

## REVIEW

## Acupuncture and the retrospect of its modern research

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### Abstract

Acupuncture is one of the oldest medical practices of Traditional Chinese Medicine (TCM). This method of treatment was discovered when primitive Chinese people discovered that pain in one part of the body can be alleviated if it stings in a particular area of the body. Acupuncture has achieved to a climax in Ming Dynasty (1368–1644 A.D.), when many famous doctors specialized in this field emerged with a lot of exclusive books on acupuncture, but the most important one was *Compendium of Acupuncture and Moxibustion* by Yang Jizhou, which represented a new milestone in the history of acupuncture's evolution. Yang Jizhou compiled a book that presents a complete and laborious description of the meridians, collaterals, acupuncture points, manipulating methods of acupuncture and their indications. According to the ancient description of the meridians and collaterals and the research on the anatomy of Western medicine, some scholars think the meridians and collaterals are closely related to the blood vessels. In recent years, many reports have showed that acupuncture has remarkable effect on the pituitary gland and adrenal cortex system, the sympathetic nerve and adrenal medulla system, the pituitary gland and thyroid gland system, the sexual glands, and the posterior pituitary system. Thus, some researchers put forth the theory of the meridians and collaterals associated with regulatory function of the neurohumoral system, and the action of acupuncture and moxibustion is brought about by the way of the nerves and body fluid.

**Keywords:** acupuncture, health status, meridian system, acupuncture points.

### ☞ Short history

Since ancient times Traditional Chinese Medicine (TCM) has treated diseases by viewing the human body as a map sectioned with different linings that are interpreted according to the natural laws of perceiving the world, "yin and yang". The main way to treat diseases has been discovered through pain and it became the center of attention in TCM – acupuncture. Common population like it, because of its good curative effect, lesser suffering, low cost, simple application and general safety [1].

Acupuncture was discovered when Chinese primitive people noted by chance that the pain in one part of the body would be alleviated when some other part was pricked. The treatment began with needles that went from stone, bone, bamboo to bronze, iron, silver, gold, and the most popular choice at the present, stainless steel.

Since ancient times until present, these medical practices have been recorded through books packed with the knowledge of the recorded times and the evolution of TCM.

Acupuncture has achieved to a climax in Ming Dynasty (1368–1644 A.D.), when many famous doctors specialized in this field emerged with a lot of exclusive books on acupuncture, but the most important one was *Compendium of Acupuncture and Moxibustion* by Yang Jizhou, which represented a new milestone in the history of acupuncture's evolution. Yang Jizhou compiled a book that presents a complete and laborious description of the meridians, collaterals, acupuncture points, manipulating methods of acupuncture and their indications [2, 3].

### ☞ The basic concepts of acupuncture

The theory of the meridians, or channels, and their collaterals concerns the study of the complete ramification and indications of each concerning the physiological functions and pathological changes of the meridians and collaterals of the human body and their relations to the internal organs, which is an essential part of the TCM fundamentals [4]. These channels and their collaterals form the basis of acupuncture, moxibustion, massage and all the other clinical departments of the TCM [5, 6].

The meridians are paths that run along the body like routes, which connect each and every part from head to toe and from left to right. These are the main lines that trace the body from the interior to the exterior. The collaterals represent networks that run crisscross all over the body, being thinner and smaller lines, unlike the meridians.

The meridians and collaterals pertain to the internal organs and extend to the extremities and joints exteriorly, integrating the internal organs, tissues and other organs into an organic whole, by which they transport *qi* and blood and regulate the *yin* and *yang* flow, keeping the functions and activities of all body parts in harmony. In Chinese acceptance, *qi* is a vital energy that flows through these meridians and participates in the homeostatic regulation of the various functions of the body [7].

The meridians include 12 regular meridians, eight extra-meridians and the subordinated lines, the 12 divergent channels, the 12 muscle regions and 12 cutaneous regions [8].

The collaterals are made up of 15 collaterals, the superficial collaterals and the minute collaterals. Among

the above, the most important ones are the eight extra-meridians who hold the clear, stable and exact routes [9, 10].

