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Perspective

A New Definition of an Acupuncture Meridian

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Abstract
This article provides a new definition of an acupuncture meridian. It suggests that a meridian consists of a distal tract of tissue that is affected by organ function. In the 1960s, Kim discovered the primo vascular system and regarded the superficial primo vessels as equating to the meridians. Instead, this article suggests that the superficial primo vessels merely underlie the meridians, in that they enable their creation, which is why some meridians are said to occur along the paths of superficial primo vessels. But the meridians themselves do not have a dedicated anatomical structure; instead they are merely tracts of tissue whose normal function is impeded when the related abdominal organ is stressed. It is hypothesized that the organ information is communicated in electrical waves that may travel through the connective tissue sheaths of the superficial primo vessels. Hence, the primo vessels serve as an inadvertent transport for this information, but the organ information is independent of the physiological purpose of the primo vascular system, as are the resultant meridians.

1. Introduction

The oldest surviving texts that contain the core knowledge in Chinese acupuncture are known as the *Nei Jing*. These are a collection of separate scripts written by different authors in around the 2nd century BC, and the collection is divided into two parts, known as the *Su Wen* and the *Ling Shu*. The authors had little useful knowledge of the body's internal anatomy and certainly had no knowledge of the body's chemistry or the microscopic anatomy of organ tissue. So to explain the phenomena related to acupuncture, these authors (by necessity) resorted to metaphor and speculation.

When food was cooked in a cooking pot, steam rose from the food and seemed to contain some essence of the food, such as the scent of the ingredients. And it was speculated that similar processes may take place in the body. Hence, the stomach was imagined to "cook" food, which then resulted in a vapor being released which contained the useful essence of the food. This vapor was known as "influence" 氣 (*chi*), and it was imagined that this vapor could "steam" between the organs (such as between the stomach and lungs) and was then circulated in the body through networks of vessels, taking the nutrition to every location.

The main vessels were termed "conduit vessels" 經脈 (*jing mai*). These were thought to be situated deep beneath the skin. From these, other vessels, known as "network

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vessels" 絡脈 (*luo mai*), were thought to branch off and rise to a superficial level, so that they could be seen and felt through the skin. All the vessels were thought to transport the vapors extracted from food and also blood. Blood was imagined to be a purely nutritive substance that was manufactured from ingested liquids and food, the manufacture taking place in the stomach itself (according to *Ling Shu*, Chapter 60 [1]) or in the various vessels (according to *Ling Shu*, Chapters 18, 71 and 81 [2—4]).

Note that the separate chapters of the *Nei Jing* often contain such contradictory statements, which could be accounted for by the fact that the content was written by different authors and that such content was usually mere speculation.

The network vessels (*luo mai*) correspond with the superficial veins or arterioles that can be seen through the skin and were used for bleeding patients, though they could not be said to *equate* to these (as they are understood today) because the *Nei Jing* "veins and arterioles" were not thought to be part of the blood circulatory system known today, with the heart acting as a pump to circulate the blood. This system was then unknown. Instead, both blood and "influences" (vapors) were thought to flow together through these conduit and network vessels, which are what are today called either "meridians" or "channels".

2. The discovery of the primo vascular system

For many years, contemporary biology and medicine doubted that these meridians existed because no anatomical structure could be found that might correspond to them. But in the 1960s, Bong-Han Kim began publishing his research into the acupuncture system. He described (what we now call) the primo vascular system (PVS), which he believed to be the anatomical structures that correspond to the meridians and acupuncture points. He reported that the system's purpose was to enable the maturing of cells for organs and other tissue. A dying cell would produce many embryonic-like cells (now called p-microcells), which travel through primo vessels. These begin within the cell nucleus itself, then leave the organ or tissue, travel through the skin, with the cells pausing at primo nodes to allow them to mature, then the matured cells complete the return journey back into the organ. It is believed that these cells travel to the skin because this closer proximity to light is beneficial for their maturing [5,6]. The superficial primo vessels (traveling through the skin) were said to correspond to the meridians, and the primo nodes on these vessels correspond to acupoints.

Since then, many of Kim's findings have been independently verified. Primo vessels have been confirmed to exist within blood vessels [7,8]; on the surface of rabbit intestines and the bladder [9]; on the surface of a rabbit's liver [10,11]; floating inside lymph vessels [12,13]; in the bovine heart [14]; and in the brain, spinal cord, and nerves of rats [15]. It has also been confirmed that the fluid circulated within these vessels is abundant with immune cells such as macrophages and mast cells and also contains very small embryonic cells, similar to stem cells [16]. However, the extent of Kim's work was so extensive that many aspects of it are yet to be duplicated by other researchers.

