Surface Electromyography in Patients with Tension - Type Headache and Normal Healthy Subjects

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Abstract

Headache is one of the most common medical symptoms and tension - type headache is the most common form. Pericranial muscles have been invoked as a source of nociception among patients with tension - type headache. This study was performed to determine surface electromyography (EMG) as representative of the electrical activity of pericranial muscles in tension - type headache and normal subjects during rest and mental calculation. Surface EMG recordings were performed in 20 normal subjects (age 33.9 ± 8.9 years) and 20 tension - type headache patients (34.5 ± 9.4 years) using electroencephalograph during the initial rest period for 5 minutes, during mental calculation for 2 minutes and 3 minutes of the rest period. Surface EMG was scored as discharge score (DS) at the third, sixth and ninth minute. The DS at each minute studied showed that the headache group had higher electrical activity than the normal group and increased EMG activity during mental stress was found in the headache group.

Key word : Electromyography, Tension Headache, Healthy Subject

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Headache is one of the most common medical symptoms. The most prevalent form of headache is tension - type headache which can occur at any age, commonly in adulthood(1). Pericranial muscles have been invoked as a source of nociception among patients with tension - type headache. Pericranial muscle activity determined by surface electromyography (EMG) has been studied to find if there was any correlation with tension - type headache. The findings are still inconsistent(2). This

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Table 1. Surface EMG scored by magnitude of amplitude.

Amplitude (μV)	Score
< 20	0
20-40	1
40-60	2
60-80	3
80-100	4
≥ 100	5

study was performed to determine the EMG activity of pericranial muscles in tension - type headache and normal subjects during rest and mental calculation.

MATERIAL AND METHOD

Surface EMG was studied in 20 normal subjects and 20 tension - type headache patients who were diagnosed according to the inclusion criteria of the International Headache Society (IHS)(3). Exclusion criteria were presence of other neurological disorders causing headache ; patients with mental disorders, dementia, epilepsy; patients with clouding of sensorium; patients with muscle relaxant intake during the previous month.

The technic of the surface EMG recording followed that of Nonaka S, et al(4).

Surface EMG was simultaneously recorded on the right and left frontal muscles, temporal muscles, occipital muscles, and cervical trapezius muscles while subjects were in the supine position. The surface EMG was recorded by an electroencephalograph, Grass model 6. Operating conditions for the electroencephalograph were such that the paper speed was 1.5 cm/sec, the time constant 0.03, and amplitude 100 μV/5 mm. The EMG was recorded during the initial rest period for 5 minutes, while performing serially mental subtraction of 7 from 100 for 2 minutes and 3 minutes of the rest period before ending the recording.

Surface EMG was scored by magnitude of average amplitude as shown in Table 1.

The sum of scores for 8 muscles was calculated and used as the discharge score (DS). DS was taken at the third, sixth and ninth minute representing the rest, stress or mental calculation and post - stress period respectively.

RESULTS

The average age of the normal subjects and the headache patients was 33.9 ± 8.9 and 34.5 ± 9.4 years respectively. There was no statistically significant difference between age of the normal and headache groups. The headache group could be divided into 2 subgroups, acute and chronic type. There were 4 subjects in the acute group and 16 in the chronic group.

The DS at the third, sixth and ninth minute in the normal group was less than that of the headache group especially at the sixth minute which represented the stress state (Table 2). The difference at each point was statistically significant.

The DS during the stress period in the headache group increased significantly from that during the resting period but returned to the level of the resting period in the post - stress period (Table 3). But these changes were not seen in the normal group.

The DS during each period of the acute subgroup was significantly different from that of the normal group. But in the chronic subgroup, the significant difference was seen only during stress (Table 4).

DISCUSSION

The DS at each minute studied (Table 2) suggested that the headache group had higher electrical activity (about mean of normal + 1 SD) than

Table 2. The discharge score (DS) during the rest (3 min), stress (6 min) and post - stress (9 min) period.

Period	Minute	Discharge Score		P-value
		Normal	Headache	
Rest	3	5.25 ± 3.93	8.45 ± 4.93	0.027246
Stress	6	6.0 ± 3.87	10.55 ± 5.63	0.005186
Post - stress	9	5.05 ± 3.99	8.85 ± 5.04	0.01145

Table 3. Comparison of the discharge score between the rest (3 min), stress (6 min) and post - stress (9 min) period.

Period	Minute	P-value	
		Normal	Headache
Rest - stress	3-6	0.21530	0.00060
Rest - post - stress	3-9	0.55690	0.60590
Stress - post - stress	6-9	0.06080	0.00100

the normal group. This finding was in concordance with observations made by Schoenen[5], but did not correlate with that of Hatch et al[6] in 1991. Hatch et al found no significant difference of EMG activity between each group. This may be due to difference in the technic and number of muscles studied. He examined only one muscle (neck) but the DS used in this study represented the electrical activity of eight pericranial muscles. Hudzinski et al[7] stated that determining the existence of muscle contraction might be effectively recorded using multisite EMG monitoring.