The *yin* meridians are those that run along in the medial aspect of the extremities, whereas those in the lateral aspect are called *yang*. The medial aspect of the extremities can be subdivided into the anterior border, the mid-line and the posterior border, so the *yin* meridians running through these parts called *taiyin* (greater yin), *jueyin* (reverting yin) and *shaoyin* (lesser yin), accordingly. The lateral aspect of the extremities can also be subdivided into the anterior border, the mid-line and the posterior border, so *yang* meridians are termed *yangming* (yang brightness), *shaoyang* (lesser yang) and *taiyang* (greater yang).

Each meridian is determined by the organ name to which the meridian pertains. For instance, the meridian pertaining to the heart has the name the heart meridian.

The 12 regular meridians are linked with each other through the internal meridians and the reticular branches, which constitute six pairs of exterior–interior relationship [11, 12].

The exterior–interior relations of the 12 regular meridians not only strength the connection between the exterior meridians and the interior meridians, coordinate the viscera and bowels that are of mutual exterior–interior relationship in terms of physiology, but also cause them to have a pathological influence on each other. In treatment, the acupuncture points of the 12 regular meridians with mutual exterior–interior relationship can be alternatively used. For example, in treating disease of the large intestine, the points of the lung meridian of hand – *taiyin* – can be applied.

The motion of the *qi* and the blood inside the 12 meridians is circulative and continuous [13]. The *qi* and blood start their circulation from the lung meridian of hand – *taiyin*, then pass through the last channel, the liver meridian of foot – *jueyin*, and again to the lung meridian of hand – *taiyin*. The terminus of one meridian connects with the starting point of another meridian, thus forming an endless ring.

The 12 divergent channels are the branches which derive from, enter, emerge from and join the 12 regular meridians which, in turn, reach the deeper parts of the body through these branches. Most of the 12 divergent channels derive from the regular meridians at the upper and lower regions of the elbows and knees and then enter the thoracic and abdominal cavities, where they connect their pertaining *zang* or *fu* organs to which they pertain [4, 14]. Then, they emerge from the body superficies at the head and the neck. In the regions, the *yang* divergent channels join the regular meridians and *yin* divergent channels connect the internally–externally related *yang* divergent channels. Thus, the 12 divergent channels strengthen the connections between the *zang* and *fu* organs, bring the 12 regular meridians and all parts of the body closer, and extend the scope of indications of the acupoints.

The 12 muscle regions are the conduits which distribute the *qi* of the 12 regular meridians to the muscles, tendons, and joints, and which are the external connecting regions of the 12 regular meridians. The distribution of the muscle

regions corresponds to the body–superficies courses of the regular meridians. All the muscle regions function in a course which starts from the terminals of the limbs and runs on to the head and trunk. Instead of entering *zang* and *fu* organs, they travel along the body surface, and connect with the joints and bones. The main functions of the muscle regions are to connect with all bones and control them to ensure easy flexing and extending of the joints and normal motion of the body. This is referred to in Chapter 44 of the book *Plain Questions*: “The tendons control and connect with bones to ensure proper joint functions” [15].

The 12 cutaneous regions refer to the body superficies on which the functions of the 12 regular meridians are reflected, and the sites where the *qi* of the collateral’s spreads. The cutaneous regions are within the domains of the 12 regular meridians. In the Chapter 56 of the book *Plain Questions*, it points out: “The cutaneous regions are marked by the regular channels”. Since the cutaneous regions are the most superficial part of the body tissue, they render protection to the organism [16].

The eight extra-channels are:

- *Du* (back middle or governing) meridian;
- *Ren* (front middle or conception) meridian;
- *Chong* (penetrating or vital) meridian;
- *Dai* (girdling or belt) meridian;
- *Yin qiao* (*yin* motility) meridian;
- *Yang qiao* (*yang* motility) meridian;
- *Yin wei* (*yin* linking or maintaining) meridian;
- *Yang wei* (*yang* linking or maintaining) meridian.

