LATENT PERIOD OF BLINKING REFLEXES IN MAN IN RESPONSE TO STIMULATION OF THE EYES BY A JET OF AIR

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UDC 612.833.847

The blinking reflex in response to stimulation of the eyes by a jet of air was recorded electromyographically. The latent period (LP) of the blinking reflex is independent of the position of the recording electrodes (upper eyelid, lower lid, outer angle of the eye). In experiments on 18 healthy subjects, in response to simultaneous stimulation of both eyes the LPs on the left and right sides were practically equal. During simultaneous stimulation of both closed eyes the LPs were shorter than during stimulation of both open eyes.

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The evoking of blinking reflexes by stimulation of the cornea of one eye is accompanied by a response on both sides. Results indicating that during stimulation of the cornea of one eye the LP of the blinking reflex on the opposite side is lengthened on the average by 4-6 msec have been described [3, 4]. This delay may be due to slowing of the conduction of afferent stimuli on account of their passage along commissural fibers. This hypothesis is all the more likely to be correct because investigations of the reaction time in man have shown that a period of 4-7 msec is required for passage of an impulse along the commissural systems [1, 2].

However, delay of the response on the unstimulated side could be a result of functional asymmetry of the cerebral hemispheres. It therefore seemed more rational to carry out experiments in such a way that, besides determining LP on the stimulated and unstimulated sides during unilateral stimulation, the LPs of the blinking reflexes were also determined during simultaneous bilateral stimulation.

To obtain reliable data concerning the duration of LP of the blinking reflexes, a method of evoking them had to be used which would enable the stimulus to be applied repeatedly and also allow a larger number of observations to be made. The LPs of blinking reflexes are characterized by considerable variability, from 40 to 100 msec [4]. A method which satisfies this condition is the use of a jet of air as the active stimulus. When a jet of air is used, the stimulation extends not only to the cornea, but also to a region including the conjunctiva, eyelids, and eyelashes. This being so, the LP of the response to stimulation of the open eyes must differ from the LP of the response to stimulation of the close eyes.

Since in these experiments differences in the LPs may be measured in milliseconds, it is essential to determine whether the duration of the LP is influenced by the location of the recording electrodes used to record the electromyogram (EMG) of the circular muscle of the eye.

The object of this investigation was to determine the LP of blinking reflexes to stimulation of both eyes simultaneously, and to stimulation of one eye, and to compare these LPs with the eyes open and closed.

EXPERIMENTAL METHOD

Blinking reflexes were evoked by application of a jet of air from a specially constructed apparatus. The jet stimulus was applied unexpectedly for the subjects, in the absence of any other external stimuli.

The blinking reflex was evoked with the eyes open and closed. During simultaneous stimulation on both sides, a pressure drop of 2.6 mm Hg was produced on each of them, while during stimulation of the right or left side only, the pressure drop was 4.6 mm Hg.

Academician N. N. Burdenko Research Institute of Neurosurgery, Academy of Medical Sciences of the USSR, Moscow. (Presented by Academician of the Academy of Medical Sciences of the USSR A. I. Arutyunov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 69, No. 2, pp. 16-19, February, 1970. Original article submitted August 28, 1969.

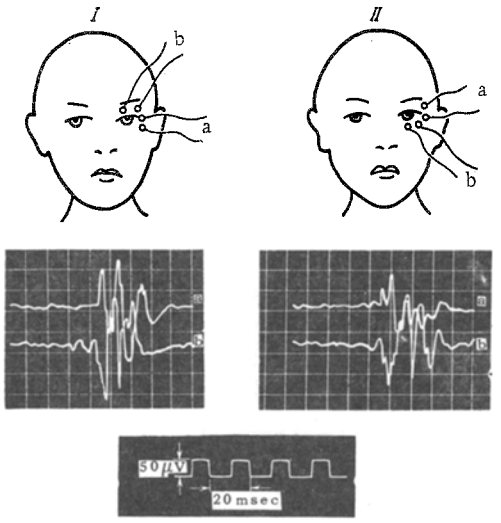

Fig. 1. LPs of response to stimulation of eye with a jet of air (scheme of experiment and EMG). I) Recording electrodes located near outer angle of eye (a) and on upper eyelid (b); II) near outer angle of eye (a) and on lower eyelid (b).

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The reflex was recorded electromyographically. The EMG was recorded with tin percutaneous electrodes, amplified by a standard UBP-02 amplifier, and fed into a dual-beam C1-18 CRO, working under quiescent conditions. The electrodes were placed on the outer angles of the left and right eyes. Scanning was started by a trigger device ensuring simultaneous application of the stimulus and starting up of the CRO. The time before the appearance of the first response on the EMG was taken as the LP. The accuracy of measurement was ±1 msec. Stimuli were applied in subjects rested for 1-2 min between each successive series of stimuli. The subjects were 18 healthy individuals aged from 18 to 40 years (12 men and 6 women, all right-handed.)

