EFFECT OF TROPAPHEN ON NERVOUS CONTROL OF THE CEREBRAL CIRCULATION

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Investigations by radioisotope, electromagnetic, and resistographic methods showed that tropaphen increases the cerebral blood flow and lowers the tone of the intracranial vessels. It inhibits reflex responses of intracranial vessels and responses of the intracranial blood flow to stimulation of the cervical sympathetic nerves and it prevents the development of experimental disturbances of the cerebral circulation of neurogenic nature. These effects of tropaphen are due to its α-adrenoblocking properties.

KEY WORDS: α-adrenoblockers; cerebral blood flow; responses of cerebral arteries; tropaphen.

The role of the sympathetic innervation in the regulation of the intracranial circulation and in the development of cerebrovascular pathology has not been finally established [1, 2, 8-10].

The present investigation was accordingly conducted to study the effect of the α-adrenoblocking agent tropaphen* [3] on the cerebral circulation.

EXPERIMENTAL METHOD

Experiments were carried out on 36 cats weighing 3-4 kg anesthetized with urethane (0.5 g/kg) and chloralose (50 mg/kg) and maintained on artificial respiration.

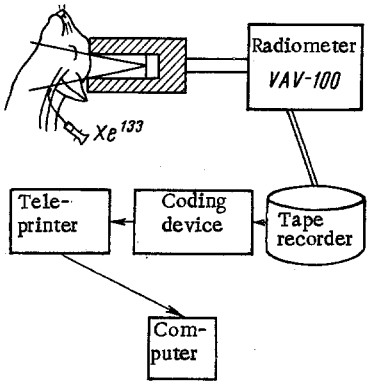

Fig. 1. Block diagram of system for recording volume velocity of cerebral blood flow with the aid of Xe^{133} (explanation in text).

The cerebral blood flow was determined with the aid of radioactive xenon (Xe^{133}) [11]. The collimator used was 30 mm high and its aperture was 20 mm in diameter. The detector was placed above the parietal region of the cat's brain. The indicator was injected into the right common carotid artery after ligation of all its extracranial branches. The output channel of a VAV-100 radiometer was connected to a "Vesna-3" tape recorder and a coding device. The number of pulses in a 10-sec interval was recorded on punched tape by means of a teleprinter. The punched tape was fed into a Minsk-22 computer (Fig. 1). The mathematical analysis involved the following stages: 1) elimination of random scatter and determination of the maximal value from the original data; 2) determination of the mean "background" value and its subtraction from the

*Tropine ester of β-acetoxyphenyl-α-phenylpropionic acid (translator's note).

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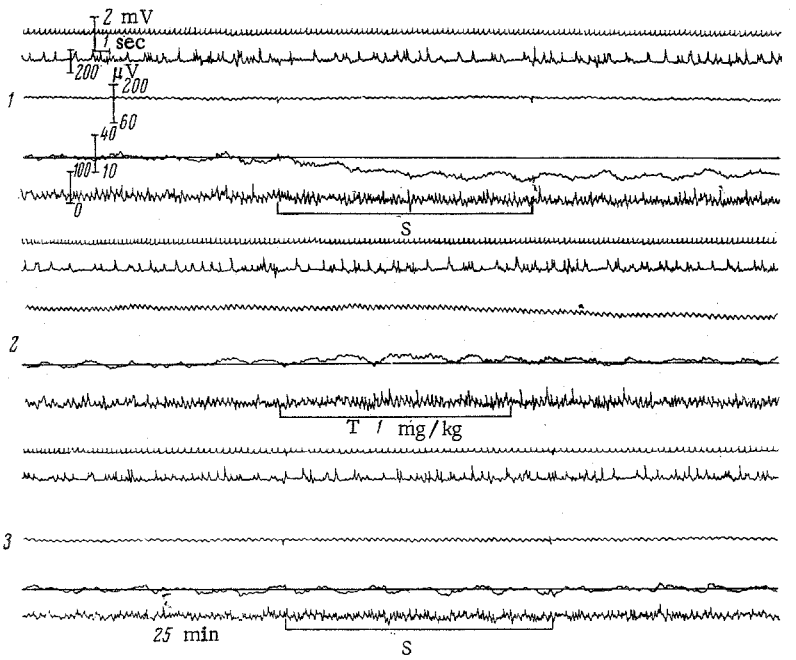

Fig. 2. Effect of tropaphen (1 mg/kg, intravenously) on responses of intracranial blood flow to electrical stimulation of cervical sympathetic nerve in a cat: 1) control test; 2) injection of tropaphen; 3) 25 min after injection of tropaphen. From top to bottom: ECG in lead II, EEG from parietal region, blood pressure (in mm Hg), averaged phasic blood flow in right carotid artery (in ml/min), marker of stimulation (S), and of injection of drug (T).

original data; 3) smoothing of the data; 4) determination of the cerebral blood flow by consecutive deduction of demonstrative functions [4, 7].

