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ACUPUNCTURE AS AN ADDITIONAL ANALGESIC METHOD IN THE PERIOPERATIVE PERIOD

AKUPUNKTURA KAO DODATNA ANALGETSKA METODA U PERIOPERATIVNOM PERIODU

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Summary

Acupuncture is a traditional Chinese therapeutic method that uses a sterile thin needle technique to puncture the skin at specific strategic points on the body. World Health Organisation has acknowledged acupuncture as a complementary treatment method for over 300 diseases. Nowadays, many available studies conducted in China, the United States, and Europe confirm the efficacy of acupuncture, its analgesic effect, while providing direct health benefits without or with minimal side-effects. There are many scientific evidence mechanisms of acupuncture's analgesic effects. One of the mechanisms is described in the oldest and best-known Gate Control Theory which explains how pain pathways are modulated through normal anti-nociceptive pathways in the spinal cord. The second mechanism of analgesia shows that there are changes in descendent inhibition of pain pathway and secretion of neurotransmitters when the acupuncture needle is placed at the specific acupuncture point. In addition, it has been proved that there is an increased secretion of endogenous opioids during acupuncture procedures, which help reduce the pain sensations. Analgesic effects of acupuncture on cerebral function have been confirmed with use of functional magnetic resonance imaging and positron emission tomography scans. Although there is an increased number of relevant studies that confirm the effects and benefits of acupuncture therapy in the perioperative period, some important factors are still missing: the standardization process of acupuncture technique, the determination of types of surgery where the acupuncture method shows the best therapeutic effect, the determination of the best technique and time interval for the most effective analgesia.

Key words: Acupuncture; Analgesics; Perioperative Period; Pain; Enhanced Recovery After Surgery

Introduction

Acupuncture is a traditional Chinese therapeutic method that uses a sterile thin needle technique to puncture the skin at specific strategic points on the body. In 1979, the World Health Organisation (WHO) acknowledged acupuncture as a complementary treatment method for over 50 diseases. The list of diseases has expanded over time and now there are over 300 indications for acupuncture treatment [1].

Sažetak

Akupunktura je drevna kineska metoda lečenja pomoću sterilnih igala koje se ubadaju u tačno određene tačke na koži. Svet-ska zdravstvena organizacija je priznala akupunkturu kao metodu komplementarne grane medicine i preporučila je za lečenje više od 300 bolesti. Danas postoji veliki broj studija sprovedenih u Kini, Americi, evropskim zemljama, od kojih mnoge potvrđuju efikasnost akupunkture, analgetski efekat, doprinos poboljšavanju zdravlja bez ili uz minimalne mogućnosti štetnih efekata. Postoji više naučno potvrđenih mehanizama o analgetskom efektu akupunkture. Jedan od njih je opisan u najstarijoj i najpoznatijoj teoriji „kontrolne kapije” gde je objašnjena modulacija puta širenja bola kroz normalan anticeptivni put u kičmenoj moždini. Drugi mehanizam je da ubadanjem iglica u akupunkturne tačke dolazi do promene u descendentnoj inhibiciji prenosa bola i lučenju neurotransmitera. Pored ovoga, dokazano je da dolazi do povećanog oslobađanja endogenih opioida koji doprinose smanjenju osećaja bola. Analgetski efekti akupunkture na funkciju mozga su potvrđeni i pomoću funkcionalne magnetne rezonancije i pozitronske emisije tomografije. Uprkos tome što postoje relevantne kliničke studije, koje idu u prilog efikasnosti korišćenja akupunkture u perioperativnom periodu, ono što nedostaje jeste: standardizacija primene akupunkture, u kojoj vrsti hirurgije se postižu najbolji terapijski efekti akupunkture, na koji način je primeniti i u kojim vremenskim intervalima da bi akupunktura dala mnogo efikasniju analgeziju.

Ključne reči: akupunktura; analgezija; perioperativni period; bol; ubrzan oporavak nakon operacije

Although acupuncture is an ancient Chinese therapeutic method, the use of acupuncture has expanded in the last four decades in Europe. Western medicine hardly accepts this type of treatment as it seems there is no scientific evidence for it. Merging the two types of therapeutic approaches, the Western and the Eastern, is hard as they have different origin. Western medicine relies on anatomy and physiology while Eastern medicine has its roots in philosophy [2].

Abbreviations

WHO	– World Health Organisation
fMRI	– functional magnetic resonance imaging
PAG	– periaqueductal gray matter
RVM	– rostroventromedial medulla
NRM	– nucleus raphe magnus
GABA	– gamma-aminobutyric acid
ERAS	– Enhanced Recovery After Surgery
TEAS	– transcutaneous electric acupuncture stimulation

Nowadays, many available studies conducted in China, the United States, and Europe confirm the efficacy of acupuncture and its analgesic effect, while providing direct health benefits with minimal side-effects [3–7].

