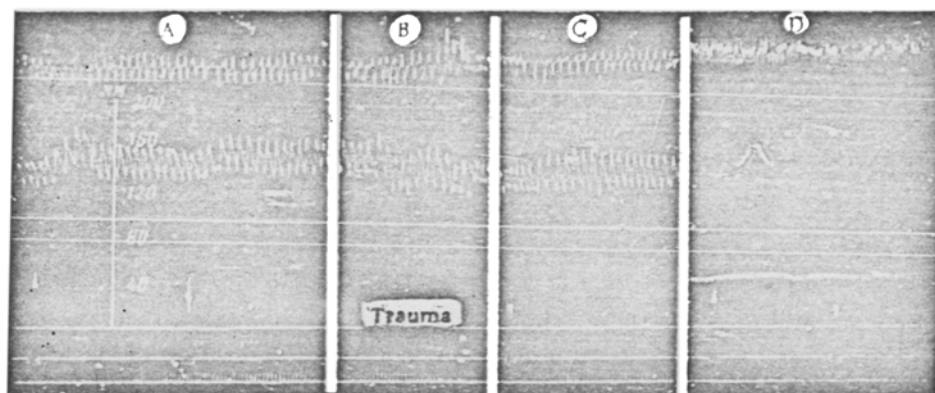


Fig. 2. Change of reflexes of the chemoreceptors of the spleen upon traumatic shock. A) Reflexes before infliction of trauma; B) Change in blood pressure upon infliction of slight trauma; C) reflexes after infliction of initial trauma; D) reflexes during torpid phase of traumatic shock. Deep narcosis. Significance of tracings (from top to bottom): respiration, blood pressure, zero line, indication of stimulation, indication of time (two seconds).
 ↑ - Introduction of Acetylcholine; ↓ - Introduction of potassium chloride.

Further traumatization led to the development of shock with a characteristic fall in the intensity of the reflexes of the interoceptors.

In the experiments of the second series (14 experiments), we studied the change in the reflexes of the chemoreceptors of the spleen with traumatic shock in weakly narcotized dogs (7 experiments) and in dogs under deep narcosis (7 experiments). The pressor reactions to the introduction of acetylcholine and nicotine after a slight initial trauma in the dogs of the first group usually exceeded the original ones; during the torpid phase of the shock usually no reflex response to introduction of the same doses of chemical stimuli was noted. Thus, in Experiment No. 3 of January 18, 1954 (the dog was a female weighing 7.2 kg) before shock the blood pressure rose after introduction of acetylcholine by 10 mm Hg and after nicotine by 8 mm Hg. The infliction of slight trauma was accompanied by an increase in blood pressure. In this condition, a sharp intensification of the reflexes investigated was seen. Thus, acetylcholine produced a rise in pressure by 16 mm Hg, and nicotine by 15 mm Hg. During the developing shock a responsive reaction to stimulation of the chemoreceptors of the spleen by acetylcholine was absent, and the reaction to introduction of nicotine was equal to 2 mm Hg. It is necessary to note that in a series of experiments, during shock, the reaction of the chemoreceptors was usually extremely slight and sometimes distorted.

The experiments of the second group of this series also showed that under deep narcosis the traumatic shock developed, but its development was accompanied by certain peculiarities. At the moment of trauma, blood pressure did not rise and sometimes started to fall immediately. The introduction in this condition of chemical stimuli in the isolated spleen led to a rise in blood pressure not exceeding the original value, i. e., the pressor effect of the splenic chemoreceptors was usually less immediately after slight trauma than before traumatization. Thus, for example, in Experiment No. 9 of February 2, 1954, before traumatization blood pressure rose after introduction of acetylcholine by 11 mm Hg, after slight traumatization, it rose by 9 mm. The same phenomenon was observed in the experiments with reactions to nicotine and potassium chloride (Experiments No. 8, 11, 12 and 14). The latter can be illustrated by Fig. 2, and also by the findings of the record of Experiment No. 11 of February 12, 1954.

Dog — mongrel male, white color, well fed, weight 8.8 kg.

Original blood pressure — 150 mm Hg.

Blood pressure reflexes of the chemoreceptors of the spleen: to acetylcholine + 26 mm Hg, to nicotine + 18 mm Hg and to potassium chloride + 21 mm Hg.

Infliction of slight trauma: blood pressure — 140 mm Hg.

Blood pressure reflexes of the chemoreceptors: to acetylcholine + 24 mm Hg, to nicotine + 18 mm Hg and to potassium chloride + 14 mm Hg.

During the torpid phase of shock, blood pressure — 50 mm Hg.

Pressor reaction of the splenic chemoreceptors to the introduction of the chemical stimuli is absent.

On the basis of the findings, one may conclude that the absence or distortion of the reflex pressor reactions of the chemoreceptors of the internal organs upon traumatic shock makes one consider as one of the cause of disturbance of blood circulation with development of shock, the removal of the usual constant tonic influences of a pressor character in the normal state of the organism from the interoceptors of the internal organs connected with the vessels.

LITERATURE CITED

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* In Russian.