

The underlying neurobiology mechanism of acupuncture and moxibustion

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Abstract

Acupuncture and moxibustion are two most important managements of traditional Chinese medicine. However, their precise scientific mechanism is still unknown. Acupuncture is usually practiced on arms with three Ying and three Yang pathways and on legs with three Ying and three Yang pathways. The Ying and Yang pathways are actually co-related with the dermatome distribution on arms and legs. The analgesic effect of acupuncture is to sharply stimulate limbs to inhibit the referred pain area in the inner organs. For examples, the inner arm Ying path: 心包經 is actually the T1 dermatome distribution. Thus, 心包經 acupuncture can control the pain in chest including lung, heart, and esophagus. The other important concept of acupuncture mechanism is it can stimulate POMC production. The neuro-endocrine POMC can generate ACTH and endorphin. ACTH will then up-regulate corticosteroid production. Thus, acupuncture also has anti-inflammatory effects such as curing allergic rhinitis. Endorphin activation can also reduce pain and produce euphoria-like feeling. Acupuncture is mediated by sharp pain via A delta fibers. A delta fiber, stimulating sympathetic acute stress response including epinephrine and norepinephrine, can compete the accompanying slow pain/inflammation transmitting c fiber. Thus, acupuncture can suppress pain and inflammation via gate-control like mechanism. Moxibustion plays the opposite role. Moxibustion produces heat sensation which transmits via c fiber. Thus, it will facilitate the host inflammatory/immune response against pathogen infection. Thus, 黃帝內經云針所不宜灸之所治. Another important mechanism for acupuncture is nerve plasticity. In stroke patients, acupuncture stimulates paralyzed limb nerve re-generation and synapse re-formation. This nerve plasticity is the same as the principle of physical rehabilitation. It is worth nothing ear acupuncture mechanism. Vagus nerve distributes in the ear chlorea. Thus, ear acupuncture can also compete the inner

organ pain sensation via vagus nerve inhibition as we view ear as another dermatome of inner organ.

Introduction

Acupuncture /moxibustion are two key components of Chinese traditional medicine. However, they are still viewed as placebo effect by western society because the 陰陽五行精氣運行 is not compatible to the modern physiology. Even they are not accepted by modern medicine, WHO still list at least 60 diseases for acupuncture indications mostly including analgesics and anti-inflammatory disorders. For examples, low back pain, tooth pain, or allergic rhinitis. Even acupuncture and moxibustion are effective in clinical medicine, there is still lacking scientific mechanism for the two useful tools. In clinical practice, chronic pain such as low back pain or chronic inflammation such as allergic rhinitis are not easily controlled by medications. The side effects emerge as drug dosage increases. Thus, simple tools such as acupuncture and moxibustion can aid clinical management for chronic pain and chronic inflammation effectively.

Mechanism of Chinese medicine philosophy

In Chinese medicine, there is 八綱辨治. Physicians need to distinguish 陰陽表裡冷熱虛實. 表裡 just distinguishes if the disease is from inner organs or outer tugen. Usually, acupuncture or moxibustion stimulating the outer tugen can control the referred pain of inner organs. This mechanism will be explained later. 冷熱 means if heat/thermal set-up points are dys-regulated. Heat shock proteins and fever are body mechanism to initiate host immune response against pathogens. Thus, 冷 means low immunity and 熱 means overactive immunity. This is related to the treatment of moxibustion. 虛實 and 冷熱 are actually co-related with overlapped symptoms. 虛 means low immunity and 實 means overactive immunity. However, 冷熱 is more related to acute immune reaction and 虛實 is more related to chronic immune reaction. Acupuncture and moxibustion mediate their actions via modulating immune responses. 陰陽 is the summary of the above symptoms. 陽 includes 表實熱 and 陰 includes 裡虛寒.

