

Article

Information Models of Acupuncture Analgesia and Meridian Channels

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Abstract: Acupuncture and meridian channels have been major components of Chinese and Eastern Asian medicine—especially for analgesia—for over 2000 years. In recent decades, electroacupuncture (EA) analgesia has been applied clinically and experimentally. However, there were controversial results between different treatment frequencies, or between the active and the placebo treatments; and the mechanisms of the treatments and the related meridian channels are still unknown. In this study, we propose a new term of infophysics therapy and develop information models of acupuncture (or EA) analgesia and meridian channels, to understand the mechanisms and to explain the controversial results, based on Western theories of information, trigonometry and Fourier series, and physics, as well as published biomedical data. We are trying to build a bridge between Chinese medicine and Western medicine by investigating the Eastern acupuncture analgesia and meridian channels with Western sciences; we model the meridians as a physiological system that is mostly constructed with interstices in or between other physiological systems; we consider frequencies, amplitudes and wave numbers of electric field intensity (EFI) as information data. Our modeling results demonstrate that information regulated with acupuncture (or EA) is different from pain information, we provide answers to explain the controversial published results, and suggest that mechanisms of acupuncture (or EA) analgesia could be mostly involved in information regulation of frequencies and amplitudes of EFI as well as neuronal transmitters such as endorphins.

Keywords: infophysics; therapy; endorphins; Fourier; series; frequency; amplitude; beat; regulation; coupling

1. Introduction

Approximately between 500 BC and 1000 BC, the Classic of Changes (Yi Jing), one of the oldest Chinese classic texts, was written in China [1]. One important theory introduced in this book, which influenced later Chinese medicine, is the balance of Yin and Yang. Yin and Yang represent two complimentary concepts, e.g., Yin represents the moon, shade and cold and Yang represents the sun, brightness and heat.

Between 221 BC and 475 BC, partially based on the theory of Yin and Yang, the medical book entitled *HuangDi's Internal Classic* was written in China [2]. In the book, theories of meridian channels in the human body and acupuncture analgesia are documented. According to the theories, the spirit or the divinity (Shen), the essential of life (Jing) and the gas or the air (Qi) can be transmitted along the meridians. If acupuncture is performed at or around some acupoints along the meridians, various diseases—particularly the pain—can be cured by balancing Yin and Yang in the patients' bodies [3].

Manual acupuncture is performed by gently twisting needles with frequencies of about 1–8 Hz [4]. Electroacupuncture (EA) has been performed in *in vivo* experiments to find out the relationship between EA frequencies and analgesic effects. Most of the published experimental data [5–13] demonstrate low frequencies (about 2–32 Hz) are better than high frequencies (about 100 Hz); though some results [14–16] show that high frequencies (about 85–100 Hz) are better than low frequencies (about 2–20 Hz). However, how EA at different frequencies produces distinct analgesic effects on neuropathic pain is unclear [12].

Other published controversial results demonstrate acupuncture treatments do not work more effectively than placebos (simulated acupuncture) for chronic low back pain. However, both the acupuncture and placebos were significantly more effective than usual care [17–18].

Scientists and clinicians have done many experiments to discover the mechanisms of acupuncture analgesia and meridian channels. Some research findings suggested that the anatomical structure of meridian channels and acupoints are related to the connective tissues and the connective tissue interstitial fluid (CTIF) system [19–26]. It has been hypothesized that the Chinese medicine system is a special channel network comprising of the skin with abundant nerves and nociceptive receptors of various types and deeper connective tissues inside the body with the flowing interstitial fluid system [3]. Following this, it is interesting that a normal person can feel currents in his or her body when he or she gets an electric shock, or that a Qi Gong master can feel currents in his or her body when he or she practices Qi Gong [27].

A gate theory based on afferent pain inhibition has been proposed to explain the mechanism of pain control [28]. According to the theory, the interneuron of the dorsal horn may be involved in different types of pain inhibition by conducting tactile signals. On the other hand, the interneuron in the dorsal horn may manage pain by releasing neuron transmitters (e.g., endorphins) [28–32]. However, to the

best of our knowledge, the mechanisms of acupuncture analgesia and the meridian channels are still unknown, from the viewpoint of a combination of information, physics, histology, anatomy and medicine.

We think that the spirit or the divinity, the essential of life, and the gas or the air, of Chinese medicine relate to information, matter and energy in today's Western sciences.

To study the initiation and transmission of, and response to biomedical information, we defined the concepts of information intensity (II), information response intensity (IRI) and information flux (IF). We proposed that information is stored in structured charges or masses (senders or producers), transmitted with (II) in a medium (a transmitter) or a free space following a transmitting function, and is recognized or responded to with IRI by other structured charges or masses (receivers or responders) [33]. Furthermore, we think that information has different expressions and different levels. In an electric field (EF) expression, we described II, IRI and IF in terms of the electric field intensity (EFI), the electric field force (EFF) (or energy (EFE)) and the electric field flux, respectively, to associate the terms in information and the terms in physics. In the framework of biomedical information, we modeled different levels of information: from ions to a nervous system [33–35]. To associate information, energy and matter, we defined three important attributes (or elements) of a signal: information intensity (default), energies and matters; and linked together these three important attributes in our most recent study [35]. We also modeled encoding, transmitting, coupling, decoding and processing of biomedical information in our previous studies [34–37].

