**Title:** The essence of meridians, mechanism of acupuncture and its challenges to the basic tenets in neuroscience (經絡實質、針刺機制及其對神經科學基本信念的挑戰)

**Abstract**

There are two basic tenets in Western neuroscience. One is the theory of inhibition and the other is the neuron doctrine. These two are in fact intertwined.

The first tenet of inhibition began with the tetanic excitation of vagus nerve by the Weber’s brothers in 1845 that caused a standstill of the frog’s heart. In the same vein, the volitional elbow flexion was also believed to display reciprocal innervations of antagonistic skeletal muscles by Sherrington. However, in recent years, we have observed only synergic and cooperative co-activations in micturition [1-4, 10], storage of urine in Wistar rats [9], and elbow flexion/forearm pronation in humans [6,7]. The so-called reciprocal inhibitions were never observed in freely moving non-anaesthetized animals or humans.

As to the second important tenet in neuroscience, EEG and peripheral effects of acupuncture in our experiments have indicated that the neuron doctrine in modern neuroscience is either infeasible or impossible to offer an explanation [11].

In order to identify the essence of meridians, we start from organogenesis. It is well-known that systems of the entire organism develop simultaneously. They also interact and modify each other. For example, the nervous systems are formed by neural ectoderm. In the mean time, the nerve is often accompanied by an artery and two satellite veins of mesoderm under a connective tissue sheath to form a neurovascular bundle. The neurovascular bundle is designated as our meridians. In addition, both the vascular system and nerve fibers have capacitive, inductive, resistive and conductive properties that are analogous to transmission lines. In TCM, the meridians are also assumed to have the ability to control and regulate its corresponding visceral organs. This assumption is quite reasonable because the entire organism develops simultaneously and the neurovascular bundle must have interacted with the visceral organs from the standpoint of embryogenesis. By the same token, the visceral organs that are associated with their corresponding meridians can also be characterized as loads with corresponding impedance values [5, 8, 11].

After the model of meridians has been established, we can then contend that the
mechanism of acupuncture is basically through the impedance matching and mismatching of meridians with its associated organs. For instance, in case of the malfunction of any specific organ, its impedance will increase and it will not match the impedance of its corresponding meridian. As a result, the normal neurovascular flow will be partially reflected back from the associated organ. For instance, on the cardiac tamponade, the pathway of the PC meridian that is associated with the functions of the pericardium runs down inside the arm. The disorder can reduce cardiac output and patients may develop hypotension and circulatory collapse. This condition can be characterized by an increase of impedance in the pericardium. If we use manual acupuncture at PC 6, the current of injury derived from the insertion of the needle will usually reduce the cable capacitance yet without changing its longitudinal inductance of the neurovascular bundle. As is well-known in the theory of communication networks, for an almost lossless transmission line, the impedance is roughly proportional to the square root of inductance to capacitance. Similarly in our case, after the control input of acupuncture at PC 6, the impedance of the pericardial meridian will be increased and possibly matched with that of the pericardium in malfunction. The upshot is that there is no more partial reflection of the neurovascular flow if the impedance is matched. The normal flow to the pericardium will be resumed, and the normal cardiac output and blood pressure can be restored within seconds. Similar reasoning can also be applied to the effect of pain relief or analgesia via acupuncture [11].

References


**Biography**

Dr. Shyang Chang received his Ph.D. degree in electrical engineering from the University of California, Los Angeles (UCLA), in 1984. In 1984 and 1985, he was a Member of the Technical Staff (MTS), Bell Communications Research, Red Bank, NJ, USA. Since 1985, he has been with the National Tsing Hua University, where he is currently a professor of electrical engineering department. His research interests are in the areas of biomedical engineering, chaos and fractals, dynamical systems, acupuncture, and Traditional Chinese Medicine (TCM). Currently, he is trying to mathematize TCM so that its principles can become the guidelines of medicine in the future. To contact him, the following information is provided: e-mail address: shyang@ee.nthu.edu.tw, tel# (886)35731146 at Department of Electrical Engineering, National Tsing Hua University, Hsin Chu, Taiwan, ROC.