It has so far been assumed that superficial primo vessels correspond to the acupuncture meridians, and researchers have tested this. In 2012, Wang et al [17] found that electrostimulation of the acupoint Stomach-36 (*Zusanli*) had a significant effect on gastric motility at the duodenum (the tube through which food exits the stomach) but that electrostimulation of a single primo vessel on the stomach organ itself had no effect. It was also found that cutting this single primo vessel did not inhibit the effect on the stomach that stimulation of Stomach-36 had. The report concluded that the effects obtained on organ function by stimulating acupoints did not appear to depend on the PVS.

Kovich's article "A curious oversight in acupuncture research [18]" demonstrates that acupuncture's effect on the organs could neither be mediated by either the nervous system or any blood-borne factor such as hormones nor be mediated by the PVS. This is primarily because the speed of acupuncture's effect on organ function is far too fast for it to be communicated via these systems. Does this mean that the PVS does not correspond to the meridian system?

3. Do primo vessels equate to meridians?

The *Nei Jing* conception of a meridian consists of a hollow vessel through with vapors and blood flow, so that the meridians form a circulatory system. From Kim's work, it is clear that nothing resembling vapors circulate in primo vessels and neither does blood. Like all body tissue, the primo vessels have a blood supply, but the blood is circulated by the cardiovascular system, which is unrelated to the PVS.

This suggests that, by the *Nei Jing* definition of a meridian, primo vessels are not meridians. But perhaps the *Nei Jing's* theoretical notion of what a meridian is was misguided.

The *Nei Jing* contains much content that was derived from practical observation, such as the signs and symptoms that result when an organ is stressed; and this content is usually fact based and is still routinely seen in clinic today. However, the theoretical elements of the *Nei Jing* tend to be untrue, such as their notions of metabolism and physiology [19] (this is only to be expected, since 2,000 years ago, there was no knowledge of the body's chemistry nor of the microscopic anatomy of the organs, so any theory on how the organs work was unlikely to be factual), and the *Nei Jing* notions of the meridians are among these theoretical elements. It is clear that some of their notions are untrue, such as the idea that vapors flow within the meridians, transporting the nourishment obtained from food, and any ideas extending from this notion must also be untrue. It was believed that the flow of these vapors could become blocked or excessive or deficient, that excess vapors could be removed by venting them through "holes" in the meridians (which is what acupoints were thought to consist of), or that blocked or deficient vapors could also be affected through these "holes", so as to restore their normal flow, which would then restore the normal function to the related organ. But since such vapors do not really flow within a meridian, any theory

involving the disruption or manipulation of such vapors must also be untrue.

4. The practical observations related to meridians

However, even though such *Nei Jing* theories are untrue, they would have been based on practical observation. After all, if there was no observation to explain, there would have been no need to form a theory. Today, experienced acupuncture practitioners can usually sense the presence and pathways of the meridians on the skin (largely by touch but also visually), so that it is safe to assume that the *Nei Jing* authors could also do this. This suggests that the meridians were initially discovered through practical observation, rather than being theoretically deduced. And in ancient China, just as happens today, these detected meridians and acupoints would have also coincided with sensations that patients experienced during a treatment. These (just as today) would have included sensations propagating along a meridian, tender locations at acupoints, shooting pains, a feeling of cold or heat along a meridian, and so on.

Such observations are the fact-based phenomena related to meridians. Hence it is clear that the meridians must exist (in one form or another) and that they reflect the health of a person's organs, since all the above sensations are linked to the health of the organ related to the meridian along which the sensations are felt. But due to the inadequate knowledge of the body's internal anatomy and physiology, the theories formed by the *Nei Jing* authors to account for these meridian phenomena were (understandably) untrue.

How could all these meridian phenomena be otherwise accounted for?

5. A new hypothesis on how acupuncture works

The hypothesis proposed by Kovich in 2016 [19] states that the organs communicate their malfunctions (and also states related to their normal function) to acupoints via an electrical wave, which can be affected at an acupoint so as to immediately rectify the related organ's malfunction.

