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Perspective

A Curious Oversight in Acupuncture Research

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Abstract
Common phenomena central to acupuncture have been overlooked by previous hypotheses on how acupuncture works, with the result that the hypotheses are unable to account for acupuncture's effects. This article describes the main features overlooked and suggests how these might be investigated in future acupuncture research.

1. Introduction

In recent decades, academics from different disciplines have produced hypotheses on how acupuncture works. But curiously, none of the hypotheses can account for the basic phenomena related to acupuncture. One crucial factor that appears to have been overlooked is the speed of acupuncture's effect on each organ's function. The following simple experiment demonstrates the point.

2. The speed of acupuncture's effect

When an organ is stressed, this causes one or more of its related acupuncture points (acupoints) to feel tender when pressed. This relationship is so reliable that it is routinely used as a diagnostic aid. If one of an organ's main acupoints is tender, then the organ needs treating; and stimulating that (or one of the organ's other tender acupoints) rectifies the organ's function, which then immediately clears the tenderness at all its related acupoints. This phenomenon is central to acupuncture.

For example, in a clinical session, I pressed the acupoint Gallbladder-41 (*Zulingqi*) on the patient's *left* foot, and she said it was extremely tender. I then pressed the acupoint Gallbladder-34 (*Yanglingquan*) below her *right* knee, and she said this was also tender but not as much. I needled Gallbladder-34 below her *right* knee, and a few seconds later, I again pressed Gallbladder-41 on her *left* foot. Even though I had not needled that acupoint, she said, "That's amazing; it doesn't feel tender at all now."

In Chinese medicine, it is recognised that these acupoints become tender when either the liver or gallbladder (or both) are stressed, and once this stress is cleared in the liver or gallbladder, this would then account for the tenderness clearing on all acupoints related to those organs.

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Since noticing this phenomenon, I have tested it many times on different patients, in relation to different organs and acupoints, and noted the same outcome. When an organ's function is corrected by acupuncture, this causes tenderness at that organ's related acupoints to immediately clear, even when those acupoints have not been needled.

In Chinese medicine, the "pulses" at the patient's wrist indicate whether the main organs are functioning normally or are stressed in some way. This also provides a diagnostic aid that is routinely used in each treatment. But importantly, this can provide an indication of the speed of acupuncture's effects on an organ. During a treatment, I routinely take the pulse of an organ, then needle an acupoint to treat that organ, then immediately retake the pulse again. Usually, the pulse indicates that the organ's function has corrected, but when this does not happen, then I chose a different acupoint to treat the organ. Using this technique, I have noted that acupuncture tends to correct an organ's function in around 1 second or so. Of course, using this technique, it would not be possible to detect a quicker correction time, because the practitioner needs to move from the needle to the patient's wrist to retake the pulse, so that the speed of acupuncture's effect on an organ's function could well be very much faster than this. The experiment is informal and subjective, but it does provide evidence that the speed of acupuncture's effect on an organ is in the region of 1 second, or possibly faster.

An average distance between a distal acupoint and its related organ could be taken to be around 1 m, assuming that any "signal" is transmitted along the meridian, directly to the organ. Therefore, the speed that any such signal travels along a meridian could be taken to be around 1 m/s or faster. And the same would be true for the "signal" from an organ, out to its distal acupoints. It is clear that an organ communicates its state to its related acupoints, because the tissue at those acupoints becomes tender when the organ is stressed; and further, this tenderness rapidly clears once the organ's function has been corrected by acupuncture.

Informally, the above common acupuncture phenomena provide a basic schema of acupuncture's effect, which is that communication between an organ and its related acupoints takes place in both directions, and any "signal" travels at the rate of around 1 m/s, or faster.

3. This rules out mediation via nerves, hormones, or the primo vascular system

This basic information, although the figures are only ballpark and informally gathered, is sufficient to disprove all acupuncture hypotheses that rely on the effect being mediated by the nervous system, by any blood-borne factors such as hormones, or even by the primo vascular system (PVS).

