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**Neurobiological Basis and Evaluation of Acupuncture in  
Pain Management**

by

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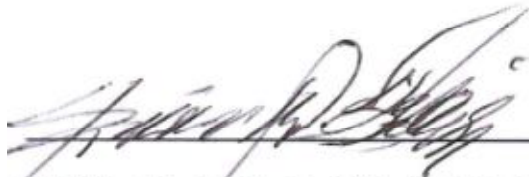
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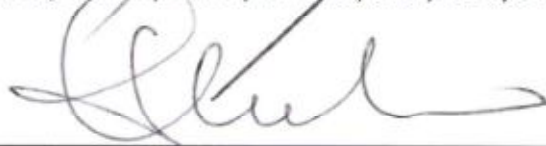
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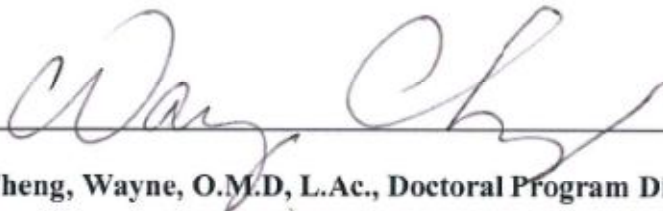
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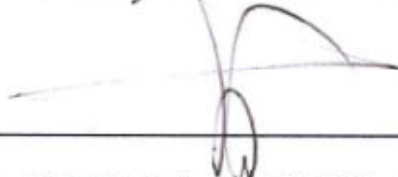
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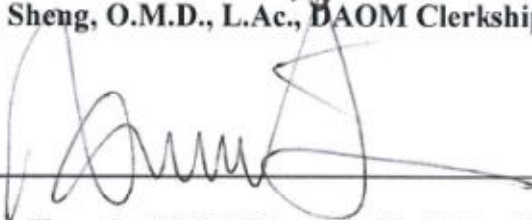
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# **Neurobiological Basis and Evaluation of Acupuncture in Pain Management**

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## **ABSTRACT**

In spite of increasing usage of acupuncture as a complimentary procedure for pain management in the modern world, still many aspects of Traditional Chinese Medicine especially acupuncture remain unclear for western medical physicians.

Pain in oriental medicine is developed when there is a disruption or blockage in meridians qi flow, as a result of Yin and Yang imbalance. So the pain diagnosis in oriental medicine is holistic process, which is based on the specific symptoms, pulse and tongue patterns. All of pain causes are categorized in abstract concepts such as Exterior/Interior, Yang/Yin, Excess/Deficiency and Heat/Cold. So, the Asian medicine does not need any specific diagnostic tools or paraclinic procedures including lab tests, imaging technologies such as X-ray, CT scan or MRI.

On the other hand, in western medicine most of pain diagnostic findings are based on various paraclinical objective data. Accordingly, because of this linear and regional thinking, there are much more diverse categories for pain diagnosis.

In this proposal, in addition to explain the pain management knowledge gap between western and oriental medicine, a comprehensive review of measurable acupuncture effects on nervous system activity including neurotransmitters and neurohumoral factors, in central and peripheral nervous systems has been proposed to fill this gap.

Although the study of neurobiological basis of acupuncture in pain management will demonstrate just one aspects of Traditional Chinese medicine, and other abstract concepts of this knowledge remain unclear for western physicians, finding similar or opposing effects of different western or oriental treatment plans on specific neurotransmitter or neural tracts, will be helpful to create effective integrated approaches and protocols for different pain categories..

Meanwhile, as a result of explaining of Chinese medicine by objective neurological data, we make a tangible understanding of oriental medicine in western medical societies.

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## I. INTRODUCTION

Both oriental and western medicine involve in controlling and managing pain which is the most challenging health issue in human life. Western medicine has its own linear and detailed thinking, but on the other hand oriental medicine describes diseases including pain as holistic imbalance in human body.

Although acupuncture has been used over thousands of years the mechanisms of acupuncture as a whole remain unclear for modern world. In modern world every theory and procedures must be evaluated by practical methods with measurable and visible results, abstract concepts such as Yin, Yang and five elements are not acceptable.

Therefore in order to have more integrated approach in pain management, oriental medicine, in spite of its abstract and holistic nature has to prove its efficacy by western regional and linear tools and terminology. While describing the neurological effects of oriental medicine procedures by western medicine language demonstrates just one aspect of oriental treatment. Just like describing a 3-dimensional object by its 2 dimensional shadow.



