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MIDDLE LATENCY SOMATOSENSORY EVOKED POTENTIALS OF THE TRIGEMINAL NERVE IN NORMAL SUBJECTS AND CLINICAL CORRELATION

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Summary: The middle latency of the somatosensory evoked potentials (SEPs) of the trigeminal nerve by electrical stimulation of the upper and lower lips in 20 healthy subjects and 25 patients who had different lesions of the trigeminal nerve and its central pathway vas studied. Changes in peak latencie and amplitude of wave N19 are correlated with clinical findings especially in multiple sclerosis (MS) and trigeminal neuralgia. The technique is simple and painless. Midle latency SEPs of the trigeminal nerve could be an appropriate method for analysis and evaluation of the function of the trigeminal nerve and its central pathway.

Key words: Somatosensory evoked potentials, trigeminal nerve, trigeminal neuralgia, multiple sclerosis

Introduction

The technique of SEPs is a diagnostic method for study of disturbancies of the function of the sensitive and sensory system in different diseases and determination of the point of lesion. There are potentials evoked by electrical or mechanical stimulation of the trigeminal nerve in the spectrum of SEPs. This is a relatively new, rarely used and not enough tested technique in the routine clinical practice.

The first study of the introduction of this technique in the examination of the trigeminal function was published by Larson and Prevec (1970). Later studies were occupied with studies of SEPs technique of the trigeminal nerve of the midle and long latencies by electrical stimulation and that were potentials of the suprathalamic generators (2,3,5). Early responses evoked by stimulation of the infraorbital nerve can reliably be recorded from the scalp of man (4). These potentials have been used in clinical practice as diagnostic tools and in assessment of damage to the trigeminal nerve after operations for trigeminal neurlagia (6). The new investigators point out the possibility of the registration of SEPs of the trigeminal nerve with short latency which apper inside of 12 ms from the stimulation supposing that they are potentials of the infrathalamic generators.

The aim of this study is the standardisation of the method of SEPs of the trigeminal nerve in normal, healthy subjects as a control group and the application of this method in patients with signs and symptoms of the trigeminal system lesions.

Material and Methods

Twenty normal, healthy subjects ranged from 22 years to 57 years (average 38) and both sexes (13 male, 7 female) and 25 patients with signs and symptoms of the trigeminal system ranged from 27 years to 62 years, both sexes (14 male: 11 female) were examined.

The neurologic examination of both groups was done under the same microclimate and technical conditions using the machine for evoked potentials "Mystral"– Medelec. The stimulation electrode was placed in such ways that the catode was put on the upper lip and the anode on the lower lip (Fig. 1.). Recording electrodes were placed 2 cm behind C5 (for stimulation of the right cranial nerve V) or behind C6 (for stimulation of the left cranial nerve V) and the reference electrode was situated in position at Fz point. C5 and C6 position are in the midle on the line which makes C3/T3 and C4/T4 according to the International 10–20 system (Fig.1.). The intensity of the stimulus was 3 times greater than the treshold of the irritation (up to

6mA), duration of the stimulus was 0,2 ms, and the frequence was 1c/s, frequency bandwidth 0,1–3000Hz. There were 256 responses in average. Each test was repeated two times. The complex of 3 waves vith different latencies was registered (Fig. 1b) out of which N wave with the latency of 19 ms was reproducible and reliable. The other waves N22 and P38 are variable and not reliable in healthy subjects so they were not either standardized of clinically applied.

All patients had CT– scan of the brain. For standardization of the method (20 subjects for control group) the average values of the latency and the amplitude of the N19 wave with 2 SD were counted. The values of the latency and the amplitude of the same wave in patients were compared with the same values of the control group.

Results

There were 25 patients with different diseases (Table 1). The decrease of the amplitude and lengthening of the latency of the wave N19 with respect to the control group was registered. The average values of the latency of the wave N19 in healthy subjects as well as in 25 patients are shown in Table 1.

Table 1. Latency of wave N19 in normal subjects and patients with different diseases

Normal subjects	20	N19 (X ± 2SD) (16.8 – 21.6ms)	N19.1ms
Disease	N	Latency of N19 (ms)	N19
Multiple sclerosis	8	20.2 ± 23.1	21.5
Trigeminal neuralgia (right)	5	21.0 ± 23.0	22.0
Trigeminal neuralgia (left)	5	21.2 ± 24.5	22.5
Wallenberg syndrom	2	20.3 ± 20.8	20.6
Tu of the right cerebrall	1	23.2	
hemisphere	1	22.7	
Infarctus cerebi	1	21.1	
Tu of pontocerebellar angle	1	22.9	
Tu of the left hemisphere	1	23.0	
Sy trunci cerebri			
Total	25		

The longest latency of the wave N19 was registered in the group of patients with MS and trigeminal neuralgia. However, the striking fall in the amplitude of the same wave was found also in patients with tumors of the brain stem and the cerebellar hemisphere.

Discussion

The clinical signs and symptoms of the trigeminal system are often found in different lesions of the brain stem as well as in the symptomatic trigeminal neuralgia in contemporary clinical practice. The technique of evoked potentials provides objectivisation even the subclinical lesions of this system what is frequently identified in demielinative diseases. For an investigation of the trigeminal pathway function different techniques of evoked potentials can be used with different stimuli such as: mechanical (slight stroke over face), air stroke (of cornea), electric stimulation (of gingiva, tooth pulp, chin, or lips) (1,2,3,4,7,8,9 and 10). By mechanical stimulation of the face a cortical wave of the long latency is recorded (50–100ms) and is very complicated for use due to numerous muscle artefacts. Electric stimulation of the tooth pulp or gingiva is an invasive and painful method. The existing technique in our investigation encom–passes the stimulation of the second and third division of the cranial nerve V in the area of the lower and upper lips and enables the possibility of recording the control respond of the middle latency (up to 50ms). Although the upper and lower lips are very sensitive to painful stimuli, the intensity of the stimulus is such that it does not provoke painful sensation, and muscle artefacts what it gives advantage to the other methods.