Longhurst [1] champions the neural hypothesis, which holds that "the clinical influence of acupuncture is transmitted primarily through stimulation of sensory nerves that provide signals to the brain, which processes this information and then causes clinical changes associated with the treatment". But, the main reasons why this cannot be true are that

- there is no direct neuronal input from the brain or spinal cord to the abdominal organs, which are largely self-governing [2,3], so that the brain could not affect organ function via nerves;
- blood is said to circulate the body at the rate of around 12 cm/s [4], which means that any hormones originating from the brain could not possibly affect an organ's function in around 1 second;
- there are no nerves travelling from the abdominal organs out to each distal acupoint (which would be motor nerves, rather than sensory nerves), so that the hypothesis cannot account for how stress in an organ produces tenderness in the local tissue at its related acupoints, which tenderness rapidly clears when the organ's function is corrected; and
- this outward communication from an organ to its acupoints takes place too quickly for it to be achievable via any blood-borne factor.

According to Kim, the superficial primo vessels correspond to the meridians, and the purpose of the PVS is to mature cells from the related organ. But, the flow rate of the fluid within the primo vessels is about 0.3 mm/s [5], which equates to 1.08 m/h. This means that nothing in the contents of this fluid would be capable of accounting for acupuncture's effect of correcting organ malfunction in around 1 second, because the communication rate is far too slow. Indeed, such malfunctions could not be produced by cellular problems within the organ, because if they were, they could not possibly be corrected so quickly by acupuncture.

It is clear that the rapid rate of communication between distal acupoints and the related organ (in both directions) rules out the involvement of the nervous system, any blood-borne factor such as hormones, or the PVS in mediating acupuncture's effect. The communication must take place over some other medium.

Other hypotheses also fail this same simple test. In 2002, Langevin and Yandow [6,7] proposed an hypothesis that focused heavily on the concept of "needle grasp", which is a phenomenon that sometimes happens (some acupuncturists produce this more than others; and when pressure or heat is used to stimulate an acupoint, this also immediately affects the organ function, yet could not possibly involve "needle grasp"). It was proposed that when an acupuncture needle is turned, this may cause distortion of the collagen fibres in the connective tissue, which may then set up a mechanical wave that spreads through the connective tissue, which could act as a signal. The hypothesis also cites the phenomenon of "meridian sensation". During an acupuncture treatment, some patients sometimes experience a sensation slowly propagating along a short section of a meridian after a nearby acupoint has been stimulated. And the hypothesis equated this with the speed that a mechanical wave would travel through connective tissue. But, in both cases, this speed is far too slow for it to be able to account for acupuncture's effect on the organs. The speed of sensation propagation along meridians is around 18 cm/min [8], whereas the communication between an acupoint and its associated organ travels at around 1 m/s, or faster. The researchers were clearly unaware of how fast this communication takes place, and wrongly assumed that the occasional

phenomenon of sensation propagation along a meridian is somehow equated with acupuncture's effects.

In 2008, Zhang et al [9] proposed the low hydraulic resistance meridian theory. This suggests that "interstitial fluid flows freely in meridians and appears to play an important role in regulating extracellular contents." The flow rate was measured at about 4 mm/s. This alone indicates that the hypothesis could not account for acupuncture's effect on an organ's function, because the communication rate would be far too slow.

4. Confusion over meridian propagation issues

There appears to be confusion among acupuncture researchers over the concept of the propagation speed of signals in connective tissue, and any relation this may have to the propagation of sensation along a meridian which is sometimes felt by some patients.

In the 1960s, Kim measured the flow rate of PVS fluid in the meridians to be about 0.3 mm/s, and the propagation speed of stimulation from one acupoint to the next on the same meridian to be about 10 times faster than this, at 3 mm/s. But, this stimulation often only travelled to the next acupoint along, and sometimes to the following one, but (in his experiments) never any further along the meridian [10]. This fact alone would rule out any role this phenomenon may play in acupuncture's effect on organ function, because it would never reach the organs, let alone that its flow rate is far too slow to account for acupuncture's effect.

