# THE RELATIONSHIP OF THE LATENT PERIOD OF EVOKED POTENTIALS IN THE GYRUS SUPRASYLVICUS MEDIUS AND GYRUS LATERALIS PARS ANTERIOR TO THE INTENSITY OF PERIPHERAL STIMULATION

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In the present work we report the results of a study of certain properties of potentials induced in the gyrus suprasylvicus medius and in the gyrus lateralis pars anterior. It is known that large potentials may be recorded from these areas, and that they have a long latent period; they are evoked by stimulation of peripheral nerves of animals under chloralose anesthesia [2, 4], in unanesthetized curarized animals [6, 8], and in unanesthetized animals bearing indwelling recording electrodes [53]. However, it is extremely difficult to record these potentials under nembutal anesthesia [5].

We have set out to determine first of all changes in the latent periods of the large potentials in relation to the intensity of peripheral stimulation. This problem has been solved by many authors [3, 10, 11] for the g. sigmoideus posterior. We have shown that these changes in the latent period of the evoked potentials also occur in the g. suprasylvicus med. and the g. lateralis pars ant. when large electrodes are used; we have not been able to show that this is so for the posterior sigmoid varus.

## EXPERIMENTAL METHOD

Acute experiments were carried out on ten adult cats. During the operation and the whole of the experiment the animals were maintained under anesthesia induced by 50 mg/kg of chloralose. The skull was opened on one side by the usual method, a tracheotomy was performed and an intravenous cannula introduced. Preparations were made of the cutaneous and muscular branches of the radial nerve of the opposite limb, which were placed in external stimulating electrodes so arranged as to prevent the nerves from drying up and protect them against cold during the experiment. The dura mater was opened immediately before the potentials were recorded. Under the influence of 2 mg/kg intravenous flaxedil the animals remained motionless, and artificial respiration was applied. Normal body temperature was maintained by a heater throughout the whole of the experiment. Square-wave electrical stimuli of duration 0.3-0.9 mseconds were applied to the cutaneous and muscular branches of the radial nerve. The intensity of the stimulating current varied from 0.02 to 0.8 ma. Stimuli were applied through a grounded transformer. The potentials were picked up by silver electrodes. The spontaneous EEG was recorded on an "Al'var 15-channel ink – writing electroencephalograph; the evoked potentials were recorded photographically on the screen of a 5-channel Krzhizhik oscilloscope. During the whole of the experiment the cerebral cortex was kept moist by warm Ringer.

## EXPERIMENTAL RESULTS

By stimulating of the superficial and deep branches of the radical nerve we produced and studied the properties of the evoked potentials in the cortex recorded from the medium suprasylvian gyrus and the anterior lateral gyrus.

