

THE INFLUENCE OF THE CAROTID PRESSORECEPTORS ON REFLEXES INVOLVING THE CAROTID CHEMOCEPTORS

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In earlier work [1] we established that the reflexes involving the chemoceptors of the carotid body play a decisive role in the pressor action of small doses of nicotine. Later we set up experiments with other representative ganglionic poisons - cytisine (0.03 mg/kg) and lobeline (0.03 mg/kg) and quite similar results were obtained. In the course of the work it was observed that the intensity of the pressor action of the nicotine, cytisine and lobeline changed depending on whether clamps were placed on the common carotid artery or whether the arteries remained free.

After a clamp was placed on the common carotid artery, the reflex rise in blood pressure in response to the administration of the same doses of nicotine, lobeline and cytisine increased considerably.

EXPERIMENTAL METHODS AND RESULTS

All the experiments were carried out on decerebrated cats. The blood pressure was taken on the carotid artery, a clamp was placed periodically on the other carotid artery. Nicotine (0.02 mg/kg), cytisine (0.03 mg/kg) and lobeline (0.03 mg/kg) were administered in the femoral vein of the cat.

The action of these substances on the blood pressure and respiration was registered before the application of the clamp and while it was in place. The results of one of the experiments using cytisine and a clamp on the common carotid artery are shown in Fig. 1.

The results of 25 experiments showed that the pressor effect during intravenous administration of nicotine, cytisine and lobeline increased considerably when a clamp was applied to the common carotid artery. Consequently, the vasomotor reflexes involving the chemoceptors of the carotid body increased after the application of a clamp on the common carotid artery.

In all the experiments we did not observe a noticeable change in the respiratory reflexes. This gave us the right to consider that the application of a clamp did not affect the sensitivity of the chemoceptors of the carotid bundle.

The sensitivity of the vessels to sympathetic vasomotor impulses while a clamp was applied to the carotid artery also did not change. Experiments with intravenous administration of adrenaline before and after the application of a clamp showed this (Fig. 2).

The unchanged pressor effect of adrenaline during the application of a clamp indicates that the compensatory effect of the pressoreceptors of the carotid sinus in response to increased blood pressure was not decreased.

The conclusion remains that the increase in the reflexes involving the chemoceptors of the carotid bundle after clamping the common carotid artery is the result of an increase in the excitability of the vasomotor center.

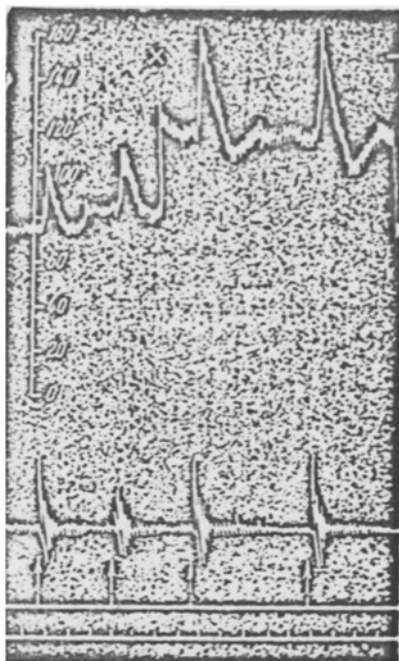


Fig. 1. Effect of cytisine on the blood pressure and respiration of a cat before and after the application of a clamp on the common carotid artery.

Curves (top to bottom): blood pressure, respiration, administration (↑) of 0.03 mg/kg cytisine, time marker (3 seconds); X-application of a clamp on the common carotid artery; - removal of clamp.

