

Research on the Effect of Light and Heat Sensing along Meridian of Chinese Medicine

Yun-Xiang Xu¹, Gui-Zhen Chen², Li-Jun Li¹, Song-Hao Liu³

¹Acupuncture and Moxibustion College, Guangzhou University of Traditional Chinese Medicine, Guangzhou 510405, China

²The Second Clinical Medical College, Guangzhou University of Traditional Chinese Medicine, Guangzhou 510405, China

³South China Normal University, Guangzhou 510631, China

Abstract:

Introduction: Photonics refers to the technology of generating and harnessing light and other forms of radiant energy whose quantum unit is the photon. Photonic technology in the meridian and acupoints research has shown the unique advantages, by which the microcosmic material basis and macroscopic phenomena research can be integrated to interpret the occurrence of propagated sensation along meridian (PSM) and its underlying mechanism. This study seeks to investigate light and heat sensing action along meridian.

Methods: From the modern research of meridian point of view, PSM is the break point to research the essentiality of meridian. The bio-photonic feature of meridian is the most promising research direction to investigate the PSM phenomena for its contribution to prove the existence of meridian objectively and spontaneously. Therefore, the bio-photonic features of meridian under physiological, pathological, therapeutic, and mechanical conditions were analyzed. Firstly, the four aspects of light sensing action were discussed, i.e. light sensing effect along meridian, blocking effect, laser induced effect and underlying mechanism of light sensing action along meridian. Secondly, the four items of heat sensing action were discussed as well, i.e. thermo-effects, heat perception ability, laser induced heat effect, underlying mechanism on heat sensing effect along meridian.

Results: The authors point out that photonic technology, e.g. ultra-weak luminescence, photonic imaging, infrared imaging and infrared spectrum analysis, biological photons detection and laser Doppler application, can achieve purposes of in vivo, dynamic, multiple comparable studies. Thereby, the effect of light and heat sensing along meridian can be detected and illustrated by the use of natural science. The effect of light sensing and heat sensing along meridians with the help of advantages of photonics is expected to interpret and quantify the meridian doctrine, to provide an important experimental basis for meridians and acupoint properties of light and heat, to find a kind of non-invasive diagnostic technique, and to promote the integration and development of meridians and modern medicine.

Conclusion: Light and heat information can be investigated to analyze the relationship between zang-fu organs and meridians, and the functional characteristics of the meridian. Hence, the effect of light and heat sensing along meridian is the break point of the research of photonics in meridian, which is beneficial to further study the meridian optics.

Keywords: effect; heat sensing; light sensing

Please cite this article as follows:

Xu YX, Chen GZ, Li LJ, Liu SH. Research on the Effect of Light and Heat Sensing along Meridian of Chinese Medicine: *J Lasers Med Sci* 2012; 3(1):6-14

*Corresponding Author: Yun-Xiang Xu, PHD; Acupuncture and Moxibustion College, Guangzhou University of Traditional Chinese Medicine, Guangzhou, 510405 China; Tel: +86-13650801055. E-mail: xuyx1968@163.com

Introduction

The science of photonics refers to the technology of generating and harnessing light and other forms of radiant energy whose quantum unit is the photon. The range of applications of photonics extends from energy generation to detection, to communications and information processing. Photonic technology in the meridian and acupoint research has shown the unique advantages by which the microcosmic material basis and macroscopic phenomena research can be integrated to interpret the occurrence of propagated sensation along meridian and its underlying mechanism. The authors point out that photonic technology, e.g. photonic imaging, infrared spectrum analysis, biological photons detection and laser Doppler application, can achieve purpose of in-vivo, dynamic, multiple comparable studies. Thereby, the effect of light and heat sensing along meridian can be detected and illustrated by the use of natural science, meanwhile the photonic technology has properties of being non-invasive, non-irritating, and avoiding interference to the effects. Acupoints are the energy and information input or output windows which have the functions of diagnosing and treating diseases. The light quantum information of acupoints not only reflects the qi and blood changes in the body, including abundant physiological and pathological information, but also reflects the functional changes of points. Hence, the light and heat information can be investigated to analyze the relationship between zang-fu organs and meridians, and the functional characteristics of the meridian. Here's the review and analysis about the application of photonics technology in the research on the effect of light and heat sensing along meridian, which could provide useful information for further meridian studies.

1 The Research on the Effect of Light Sensing along Meridian

In recent years, many people who studied the optical properties of the tissue by using modern laser technology turned to the human meridians and found the influence of laser on the meridians. They also held that the human meridian was a good optical system and at the same time developed a variety of laser acupuncture instruments to further promote the research and development of meridian.

