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USE OF REFLEX-BASED NEUROPHYSIOLOGICAL TESTING IN ASSESSING PATTERNS OF RECURRENT CRANIAL DISCOMFORT

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SUMMARY – Disabling head pain disorders such as episodic and stress-related headaches represent a substantial burden both personally and socially. Their widespread occurrence and significant impact on quality of life have been consistently observed in large-scale population studies. Global data suggest that certain headache types are among the leading contributors to years lived with disability. While some forms are more frequently diagnosed, other types remain less common in the general population but still warrant clinical attention.

Pain perception in the cranial region involves complex neural pathways, including cranial sensory branches and upper spinal segments. These neural circuits are increasingly studied in relation to diagnostic precision and targeted interventions. In this analysis, neurophysiological testing was applied to evaluate whether altered reflex pathways might be associated with chronic headache syndromes. A comparative assessment was conducted on a sample of individuals with chronic head pain and a healthy control group. Reflex integrity was tested using a neuro-electrophysiological method, and significant associations were found between abnormal reflex patterns and headache occurrence. Specifically, impaired responses were linked to a notably increased likelihood of head pain episodes, highlighting the potential utility of such methods in identifying underlying neural dysfunction in headache disorders.

Key words: *Headache – diagnosis; Migraine disorders – diagnosis; Blinking; Electromyography; Predic-tive value of tests*

Introduction

Migraine and tension type headache (TTH) are the most common disabling primary headache disorders. Epidemiologic studies have documented their high prevalence and high socioeconomic and personal impacts. According to recent data, migraine ranks as the third most prevalent disorder and seventh-highest specific cause of disability worldwide. Tension-type headache has lifetime prevalence in the general population ranging between 30% and 78% in different studies. According to the International Classification of Headache Disorders, 3rd edition, there also are many other headaches but their incidence in general population is lower than the previously mentioned headaches[1].

While it is highly doubtful that there is a significant sterile inflammatory response in the dura mater during migraine, it is clear that some form of sensitization takes place during migraine. Sensitization in migraine may have a peripheral component with local release of inflammatory markers, which would certainly activate trigeminal nociceptors, although a peripheral component is not necessary to explain the symptoms. More likely in migraine, there is a form of central sensitization that may be classical central sensitization, or a form of dysinhibitory sensitization with dysfunction of descending modulatory pathways. It is widely accepted that excessive muscle activity in peri-

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cranial muscles is of great importance for the development of TTH, as reflected in the term of muscle contraction headache. Nociceptive processes in craniofacial muscles are believed to play a role in the development and maintenance of TTH. In recent years, however, central mechanisms (sensitization of neurons in the central nervous system) have been favored[2-4].

Trigeminocervical complex (TCC) includes the pseudounipolar trigeminal ganglion that has central afferent projections to the trigeminal nucleus caudalis in the medullary spinal cord, and a peripheral projection, largely from the ophthalmic division of the trigeminal ganglion, which innervates the cranial blood vessels and other cranial structures, including the pain-sensitive dura mater, *via* meningeal nociceptors. In animal models, it has been demonstrated that the central afferent projection to the trigeminal nucleus, using stimulation of the dura mater, also extends to the C2 and C3 regions of the cervical spinal cord. The TCC also receives inputs from the greater occipital nerve that converge with inputs from the dura mater. It is thought that anatomical transition from the trigeminal nucleus to the cervical spinal cord represents a functional continuum[5,6].

It is known that the TCC is a key relay center for conveying sensory and visceral information, particularly nociceptive, from the head and orofacial region, including cranial vasculature, to higher pain processing centers in the brain, along the trigeminohypothalamic tract to the hypothalamus and trigeminothalamic (or quintothalamic) tract to the thalamus.

The blink reflex, also known as the orbicularis oculi reflex test, may be indicative of lesions or dysfunctions of the brainstem, and particularly assesses the trigeminal-facial arch. This reflex is elicited by stimulation of the supraorbital nerve on one side of the face, leading to two ipsilateral responses (R1 and R2) and one contralateral response (R2c). R1 represents an oligosynaptic pathway involving the main sensory nucleus of the trigeminal nerve and the intermediate subnucleus of the facial nerve. The second response, R2, involves a pathway of descent to the spinal trigeminal tract. The contralateral response, R2c, reflects the crossing of the brainstem in the medulla and progresses through the reticular formation to elicit a response at the contralateral facial nucleus[7-9].

The results obtained by testing the blink reflex in patients with headaches have been very heterogeneous. A lack of habituation to pain stimulus can be observed in migraineurs but not in patients with cluster headache. Some authors detected alterations in the blink reflex during a migraine attack; others noticed alterations during the inter-attack period in migraine patients[10,11]. The results have been contradictory in the evaluated population with episodic migraine, cluster headache, hypnic headache, TTH and cervicogenic headache. The aim of our study was to evaluate the potential role of electromyographic (EMG) blink reflex in establishing diagnosis of headache and evaluation of trigeminal nerve dysfunction as the possible underlying pathomorphological headache mechanism[12-14].

