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Original Article

Physiology Section

Electromyography Scanning in the Diagnosis of Tension Headache

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ABSTRACT

Introduction: Several attempts have been made to validate the purported aetiological mechanism after the prescribed proposal by the Ad Hoc Committee (1962), on the Classification of Headache which was recognised as muscle contraction or tension as a distinct headache diagnosis. The Electromyography (EMG) of the temporalis muscle in tension headache patients is measured to identify whether the correlation of EMG amplitude and intensity of pain reported by patients can be attributed to the diagnosis of Tension Type Headache (TTH).

Aim: To correlate between Surface Electromyography (sEMG) activity and pain scale in TTH patients.

Materials and Methods: The present study cross-sectional study was conducted in the Out Patient Department (OPD) of Psychiatry MLB Medical College, Jhansi, Uttar Pradesh, India during the period of 2009 to 2012 in which surface EMG responses of the temporalis muscle were recorded on 100 TTH patients before they go for any sort of treatment. Subjects aged 20 to 45 years were included, out of which 58 were females and 42 males. In this study, Pearson's correlation coefficient was calculated to investigate the correlation between muscular activity and subjective pain scores.

Results: The correlation value was (r=0.857) between EMG amplitude and pain scale in all 100 TTH patients. Male to female ratio was 1:1.38. Among the age groups 20-25 (years) and 26-30 (years) had the maximum number of patients 32% and 25% respectively.

Conclusion: All age groups showed a positive correlation between EMG amplitude and headache intensity. It was found that females in every age group was more frequently affected as compared to males and the young population had more chances of being diagnosed as TTH patients because it emerged as the largest number 32% among all age groups.

Keywords: Pain scale, Surface electrodes, Temporalis muscle, Tension type headache

INTRODUCTION

Pain is a biological phenomenon that is easy to comprehend and difficult to define. Indeed pain is relieved from the Latin word 'poena', meaning punishment [1]. Initially, pain was envisions in the fourth century BC by Plato in his oeuvre Timaeus (Plato 1998), and according to his theory, pain is a common sensory experience but rather than an emotion that occurs when a stimulus is usually stronger. Aristotle elucidates that pain is originated from excessive stimulation of touch sense. So, stimulus intensity and central summation both are critical determinants [2]. Later Descartes postulated that the brain was the center of sensations and pain was transmitted by means of small threads running from skin to brain. Sense organ for the pain is naked nerve endings in almost every tissue of the body. The synaptic junctions between the peripheral nociceptive fibers and dorsal horn cell are considerably plastic, for this reason the dorsal horn has been called a gate where pain impulses occur [2].

Headache or cephalgia is symptom of various conditions of the head, of which some causes are benignant while others are unfavourable medical emergencies. Ad Hoc Committee has been appointed by National Institute of Neurological Diseases and Blindness in 1962 on the Classification of Headache, the committee proposed 15 different categories of headache syndromes. This suggested that the muscle contraction headache syndrome accounts for the vast majority of presenting headaches [3,4]. The TTH is most common type of headache which shows the recurrent episodic form of headache lasting from a few minutes up to a few days, in which compressive contracture type of pain occurs, mild to moderate intensity, non pulsating, bilateral, not worsen by physical activity [5]. These headaches were initially recognised by numerous terms such as stress headache, muscle contraction headache, psychogenic headache, psychomyogenic headache, etc. Nevertheless, the International Classification Headache Diagnosis I (ICHD I) has picked out the term TTH in 1988 and that has been retained by ICHD II [5,6].

The words "tension" and "type" underscore, it is not certain pathogenesis and indicated various kinds of mental or muscular tension may play an instrumental role. When the clinical and neurophysiological studies are increased they leave little doubt of neurobiological and decrease the fact of psychological diseases [7-9].

Despite being the most prevalent primary headache TTH, has not received the attention it deserves due to an unclear aetiopathogenesis. Since tension headache has been defined as a stress-related disorder (Ad Hoc, 1962), studies of EMG reactivity are important in the investigation of aetiological mechanisms for this type of headache. Several investigators have found that tension headache sufferers show higher levels of resting muscle activity when compared to normal control [10-13].

sEMG is the painless and non invasive recording of action potentials of muscle with skin surface electrodes, which is used as an indicator of muscle recruitment. sEMG shows the magnitude and timing pattern of muscle recruitment, along with the activity of certain muscles in relation to others. The present study was performed to understand the role of sEMG of temporalis muscles in TTH patients.

According to previous studies, only a few reports are available on the association between EMG activity and tension headache, and no study was from the Jhansi region. Therefore, this study was conducted to investigate muscle activity, evaluated by sEMG, and correlation between tenderness on temporalis, which was assessed by subjective pain scale in patients of concurrent TTH.

MATERIALS AND METHODS

This was a cross-sectional study involving a total of 100 patients ranging with an age group of 20 to 45 years. Patients were

recruited using convenient sampling from Out Patient Department (OPD) of Psychiatry MLB Medical College, Jhansi, Uttar Pradesh, India during the period of 2009 to 2012. The study was performed as per the Declaration of Helsinki with informed consent from the patients.