The recording of the cortical response above the right and left parietal regions, the positions of C5 and C6 respectifully, refer to the supposition that the generator of the waves is the sensitive cortex of the mentioned regions, thalamus or the thalamo–cortical pathways. However, for the identification of the generator of these waves it needs stereotaxia experiments.

Our results in healthy subjects showed clearly that the latency of the wave N19 did not change either with the identification of the stimulus or with the increased age. These results are in opposition

with the results of Bernet et al (3). There were no statistically significant differences in the latency and the amplitude of the wave N19 between cerebral hemispheres as well as between both sides

Leandri et al. (7) recorded waves W1, W2, W3, P4, N5, P6 and N7 from the scalp after stimulation of the infraorbital nerve from 96 healthy subjects, selected according to age and six. The infraorbital nerve was stimulated by means of 2 needle electrodes in order to avoid stimulation of facial muscles and to minimize the electrical artefact. The electrodes must be inserted into the infraorbital foramen for a few millimetres. However, this method is painful and to demands the anesthisia.

Bernet et al. (3) recorded three–phasic waves above theparietal regions by electrical stimulation of only the second divison of the cranial nerve V (the upper lips area) but they were not able to make conclusion because the second and the third waves were variable and unreliable which made the method less useful for clinical practice. Our results unambiguously show the reliability of only the wave N19 which is reproducible at repeated stimulation and uncertainity and variability of the late waves (N22, P38). The results indicate the assumption that the generator of the wave N19 is perhaps the primary sensitive cortex, while for thewaves N22 and P38 the generator is the secondary sensitive cortex region.

Our investigation mostly include patients with MS and trigeminal neurlagia where the longest latency of the wave N19 in relation to other patients and control group was registered and can be explained by the process of demielinisation of the brain stem. Similar results were obtained (11, 12 and 13) in patients with trigeminal neuralgia. However, the flaw of this method is the inability to locate the point of lesion along the trigeminal pathway. On the other hand, the method has its clinical significance in revealing the "silent" lesions of this system especialy in probable form of MS.

Two patients with the Wallenberg syndrom showed the normal SEPs of the trigeminal nerve that can be explained by the anatomic localization of the peripheral part of the trigeminal pathway and its sensitive nucleus which is not involved by this syndrom of the brain stem.

Patients with brain stem tumors and tumors of the cerebellar hemisphere shoved also the lengthening of the latency of the wave N19 but the more striking changes were revealed in the amplitude of this wave, probably due to the compression of the tumor on the trigeminal pathway in the vicinity of the brain stem.

For the investigation of the function of the trigeminal system at the brain stem level the most reliable method is SEPs of the cranial nerve V short latency described by Soutsel and his associates in 1991 (8). According to their research the technique of the recording of the provoked responses of short latency by electrical stimulation, provided detection of the series of waves (T1, T2, T3, T5 and T7) which appear inside 12 ms from stimulation. The waves T1 and T2 are peripheric in origin (generators are trigeminal nerve and the Gasserian ganglion). The generator of the wave T3 is the in priciple sensory nucleus of the cranial nerve V, and waves T5 and T7 are the medial lemniscus and thalamus. Regarding that this technique provides the investigation of the function of the peripheral part of the trigeminal pathway and its part in the brain stem then the complementary application of both methods would be reliable for clinical practice in examination and disturbed function of the trigeminal system.

Finally, our results have confirmed the possibility of the application of this relative new and rarely used method of SEPs of the trigeminal nerve of the middle latency in clinical practice for investigation of the disturbed function of the trigeminal system to locate the point of lesion.

The study was performed in 20 normal control subjects and in 25 patients with varying diseases. Furthermore, the authors will continue their study with the aim to include larger numbers of patients with specific diseases.

Conclusion

SEPs of the cranial nerve V is a noninvasive and painles method simple and easy for use in clinical practice. This method can be applied as a complementary diagnostic test for the investigation of the disturbed function of the trigeminal system in clinical and subclinical lesions without any possibility to locate the point of the lesion.

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SOMATOSENZORNI EVOCIRANI POTENCIJALI SREDNJE LATENCE TRIGEMINALNOG NERVA U ZDRAVIH ISPITANIKA I KLINIČKA PRIMENA

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Sažetak: Somatosenzorni evocirani potencijali (SEP) srednje latence nervusa trigeminusa električnom stimulacijom u predelu gornje i donje usne ispitivani su kod 20 zdravih ispitanika i 25 bolesnika sa jasnim kliničkim znacima lezije trigeminalnog sistema u perifernom i centralnom delu. Rezultati ispitivanja su pokazali promene u latenci i amplitudi talasa N19 i korelirani sa kliničkim nalazima različitih oboljenja, posebno kod multiple skleroze (MS) i trigeminalne neuralgije. Tehnika je jednostavna za upotrbu i bezbolna. Može imati praktičnu kliničku primenu kao dopunska dijagnostička metoda za ispitivanje poremećaja funkcije trigeminalnog nerva i centralnih puteva.

Ključne reči: Somatosenzorni evocirani potencijali, nervus trigeminus, trigeminalna neuralgija, multipla skleroza

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