1.1 The Research on the Propagated Effect of Light Sensing along Meridian

In 1975, the LIN Xian-zhe research team in Yunnan College of Traditional Chinese Medicine cooperating with the Beijing Chinese Medicine Hospital observed the electric light figures in the fingertips of some meridian sensitive subjects and some patients with a radiation field camera, point light vacuum imagers and other equipment (1). In the late 1970s, YAN Zhi-qiang, et al in the Chinese Academy of Sciences Biophysics Institute, found that the human body meridians and acupoints could irradiate a strong "cold light", which is an ultra-weak luminescence. Meanwhile, the ultra-weak luminescence information was taken as an index for the objective of quantitative study of the law of perceptible propagated sensation along meridians in human body, and the skin PE (propagated effect) strength on meridians was found stronger than control lines on both sides. They further found that there are 12 high-intensity light-emitting points and lines on the body surface, the luminous intensity are significantly different from lines 0.5cm lateral. The location of these wires completely coincides with the classical meridians and is 93.6%, basic consistence is 5.9%, that is a coincidence rate of 99.5%, and at the same time they coincided with the low impedance lines and latent propagated sensation along meridian which were detected by low-voltage tester and the percussion hammer method. All of the above indicated that the characteristics of luminescence of human body meridians had significant features along meridians (2).

XIE Shu-sen, et al through experiments also observed that the visible-near infrared reflectance spectroscopy on healthy body is obviously different between acupoint and nearby non-acupoint regional tissues, which means different physiological parameters and optical properties parameters between acupoint and non-acupoint regional tissues (3).

1.2 The Research on the Blocking Effect of Light Sensing along Meridian

Weak photon radiation from biological organism is a unique phenomenon produced by the energy generation, the molecular transits in vivo and

radiates externally. It reflects the characteristics of organisms associated with the process of life. Acupoints are the energy and information input or output windows, with the functions of treating and diagnosing diseases. The light quantum information of points not only reflects the “qi” and blood changes in the body, but also abundant physiological and pathological information. Under pathological state, the light sensing along meridian may be blocked, and the blocking can affect the laser regulation function.

LIN Xian-zhe, et al designed and produced a type FZ-1 radiation field camera by themselves. The camera is adjustable with 35 kV output voltages, and has five fingers (toes) corona in frequency range from 30 to 150 kHz. In their research on 33 patients, 31 cases had complete corona ring changes in their five fingers (toes). However, they observed that left toes corona rings were incomplete in two cases of male gallstone patients before surgery. That is to say, in accordance with traditional Chinese medicine meridian theory, there were no corona rings in the parts of the gall bladder meridian, the liver meridian, kidney, and bladder meridians. The same result was obtained through repeated shooting before surgery. While shooting after the gallbladder removal surgery, the incomplete corona light rings were recovered. According to the Chinese medicine meridian theory, if the gall bladder is sick, the gall bladder meridian is also sick, and it may also cause the liver meridian to become abnormal, it may even affect the kidney and bladder meridians. Therefore, the changes in these two cases are basically in line with the meridian theory (1). The research of points’ ultra-weak bioluminescence shows that the same name points on the left or right side surface of healthy people have symmetrical luminous intensity, while asymmetrical on people under a pathological state (4). YAN Zhi-qiang, et al in a study found that the meridian luminous intensity in the loss of blood and death in rabbits decreased significantly (2). Studying the distribution characteristics of the weak photon radiation of the human body and its congruent relationship with zangfu organs, meridians, acupoints, etc. and comparatively analyzing it with various characterization of “qi” can deepen the understanding of the essence of “qi” in Traditional Chinese Medicine (TCM).

Based on the experimental platform of optical

transmission characteristics in Fujian Normal University, we observed the light transmission characteristics along the Pericardium Meridian under different pressure states, and the results suggested that the body’s meridians would be good channels for light wave. That is to say, the light wave can be transmitted along meridians, and can also be blocked. The study once again proved the objective existence of the phenomenon of propagated sensation along meridians (PSM) and the phenomenon of being blocked (5).

1.3 The Research on the Laser Induced Effect of Light Sensing along Meridian

XIE Shu-Sen, et al hold that the bio-photon is not only an information carrier, but also an energy carrier, so the light irradiation points may produce a variety of effects (3).