Study Procedure

The patients included under the study were the diagnosed cases of chronic tension headache according to the criteria given by International Headache Society (2003) [14]. After being diagnosed as the case of tension headache, patients were included (before any sort of treatment) for headache assessment by comparative pain scale proposed by Jack Harich, Health Organisation of Pudendal Education [Table/Fig-1] [15]. Then patients were taken for the EMG activity in a separate room and then corresponding recording was made. EMG of muscle temporalis was recorded on Biopac Student Lab (BSL) system through surface electrodes.

Comparative Pain Scale [15]		
Normal	0	No pain. Feeling perfectly normal.
Minor Does not interfere with most to adapt to pain psychologically and with medication or devices such as cushions.	I Very Mild	Very light barely noticeable pain, like a mosquito bite or poison ivy itch. Most of the time you never think about the pain.
	2 Discomforting	Minor pain, like lightly pinching the fold of skin between the thumb and first finger with the other hand, using the fingernails. Note that people react differently to this self-test
	3 Tolerable	Very noticeable pain, like an accidental cut, a blow to the nose causing a bloody nose, or a doctor giving you an injection. The pain is not so strong that you cannot get used to it. Eventually, most of the time you don't notice the pain. You have adapted to it.
Moderate Interferes with many activities. Requires lifestyle changes but patient remains independent. Unable to adapt to pain.	4 Distressing	Strong, deep pain, like an average toothache, the initial pain from a bee sting, or minor trauma to part of the body, such as stubbing your toe real hard. So strong you notice the pain all the time and cannot completely adapt. This pain level can be simulated by pinching the fold of skin between the thumb and first finger with the other hand; using the fingernails, and squeezing real hard. Note how the simulated pain is initially piercing but become dull after that.
	5 Very Distressing	Strong, deep, piercing pain, such as a sprained ankle when you stand on it wrong or mild back pain. Not only do you notice the pain all the time, you are now so preoccupied with managing it that you normal lifestyle is curtailed. Temporary personality disorders are frequent.
	6 Intense	Strong, deep, piercing pain so strong it seems to partially dominate your senses, causing you to think somewhat unclearly. At this point, you begin to have trouble holding a job or maintaining normal social relationships. Comparable to a bad non migraine headache combined with several bee stings, or a bad back pain.
Severe Unable to engage in normal activities. Patient is disabled and unable to function independently.	7 Very Intense	Same as 6 except the pain completely dominates your senses, causing you to think unclearly about half the time. At this point you are effectively disabled and frequently cannot live alone. Comparable to an average migraine headache.
	8 Utterly Horrible	Pain so intense you can no longer think clearly at all, and have often undergone severe personality change if the pain has been present for a long time. Suicide is frequently contemplated and sometimes tried. Comparable to childbirth or a real bad migraine headache.
	9 Excruciating Unbearable	Pain so intense you cannot tolerate it and demand pain killers or surgery, no matter what the side-effects or risk. If this doesn't work, suicide is frequent since there is no more joy in life whatsoever. Comparable to throat cancer.
	10 Unimaginable Unspeakable	Pain so intense you will go unconscious shortly. Most people have never experienced this level of pain. Those who have suffered a severe accident, such as a crushed hand, and lost consciousness as a result of pain and not blood loss, have experienced level 10.

[Table/Fig-1]: Showing the comparative pain scale.

After cleaning the skin overlying the muscle, one of the electrodes was placed 10 mm lateral to the external angle of orbit and the other directly above the first while, the reference electrodes is placed on frontal bone. EMG was recorded in sitting position.

Subjects were divided in five age groups. Maximum numbers of patients were in age group 20-25 years which were 32 subjects and minimum numbers of subjects were in age group 41-45 years which were 12 subjects.

STATISTICAL ANALYSIS

The results were presented as mean±Standard Deviation (SD). Pearson's correlation coefficient was used to assess the association between numerical variables. Correlation was also shown by scatter diagram to assess the relationship between numerical variables in each age group.

RESULTS

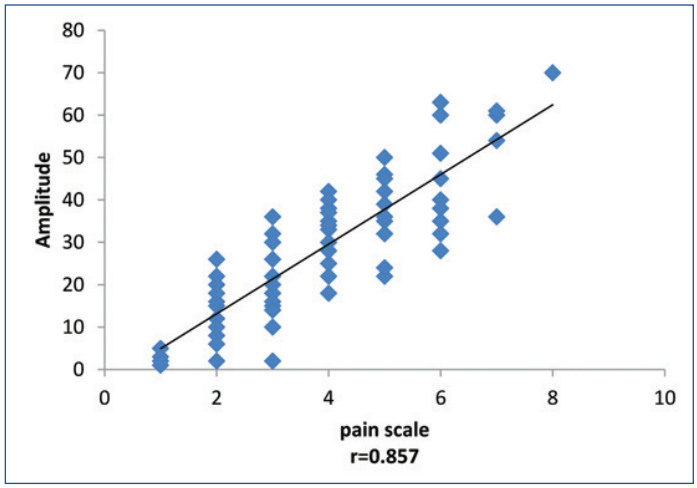
The baseline data showing the different age groups and gender distribution the study population is shown in [Table/Fig-2]. The mean value for pain scale and amplitude of EMG are shown [Table/Fig-3]. The correlation between pain scale and EMG amplitude of TTH patients is shown [Table/Fig-4].