Mechanism of acupuncture

Even acupuncture is very effective in clinical medicine, the underlying mechanism of acupuncture is still unknown. Here, I will propose a principle for acupuncture. There

are six 經絡 (three Yang & three Ying) in arms and another six 經絡 (three Yang & three Ying) in legs. The distribution of these 經絡 is actually the distribution of dermatomes. Acupuncture mediates its action via controlling referred pain. The dermatome is reflecting the embryology relation to the inner organs. For example, T1 dermatome is the Ying side of arms which is the same as 手太陰心包經. 內關穴 belonging to 十總穴 is controlling the chest organs (內關心胸胃). T1 dermatome reflects the cardiac plexus innervated organs. Coronary heart disease usually causes referred pain radiating to the inner middle arms, especially left limb. On the contrary, if we perform acupuncture on 手太陰心包經 (T1 dermatome), we are able to inhibit the pain originated from the cardiac organs. It could be due to the pain transmission competition between the 表 dermatome and the 裡 inner organs from the same embryonic origin. We can also use this principle to apply to other useful 十總穴 such as 頭項尋列缺(C5 dermatome of arm; C1-C5 form cervical plexus innervating neck and occipital area), 脅肋尋支溝(C7 dermatome of arm; C5-T1 form brachial plexus innervating lateral chest, back, and upper arms), 肚腹三里留(足陽明胃經 L3 dermatome of leg; T12-L4 form lumbar plexus innervating abdominal organs), 安胎公孫求(足太陰脾經 L4 dermatome of leg), 婦科三陰交(L4-L5 dermatome boundary of leg). L4-S4 form sacral plexus innervating pelvic organs. Besides, 面口合谷收(C6 dermatome of hands) is because facial pain will input to spinal trigeminal nucleus which could extend to C2/C3 with deviating fiber in C6 (lowest limit). Finally, 阿是不可缺 means that we can perform acupuncture on the pain point to trigger sharp stinging pain for inhibiting/competing chronic pain and inflammation. Although there are six 經 in the arms, there are only five dermatomes in the arms(inner arm: C5 T1 C8 and outer arm: C6 C7 C8, both from radial to ulnar side). The ulnar inner arm is called 手少陰心經 and the ulnar outer arm is called 手太陽小腸經. It is said that 心與小腸經相表裡 表經裡治 裡經表治. So the two should belong to the same dermatome: C8.

The second important mechanism of acupuncture is that it can up-regulate POMC production from skin cells(epithelium) and nerve cells. The neuropeptide POMC can form ACTH, endorphin, MSH, and lipotropin. ACTH can then up-regulate glucocorticoid. Endorphin can cause euphoria sensation and suppress pain and discomfort. Glucocorticoid can suppress inflammation which contributes to chronic pain. MSH can suppress appetite and lipotropin can cause lipolysis those are the mechanism for acupuncture caused body weight loss. ACTH can also stimulate epinephrine and norepinephrine to up-regulate sympathetic tones. The up-regulated steroid, epinephrine, and norepinephrine is acute stress and pain response. Acute stress can also elevate adenosine levels. The acute sharp pain is transmitted via A

delta fiber compared to chronic pain and inflammation transmitted by C fiber. Both A delta fiber and C fiber belong to spinalthalamic tract, and they could compete with each other. Thus, the stimulation of acute stress/pain can suppress the chronic pain and inflammation. Epinephrine and norepinephrine can also aid to suppress inflammation. Thus, acupuncture can mediate its action via suppressing immunity. Thus, acupuncture can treat allergic and autoimmune diseases such as allergic rhinitis. In addition, cold sensation is also transmitted via A delta fibers. The hot sensation via C fiber is also competing the cold sensation via A delta fiber. Thus, cold sensation produced by certain menthol oil can reduce the local heat, pain, and inflammation. Acupuncture can also reduce fever by this mechanism. The analgesic effects of acupuncture can be viewed by functional MRI in hypothalamus area, the key control area of autonomic system. This is so called 針治實症熱症陽症.

The third mechanism of acupuncture is via nerve plasticity. Acupuncture can also be used to treat limb paralysis in stroke and cerebral palsy patients. The mechanism is not via anti-inflammation or analgesics. It is due to stimulation of nerve plasticity. Nerve plasticity is the underlying principle of rehabilitation. If we continue to stimulate paralyzed limbs, we will be able to restore the sensory-brain cortex-motor circuit which is damaged in diseases such as stroke or cerebral palsy. Physical therapy or occupation therapy is to stimulate limb or face activity to restore their functions. Acupuncture via stimulating peripheral sensory and motor nerves can also promote nerve plasticity to aid the restore of the sensory-brain cortex-motor circuit. Repetitive stimulation via rehabilitation with acupuncture in injured peripheral limbs can help to re-build the circuit specifically. Besides, acupuncture can stimulate NGF production to cause synapse formation and neuron genesis. This may be the reason of nerve plasticity. This is the third mechanism of acupuncture.