Unlike the 12 regular meridians, none of them belongs to the *zang–fu* organs, nor are they exterior–interior related. Their courses are unique, and hence the name, the extrachannels. They have three main functions:

(1) Strengthening the association between the 12 regular meridians;

(2) Regulating the *qi* and blood of the regular meridians, such as in storage, drainage of the *qi* and blood;

(3) Not only being closely related to the liver, the kidney and other internal organs, but also to the uterus, brain, bone marrow and extraordinary organs [2, 11, 16].

They therefore more link up to reproduction and assist 12 regular meridians to maintain the whole body.

The 15 collaterals include the 12 regular collaterals, which separate from the 12 regular meridians, the collaterals of the *ren* and *du* and the major collateral of the spleen. They are named respectively after the names of the points from where they start. Their main function is to strengthen the association of the *yin–yang* meridians and the externally–internally related meridians on the body surface. For example, the collateral of the *ren* meridian connects with the *qi* of the channel on the abdomen, the *du* meridian ensures fluent passage of the *qi* of the meridians on the back, and the major collateral of the spleen links up the pass-ways of the *qi* of the meridian on the sides of the chest [17, 18].

Superficial collaterals are those which are distributed on the superficial parts of the body, and the smallest branches of the collaterals are called “minute collaterals”. They are innumerable and spread all over the body working to transport *qi* (vital energy) and blood to sustain the body [19].

The 14 meridians include the 12 regular meridians, and *ren* and *du* meridians, which are mostly associated with the clinical application. Their body–surface distribution is as follows. The *yin* meridians pertaining the six *zang* organs (heart, liver, spleen, lung, kidney and pericardium) are distributed on the medial aspects of the four limbs, and the thoracic and abdominal regions, among which, the three *yin* meridians of hand are distributed on the medial aspects of the upper limbs, while the three *yin* meridians of foot in the medial aspects of the lower limbs. The *yang* meridians pertaining to the six *fu* organs of the gallbladder, stomach, large intestine, small intestine, urinary bladder and *sanjiao* (triple warmer), are mostly distributed on the lateral aspects of the four limbs, head and face, and the lumbar region and the back. Among them, the three *yang* meridians of hand are distributed on the lateral aspects of the upper limbs, while the three *yang* meridians of foot, on the lateral aspects of the lower limbs. The three *yang* meridians of hand and foot are arranged in a sequence, in which *yangming* meridians are the anterior ones, *shaoyang* meridians in the medium ones and *taiyang* meridians the posterior ones. With respect to the three *yin* meridians of hand and foot, *taiyin* meridians are the anterior ones, *jueyin* meridians the medium ones, and *shaoyin* meridians the posterior ones, *jueyin* meridians are the anterior ones, *taiyin* meridians the medium ones. The *ren* and *du* meridians are distributed along the anterior and posterior midline of the trunk, neck and nape, and the head and face, with the *ren* meridian on the anterior midline. Both the *du* and the *ren* meridians have their clearly independent points, which are also popularly used in the treatment of diseases [2].

Acupoints are the loci through which the *qi* of the *zang–fu* organs and the meridians is transported to the body surface, 365 of which have so far been discovered [20]. It falls roughly into three categories: acupoints of the 14 meridians, extraordinary points and *Ashi* points.

Acupoints of the 14 meridians, also known as the “regular points”, are distributed along the 12 regular meridians and the *du* and *ren* meridians. As the major part of acupoints they have their regular locations, regular names and pertaining meridians, but due to their large content, herein not been described in detail.

Besides, there are also specific points on the 14 meridians. The specific points of the 14 meridians refer to those that have specific therapeutic properties. They have their special names given after their different indications and functions. Ten types of specific points have been summarized out, which are five *shu* points, *yuan* (primary) points, *luo* (connecting) points, *xi* (cleft) points, back – *shu* points, front – *mu* points, crossing points, influential points, confluence points and lower *he* (sea) points [21].