The state of the cerebral circulation also was judged from the inflow of blood into the cats' brain through the maxillary artery. The inflow was determined by means of an electromagnetic blood flowmeter. The EEG, ECG, and arterial pressure were recorded at the same time. The vascular component of the action of the drug on the cerebral hemodynamics was differentiated by separate bilateral perfusion of the carotid and vertebral arteries [5].

The acid–base balance and partial oxygen pressure in samples of arterial blood and cerebrospinal fluid were determined by means of an ABC-1 Radiometer.

Tropaphen was injected intravenously in doses of 0.5-2 mg/kg.

EXPERIMENTAL RESULTS AND DISCUSSION

The experiments with Xe^{133} showed that tropaphen (1 mg/kg) definitely increased the volume velocity of the intracranial blood flow. Similar results were obtained in experiments to record the blood flow into the brain by means of an electromagnetic flowmeter. The intracranial circulation increased under the influence of tropaphen on the average by 31 ± 4.4%. No significant changes were observed in the EEG and ECG (Fig. 2).

In a dose of 1 mg/kg, tropaphen lowered the vascular tone in the territory supplied by the carotid arteries by 20 ± 3.3% and in the vertebral arterial system by 19 ± 3.3%. Under these circumstances the arterial pressure fell by 43 ± 6.2%.

No differences were found in pH, pCO_2, pO_2, and the percentage of oxyhemoglobin in samples of arterial blood taken before and 3, 15, 30, and 60 min after the injection of tropaphen. Tropaphen had no significant effect likewise on pH, pO_2, and pCO_2 in the cerebrospinal fluid.

Constrictor responses of the intracranial arteries were induced by electrical stimulation of afferent fibers of the tibial nerve (20-40 V, 20-40/sec, 1 msec). Tropaphen (1-2 mg/kg) considerably inhibited these responses, as well as the changes in arterial pressure.

Electrical stimulation of the cervical sympathetic nerve (3-10 V, 3-10/sec, 1 msec) was accompanied by a marked decrease in the volume velocity of the cerebral blood flow. Under these circumstances the intracranial circulation was reduced by 51 ± 3.1%, indicating the importance of the neurogenic component in the regulation of cerebrovascular tone. In this case also tropaphen sharply inhibited the response of the intracranial vessels (Fig. 2). Similar results were obtained in experiments using resistography.

The effect of tropaphen was studied also during disturbance of the cerebral circulation produced by potassium chloride [6]. If tropaphen was given 20-30 min before potassium chloride, spasms of the cerebral vessels and the generalized pressor response were considerably reduced. Tropaphen lowered the tone of the cerebral vessels and the arterial pressure also if these were increased through the action of potassium chloride on the CNS.

Tropaphen thus increased the volume velocity of the intracranial blood flow and, at the same time, reduced the tone in the arterial systems of the brain. It considerably inhibited reflex responses of the intracranial vessels and changes in the intracranial blood flow caused by stimulation of the cervical sympathetic nerves. It also has a therapeutic and prophylactic effect in cases of experimental disturbance of the cerebral circulation of neurogenic nature. The absence of changes in the indices of the acid-base balance of the blood and brain tissue metabolism under the influence of tropaphen evidently rules out any possibility of an indirect effect of the drug on the cerebral hemodynamics. The pharmacological effects of tropaphen are due in all probability to its ability to block the α-adrenergic structures of the intracranial vessels.

The results point to the importance of α-adrenergic structures of the intracranial vessels in the regulation of the cerebral circulation and in the development of cerebrovascular pathology. Meanwhile the ability of tropaphen to increase the cerebral blood flow, as a result of its marked action on the nervous control of the cerebral circulation, enables it to be recommended for clinical use in neurological practice.

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