Studies on Neuromuscular Disorders
Histochemical Study on Human Voluntary Muscles

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In electromyographic study in myasthenia gravis, two groups of NMUs were demonstrated in EMG recorded from the myasthenic deltoid muscle during voluntary contraction. One is the group of NMUs with low amplitude and relatively regular intervals, showing tendency to wane during voluntary contraction, while the other is NMUs with high amplitude and irregular intervals, without tendency to wane.

On the other hand, it is well known that the mammalian voluntary muscles contain two groups of fibers, red and white fibers, which have different physiological and biochemical properties.

In view of these facts, histochemical study on various human voluntary muscles were performed in our laboratory in relation to the muscular involvement in myasthenia gravis.

Materials and Methods

Extraocular muscles, M. lingualis, M. thyreoides, M. omohyoid, M. Intercostalis, Diaphragm, M. Deltoides, M. Biceps, M. Triceps and M. Quadriceps obtained from autopsied materials without evidence of neuromuscular disorders were studied.

Neotetrazolium method according to Rutenberg and Seligman for succinic dehydrogenase activity and Sudan Black B staining for lipid were employed.

The diameter of each muscle fibers were measured at the same time.

Results

1. Most human voluntary muscles were composed of two groups of fibers. The fibers which have high activity of succinic dehydrogenase are also rich in lipid and uniformly small in diameter. The fibers which showed only slight activity of succinic dehydrogenase contain only small amount of lipid and are larger in diameter.

2. The human external ocular muscles, most frequently involved initially in myasthenia gravis, mostly consisted of white fibers of low succinic dehydrogenase activity and larger diameter.

3. The diaphragm and intercostal muscle, involved rarely in myasthenia gravis at the onset contain only one third of white fibers in the total muscle.

4. The skeletal muscles such as M. deltoideus, biceps, triceps and quadri-
cephs ranked between external ocular and respiratory muscles in the ratio of white or enzymatically hypo-active fibers to red or enzymatically high active fibers. The histochemical pictures in human muscles are correlated with the frequency of involvement of myasthenic symptoms at the onset of the disease.

5. The situation of the tongue muscle is rather unique. This muscle consisted of uniformly highly active red fibers, which are quite different from those seen in other muscles in histochemical reaction and diameter.

Comment

The histochemical study on human voluntary muscles, in addition to the electromyographic study previously reported, suggested that the white muscle fiber is more easily affected by myasthenic block than the red fiber. Such a difference in pathophysiological properties between white and red fiber was also demonstrated in pharmacological study of Zaimis.

We would like to conclude, therefore, that the pattern of each muscles in ratio of white and red fiber characterized the clinical feature of myasthenia gravis.

References


Discussion

Dr. Misonou: About a decade years ago, I have observed tetrazolium reaction (by use of TTC) of vaginal smears, and found two types of reactive cells in cancerous cases. One is tumor cell itself and the other is possibly wandering phagocytes which contain lipid granules. However, this reaction is not specific for cancer. I would point out that formazan granules not always indicate the sites of dehydrogenase reaction, and especially one must be cautious to the existence of lipids.

Dr. Ogawa:

1) For dehydrogenase reaction, early tetrazoliums such as NT, BT are not suitable because of solubility of their formazan into lipids. It is desirable to use nitro-BT as a hydrogen acceptor and to fix the tissues before incubation.

2) Kull's acid fuchsine method and Mallory's PTAH method are preferable for mitochondria stain. Sudan black B staining is not specific for mitochondria.

Dr. Mozai:

It may be not appropriate to use early NT for succinic dehydrogenase reaction. Hereafter, we will use nitro-BT. Sudan black B does not specifically stain mitochondria but phospholipids are much contained in mitochondria.