According to the analysis done by WHO, which included several randomized controlled trials, acupuncture has proven to be a highly effective method in the treatment of headache, postoperative nausea and vomiting, migraine, chronic neck pain, shoulder periarthritis, elbow pain, chronic back pain, knee osteoarthritis and various of different pain syndromes. The results were significantly better when acupuncture was performed in addition to conventional pain treatment in comparison to only conventional pain treatment [1, 8]. In addition, acupuncture helps reduce the severity of symptoms of chronic diseases, helping patients have better quality of sleep, reducing anxiety, fatigue, and helping them have more energy, which all reflect on better quality of life [9].

Acupuncture is based on the premise that humans, as all living beings, are filled with life energy that circles the human body through specific pathways or meridians. Meridians are energetic flows of

energy named *Chi*, which is composed of Yin and Yang (**Figure 1**). When a human is healthy, Yin and Yang are balanced. The disease develops when Yin and Yang are imbalanced due to the blockage in energy flow. Acupuncture helps return the body to a balanced state by stabilizing the energy flow [2].

Mechanism of pain

It is important to know the pain pathophysiology in order to understand the analgesic effect achieved by acupuncture [10].

Pain is an unpleasant sensory and emotional experience that accompanies the existing or potentially existing tissue damage [11].

Pain can be classified by duration, pathogenesis, localization and etiology. Pain experienced during surgery or during postoperative period is nociceptive pain resulting from tissue damage and lesion [12].

Pain pathways consist of an ascending excitatory pathway and a descendent inhibitory pathway. Ascending pathways carry excitatory information from peripheral tissues, through the spinal cord to the brain. Descending pathways carry inhibitory information from the brain to the spinal cord. The spinal cord is called the "Pain gate" and it is a place where the ascending and descending pathways meet. The predominance of the excitatory or inhibitory pathways determines the feeling of pain and its intensity (**Figure 2**) [10].

Tissue damage causes the release of proinflammatory mediators (prostaglandins, bradykinins, leukotrienes, interleukins, etc.) and activation of nociceptive receptors [10, 13].

Nociceptors are pain receptors in the form of bare nerve endings that react to mechanical, thermal and pain sensations. By activating the receptors, the stimuli are transmitted by an ascending pathway up to the spinal sensory ganglia, which represents the first-order



Figure 1. Traditional Chinese medicine – Yin and Yang
Slika 1. Tradicionalna kineska medicina – jin i jang
Wikipedia Contributors. Yin and Yang [Internet]. Wikipedia. Wikimedia Foundation; 2019. Available from: https://en.wikipedia.org/wiki/Yin_and_Yang

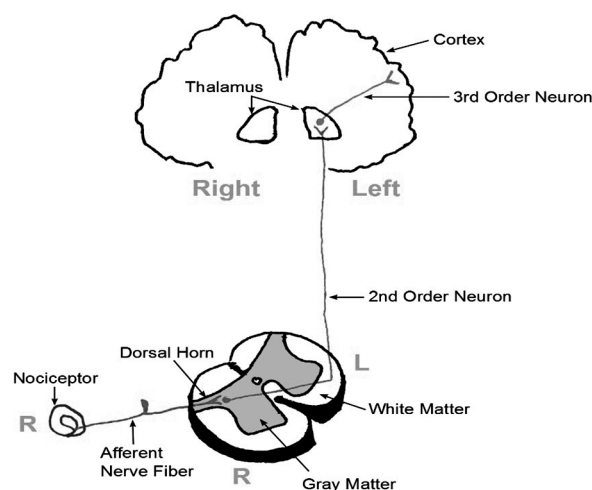


Figure 2. Pain transmission pathway

Slika 2. Put širenja bola

Pain Pathway Flowchart: The Complete Steps [Internet]. www.zenflowchart.com. Available from: <https://www.zenflowchart.com/blog/pain-pathway-flowchart-the-complete-steps>

neuron. The first-order neuron body within the ganglia projects its axons to the posterior gray horn of the spinal cord, where it builds a synapse with the body of the second-order neuron [10, 13].

The transmission of sharp, well-defined painful stimuli from nociceptors goes through two classes of nociceptive fibers to the spinal cord. These fibers are A- β and A- δ myelinated fibers. Chronic, dull pain is transmitted through slow, non-myelinated C fibers [10, 13].

