

EVIDENCE OF THE AUTOMATIC ACTION OF ISOHEMOTRANSFUSION ON THE FUNCTIONAL CONDITION OF THE NERVOUS SYSTEM

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In recent years a great deal of information has been obtained, showing the importance of changes in the functional condition of all links of the corticovisceral reflex arc in the mechanism of action of various forms of blood transfusion [1, 3, 4-11, 13, 18]. It has been demonstrated that various forms of blood transfusion modify the functional state of the central nervous system [1, 4, 11, 19, 20]. In this connection there is some immediate importance attached to the elucidation of the mechanisms by which the transfused blood changes the functional condition of the nervous system.

The role of reflex mechanisms in the action of the various forms of blood transfusion has been demonstrated by many workers [3, 6, 9, 11].

Bearing in mind the specific nature of isohemotransfusion it was to be expected that it would have the power to alter the functional condition of the nervous system automatically. This was suggested by N. A. Fedorov [18], but it has not been proved experimentally.

The proof of the automatic action of the transfused blood on the cerebral cortex has met with great technical difficulties. We know that blood transfusion modifies the conditioned reflex activity of the cerebral cortex [3, 6, 18, 20]. This could, however, depend on humoral factors. Strengthening the processes of inhibition in the cerebral cortex (by sodium amytal or bromide) alters the reaction of the body to the various forms of blood transfusion. This does not explain the mechanisms of its effect on the functional condition of the cerebral cortex. Finally, by intravenous injection of novocain before blood transfusion, the reaction of the body to the transfusion can be changed.

We carried out investigations on the superior cervical sympathetic ganglion which by its special features may be regarded as part of the central nervous system brought out to the periphery.

We started from the consideration that by denervation of the ganglion (by division of the preganglionic fibers) it is deprived of the possibility of reflex stimulation, so that the changes which could occur in the functional condition of the ganglion during blood transfusion could, under these conditions, take place automatically — by an "internal humoral route."

EXPERIMENTAL METHOD

The sympathetic nerve in cats under urethane anesthesia was dissected out and divided. An electrode was passed beneath the cranial end of the divided nerve. Stimulation, lasting 5 seconds, was carried out by means of an induction apparatus, with a current voltage of 2v and the distance between the primary and secondary induction coils 5-8 cm.

The blood pressure in the carotid artery was recorded on a kymograph by means of a manometer, and the contraction of the nictitating membrane by means of a lever which was attached to it.

The investigation was carried out on 27 cats, of which 17 were experimental and 10 were donors.

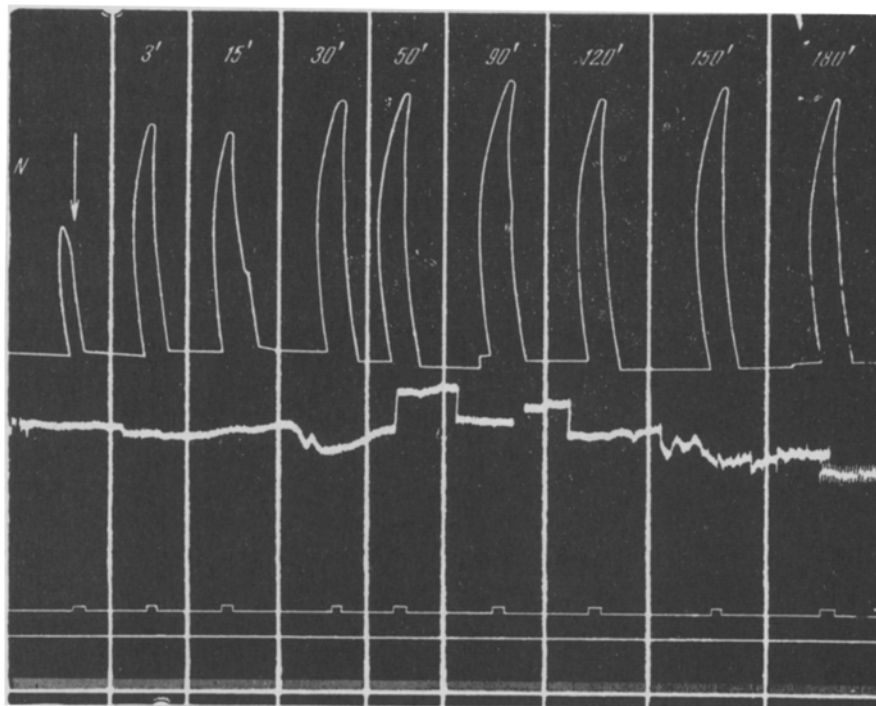


Fig. 1. The effect of blood transfusion on the functional condition of the superior cervical sympathetic ganglion of the cat.

Significance of the curves (from above down): contraction of the nictitating membrane, arterial pressure (mercury manometer), stimulus marker, zero line of the mercury manometer, time marker — 1 second; N — reaction of the nictitating membrane before blood transfusion; — isohemotransfusion — 4 ml/kg. The figures above indicate the time in minutes after isohemotransfusion.

