INFLUENCE OF THE VERTEBRAL NERVE ON THE COCHLEAR CIRCULATION

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The rheocochleogram (RCG) was recorded in anesthetized cats before and after stimulation of the vertebral nerve with square pulses (5-10 V, 10 msec, 10/sec). After stimulation of the ipsilateral vertebral nerve there was a clear decrease in amplitude of the RCG, smoothing out of its apex, and upward displacement of its dicrotic wave, evidence of increased tone of the cochlear vessels and their reduced filling with blood. Preliminary injection of the sympatholytic bretylium abolished the response of the cochlear vessels to vertebral nerve stimulation. The systemic arterial pressure rose. Similar but less marked changes were observed in response to stimulation of the contralateral vertebral nerve. The significance of these results is discussed in relation to the mechanism of cochleo-vestibular disturbances in the vertebral artery syndrome.

Many clinical investigations of otoneurological disturbances in the vertebral artery syndrome have been described [1, 3, 5-7, 9, 10]. Audiographic changes in patients with cervical osteochondrosis are attributed to a deficient blood supply to the cochlea and to the brain-stem nuclei of the VIII pair of cranial nerves as a result of irritation of the vertebral nerve.

This paper describes an experimental attempt to detect responses of the cochlear vessels to stimulation of the vertebral nerve.

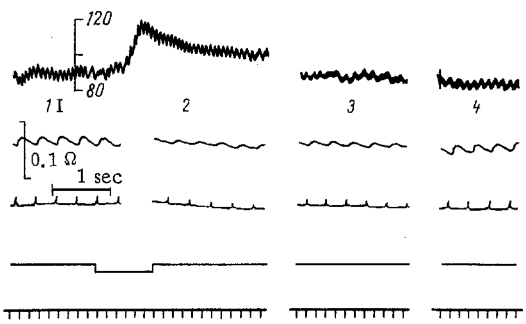

Fig. 1. Changes in RCG after stimulation of ipsilateral vertebral nerve. From top to bottom: arterial pressure, RCG, ECG, marker of stimulation, time marker 5 sec; 1) before stimulation; 2, 3, 4) 1, 5, and 30 min, respectively, after stimulation.

EXPERIMENTAL METHOD

Experiments were carried on 22 adult cats anesthetized with chloralose (0.04 g/kg) and urethane (0.6 g/kg) using artificial respiration. To study the cochlear circulation, the method of rheocochleography developed by the writers [8] was used. The rheogram of the cochlear vessels was recorded by means of the RGI-01 rheographic attachment and the ÉÉChS-1 two-channel ink-writing electroencephalograph, the second channel of which was used to record the ECG in standard lead II. The systemic arterial pressure was recorded by a mercury manometer in the common carotid artery.

The vertebral nerve was exposed in the neck before its entry into the vertebral canal. The initial rheocochleogram (RCG) was recorded, and the vertebral nerve was then stimulated by square pulses (5-10 V, 10 msec, 10/sec). The duration of stimulation was 10-30 sec. The

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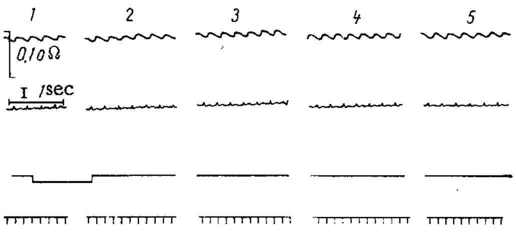

Fig. 2

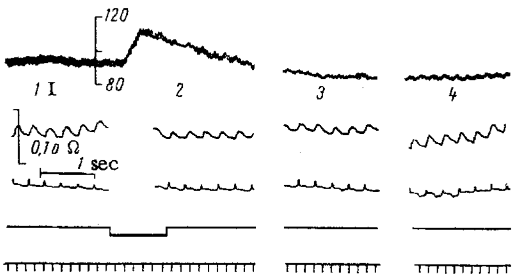

Fig. 3

Fig. 2. Character of RCG after stimulation of vertebral nerve in animal receiving bretylium. From top to bottom: RCG, ECG, marker of stimulation, time marker 5 sec; 1) before stimulation; 2, 3, 4, 5) 1, 5, 20 and 40 min, respectively, after stimulation.

Fig. 3. Changes in RCG after stimulation of contralateral vertebral nerve. Legend as in Fig. 1.

RCG was again recorded 1, 3, 5, 10, 20, and 30 min after stimulation of the nerve.

EXPERIMENTAL RESULTS

Stimulation of the vertebral nerve led to a decrease in amplitude of the RCG on the same side on the average by 42.1 ± 5.1% ($P < 0.001$). The effect developed immediately after stimulation but was most marked after 1-2 min, and it continued for 5-20 min (Fig. 1). The response was directly dependent on the strength and duration of stimulation.

The decrease in amplitude of the RCG was frequently accompanied by changes in its shape: by flattening or smoothing out of the rheowave, by convexity of the dicrotic phase, and by upward displacement of the dicrotic wave. No significant changes were found in the duration of the anacrotic and catacrotic phases of the RCG. The systemic arterial pressure rose on the average by 47 ± 3.9% after stimulation of the vertebral nerve but the effect was of short duration (3-4 min). These changes in the amplitude and shape of the RCG indicate that vertebral nerve stimulation increases the tone of the cochlear vessels and reduces their filling with blood. Presumably this leads to a decrease in the blood supply to the cochlea. An earlier investigation [2] showed a marked decrease in the volume velocity of the blood flow in the region supplied by the vertebral artery during stimulation of the vertebral nerve.

The increase in tone of the cochlear vessels during stimulation of the vertebral nerve can be regarded as a specific response, for in experiments in which the sciatic nerve was stimulated the decrease in amplitude of the RCG averaged only 5-9% for not more than 1 min and was not significant. The shape of the rheowave under these circumstances likewise showed no significant change.

Since the vertebral nerve is a sympathetic nerve, in a series of six experiments the sympatholytic agent bretylium (15 mg/kg) was given. The results of these experiments show that bretylium completely abolishes the vasoconstrictor effect of vertebral nerve stimulation (Fig. 2). A no less important problem is whether stimulation of the vertebral nerve on one side has any effect on the blood supply to the cochlea on the opposite side. Experiments showed a decrease in amplitude of the RCG in response to stimulation of the contralateral vertebral nerve, but the effect was weaker (Fig. 3) than to stimulation of the ipsilateral nerve. Changes in the shape of the rheographic wave characteristic of an increase in tone of the cochlear vessels also were observed.

It was shown previously [4] that the vertebral nerve accompanies the artery of the same name as it enters the cranial cavity and participates in the formation of the plexus surrounding the basilar artery. The nerve fibers of this plexus evidently supply both internal auditory arteries.

The results of these experiments thus shed light on the mechanism of the cochleovestibular disturbances in cervical osteochondrosis, when irritation of the vertebral nerve leading to a disturbance of the blood supply to the cochlea may take place.

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