Extraordinary points have regular names and regular locations, but do not enter in the 14 meridians. They are also named “extra points” and are especially effective in the treatment of certain diseases.

*Ashi* points are also called “tender spots”. They have no specific names and definite locations, and the tender spots and other sensitive spots are places of response and reaction on needling and moxibustion.

The physiological functions of the meridians are known

mainly as “the *qi* meridian” in TCM. It connects the whole human body, which consists of the five viscera, six bowels, five sense organs, skin, muscles, tendons, bones, etc. Each of them has its own special physiological functions. It is through the connecting role of the meridians that these functions can be coordinated, thus making the body an organic whole. Only by receiving nourishment from the *qi* and the blood can each of the organs in the body give full play to its physiological functions. Most importantly, the meridians are the pass-ways through which the *qi* and the blood circulate. *Classic on Medical Problems* states: “the function of the meridian is to transport the *qi*” and the blood and circulate the *yin* and *yang* in order to nourish the body.

The meridians induce stimulation and transmit information. If some region of the human body is stimulated, such stimulation will be transmitted along the meridian to the related viscera or bowels in the body. As a result, the relevant physiological or pathological changes take place. These changes are reflected on the body surface through the meridians. “Getting the *qi*” and “circulating the *qi*”, the normal sensation felt by the patient during acupuncture, truly embody the inducing and transmitting functions of the meridians and collaterals.

The meridians and collaterals can regulate the functional activities of the human body, keeping them coordinated and balanced. When dysfunctions occur in some organ, acupuncture and other therapy can be used in order to help further stimulate the regulating function of the meridians and bring the organ back to normality. For example, experiments have proved that it can regulate peristalsis and secretion of the stomach to puncture *Zusanli* point of the stomach meridian of foot – *yangming*. When deficiency occurs in peristalsis and secretion of the stomach, stimulating this point gently with a needle may strengthen the peristalsis of the stomach and increase gastric acidity. If peristalsis and secretion of the stomach are excessive, a forceful stimulation in the point with a needle will have an inhibitory effect. Another example, puncturing the *Neiguan* point of the pericardium meridian of hand – *jueyin* can cure both bradycardia and tachycardia, performing a biphasic regulative function.

The meridians and collaterals have a direct bearing on the occurrence and progress of diseases. If a meridian is in functional disorder, it is apt to be attacked by exogenous factors; then, the exogenous factors will further intrude into the internal organs along the meridians [22].

The theory of the meridians and collaterals has long been widely applied to direct clinical treatment of all the departments of TCM, in particular, acupuncture, moxibustion, massage and herbal prescriptions. For instance, “the method of selecting points along the meridians” is a good example. To be specific, the *Zusanli* point of the stomach meridian of foot – *yangming* should be selected for the treatment of stomach; the *Qimen* point of the liver meridian of foot – *jueyin* should be punctured for curing liver disease. The selection of regions of massage is also based on this theory.

It is also through the meridians and collaterals that the herbs exert an influence on the pathological region and take effect as expected. Through protracted and repeated practice, TCM doctors have discovered that a certain

herb possesses a selective effect for a certain disease of some meridians and its pertaining organ, thus creatively formulating a theory of “classifying herbs according to their respective therapeutic effect on the disease of a specific meridian and its pertaining organ”. For example, through the work done by Chinese *Ephedra* (*Ephedrae herba*) on the meridians of the lung and the urinary bladder, sweat is induced, asthma relived, and diuresis promoted. Another example, through *Bupleurum* root (*Bupleuri radix*) acts on the meridians of the liver and the gallbladder and regulate the vital energy by alleviation of mental depression. The theory of “medicinal guides” was formulated by ancient Chinese medical men according to the theory of the meridians and collaterals. Taking some examples, in treating headache, *Notopterygium* root (*Notopterygii rhizoma et radix*) should be prescribed if it is due to *taifang* disturbance, or *Angelica dahurica* root (*Angelicae dahuricae radix*) should be prescribed if due to the disturbance of the *yangming*, or thorax – *Bupleuri radix* prescribed if due to the disturbance of the *shaoyang*. The above-mentioned “medicinal druids” do not only work their way through the relative channel and its pertaining organ, but also direct other medicines to the right meridian and organ to bring their therapeutic action into play [23].

