

# Pain threshold in migraine and tension-type headache by pressure algometry in craniocervical muscles and peripheral nerves in both genders

## Abstract

**Objectives:** Our objective was to determine the pain threshold in migraine and tension-type headache patients by pressure algometry in craniocervical muscles and peripheral nerves in both genders.

**Methods:** Migraine or tension-type headache patients, diagnosed according to criteria of International Classification of Headache Disorders-2, were evaluated by pressure algometry in skin adjacent to four craniocervical muscles (temporal, masseter, sternocleidomastoid, and trapezius) and seven peripheral nerves (greater occipital, supra-orbital, infra-orbital, mentonian, median, ulnar, and radial) bilaterally. We studied 25 migraine patients (38.4%), 20 tension-type headache patients (30.8%), and 20 patients (30.8%) were controls. Of the 65 patients, 41 (63%) were female and 24 (37%) male. The age ranged from 20 to 50 years.

**Results:** The pain threshold was significantly lower in both migraine and tension-type headache patients compared with the control group ( $p < 0.001$ ) in craniocervical muscles and peripheral nerves in both genders. However, there were no significant statistical differences between migraine and tension-type headache patients, as well as between men and women.

**Conclusion:** Migraine and tension-type headache patients have lower pressure pain threshold at all stimulated points in craniocervical muscles and peripheral nerves in both genders.

**Keywords:** measurement of pain, pain threshold, pressure algometry, primary headaches, migraine, tension-type headache

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## Introduction

Among the painful syndromes, headache is one of the more frequent complaints in daily clinical practice, especially in migraine and tension-type headache patients.<sup>1,2</sup> The consequences are both direct (health expenses) and indirect (work absence).<sup>3</sup>

In the last years, the phenomenon of the central sensitization has been considered an important component in the pathogenesis of migraine. This mechanism proposes that the changes in the neurophysiology lead to an increase in the sensitivity to normal stimuli.<sup>4</sup> However, there is a consequent difficulty to assess the degree of patient distress due to headache is a subjective symptom.<sup>5</sup>

There is a technique to measure the physiology of the nociceptive system, known as pressure algometry. It has a direct action on the responsive peripheral nociceptors to the pressure stimuli, making possible the study of the nociceptive integrity in normal individuals or with different pain syndromes.<sup>6</sup> Our aim was to determine the pain threshold in migraine and tension-type headache patients by pressure algometry in craniocervical muscles as in nerves peripheral in both genders.

## Patients and methods

### Study design and Patients

This was a prospective study with comparison of groups. The study population comprised a non-random and convenience sampling, consisting of the first 20 control patients, 25 migraine patients and 20 tension-type headache (TTH) patients (comparison group).

### Inclusion criteria

Patients aged between 20 and 50 years, no complaint of headache

(control), with migraine or tensional-type headache, according to the diagnostic criteria of International Classification of Headache Disorders (ICHD)-2<sup>7</sup> and absence of abortive medication for at least 5 days were included in the study.

### Exclusion criteria

Patients with psychiatric disorders, skin diseases (psoriasis, herpes zoster and leprosy that interfere with the perception of pain), patients with any type of secondary headache, abnormal neurological or neuroimaging examination, congenital insensitivity to pain, fibromyalgia, surgical procedure skull, face or cervical spine, and those who used stimulants or have pain in the last 24 hours.

### Data collection

Patients who met the inclusion and exclusion criteria were invited to participate by signing the consent form. Patients in group with headache and the control group were subjected to the evaluation of thresholds of pain perception in selected areas of the body. In all three groups, a single examiner assessed the pain threshold by pressure algometry in selected areas of the body. A skin surface of 0.5 cm diameter adjacent to four craniocervical muscles (temporal, masseter, sternocleidomastoid and trapezius) and seven peripheral nerves (greater occipital, supra-orbital, infra-orbital, mentonian, median, ulnar and radial) was stimulated bilaterally. Participants rested for 10 minutes before obtaining the stimulus.