The hypothesis suggests that body tissue interprets the organ information that is contained in the electrical waves that are omnipresent in the body. Usually such electrical waves would contain the combined information from all the organs, but since each superficial primo vessel extends from a particular organ, the electrical wave in its connective tissue sheath only contains the information from that single organ, and it is this accident that is said to produce the phenomenon of acupuncture. Because this concentrated information from a single organ is present at every location along a particular meridian, when the organ is stressed, this may enable that information to also similarly stress the distal tissue to the extent that tenderness results at key locations. The exact location is said to be determined by the relationship between the particular organ malfunction and the geometry of the limb along which the meridian flows. This (tender, or otherwise affected) location then constitutes an acupoint. And by stimulating the tender location (the acupoint), this inevitably affects the local tissue, which changed state, it is assumed, is then immediately propagated back to the related organ, which is able to somehow encourage the organ to cancel out the stress in itself that caused the distal location to become tender.

6. The definition of a meridian

If the above hypothesis is correct, then a meridian does not have a dedicated anatomical structure, but rather is a tract of distal tissue that is affected by organ function. The information from the organs is inadvertently carried on an electrical wave which may propagate along the connective tissue sheaths of the superficial primo vessels, and this enables that information to affect the function of the tissue local to the primo vessels. Hence, the PVS enables the creation of the meridians, but the meridians then consist of this separate, affected tissue. Therefore the meridians are separate from the superficial primo vessels, and it is this affected tissue (the meridians and acupoints), rather than the primo vessels or nodes, which are stimulated to achieve acupuncture's effects on the organs.

The author accepts that the PVS probably has the physiological purpose first identified by Kim (playing a key role in cell replacement) but suggests that acupuncture is a separate system—and one that has design criteria unrelated to any criteria familiar to conventional physiology (i.e., those pertaining to the known systems, such as the nervous, hormonal, endocrine, immune, circulatory, and so on); but a design criteria that is nonetheless clearly able to interact with the body described in conventional physiology.

Note that in this new definition of a meridian, the term "tract of tissue" is used, rather than "path" or "channel", since this avoids the implication that something flows along a meridian.

In his 2008 review, Ahn [20] found that the phenomenon of reduced impedance at acupoints and meridians was unreliable and that even though such phenomena could sometimes be detected in some patients at certain times, it did not appear to be a permanent, reliable feature. The current article's definition of meridians and acupoints could explain this variability, since it suggests that an acupoint does not have a dedicated anatomical structure but merely consists of effects in other tissue at that location, which vary depending on the health of the organ related to the acupoint.

This definition also makes sense in practical terms. If a meridian *did* consist of a superficial primo vessel, then it would be necessary for an acupuncture needle to pierce the tiny primo vessel (which is about the diameter of a human hair) to achieve its effects. This could certainly not be routinely achieved. Whereas with this new definition, it is only necessary for the needle (or other form of stimulation) to affect the tissue in the vicinity of the primo vessel to achieve its effects.

This simple mechanism would be able to account for every one of the meridian phenomena related to acupuncture, as described below.

7. Meridian phenomena and their explanations

The following are examples of common phenomena related to the meridians, which are routinely encountered in clinic today and which the *Nei Jing* authors must have also been aware of.

This section is not intended as a proof of the above hypothesis but is more intended to enable acupuncturists to accept the above hypothesis, even though it may seem contrary to their clinical experiences. It is generally no longer imagined that the *Nei Jing* theories are correct, and it is accepted that neither vapors nor blood flow through the meridians. Instead, in recent decades, there is the trend to imagine that some type of energy flows along meridians instead. When experiencing the following common phenomena, it is easy to imagine that something *does* flow along the meridians, but the following are alternative explanations that account for the phenomena without requiring any substance (including energy, vapors, blood, or any other substance) to circulate in the meridians.

When an acupoint is first stimulated, the patient usually feels a sensation at the acupoint. It could be a mild tingling, an ache, or a stinging or burning pain. The intensity of the sensation varies between patients and seems to be proportional to the degree of stress in the related organ. A possible explanation for such sensations is that when the acupoint is stimulated, this causes the organ function to start to change, which change would then be immediately reflected at the stimulated acupoint, affecting its local tissue, and this could account for the sensation felt. Such sensations usually diminish over the space of a few seconds, which may represent the time taken for the malfunction to clear from the organ. This is also supported by the fact that when an organ is not stressed and one of its related acupoints is stimulated, it can be difficult to induce any sensation at the acupoint. In other words, if there is no malfunction in the organ, no change is induced, and therefore no sensation is felt.