In this study, we continue to use our previous definitions and modeling results. We consider information as data [38]. We focus on the EFI (II) of the transmitting function of nerves and propose our information models to approach mechanisms of acupuncture analgesia and meridian channels of Chinese medicine, based on Western theories of information, trigonometry, Fourier series, and physics, as well as the published biomedical data [3–32,39–41]. We are trying to build a bridge between Chinese medicine and Western medicine by investigating the Eastern acupuncture analgesia and meridian channels with Western sciences. We are also trying to find equivalent or correspondent terms or scientific concepts in both medicines, such as the Yin and Yang in Chinese medicine that could represent low and high values, respectively, of frequencies or amplitudes of waves in Western science.

2. Results and Discussion

Figure 1 shows one of our models of acupuncture analgesia and meridian channels. We model meridians as a physiological system that is mostly constructed with interstices in or between systems of the integumentary, the nervous, muscular, cardiovascular, skeletal, lymphatic, endocrine, respiratory, digestive, urinary and the reproductive systems [40]. Major components in the meridians are loose connective tissues that consist of electrolytes, cells and proteins [39]; the electrolytes provide rich ions and fluids for the meridians. We also think that the meridian system is mostly in longitudinal direction (ascending from toes or fingers), is approximately symmetric about the middle line (from the nose to the umbilicus), and is roughly parallel to systems of the integumentary, the nervous, muscular, cardiovascular, skeletal, lymphatic, and the endocrine. We believe the orientation, the symmetry and the parallelness of the systems are formed during the embryo's development. Similar to systems of the

nervous, cardiovascular, lymphatic, endocrine, respiratory, digestive and the urinary, the meridian system should be unblocked according to the theory of Chinese medicine. If the systems are blocked, diseases can occur. The block could cause pain to patients. The pain information is sensed by free endings and transmitted to the brain through nerves. If acupuncture or EA is applied at or around a pain point, *i.e.*, ashi point and near a non-pain sensor, such as a sensor with a capsule, the treatment information could regulate the pain information of nerves, and the regulated information could be deferent from the pain information. Therefore, the brain could receive deferent information from that of the pain; *i.e.*, the acupuncture or EA analgesia occurs. On the other hand, the pain source could be some abnormal materials that block the meridians. After removing the abnormal materials from the meridians, *i.e.*, unblocking the meridians, the disease is cured. We believe movements of acupuncture (or EA) or muscle contraction by nervous reflex could remove the block and cure the pain.

Figure 1. Our model of acupuncture (or EA) point. The ashi point is at the pain point. The directions of meridian channel currents are assumed.