The Wagner digital algometer with a liquid crystal display five digit, measuring 0.5 inches and with certified calibration was used perpendicularly to the skin. Participants were instructed to inform the first unpleasant sensation of pain. Immediately after the perception of pain, the painful stimulus was discontinued and the values were recorded in kgf/cm<sup>2</sup>.

### Statistical analysis

All collected data were organized in database. The quantitative variables were expressed as mean and standard deviation. The Kruskal-Wallis and chi-square tests for differences between averages and categorical variables were used respectively, assuming a significance level of 0.05. Dunn's test carried for pared comparison. The tests were carried out with an error of 5.0%. The typing of data was done in the Excel and the statistical program used for the obtainment of statistical calculations was the BioEstat, version 5.0 for Windows.

### Ethical aspects

This study was approved by Ethics in Research Involving Human Subjects Committee at the Federal University of Pernambuco, Brazil. All patients signed the Informed Consent Form.

### Results

There were 65 patients averaging 39.0±7.2 in age (95% CI 37.5-40.5) and ranging from 20 to 50 years old, of which 41 (63.0%) were women. Twenty-five patients (38.4%) were diagnosed with migraine, 20 patients (30.8%) with TTH, and 20 patients (30.8%) were controls, whose distribution differed according to sex and age, as observed in Table 1. Migraine and tension-type headache were predominant in women. These differences were significant. The pain threshold was significantly lower in both migraine and TTH patients compared with the control group (p< 0.001). However, there were no significant statistical differences between the migraine and the TTH patients (Tables 2 & 3).

**Table 1** Clinical features of 65 patients without complaints of headache (control), with migraine or tension-type headache

Variables	Groups Control (n=20)	Migraine (n=25)	TTH (n=20)	p Value
Gender				0.857
Female (n;%)	10 (50.0)	18 (72.0)	13 (65.0)	
Male (n;%)	10 (50.0)	7 (28.0)	7 (35.0)	
Age (years)				< 0.001
Mean (sd)	38.5 (5.7)	38.5 (5.6)	39.2 (4.4)	
Variation	29-49	20-48	23-50	

SD: Standard Deviation; TTH: Tension-Type Headache

**Table 2** Distribution of measures of pain threshold in 41 women without complaints of headache (control), with migraine or tension-type headache

Stimulated Points	Groups Control	Migraine	TTH	p Value
<b>Muscles</b>				
Temporal				
Right	2.47 ± 0.40	1.57 ± 0.56	1.72 ± 0.37	< 0.001
Left	2.52 ± 0.40	1.54 ± 0.53	1.68 ± 0.32	< 0.001
Masseter				
Right	2.50 ± 0.24	1.64 ± 0.59	1.85 ± 0.30	< 0.001
Left	2.51 ± 0.30	1.52 ± 0.54	1.77 ± 0.33	< 0.001
Sternocleidomastoid				
Right	2.17 ± 0.18	1.32 ± 0.50	1.66 ± 0.41	< 0.001
Left	2.27 ± 0.27	1.43 ± 0.49	1.68 ± 0.46	< 0.001
Trapezius				
Right	2.36 ± 0.25	1.82 ± 0.55	1.93 ± 0.25	0.003
Left	2.39 ± 0.29	1.77 ± 0.62	1.94 ± 0.24	0.007
<b>Nerves</b>				
Greater Occipital				
Right	2.88 ± 0.62	1.76 ± 0.49	1.85 ± 0.23	< 0.001
Left	2.87 ± 0.74	1.78 ± 0.53	1.86 ± 0.34	< 0.001
Supra-orbital				
Right	2.55 ± 0.41	1.80 ± 0.47	1.71 ± 0.36	< 0.001
Left	2.50 ± 0.36	1.84 ± 0.50	1.75 ± 0.30	0.001
Infra-Orbital				
Right	2.11 ± 0.31	1.39 ± 0.54	1.58 ± 0.39	0.001
Left	2.14 ± 0.31	1.45 ± 0.49	1.56 ± 0.32	0.002
Mentonian				
Right	2.29 ± 0.31	1.57 ± 0.46	1.57 ± 0.34	< 0.001
Left	2.37 ± 0.28	1.58 ± 0.51	1.58 ± 0.37	< 0.001
Median				
Right	3.17 ± 0.37	2.18 ± 0.81	2.25 ± 0.34	0.001
Left	3.23 ± 0.40	2.14 ± 0.85	2.27 ± 0.28	< 0.001
Ulnar				
Right	3.43 ± 0.37	2.11 ± 0.78	2.29 ± 0.28	< 0.001
Left	3.44 ± 0.43	2.13 ± 0.83	2.28 ± 0.29	< 0.001
Radial				
Right	3.48 ± 0.35	2.09 ± 0.71	2.22 ± 0.27	< 0.001
Left	3.44 ± 0.32	2.04 ± 0.76	2.24 ± 0.26	< 0.001