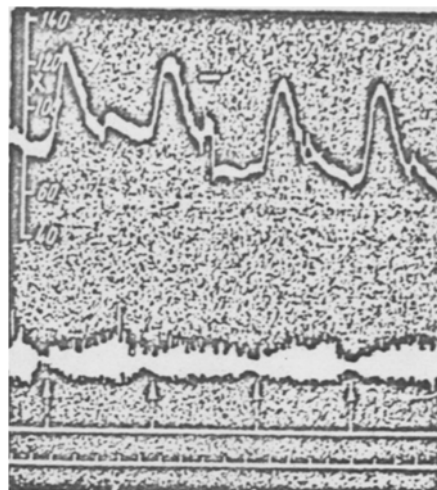


Fig. 2. Effect of adrenaline on the blood pressure of a cat before and after the application of a clamp on the common carotid artery.

Curves (top to bottom): blood pressure, respiration, administration (↑) of 0.01 mg/kg adrenaline, time marker (3 seconds); X-application of clamp; - removal of clamp.

The reason for this cannot be ischemia of the vasomotor center, since the respiratory center, which is no less sensitive to ischemia, did not change its excitability.

One can believe that the increased excitability of the vasomotor center depends on the fact that the pressure in the carotid sinus is reduced after the application of a clamp on the artery. Apparently, the impulses which come from the pressoreceptors of the carotid sinus and which inhibit the vasomotor center are reduced in the course of this. Consequently, the pressoreceptors have a constant inhibitory effect on the excitability of the vasomotor center, lowering the pressor effect from the chemoreceptors by this means, under normal systemic conditions. In order to discover whether the excitability of the vasomotor center to the reflex influences of other receptors changed, we set up 10 experiments on decerebrated cats in which we studied the pressor reflex with the stretch receptors of the urinary bladder.

A small rubber balloon, connected to manometer and a bulb, was inserted in the urinary bladder. The pressure in the urinary bladder was raised by forcing air into the balloon (to 80 mm of mercury), causing a considerable pressor effect. The experiments were carried out at intervals of not less than 15 minutes.

The results of all the experiments showed that the pressor effect increased somewhat after a clamp was applied to the common carotid artery (Fig. 3).

In connection with the results which we obtained, it should be mentioned that T. Bernthal [2] described the inhibitory effect of impulses from the receptors of the aortic zone on the pressor reflexes of the chemoreceptors of the carotid sinua.

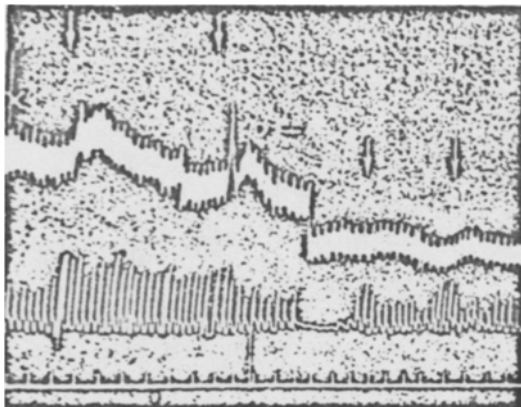


Fig. 3. Change in the pressor effect from the urinary bladder when a clamp is applied to the carotid artery.

Curves (top to bottom): blood pressure, respiration, time marker (3 seconds); ↓ inflation of the urinary bladder (80 mm of mercury); X-application of the clamp; - removal of the clamp.

The rise in blood pressure which is produced by the intravenous administration of nicotine, lobeline and cytoline and which is basically the result of a reflex from the chemoreceptors of the carotid sinus on the adrenal gland, increased after a clamp was applied to the common carotid artery.

Physiological analysis of the phenomenon described permits the conclusion to be drawn that the excitability of the vasomotor center is increased after the common carotid artery is clamped. This can be explained by the removal of inhibitory impulses from the pressoreceptors of the carotid sinus, near which the pressure is lowered after a clamp is applied.

Under normal systemic conditions, the pressoreceptors of the carotid sinus always decrease the pressor reflexes from the chemoreceptors of the carotid bundle, producing a constant inhibitory effect on the excitability of the vasomotor center.

LITERATURE CITED

- [1] E. S. Fedorchuk, Byull. Eksptl. Biol. i Med. 37, 6, 7-11 (1954).
- [2] T. Bernthal, Am. J. Physiol. 121, 1, 1-20 (1938).