From the second mechanism of acupuncture, we know the relationship between sympathetic system and needle stimulation. Actually, the useful clinical 背俞穴 are located near the sympathetic ganglion. For example: 肺俞:T3 心俞:T5 肝俞:T9 膽俞:T10 脾俞:T11 胃俞:T12 腎俞:L2 大腸俞:L4 小腸俞:S1 膀胱俞:S2. By stimulating these positions, we can affect the specific inner organs innervated by these specific sympathetic ganglions. This further explains the sympathetic mechanism of acupuncture.

Here, I will explain the mechanism of ear acupuncture. The inner ear chonchae is innervated by vagus nerves. Vagus nerve is the main parasympathetic nerve innervating majority of visceral organs in chest, abdomen, and pelvis. Thus, if we use

ear acupuncture, vagal tone will be triggered. It can help to control inner organ pain, nausea/vomiting, and insomnia via parasympathetic tone.

Mechanism of moxibustion

Moxibustion is just the opposite of acupuncture. 針治實症 灸治虛症 針所不治 灸之所宜. Moxibustion is to produce local heat via 經絡 & 穴道. Heat sensation is transmitted via C fiber. C fiber is mediating heat, chronic pain, and inflammation. Heat will generate fever and up-regulate heat shock proteins. Fever can stimulate host immune response. And, heat shock proteins can serve as danger signals to trigger immunity via binding Toll-like receptors and serving as antigen chaperons. Heat can also increase host metabolic rate to combat outside pathogen infection. Thus, moxibustion can up-regulate host immunity. When a child is frequently undergoing URI or other infections, moxibustion can be used to promote host immune response against outside pathogens. Moxibustion is used during host hypo-immunity. Thus, 灸治虛症寒症陰症. Acupuncture facilitates A delta fiber competing C fiber, and moxibustion facilitates C fiber competing A delta fiber. This is the mechanism of acupuncture and moxibustion. I call this facilitation-competition theory.

The mechanism of message

Message is also used to relieve pain and inflammation. This can be explained by gate-control theory. The light touch or pressure sensation is transmitted via A beta fibers. The A beta fibers can also compete A delta or C fibers which transmitted acute pain and chronic pain, respectively. Thus, message (light touch and pressure) via A beta fiber can also suppress the pain and inflammation. However, since A beta fiber is not belonging to spinalthalamic tract, there is no direct contact inhibition like the competition between A delta fiber and C fiber. Thus, the message via A beta fiber is less effective than acupuncture or moxibustion. The mechanism of 拔罐 & 推拿 is similar to message.

The mechanism of 刮痧 & 放血

The mechanism of 刮痧 & 放血 is to trigger bleeding reaction (micro or macro-bleeding). Acute bleeding reaction is an acute stress response. The acute blood loss will up-regulate catecholamine (epinephrine and norepinephrine), corticosteroid, vasopressin, and ACTH. Thus, it is similar to acupuncture which can

treat inflammatory disease and chronic pain. However, acute bleeding has its risk for blood loss and infection. Besides, 刮痧 cannot specifically stimulate certain dermatome and certain A delta fibers competing C fibers. 刮痧 may also trigger C fiber activation. Thus, it cannot be as useful as acupuncture.

Conclusion

The modern clinical medicine is very useful. However, it suffers from difficulties in managing chronic pain and inflammation. For examples: chronic low back pain and chronic allergic rhinitis are two troublesome cases not easily controlled by modern medicine. The traditional Chinese medicine such as acupuncture can help to manage these chronic pain and inflammation. In addition, moxibustion can help to up-regulate host immunity during the invasion of pathogen infection. Thus, acupuncture and moxibustion could be very useful and simple complement treatments to modern clinical medicine.

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