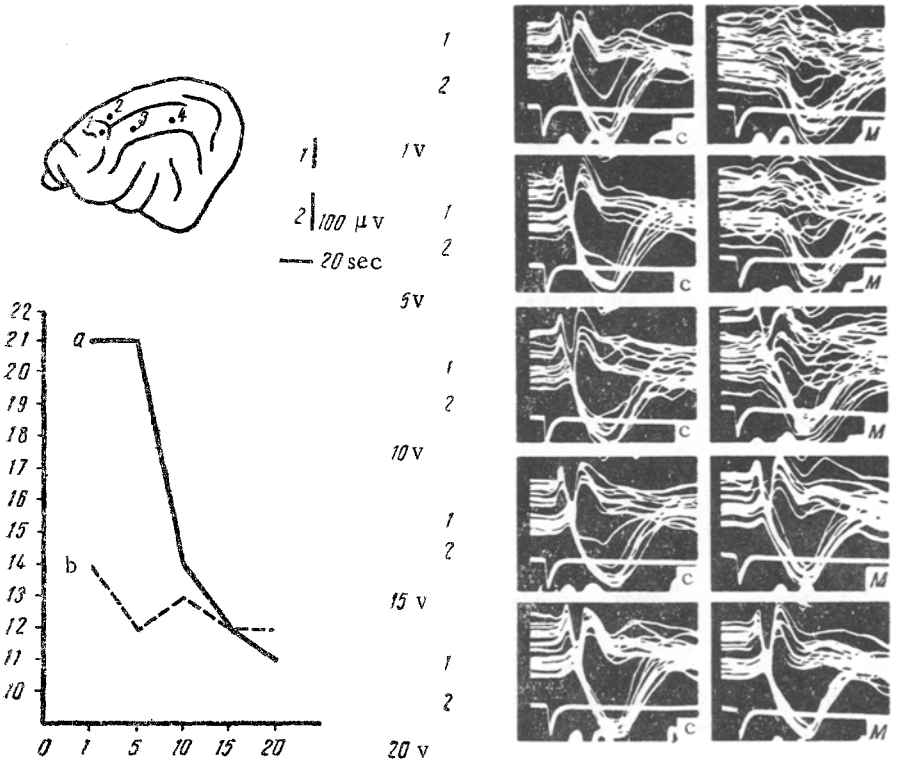


Fig. 1. Relationship between the latent period of the evoked potentials and the anterior part of the lateral gyrus to intensities (1-25 v) of peripheral stimulation of the cutaneous (c) and muscular (m) branches of the radial nerve; the relationship is shown in the graph (left lower part of the picture). Points 1, 2, 3 and 4 on the diagram of the brain indicate the sites of the recording electrodes. Abscissa – strength of stimulus pulse (in v); Ordinates – duration of the latent period of the evoked potentials (in mseconds); a) muscular branch; b) cutaneous branch.

As can be seen from Fig. 1, on stimulation of the muscular branch (m) with electrical impulses of increasing intensity (from 0.1 to 25 v) there was a marked reduction of the latent period of the positive phase of the high-voltage potential recorded from the anterior part of the lateral gyrus. The latent period of potentials obtained from the same portion of the cerebral cortex in response to stimulation of the cutaneous branch of the radial nerve (c) showed practically no change.

Figure 2 shows this relationship also but for another part of the cerebral cortex. The length of the latent period in the medial suprasylvian gyrus is influenced by the intensity of the stimulus. It is much greater when the radial nerve is stimulated. These changes in the latent period of the high-voltage positive phase of the electrical cortical response of the cerebral hemisphere to electrical stimulation varies from 0 to 2 mseconds on stimulation of the cutaneous branch, and from 5 to 10 mseconds on stimulation of the muscular branch of the radial nerve.

The curve showing the relationship of the latent period of the high-voltage positive oscillation to the intensity of the peripheral stimulus when records were made from the medium suprasylvian and the anterior part of the lateral gyrus is usually not continuous but shows breaks (see Fig. 2). From the same figure it can be seen that after a certain intensity of electrical stimulus there is no further shortening of the latent period.

Roitbak [1] summed up the results of experiments concerning the relationship between the intensity of peripheral stimulation and cerebral evoked potentials, pointing out that increase of peripheral stimulation causes a greater amplitude of the positive potential and an increase of the extent of the region from which potentials may be obtained. He describes no alteration of the latent period of these potentials in relation to increase of peripheral stimulation; we too, failed to record any more marked changes in the latent period in the primary projection region (posterior sigmoideus gyrus).

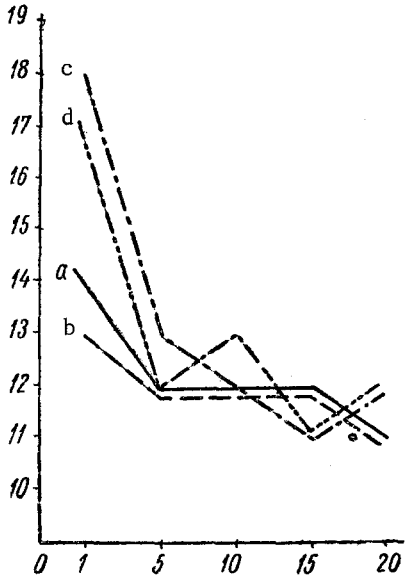


Fig. 2. Relationship of the latent period of evoked potentials in the anterior (see point 3 of Fig. 1) and posterior (see point 4 in Fig. 1) zones of greatest evoked activity in the medial suprasylvian gyrus stimulation of the cutaneous (ab) and muscular (cd) branches of the radial nerve. Abscissa – Stimulus (in v); Ordinate – Duration of latent period of evoked potentials (in mseconds); a) posterior zone; b, c) anterior zones.

