The relationship between nervous system and meridians

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Abstract. The nervous system and Chinese meridians have played vital roles in western medicine treatment and traditional Chinese medicine treatment, respectively. However, few studies have focused on relationships between them and develop effective treatments combining them. This paper discuss relationships between the nervous system and meridians from structures, functions, treatments and modern methods used to study them. Hopefully through this article, relationships between the nervous system and meridians will be revealed to some extent.

Keywords: Relationship, Chinese meridians, The nervous system.

1. Introduction

Meridians, known as one of the most representative symbols for China, have been studied by scientists all over the world for nearly centuries. It is a channel through which the vital life force "qi" flows, in the function of supporting the human body as a whole, that at the same time could be more vividly understood as the circulatory system in modern medicines. Meridians could be divided into two categories, and of the two works by contradicting and relying on each other, which is so-called "Yin" and"Yang" in Chinese. The nervous system, one of the big eight systems of the human body, which is in charge of controlling the internal environment of the body, is that it has some way relationship with the Meridians, that could rub out the spark of collisions between western and eastern medicines nowadays. Moreover, in Chinese Traditional Medicine, meridians are often associated with another theory of zang-fu organs. They are thought to regulate visceral activities. However, there are still a lot of blanks in the researches of the relationship between nervous system and meridians. To illustrate, although there are various theories about the nature of meridians, none of them haven't been fully proven. In addition, in terms of the way meridians regulate the viscera, most scholars believe that the regulation has the involvement of nervous system, however, it's still puzzled whether this regulation is spontaneous, and how the changes in nervous systems may influence the meridians. Moreover, the mechanism of using meridians to treat diseases has also been inconclusive. It is commonly known that theories of meridians and the nervous system have guided treatments of diseases separately for a long time. Our topic is to find relationships between Chinese meridians and the nervous system. After collecting information of Chinese meridians and the nervous system, this paper compared Chinese meridians and the nervous system in fields of structures, functions, treatments and methods used when researchers study them. Hopefully through this article, relationships between Chinese meridians and the nervous system would be more clear, which will lay the foundation of developing therapies combining Chinese meridians theory and the nervous system theory and improve therapeutic effect for neurological diseases.

2. Meridians

2.1. The Background of “Jing Loo”

In terms of meridians, "Jing Luo" is a channel that supports the vital life force "qi" flows, which could be more vividly clarified as a transportation vessel channel. "qi", is one of the most ancient and traditional words in China, has been spread through the ages. People often used "qi" to illustrate the manifestation, as well as the intelligence of the body as a whole, so that it could create and make up a circulation project that supports the eight human body systems, including the digestive system, nervous system, et cetera.

2.2. The Classification of Meridians

The various types of meridians are often categorized into twelve categories depending on their functions, and most of them work by processing in high association with solid organs, especially the liver, and kidney, that so-called "Zang fu" in Chinese. By corresponding "Zang fu" with each type of meridian, it is convicted to be divided into two groups, which are named as "Yin" and "Yang". Of all the two, the "Yin" group arm is matched up with the Lung, Heart, and Pericardium, while its legs are the Spleen, Kidney, and Liver. Also, the "Yang" group, which included Triple Burner, Small Intestines, and Big Intestines, are commonly known for the function of helping, as well as assisting with the digestive system that regulates the whole body.

2.3. The Structure of “Jing Mai”

One of the biggest channels that support the flow of "qi" work is "jingmai", which is also known as a collective system in nowadays western medicines. According to what it has been stated in the "Meridians in Traditional Chinese Medicine?", created by AMC-Miami Florida Institution, seventy-two major channels are involved in "jingmai", and twenty of them are considered the most crucial one when Chinese people use acupuncture as a special treatment. Furthermore, "Luomai", which belongs to "jingmai", are also collateral vessels that link the interior and exterior meridians together.

2.4. The Relationship between Meridians and the Nervous System

The nervous system, one of the eight biggest systems in the human body, is mainly made up of nerves and spinal cords that support communication, as well as the movement of the body, in the association of the central brain. "jingmai", specific channels in Chinese medicine, are similar to the spread of nerves when focusing the body in a whole perspective. It is well-known and believed that meridians, "jingmai", along with the nervous system, were the one of the most popular and effective ways of treatment in China at present, due to their two of structure and function similarities [1].

3. Relationship between Chineses meridians and the nervous system on structures

Chinese meridians are classified into “Jingmai” and “Luomai”. “Jingmai”, which consists major meridians, plays a role in regulating fundamental substances like the “qi” throughout human body. All channels of “Jingmai” can be categorized into three groups: twelve major or primary meridians, eight extraordinary vessels and twelve divergent or distinct meridians.