Only those EMGs in which the LP could be definitely determined were selected for statistical analysis.

EXPERIMENTAL RESULTS

In a preliminary series of experiments, an attempt was made to discover whether the LP depends on the location of the recording electrodes. For this purpose the EMG was recorded with the recording electrodes on the upper eyelid, the lower eyelid, and in the region of the outer angle of the eye. The scheme of the experiment and some typical results are shown in Fig. 1. It is clear that the circular muscle of the eye is stimulated in all parts simultaneously. The location of the recording electrodes thus has no effect on the accuracy of measurement of the LP.

The EMG of the blinking reflex during simultaneous stimulation of both eyes is shown in Fig. 2a. In this case the LPs were practically identical. The picture was different when stimulation was unilateral. The recordings given in Fig. 2 show that the LP of the blinking reflex is shorter on the stimulated side than on the opposite side (Table 1). In most cases these differences in LP duration amounted to 6-8 msec (from 4 to 30 msec).

In the next series of experiments the duration of the LP of blinking reflexes when the closed eyes were stimulated was compared. As in the previous series, the LPs of the blinking reflexes were determined during simultaneous stimulation of both eyes and during stimulation of the right or the left eye only. The results obtained do not differ in principle from those of series I.

Application of a jet of air to the closed eyes evoked the same type of blinking reflex as when the cornea was stimulated. LP on the stimulated side was shorter than on the opposite side. The fact was noted that LPs of blinking reflexes during stimulation of both closed eyes by the jet of air were shorter than LPs during application of the jet of air to the open eyes (Table 1).

The results obtained in these experiments indicate that during simultaneous stimulation of both eyes the LPs of the blinking reflexes on the left and right sides are practically indistinguishable. This suggests that functional asymmetry of the hemispheres does not therefore play a part. Confirmation of this hypothesis could be obtained by comparing LPs of blinking reflexes recorded in right-handed, left-handed, and ambidextrous persons.

The results of measurements of the LP during unilateral stimulation were in agreement with those described in the literature [3, 4]. Delay on the unstimulated side also took place when the stimulus was applied to the closed eyes. Delay of the response is independent of the side to which the stimulus was applied and is evidently determined by the time taken for the impulse to pass through commissural structures.

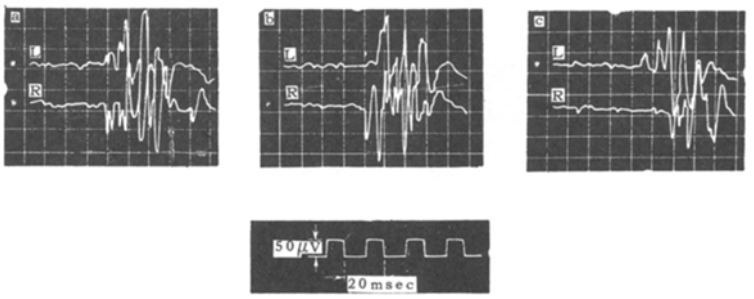

Fig. 2. Typical EMGs during stimulation of both eyes (a), and of the right (b) and left (c) eyes. Stimulated side denoted by *; L) left side; R) right side.

TABLE 1. Latent Period (in msec) of Blinking Reflex in Response to Stimulation of One or Both Open or Closed Eyes by a Jet of Air (M ± m)

Stimulated eye	Eyes open		Eyes closed	
	LP on right	LP on left	LP on right	LP on left
Both	52,7± 1,06 n=243	52,1± 1,23 n=244	39,05± 1,73 n=89	39,7± 1,64 n=90
Right	45,25± 0,9 n=218	52,8± 1,27 n=177	43± 1,6 n=79	51± 2,2 n=72
Left	50,05± 1,1 n=196	43,0± 1,0 n=219	49,0± 2,9 n=62	43,0± 2,19 n=62

Since the blinking reflex could be evoked with the eyes closed, this means that under ordinary conditions (stimulation of the open eyes) the receptor field consists not only of the cornea, but also of the eyelids and the base of the eyelashes. The cornea apparently possesses the more sensitive receptor apparatus than the skin of the eyelids. Yet the mean value of the LP in the case when corneal stimulation was excluded or, at least, was considerably reduced, i.e., when the jet of air was applied to the closed eyes, was much shorter than when the jet of air was applied to both open eyes. The shorter mean LP of the blinking reflex when the jet of air was applied simultaneously to both closed eyes could be explained by the fact that, under these circumstances, besides the usual LPs of the order of 30-70 msec, other responses with very short LPs of the order of 11-18 msec were observed. These responses, their LP, and shape, resembled the first component of the glabellar reflex [4].

LITERATURE CITED

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