## **II. MATERIALS AND METHODS**

Relevant research concerning neurological effects of acupuncture treatment will be identified by searching the English medical database such as EBSCO Research, PubMed and Wanfang Data. These data bases will be searched for publications from 1970 through to the present (2015), but key articles will obtained primarily from MEDLINE, and The Cochrane Library. The Google Scholar will also be a helpful search engine in this regard.

In order to ensure that relevant studies will not be missed, the search terms will be remained broad. These are "Acupuncture treatment", plus "Pain Management" or "Pain Control" plus "Neurology" or "neurological", anywhere in the title or abstract. The languages will be restricted to English and Farsi. Studies will be eligible for consideration in this review if: (a) the focus of the study is Acupuncture treatment, and (b) the article is written or approved by western medical communities and published in Scholarly Journals.

### III. RESULTS

Chronic low back pain is a common health issue associated with disability and high medical expenses. In western countries, about 70% of individuals have back pain in their lifetime. Patients with back pain causes more than \$90 billion in health care expenses every year.<sup>1</sup>

In a randomized, placebo-controlled clinical trial with after 9 month follow up, 131 patients with non-radiating low back pain for at least 6 months have been recruited. These patients were divided into three groups (acupuncture, sham acupuncture and control). Patients in control group only received physical therapy for 12 weeks, and in other two groups patients received 20 sessions of either acupuncture or sham acupuncture in addition to physical therapy over the same 12-week period. The results indicate that acupuncture had a better result than physical therapy regarding pain intensity, pain-related disability, and psychological distress. Regarding the psychological stress reduction, the When compared with sham acupuncture, acupuncture was more effective than sham acupuncture.<sup>2</sup>

In another study, 1162 patients with chronic low back pain were recruited, low back pain was improved for at least 6 months, in patients who were treated by acupuncture therapy. The acupuncture effectiveness, either true(47.6%) or sham (44.2%), was almost twice that of conventional therapy (27.4%).<sup>3</sup>

In another large-scale clinical trial, 3,093 patients with chronic low back pain were randomly divided into two groups: conventional medical care group and acupuncture treatment group. Low back pain, quality of life and back function, were

assessed at the beginning and after 3 and 6 months of duration. Meanwhile, the cost-effectiveness of different therapies was also analysed. The results showed that routine care plus acupuncture was associated with a marked clinical improvement in these patients and it was more cost-effective.<sup>4</sup>

On the whole, the clinical practice guideline which was issued by American College of Physicians and the American Pain Society for chronic low back pain recommends physicians to consider acupuncture as an alternative and non-pharmacologic therapy for low back pain.<sup>5,6</sup>

However, In order to evaluate the efficiency of acupuncture treatment for cancer-related pain, a systematic review of literatures was done. as compared with the drug therapy alone, acupuncture plus drug therapy resulted in increased pain-free duration and pain remission rate, and better quality of life without serious side effects.<sup>7</sup>

In another study, many aspects of treatment results including analgesic usage, returning to work and sleep quality, were improved after 8 weeks of acupuncture on the low back pain treatment in 50 patients. These effects lasted up to 6 months.<sup>8</sup> Meanwhile , the duration of acupuncture therapy in a single session had different effects on treatment results. While there is significant difference between 15-mins and 30-mins treatment, a 45-mins acupuncture treatment did not have more effect than 30-min therapy.<sup>9</sup>

Another study demonstrated that, using electrical acupuncture stimulation with percutaneously placed needles in 30-mins and 45-mins durations had similar effects in sleep quality scores, oral analgesic usage, the visual analogue pain scale and physical activity. But these effects were better than 0 (no treatment) or 15-min acupuncture

therapy.<sup>10</sup> Overall, both acupuncture and transcutaneous electrical stimulation (TENS) demonstrated significant effects on pain reduction, whereas acupuncture was more effective than TENS in lumbar spine range of motion.<sup>11</sup>

Regarding chronic neck and shoulder pain, there are some assuring results on the treatment of shoulder and neck pain by acupuncture. In one study, chronic pain in neck and shoulders were reduced for at least three years with a improvement in pain-related activity, depression, anxiety, sleep quality, and quality of life.<sup>12,13,14</sup>

These results are also were supported by several clinical trials of acupuncture on chronic neck pain with sample sizes from 115 to 177 patients. These studies showed that acupuncture was better than controls in overall range of motion and neck pain reduction.<sup>15</sup>

Meanwhile, in treating balance disorders caused by cervical torsion after whiplash injuries, acupuncture has been demonstrated to be an effective treatment. Whiplash injury usually is associated with a long-lasing chronic neck and shoulder pain, these studies suggest that acupuncture can be an alternative treatment approach for the whiplash injury-related disorders.<sup>16</sup>