Twelve primary meridians are the most siginificant meridians, which have connections with viscera and transport fundamental substances through the body. For twelve major meridians, six of them, which are on the posterior and lateral part of human body, are named Yang meridians. The other six meridians are on the anteromedial part of human body, being named Yin meridians. Eight extraordinary vessels are responsible for connecting twelve primary meridians. In traditional Chinese meridians, twelve divergent or distinct meridians link up with the wei (defensive) and yuan (parental) qi. “Luomai”, which is also named collateral vessels, is the system of branches of the “Jingmai” [2]. “Luomai” has three categories: fifteen connecting collaterals, muscular collaterals and superficial

collaterals. The interior and exterior meridians are linked together by fifteen connecting collaterals. In addition, in human body, tendons, muscles and joints receive fundamental substances including "qi" and blood with the help of muscular collaterals. Superficial collaterals undertake central functions of meridians [2]. The relationship between "Jingmai" and "Luomai" on structure is similar to that between the central nervous system and the peripheral nervous system. Regions of meridians have lower skin resistance and increased temperature compared to non-meridians [3]. Organs, extremities and joints of human body are connected with meridians, which spread horizontally and vertically across the surface of human [4]. Meridians have special acoustic characteristic. When a certain mechanical force is applied to acupuncture points of meridians, the sound produced by them is significantly different from the sound non-meridians regions, which is manifested by increased volume and higher pitch. The sound is transmitted in two directions. In terms of the same person, the luminescence intensity of the acupoint is higher than that of the surrounding non-acupoint. The luminescence intensity is relatively constant at a certain location and is symmetrical on the left and right body surfaces of health people [5]. Studies have shown there may be various relationships between Chinese meridians and the central nervous system in terms of anatomy and structure. Tian and Zhou found that acupuncture at Guangming point caused the excitement of bilateral occipital visual cortex, and acupuncture at Zusanli and Furabbit point made hypothalamus, hippocampal gyrus and frontal gyrus in an aroused state, revealing certain relationship between meridians and cerebral cortex [6]. The position of spinal motor neurons innervating acupoint muscles in the spinal cord is found to be mirrored by the arrangement of acupoints on the body surface [7]. Afferent signals caused by stimulations to meridians will be integrated and transformed into regulatory outputs by the central nervous system [8]. Meanwhile, meridians and the peripheral nervous system in arms and legs are overlapped to some extent. And the peripheral nervous system stimulation is potentially responsible for acupuncture anesthetic block [9]. It also worth noting that the travel direction of propagated sensation, which is from proximal end of acupuncture points to the distal area along a meridian, is opposite to that of sensory nerve conduction [10].

4. Relationships between the nervous system and Chinese meridians on functions

In terms of functions, we study their relationship in two different aspects. The first one is how meridians and nervous system regulate viscera. As for nervous system, it has two different paths to transmit signals to controls viscera. One is from cerebral cortex to the viscera, the other is from spinal cord to viscera. For meridians, as one of the most fundamental and virtue concept, meridians are always connected with Zangfu theory, which suggests that the stimulation on meridians may play a role on the regulation of viscera. Nowadays, many scholars believe that the regulation of viscera by meridians requires the participation of nervous system. In the 1950s, they have first purposed the hypothesis of "meridian - cortex - viscera", which is the path that meridians use to send signals to master the viscera. They believe that the conditioned reflex with the involvement of the cerebral cortex is the basis of the activity of the meridian. Some researchers used fMRI to study the acupuncture points with the excitement of cortex. The results showed that acupuncture point Zusan Li and Futu can lead to the excitement of hypothalamus, hippocampus. It illustrates that there are specific connections between acupuncture points, meridians and cerebral cortex. However, this connection, the mechanism of why acupoint stimulation can excite the cerebral cortex, hasn't been solved. Through dissection, scientists find that the acupoint is fully covered by nervous, which seems can explain the path that the stimulus are transmitted to cortex from the acupoint. Furthermore, it still need to be consider that what this kind of stimulation is. Some scholars have observed that after stimulating the acupoints, the temperature of the human skin rises; this part of the tissue is more oxygen efficient; metabolism is enhanced. This series of responses are resemble to the reactions when the sympathetic nerves are excited. Therefore, it can be conjectured that the stimulation of the acupoint by the needle causes the excitation of the sympathetic nerve, which then plays a role in

regulating the body. At the same time, the numbness and pain caused by the needle to the acupoint also suggest that there is a connection between them [11].

The second aspect is about meridians and electrophysiology. This part mainly discusses the connections between the approaches that nervous system and meridians used to transmit information. As for nervous system, it uses synapses to transmits signals. They are several types of synapses. The first one is electrical synapses. They transmit information by potential changes, and the speed of transmission fast. Electrical signals can be conducted in both directions. They are usually found in invertebrate. The second one is chemical synapses. They transmit information by releasing neurotransmitters, and their conduction is unidirectional. There is an obvious delay phenomenon when nerve signals pass through synapses. Such synapses widely exist in the nervous system of mammals.Some scholars think that they still in our body, however, the electrical synapse is separated from the nervous system through long evolution and constantly perfected to form a system, that is, the electrophysiological circuit system. And this system is meridians [12].

