NEUROSCIENCE, NEUROPHYSIOLOGY AND ACUPUNCTURE

Part 3

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ELECTROACUPUNCTURE

Electroacupuncture analgesia is a well established phenomenon [42,43,44]. In general, the lower the pulse repetition rate of electrical stimulation, the lower the time required to reach maximum analgesic effect and the longer the effect remains. The higher the pulse repetition rate, the shorter the time required to optain maximum pain threshold, and the effects remain for a shorter time (**table 2** and **3**). Also, periaqueductal central gray (PAG) stimulation produced analgesia is similar to acupuncture analgesia in many respects.

According to other studies Xie-Guo-Xi, Han-Ji Sheng (1985) the high frequency of stimulation of the points of acupuncture has above all metameric local action while, on the contrary, low frequency (1-15 HZ) generalized analgesic action. In cases of dissection of the spinal cord all frequencies are inadequate.

Electroacupuncture to a frequency of 2 HZ provokes analgesia mainly through methionine- enkephaline, with 100 HZ mainly through A dynorphine while with 15 HZ both neurotransmitting sybstances are detected in almost equal quantities. There is more recent work (especially on high frequency current) in which it is held that the stimulation at a frequency in excess of 10 Hz increases enzymatic degradation of circulating opiate substances reducing the analgesic effect.[45]

Also, new electrotherapy techniques (MENS - microcurrent electrical neuromuscular stimulation) and electroacupuncture with current intensities in the order of 400 ìÁ at 10-60 Volts (low voltage pulsed microamp stimulation) and extremely long pulse duration with total current equal to 5x10-6 coulombs/sec, are awaiting the results of the clinical tests to which they are subjected [46,47]. This technique is based to Arudt-Schulz law that microamperage (ìA) currents are better at enhancing cellular physiology processes than are currents of higher amplitude. Several clinical studies have documented the enhancing effects of MENS on wound healing, on tendon repair in animal models, on recovery of injured athletes suffering from ruptured ligaments and tendons. Also, laboratory studies shows the ability to MENS device to stimulate cellular physiology and grouth (increased ATP by almost 500%, increased membrane transport by 30-40% and increase protein synthesis by up to 73%).

The endogenous opioid peptides such as endorphine, enkephalin and others are not related exclusively to pain. They are directly related to all forms of dependence (drugs, smoking, alcoholism). Low levels of methionine-encephalin have been found in patients suffering from Parkinson's disease. Very high concentration levels have been reported in the dorsal cochlear nucleus and the intermediate geniculate body in patients suffering of schizophrenia. There is also significant evidence as to their role in the regulation of food intake (obesity). In particular with regard to obesity, it has been found that there is a large number of "saturation" peptides and "stimulating apetite" peptides in the hypothalamic nuclei of the brain and the gastro-intestinal tract, functioning as hormone inhibitors or as neurotransmitters.

It has also been clinically established that acupuncture acts on the following body systems [48] (**table 4**). The action on the above mentioned body systems must be attributed to the ability of acupuncture to influence the function of the Central Nervous System.

The prominent Nobel winning neuroscientist Gerald Edelman [49] mentions that there is no more complex functional structure in the universe than the human brain. The most specialized and exciting type of cell is the neuron. The neuron, the structural unit of the brain, is unusual as regards its shape, its electrical and chemical function and the way in which it connects to other neurons forming networks. Only in the cortex there are about ten billion neurons. Each neuron is connected to others through synapses. It is surprising that there are one million billions of connections in the synapses of the cortex. If we started counting them, at a rate of one synapse per second, we would finish counting after thirty-two million years. One piece of our brain of a size equal to the head of a match contains one billion synapses. If we tried to calculate the many ways in which synapses may be combined, we would have a number consisting of 10 followed by millions of zeroes (the number of positive charged particles in the universe is 10 followed by 80 zeroes). The brain is connected to the outer world through specialized neurons called sensory neurons that form the sensory organs and supply the brain with input signals, while output signals are transported to the brain through neurons connected to muscles and glands. The largest areas of the brain, however, exchange signals with some other areas of the brain without any intervention from the outside world. Edelman points out that the brain is more in contact with itself and the interior of the body than with anything else. The corpus callosum connecting the right to the left hemisphere contains 200 million fibers. The brain tissue is a complex network that communicates electrochemically both to the outer and to the inner environment. It emits and receives dynamic formations of signals and answers to these signals. The formations of its neurons influence the functionality of the heart, the kidneys, the lungs, the muscles, the skin and the glands. The brain regulates breath, digestion, blood circulation and naturally analyses the acupuncture stimulus.

It is very difficult for me to give a solution to the problem of the action of acupuncture. However, it is not difficult to underline the contribution of acupuncture in the balance of the chemistry of our nervous system and of the role of the hundreds of neurotransmitting substances that regulate in whole or in part our health and disease, emotional behavior, instincts, desires and the psychic disposition of man.

