ELECTROMYOGRAPHIC STUDY OF BLINKING REFLEXES IN PATIENTS AFTER INTRACRANIAL HEMORRHAGES

S. K. Guseinova

UDC 616.831-003.215.07:617.77-009.812-07:617.772-073.97

Blinking reflexes (the glabellar reflex and the reflex to a puff of air) in healthy subjects and in patients with intracranial hemorrhages were investigated electromyographically. Different types of disturbance of the blinking reflexes produced by a lesion of the brain stem were found in the patients: a severe disturbance of reflexes to a puff of air accompanied by mild changes in the glabellar reflexes; a disturbance of the glabellar reflexes accompanied by relatively normal reflexes to a puff of air; almost complete absence of glabellar reflexes and of reflexes to a puff of air.

KEY WORDS: cerebral hemorrhage; blinking reflex; electromyography.

An important place in the clinical picture of acute intracranial hemorrhages is occupied by symptoms caused by disturbances of brain-stem functions: disturbances of consciousness, pupillary and oculomotor disturbances, changes in muscle tone and reflexes, disturbances of respiration and the circulation. Disturbances of the blinking reflexes, whose arc is closed in the brain stem, are of great topical diagnostic importance [1, 4, 7, 9, 11]. However, visual assessment of the blinking reflexes usually does not reveal their fine disturbances and does not permit changes in the temporal characteristics of these reflexes to be established. Much more precise quantitative characteristics of the blinking reflexes can be obtained by an electromyographic method [1, 4].

The object of this investigation was to make an electromyographic study of blinking reflexes in patients with intracranial hemorrhages.

EXPERIMENTAL METHOD

Electromyograms (EMGs) of blinking reflexes in 10 healthy subjects (aged from 20 to 60 years) and 41 patients with intracranial hemorrhages of varied etiology (24 patients with head injuries, 15 with rupture of arterial and arteriovenous aneurysms of the brain, one with hypertension, one with a brain tumor) were analyzed.

Disturbances of consciousness of varied degree were observed in 25 patients: degree I corresponded to slight drowsiness or concussion, degree II to stupor; in degree III mental activity was completely absent but the response to nociceptive stimulation was intact; and degree IV was characterized by the absence of response to any stimulus and also by disturbance of the vital functions. Besides disturbances of consciousness, these patients also had pupillary and oculomotor disturbances and changes in muscle tone and reflexes.

Consciousness was undisturbed in the other 16 patients. However, they were found to have brain-stem symptoms in the form of spontaneous nystagmus, hyperreflexia of caloric nystagmus, and pyramidal signs. The EMG of the orbicularis muscle was recorded by bipolar disc electrodes fixed to the upper and lower lids of both eyes. The blinking reflexes to glabellar stimulation and to a puff of air were studied. A jet of air from a syringe was blown on to the cornea and lids. The glabellar reflex was evoked to tapping a metal

N. N. Burdenko 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. 78, No. 8, pp. 28-31, August, 1974. Original article submitted April 20, 1973.

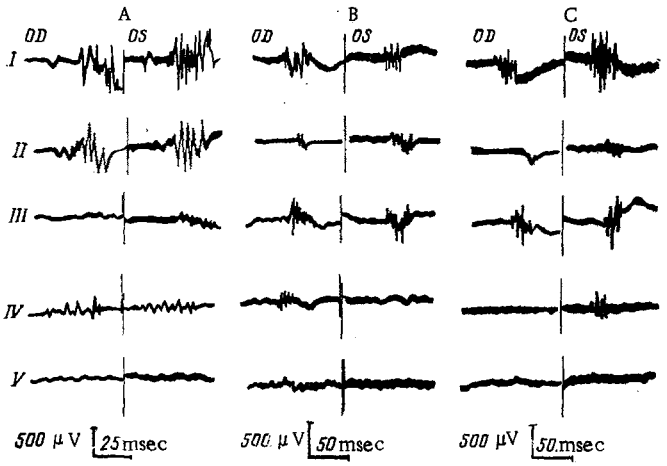

Fig. 1. EMG of blinking reflexes in patients in a comatose state: I) blinking reflexes unchanged; II) decrease in amplitude and duration of reflex to a puff of air; III) loss of the first component of the glabellar reflex, increase in the latent period and decrease in amplitude of the second component of the glabellar reflex; IV) loss of the companion reflex to a puff of air; V) absence of glabellar reflex and reflex to a puff of air; A) glabellar reflex; B) reflexes to a puff of air applied to the right eye; C) reflexes to a puff of air applied to the left eye.