5. Relationship between the nervous system and Chinese meridians on treatments

5.1. how meridian theory can be used to treat neurological problems

5.1.1 Treatment of subacute allergic myelitis and syringomyelia with meridian theory

Meridian theories can be used to treat neurological problem. Patients with subacute allergic myelitis and syringomyelia, a long period of bladder injection through acupoint can effectively control the progression and deterioration of the disease, and without any side effects. This means that acupoint injection of bladder meridian acupoints can not only treat the corresponding viscera diseases, but also promote the recovery of spinal cord function affected by lesions [13].

5.1.2 Treatment of Cervical Spondylotic Radiculopathy by Meridian Differentiation

Among the common types of cervical spondylosis, CSR accounts for about 60%-70% of all cervical spondylosis. At present, the treatment for CSR is divided into conservative treatment and surgical treatment. Due to the disadvantages of surgical treatment, such as large damage, slow recovery and easy recurrence, patients tend to adopt non-surgical treatment, including traditional Chinese medicine, scraping, bloodletting, acupuncture, traction, correction of bad posture, etc. Acupuncture is generally accepted by patients due to the precise effects [14].

5.1.3 Treatment of hemicrania by Meridian theory

According to traditional Chinese medicine, cerebral collaterals can be divided into cerebral Qi collaterals and cerebral blood collaterals, which are the channels for the circulation and delivery of qi and blood. According to modern medicine, cerebral blood collaterals are more closely related to intracranial circulatory system, and the biological nature of cerebral Qi collaterals is intracranial nerve conduction system. During the acute or intermittent period of migraine, the platelet aggregation function is enhanced, and the blood viscosity is enhanced, even combined with leukoencephalopathy. Acupuncture and moxibustion of traditional Chinese medicine can improve microcirculation, regulate nervous system function and affect the release of neurotransmitters by regulating blood flow in the brain. So acupuncture plays a role in alleviating migraine attacks [15].

5.2. Comparing of treatments based on meridians and the nervous system

The traditional treatment method of meridian is acupuncture. The positions the body position should be determined before acupuncture. The doctor needs to prepare the necessary needle for the acupuncture, and kill the microbes on the pinpoint to free from infection. Doctor also needs to ensure the size of the pinpoint is suitable for the patient. During the process, the doctor mainly uses his hands to press the area to be acupunctured to determine the point to be acupunctured. During acupuncture, the needle should be inserted as painless as possible, and the needle applicator should pay attention

to determine the direction, Angle and depth of the needle. After the needle enters the body, the combination of lifting and inserting, twisting and other operating methods is used to achieve different purposes, and different operating intensity should be adopted according to the feelings of patients. When the acupuncture process has done, the pinpoints need to out the patient' s body. Doctor should twist the handle slightly before pulling out the needle. When patient feel a relaxed and smooth feeling under the needle, doctor can pull out the needle. Needle out should be carried out according to the order of first up, then down, first inside and then outside. The sterilized cotton ball is held in the left hand to press the acupoints, and the needle handle is held in the right hand to twist the needle. The action should be gentle, and the needle hole should be pressed for a moment after the needle is released to avoid bleeding, especially in the head and face and other parts that are easy to bleed, and the pressure should be pressed for a long time.

The treatment method of nervous system need to use a series of medicine. Treatment of neurological diseases can be divided into inflammatory diseases that require antibiotic treatment, such as intracranial bacterial or viral infections, which require antiviral treatment. In addition, diseases caused by intracranial and cerebrovascular diseases should be determined to be caused by arteriosclerosis and, if so, should be treated with antiarterial sclerotherapy and, if necessary, neurointerventional therapy. If some people get the neurological disease causing by the autoimmune disease, such as myasthenia gravis, hormonal immunosuppressive therapy is needed. If the disease of the nervous system is due to a tumor, the tumor needs to be targeted for treatment. In addition, the disease of the nervous system can be treated with medicine by improving brain metabolism, and promoting microcirculatio. Vitamin B group can also play a role in symptomatic treatment of nutritional nerve.

5.3. How to explain meridian therapy with the nervous system theory

Scientists discuss the essence of meridians with the method of comparing traditional Chinese medicine (TCM) with western medicine. They consider that the channels (meridians), nutrient-blood (yingxue), muscle channels (jingjin), defensive qi (weiqi), and skin (pifu) are the essence of meridians in TCM. The nervous system and circulatory system of western medicine are the main body of the meridians; the muscles and skin belong to the minor part of the meridians. The channels of TCM correspond to the blood vessels and lymphatic vessels of western medicine; the muscle channels of TCM correspond to the muscles and nerves of western medicine; the nutrient-blood of TCM corresponds to the blood and lymph fluid of western medicine; the skin of TCM is similar to the skin in western medicine. The function of defensive qi is very important, whose function and position are similar to those of many nerves [16].