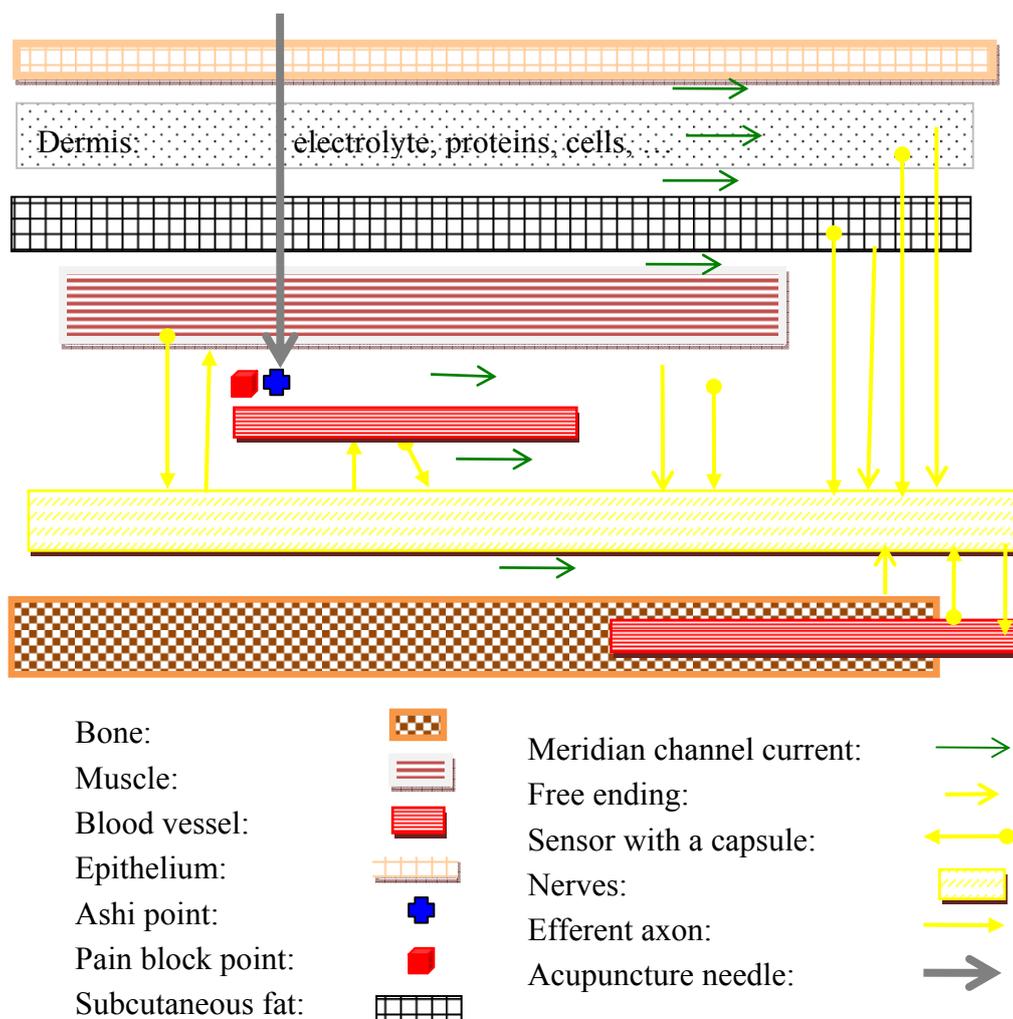


Figure 2 illustrates our models of interactions between acupuncture and nervous sensors. Interactions involving either manual mechanic or automatic electric stimulations are shown.

Figure 3 shows our model of endorphins, the nervous II (EFI) of acupuncture (or EA), the point of pain, and the information descending and within a spinal cord. The information intensities (II) are

coupled, mixed and transmitted in the spinal cord. The EFI directions are assumed. We think the coupling is mostly by EFI or neuronal transmitters.

Figure 4 demonstrates our model of the nervous II (EFI) of pain and acupuncture (or EA). The information intensities are coupled, mixed and transmitted, in a spinal cord root. The EFI directions are assumed. We think the coupling is mostly by EFI. Ionic channel currents also play important roles in the coupling.

Figure 2. Our models of interactions between acupuncture and nervous sensors at an ashi point. (a) No treatment; and treatment with (b, c) manual mechanic stimulation; and (d, e) automatic electric stimulation. We assume the sensors have net negative charges. The directions of the meridian channel currents are assumed.