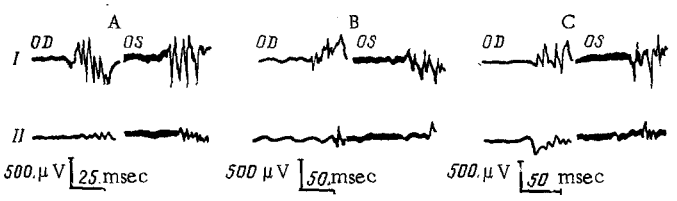

Fig. 2. EMG of blinking reflexes in patients with fluctuation of the level of wakefulness: I) disturbance of consciousness of degree I-II: first component of the glabellar reflex absent, reflex to a puff of air and second component of glabellar reflex unchanged; II) disturbance of consciousness of degree II-III: lengthening of latent period of reflex to puff of air and second component of glabellar reflex, decrease in their amplitude. Remainder of legend as in Fig. 1.

plate fixed above the bridge of the nose with a small hammer. Stimulation was synchronized with the operation of the recording apparatus. The blinking reflexes were recorded for 75-150 msec. Stimulation was applied at intervals of 15-20 sec. Each investigation consisted of a series of 20-25 stimuli.

EXPERIMENTAL RESULTS AND DISCUSSION

Analysis of the EMGs of the blinking reflexes of the healthy subjects showed that the glabellar reflex consists of two components. The first component had a latent period of 12-15 and the second of 20-40 msec. The latent periods of both components of the glabellar reflex under normal conditions were equal on the right and left sides. A difference between them was observed rarely and it did not exceed 4 msec. In some subjects the first component of the glabellar reflex was absent in 1-2 of 20 stimulations, but the second component was absent more often.

The reflex to a puff of air had a latent period of 40-69 msec. The latent period of the direct reflex to a puff of air (response on the side of stimulation) was shorter than the latent period of the companion

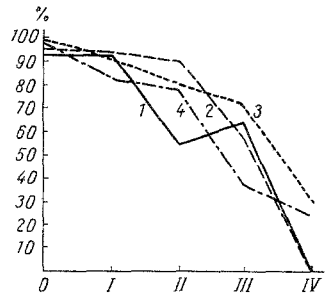

Fig. 3. Dependence of blinking reflexes on degree of disturbance of consciousness. Abscissa, degree of disturbance of consciousness; ordinate, percentage preservation of blinking reflexes: 1) first component of glabellar reflex; 2) second component of glabellar reflex; 3) direct reflex to a puff of air; 4) companion reflex to a puff of air.

reflex to a puff of air (response on the side opposite to stimulation). The difference between the latent periods of the direct and companion reflexes usually did not exceed 4-8 msec, but sometimes it reached 10-15 msec. The absence of a companion reflex under normal conditions was extremely rare. The amplitude of the direct reflex to a puff of air was 1.5-2 times greater than the amplitude of the companion reflex.

These data for the structure of the blinking reflexes agree with those published in the literature [3, 4, 6, 12].

In 10 of the 16 patients without disturbance of consciousness studied the EMG of the blinking reflexes was normal. In the remaining six patients the first component of the glabellar reflex was lost and the companion reflex to a puff of air disturbed (lengthening of the latent period or absence of response) more often than normally.

Changes in the EMG of the blinking reflexes in the absence of a lesion of the peripheral fibers of nerves V and VII point to a lesion of the brain stem [1, 3, 4, 9, 11].

Changes in the blinking reflexes observed in the patients examined also were probably due to a lesion of the brain stem. Some patients with disturbances of consciousness had normal EMGs of their blinking reflexes, others showed abnormal EMGs of various types. In the first type, mild changes in the glabellar reflexes were accompanied by a severe disturbance of reflexes to a puff of air. In the second type a severe disturbance of the glabellar reflexes was accompanied by relatively normal reflexes to a puff of air. The third type consisted of loss of the companion reflex to a puff of air whereas the direct reflex to a puff of air and the glabellar reflex were undisturbed. In the fourth type the glabellar reflexes and reflexes to a puff of air were almost completely absent. The most characteristic types of disturbances of the blinking reflexes are illustrated in Fig. 1.