5. Charge mobility in semiconductors

There is also confusion over the concepts of charge mobility (which is similar to electron drift) and the propagation speed of an electrical wave. This last concept is unrelated to the first.

Normally, electrons and charged particles have no measurable geographical movement. They shoot around in random directions, but remain in roughly the same geographical location. When a direct current is applied to a conductor, the electrons or charged particles then drift very slowly along that conductor. In the case of electrons moving along metal wires, this is known as *electron drift* and is extremely slow, in the order of millimetres per hour [11]. In a piece of connective tissue where semiconduction takes place, this drift is known as *charge mobility*, and is also very slow.

Neither of these speeds provide the propagation rate of an electrical wave along these conductors. Any change in the electrical potential is passed between each charged particle along the conductor, without those particles moving geographically. In metal wires, the rate of propagation is very near the speed of light; and in connective tissue, is also extremely fast.

The velocity that an electrical wave propagates through a substance is dependent on the *relative permittivity* of that substance. And the relative permittivity varies depending on the frequency of the wave—that is, on how many times per second the voltage changes. Once these factors are known, the velocity is given by the following formula [12]:

$$\text{Velocity} = \frac{\text{Speed of light}}{\sqrt{\text{Relative permittivity}}}$$

For example, when the signal's frequency is 1 Hz, the relative permittivity of connective tissue is 20,058,555 [13], which gives a velocity of almost 67,000 m/s. This is 670 times faster than nerve impulses travel. In biological terms, this means that communication via an electrical wave through connective tissue is, in effect, instant.

However, some researchers cite the very slow rate of charge mobility in semiconductors, wrongly assume that this indicates the speed that an electrical wave would propagate through connective tissue, and when this very slow rate is in the same ballpark as the propagation rate of the occasional meridian sensation, assume that the one equates to the other and that they have thus somehow explained acupuncture's effects. But, every element of such arguments is flawed. Not only is the understanding of the science wrong, but the lack of first-hand knowledge of acupuncture also fosters its own misunderstandings.

6. Other pertinent discoveries

In 1941, Szent-Gyorgyi [14] suggested that proteins are semiconductors. And in 1981, Szent-Gyorgyi [15] also demonstrated that a protein called collagen is a semiconductor. Collagen is the main component of the body's connective tissue, which is the material that forms the constructive fabric of almost every element of the body, down to the microscopic level. It is widely found throughout bones, ligaments, tendons, cartilage, and also the coverings of the bones and muscles, which is known as the fascia. Hence, it is now widely accepted that many tissues in our body have semiconducting properties and that true electrical currents can flow within them.

In 1965, Kim [16] reported that the superficial primo vessels (which are thought to equate to the meridians) are encased in connective tissue.

In organic semiconductors, the chemical doping is said to be provided by sodium—calcium (and also potassium—calcium) exchange, which happens through an oxidation—reduction (redox) process [17]. In other words, when there are unusually high concentrations of these ions in the connective tissue, this can be taken as an indicator that semiconduction is taking place. In 1998, Chen et al [18] found that the calcium concentration on 25 acupoints of the gallbladder meridian, between Gallbladder-20 (*Fengchi*) and Gallbladder-44 (*Zuqiaoyin*), was four times more than that at non-acupoint and non-meridian areas. In 2000, Chen et al found that the calcium concentration in the area of the acupoint Gallbladder-36 (*Waiqiu*) was on average 6.80 times higher than that at non-acupoint areas elsewhere in the human body [19]. And again in 2000, Liu et al [20] found that the relative concentration of calcium at four points on the stomach meridian on the lower leg was on average 6.73 times higher than that between the points. Hence, this implies that a direct current is present within the connective tissue sheaths of the meridians.