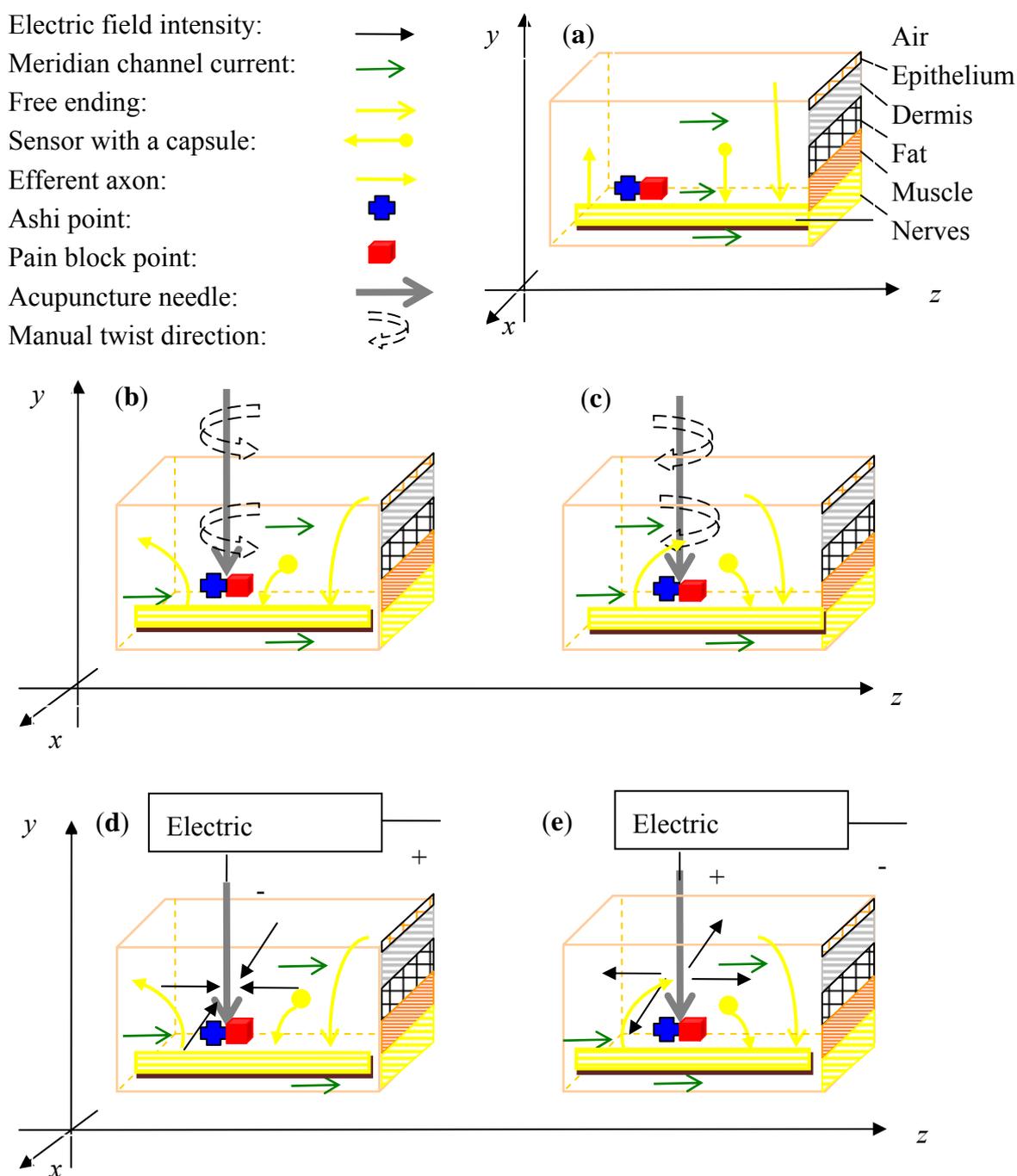


Figure 3. Our model of the nervous II (EFI) of acupuncture (or EA), pain, descending and inter in a spinal cord. Neuronal transmitters, endorphins, are also included.

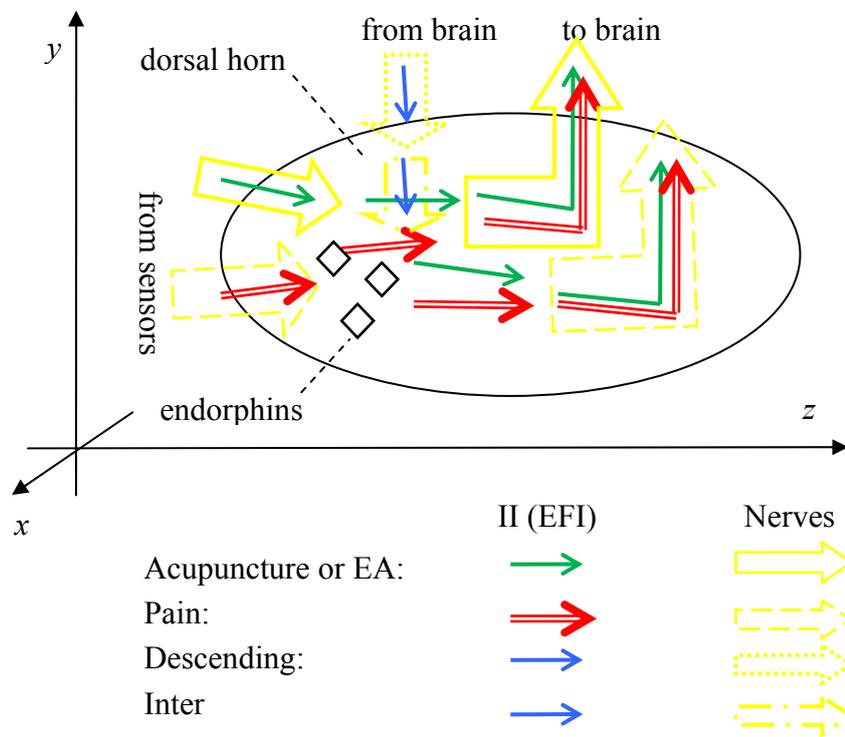
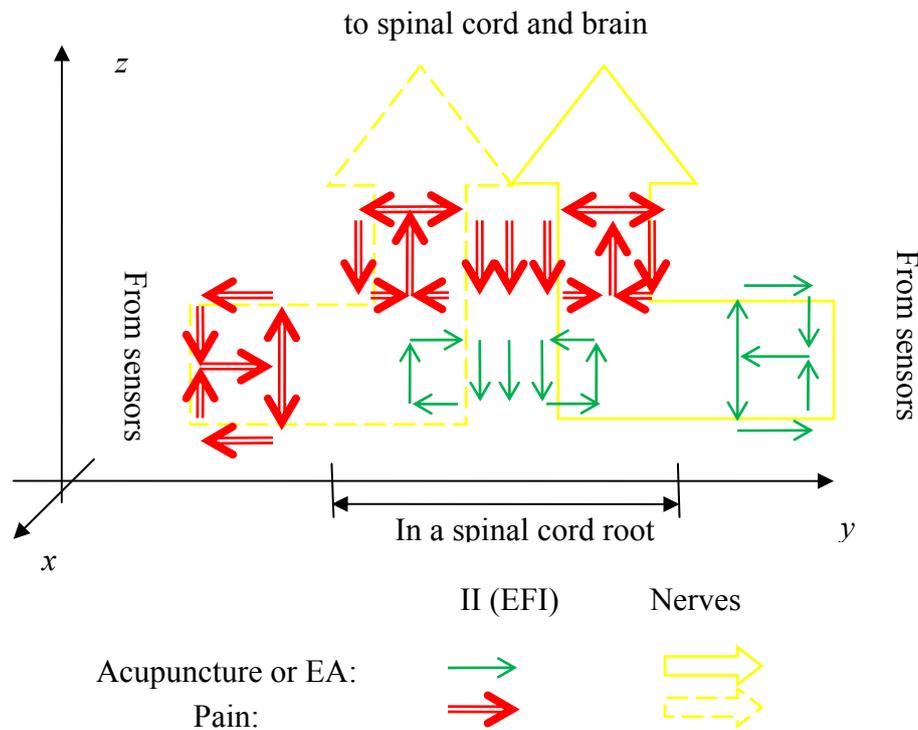


