

# INVESTIGATION OF EVOKED POTENTIALS TO PHOTIC STIMULATION IN MAN AFTER DEAFFERENTATION OF THE VISUAL CORTEX

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Evoked potentials (EPs) to photic stimulation in the occipital cortex were investigated in 28 patients with homonymous hemianopia caused by a focal lesion of the visual system. Asymmetry of the EPs in the two hemispheres was recorded only in cases of complete homonymous hemianopia. A reduction in the response on the side contralateral to the hemianopia was observed in patients with lesions of the visual pathways at the level of the optic tract and as a result of the spread of the pathological focus to the occipital lobe. In patients with a lesion affecting predominantly the mediobasal zones of the temporal lobe and with homonymous hemianopia caused by a lesion of the optic radiation, responses in half of the cases were higher in amplitude on the side of the focus or were recorded only in the deafferented occipital region.

KEY WORDS: evoked potentials in man; visual cortex; lesion of the visual pathways.

In focal lesions of the visual system in man various types of changes in the evoked potentials (EPs) are recorded. Some workers have found an increase in the latent period and a decrease in the amplitude of components of the EP on the side of the lesion [2, 10, 12-14]. In the opinion of other workers, the amplitude of the response in homonymous hemianopia may be either lower or higher on the side of the lesion, with ill-defined changes in the latent period [3, 6, 11].

This paper describes an attempt to discover the relationship between changes in EPs and disturbances of the flow of afferent impulses into the cortex when blocked at different levels.

## EXPERIMENTAL METHOD

EPs to photic stimulation were investigated in the occipital cortex of 28 patients with homonymous hemianopia. In 21 patients examination of the visual fields revealed complete and, in certain patients, incomplete homonymous hemianopia. The visual acuity was 1 in both eyes in 12 patients, from 0.4 to 0.9 in nine patients, and reduced to 0.2-0.02 in one or both eyes in only seven patients. On the basis of observations at operation and the results of contrast methods of investigation the level of the lesion in the optic pathway was established. Changes in the visual fields of 16 patients were due to tumors, in five patients to trauma, in four patients to vascular lesions, and in three to inflammatory disorders. The EPs were recorded by a monopolar method on the "Medicor" 8-channel electroencephalograph. EPs were recorded and analyzed simultaneously at two symmetrical points of the occipital cortex ( $O_1$  and  $O_2$  according to the International 10-20% scheme). Flashes were applied to the open eyes from a "Medicor" photosimulator at intervals of 2 sec. The duration of the flashes was 10 msec and their intensity 0.045 J/flash. The lamp was placed 30 cm from the subject's eyes. EPs were isolated with the aid of the "Ritm" analogue-to-digital instrument, designed by the Computer Research Institute (NIIschetMASH) by the synchronous accumulation method. In each series 30 responses were aggregated.

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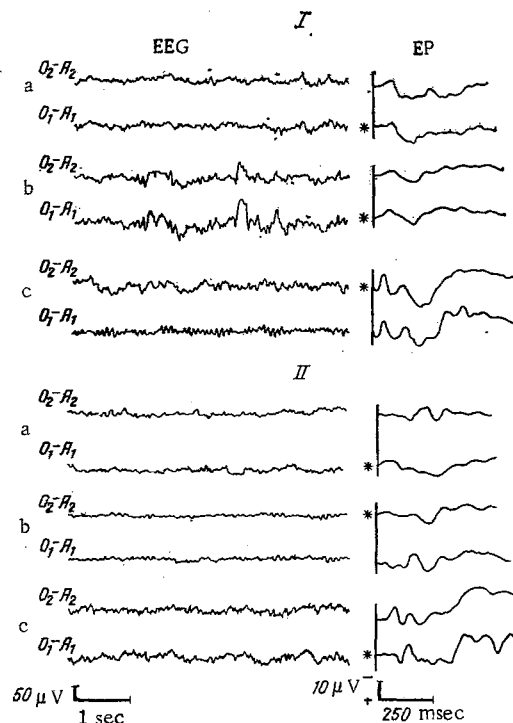


Fig. 1. EPs of occipital cortex in patients with homonymous hemianopia: I) incomplete homonymous hemianopia; II) complete homonymous hemianopia with lesion of optic tract;  $O_2-A_2$  right,  $O_1-A_1$  left occipital region; a, b, c) different patients. Deafferented occipital region marked by asterisk.