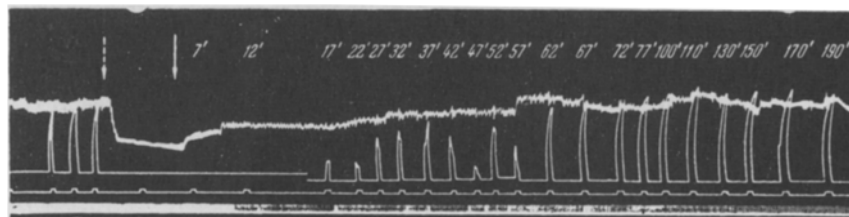


Fig. 2. The same as in Fig. 1, after preliminary administration of hexatonid. Significance of the curves (from above down): arterial pressure (mercury manometer), contraction of the nictitating membrane, stimulus marker, time marker — 1 second, zero line (of the mercury manometer); — injection of 10 mg/kg of hexatonid; — isohemotransfusion.

EXPERIMENTAL RESULTS

In the first series of experiments (5 cats) we studied the effect of blood transfusion on the functional condition of the superior cervical sympathetic ganglion. The results of all the experiments followed the same pattern. Transfusion of blood (3-4 ml/kg) caused a marked and prolonged increase in the tone of the nictitating membrane which was observed throughout the whole experiment (in individual cases up to 19 hours). This effect did not appear at once, but after the lapse of 3-5 minutes (Fig. 1).

Since the work was done on a specialized nerve-muscle preparation, the results could depend either on changes in the functional condition of the ganglion or on an increase in the reactivity of the effector organ (the muscle of the nictitating membrane). If the result obtained was due to a change in the functional condition of the ganglion, this effect would be absent after ganglion block.

In a second series of observations, made on 6 cats, a ganglion-blocking drug (10 mg/kg of tetamon or the same dose of hexatonid) was first injected, and this was followed after 5 minutes by isohemotransfusion. The results after injection of both these drugs were in principle of the same pattern, but were more marked after hexatonid, which blocks the transmission of nerve impulses in ganglia more strongly and for a longer time (Fig. 2).

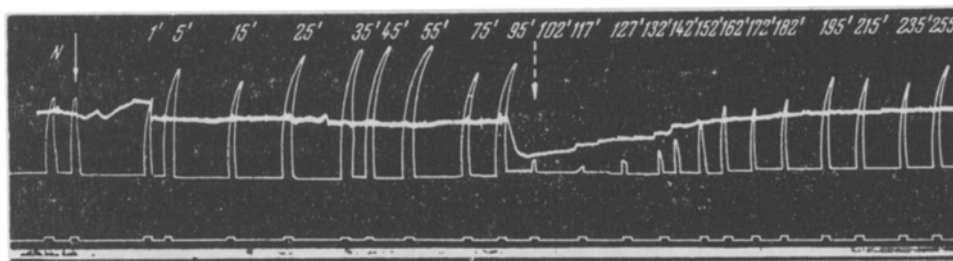


Fig. 3. The same as in Fig. 1, but hexatonid was given last. Legend as in Fig. 2.

The investigations showed that blocking the synaptic transmission in the sympathetic ganglion prevented the appearance of the effect due to isohemotransfusion. As the ganglion block died away, as shown by the rise in the arterial pressure, the effect due to isohemotransfusion reappeared.

In a third series of investigations (6 cats), the plan of the experiments was changed: isohemotransfusion preceded the injection of the ganglion-blocking drugs. As in the previous series, after injection of hexatonid and tetamon, results of the same pattern were obtained, but more marked after hexatonid. In the experiments of this series, transfusion of blood was accompanied by a pronounced increase in the tone of the nictitating membrane, which was removed during the 70-100 minutes of the blocking of the impulses in the ganglion. As the ganglion block wore off, the effect of isohemotransfusion was restored (Fig. 3).

Isohemotransfusion was thus accompanied in the cat by increased function of the superior cervical ganglion. Since these investigations took place after division of the preganglionic sympathetic fibers, the results proved that blood transfusion could act automatically on the functional state of the nervous system.

Information of importance in the solution of practical problems was forthcoming from our investigations.

In 1954 we proposed the use of ganglion-blocking drugs in the prophylaxis of transfusional reactions after various forms of blood transfusion. Clinical observations, which we made jointly with N. N. Novachenko [10], confirmed the value of this suggestion. The question naturally arose: did the administration of ganglionblocking drugs before transfusion prevent only the development of a pathological transfusional reaction or did it prevent the general reaction of the body to the blood transfusion. Clinical observations showed that the preliminary injection of ganglion-blocking drugs prevented the development of a pathological transfusional reaction without blocking the subsequent stimulating effect of the blood transfusion. The present investigations confirmed that the preliminary injection of ganglion-blocking drugs prevented the effects of isohemotransfusion only temporarily (for 70-100 minutes), after which they were shown in full measure.

The second practical problem consisted of the value of ganglion-blocking drugs in terminating already existing transfusional reactions. It was found that the administration of ganglion-blocking drugs after transfusion blocked a reaction which had developed to the transfused blood for a short time (70-110 minutes).

The findings described, which indicate the possibility of an automatic action of transfused blood, thus provide a further experimental basis for the use of gangliolytic drugs in the prevention and treatment of transfusional reactions.

SUMMARY

Isohemotransfusion increases the function of a denervated sympathetic node (section of a preganglionic fiber) demonstrating the automatic effect of the transfused blood on the functional condition of the nervous system. The data obtained proves the expediency of gangliolytics administration for the prophylaxis and checking the transfusional reactions.

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