1.3.1 The Subjective Effect of the Laser Induced Light Sensing along Meridian

Clinically, some patients have specific reactions to acupoint laser irradiation, such as sourness, distention, pumping, warm flow, ants walking or crawling feeling, cold flow, and so on. Some patients who received laser irradiation on Renyin (ST9) have feeling from Renyin(ST9) to supraclavicular fossa along the stomach meridian of Foot Yangming. While laser irradiating Sizhukong(SJ23) or Guangming(GB37), some patients have involuntary eye movements; and while irradiating Tiantu(RN22), some patients have a sense of suffocation. They show that acupoints laser irradiation can obtain qi.

JAM-DL-type semiconductor laser equipment, which was produced by Jiangxi Academy, wavelength 650nm, power 25mw, was applied in the clinical treatment to irradiate acupoints noninvasively for a variety of diseases to induce a sensation transmitted along the meridian to the disease location, and had received satisfactory results(6). Typical cases: Mr. Ma, a male retired cadre with hemiplegia, 70 years old, visited a doctor in September 7th, 1999 with the chief complaint of the right limbs motor dysfunction for 4 months. 4 months before, he had been hospitalized for cerebral hemorrhage. After treatment, he had sequel of motor dysfunction, the main symptoms were askew mouth, sticky mouth, failure to lift right arm and weak right leg unable

to walk, red tongue, dry coating and taut pulse. His disease was diagnosed as paralysis. He had also been treated with acupuncture, but got no significant improvement of symptoms, so he came over to receive laser treatment. We found there was a clear tender spot on his right KI5, so we irradiated the acupoint with laser (at 3cm distance from skin, the radius of light beam 1 mm). After five minutes irradiation, he said that his foot was warm and the warm feeling like a water flow with the thickness of a chopstick walking upwards through the calf slowly. After seven minutes, he felt the warm flow crossing the knee and reached the inner thigh. The course was similar with the course of the kidney meridian of Foot Shao Yin. After nine minutes, he felt a warm sensation in posterior neck, and after 0.5minutes, the warm sensation crossed the right shoulder, along the upper arm, elbow, and finally spread along the lateral forearm to five fingers, and the patient immediately raised his right arm to its normal height, and felt fresh in mouth. After treatment, the patient could lift the right arm and walk better than before. The patient was treated three sessions totally with laser irradiation and 10min for each session. In every treatment, the phenomenon of qi extending to the disease part was observed.

1.3.2 The Objective Effect of the Laser Induced Light Sensing along Meridian

Liu Xiang-rong, et al designed an automatic measurement system for scattering light survey of meridian and surrounding non meridian, as a 808 nm central wavelength was applied, and the effect of laser power on light decay rate of tissue were discussed. The results showed that there were significant differences between meridian and surrounding non meridian. It indicated that laser power had no influence on attenuation of light in biological tissues, so it proved the attenuation is determined by tissue optical characteristics(7).

LIU De-bo once irradiated Hegu (LI4) with 3mW of He-Ne laser, and used two needles which were connected with the EMG to insert Quchi(LI11) and Chize(LU5) respectively. While needling, sourness, numbness, distention sensation arrived 4-5minutes later, on the EMG screen connected to Quchi (LI11) appeared regular fluctuating low-frequency radio waves and the waves disappeared when the laser

was removed. However, no waves appeared on the screen connected to Chize (LU5) (8).

In 1981, TIAN Dao-zheng irradiated the distal points of 30 cases with the He-Ne laser to identify sensitive points with the percussion method and got meridian sensation transmission lines. The positive result was 60.38% and the proportion was higher than irradiating non-acupoints. These lines were subcutaneous, and could be blocked by finger pressure (2 ~ 3mmHg), and re-appeared when the pressure was relieved (9).

ZHU Jian-xin studied the influence of the meridian blocking on the effect of the laser acupuncture analgesia, and he thought that the meridian blocking would significantly influence the laser acupuncture transmission pathway (10).

1.4 The Mechanism Research of Light Sensing along Meridian

1.4.1 Communication Theory

LIU Cheng-yi, et al who studied the production of the ultra-weak luminescence (PE) and the PE mechanism of action within cells in two photobiological procedures, thought that the action between cell populations might be not only through chemical mediator, but also through optical communications. In acupuncture, the change of the cell physiological state at acupuncture point would change its PE mode, and then the changed PE mode would act on neighboring cells to change their physiological state which gradually influence the next neighboring cells. Due to the uneven nature of the cell membrane, PE's direction may be anisotropic which causes the sensing direction along meridian (11).