Figure 4. Our model of the nervous II (EFI) of pain and acupuncture (or EA) in a spinal cord root.



We assume that the electric (or mechanic) stimulation periodically deforms the configuration of the nervous sensors by corresponding Lorentz (or Newtonian) forces (see Figure 2), if the stimulation is strong enough [37]. Since the electric resistance of dermis is only one-fifth of that of the subcutaneous fat [42] and approximately equal to that of parallel muscles [43], the electric stimulation currents will mostly flow in the dermis [44], parallel muscles and other meridian channels. The nervous sensors receive the maximum stimulation compared with other cells (except muscles) because their size is much larger than the others. Therefore, electric stimulation with mild pain will not cause electroporation, *i.e.*, it will not usually hurt other cells, including muscles [45,46]. The periodical alternation of sensory (or ionic channel) radial shapes by the stimulation periodically changes ionic channel currents because the currents are very sensitive to the radial shapes [47,48]. Nervous sensors sample, collect and encode the information in the meridians. The nerves use biological energy (such as ATP), to actively transmit [37] the encoded information, activating potential signals while ascending or descending along the nervous system [34]. Moreover, crossings of information within a system or between the systems play very important roles in application of the acupuncture or EA analgesia. We think the horns or the roots of the spinal cord in the nervous system are the key locations for the information crossings, because the nervous fibers are very compact there [39–41]; therefore, the encoded information in the nerves can be easily coupled from nerves of one organ to others, see Figures 3 and 4. To complete our models, the roles of neuron transmitters, *e.g.*, endorphins [28–32], have been included in Figure 3. The mechanism of pain control by neuron transmitters could be that the transmitters block information transmitters or EFI from pain.

Our mathematical modeling results of acupuncture or EA analgesia are described as the following. We assume that a (quasi) periodical (electrical, mechanical or chemical) information source in a meridian channel, *e.g.*, caused by pain or acupuncture (or EA), initiates a (quasi) periodical variation of the charge $Q(r, \theta, z, t)$, in cylindrical coordinates, inside a nervous sensor. The longitudinal direction of a sensor's nerve is along a (changing) z axis, coordinates r (radial) and θ (angular) are in the transversal directions; t is time; r, θ, z and t are independent from each other. Since the nerve fibers are much larger in the longitudinal direction than in the radial direction, we consider the charge is approximately uniform in the transversal directions, *i.e.*, $Q(r, \theta, z, t) \approx Q(z, t)$ [34], to simplify our models and to get analytic solutions.

After the stimulations are above thresholds, nerve fibers are fired. The nervous information is transmitted along the nerves. The propaganda attenuation of signals or information is compensated by the active transportation [34,37]. The information is mostly frequency encoded and (quasi) periodical functions [40]. In fact, patients feel pain in their brains. electroencephalography (EEG) demonstrates that the brain signals are periodical and (quasi) sinusoidal. Different frequencies represent different brain activities. Therefore, we assume pain and acupuncture information is also frequency encoded. If two periodical functions mix together in the same direction, regulation of frequencies, amplitudes and wave numbers may occur according to the wave theory. Based on the mathematic theorem of Fourier series (FS), any periodical function can be represented as a superposition of sinusoidal wave series. We approximately describe a periodical function of nervous information with the FS, generally as:

$$Q(z, t) = -\left\{ \frac{a_0}{2} + \sum_{n=1}^{+\infty} [a_n \cos(nk_z z + n\omega t) + b_n \sin(nk_z z + n\omega t)] \right\} \quad (1)$$

where k_z is a wave number in z direction; $\omega = 2\pi f$, ω and f are fundamental angular frequency and frequency, respectively, they relate to frequencies and intensities (amplitudes) of acupuncture or EA because neuronal information is frequency encoded [34]; a_n and b_n are constants, and the encoded electric current (a vector) in z direction is:

$$i_z(z, t) = \frac{dQ}{dt} z_0 = \omega \sum_{n=1}^{+\infty} [na_n \sin(nk_z z + n\omega t) - nb_n \cos(nk_z z + n\omega t)] z_0 \quad (2)$$

where z_0 is a unit vector in z direction. The area averaged and encoded electric current density (a vector) in the z direction is

$$j_z(z, t) = \frac{i_z(z, t)}{S_z(z)} = \frac{\omega}{S_z(z)} \sum_{n=1}^{+\infty} [na_n \sin(nk_z z + n\omega t) - nb_n \cos(nk_z z + n\omega t)] z_0 \quad (3)$$

$S_z(z)$ is an effective transversal area. The area averaged and encoded EFI (a vector) in z direction is

$$E_z(z, t) = \frac{j_z(z, t)}{\sigma_z} = \frac{\omega}{\sigma_z S_z(z)} \sum_{n=1}^{+\infty} [na_n \sin(nk_z z + n\omega t) - nb_n \cos(nk_z z + n\omega t)] z_0 \quad (4)$$

where σ_z is an effective conductivity in the z direction and is approximately assumed to be a constant to simplify our models. Let the area averaged amplitude be

$$A_n = \frac{na_n \omega}{\sigma_z S_z(z)} \quad (5a)$$

and

$$B_n = \frac{nb_n \omega}{\sigma_z S_z(z)} \quad (5b)$$

then

$$E_z(z, t) = \sum_{n=1}^{+\infty} [A_n \sin(nk_z z + n\omega t) - B_n \cos(nk_z z + n\omega t)] z_0 \quad (6)$$

If two components of two encoded EFI in z direction, after their coupling in a pain nerve (see Figure 3 and Figure 4), have forms, respectively,

$$E_{\alpha z}(z, t) = \sum_{n=1}^{+\infty} [A_{\alpha n} \sin(nk_{\alpha z} z + n\omega_{\alpha} t) - B_{\alpha n} \cos(nk_{\alpha z} z + n\omega_{\alpha} t)] z_0 \quad (7)$$

$$E_{\beta z}(z, t) = \sum_{n=1}^{+\infty} [A_{\beta n} \sin(nk_{\beta z} z + n\omega_{\beta} t) - B_{\beta n} \cos(nk_{\beta z} z + n\omega_{\beta} t)] z_0 \quad (8)$$

where α is about an acupuncture (or EA) and β is about a pain. And,

$$A_{\alpha n} = \frac{na_{\alpha n} \omega_{\alpha}}{\sigma_z S_{\alpha z}(z)} \quad (9a)$$

$$B_{\alpha n} = \frac{nb_{\alpha n} \omega_{\alpha}}{\sigma_z S_{\alpha z}(z)} \quad (9b)$$

$$A_{\beta n} = \frac{na_{\beta n} \omega_{\beta}}{\sigma_z S_{\beta z}(z)} \tag{10a}$$

$$B_{\beta n} = \frac{nb_{\beta n} \omega_{\beta}}{\sigma_z S_{\beta z}(z)} \tag{10b}$$

Based on the superposition principle of EFI and trigonometry, the sum of the two components along the pain nerve is

$$E_{\alpha z} + E_{\beta z} = \sum_{n=1}^{+\infty} [A_{\alpha n} \sin(nk_{\alpha z}z + n\omega_{\alpha}t) + A_{\beta n} \sin(nk_{\beta z}z + n\omega_{\beta}t)]z_0 - \sum_{n=1}^{+\infty} [B_{\alpha n} \cos(nk_{\alpha z}z + n\omega_{\alpha}t) + B_{\beta n} \cos(nk_{\beta z}z + n\omega_{\beta}t)]z_0 \tag{11}$$

We can execute the additions in pairs for each n number in equation 11, e.g., the first addition ($n = 1$) of sine waves is

$$A_{\alpha 1} \sin(k_{\alpha z}z + \omega_{\alpha}t) + A_{\beta 1} \sin(k_{\beta z}z + \omega_{\beta}t) = A_{\alpha\beta 1} [\sin(\frac{1}{2} \delta k_{\alpha\beta z}z + \frac{1}{2} \delta \omega_{\alpha\beta}t + 45^\circ) \cos(\overline{k_{\alpha\beta z}z} + \overline{\omega_{\alpha\beta}t} - 45^\circ - \gamma) + \sin(\overline{k_{\alpha\beta z}z} + \overline{\omega_{\alpha\beta}t} - 45^\circ + \gamma) \cos(\frac{1}{2} \delta k_{\alpha\beta z}z + \frac{1}{2} \delta \omega_{\alpha\beta}t + 45^\circ)]z_0 \tag{12}$$