The axons of the second-order neuron build an ascending pathway that crosses the medial line and ends in the thalamus, which is considered a third-order neuron. The thalamus not only represents a relay station where the synapsis between the second- and the third-order neuron is built, but also a place where impulses traveling to the cerebral cortex are transformed and modulated. A number of neurotransmitters are released during this process [10, 13, 14].

The information is transmitted from the thalamus to the cerebral cortex and subcortical structures, where the fourth-order neuron is located and the painful stimuli are finally integrated. Cerebral areas that are activated the most are primary and secondary somatosensory cortex, periaqueductal gray matter (PAG) in the upper brain stem, rostroventromedial medulla (RVM), locus coeruleus, nucleus raphe magnus (NRM) and nucleus reticularis gigantocellularis. The formation of localization, nature and pain intensity take place in cortical structures, and the emotional perception of pain is formed [10, 13, 14].

The inhibitory pathway that modifies the pain response travels in the opposite direction, from the upper brain areas to the spinal cord. With use of the inhibitory pathway, PAG and RVM send inhibitory signals by releasing endogenous opioids, gamma-aminobutyric acid (GABA) and glycine, which can produce analgesic effects. On the other hand, pain perception is enhanced by substance P, glutamate and aspartate [10, 13, 14].

Acupuncture mechanisms of action

Many acupuncture methods are known: manual, electroacupuncture, laser acupuncture, moxibustion, auriculotherapy, acupressure. Nevertheless, the application of acupuncture on specific points to achieve analgesia and other regional and systemic effects is common for all of them [15]. From the scientific point of view, the mechanism of acupuncture in reducing pain response to painful stimuli is complex. The changes occur in peripheral and central structures and include direct and indirect neurochemical effects [16–18].

One of the oldest, best known, and scientifically proven theories of acupuncture action mechanism is the “Gate Control Theory” [19, 20]. This theory suggests that the modulation of pain pathway happens through a normal anti-nociceptive pathway in the spinal cord. “The gate” in the posterior gray horn of the spinal cord controls the transmission of nerve impulses from the peripheral into the central nervous system. Under normal circumstances, the gate is open and pain-

ful stimuli can pass freely through small-diameter fibers. When the acupuncture point is stimulated by the needle, another wave of non-painful stimuli travels to the gate. These stimuli are transmitted through A- β and A- δ myelinated fibers, which are thicker and transmit information faster into the spinal cord, where they bind to specific spots in synapses in the posterior gray horn. As a result, the gate is overcrowded with signals, which causes the gate to close. C-fibers, which transmit signals slower, do not have any spots to bind to at the synapses, because the gate is closed. The competitive inhibition of painful stimuli by non-painful stimuli causes the reduction or disappearance of pain [2, 20].

The acupuncture effect that causes the analgesic effect is much more complex than what the Control Gate Theory explains. By stimulating the acupuncture spot with a needle, the signals are generated and transmitted to the specific cerebral areas. In addition, there is a change in the secretion of neurotransmitters where the excitatory neurotransmitters are inhibited. On the other hand, the concentration of inhibitory neurotransmitters increases (GABA, serotonin, norepinephrine, endogenous peptides) [21, 22] (**Figure 3**).

Acupuncture causes the activation of the descending inhibitory pain pathway, which means that specific cerebral areas are activated so that the response to outside painful stimuli of neurons in the posterior gray horn is reduced [21]. PAG cerebral area collects

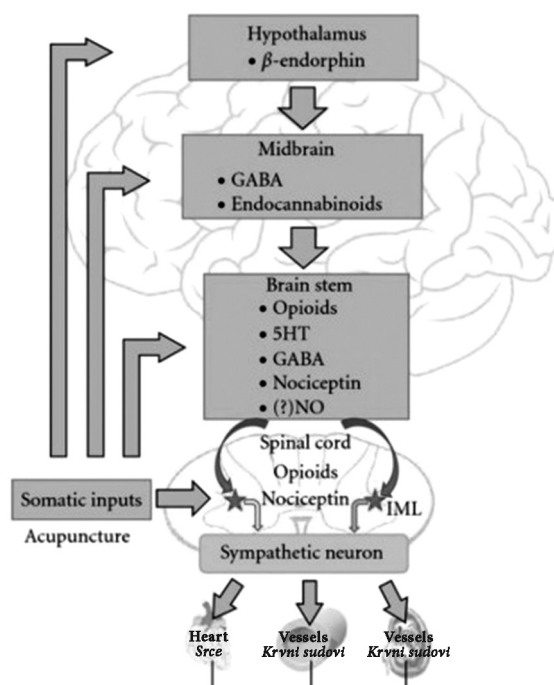


Figure 3. Changes caused by acupuncture point stimulation
Slika 3. Promene koje nastaju stimulacijom akupunkturne tačke