1.4.2 Energetic Theory

Most scholars supporting energetic theory are physicists. For example, Zhang Bing-wu early in the 1950s proposed the hypothesis of meridian waveguide. One of his famous experiments was placing a tiny wireless transmitter in a pig's stomach that detected a strong signal at the stomach meridian. The electronic excitation energy is a kind of electromagnetic potential energy, when the electron is at a high level track, and resonance energy transfer means that this energy transfers from an electron to another electron in a non-radiative

pattern. Because the energy transfer distance is very short, it decays quickly. Lin Xian-zhe proposed soliton energy migration hypothesis. The soliton is a special form of energy, in which the energy density is concentrated, with a slow speed, and less attenuation, and is one of the possible forms of energy migration (12). In addition to these hypotheses, Sun Ping-Sheng proved by experiment that the meridian line was a good transmission pathway for sound wave. Fei Lun, et al found that the meridian line was a good transmission pathway for infrared waves (13). Russian scholars reported the light conductivity of meridians. Liu Yu-sheng thought that the meridian is a kind of liquid crystal material, and accordingly developed a spectrum of laser treatment instrument (14).

All in all, the meridian line has good conductivity for electromagnetic and mechanical waves. The involved material bases of the nature include the liquid crystal properties and collagen fibers of biological tissue which have become an element of meridian study at present.

2. The Research of Heat Sensing Effect along Meridian

2.1 The Temperature Research of Heat Sensing Effect along Meridian

The skin temperature measurement of meridian acupoints can obtain objective and quantitative temperature data of effects of the meridian heat sensing in the case of non-invasive method, while the traditional Chinese medicine methods, such as tongue diagnosis, pulse diagnosis and meridian palpation, etc. could only obtain qualitative data. Although some of the other biophysical properties (e.g. resistance) of points also were able to take quantitative measurements. The skin temperature of meridians and acupuncture points can directly reflect the theories of “Yin and Yang”, “cold and heat”, “warm for reinforcing and cold for inducing”, etc. Hence the advantage is obvious.

In previous studies, with the lack of the normal skin temperature range of acupuncture points, they often took symmetric temperature deference greater than under normal circumstances as the meridians imbalance criterion. Wand Dan-fen thought that under the same state the range of temperature of the points with the same name was within 0.5

degree centigrade (15). Through observing back infrared thermal imaging of patients after stroke, Zhang Su-fen also thought that in healthy people the range of temperature of the same name points would be within 0.5 degree centigrade, and in patients the range would be more than 0.5 degree centigrade, even up to 2.0 degrees centigrade (16). However Yan Zhi-qiang et al observed the trunk and limb points' temperature of coronary heart disease patients and healthy people. The result showed that patients' range of temperature at the Heart, Pericardium, Lung and Bladder Meridians increased more than non-acupoints, but the mean is less than 0.5 degree centigrade (17). Therefore, based on current research data, 0.5 degree centigrade is not the standard to judge abnormality, yet more researches are needed to determine the appropriate level of the normal range difference.

For temperature measurement, thermometer, liquid crystal imaging, infrared thermometry and thermal imagery are commonly utilized in the current researches. Among them, the liquid crystal temperature measurement is now rarely used because of its complex operation. The thermometer is most convenient for temperature measurement, but sufficient exact equipment should be selected for obtaining reliable data, because the range of point temperature was mostly in the 0.1 degree centigrade level shown by the previous studies. Infrared thermal imaging technology has been used mostly for meridian imaging (18-21). The studies have shown that the human body surface has infrared radiation phenomenon, the radiation intensity has individual differences and is obviously time-related, and also the temporal rhythm of temperature change between non-acupoints and acupoints is basically the same. Meanwhile, at acupoints the heat conduction tends to be along meridians and at non-acupoints the heat transfers to all directions similarly, suggesting that meridian line is a good pathway for heat. Xu Jin-sen, et al used infrared imaging system for observation of healthy adult volunteers (22). The results showed when heating the meridian or non-meridian lines of medial forearm at the same time, the skin temperature changed and expanded faster along meridians than along non-meridians, and with the heating time extension, they gradually formed three infrared radiation tracks which basically coincided with the running routes of the Three Yin Meridians

of Hand. The advantages of infrared imaging are all the points within the temperature range, and can be recorded simultaneously, not getting in contact with the object is needed when taking temperature in order to have no interference. Among them, the Temperature Texture Mapping (TTM) infrared imaging has certain advantages on meridian researches (23). For example, Zhang Dong with infrared imaging observed that cholecystitis and pericarditis in animals had shown the corresponding meridian high-temperature zone which confirmed visceral lesions really could cause temperature change at meridians (24-25). However, it is difficult to locate specific points. Therefore, the infrared thermal imaging methods for locating acupuncture points still need further exploration for application.

