THERAPEUTIC EFFECT OF LOW LEVEL LASER THERAPY ON TENSION TYPE HEADACHE PATIENTS

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ABSTRACT

Aim. The aim of this study was to study the effect of Laser (low-level laser therapy) and placebo laser on patients with tension type headache who suffered from pericranial tenderness. Materials and Methods. Thirty patients (12 males and 18 females) were diagnosed as having tension type headache associated pericranial tenderness. Diode laser with wavelength 905 nm laser diode, hand pointer laser displays, continuous and pulsed mood operation. Each patient received 15 sessions from real and sham groups for five weeks by three sessions every week every other day according to trigger points (Trps) of pericranial tenderness related to tension type headache directly to the trigger points. Evaluation methods were total tenderness score, duration of pericranial tenderness with tension type headache and Wong-Baker faces pain rate scale. Results. Results obtained from the actual laser study group revealed significant relief of pericranial tenderness pain, a decrease in duration of pericranial tenderness episodes. Conclusion. This study concluded that using the low level laser in infrared range with wavelength 905 nm, is a physical therapy modality for relieving pericranial tenderness with tension type headache patients. Also, improvement in life quality, activity daily living and psychological status observed.

Key words: Pericranial tenderness, Tension type headache (TTH), Low level laser (LLLT), Trigger points (Trps)

I. INTRODUCTION

Tension type headache (TTH) the most prevalent headache disorder worldwide (1). Tension type headache ranks third in terms of global prevalence, and sixth in terms of global incidence, both higher than of migraine (2). Tension type headache (TTH) is the most frequent primary headache disorder in which both peripheral and central mechanisms suggest as important pain components (3-6).

Tension type headache diagnostic criteria include mild-moderate pressure-type pain in bilateral distribution occur with or without pericranial tenderness (7-8).

Tension Type Headache Diagnostic Criteria (ICHD-3); for infrequent episodic tension-type headache, headache occurring on <1 day per month (<12 days per year), for frequent episodic tension-type headache, headache occurring on 1 to 14 days per month (≥12 days and <180 days per year), for chronic episodic tension-type headache, headache occurring on ≥15 days per month (≥180 days per year). 4) In probable tension-type headache, fulfilling one of the diagnostic criteria for tension-type headache, but not meeting criteria for migraine.

Headache lasting from 30 minutes to 7 days

Headache has at least two of the following characteristics: Bilateral location, pressing or tightening (non-pulsating) quality, mild to moderate intensity and not aggravated by routine physical activity such as walking or climbing stairs. Both of the following: no nausea or vomiting (anorexia may occur) and no more than one of photophobia or phonophobia. However for chronic tension-type headache no more than one of photophobia,
phonophobia or mild nausea and neither moderate or severe nausea nor vomiting. Not better accounted for by another ICHD-3 diagnosis.

TTH is the muscular in origin while peripheral and central nervous system factors play basic role in the chronicity (9). Trigger points (TrPs), is hyper-irritable and painful locations with taut band of skeletal muscle. Active TrPs associate with pain complaint and press of the trigger point stimulate a referral pattern of nondermatomal pain, which match with the patient’s pain complain symptoms. Latent TrPs not cause pain and lack the referral pain like in active TrPs (10-12).

Latent trigger points, painful only if palpated, active trigger points produce pain in motion and at rest (13). Both active and latent TrPs stimulate motor dysfunctions, e.g. weakness, increase motor irritability, muscular imbalance and altering motor recruitment (14-15). Sustain muscle fibers contraction in TrPs promote hypoxic state with ischemia which following the high concentrations of substances like calcitonin gene-related peptide (CGRP) and substance P, which leads to an increase in peripheral nociceptive transmission (16).

Activities aggravate muscular tension, bad posture, and poor ergonomic environment involve; over-head activity, just for 10 minutes, reduce the pain threshold and cervical ROM (17-18). Low level laser therapy able to decrease the severity, elevate pain threshold, and improve cervical ROM (19-20).

Modify of neurotransmitters presents as a possible mechanism for pain relief, like serotonin and endorphin which increase following laser therapy for facial pain (21). Near-infrared laser therapy advancement functional and morphological results in range of central nervous system lesions in vivo, by decease oxidative stress status (22).

Infrared laser emissions successful to reduce facial pain up to 180 days after treatment (23). The effects of LLLT occur due to an increase in oxidative metabolism in mitochondria (24). LLLT appears an effective therapy modality for achieve pain relief in adult patients with musculoskeletal problems (25).

II. MATERIALS AND METHODS

Design
The study was designed as a prospective, randomized, controlled trial. It was carried out between March 2019 and September 2020. It followed the Guidelines of Declaration of Helsinki on the conduct of human research. Approval of EACRP ethics com-mittee has been obtained with reference number (PHYSLAS00221015) (RCT registration number NILESMAL0012/2016).