Age (years)	Male n (%)	Female n (%)	Total
20-25	14 (44)	18 (56)	32
26-30	11 (44)	14 (56)	25
31-35	8 (44)	10 (56)	18
36-40	5 (38)	8 (62)	13
41-45	4 (33)	8 (67)	12
Total	42	58	100

[Table/Fig-2]: Age and gender distribution of the study population.

Parameters	20-25 years	26-30 years	31-35 years	36-40 years	41-45 years
Age (years)	22.75±2.19	27.96±1.46	32.83±1.61	36.62±5.54	43±1.47
Pain scale	3.34±1.65	3.64±1.72	3.56±1.61	4±1.41	4±1.58
Amplitude (µv)	25.57±15.78	25.8±14.78	27.39±17.94	26.23±15.10	29.08±14.24

[Table/Fig-3]: Mean value for pain scale and amplitude of EMG (Mean±SD).



[Table/Fig-4]: Scattered graph fzor correlation between pain scale and EMG amplitude of TTH patients.

DISCUSSION

Of all 100 subjects, there were 42 males and 58 females, so the ratio derived was 1:1.38. That indicates that women are more likely to be affected by headache than men. The result of the study favours the result of Rasmussen BK and Olesen J. They found this ratio 1:1.4 in 1994 and concluded that women are slightly more affected than men [16].

The same results were found in another study which reported that pressure pain mechanically makes more impact on females frequently, and affects them more than males. Female shows more softness of pericranial muscles and insertion of tendons than males. Similarly, young subjects are more frequently affected than their old counterparts as older subjects are less sensitive to pain than the young subjects. Tenderness in pericranial muscles was highly significant in subjects with TTH compared to migraineurs and without any experience of headache [9].

Out of these 100 patients, only 11 patients showed normal EMG activity despite being diagnosed as the case of TTH and having a measurable headache (according to comparative pain scale). Rest 89 patients showed increased EMG activity. The inconsistent results regarding an abnormal resting EMG level in tension headache suggest that subgroups may exist. The critical differentiating variable in this respect might be the aetiological mechanism involved in headache. On the other hand, abnormal resting EMG levels may simply be a consequence of prolonged headache.

In the present study, severity of pain in tension headache increases as there is a corresponding increase in the sEMG activity of frontalis muscle because EMG activity is much higher in moderate and severe tension headache patients in comparison to a mild headache. Also, reported, in Hatch JP et al., 32 subjects diagnosed with repeated TTH and 42 control subjects participated in two laboratory session in which EMG activity, electrodermal activity, heart rate and finger temperature were recorded. High EMG activity was recorded in subjects with headache than the control subjects during baseline and stressful task performance [17]. Some previous research also found significantly higher EMG activity in TTH patients as compared to the control group [18,19].

Harphadungkit K et al., performed sEMG as representative of the electrical activity of the pericranial muscle in TTH and normal subjects during rest and mental calculations. They also reported increased EMG activity during mental stress in the headache group as similar when compared to this study [20].

The TTH patient shows insufficient relaxation while resting when EMG activity increased. In a previous study, according to Jensen R, the multifactorial disorder is a TTH with several concurrent pathophysiological mechanisms [9]. It was found that a peripheral mechanism of TTH is most likely in the repeated subform than the secondary, supraspinal modulation of incoming stimuli seem to be involved in subjects with chronic TTH.

Yet another hypothesis is that elevated EMG is reflective of the frequency of headaches. Vaughn R et al., indicated that subjects who reported more frequent headaches to exhibit overall higher EMG levels [21]. Clearly, more research is needed in order to rule out a possible causal role of high levels of resting EMG in at least a certain subgroup of tension headache sufferers. However, it may be that other factors such as physiological reactivity (especially EMG) are more important in explaining the aetiological mechanisms of tension headache.

Limitation(s)

The limitations of this study were that only one muscle was tested, hence comparison with any other muscle was not possible. If multiple rather than single physiological measures are used, a more clear correlation can be observed. Precise sEMG recordings are not received as compared to needle EMG recordings, which, however, would not have been possible to do in present study.

CONCLUSION(S)

The present study showed a positive correlation existing between headache intensity and EMG activity. Out of all 100 patients, 89 patients showed increased EMG activity. The inconsistent results obtained fro present study regarding an abnormal resting EMG level in tension headache suggest that subgroups may exist. The critical differentiating variable in this respect might be the aetiological mechanism involved in headache. On the other hand, abnormal resting EMG levels may simply be a consequence of prolonged headache.

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