REFLEX TONE IN THE TONGUE MUSCLES

(ELECTROPHYSIOLOGICAL INVESTIGATION)

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Tone in skeletal muscles is maintained by reflex action. One of its important features is that it is capable of maintaining organs in a definite position without noticeable signs of fatigue.

The reflex mechanisms of the maintenance of muscle tone in the limbs and trunk has been very fully studied. The tonic reflexes of the eye, ear and other muscles have also been described.

However, up till now no investigation has been made of the tongue muscles. The present work is devoted to an investigation of this problem.

EXPERIMENTAL METHODS

The muscle tone of the tongue was recorded with a myograph and an electromyograph. The latter recorded the muscle potentials of the tongue by means of an amplifier and a cathode ray oscillograph. The potentials were led off by needle electrodes. The experiments were carried out on cats.

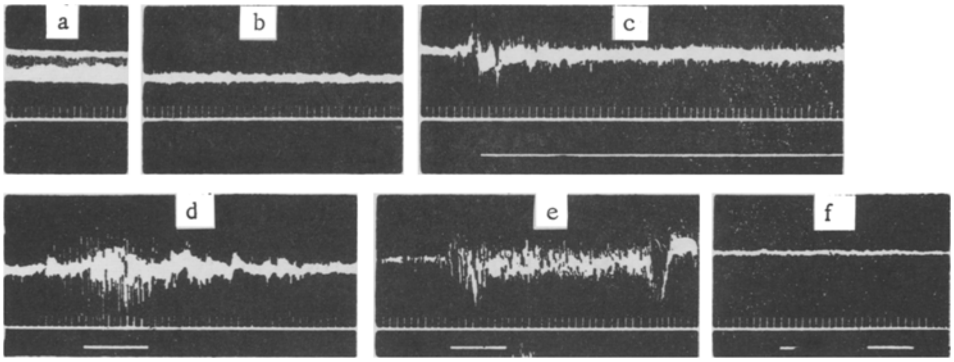
The proprioceptors of the tongue were stimulated by stretching the tongue with a load of 20, 50, 100 and 200 g. The duration of the stimulus was from 0.1 to 5 seconds. A pneumatic method was used to record the stimulus on the film.

EXPERIMENTAL RESULTS

Investigation of the tongue muscle potentials showed that after section of the sensory nerves supplying the mucous membrane of the mouth (lingual, glossopharyngeal and superior laryngeal), when only the hypoglossal nerves were preserved, a fairly regular discharge could be recorded from the tongue muscles during rest. They had an amplitude of 40-45 μv and a frequency of 30-35 c/s (see Fig. b). These potentials represented lingual tone at rest.

After recording the background noise due to spontaneous activity the tongue was stretched by hanging on to it weights of 20 or 50 g. After this, as a rule, the amplitude of the potentials increased to 60-80 μv and the frequency to 80 c/s or more (see Fig. c).

After this increase in tonic muscular activity of the tongue, increasing the load by a further 100 g immediately caused volleys of potential of amplitude 250 microvolts and frequency 100-150 c/s. These powerful volleys of bioelectric potentials were maintained for the whole of the time for which the load was applied, and even for some seconds after it had been removed (see Fig. d). The after discharge gradually died away, rapidly at first, and then more slowly. If the load was not removed, the discharge rate became considerably reduced after a certain time.



Electrical activity of the tongue muscles. Traces (from above downwards): action potentials of the tongue muscles, time intervals of 0.1 seconds, mark showing stimulation.

a) Calibration signals. Amplitude 50 microvolts. Amplification the same for all traces; b) electrical activity of the tongue at rest (without load); c) activity on stretching with load of 60 g; d) activity on stretching with load of 100 g; e) activity on stretching with load of 200 g; f) absence of electrical activity on stretching with load after section of hypoglossal nerves.

A further increase of the load to 200 g during well-shown tonic activity caused a still stronger effect – the amplitude of the potentials was 200-250 μv, and isolated potentials reached a value of 300 or more μv, while the frequency rose to 200 or more c/s (see Fig. e). There was a considerably longer after discharge which lasted up to 2-3 and sometimes 5 minutes.

Stretching the tongue with a load of 250-300 g at the moment of applying the load produced volleys with an amplitude of 200 microvolts, and a frequency of 70-80 c/s after which there was a marked reduction in activity. Isolated potentials were recorded. Thus increase of the load beyond a certain optimal value instead of causing an increase in the potentials, caused a suppression of the electrical activity and even a disappearance of the background potentials. If this overload was removed after 3-7 seconds the background bioelectric potentials appeared again.

Besides stretching the tongue rapidly and for short periods we also tried the effect of a very gradual extension. In this case the volleys of potentials described above were not observed.

Increase in electrical activity occurred not only in the case of longitudinal extension, but also with transverse stretching and in response to compression, (but only when this was short and sharp). In these cases the amplitude of the potentials was 50-60 μv the frequency – 70-80 c/s, and the potentials disappeared when the stimulus was removed.

In further experiments tension was applied to the tongue by hanging on weights of 50-100 g. After the appearance of the potentials described above, the two hypoglossal nerves were cut simultaneously. At the moment of the nerve section a stream of impulses appeared, but after 1-2 seconds this sharp burst of electrical activity ceased. After preliminary bilateral section of the hypoglossal nerves neither stretching nor compressing the tongue caused any potentials to appear.

In several experiments a bilateral novocaine block of the hypoglossal nerves, using 1% novocaine, was made. After 8-10 minutes from the time of the novocaine injection, there was a sharp reduction of the potentials associated with the normal tone of the tongue, and after 12-15 minutes the potentials ceased altogether, after which neither stretching nor compressing the tongue and the hypoglossal nerve caused any potentials to appear. There was a considerable lengthening of the tongue which hung out of the mouth. After washing out the novocaine for 20-30 or more minutes the previous potentials returned, but were weaker.

Thus the normal tone of the tongue muscles and the potentials associated with it are reflex in nature and closely associated with the lingual nerve centers. Proprioceptor impulses from the tongue muscles pass into the central nervous system, causing tonic excitation of the centers controlling the tongue muscles.

SUMMARY

The tonus of the tongue muscles was studied in animals. Experiments were performed on anesthetized cats. The tongue was stretched with weights ranging from 20 to 30 g. Reaction of the tongue to stretching was registered by a cathode ray oscillograph. It was established that the more the tongue is stretched, the greater its electric activity i. e. the more pronounced the proprioceptive reflex of stretching. Section of hypoglossal nerves destroys the tonus of the tongue muscles "at rest", as well as proprioceptives reflexes to stretching.

LITERATURE CITED

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** Russian Translation.