Some scholars investigated whether the temperature characteristics of meridians and acupoints are limited to the skin surface of points. Wang Hua, et al observed the temperature between different depths, and between points (Quchi(LI11), Qian Sanli(Extra), Hou Sanli(Extra), Xiajuxu(ST39)) at meridians and non-acupoints on rabbits. The result showed that the temperature of acupoints and non-acupoints at meridians was higher than con-points. Authors believe that heat, one form of energy metabolism, can be used as a standard of energy metabolism, so the study result suggests that the deep tissue energy metabolism of acupoints and non-acupoints at meridians is stronger than con-points (26). Gao Ling-Yun observed the skin and subcutaneous tissue temperature at Governor Vessel and the line 2cm lateral to the Governor Vessel in healthy people, and the result showed the skin and subcutaneous tissue temperature at Governor Vessel was significantly higher than the lateral line (27). Zhang Dong, et al with infrared thermal imaging technology and plug-in temperature measurement, took temperature at the stomach meridian of Foot Yangming (skin, sub-epidermal 5, 10 mm) in rabbits after moxibustion. The result showed high temperature heating line formed by moxibustion which might only appear in the surface and the skin (28).

In the future, the research of the temperature measurement of meridian or acupoints may have two directions. One direction is to continue observing the temperature characteristics of meridians and studying its mechanism, which will also help to understand the substance of the meridian. Another direction is through measuring of the temperature

value to identify the meridian imbalances, thus to analyze the pathogenesis, guide treatment and also be used as supplementary indicators to assess the therapeutic effect.

2.2 The Heat Perception Research of Heat Sensing Effect along Meridian

Japanese Samurai Akabane created a “heat-perception test device”. They used joss-stick fire to test feel sensitivity of Jing-well points of hands and feet for diagnosis. However, while joss-stick burning, the heat difficultly maintain stability because of air flow. Even more, it is difficult to master the distance between the skin and joss-stick. The heat-knowing measurement method of meridian was introduced to China from Japan in 1950. 60 years past, because of the limit of measurement system and interpretation method, it encountered many obstacles in the clinics, and was gradually restricted to laboratory studies. Through continuous improvement, the method could return to clinics and play a guiding role for disease assessment and treatment in the field of using acupuncture and moxibustion to treat cancer, endocrine diseases, ENT diseases, etc. From the standpoint of heat sensing along meridian to explain the phenomenon of life, it can provide a new way of thinking about the objectification and quantification of the meridian differentiation.

Dong zhong-wu (29) designed the “heat-perception power measuring device” to make the operation more convenient, and standardized. Zhu Wen-Hong, et al (30) randomly selected 209 healthy young people aged 20 to 24 years for the test subjects and measured twelve Jing-well points heat-knowing value at different times in the morning and afternoon. Statistical results showed that except for a few Jing-well points, Jing-well points with the same name had no significant difference in the morning and afternoon, male and female, or the left and right side. This study suggests that each Jing-well point has its normal heat-knowing value in the crowd, and it will help the clinical diagnosis.

Chen Ri-Xin created “heat sensitive spot moxibustion” according to the heat sensitive spot which can be found through moxa-stick moxibustion in the body surface. It is usually located around the affected site, or the acupuncture point along certain diseased meridian. He thought that the

heat sensitive spot is a kind of reactant spot which reflects the pathological changes of the human body. While moxibusting the sensitive spot, some kind of *De qi* (arrival of qi) phenomena will be manifested, e.g. warming deepening, warm spreading out, heat sensation transmitting along the meridian, and the symptoms relieved significantly afterwards (31). It is indicated for the treatment of lumbago, dysmenorrhea, chronic obstructive pulmonary disease, apoplexy, peripheral facial paralysis, rheumatic arthritis, etc. (32-34).

2.3 The Research of Laser Induced Heat Sensing Effect along Meridian

Laser interaction on the organism can lead to many unique biological effects, such as thermal effects, electromagnetic effects, pressure effect, and photochemical effects. Laser acupoint irradiation mainly leads to thermal effects. The essence of the laser acupoint irradiation is as follows: under the mutual effect of the laser and body, the state of cellular, molecular and atomic at acupuncture points changed after absorbing laser energy, the signal generated at the acupuncture points transfer to disease parts through meridians and the nervous system, to improve the sick part function and achieve the purpose of medical treatment (35).