Note: p value based on the Kruskal-Wallis test. Legend: TTH: Tension-Type Headache.

**Table 3** Distribution of measures of pain threshold in 24 men without complaints of headache (control), with migraine or tension-type headache

Stimulated Points	Groups Control	Migraine	TTH	p Value
<b>Muscles</b>				
Temporal				
Right	3.21 ± 0.48	2.17 ± 0.48	1.82 ± 0.54	< 0.001
Left	3.27 ± 0.53	2.12 ± 0.54	1.80 ± 0.56	< 0.001
Masseter muscle				
Right	3.19 ± 0.42	2.39 ± 0.52	1.94 ± 0.53	< 0.001
Left	2.72 ± 0.39	2.21 ± 0.38	1.87 ± 0.46	< 0.001
Sternocleidomastoid				
Right	3.02 ± 0.55	1.86 ± 0.55	1.49 ± 0.54	< 0.001
Left	3.02 ± 0.61	1.83 ± 0.48	1.46 ± 0.51	< 0.001
Trapezius				
Right	4.23 ± 1.57	2.59 ± 0.42	2.14 ± 0.78	< 0.001
Left	4.32 ± 1.45	2.69 ± 0.51	2.18 ± 0.82	< 0.001
<b>Nerves</b>				
Greater Occipital				
Right	3.49 ± 0.63	2.45 ± 0.43	2.20 ± 0.45	0.001
Left	3.56 ± 0.67	2.36 ± 0.43	2.15 ± 0.44	0.001
Supra-Orbital				
Right	3.27 ± 0.46	2.18 ± 0.36	1.90 ± 0.32	< 0.001
Left	3.15 ± 0.45	2.17 ± 0.39	1.89 ± 0.27	< 0.001
Infra-Orbital				
Right	2.63 ± 0.23	2.05 ± 0.25	1.76 ± 0.30	< 0.001
Left	2.49 ± 0.32	1.95 ± 0.20	1.71 ± 0.30	< 0.001
Mentonian				
Right	2.71 ± 0.37	2.07 ± 0.33	1.75 ± 0.32	< 0.001
Left	2.72 ± 0.39	2.04 ± 0.32	1.75 ± 0.30	< 0.001
Median				
Right	4.41 ± 0.45	3.12 ± 0.63	2.75 ± 0.50	< 0.001
Left	4.51 ± 0.67	3.23 ± 0.62	2.67 ± 0.60	< 0.001
Ulnar				
Right	4.44 ± 0.62	3.28 ± 0.53	2.76 ± 0.64	< 0.001
Left	4.36 ± 0.51	3.14 ± 0.49	2.70 ± 0.59	< 0.001
Radial				
Right	4.43 ± 0.63	3.09 ± 0.32	2.67 ± 0.44	< 0.001
Left	4.43 ± 0.89	3.09 ± 0.33	2.75 ± 0.49	< 0.001

Note: p value based on the Kruskal-Wallis test. TTH: Tension-Type Headache

**Table 4** Lower pain thresholds in patients with painful headache compared with controls, according to some authors

References	Control (n; %)	Pain Syndromes	Stimulated Points (n)	Lower Pain Threshold (%)
Sand et al., <sup>26</sup>	40 25	TTH, Migraine or Cervicogenic Headache	13	100
Fernández-de-las-Peñas et al., <sup>28</sup>	25 40	TTH	9	100
Fernández-de-las-Peñas et al., <sup>29</sup>	40 50	Unilateral Migraine	10	100
Grossi et al., <sup>30</sup>	44 34.1	Episodic or Chronic Migraine	8	100

TTH: Tension-Type Headache

It was also observed that the absolute values obtained at the tested points were lower in women than in men, however, this data is not statistically significant. The absolute values of pain thresholds were lower in patients with longer duration of headache (over 10 years) compared with the shorter time (less than 3 years).