Regarding acupuncture treatment as a complimentary therapy for patients with neck pain caused by neck tension syndrome, a study showed that the combination treatment of acupuncture and physical therapy had better results than acupuncture or physical therapy alone. All groups in this study showed significant improvement after 10-week treatment, but the group which received a combination of acupuncture and physical therapy had better results in function improvement and pain reduction and than other

groups which received only acupuncture or physical therapy. At six-month follow-up, all groups maintained improvement ( $p < 0.05$ ). This study suggests that acupuncture treatment may provide an enhanced therapy for musculoskeletal rehabilitation by physiotherapy in tension neck syndrome.<sup>17</sup>

In a study which was done on randomized, double-blind, sham-controlled basis acupuncture, sham acupuncture and dry needling have been compared in patients with chronic neck pain. All patients were randomly assigned to an acupuncture group or a control group who did not receive acupuncture. Distal points acupuncture demonstrated better results in motion-related pain scores reduction and range of motion improvement.<sup>18</sup> For neck pain caused by cervical spondylosis, in one study which involved 106 patients, all patients randomly assigned into a real acupuncture treatment group and a control group with sham acupuncture treatment. 75.5% of patients in acupuncture group and 52.8% in the control group were improved ( $P < 0.05$ ).<sup>19</sup>

In order to evaluate the effectiveness of acupuncture plus routine care in patients with chronic neck pain as compared to treatment with routine care alone, a randomized, controlled multi-center trial was done. In this study 14,161 patients who had chronic neck pain for more than 6 months were randomized to an acupuncture group or a control group receiving no acupuncture. Patients in acupuncture group received 15 acupuncture sessions for 3 months. The results demonstrated a significant improvement in disability and neck pain in the randomized acupuncture group ( $P < 0.001$ ). This large scale clinic study showed that combination of acupuncture with routine medical care in patients with

chronic neck pain may have better results than routine medical care alone in both disability reduction and pain improvement.<sup>20</sup>

There are some evidences that acupuncture has more effects on pain relief than some types of sham controls. This matter was shown in two meta-analysis studies with 14 clinical trials measured immediately after the treatment and at short-term follow-up. There were also some evidences that showed acupuncture had more effects than massage at short-term follow-up. On the whole, acupuncture has a short-term effectiveness and efficacy in neck pain treatment.<sup>21,22</sup>

Meanwhile, acupuncture might be associated with better health economic effects. A study concluded that according to international cost effectiveness threshold values, acupuncture is a cost-effective treatment in patients with chronic neck Pain.<sup>23</sup>

Acupuncture has become an effective treatment modality for those patients who suffer from tension headache, migraine, and other types of headaches.<sup>24</sup> In a study, 302 patients suffering from migraine headache were randomly assigned into three groups (acupuncture, minimal acupuncture and waiting list). This study showed that a significant deference of treatment effects between those treated with acupuncture and minimal acupuncture and those on the waiting list for treatment.<sup>25</sup> Many studies (sample size from 50 to 2,022 ), have also shown similar result for tension or migraine headache treatment by acupuncture.<sup>26</sup> Regarding treatment economic issue, according to international cost-effectiveness threshold values, acupuncture is a cost effective therapy for primary headache.<sup>27</sup> In addition, many children with headache also benefit from

acupuncture.<sup>28</sup> For many patients, acupuncture is more effective than sumatriptan with less complications.<sup>29</sup>

In another study, on 29 patients with Chronic tension-type headache (CTTH), it is demonstrated that electro acupuncture was superior to sham acupuncture to alleviate pain (VAS scores  $2.38 \pm 1.77$  and  $3.02 \pm 2.49$ , respectively,  $P=0.005$ ), and the brain-derived neurotrophic factor (BDNF), which is neuroplasticity mediator in EA group was also higher than the sham group.<sup>30</sup>

Two to four month prophylactic acupuncture treatment of migraine without aura has significantly decreased the number of attacks comparing to oral therapy with flunarizine.<sup>31</sup> A comprehensive study of 27 clinical trials for evaluation of acupuncture efficacy in treatment of primary headaches (tension headache, migraine headache, and mixed forms), demonstrated that favourable outcomes of using acupuncture.<sup>32</sup> Another study of eleven trials with 2317 patients concluded that acupuncture treatment has significantly improved headache in short-term (for 3 months) comparing control and sham groups, pain score and the number of headache days. So this study demonstrated acupuncture therapy as a powerful non pharmacological treatment in patients with tension headaches.<sup>33</sup>

#### IV. DISCUSSION

The word "pain" is used to describe a wide range of unpleasant sensory and emotional experiences associated with actual or potential tissue damage. Pain is a subjective feeling and each individual learns to use this term through experiences related to injury in early life. While nature has been convinced that pain is a signal we cannot ignore.