In addition, the clinical applications of acupuncture anesthesia, auricular needles are created under the guidance of the theory of the channels and collaterals and will inevitably further prove and develop this theory.

The therapeutic properties of acupoints manifest themselves in the following three aspects.

#### Local and adjacent therapeutic properties

All the points in the body share the common feature in terms of their therapeutic properties. Each point located on a particular area is able to treat any disorder of the nearby tissues and organs.

#### Remote therapeutic properties

This is the basic regularity of the therapeutic properties of the points of the 14 meridians. The points of the 14 meridians, especially those of the 12 regular meridians located below the elbow and knee joints, are effective not only for local disorders but also for disorders of the tissues and *zang-fu* organs so far as the course of their pertaining meridians can reach. Some even have systemic therapeutic properties. For example, *Zusanli* point not only treats the disorders of the lower limbs, but also regulates the whole digestive system, even has certain effect on body defensive and immune reactions of the body.

#### Special therapeutic properties

Clinical practice has proved that needling certain points may forth biphasic beneficial regulation on a variety of functional abnormalities of the body. For instance, puncturing the *Tianshu* point relieves both diarrhea and constipation. In addition, the therapeutic properties of some points show relative specificity, e.g., the *Dazhui* point, which has an antipyretic effect, and the *Zhiyin* point helps correct the malposition of a fetus.

The general principles of acupuncture treatment are worked out by repeatedly practicing acupuncture and

moxibustion under the guidance of the theories of TCM. They are of universal significance in decision of the treating methods, selection of points and manipulations [24–26].

The regulation of *yin* and *yang* is a fundamental principle in clinical acupuncture treatment. According to the theories of TCM, diseases result mainly from relative imbalance of *yin* and *yang*, where *yang* in excess or deficiency or *yin* in excess or deficiency. The mechanism of acupuncture treatment lies in regulation of *yin* and *yang*; in doing so, it brings the body back to the physiological state of “*yin* and *yang* in equilibrium” and cures patients of the illness.

Regulation of *yin* and *yang* by acupuncture is completed by point prescription and needling manipulations.

Point prescription includes two or more points, which are selected according to the symptoms and cause of disease, and the functions and the natures of the points. The methods often used in clinical treatment for point prescription are such as selection of points on the diseased meridian, the combination of the exterior–interior points, the combination of the anterior–posterior points (also known as the combination of abdomen – *yin* points and the back – *yang* points), the combination of the distant–local points and the combination of the left–right points. For example: *Zhongfu*, *Chize*, and other points of the lung meridian of hand – *taiyin* – selected to make up a prescription for cough due to disease of the lung; if the kidney meridian of foot – *shaoyin* – is affected, selecting *Kunlun* and *Jinggu* of the urinary bladder meridian of foot – *taiyang*; selecting *Zhongwan* anteriorly and *Weishu* posteriorly for epigastric pain; selecting *Hegu* on the right side to treat facial paralysis on the left side, and vice-versa and also the points on both sides selected clinically in treatment of the diseases of the internal organs, so as to strengthen the coordinating effects.

Needling manipulations and needling methods play an important role to induce the needling sensation, bring about the desired therapeutic results and guarantee safety. Generally, the angle and depth of needling insertion, the speed of needling insertion and withdrawing the needle and others depend on the pathological condition, the location of points, the different objectives and the seasons; patients with different constitutions and body types have not same needling sensation and treating effects. Therefore, the consideration must be fully paid according to each patient’s concrete condition and location of points. Only by doing it in such a way can better therapeutic results be obtained [16, 27, 28].