where

$$A_{\alpha\beta 1} = \sqrt{A_{\alpha 1}^2 + A_{\beta 1}^2} \tag{13}$$

$$\sin \gamma = \frac{A_{\alpha 1}}{A_{\alpha\beta 1}} \tag{14}$$

$$\cos \gamma = \frac{A_{\beta 1}}{A_{\alpha\beta 1}} \tag{15}$$

We mathematically define half sums (averaged values) of wave numbers and frequencies, respectively, as,

$$\overline{k_{\alpha\beta z}} = \frac{k_{\alpha z} + k_{\beta z}}{2} \tag{16}$$

$$\overline{\omega_{\alpha\beta}} = \frac{\omega_{\alpha} + \omega_{\beta}}{2} \tag{17}$$

and half differences of wave numbers and frequencies, respectively, as:

$$\frac{1}{2} \delta k_{\alpha\beta z} = \frac{k_{\beta z} - k_{\alpha z}}{2} \tag{18}$$

$$\frac{1}{2} \delta \omega_{\alpha\beta} = \frac{\omega_{\beta} - \omega_{\alpha}}{2} \tag{19}$$

2.1. Information Regulation (Interference) of Frequencies

Because nervous information is mostly frequency encoding [40,41], the information regulation of frequencies is the most significant among the regulations. Equations 17 and 19 represent the information regulation (interference) of frequencies. For the cases of the EA where low frequencies (2–32 Hz) are better we assume, frequencies of the pain are significantly higher than that of the EA; equation 7 and ω_α are EA related and equation 8 and ω_β are pain related. Therefore, the regulated frequencies are lower than the pain frequency, *i.e.*,

$$\overline{\omega_{\alpha\beta}} < \omega_\beta \quad (20)$$

$$\frac{1}{2} |\delta\omega_{\alpha\beta}| < \omega_\beta \quad (21)$$

and the brain receives non-pain information. The modeling results could answer why and how the low frequencies of EA are helpful to the analgesia.

In a similar way, for the cases of EA where high frequencies (85–100 Hz) are better, we assume frequencies of pain are significantly lower than that of EA; Equation 8 and ω_β relate to EA and Equation 7 and ω_α relate to pain; and $0 < 2\omega_\alpha < (\omega_\beta - \omega_\alpha)$. Therefore, the regulated frequencies are higher than the pain frequency, *i.e.*,

$$\overline{\omega_{\alpha\beta}} > \omega_\alpha \quad (22)$$

$$\frac{1}{2} |\delta\omega_{\alpha\beta}| > \omega_\alpha \quad (23)$$

and the brain receives non-pain information. The modeling results could answer why and how the high frequencies of EA are helpful to the analgesia.

When $\omega_\alpha \cong \omega_\beta$, *i.e.*, frequencies of EA and pain are almost equal, Equation 12 represents a sum of two beat waves. $(\omega_\beta - \omega_\alpha)/2$ (see Equation 19) represents a beat frequency that is much lower than the pain frequency. The beat frequency forces the two beat waves to very slowly increase the modulated amplitudes (see Equation 12). The regulation is principally consistent with, or similar to, the amplitude modulation (AM) of the electromagnetic wave. Therefore, the nervous system gradually adapts to the pain (amplitudes). The results could also explain why and how EA works at high frequencies (85–100 Hz), if both frequencies are high and almost equal.

2.2. Information Regulation of Amplitudes

Information regulation of amplitudes is also important. Equation 13 represents information regulation of amplitudes. The acupuncture or EA amplitudes should be appropriate, that means the amplitudes depend on individual patient's pain tolerance. If they are too high, they produce extra pain, usually this is against the acupuncture (or EA) analgesia. If they are too weak, they do nothing for the regulation. Mild pain and mild feeling could be the maximum and the minimum sense, respectively, for the regulation. In theory, the regulated amplitudes are never equal to 0. However, if the acupuncture (or EA) induces the interneurons to release neuron transmitters, such as endorphins, the transmitters could decrease the original amplitudes of the pain information. Therefore, acupuncture

analgesia occurs too. In theory, the decreased amplitudes are equal to 0 when the information is completely blocked; in this case, the acupuncture analgesia is equal or similar to anesthesia.

2.3. Information Regulation of Wave Numbers

Because wave numbers are related to frequencies, information regulation of wave numbers should be significant too. Equations 16 and 18 represent an information regulation of wave numbers. Standing waves could occur between the sensor and the coupling point, when $k_{\alpha z} = -k_{\beta z}$ (the two waves travel in opposite directions) and $\omega_{\alpha} = \omega_{\beta}$ (see Equation 19). The result of Equation 12 reduces to a sum of two standing waves:

$$A_{\alpha\beta 1}[\sin(k_{\alpha z}z + 45^{\circ})\cos(\omega_{\alpha}t - 45^{\circ} - \gamma) + \sin(\omega_{\alpha}t - 45^{\circ} + \gamma)\cos(k_{\alpha z}z + 45^{\circ})] \quad (24)$$

When the two amplitudes are equal, using Equations 13–15, we obtain pure standing waves from Equation 24:

$$2\sqrt{2}A_{\alpha 1}\sin(\omega_{\alpha}t)\sin(k_{\alpha z}z + 45^{\circ}) \quad (25)$$

Obviously, values of Equation 25 are always 0 at some special locations, known as nodes, such as $k_{\alpha z}z + 45^{\circ} = n\pi$, where $n = 0, 1, 2, \dots$

Alternatively, information regulation of wave numbers and standing waves can also be performed by the information descending from the brain. The descending information could be induced by acupuncture or EA.

