

EXPERIMENTAL HYPERTENSION IN DOGS CAUSED BY LIGATION OF THE THREE MAIN ARTERIES OF THE BRAIN

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Acute ischemia of the brain in dogs is known to cause an increase in the arterial pressure [3]. However, there is no agreement in the literature on the possibility of creating experimental chronic hypertension by means of cerebral ischemia, and it is not known whether hypertension can be produced in general in dogs by creating ischemia of the brain without disturbing its functions.

Profiting by the experience of other investigators during recent years, the authors have carried out experiments which have contributed to the successful completion of the present study [2]. An attempt was made to create cerebral ischemia by ligating three of the main arteries of the brain.

EXPERIMENTAL METHOD

Ligation of three of the main arteries of the brain in the dog was carried out in two stages: in the first stage one vertebral artery, usually the left, was ligated and the left carotid artery was exteriorized into a skin flap by Van Lersum's method; in the second stage, after the wound from the first operation had healed, ligatures were applied to the second, right, vertebral artery and to one common carotid artery, usually the right, below the carotid sinus.

To ligate the vertebral artery the skin incision was made along a line joining the upper end of the manubrium sterni and the head of the humerus. The underlying tissues were displaced by blunt dissection. By the same method, the transverse process of the 7th cervical vertebra was exposed; this is distinguished by its protuberance, especially when the dog's head is bent forward. When this process was reached, the pulsation of the vertebral artery, entering the foramen in the transverse process of this vertebra, was detected with the index finger. At this stage special care was necessary to avoid injury to the pleura. The vertebral artery was mobilized, and the ligature passed beneath it and tied around the artery. Healing was usually complete after 7-10 days.

The arterial pressure was measured once every week in the common carotid artery in the skin flap by an auscultatory method. The mean value of three successive measurements was taken.

EXPERIMENTAL RESULTS AND DISCUSSION

The two-stage operation by the method described above was first carried out on 4 dogs. The second operation was performed about one month after the first. Soon after this, the arterial pressure rose, the systolic pressure to a greater degree than the diastolic (Fig. 1).

The arterial pressure was measured in the animals undergoing the operation for more than one year. In all the dogs, on which the experiments were carried out in this manner, persistent hypertension developed. The same operations were then performed on a further 8 dogs. The results were the same. The systolic pressure in some dogs rose to 200-210 mm and remained at this level.

Injection of serpasil, the hypotensive drug, into the animals in a dose of 25 μ g/kg body weight caused the arterial pressure to fall for 24 h. Other hypotensive preparations gave the same effect (Fig. 2).

Constriction of the lumen of the main arteries to the brain or ligation of most of them, as the present and other authors have shown, thus leads to an increase in the arterial pressure of dogs. It has been considered that this form of hypertension develops as a result of accidental injury to the nerves of the carotid sinus region [6, 8, 9]. However, in the present experiment blood reached the brain of the animals through one main artery and its collaterals, so that ischemia of the brain cannot be excluded as the cause of the increased arterial pressure.

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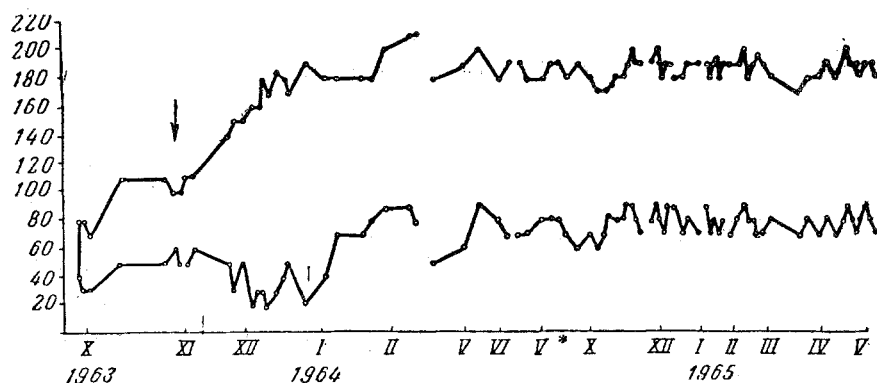


Fig. 1. Diagram of changes in the arterial pressure of the dog Buba after two-stage ligation of three main arteries supplying the brain. Here, and in Figs. 2-4: along the axis of abscissas—arterial pressure (in mm), along the axis of ordinates—time during which the arterial pressure was measured (months and years). Top curve—systolic, bottom curve—diastolic pressure. Circles—results of measurement on one day. If the arterial pressure was not measured for more than one month, the curve was not joined. Arrow—second operation during which the second vertebral artery and one common carotid artery was ligated.

* As in Russian original — Publisher's note.