Participants
A convinced thirty adult patients (12 males and 18 females), diagnosed with pericranial tenderness linked to tensiontype headache participated in the study. They were recruited from the pain management units and Neurology Sohag University Hospitals Outpatients Clinics, General and Military Hospital in Sohag City (Upper Egypt), Egypt. The participants' age was 25-60 years. Participants were included if they 1. Diagnosed with stress level Headache (TTH) pericranial tenderness. 2. Corresponded to the International Headache Society (IHS) 3rd edition pain of headache diagnosis guidelines. 3. Had good cognitive skills which allowed them to understand the study requirements. The exclusion criteria were suffering of cancer and/or human immunodeficiency virus (HIV), had a history of head and/or neck trauma, head and/or neck surgery, central nervous system lesion (e.g. Stroke), have cervical discs’ lesions, uncontrolled hyper tension (> 190/110 mmHg), have psychological abnormalities, have cranial nerves lesions (e.g. Facial palsy), skin diseases, coexisted headache types [e.g. TTH & Migraine], have blindness and/or deafness, temporomandibular disorders (TMD), increased intracranial pressure, muscles diseases (e.g. Myopathy) and have head and/or neck vascular problems.

Randomization
Each participant was informed about the nature, purpose, and benefits of the study, the right to refuse or withdraw at any time, and the confidentiality of any obtained data. Participants were randomized into 2 equal groups (a&b) by a computer based randomization program. After randomization, there was not any dropping out of subjects from the study.

Interventions
Group a (True Laser) consisted of 15 patients (7 males and 8 females) obtained true laser at trigger points. Group b (sham laser) consisted of 15 patients (5 males and 10 females) received sham laser at trigger points.

**Laser equipment and application**

Low level laser therapy (LLLT) equipment with, wavelength 905 nm laser diode, hand pointer laser displays continuous and pulsed mood operation, Class III B, 230 V power supply and Italian model LIS 1050. The laser system was calibrated by the National Institute of the laser enhanced sciences at Cairo University.

Each patient from real and sham groups received 15 sessions to trigger points linked to tension type headache directly to the trigger points and perpendicular probing contact to the scalp, three sessions per week every other day, up to a maximum of ten points. The actual group got laser with (50 m Watt) and sham group got sham laser with (0 m Watt). All groups with a time of one minute per point, using continuous mode and using contact skin method after using alcohol to clean the skin of application area per session, all sessions performed for all patients from long setting and supine lying positions.

**Outcome measures**

The comprehensive sheet for each subject included the name, age, gender, work, address and telephone number. In all patients, comprehensive history was documented and thorough neurological examinations were carried out with investigations. Detailed questionnaire about tension type headache history, pericranial tenderness, to all patients, the trigger points, the drug overuse of analgesics and factors linked to tension type headache were made.

**Total tenderness score**

In this study, the Maximum Tenderness Score was used to assess the laser effect in patients with TTH. A combination of behavioral and verbal components, each scored on a four-point Likert scale, described as 0 denial of tenderness, no visible reaction 1 verbal report of discomfort or mild pain, no visible reaction 2 verbal report of moderate pain, with or without overt reaction 3 verbal observation of marked pain and clear reaction, according to Langermark and Olesen (26). This evaluation was conducted from supine and long set positions to eliminate muscle tension by neck extenders, and then by manual pressure applied to seven pairs of muscles and/or tendon inserts, including massage, temporalis, frontalis, trapezius, sternocleidomastoid, occipital muscle inserts, and mastoid processes. Palpation was repeatedly bilateral over the muscle / insertion surface by applying second and third finger pressure which is equivalent to one kg when making small circular motions for four to five seconds. The answer of the patients was registered, and the maximum Total Tenderness Score (TTS) was 42 (7 x 2 x 3 tender spots upper right / left).

**Duration of pericranial tenderness with tension type headache episodes**

This assessment was performed before the start of the study and after the end, and after one month later, the evaluation was carried out through telephone calls. This assessment was achieved by asking the patients the following question by hours, what were the total hours of pericranial tenderness with a tension type headache you had last month? Headache diary is also used as a diagnostic tool and the most effective tool for determining headache severity, frequency and length of headache, and is highly recommended for use in nonpharmacological randomized controlled trials (27-28).

**Wong-Baker FACES Pain Rating Scale**

This assessment was done before and after the treatment by asking patient to choose the face that best match the pain he experienced. Explained to the patients that each face represents a person who has no pain (hurt), or some, or a lot of pain.

Figure1
Statistical analysis

According to the randomization list, data were collected and tabulated, then analyzed using SPSS (v. 25) to investigate and detect whether there were statistical differences in the effect of low level laser (LLLT) (infrared) and sham laser on patients with pericrania tenderness and tension type headache. Descriptive analyzes in mean and standard deviation form. For each party, paired t-test was performed to compare the pre and post-sessions. For comparison of both classes, an unpaired t-test was performed. Results expressed as mean and standard deviation (SD), meaning level at p-value 0.05.