Under the effect of laser radiation, the biological tissue absorbs light energy and turns it into heat energy. Because heat energy generated by laser is far greater than the heat energy produced by tissue, we can think that the tissue gets hot just only as a result of laser irradiation. In the process of laser heating biological tissue, the heat generation rate of tissue not only depends on the laser output rate, but also on the thermal properties of the tissue. Thermal properties of biological tissue include tissue thermal conductivity, thermal diffusivity, specific heat and heat capacity, etc., which connect with the tissue water content (36).

Liu Song-hao, et al through observing the impact of photonic Chinese medicine information instrument on the TTM, found that stimulating “Hegu (LI4)” with the laser alone could cause changes in the distribution of thermal radiation intensity. It indicated that laser stimulation of acupoints could definitely regulate blood circulation and metabolism. Obvious change areas in heat radiation are head, neck, arms (basically within the range of the distribution of the

large intestine meridian) and the nape, back (within the range of the distribution of Du meridian), followed by the front side of legs (which is the distribution area of the stomach meridian). “LI4” is the Yuan-source point of the large intestine meridian of Hand-Yangming, and reducing method was often used in the traditional acupuncture method. In this study, using a strong continuous signal (equivalent to a stronger reducing signal) to stimulate Hegu (LI 4) for 10 min, the changing trend of thermal radiation in the posterior head and face, nape and back is down, which indicates a clear role in reducing effect (37).

2.4 The Mechanism Research of Heat Sensing Effect along Meridian

The preliminary view holds that the temperature of points at the deep tissue may be higher than meridian surface under the state of not being stimulated, but when the acupoint is stimulated, the high temperature line is formed only at the superficial skin. The formation of surface temperature is directly related to the local blood flow (38). However, the difference of the temperature characteristics between meridian points at deep tissue and on skin surface is difficult to be explained by the vessels distribution. Hu Xiang-long analyzed the difference between the radiation track along meridians and high temperature belt caused by the deep big blood vessels from four aspects (39), and excluded the possibility of temperature along meridians caused by large blood vessels. There are no large longitudinal subcutaneous vessels in the back, waist, chest and abdomen, but infrared radiation pathways that are recorded are consistent with the governor vessel, the conception vessel, the bladder meridian, the stomach meridian, the spleen meridian and so on. There are many longitudinal blood vessels in the limbs and they are relatively close to meridians. Therefore Hu especially made a comparison to identify infrared radiation meridian lines, and the result showed that the infrared radiation meridian lines were not uniform with vessels distribution. The infrared images of blood vessels are different from meridians infrared radiation. In the former, images' edges are smoother, regular and continuous; in the latter; images' edges are intermittent and vary in width. The skin temperature over large blood vessels should be higher than the surrounding

skin. The infrared radiation belt can also be a low temperature zone. For the temperature changes of certain acupoints associated with specific diseases, it is difficult to understand from the only point of blood vessels distribution. This should be the performance of meridians' properties.

The skin temperature response at points is related to the neural regulation and microcirculation of skin and subcutaneous tissue which is different from non-acupoints. The skin zones are closely related to the autonomic nervous system. Liu Li-Yuan's study has shown that acupuncture can raise the skin content of norepinephrine, epinephrine and other catecholamine in the meridian lines; and the distribution of catecholamine is very uneven, some parts are extremely rich, showing longitudinal direction or point lumps and most of them are consistent with meridians (40). The micro-circulation controlled mechanisms are different between meridians, acupoints and non-meridians. Mu Xiang, et al. has found that the blood flow at acupoint was significantly higher than the corresponding control point and the blood flow was relatively slower; the micro vessels had characteristics of a synchronized contraction and relaxation at acupoints, while not at the control point (41). Different from non-meridians, the temperature characteristic of meridians and acupoints, which should be with the other biophysical properties, is the meridian, points characteristics of their own (42).

Summary

The meridian theory of Chinese medicine, owing to its profound theory, along with its history and definite effect, has aroused interest and concern of scholars at home and abroad. With the rapid progress of science and technology, a new discipline, the photonic Chinese medicine is generated by crossing the technology frontier of modern biomedical science and TCM and Western medicine. The photonic Chinese medicine will provide important theory and technology platform for the modern research of TCM meridians.