The presence of these various types of disturbances of blinking reflexes in patients with brain-stem lesions can be explained on the basis of the known structure of the arc of these reflexes. Some workers [1, 2] consider that the afferent pathway of the first and second components of the glabellar reflex may be in either the trigeminal or the facial nerve. The afferent pathway of the arc of the second component of the glabellar reflex ends in the sensory nucleus of the trigeminal nerve, located in the tegmentum of the pons [10, 13]. The absence of the first component of the glabellar reflex in some cases may therefore indicate a lesion of the pons.

The reflex to a puff of air in these cases in disturbed if axons running to the cells of the long sensory nucleus of the trigeminal nerve, located in the dorsal zone of the medulla, and descending to the superior cervical segments of the spinal cord [9], are ruptured. The arc of the orbicular (superciliary) reflex may pass through the mesencephalic nucleus of the trigeminal nerve [8] and, consequently, this reflex will be disturbed in a lesion of the midbrain. A pathological process in the medulla causes a disturbance of the polysynaptic arc of the blinking reflexes because of damage to the spinal tract or the long sensory nucleus of the trigeminal nerve [7]. The existence of the various types of disturbance of the blinking reflexes observed in these patients presumably depends on the level and degree of involvement of the brain stem.

In the patients with a fluctuating level of wakefulness who were examined, in some cases a sharp decrease in amplitude or disappearance of the reflex to a puff of air and of the second component of the glabellar reflex was observed during electromyographic investigation (Fig. 2). The disturbance of the polysynaptic component of the blinking reflexes was evidently explained by disturbance of the function of the reticular formation. Around the nucleus of the hypoglossal nerve Rossi and Zanchetti [2] observed inhibition of the reflex to a puff of air. The late component of the orbicular reflex was completely inhibited in coma; this effect evidently depends on disturbance of the function of the reticular formation [8]. The polysynaptic component of the orbicular reflex depends on the level of wakefulness and the emotional state [5]. In a lesion of the brain stem the polysynaptic arc of the blinking reflexes is most often affected [1]. In the present investigation a tendency was observed for disturbance of the blinking reflexes to be more frequent if consciousness was more deeply disturbed (Fig. 3). A correlation thus exists between the depth of the disturbance of consciousness and the degree of disturbance of the blinking reflexes; this correlation is more

clearly revealed in the case of the polysynaptic component of the blinking reflexes. Disturbances of the blinking reflexes associated with disorders of consciousness are inconstant in character and highly variable; this effect evidently reflects the functional state of the structures of the brain stem. As the patient recovers from his comatose state, the blinking reflexes return to normal.

LITERATURE CITED

1. S. M. Blinkov, N. A. Smirnov, and T. L. Khomeriki, Vopr. Neirokhir., No. 1, 35 (1973).
2. G. F. Rossi and C. L. Zanchetti, The Reticular Formation of the Brain Stem. Anatomy and Physiology [Russian translation], Moscow (1960), p. 73.
3. T. L. Khomeriki, Variability of Blinking Reflexes under Normal and Pathological Conditions, Author's Abstract of Candidate's Dissertation, Moscow–Tbilisi (1970).
4. A. R. Shakhnovich, The Motor Apparatus of the Eyes under Normal Conditions and in Local Brain Lesions, Author's Abstract of Doctoral Dissertation, Moscow (1966).
5. E. Ferrari and C. Messina, Electroenceph. Clin. Neurophysiol., 3, 55 (1972).
6. E. Kugelberg, Brain, 75, 385 (1952).
7. J. Kimura, Strokes, 2, 576 (1971).
8. J. Kimura, Arch. Neurol. (Chicago), 22, 156 (1970).
9. L. W. Lyon and M. W. van Allen, Arch. Ophthalm., 87, 148 (1972).
10. J. Magladeri and R. Tiesdalle, Arch. Neurol. (Chicago), 5, 269 (1961).
11. N. S. Namerov and A. Etemadei, Neurology (Minneapolis), 1200 (1970).
12. G. Rushworth, J. Neurol., Neurosurg. Psychiat., 25, 93 (1962).
13. A. Stuppler and H. Dobbelstein, Nervenarzt, 34, 347 (1963).