Increased EMG activity during mental stress was found in the headache group (Table 2 and 3). This finding corresponded with that of Formisano R et al[8]. Gobel H et al[9] stated that the intraindividual phasic comparison of pain reactions appeared to be more important than the absolute interindividual tonic comparison. This finding also stressed the importance of phase comparison (rest, mental stress and post stress).

The DS of the acute headache subgroups was higher than that of the normal and chronic subgroups, but it was not statistically significantly different from that of the chronic subgroups (Table 5). This suggested that electrical activity in the pericranial muscles increased during headache regardless of acute or chronic conditions. These findings are comparable to the report of Schoenen[5], where muscle activity was considered to be one of several pathophysiologic changes not a cause of pain.

Table 4. Comparison of the DS during each period between each headache subgroup and normal.

Period	Minute	DS			P-value
		Normal	Headache		
			Acute	Chronic	
		(N=20)	(N=20)	(N=16)	
Rest	3	5.25 ± 3.93	12.0 ± 3.47		0.00448
				7.56 ± 4.91	0.122016
Stress	6	6.0 ± 3.87	14.75 ± 5.57		0.001137
				9.5 ± 5.3	0.026730
Post - stress	9	5.05 ± 3.99	12.0 ± 4.08		0.004626
				8.06 ± 5.05	0.050781

Table 5. Comparison of the discharge score (DS) between acute and chronic headache subgroups.

Period	Minute	DS		P-value
		Acute	Chronic	
Rest	3	12.0 ± 3.47	7.56 ± 4.91	0.105222
Stress	6	14.75 ± 5.57	9.5 ± 5.3	0.092872
Post - stress	9	12.0 ± 4.08	8.06 ± 5.05	0.164538

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REFERENCES

1. Diamond S. Tension-type headaches. In: Dalessi DJ, Silberstein SD, eds. Wolff's headache and other head pain. 6th ed. New York: Oxford University Press, 1993: 235-61.
2. Pikoff H. Is the muscular model of headache will viable? A review of conflicting data. Headache 1984; 24: 186-98.
3. Headache Classification Committee of the International Headache Society. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Cephalgia 1988; 8 (Suppl 7): 1-96.
4. Nonaka S, Fuchinoue T, Nakamura N, Fukushima T, Hirakawa K. Study on muscle contraction headache (second report) - objective diagnosis of muscle contraction headache using electromyograms. J Jpn Accidental Med 1971; 19: 115-34.
5. Schoenen J, Gerald P, De Pasgua V, Juprelle M. EMG activity in pericranial muscles during postural variation and mental activity in healthy volunteers and patients, with chronic tension - type headache. Headache 1991; 31: 321-4.
6. Hatch JP, Prihoda TJ, Moore PJ, et al. A naturalistic study of the relationships among electromyographic activity, psychological stress, and pain in ambutatory tension - type headache patients and headache - free controls. Psychosom Med 1991; 53: 576-84.
7. Hudzinski LG, Lawrence GS. Significance of EMG surface electrode placement models and headache findings. Headache 1988; 28: 30-5.
8. Formisano R, Buzzi MG, Cerbo R, et al. Idiopathic headaches : a neuropsychological and computerized electromyographic study. Headache 1988; 28: 426-9.
9. Gobel H, Weigle L, Kropp P, Soyka D. Pain sensitivity and pain reactivity of pericranial muscles in migraine and tension - type headache. Cephalgia 1992; 12: 142-51.

การศึกษาคลื่นไฟฟ้ากล้ามเนื้อในอาการปวดศีรษะและคนปกติ

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อาการปวดศีรษะเป็นปัญหาที่พบบ่อยในเวชปฏิบัติ โดยพบเป็นชนิด tension (tension – type headache) มากที่สุด โดยทั่วไปเชื่อว่า กล้ามเนื้อที่อยู่รอบกะโหลกศีรษะ (pericranial muscles) เป็นตำแหน่งที่ก่อให้เกิดอาการปวด คณะผู้วิจัยจึงได้ทำการศึกษาเปรียบเทียบคลื่นไฟฟ้ากล้ามเนื้อชนิดพื้นผิวของกล้ามเนื้อดังกล่าวในคนปกติและผู้ป่วย tension – type headache กลุ่มละ 20 คน อายุเฉลี่ย 33.9 ± 9 และ 34.5 ± 9 ปีตามลำดับ โดยทำการบันทึกสัญญาณคลื่นไฟฟ้า 10 นาที แบ่งเป็น ขณะพักเริ่มต้น 5 นาที ขณะคิดเลขในใจ 2 นาที และขณะพักหลังคิดในใจ 3 นาที และเปรียบเทียบขนาดศักย์ไฟฟ้าที่เกิดขึ้น พบว่า ขนาดศักย์ไฟฟ้ากล้ามเนื้อของผู้ป่วยจะสูงกว่าคนปกติ และมีขนาดเพิ่มสูงขึ้นในขณะที่คิดในใจ ซึ่งการเพิ่มสูงขึ้นนี้ไม่พบในกลุ่มปกติ

คำสำคัญ : คลื่นไฟฟ้ากล้ามเนื้อ, ปวดศีรษะ, คนปกติ

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