Patients and Methods

Our study included 60 patients with different types of primary headaches and 30 control subjects without symptoms of primary headaches. Headache diagnosis was established according to the International Classification of Headache Disorders, 3rd edition. In all patients, trigeminal and facial nerve function was evaluated by use of EMG blink reflex. EMG results were correlated with the diagnosis of headache. EMG blink reflex was performed according to the standardized procedure. Statistical analysis was performed by use of χ^2-test and statistical significance was set at $p<0.001$.

Results

In our study, we included 60 patients with headache and 30 control subjects. There was no statistically significant difference in mean age between the groups (42.9±12.99 *vs.* 42.63±11.7 years). In headache group, there were 27% of women and 73% of men, and in control group 37% of women and 63% of men (Table 1).

There was a statistically significant difference in the percentage of normal EMG blink reflex findings between the headache group and control group (41.67% *vs.* 80.0%). EMG reflex showed pathologic finding unilaterally in 33.33% of headache patients and 13.33% of control subjects, and pathologic finding bilaterally in 25% of headache patients and 6.67% of control subjects, yielding statistically significant differences in both cases (Table 2).

The probability that the patient with headache had a pathologic and normal EMG blink reflex was 58%

Table 1. Demographic data and results of EMG blink reflex in study population

	Headache	Controls
Number of patients	60	30
Mean age (years ± SD)	42.9±12.99	42.63±11.7
Women/men (%)	27/73	37/63
Normal finding	41.67%	80.0%
Pathologic changes unilaterally	33.33%	13.33%
Pathologic changes bilaterally	25.0%	6.67%

EMG = electromyography

Table 2. Number of patients with normal and pathologic EMG blink reflex finding in headache and control groups

	Blink reflex		
	Normal	Pathologic	All
Headache	25	35	60
Controls	24	6	30
All	49	41	90

EMG = electromyography

Table 3. Frequency of patients with normal versus pathologic EMG blink reflex finding according to the presence of headache symptoms

	Blink reflex	
	Normal	Pathologic
Headache	25/60 (0.42%)	35/60 (0.58%)
Controls	24/30 (0.80%)	6/30 (0.20%)

EMG = electromyography

and 42%, respectively. If the patient had no symptoms of headache, there was 20% probability that the EMG blink reflex was pathologic and 80% probability that the EMG blink reflex was normal (Table 3).

In patients with normal EMG blink reflex finding, there was 51% probability that the symptoms of headache were present and 49% probability that the symptoms were not present. In patients with pathologic EMG blink reflex, there was 85% probability that the headache symptoms were present and 15% probability that the symptoms were not present. We demonstrated that patients with trigeminal dysfunction in EMG blink reflex had a 5.6-fold higher risk of developing headache in comparison to subjects with normal EMG blink reflex finding (Table 4).

Table 4. Frequency of headache according to pathologic versus normal EMG blink reflex finding

	Blink reflex	
	Normal	Pathologic
Headache	25/49 (0.51%)	35/41 (0.85%)
Controls	24/30 (0.49%)	6/41 (0.15%)

EMG = electromyography

Discussion

In neurological evaluation of patients with headache, it is always of great importance to find some biomarker that will confirm or exclude the diagnosis of headache. Unfortunately, diagnosis is still made according to patient history. The role of EMG blink reflex in the evaluation of different types of headache is still under investigation. In migraine patients, different authors have shown that changes of EMG blink reflex can be found in migraine attack, as well as in the interval between two attacks. In the studies evaluating other types of headache, results are very heterogeneous. In our study, 58% of patients with headache had changes in EMG blink reflex, unilaterally in 33.33% and bilaterally in 25%. In control subjects, the probability that the EMG blink reflex would be pathologic was 20%, showing that there is subclinical dysfunction of the TCC[11-14].

Previous studies have shown that patients with episodic migraine may present alterations in blink reflex, particularly regarding habituation to the stimulus, while TTH, cluster headache, cervicogenic headache and hypnic headache all presented negative or controversial information on the blink reflex responses. We showed that patients with trigeminal dysfunction in EMG blink reflex had a 5.6-fold higher risk of developing headache as compared to subjects with normal EMG blink reflex finding.

Once again, our study showed that there was dysfunction of the TCC in different types of headache, not only in migraine, and that changes in EMG blink reflex could predict an increased risk of developing headache in symptom-free persons. Further investigations should be performed in patients with different types of headache to evaluate the role of different central and peripheral components of blink reflex in correlation with clinical picture of headache, as well as reaction to therapeutic interventions.

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