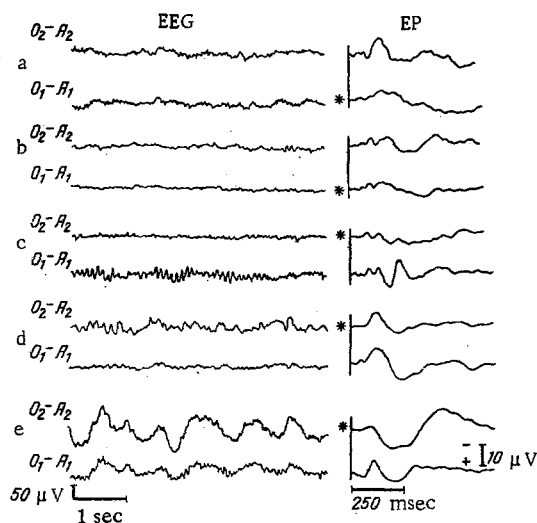


Fig. 2. EPs in patients with complete homonymous hemianopia due to a lesion spreading to the occipital lobe: a, b, c, d, e) different patients. Remainder of legend as in Fig. 1.

## EXPERIMENTAL RESULTS

Tests on healthy subjects showed that the configuration and also the amplitude and temporal parameters of components of the EPs to photic stimulation varied considerably in different parts of the cortex from one subject to another [1, 4, 5, 7, 9]. However, at symmetrical points of the cortex EPs were re-

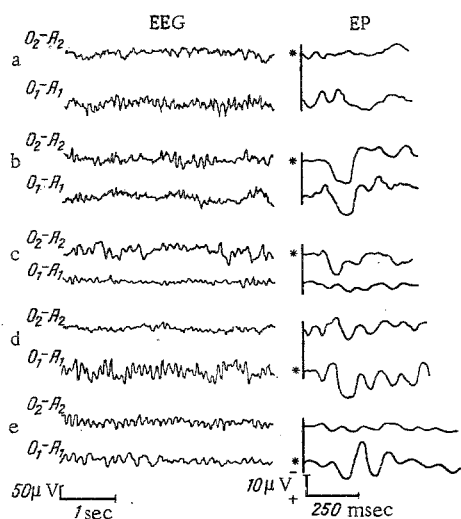


Fig. 3. EPs in patients with complete homonymous hemianopia due to a lesion of the optic radiation. Legend as in Fig. 2.

With a different form of manifestation, the EPs registered without distinct asymmetry as to hemispheres. This pertains to both the late (Fig. 1, I, a, b) and early (with a latent period up to 100 msec; Fig. 1, I, c) components of the response.

In patients with complete homonymous hemianopia the EPs in the occipital cortex were asymmetrical in character, to an amount that depended on the level of the block to the visual impulses. Absence of the EP, a decrease in the amplitude of its components or of the response as a whole, and an increase in the latent period on the side of lesion were found in patients with hemianopia due to a lesion of the optic tract (three patients) and when the pathological process spread to the occipital lobe (eight patients). The EEGs and EPs of three patients with tract hemianopia are given in Fig. 1: II. No marked asymmetry is observed in the EEGs of the occipital cortex, whereas the EPs are obviously different at symmetrical points. In the deafferented hemisphere either no EP is recorded (Fig. 1: IIa), or the early components of the response are absent (Fig. 1: IIb, c). In one patient (Fig. 1: IIb) the amplitude of the later waves of the response also was reduced.

In patients with a local brain lesion spreading to the occipital lobe distinct asymmetry of the EPs also was observed even if no clear difference was present on the EEG (Fig. 2a, b). The response was either absent (Fig. 2a) in the affected hemisphere, the amplitudes of all components of the EP were reduced (Fig. 2b, c), or the early waves of the EP were absent (Fig. 2d, e).

In patients with homonymous hemianopia due principally to a lesion of the optic radiation (10 patients) the changes in the EP on the side of the pathological process were inconsistent. EEGs and EPs recorded from the occipital cortex of patients with a lesion of the optic pathway at the level of the optic radiation are given in Fig. 3. Although severe pathological changes in the EEG waves were absent in all these patients on the side of the lesion, the EPs on the affected side varied in appearance. Reduction of the response or absence of its early waves was observed in two patients in the deafferented occipital region (Fig. 3a, b). In the other three patients the response was clearly visible on the side of the lesion, whereas in the "healthy" hemisphere it was lower in amplitude (Fig. 3d) or absent (Fig. 3c, e). In these patients in response to photic stimulation regular activity with a frequency of 8-10 Hz was recorded. The appearance of this regular activity in the affected and sound hemispheres was observed chiefly in patients with a lesion involving the mediobasal zones of the temporal lobe.

The investigation of EPs to photic stimulation in patients with homonymous hemianopia thus demonstrated great variability in the shape of the EPs and also in the temporal and amplitude parameters of the response. The responses were asymmetrical in the occipital regions of the cortex of these patients only if homonymous hemianopia was complete. Reduction of the EPs on the side of the lesion was observed in patients with hemianopia due to a lesion of the optic tract and if the pathological process spread to the occipital lobe. No direct correlation was found between reduction of any particular wave of the response and the presence of homonymous hemianopia in the patient. In local lesions, predominantly in the mediobasal zones of the temporal lobe, in half of the cases the EP was more clearly defined on the side of the lesion and it was accompanied by the appearance of regular activity in both hemispheres with a frequency of 8-10 Hz.

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