According to the theories of TCM, *xu* (insufficiency or asthenia) indicates the insufficiency of genuine *qi* (including the body resistance). *shi* (excess) indicates the exuberance of pathogenic *qi* (or pathogen). For patient with excessive heat syndrome, superficial puncture to cause bleeding should be used often for elimination of the excessive heat; for patient with asthenic cold syndrome, reinforcing method, such as prolonged retaining of needle or applying moxibustion for restoring *qi* and dispelling cold, is often employed; for patient with intermingled insufficiency and excess syndrome, reinforcing and reducing methods are used simultaneously.

The conception of the primary fundamental and the secondary incidental are relative to each other involving different meaning. For instance, the genuine *qi* is the primary, and the pathogenic factor is the secondary; the etiology is the primary, and the manifestation is the secondary; the original disease is the primary, while the consequent disease is the secondary. This concept represents the two opposite aspects of one entity during the course of a disease. The incidental is generally the phenomenon and the secondary aspect, the fundamental cause is generally the nature and the primary aspect of a disease. Under general circumstances, the principle is treating the incidental first when it is acute or emergent, and treating the fundamental later when the cause becomes insidious or gradual. However, if the incidental and the fundamental are both emergent, they must be treated at the same time.

In acupuncture treatment, a disease should be assessed according to such different situations of the primary, the secondary, the root cause, the symptoms, the acute and the chronic so as to determine the principle of treatment. For some diseases resulting in constipation and dysuria, for example, points helping defecation and urination should be selected first to treat the disease, that is, to treat the symptoms first when they are acute; then some points to treat the root cause or original disease are selected, that is, to treat the root cause when the acute symptoms are relieved. For edema due to insufficiency of genuine *qi* or blood resistance weakened while pathogenic factor still prevailing, select both the points strengthening body resistance to treat the root cause and the points inducing diuresis to alleviate edema. The latter is most widely used in clinic [28, 29].

As how the ancient Chinese medical men to find the meridians and acupoints has been a discussed miracle, how to bring them to light of their structure, function and nature has also at least partly been a mystery to modern human beings. Numerous scientific people from not only medicine province but also biology, chemistry, physiology, electricity, magnetism fields and so forth have made a great deal of study in order to seek the answer.

## ☐ Modern studies on the meridians and collaterals

### The meridians and collaterals, and the neural segments

TCM considers the meridians and collaterals are the pathways which connect the exterior and interior, and *zang-fu* organs. In the light of modern medicine, the nerves associate the body surface with the internal organs. Therefore, the relationship between the meridians and collaterals and the nerves should be considered, or in another word, it should be thought whether or not the meridians and collaterals are actually the nerves. Some researchers explain the association of the meridians, collaterals and acupoints, and internal organs to connection link of body–neural segments–internal organs. Because:

- Firstly, judging from the relationship between the locations and indications of the acupoints on the trunk of the body, and the neural segments, through anatomical observations and analysis, it is found that the back – *Shu*

and the front – *Mu* points and the points of the *ren* channel are identical with the internal organs to which these points pertain and which they govern in the neural segments. For instance, *Zhongfu*, the front – *Mu* point of the lung, and *Feishu*, the back – *Shu* point of the lung, are both controlled by the 1<sup>st</sup>–5<sup>th</sup> segments of the thoracic nerves and the nerves which control the lung come from the same neural segments. Another example is that the *Shan Zhong* point controlled by the 4<sup>th</sup> neural segment of the thoracic nerve is indicated in diseases of the respiratory system. This shows points and their corresponding internal organs have identity in the neural segments.

- And secondly, judging from analysis of the therapeutic properties of the points of the meridians and collaterals, the meridians and collaterals are closely related to the neural segments. For instance, the points of the heart meridian of hand – *Shaoyin* may be used to treat diseases of the heart, lung and trachea; the same meridian passes the medial aspect of the tip of little finger, the medial aspect of the forearm and the chest; the skin of these areas, where the meridian passes, is controlled by the 1<sup>st</sup>–3<sup>rd</sup> neural segments of the thoracic nerves, which at the same time control the cutaneous nerves of these areas. This indicates that these areas and the heart, lung and trachea are under the domination of the same neural segments [30].