The ability to diagnose different diseases depends on the knowledge of the different pain characters. Sensitiveness to noxious stimuli is essential for survival of an organism. Without these abilities, the organism has no means to prevent or minimize organ injury. Individuals who have congenital insensitivity to pain are easily injured and most of them die at an early age.

For thousands of years, physicians have tried to cure pain without knowing the details of the ways in which pain feeling is created in the injured part of the body and transmitted to the brain, or even the ways in which any of their herbs worked. Recent discoveries about how the body detects, transmits and reacts to painful stimuli, have provided efficient tools for treatment of acute and chronic pain.

According to Traditional Chinese Medicine the human internal “organs” are composed of Yin and Yang system. This theory suggests that health can be achieved by maintaining the human body in a balanced status of Yin and Yang, and diseases are developed as a result of internal imbalance between Yin and Yang systems. Furthermore, this theory of Traditional Chinese Medicine indicates that qi, as the life energy which circulates through specific tracts, so called meridians, in human body produces effects on



human health. The balance of the opposing energy of Yin and Yang systems is considered to be the basis for a healthy circulation of qi. Therefore any imbalance of the Yin and Yang system would cause the disruption or obstruction of the qi circulation in meridians which leads to a state of disease or pain. By inserting needles at specific acupuncture points along the meridians, normal balance of the Yin and Yang systems can be restored and the blockage from the qi flow within meridians will be removed.

Both peripheral and central nerve system, are affected by acupuncture treatment through neurotransmitters, neurohumoral factors.

The analgesic effect of acupuncture can be abolished by posthepetic neuralgia or local anaesthetics, so there is a close consistency between peripheral nervous system and meridians and an intact peripheral nerve system appears to be essential for the acupuncture analgesic effects.<sup>34,35</sup>

For its neurohumoral effects it has been revealed that acupuncture can increase the endogenous endorphins production and its analgesic effects is blocked by naloxone as a opioid receptor antagonist.<sup>36</sup> The humoral factors, which may mediate acupuncture analgesia are released into the cerebrospinal fluid after acupuncture.<sup>37</sup>

In Central nervous system some studies demonstrated that Electric Acupuncture at different frequencies could have different effects on the production and release of neuropeptides.<sup>38</sup> Meanwhile, newly developed neuroimaging technologies such as functional magnetic resonance imaging (fMRI) and positron emission topographic (PET) showed that the pain neuronal activities in somatosensory Cortex, Prefrontal Cortex,

Thalamus, Hypothalamus and Periaqueductal Gray (PAG) in the human brain have been weakened by the filling of “qi arrival” after acupuncture.<sup>39,40</sup>

Many studies indicate that the production and release of neurotransmitters such as epinephrine, norepinephrine, dopamine, and 5-hydroxytryptamine have been significantly affected by acupuncture.<sup>41</sup> These effects are inhibited by naloxone, which suggests endogenous opioids involvement in this process.<sup>42</sup>

Regardless of how patients outcome of acupuncture treatment, it is demonstrated that acupuncture increases awareness and acceptance of the chronic nature of pain, and also attention to the need to take responsibility for their own health.<sup>43</sup>

## V. CONCLUSION

In spite of extensive studies in oriental medicine, especially acupuncture, for treatment of back, neck and knee pain, and also headache. However, researchers are still beginning to understand whether acupuncture can be helpful for pain management.

Although there are some medical treatment options, long-term effects of these medical treatments remain limited. During the last years, acupuncture has been one of the most frequently alternative therapies for treating low back pain

In fact, because of detailed and linear thinking in modern medical science, it is very difficult for researchers to explaining the holistic effect of acupuncture on human body. Western medical scientists mostly are looking for causes and effects in a specific organ, and even we have various sub-specialities for a single organ. Therefore this detailed thinking sometimes is unable to describe multiple effects of acupuncture on whole body and different organs.

In order to integrate these two different fields more efficiently, it is necessary to have more holistic view in western medicine and more specific view in Oriental medicine.

In addition, it is concluded that acupuncture in selected patients and when used by an appropriately qualified practitioner appears to be a cost-effective therapy for use in general practice, reducing the need for more expensive hospital referrals.

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