*Mechanism Research*

# To understand moxibustion from the biological effect of local thermal stimulation*

# 基于热刺激生物效应分析探讨艾灸起效原理*

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ABSTRACT

Moxibustion is one of treatment modalities in Traditional Chinese Medicine (TCM). Its working mechanism is activated through heat-induced local thermal stimulation. By reviewing and compiling clear, scientific analysis of the biological and physiological effects from local thermal heat, the authors provides a coherent and systemic source to aid us to form an understanding of the mechanism of moxibustion's promotion of *qi* and blood circulation throughout the body from local thermal stimulation. This has been done by a rigorous review of previous studies of the thermal effect on the body. The following presents the local, distal and systemic biological effects from local thermal stimulation while also discussing the similarities and differences between local thermal stimulation and moxibustion.

**KEY WORDS:** moxibustion; rule; local thermal stimulation; the biological effect

Moxibustion, literally meaning the burning of moxa (Artemisia Vulgaris, commonly referred to as mugwort), is one of the main external treatment methods of TCM. Using moxa as its functional medium, moxibustion plays the role of promotion of *qi* and blood circulation. This, in essence, forms the unique warming-dredging functional theory of moxibustion. Local thermal stimulation induces a series of biological and physiological effects[1] which provides the fundamental basis for exploring the warming-dredging/promotion of *qi* and blood theory of moxibustion. In this review, we research moxibustion possible from the biological effect of local thermal stimulation.

## LOCAL THERAPUTIC EFFECT OF LOCAL THERMAL STIMULATION

### The effect on the skin

Treatment of infectious skin diseases: It has been confirmed that local thermal stimulation can treat infectious skin diseases such as warts, herpes, cutaneous leishmaniasis and so forth[2-4]. Successful treatment on one target wart could lead to elimination of other untreated lesions in patients with warts[2]. Some researchers[3] used locally concentrated heat to intervene in herpes labialis. The next day, the systemic itching and swelling was relieved and the curative effect of heat was superior to that of topical acyclovir. Leishmania, the parasite responsible for the disease leishmaniasis, is heat sensitive. Radiofrequency heat treatment which creates thermal energy generating heat that penetrates the subcutaneous skin layer was used to treat leishmania infection[4]. The cure rate was 80.7%. It is worth noting that it was significantly higher than intralesional meglumine antimoniate injection (55.3%).

Promoting of wound healing: Local thermal stimulation can remedy cutaneous necrosis and

chronic wounds[5-6]. After skin sparing mastectomy, the recurrence of skin necrosis has a high probability. A pilot study[5] showed that 36% of women without local heat-treatment developed skin flap necrosis whereas only 12% developed skin flap necrosis in the treatment group, a 24% difference. Diabetic foot ulcer is difficult to heal due to the poor circulation and damage to sensory nerve endings. Petrofsky JS et al.[6] found that heating with electrical stimulation was effective. After such, blood flow in the skin layers in and around the wound increased and the average wound area decreased substantially. It is of significance to note that local heat would appear to be a relevant part of this therapy because electrical stimulation alone has produced little healing.

Enhancing percutaneous drug absorption: Regarding transdermal uptake of nicotine using a nicotine skin patch, the study[7] displayed that controlled heat application caused a nine fold increase in skin perfusion and a thirteen fold increase in nicotine uptake. Therefore it is clear that local thermal stimulation improves skin permeability and increases the kinetic energy of drug molecules to make a significant increase in nicotine uptake.

### The effect on muscles and joints

Relieving sports fatigue: Heat stimulation can trigger a local muscle tissue reaction, facilitate the ability of muscle cells and augment the stress tolerance of muscles to protect against subsequent stress or injury. It was reported that local thermal stimulation applied onto the left quarter ventral abdomen muscle of male Sprague-Dawley rats could remove the inflammation caused by muscle injury and relieve pain[8]. Other experiments[9] showed that muscle glycogen concentration increased with heat pack application after exercise to alleviate sports fatigue.

Muscle recovery and joint injury: Light exercise raises the blood flow to the muscles and the muscle temperature rises. But other tissues such as those surrounding the knee and its ligaments can only be heated effectively externally and even then, still may be relatively rigid. Petrofsky JS et al.[10] reported that hydrocollator heat packs and Therma Care heat wraps applied on the quadriceps and knee were beneficial for the flexibility of both the muscles and ligaments.

### The effect on the skin's (dermal and subcutaneous layers) blood vessels

Increasing local arterioles perfusion: Boignard A et al.[11] used thermal hyperemia to intervene in Secondary Raynaud's phenomenon. They found that cutaneous vascular conductance raised to a level of 42.6 mV/mm Hg, which means that heat could improve blood perfusion to the arteriole's extremeties in Secondary Reynaud's phenomenon patients.

Increasing local capillaries perfusion: Local thermal stimulation enhances capillary perfusion and promotes capillary dilation. Widmer RJ et al.[12] found the number of perfused capillaries increased and the percent time precapillary sphincters remained open increased after thermal stimulation.

Note, too high a temperature can also excite the sympathetic nerve and cause vasoconstriction. It was found that after heat application around the ocular area, the blood velocity of the retina and choroid slowed and the blood flow of the superior temporal retinal arteriole and the superior nasal retinal arteriole were reduced[13].

## DISTAL THERAPUTIC EFFECT OF LOCAL THERMAL STIMULATION

### The effect on distal blood vessels

Enhancing distal blood vessels perfusion: This local stimulation increases remote skin blood flow and bone blood perfusion. Jan YK et al.[14] found that the skin's blood flow in areas remote to the applied heat increased slightly. Further examination revealed phase synchronization between neurogenic blood flow oscillations (BFO) was significantly higher. Using the technique of positron emission tomography (PET), Heinonen I et al.[15] confirmed that thermal stimulation increased bone blood flow so that heat can improve the local blood supply after fracture and promote fracture healing. But too high a temperature would inhibit revascularization in bone grafts[16].

Inhibiting arterial stenosis: Brasselet C et al.[17] reported that thermal stimulation significantly reduced the speed of the rabbit iliac artery in-stent restenosis and inhibited in-stent neointimal hyperplasia to prevent in-stent restenosis. The way to inhibit restenosis is speeding up the artery blood flow and reducing the deposit of intravascular impurities.

### The effect on the viscera

(1) Heart

Surface thermal stimulus protects the myocardium and prevents heart damage[18-19]. Diode laser radiation was used to locally heat the left ventricle by irradiating the epicardial surface of a rat's heart. Gong B et al.[18] found a significant degree of reduction in infarct size observed in animals with infarcted left coronary

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