III. RESULTS

The participant characteristics of both groups were summarized in table 1. There was no significant difference in the mean age, weight and height between both groups (p < 0.05). The obtained results showed highly significant differences between all variables for pre and post-treatment assessment. Table 1 & Figure 1

Table 1 Comparison between the mean values in pre and post treatment for total tenderness score, duration of tension type headache pericranial tenderness attacks, and Wong-Baker faces pain rating scale for group a and b:

<table>
<thead>
<tr>
<th>Pairs</th>
<th>Assessment Parameters</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>T</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>laser total tenderness score pre-treatment (Group a)</td>
<td>25.33</td>
<td>3.086</td>
<td>-19.858</td>
<td>.0001***</td>
</tr>
<tr>
<td></td>
<td>laser total tenderness score post-treatment (Group a)</td>
<td>14.93</td>
<td>3.770</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>sham laser total tenderness score pre-treatment (Group b)</td>
<td>24.27</td>
<td>4.061</td>
<td>2.549</td>
<td>.023**</td>
</tr>
<tr>
<td></td>
<td>sham laser total tenderness score post-treatment (Group b)</td>
<td>19.87</td>
<td>5.153</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Laser Headache time pre-treatment (Group a)</td>
<td>104.00</td>
<td>51.242</td>
<td>6.468</td>
<td>.0001***</td>
</tr>
<tr>
<td></td>
<td>Laser Headache time post-treatment (Group a)</td>
<td>57.33</td>
<td>28.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sham Laser Headache time pre-treatment (Group b)</td>
<td>83.33</td>
<td>36.775</td>
<td>2.615</td>
<td>.020**</td>
</tr>
<tr>
<td></td>
<td>Sham Laser Headache time post-treatment (Group b)</td>
<td>72.67</td>
<td>27.115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Laser wong-baker pre-treatment (Group a)</td>
<td>7.47</td>
<td>1.187</td>
<td>16</td>
<td>.0001***</td>
</tr>
<tr>
<td></td>
<td>Laser wong-baker post-treatment (Group a)</td>
<td>3.20</td>
<td>1.014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Sham Laser wong-baker pre-treatment (Group b)</td>
<td>7.20</td>
<td>1.474</td>
<td>6.5</td>
<td>.0001***</td>
</tr>
<tr>
<td></td>
<td>Sham Laser wong-baker post-treatment (Group b)</td>
<td>5.47</td>
<td>1.187</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Showed high significant difference p < 0.023
*** Showed extremely high significant difference p < 0.0001
IV. DISCUSSION

Low level laser therapy increase cell physiology by improve all cell redox potential toward more oxidation and increase ROS with decrease reactive nitrogen species, all changes in redox state activate many intracellular-signaling pathways, include synthesis of nucleic-acid and protein, activate enzyme, and cell cycle progress (29).

Indeed, several possible mechanisms attribute to LLLT such as: increase endogenous opioid neurotransmitter production (30), increase the production of anti-inflammatory cytokines (31-33), increase adenosine triphosphate (ATP) production at the cellular level (34-36), raise threshold to thermal pain and enhance local blood circulation (37 38).

60 patients with facial pain syndrome with one trigger point in the anterior masseter and anterior temporal muscles assigned randomly to six groups and 10 patient each group: Groups 1-3 treated (780 nm) laser, applied in continuous mode, twice a week, for four weeks. Groups 4-6 treated with placebo applications, by same parameters as the treated groups. Pain scores assessed just before, immediately after fourth application, immediately after eighth application, through 15 days and one month after treatment, pain reduced (P< 0.001). Analgesic effect of the LLLT similar to the placebo groups. Using the parameters described in experiment, LLLT effective in reduce the pain experienced by patients with facial pain syndrome (39). Our study gave an evidence but with different wavelength.

Low level laser therapy suitable for decreasing the pain severity, increasing pain threshold and increasing cervical range of motion (19’20). Low level laser therapy improve muscle performance and reduce of muscle fatigue, at wavelength from 655-950 nm (40).

Reactive oxygen species represent as causative of pain, by induce hyperalgesia (41). An evidences support efficacy of LLLT in modulation of antioxidant capacity (42) as well as reduce in ROS (43).

Conflicting of LLLT effect due to inequality in patient groups, treatment plan, laser parameters, and dosimeter and follow-up (44’45).

The placebo effect, promote analgesia by liberation of endogenous opioids with activation for descending neural pathways of the pain modulation, which influence by many factors: Memories, belief, the hope of a treat, learn professional-patient relationship, and socio-cultural context, among others (46’47).
CONCLUSION

This study concluded that using the low level laser in infrared range with wavelength 905 nm, is a physical therapy modality for relieving pericranial tenderness with tensiontype headache patients. Lowlevel laser 905 nm in patients with pericranial tenderness with tensiontype headache patients, decreased tenderness severity, decreased tenderness duration of tension type headache. Also, improvement in life quality, activity daily living and psychological status observed.

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REFERENCES