Delaney, S. The Science of Why Acupuncture Relieves Pain & Makes You Feel Great! [Internet]. West Street Wellbeing. 2019 [cited 2023 Sep 16]. Available from: <https://www.weststreetwellbeing.com.au/the-science-of-why-acupuncture-relieves-pain-makes-you-feel-great/>

the information from the upper cerebral centers and releases neurotransmitters norepinephrine and serotonin, thus inhibiting pain by the descending pathway. In addition, stimulating the acupuncture spots, PAG influences the hypothalamic-pituitary-adrenal axis, which, in addition to having a neuroendocrine effect, also leads to the release of endogenous peptides: endorphins, enkephalins and dynorphins. These endogenous opioids have neurotransmitter and neuromodulatory effects on the three types of receptors - μ , δ , κ , and help produce analgesia [23–25].

In the research Pomeranz and Chin conducted on mice, they examined the effect of acupuncture in reducing acute pain. The reduction of pain was greater in the group where acupuncture needles were placed on specific acupuncture spots than in the group where needles were placed on non-acupuncture spots. The analgesic effect of acupuncture was blocked by opioid antagonist naloxone, which confirms that the analgesic effect is produced by releasing endogenous opioids [26].

Analgesic effects of acupuncture on cerebral function have been confirmed by using functional magnetic resonance imaging (fMRI) and positron emission tomography scans. While painful stimuli were induced and acupuncture was performed to treat the acute pain, the fMRI showed a reduction in activity in specific pain-related cerebral areas [27, 28].

Acupuncture as an additional analgesic method

The Enhanced Recovery After Surgery (ERAS) Society has published several clinical practice guidelines designed to improve perioperative care and enhance postoperative recovery [29]. One of the main aspects of ERAS is using multimodal analgesia in pain treatment by reducing the use of opioids and their side effects [30].

Lately, the number of clinical trials that examine the efficacy of acupuncture as an additional method of analgesia during general or regional anesthesia and postoperative pain treatment is increasing. Accumulated evidence from clinical trials and updated reviews confirm the beneficial effects of acupuncture in reducing the need for opioids and consequently its side effects, which makes it a promising approach in perioperative management, especially with respect to ERAS. Further efforts need to be made to optimize the clinical application of perioperative acupuncture [31–34].

The study conducted by Sahmeddini et al. on 90 patients showed a positive effect of electroacupuncture on pain reduction after nasal septoplasty. The control

group underwent sham acupuncture. The intensity of postoperative pain was similar in both groups, but nausea and vomiting occurred significantly less in the acupuncture group [35]. Another study that included 60 patients who had sinus surgery and were treated by transcutaneous electric acupuncture stimulation (TEAS) 30 minutes before the surgery, showed that the TEAS procedure reduced the intraoperative consumption of remifentanyl by 39%. It also showed reduced time until extubation and a decrease in anesthesia-related side effects [36].

Sun et al. meta-analysis included 15 studies that assessed the intensity of postoperative pain where acupuncture was performed after different types of surgery. 608 patients of the total number of 1166 had acupuncture to reduce postoperative pain. The acupuncture techniques included manual needle acupuncture, moxibustion, transcutaneous electroacupuncture, and acupressure. Meta-analysis showed that the pain intensity measured by the visual-analog pain scale was significantly reduced in the group that had acupuncture. Researchers discovered that acupuncture was correlated with the reduction of cumulative opioid analgesic consumption in the postoperative period. Relative reduction of opioid consumption with acupuncture stimulation was 21% eight hours after surgery, 23% after 24 hours, and 29% after 72 hours [37].

The use of electroacupuncture in ERAS had great effects in the perioperative period, and it is believed that it will have a significant role in rehabilitation and treatment in the future [38–41].

Conclusion

According to data from the literature and the latest clinical research, encouraging results were obtained that acupuncture can be used as an additional analgesic method in the perioperative period. The use of acupuncture reduces the dose of analgesics, opioids and non-steroidal anti-inflammatory drugs. It enables patients to wake up faster from anesthesia, reduce postoperative nausea and vomiting, achieve better intestinal motility, faster mobilization of the patient and reduce treatment costs. Despite the fact that there are relevant clinical studies that support the effectiveness of using acupuncture in the perioperative period, what is missing is: standardization of the application of acupuncture, type of surgery where the best therapeutic effects of acupuncture are achieved, how to apply it and at what time intervals in order for acupuncture to provide much more effective analgesia.

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