For the light transmission and heat transfer theory of biological tissue are always the concern in laser medicine and biomedical photonics, especially in recent years, photonics is acclaimed for its non-destructive, information-rich, efficient and

reliable, simple and repeated treatment advantages. International conferences and research projects with this theme are also increasing year by year.

The research of light and heat sensing effect along meridians with the help of the advantages of photonics is expected to interpret and quantify the meridian doctrine, to provide an important experimental basis for meridians and acupoints' properties of light and heat, to find a kind of non-invasive diagnostic technique and to promote the integration and development of meridians and modern medicine.

Acknowledgments

This work was supported by the National Key Basic Research Program of China (973Program) under grant No.2006CB504505, the 3rd Special Fund of China Postdoctoral Science Foundation (201003344)

References

1. Lin XZ, Lu WX, Li GQ, Yun G. A research into electroluminescence of meridians and acupuncture points on human bodies. *J Discov Nat.* 1990; 9(31): 50.
2. Yan ZQ. Exploration on the Relationship between Propagated Sensation along Channels and Variation in Luminescence of Acupuncture Points. *J Tra Chin Med.* 1980; 8: 53.
3. Li L, Yang HQ, Xie SS. Meridian Optics: A Photonics Research on Meridian phenomena. *J Sci Chin.* 2007; 37(S1): 62-67.
4. Pang DB, Chi XS, Li YM, et al. Difference of the weakest visible light emission between the left and right Zhongchong(LR3) point and Control areas around it in Human body. *Chin J Bas Med TCM.* 1998; 4(12):44-7.
5. Chen GZ, Xu YX, Wang YH, Yang HQ, Lin QY, Li LJ, Guo ZY, Liu SH. Optical transport properties along the pericardium meridian under different pressure: *J Lasers Med Sci* 2011; 2(3):89-97
6. Wu LY, Chen RX. Report on 3 cases of propagated sensation along the channel to disease location induced by laser irradiation. *J Jiangxi Coll TCM.* 2001; 13(1):12.
7. LIU XR, CHEN CS, YU JW, et al. Light propagation characteristics of meridian and surrounding non-meridian tissue. 2010; 39(S1): 29-33.
8. Cen LF. The primary exploration of evidence of laser acupuncture based on meridian theory. *Guangdong Provincial Association of Acupuncture and Moxibustion the 11th Science Proseminar Thesis Assemblys* 2010:547.
9. Tian DZ. Photonic Needle and Meridian. *Laser Journal of Sichuan* 1981; 2(2):51.