Nevertheless we do not consider that we have established any fact contradicting the results obtained by certain authors by means of a large electrode [3, 12]. They found various changes in the latent periods of the discharges of single neurons in the posterior sigmoid gyrus, changes which were related to the intensity of peripheral stimulation. In one group of cells the latent period of the discharges showed scarcely any change, whereas in others it altered considerably. Of course, with the recording technique we use it was impossible to observe the fine changes in the latent period of individual neurones in the posterior sigmoid gyrus because the ultimate potential recorded by a large electrode is the algebraic sum of the activity of a large number of neurons. However, the trend of the changes in the latent period recorded by a large electrode in the anterior part of the lateral gyrus and the medial part of the suprasylvian gyrus indicates that here too the relationships differ from those found in the posterior sigmoideus gyrus.

The question arises as to whether the reduction of the latent period of the evoked potential recorded by a large electrode can be interpreted in general to changes in the intensity of peripheral stimulation. A local excitation and a corresponding local potential develops in the cell bodies of the neurons of the cerebral hemispheres under the influence of afferent impulses [1]. It is known that very strong electrical stimuli affect a large number of fibres of a peripheral nerve; this leads to an increase of afferent impulses and, consequently, to the development of a very strong local excitation in cortical neurons. Evidently a very strong peripheral afferent stimulation will cause the cortical neutrones to reach the level of excitation necessary for their discharge much earlier than will a less powerful stimulation. Consequently, the strength of the peripheral stimulus will also affect the length of the latent period of the evoked potential recorded by a large electrode. However, the increased local excitation produced by increased peripheral stimulus may proceed only up to a certain limit.

We may suppose that the changes of local excitation of cortical neurones brought about by variations of peripheral stimulation are not identical in all cortical regions irrespective of which analyzers are stimulated. On these lines we may to some extent explain the different changes of the latent period of the evoked potentials in the suprasylvian gyrus and the anterior part of the lateral gyrus in response to stimulation of the cutaneous and muscular branches of the radial nerve.

In studying this problem we cannot ignore the results of Lloyd [9] and Grbek. According to Lloyd, in the muscular branches groups of Ia and Ib they do not occur at all in the cutaneous branches. On the other hand the II group of fibers are found primarily in the cutaneous branches, and far fewer are present in the muscular branch. Group III nerve fibres may be found both in the muscular and in the cutaneous branches of peripheral nerves. According to Grbek the cortical field of the propriocective analyzer is exceptionally sensitive to the action of anesthetics. Evoked cortical potentials in response to stimulation of muscular receptors appear usually only in unanesthetized curarized preparations. The authors conclude that Mountcastle has failed to establish a cortical projection of the Ia and Ib system of nervous afferents for the very reason that they worked with anesthetized animals.

Therefore, taking into account the data of Lloyd and Grbek we may suppose that the evoked potentials which we recorded from the suprasylvium gyrus and from the anterior part of the lateral gyrus represent a response to peripheral stimulation only of the II and III groups of afferent nerve fibres. The smaller number of Group II afferent fibres in the muscular branches may be related to the smaller changes of the latent period of evoked potentials recorded from the medial suprasylvium gyrus and from the anterior part of the lateral gyrus in response to increasing the stimulation of peripheral nerves.

## SUMMARY

Acute experiments were carried out on anesthetized adults cats. We studied changes in the latency of the positive phase of high-voltage evoked potentials recorded from the medial suprasylvian gyrus and from the anterior part of the lateral gyrus, and their dependents on the intensity of peripheral stimulation.

We found that:

1) During electrical stimulation of the muscular branch of the radial nerve increase in intensity of the stimulus leads to a shortening of the latency of the positive stage of evoked potentials recorded from the medial suprasylvian gyrus and the anterior part of the lateral gyrus.

2) Variation in the latency of evoked potentials recorded from any given area of the cat brain under constant conditions of stimulation of the cutaneous branch of the radial nerve is practically negligible.

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