## Discussion

In migraine and TTH patients, central sensitization is expressed clinically by a phenomenon called cutaneous allodynia,<sup>8</sup> which perception of pain generated by painless stimulus. These sensations have been described in several pain syndromes<sup>9</sup> and occur when performing daily activities such as combing hair or wearing tight clothing.

It is believed that nociceptors are sensitized after repeated attacks of headache. Neuropeptides such as substance P and peptide calcitonin

gene-related (CGRP) are released during acute migraine and produce perivascular neurogenic inflammation. CGRP is a glutamatergic neuromodulator of trigeminal ganglion synapses in the central nervous system (CNS) that transmits sensory information. Thus, CGRP may act by sensitizing synapses in the CNS.<sup>10</sup>

This modulation can be performed in two ways: presynaptic and postsynaptic. The presynaptic role is supported by increased levels of CGRP, and cAMP release of substance P from cultured trigeminal ganglion neurons.<sup>11</sup> On the other hand a function could involve postsynaptic signals cAMP or calcium CGRP receptor and may activate glutamate receptors.<sup>12,13</sup> Therefore, receptor antagonists CGRP could be a possible therapy for other pain disorders.<sup>14</sup> This inflammatory state probably sensitizes cranial nociceptors and subsequently decreases its activation threshold expanding their receptors.<sup>15</sup> Second-order and third-order neurons become activated and exposure to repeated episodes of pain eventually results in

decreased pain threshold<sup>16</sup> reaching up to 79% of patients with cutaneous allodynia.<sup>17</sup>

In our study women are the most affected by migraine, agreeing with the literature<sup>18,19</sup> and a high percentage of women (40 to 50%) have migraine attacks before, during or just after menstruation, which points to an association of migraine with female hormonal levels.<sup>20</sup> Conversely, hormonal contraceptives may cause no change or even improve pain.<sup>21-23</sup>

Our results revealed lower painful thresholds in TTH patients, whose have genetically predisposed individuals<sup>24</sup> or an exaggerated sensitivity to neuronal various stimuli, with facilitation of pain.<sup>25</sup> However, there was no significant difference between the group of patients with migraine and the other with tension-type headache, agreement other studies.<sup>26-29</sup>

We have not observed any difference in painful thresholds of patients with a higher frequency of pain. Our findings are in agreement with a study that evaluated women with episodic and chronic migraine.<sup>30</sup> In our study, the painful thresholds in migraine and TTH patients were lower than the control group at all points stimulated, similar to other studies with primary headaches, as seen in Table 4.

In our study, the pain thresholds in the extremities of the upper limbs, in the territory of the median, ulnar and radial nerves are lower in migraine and TTH patients than in the control group, supporting the idea that the repetition of pulses on C-fiber sensory amplifies the signals.<sup>31</sup> Development of pulsatility in the initial phase of migraine is mediated by sensitization of peripheral neurons of the trigeminal vascular system and allodynia cutaneous later during acute migraine is propelled by sensitization central neurons.<sup>32</sup> We have found the lowest pain thresholds in patients with longer duration of headache (over 10 years), probably by constant inflammatory state that sensitizes cranial nociceptors, leading to decreased activation of its receptors. To our knowledge, this was the first research pain threshold by pressure algometry in migraine and tension type headache in craniocervical muscles and peripheral nerves in both genders.

## Conclusion

Migraine and tension-type headache patients have lower pressure pain threshold at all stimulated points in craniocervical muscles and peripheral nerves in both genders.

## Conflict of interest

There are no conflicts of interest.

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