At present, acupuncture is widely used in the treatment of nerve injury diseases. From the perspective of the mechanism of nerve repair by EA (Electronic Acupuncture), experimental studies have shown that EA can promote the expression of neurotrophin-3 and inhibit neuronal apoptosis to promote nerve repair and regeneration [17].

6. Modern methods used to study Chinese meridians and the nervous system

6.1. Detection of physiological indexes changes

6.1.1 Bioelectricity

Bioelectricity is associated with electrical phenomena inside human body and can be detected by microelectrodes. When cells are triggered, ion channels open and action potentials are generated, current flow will occur and biopotential differences can be measured [18]. Considering low resistance and high conductivity characteristic of meridians, electrodermal screening can be used to detect the location of meridians and study them. One specific case that studies Chinese meridians is, by employing a physiological recording electrode and examing nervous system action discharge, Xu et al. proved the presence of propagated sensation along the meridian and found the corresponding

relationship between peripheral stimulated site and primary cortical somatosensory area [19]. On the same time, electrical signals happen when neuron cells communicate with each other and Electrical current generated by them at the same time can be detected by electrodes placed on human skin. Thus electrical activity can also be measured to study the nervous system. Electroencephalography is a way to record electrical activity for the central nervous system. Electroencephalography records voltage variations at the scalp and reflects brain's activity and its results are called electroencephalogram or EEG [20].

6.1.2 Metabolites in the body

The specificities of physiological characteristics and functions of meridians suggest that the chemical composition of meridians might be different from their adjacent areas. In this way, measuring chemical changes of meridians is a way to study meridians [21]. Transcutaneous CO2 emission is a typical case. Transcutaneous CO2 emission (TCE) refers to the CO2 produced from tissues and emitted from skin when the citrate cycle takes place in living cells. Scientists found that TCE along the meridians is higher in healthy people. By measuring changes in partial pressure of oxygen (PO2) and exhaled volume of carbon dioxide (CO2) in positions of meridians, scientists can explain how acupuncture regulates human energy metabolism and plays a therapeutic role [22]. What's more, biochemical techniques are useful to study changes of neurotransmitter systems of the nervous system. By measuring and analyzing amounts and categories of neurotransmitter, scientists can be aware of therapeutic effects of drugs on depression [23]. In a summary, detecting changes of bioelectricity and biochemical are used to study both Chinese meridians and the nervous system frequently.

6.2. Combination with genomics

A unique way to study Chinese meridians is combining it with genomics. Genomics tells researchers genetic sequences' structure and their potential function as well as their downstream biological products [24]. Both the genetic information and meridians reflect the wholeness of human body, and specific gene expression on positions of meridians, including types and quantity of RNA and protein could be used to explain effects of meridian therapy on the body. For example, by using gene chip technology, Wang et al. found that the effect of acupuncture at Yongquan point on the gene expression of aging rats involves immunity, growth and development, basal metabolism and cytoskeleton movement, which proves that acupuncture therapy is a holistic regulation from the gene level. They also claimed that the application of gene chip technology can simultaneously semi-quantitatively study the expression status of thousands of genes, and the overall mechanism of acupuncture can be studied from the microscopic gene level and its molecular efficacy can be judged, so as to improve the scientific research level of traditional Chinese medicine [25].

6.3. Neuroimagine technologies

There is already mature method to present image of the nervous system and locate its position on human body. By contrast, showing precise portraits of meridians still needs enormous work to be done. It will be easier if we can study the nervous system's anatomy and functions based on three-dimensional portraits, which can be provided by neuroimaging techniques. Another advantage of neuroimaging techniques is that patients' brain tissues will not be invaded and damaged seriously. Magnetic resonance imaging (MRI) is a widely used technique of neuroimaging techniques. When employing it, the patient is placed in a strong magnetic field; atoms that make up the brain tissue will give off electromagnetic energy. Detectors around patient's head will record the energy and A computer will analyze it and present three-dimensional portrait of patient's brain. Healthy tissues as well as tumors, degenerated tissues, blood clots will be shown on it [26].

7. Conclusion

The nervous system, one of the big eight systems of the human body, that it has some way relationship with the Meridians. Meridians, known as one of the most representative symbols for China, have been studied by scientists all over the world for nearly centuries. This review focused on relationships between the nervous system and meridians from structures, functions, treatments and modern methods used to study them. In the future, the study on relationship need to be further performed.

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