Sometimes, a section of the meridian related to a stressed organ may feel cold to the touch, or a key acupoint may feel distinctly cold in relation to the surrounding skin. And when the organ is treated with acupuncture, even where acupoints not on this cold section are used, the coldness tends to immediately clear. This could be accounted for as follows. When the information from the stressed organ is communicated to its related meridian, this information affects the local tissue along the meridian, which appears to prevent some aspect of the local tissue from working properly. One consequence is that tenderness appears at the key acupoints, and another may be that the function of the tissue along the meridian is affected to the extent that the tract of muscle, and hence the skin, is not warmed normally. But once the organ is treated, the function of the local tissue along its related meridian returns to normal, which restores the normal warmth to the tract of muscle and skin.

Another phenomena related to the above is this. Sometimes, when an acupoint is stimulated, the patient feels warmth spreading along the path of the meridian. The above explanation could also account for this. While the related organ was stressed, the tract of tissue along its meridian also failed to function normally, so that the muscle and skin were not warmed normally. Usually the patient is unaware of this, since it may have developed over a period of many months or even years. But once the organ is treated with acupuncture, the tract of affected muscle and skin immediately returns to normal function, restoring the normal warmth of the skin, and the patient experiences this as an unusual warm sensation quickly spreading along the path of the meridian.

Other anomalies that occur along the path of the meridian related to a stressed organ are dry or rough skin, redness around key acupoints, boils, or pain and weakness in nearby joints. All these could be accounted for by the muscle, skin, and other structures along the path of the meridian, failing to function normally in response to the information communicated along the superficial primo vessel extending from a stressed organ. Such red patches or pain at key acupoints tend to clear within seconds of the organ being treated, even when the acupoint where the redness or pain is centered is not stimulated—which supports the notion that the impeding information could only be communicated via an electrical wave because no other known method could account for such speedy communication between an organ and these distal locations.

Some patients sometimes feel a tingling sensation propagating along a short section of a meridian after a nearby acupoint has been stimulated. In the author's experience, this is most commonly felt along the stomach meridian below the knee, but it can also be felt on other meridians. When a particular stress (or malfunction) has been present for some time in an organ and the organ is prompted by acupuncture to "shed" that malfunction, this is probably a gradual process that may take a few seconds to complete. If this is the case, the malfunction may be viewed as gradually "moving" out of the organ, perhaps to a more superficial level of the organ. And when this changing state is reflected to the distal meridian, it may appear at a more and more "superficial" position on the meridian (more toward the end of the limb), which would give the impression that the sensation were gradually moving along the meridian.

A similar situation happens when an organ has been deeply affected by a certain malfunction, so that when this is treated, the organ is slow to recover. This happens often when the lungs are treated after a bereavement but can also happen in relation to the liver or other organs. After the treatment, the patient may develop pain and weakness at a joint along the organ's meridian, which then seems to gradually move along the limb from joint to joint until it reaches the tip, when it ceases. The whole process may take a week, a few weeks, or even several months, depending on the patient. This could be explained in the same way as mentioned previously. As the organ gradually heals, the malfunction is held less deeply within it. It moves gradually to a more superficial level of the organ's function, and as this happens, the "new" malfunction is reflected to a more superficial level of its related meridian. That is, a location more toward the tip of the limb.

Occasionally, when an acupoint is strongly stimulated, the patient may feel a strong sensation, similar to an electric shock, shooting along the entire length of the meridian in a fraction of a second. In this case, it may be

that the organ function was so strongly stimulated that this state (of its function being strongly stimulated) was immediately communicated to every location along its related meridian. Theoretically, an electrical wave propagates along connective tissue at 67,000 meters per second, which is 670 times faster than a nerve impulse travels [18]. In other words, the tissue along the entire length of the meridian would reflect this stimulated state, in effect, immediately and simultaneously. This may activate the local sensory nerves, but for the patient to become aware of this, the nerve impulses would then need to travel to their brain. The signals from the meridian locations nearer to their brain would be received first, followed by the ones further along the limb and the ones at the tip of the limb would be received last. Hence, to the patient, this would be felt as a "nerve" sensation, rapidly shooting along the meridian to the tip. Nothing would have traveled along the meridian, though this is the impression the patient would be left with.

Hence, all the common phenomena related to an acupuncture treatment may be accounted for by this hypothesis, without the need for any substance to flow within the meridians or for the meridians to have a dedicated anatomical structure.

8. The prospects

Kovich's previous article [18] suggested that investigation of the electrical properties at acupoints during a treatment may provide experimental data to support the above hypothesis. With the nature of the meridians now more clearly defined, it is hoped that this may lead to rapid advances in the scientific understanding of acupuncture's effects on organ function; and possibly also lead to the investigation of other routine effects that this electrical communication of organ information may have in the body.

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