The research on the phenomena of meridian transmission further confirms the existence of the meridians and collaterals. The course of the meridian transmission is basically similar to the course of the meridian described in the ancient Chinese medical books, but it's quite difficult to explain it. Because the tissue structure of the meridians and collaterals is not found in the peripheral part of the body, some scholars hold that the meridians transmission takes place in the central nervous system (CNS). There are three main arguments:

- (1) Phantom limb sensation, which is that the amputee still feels the needling sensation transmitted to his missing limb on arrival of *qi*, when given acupuncture.

- (2) Conditional reflex generalization: some researchers gave acupuncture on the *Zusanli* point of a dog to produce a conditional stimulation and gave food to the dog to cause its salivary secretion as an unconditional stimulation. After repeated stimulation, when the conditioned reflex was established, acupuncture on the *Zusanli* point along may cause its salivary secretion. At the same time, needling the other points of the stomach meridian may also bring about its salivary secretion, but needling the points of the foot – *taiyang* or foot – *shaoyang* meridian will certainly not. This indicates that the conditioned reflex has a tendency to be generalizes along the meridian. In light of the physiological view, the conditional reflex generalization goes on in the CNS, not in the exterior of the body [30, 31].

- (3) Acupuncture transmission under anesthesia: it is found that after lumbar anesthesia, needling the *Qihu* point on the chest may produce acupuncture transmission in most of the subjects, which may travel along the lower limb on to the anesthesia area, and further to the tip of the toe [32, 33].

From the description above, it is assumed that the meridians and collaterals are the specific functional

association between the areas of the cerebral cortex. Needling a certain point may activate the corresponding excitation spot in the cerebral cortex. The excitation spreads regularly, according to its specific functional association and along a certain course, when the excitation occurs in a corresponding projection area of the body surface [28].

According to the ancient description of the meridians and collaterals and the research on the anatomy of Western medicine, some scholars think the meridians and collaterals are closely related to the blood vessels. During the autopsy, scholars observed 309 acupoints, of which 24 are located at arterial trunk, making up 7.77% of all the points they observed, 206 by the sides of the arterial or venous trunk, accounting for 84.79% of the total. This indicates that acupoints are closely associated with the blood vessels. In the *Anhui Medical College*, there was an experiment in which Chinese ink was injected into the acupoints on the freshly amputated legs, and the 57 points observed. The local tissue around 17 points on eight of the amputated legs, a fibrous structure filled with Chinese ink started from each of this area. The fibrous structures extended along these different courses of the three *yin* meridians, eight of them along the liver meridian, four of them along the spleen meridian and five of them along the kidney meridian. On each of the legs, the fibrous structures filled with Chinese ink were close each other at the *Sanyinjiao* point, having a tendency of confluence. It was verified by the tissue slices that all the fine vessels filled with Chinese ink were small veins. This shows the idea that meridians and collaterals and their points are very close to the system of blood vessels [21].

The meridians and collaterals, and the neurohumoral system mainly involve researches on the relationship between the neural mediums and hormones, and the channels and collaterals. The neural mediums are important substances, which regulates the physiological activities of the organism. At present, researchers are focused on monoamines and choline. A large number of study results have confirmed that the neural mediums play a big role in acupuncture analgesia. In recent years, many reports have showed that acupuncture has remarkable effect on the pituitary gland and adrenal cortex system, the sympathetic nerve and adrenal medulla system, the pituitary gland and thyroid gland system, the sexual glands, and the posterior pituitary system. Thus, some researchers put forth the theory of the meridians and collaterals associated with regulatory function of the neurohumoral system, and the action of acupuncture and moxibustion is brought about by the way of the nerves and body fluid [34–36].

Certain research data show that there is a regularity between the meridians and collaterals and the electric changes of the skin at the acupoints. Indeed, on the skin there are some spots with higher magnitude of current, which are distributed in the as way as the acupoints, moreover, some spots are arranged in a line, which confirms to the course of the meridian and collateral. Therefore, some research fellows think the meridians and collaterals, in fact, are the specific pathways of bioelectric current; while the *qi* and blood of the *zang-fu* organs are traveling in the meridians and collaterals, certain electric

potential changes produced, and the electric current travels along the specific pathways crisscross and all over the body, forming the system of the meridians and collaterals [30, 35, 37].

