Electromyographic Study on Various Brain Diseases Undergoing Operations

By

Tomoki Komiyama
(小宮山 知己)

From the Department of Surgery, Tohoku University, Faculty of Medicine, Sendai. Director: Prof. S-T. Katsura

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Studies of E.M.G. have made a great advance recently\(^1,2\). It has become evident that the E.M.G. is significant for the diagnosis of diseases on the lower motor neuron. Clinical application of E.M.G. on disease of the upper motor neuron is, however, not clarified. Sargent\(^3\) expressed that E.M.G. has only diagnostic significance on disease of the lower motor neuron. It is conceivable that some abnormal findings will be detected on disease of the upper motor neuron by E.M.G.

The author made an electromyographical study on cerebral disease exemplify its diagnostic significance.

EXPERIMENTAL

Materials and Method

5 cases of brain tumors, 2 cases of cerebral trauma, 4 cases of cerebello-pontine tumor, 3 cases of hydrocephalus and 4 cases of cerebral abscess were examined. E.M.G. from the extremities were recorded by a concentric needle electrode with an oscillograph equipped with a R–C 4 stage amplifier and plate electrode with an ink-writing electroencephalograph, at rest, during passive extension, voluntary contraction and on foot. The pattern of wave and fluctuation of the impulse interval of single motor unit was observed. According to the pathology of the patient, various changes were observed on the E.M.G.

Results and Discussion

Spontaneous discharge at rest and during passive extension

5 cases showed spontaneous discharge at rest. The waves had an amplitude over 200 \(\mu\)V, and impulse interval was relatively stabilized as in normal wave (Fig. 1). These findings are obviously different from fibrillation voltage or fasciculation voltage which appears in case of disease.
with motor neuron. 7 cases showed discharge during passive extension. The E.M.G. showed normal waves, which can be regarded waves due to severe spastic paralysis. The difference of the wave due to localization of the tumor could not be recognized.

**Synchronization voltage**

Abnormal E.M.G. which showed synchronization voltage was seen in 2 cases of cerebral tumor and one case of trauma to the brain during active contraction. The wave showed spike discharge with large amplitude 2-3 mV. Even at maximum contraction, it didn’t show interference voltage, but was recognized as single oscillation (Fig. 2). The amplitude showed waning and waxing (Fig. 3), and simultaneous charge (Fig. 4). From the above findings, the E.M.G. can be regarded as synchronization...
Synchronization voltage is said to appear only in case of destruction and degeneration of cells in the anterior horn in the spinal cord.

It is interesting that it was demonstrated in patients with cerebral diseases. 2 of 3 cases had tumors in the temporal lobe, and one was suffering from depression fracture of the skull of the temporal region. Both showed compression to the motor area. Clinical symptoms of motor paresis were shown in both cases, whereas hemiplegia due to bleeding into the internal capsule didn’t show synchronization voltage. Therefore, it seems that there is no direct relationship between the pathology of subcortical pyramidal tract and synchronization. Synchronization voltage which occurs in case of cerebral disease may appear only when the cortical motor area is compressed. This phenomenon is not only interesting to consider the mechanism of synchronization voltage, but also has diagnostic significance.

**Grouping voltage**

7 cases among those with cerebellar tumor, cerebellopontine tumor and hydrocephalus showed grouping voltage during voluntary contraction. All showed cerebellar ataxia. Grouping voltage was determined not only from the wave, but also from measuring the approach of spike discharge from different motor unit by Kawamura’s method. The degree of grouping and strength of motor ataxia was found in parallel, while in those with motor paresis, grouping voltage was never found. It seems that grouping voltage is an important electromyographic finding in cerebellar ataxia.

**E.M.G. during standing**

According to the observations of E.M.G. of the lower extremities during standing, those patients with cerebellar ataxia showed participation of muscles which did not work in healthy persons. Action potentials of the muscle were not stabilised. E.M.G. was changeable in case of Romberg’s syndrome (Fig. 6).
Fig. 5. Cerebellar tumor. M. flexor carpi radialis. Grouping voltage is seen during active contraction.

Fig. 6. Electromyogram on foot, taken by 8 elements ink writing electromyograph.

Fluctuation of the impulse interval of single motor unit

In those patients with motor paresis, the impulse interval are usually stabilized, while in those with motor ataxia, it fluctuates extensively. Grouping voltage and the interval discharge have a close relationship as being pointed out by Kawamura during the electromyographic observation in Graves' disease6).

CONCLUSION

Various abnormal findings in E.M.G. were recognized in those patients with disease of the upper motor neuron. The author believes that the diagnostic significance of E.M.G. will increase with future studies.

References

5) Buchthal & Clemmesen, ibid., 1943, 18, 377.