Electrically Elicited Blink Reflex and Early Acoustic Evoked Potentials in Circumscribed and Diffuse Brain Stem Lesions

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1. Introduction and Objectives

Modern radiological investigation techniques permit an increasingly precise imaging of the brain stem and adjacent structures. The imaging of individual structures and their reconstruction in various planes reveals the presence of space-occupying processes, haemorrhages, structural alterations, oedematous swelling and substance defects as density differences or zones of different signal intensity. However, just like conventional X-ray methods, computer tomography and nuclear magnetic resonance tomography does not reveal the extent of a functional disorder in the transverse and longitudinal section of the brain stem. Besides clinical investigation, additional electrophysiological measures are necessary for this purpose. With the aid of these methods, neurological deficits and clinically latent disorders can be collated with pathological alterations in the brain stem. Since the electroencephalogram in brain stem lesions merely shows non-specific alterations, the registration of electrically elicited brain stem reflexes and evoked brain stem potentials have increasing significance, since their generators and connection pathways in the brain stem are known and circumscribed or diffuse functional disorders can be inferred from changes in these potentials. Their registration is simple, can be repeated as often as desired and is not a burden for the patient.

Whereas registration of early acoustic evoked potentials has attained increasing importance in neurological-neurosurgical conditions since the introduction of electronic averagers by Dawson in 1952, the blink reflex already analysed electromyographically in 1952 by Kugelberg as a very informative diagnostic criterion has hardly penetrated the consciousness of neurosurgeons.

In the present paper, the topodiagnostic value of early acoustic evoked potentials and the blink reflex will be illustrated with reference to a large number of conscious patients and patients with disturbances of consciousness. In addition, its significance in coma monitoring and as a prognostic criterion in patients in acute midbrain syndrome will be shown. Since the development of the acute midbrain syndrome can as a rule not be detected electrophysiologically under clinical conditions, in an experimental part of the study an acute elevation of supratentorial pressure with secondary incarceration of the midbrain was induced in a simulated epidural haematoma in cats. The alterations of the blink reflex and the acoustic evoked potentials occurring during the elevation of intracranial pressure allow an insight into the dynamics of the incipient disturbance of brain stem function which will be discussed in relation to literature data and our own clinical findings.

2. Historical Review

2.1. Blink Reflex (BR)

Overend in 1896 was the first to describe reflex muscular contraction of the orbicularis oculi muscle on tapping the glabella. Kugelberg analysed the reflex electromyographically in 1952. He was able to demonstrate two separate components in mechanical and electrical stimulation of the supraorbital nerve. Later, the reflex pathway was investigated experimentally in cats. The alteration of the late blink reflex response (R2) in humans was first described in medullary lesions, in damage to the descending nucleus of the trigeminal nerve and in pontine lesions. According to the investigations of other authors, the polysynaptic connections for R2 reached in the oral direction as far as the level of the nuclei of the facial nerve and in pontine lesions. However, alterations of R2 have also been described in mesencephalic vascular damage and mesencephalic m.s. foci. Later, a connection between the lack of R2 and damage to the mesencephalic reticular formation in decerebrated patients was discussed. Various authors have registered the blink reflex in comatose patients. Some authors regard the blink reflex as an informative prognostic criterion.

Our own investigations indicate that the late response of the blink reflex is impaired even in circumscribed mesencephalic lesions, so that alterations of R2 have topodiagnostic and prognostic significance both in chronic and in acute disorders of brain stem function.

2.2. Early Acoustic Evoked Potentials (BAEP)

As early as a few years after the discovery of electroencephalography, potentials could be registered from the