Other researchers say the meridians and collaterals are the electromagnetic waves formed by electrons or electron beams traveling along specific pathways. For this reason, some doctors apply a high magnetic body to the acupoint of the meridian and collateral to make advantage of the effect of the magnetic field exerted on the bioelectric activities of the meridians and collaterals. This is known as “magnetotherapy” [38].

As the mentioned, we have known that acupoints are the specific points closely relating to the activities of the channels and collaterals and *zang-fu* organs, through which, *qi* and blood can gather and travel by applying acupuncture. Therefore, herein the collections of acupoints’ studies concentrate on the research of their morphological structures which link to or condition the roles of the acupoints.

Some researchers think the blood vessels of the point distribute with the regularity of some 45.15% points located by main vessels and 18.6% points, at the blood vessels. The others believe the nerve–vessel doctrine that stimulating points has the action on puncturing autonomic nerves and fine blood vessels, so that the reflexive effect comes through the conduction of the neural fibers. Because they found through histological observation that very rich fine blood vessels and more developed capillary network exist in around 99.6% of the subcutaneous tissue underneath the points. Other gross-anatomic researches on the histological morphology of the point confirm the most points locate at the neural trunks or nerve branches and the fine neural fibers pass through most points [39].

The morphological study of the *Sanyinjiao* point by observing the grossly stratified dissection and computed tomography (CT) cross-section of the point reported as follows. No special structures have been found besides nerves, blood vessels, lymphs, fascias, tendons and muscles comparing the areas of points and non-points. However, the distribution of the normal structures of the body is different and the *Sanyinjiao* point is made up of not one kind of tissue, while a co-built stereo-structure of many types of different tissues [40].

The latest report on the experimental approach and research thinking of the structural basis of the meridians and collaterals was put forth these recent three years. The researchers have spent more than eight years on the research and established:

(1) The point is a complicated structural system including concentrated fine blood vessels, autonomic neural plexuses and lymph vessels.

(2) The finding, existing a length of 15.5  $\mu\text{m}$  spontaneously shape-narrowed wave in each point, reflects that there must be a radiation structure with focused particular energy.

(3) In the stereo-structure of each point, the multi-mineral element-concentrated loci and areas were found. The  $\text{Ca}^{2+}$  density increases during needling points. As every knows, each mineral element has special close relation with the neural functions, and then a series of reactions after neural activities.

(4) Underneath each point, there is a specially distributed and concentrated fine blood vessel network, in which the capillaries in parallel placing have the same direction of the meridians. Thus, it is not difficult to understand that the blood and body fluid between capillaries can transport in long courses along the directions of the meridians.

Also, this possibly explain the theory of “Classifying herbs according to their respective therapeutic effect on the disease of a specific meridian and a pertaining organ” and other clinical methods, such as moxibustion, massage and so on.

## ☞ Conclusions

Acupuncture is one of the most popular TCM treatment methods. Meridians and acupoints represent complicated structures that have been demonstrated through different electric potentials and through a histochemical composition specifically demonstrated by us, which in fact strengthens the existence of an energetic system regulation of the human body homeostasis.

The entire Eastern medicine establishes the basis for therapy by harmonizing the biological constants of the body, unlike the Western medicine, where the focus is concentrated on the effect brought by the drugs through chemical synthesis harmonization and different medical techniques. Comparing the two, we can clearly see that TCM successfully treats metabolically imbalances, which appear in a multitude of maladies, while Western medicine successfully treats diseases surgically, infectious and contagious diseases, in which the causal factor can be removed either through medication or surgical techniques. Following these conclusions, at the moment, in the United States of America, the concept of integrative medicine was accredited for both categories, Eastern and Western medicine, being used in a personal way, regarding the disease and the patient.

## Conflict of interests

The authors declare that they have no conflict of interests.

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