10. Zhu JX, Yu C. Influence of meridian blocking on the analgesic effect of laser induced to acupoints: Exploration on stimuli signal conduction pathway of analgesia effect induced by acupoint laser acupuncture. *Chin J Vet Med.* 1989; (9):49
11. Liu CY, Liu SH, Hu XL. Time theory on meridian II: Research on propagation of sensation along the channels. *J South Chin Univ (Nat Sci Ed).* 1998; 1:46-50.
12. Lin XZ, Xia o Y. Mechanism underlying the formation of the propagated sensation along meridians in human body. *J Yunnan Coll TCM.* 1995; 18(3):32-9.
13. Fei L, Cheng HS, Cai DH, et al. Experimental exploration and research prospect on meridians material foundation and functional characteristics. *Chin Sci Bull.* 1998; 43(06):658-72.
14. Liu, Y S. Progress and achievement on application of laser technology to research meridians. *Chin J Laser Med.* 2000; 9(3): 196.
15. Wang DF, Li ZY. Relationship between disease and the unbalanced skin temperature of acupoints on both sides. *J Heibei Coll TCM.* 1995; 10(2): 36-8.
16. Zhang SF, Liu ZQ, Chen RX. Application technology of modern acupuncture and moxibustion. See: Lin WZ, Wang P. *Experimental acupuncture and moxibustion science.* Shanghai Sci Tech Publ. 1999. 210.
17. Yan ZQ, Wang YZ, Zhang L, et al. Observation on unbalanced temperature law of regular point and auricular point in coronary patients. *J TCM.* 1985; 1: 51-3.
18. Zhang D, Fu WX, Wang SY, et al. Displaying of infrared thermogram of temperature character on meridians. *Acupuncture Res.* 1996;21(3); 63.
19. Zhang D. Application of infrared thermography in studies of acupuncture mechanisms and meridians. *Chin Acupuncture Moxibustion.* 2004;24(1); 37.
20. Liu QC. Application of infrared imaging technique in meridian study. *Chin J Clin Rehabil.* 2006; 10(23); 28..
21. Yang HQ, Xie SS, Hu XL, et al. Phenomenon of human meridian and its time correlation based on infrared thermal imaging. *J Infrared Millimeter Waves.* 2007; 2621(5): 340-3.
22. Xu JS, Hu XL, Wang PQ, et al. Comparison of the thermal conductivity of the related tissues along the meridian and the non-meridian. *Chin acupuncture moxibustion.* 2005; 25(7): 477-82.
23. Yang HQ, Xie SS, Hu XL, et al. Appearance of human meridian-like structure and acupoints and its time correlation by infrared thermal imaging[J]. *Amer J Chin Med.* 2007; 35: 231-40.
24. Zhang D, Fu WX, Ye YY, et al. Display of high-thermal line along meridian on body surface of experimental cholecystitis rabbits. *Shanghai J Acupuncture Moxibustion.* 2001; 20(1): 42-3.
25. Zhang D, Wang SY, Ma HM, et al. Infrared thermal imaging on the temperature reaction along the meridian on the internal disease (Pericarditis). *Chin J Basic Med TCM.* 2004; 10(7): 52-4.
26. Wang H, Liu YX, Zhang HP, et al. Determination of deep temperature of acupoint, non-acupoint on meridian and control point of rabbit. *Acupuncture Res.* 1995; 20(4): 47-51.
27. Gao LY. Measurement temperature of deep tissue in different depths underneath the skin along du meridian coupse. Master Thesis of Fujian College of TCM. 2000, 5.
28. Zhang D, Wang SY, Wang YC, et al. Measurement of depths temperature under thermal line along meridian. *Chin J Basic Med TCM.* 2001; 7(10): 62-4.
29. Dong ZW. Power source supply thermosensitive detector. *Jiangsu J TCM.* 1959; 2: 42.
30. Zhu WH, Xue CY, Ma WZ, et al. A Study of the thermosensitivity determination for the normal value of the twelve well-point. *Acupuncture Res.* 1996; 1: 6.
31. Chen RX, Kang MF, A new reflection spot of disease: Heat sensitive spot and its clinical significance. *J Jiangxi Univ TCM.* 2006; 18(2):29-30.
32. WEI W. Heat sensitive spot moxibustion combined with electroacupuncture for 32 cases of peripheral facial paralysis. *J Tradional Chin Med.* 2011; 52(7): 601-3.
33. HAN Y, LIU HS, SONG YZ, et al. Clinical observation for treatment of lumbar back myofascitis of weightliters by moxibustion on heat-sensitive outpoints. *J Nanjing Inst Phys Edu (Nat Sci).* 2011; 10(2): 17-20.
34. JIANG M, Heat sensitive spot moxibustion for the treatment of 60 cases of primary dysmenorrheal. *Jiangxi J Traditional Chin Med.* 2009; 40(322): 63-4.
35. Chen WG., et al. The new theory of laser acupuncture. *Laser J.* 1995;16(5):215.
36. Zhao YQ, Fan, SF, Li XX. Research of the photothermal interaction between bio-tissue and laser. *Foreign Med Sci (Biomed Engineering Fasc).* 2004; 27(2): 101-4.
37. Liu SH, Guo ZY, Tang JY, et al. Autothemo therapy of light quanta with chinese medicine character. *Sci Chin Ser G:Phys Mech Astron.* 2007; S1:13-20.
38. Zhang D, Xue LG., Wei ZX, et al. Analysis of the relationship between the facial skin temperature and blood flow. *J Biomed Engineering.* 1999; 16(1): 81.
39. Hu XL, Wang PQ, Xu JS, et al. The Main characteristics of infrared radiant track along meridian courses over human body surface and the condition of its appearance. *J Infrared Millimeter Waves.* 2001; 20(5): 325-8.
40. Liu LY, Hao CJ, Fan JY. The catecholamine in skin and hair follicles are related to the effect of acupuncture and the nature of meridian. *J Beijing Normal Univ (Nat Sci).* 1996; 32(4): 534-40.
41. Mu X, Duan HQ, Chen W, et al. Physiological research on the relationship between essence of acupuncture point and microvasculum. *Chin J Basic Med TCM.* 2001; 7(12): 47-52.
42. Wei PX. Clinical study on the relationship between the change of infrared thermal imaging of the stroke patient on the back and meridian and outpoints. *Fujian College of TCM Thesis.* April 2006.