However, in this paper, it is very difficult for us to model how information regulation of wave numbers could help acupuncture analgesia based on the currently published biomedical data. This topic is our future study.

In the same way as the above, we can respectively obtain all addition results of sine and cosine waves for each n number in Equation 11. The results are the same as or similar to that of the above. But, the higher the n number, the lower the weight of the term, according to FS theory.

In the same way as discussed above, we can also obtain regulated information of nerves treated with acupuncture or EA. The results are mathematically the same as, or similar to that of the above. The regulated information could manage pain in the brain or by descending information, such as by releasing endorphins or by producing standing waves in pain nerves.

Similar to the processing of information or signals of EEG and electrocardiogram (ECG) or (EKG), we mostly analyze the electric and ignore the magnetic, because the magnetic field can be neglected compared to the electric field [49].

Our modeling results suggest that information regulation of frequencies, amplitudes and wave numbers of nervous signals are approximately equivalent to the balance of Yin and Yang in Chinese medicine if Yin and Yang, respectively, denote low and high values of frequencies, amplitudes and wave numbers. Our modeling results could also explain the phenomenon of electric shock and Qi Gong.

We think that the mechanism of massage analgesia is the same as, or similar to that of the acupuncture (or EA) analgesia based on our models in this article, because the both treatments initiate information intensities (II) of the mechanic or the electric, after which the information is sampled, encoded and transmitted in the patients' nervous system, and the treatment II reduces the pain II. We

also think that the placebo treatments (simulated acupuncture) [17,18] are actually similar to massage analgesia. Therefore, the placebo treatments do help analgesia. The acupuncture (or EA) analgesia provides intensive and invasive treatments; the massage analgesia provides mild and non-invasive treatments. Which treatment is suitable for a patient depends on the individual patient. This policy is consistent with that of individualized medicine [50]. We strongly recommend a non-invasive treatment should be the first priority to be chosen for a clinical trial (or treatment). In particular, for those patients to whom acupuncture analgesia does not work at all [51], massage analgesia could be the optimal choice for alternative medicine.

We believe the principles of our models for the nervous system are also expandable to the other physiological systems or between the systems. We also believe that our models in this study are helpful for clinical application of acupuncture analgesia in a view of information regulation of frequencies, amplitudes and wave numbers.

For clinical EA application, we do not need to consider the electromagnetic radiation effects, because the energy is very low [52]. For the electromagnetic radiation therapy [52], a single elementary particle, e.g., a photon, is considered as an information carrier. We define the photon frequency as ω . The relationship between the ω and the energy follows the Einstein-Planck equation, $E = h\omega/2\pi$, where h is the Planck constant.

We propose a new term of infophysics therapy in this investigation. We think all infophysics therapies, such as the singing [53] the song [54], the music [55], the poetry [56], and the acupuncture and the massage, have the same or a similar mechanism, in a view of biomedical infophysics. Frequencies and amplitudes play important roles in infophysics therapy. Specially, we believe frequencies are the most informative of all information expressions.

3. Conclusions

We propose a new term of infophysics therapy and develop information models of acupuncture analgesia and meridian channels. According to our models, mechanisms of acupuncture (or EA) could be mostly based on the nervous information regulation of frequencies and amplitudes as well as neuronal transmitters, such as endorphins. The information regulation mostly initiates at the horns or the roots of the spinal cord, because the nerves are so compact that information crossings, interferences or couplings are easily performed. The frequency regulation is mathematically executed with half sum or half differences of frequencies, and beat waves. The acupuncture or EA amplitudes should depend on the individual patient's pain tolerance; mild pain and mild feeling could be the maximum and the minimum senses, respectively. The regulated amplitudes are never equal to 0 in theory. We consider information regulation of interneuron transmitters, such as endorphins, as the amplitude decrements. In theory, the decreased amplitudes can be equal to 0; in this case, acupuncture or EA analgesia is equal or similar to anesthesia.

We model the meridian channels as a physiological system that is mostly constructed with interstices in or between other physiological systems; the major components in the meridians are the loose connective tissues that consist of electrolytes, cells and proteins. An information source initiates the information in the meridians, and the information can be passively propagated with an external force in multiple directions in the meridians. The nervous sensors sample, collect and encode the

information in the meridians, and the nerves use biological energy, such as ATP, to actively transmit the information in ascending or descending direction along the nervous system.

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