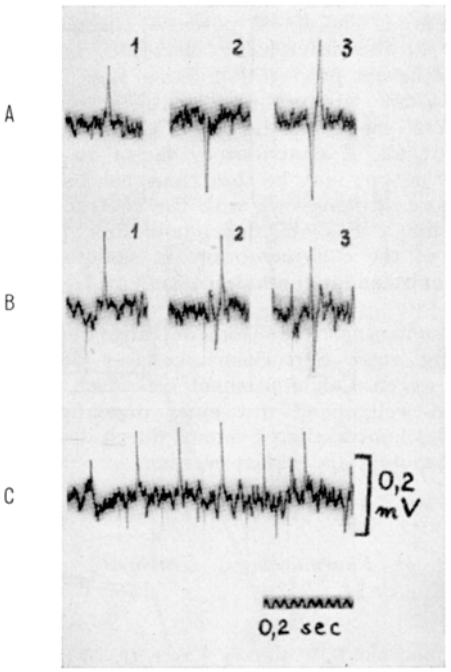
Modifications of the Vestibular Nerve Activity by Stimulation of the Efferent Vestibular System

The efferent fibres inside the vestibular nerve were histologically demonstrated by numerous authors[1-9]; these fibres rise from the ipsilateral and contralateral groups of cells, close by the Deiters nuclei. The problem of the function of these fibres is still to be solved.

Experimental. All experiments were performed on normal adult cats (20 animals weighing from 2 to 4 kg). Ether anaesthesia was used during the early stage of the experiment; tracheotomy was undertaken for tracheal cannulation; both bullas were visualized and opened to put in a cotton plug imbibed with physiological solution. The occipital bone was then removed and the cerebellum suctioned out to reveal the floor of the fourth ventricle and the vestibular nerves coming out of the internal auditory meatus. The recording of the electrical discharges of the vestibular nerve was made in the awake animals, immobilized by curarization (2 mg/kg) and supplied with controlled respiration. The different steel electrode (30–40 μ) was then placed upon the vestibular nerve and controlled by a micromanipulator. The indifferent electrode was fixed in the frontal bone. Standard apparatus for recording was used. The cotton plugs placed in the bullas were connected with an electrical apparatus in order to stimulate the labyrinth by means of galvanic current at different intensity varying from 0 to 0.2 mAmp. In this manner the location of the electrode exactly upon the vestibular nerve fibres is controlled. The nuclear contralateral region was stimulated by means both of unipolar and bipolar concentric electrodes placed in the floor of the fourth ventricle close by the Deiters nucleus and orientated with a Horsley-Clarke stereotaxis apparatus. Electronic square-wave-stimuli were used, whose frequency, pulse duration and voltage output could be modified at will: the duration of each stimulus was from 0.1 to 1 msec and the magnitude from 0.5 to 4 V.



Patterns of spontaneous and evoked potentials in left vestibular nerve. Unanaesthetized and curarized cat. *A*: spontaneous potential; 1 positive monophasic spike; 2 negative monophasic spike; 3 diphasic spike. – *B*: evoked potential, obtained from stimulation with single electrical shocks applied to the right Deiters nucleus (artifacts downward); 1 positive monophasic spike, 32 msec after stimulation; 2 diphasic spike, with a small initial negative phase, 26 msec after stimulation; 3 diphasic spike, with the same amplitude of positive and negative phases, 32 msec after stimulation. – *C*: repeated stimulation (12 cps) shows repeated burst in unit from vestibular nerve, 32 msec after stimulation.

Results. It is well known that a spontaneous discharge can be recorded from the vestibular nerve[10-14]. Square-wave stimulation of the floor of the fourth ventricle, close by the Deiters nucleus, is generally followed by a monophasic, sometimes also biphasic spike, which is recorded from the vestibular nerve fibres of the contralateral side; the waveform and the voltage of these spikes are quite similar to the spontaneous ones (Figure). The latency between the square-wave stimulus and the recording of the evoked potential is 22–32 msec. The repeated stimulation (12 pulses per sec) demonstrated the constancy of this phenomenon. Square-wave stimulation of the nuclear vestibular area occasionally causes a decrease in the frequency of the spontaneous activity recorded from the contralateral nerve. In order to clarify this phenomenon further experiments are being carried on. The midline cutting of the floor of the fourth ventricle abolishes these phenomena.

Conclusions. The observations reported here demonstrate that the stimulation of the floor of the fourth ventricle, close by the area of the Deiters nucleus, elicits a discharge at the level of the contralateral vestibular nerve; sometimes a reduction of the spontaneous activity of the contralateral vestibular nerve can be demonstrated. These phenomena suggest that the events originating within the central nervous system may modulate, presumably through the vestibular efferent pathways, the activity of the vestibular apparatus even as far as the vestibular receptors.

Riassunto. La stimolazione elettrica della zona nucleare vestibolare in vicinanza del nucleo di Deiters (dove presumibilmente originano le fibre efferenti vestibolari) è seguita, dopo un periodo di latenza pressochè costante (22–32 msec), dalla comparsa di potenziali bioelettrici nel nervo vestibolare controlaterale.

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