If information carried on an electrical wave were present in this direct current, the wave would propagate along the meridian at around 67,000 m/s. In other words,

communication within the body carried on this medium could be considered to be instant. For example, the liver and gallbladder meridians flow into one another before returning to the organs, and assuming that in an adult, the combined length of these two meridians is about 4 m, then any change in an electrical wave instigated at a liver acupoint would be propagated to every liver and gallbladder acupoint, and also to the liver and gallbladder organs themselves, in around 0.00006 seconds. And, any change in the function of these organs (such as when the function is corrected by acupuncture) would also propagate to every liver and gallbladder acupoint in this same short time.

7. Communication via an electrical wave

The hypothesis proposed by the author in his study, in 2016 [21], holds that the organs communicate their malfunctions 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 as each superficial primo vessel extends from a particular organ, the electrical wave in its connective tissue only contains the information from that single organ, and it is this accident that produces 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 enables that information to also similarly stress the local tissue to the extent that tenderness results. The exact location is determined by the relationship between the particular organ malfunction and the geometry of the limb along which the meridian flows. This location then constitutes an acupoint. And, by stimulating that tender location (the acupoint), this inevitably affects the local tissue, which changed state, it is assumed, is then immediately communicated 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.

As can be seen, the hypothesis does not rely on any of the communication methods known to biology. Naturally, when academics strive to explain acupuncture, those known systems (such as the nervous and hormonal systems) are the mechanisms they use to form their hypotheses, because those are the only tools available to them. But, the routine clinical experiences found in acupuncture indicate that the communication between an acupoint and its related organ happens in both directions and takes place in around 1 s (or very much faster), therefore this cannot be explained by the communication mediums currently known to biology, so that the answer must be sought elsewhere.

8. A direction for new acupuncture research

It seems that the most imperative need is for experimental data that confirms the speed of acupuncture's effect on the organs. If the communication speed suggested in this article is confirmed, this would rule out the involvement of the nervous and hormonal systems, and also the PVS, and guide further research in an appropriate direction.

If the communication takes place via an electrical wave, the real-time monitoring of electrical properties at several acupoints during a treatment would seem to be the most straightforward way to obtain such data.

For example, in the clinical experiment reported at the start of this article, the electrical properties at left Gallbladder-41 (*Zulingqi*) and right Gallbladder-34 (*Yanglingquan*) could be monitored while right Gallbladder-34 is needled. However, this procedure could only yield results on a patient whose liver was in a stressed state before the treatment, because in a patient whose liver did not need treatment, there would be no changed function for the liver to communicate to its related acupoints. Hence, the exact acupoints chosen would need to be tailored to each patient, depending on the Chinese medicine diagnosis. In a patient whose liver was stressed, the needling of the right acupoint should correct the liver stress, and this changed state would then be communicated to every related acupoint on the patient, including the left test acupoint, Gallbladder-41; and the speed of this communication would then be known.

Other questions that would then arise would be: how could it be confirmed that the liver was stressed before the treatment; how could it be confirmed that the liver function had been modified by the treatment; and how could it be confirmed that this modified function occurred because of the first acupoint being needled?

As an initial indicator, the *back shu* acupoints for the test organ could also be monitored in real time. These acupoints are not situated on the organ meridian, and are a more direct indicator of states in the organ. In the case of the liver, the acupoint would be Bladder-18 (*Ganshu*). In the above experiment, the predicted results would be that the electrical properties at the various acupoints would change in the following sequence. Right Gallbladder-34, Bladder-18, then left Gallbladder-41. It is possible that the time interval between each event could be in the order of a fraction of a millisecond, so that to demonstrate this sequence, the real-time monitoring of the electrical properties at each location would need to be recordable down to this timescale.

Such results could only be regarded as an initial indicator of the organ's involvement, because the monitoring takes place via the acupuncture meridian system itself. Incontrovertible evidence could only come from non-acupuncture measurements. But, as these would need to be made in real time, blood-borne factors could not be used. Instead, it seems most likely that monitoring the organ's electrical activity would be the only way to obtain such data; and the challenge of devising a method to achieve this monitoring would be one of the experiment's hurdles.

Disclosure statement

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