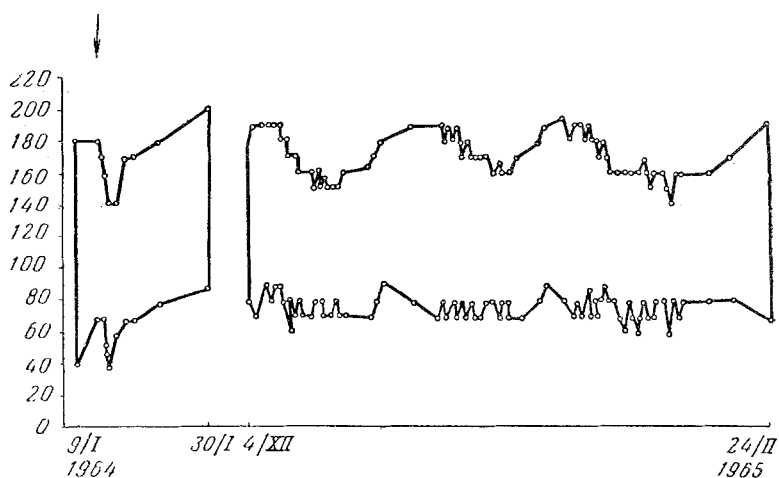


Fig. 2. Hypotensive drugs and duration of their administration to the dog Buba.

In collaboration with G. Iovlev, serial angiography of the brain was performed on some of the dogs undergoing the operation. Comparison of the serial angiograms showed that the contrast material entered the ligated arteries later, and disappeared from them more slowly than in the unligated carotid artery. Evidently, the contrast material filled the ligated arteries retrogradely and through the collateral arteries of the skin and muscles. Hence, the contrast material also filled the carotid sinus of the ligated carotid artery. It follows that the arterial pressure in the carotid sinus of the ligated common carotid artery was below the usual level.

It was concluded from these findings that when the experiments were carried out as described above a decisive role in the elevation of the arterial pressure of the experimental dogs was probably played by a decrease in the pressure in the carotid sinus of the ligated common carotid artery. Blood entering the carotid sinus retrogradely did not create the necessary pressure in the sinus, thus stimulating the baroreceptors, so that the blood pressure was raised by a reflex mechanism. To test this hypothesis, the carotid sinus of the ligated common carotid artery was removed from two dogs in which hypertension had been produced 6 months previously by this method, and observations were then kept on the dynamics of the arterial pressure (Fig. 3). As Fig. 3 shows, the arterial pressure began to fall gradually. It became only a little higher than the pressure before the second operation, and then rose to 170-180 mm.

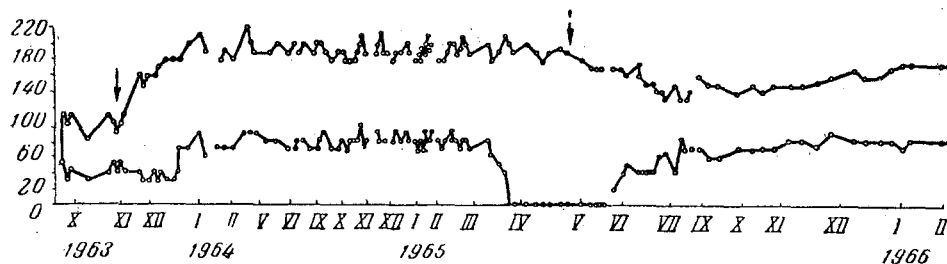


Fig. 3. Dynamics of arterial pressure of the dog Boyan. Broken arrow—third operation during which the carotid sinus of the ligated common carotid artery was removed. The fall of the diastolic pressure to 0 was the result of injury to the aortic valve during catheterization.

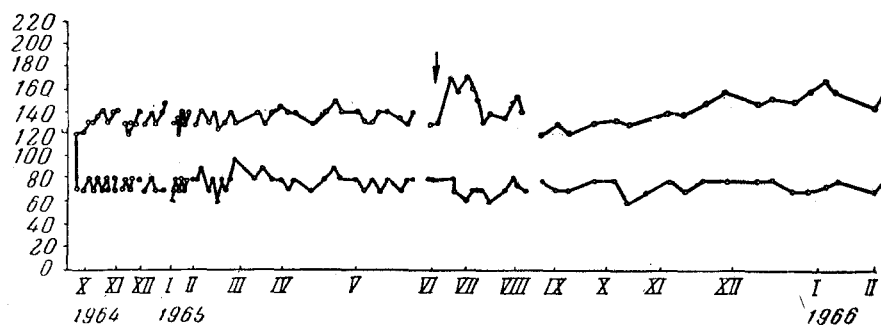


Fig. 4. Diagram of the arterial pressure of the dog Vikhre. During the second operation, besides ligation of the common carotid artery, the carotid sinus was removed.

Yet another variant of the experiment was carried out. During the second operation not only were the vertebral and common carotid artery ligated, but the carotid sinus was also removed.

As may be seen in Fig. 4, the arterial pressure of the dog Vikhre rose slightly after removal of the carotid sinus, and then fell to a minimal value, after which it again rose slightly.

It may be supposed that the high values of the arterial pressure were the result of a reflex reaction from the carotid sinuses, and were also connected to some extent with the cerebral ischemia. The model of experimental hypertension described above may be used for testing antihypertensive agents.

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