It has been noted that depression is related to a disorder of the metabolism of noradrenalin and serotonin. The antidep ressant action of amphetamines and the existence of benzodiazepine receptors in the cerebellum and the limbic system is also known. The role of gamma-aminobutyric acid (GABA), a well-known neurotransmitter for its inhibitory role in neurotransmission (through the K^+, Na^+, Cl^- pump) and its intense ancholytic action is perhaps more general [50,51,52,53].

Acupuncture is used for the treatment of a multitude of functional disorders such as metabolic diseases, endocrine disorders, mental disorders, functional, respiratory and digestive disorders, allergies, neurovegetative disorders etc. Reference of the neuronic theory of the action of acupuncture on these disorders is based on one hand on the investigation of the unknown homeostatic role of the reticular formation of the brain matter and on the other on the multitude of neurotransmitting substances that are detected peripherally following treatment with acupuncture (cholecystokinin, bombesin, neurotensine, CRH (corticotropin releasing factor), dynorphin, neuropeptide Y, encephalins, amines etc.) and in the

mode of action, secretion, activation and enzymatic inactivation of the above mentioned substances. It appears that these substances are similar in action to the classical endocrine gland hormones, activating negative and positive feedbach mechanisms. The role of acupuncture in these diseases has been only clinically established.

THE RETICULAR FORMATION

The reticular formation consists of groups of neurons and of neural fibres which unite the cerebral nuclei between them and each one separately with subcortical centres, thalamic centres, cerebellum centres, parencephalic centres, medulla oblongata and spinal cord. Functionally, it controls the mechanisms of wakefulness and those of sleep, muscular tonus, level of consciousness, cardiac and respiratory rhythm, vessel tonus, regulating and mediating motor, autonomic and sensory functions.

On the level of the nuclei of the reticular formation is led almost all information concerning sensibility and in a slow rhythm (because of the multiple synapsis) are transformed and analysed qualitatively and quantitatively. As a result of this analysis, the nervous signal coming from the periphery when it reaches the upper centres (brain nuclei) is differentiated from the initial one. That agree with hypothesis that mechanical, thermal and chemical noxious stimuly have effect on neuron activity of medullary and mesencephalic reticular formation especially around nucleus gigantocelularis (NGC). Also, Casey and Meltzack [54] suggested that reticular neurons may mediate the affective/motivasional dimension of the pain experience and pain-related behavior, indicating the role of reticular formation in pain perception and modulation.

This descending modulation system brings significant functional alterations to the peripheral organs. Indeed, implantation of electrodes in areas of the reticular formation of the medulla oblongata and above all outside the cerebral nuclei brought big alterations on a cell, tissue, organic and functional level to the guinea pigs such as hydronephrosis, organic dysplasia, bone deformity etc. It seems that the activating system of the reticular formation regulates the level of wakefulness of the functional nuclei of the central nervous system according to the information it receives from the sensory pathways. It is capable of making thrive or of repressing a multitude of body and psychic symptoms such as worry, dyspnotic phenomena, sweating, insomnia, irritability, change of cardiac and respiratory rhythm, vessel tonus. Interference with the homeostatic mechanisms of the reticular formation can be achieved only through sensory stimulation. Acupuncture can very possibly be a kind of similar stimulation. Particular points such as auricular points Shen Men, Jerome and Master sensorial point, and somatic points such as H7, H3, L.I.3, GB20, ST41, P 6, UB10 act the equilibrating way mainly on the mental diseases and are used on patients with mental disorders intensely somatised.

CONCLUSION

The restoration of morphological and functional homeostasis and the maintenance of the dynamic equilibrium of the body that is gradually restored after acupuncture treatment may be explained only if we consider the body as an open thermodynamic system that may transform exogenous influences from the environment and modify the function of its systems accordingly. This consideration constitutes the theoretical basis of Cybernetic systems (cybernetics: the field that deals most directly with information processing and feedback).

In this manner one can sketch today the therapeutic action of Acupuncture. The profound knowledge of the principles of acupuncture, the mechanism of action and reaction of the organism at a normal and pathological state, the concept of the organism as a unique whole (Hippocrates) the mental follow-up of the meridians where vital energy circulates and the selection of acu points are the most important difficulties that doctors have to face with before understanding, learning and applying acupuncture.

It is a fact that the traditional applications of this therapeutic system that are derived from sources lost in the depths of time and verified in everyday medical practice are for us, western physicians a starting point but also a leading point for contemporary medical research concerns.

I point out that the rejection of a method is not a scientific position. In the history of science, the motive force of progress was the innate tendency towards interpretation (and investigation) of natural phenomena. No matter how many problems we shall face in the preparation of research protocols to establish the action, indications, counter-indications and side effects of acupuncture. Their solution will always be the target of medical science.

Besides, the physician is not obliged to study Chinese Philosophy in order to exercise acupuncture. However it is necessary that he takes in his hands a weapon tested throughout the centuries, enriching his therapeutic armament having as his sole criterion the relief of man from pain.

«Each addition of knowledge is an addition of human power».
HORATIO

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