Scientific Interpretation of Deqi Phenomenon

As emphasized by the rules of classic acupuncture, inserting the needle into an active point to provoke a propagated sensation which passes with varying range along the meridian is one of the basic requirements for an optimal therapeutic acupuncture effect. According to old Chinese notions these sensations were manifestations of "Qi" energy flow and therefore they were called "DEQI" phenomenon.

In classic needle acupuncture these sensations can be induced at various speeds, with different intensity and in varying range by inserting the needle to the prescribed depth and by its manipulation, most frequently by twisting in and twirling out, by rotation at various speeds and amplitudes, by combination of both methods; passing with the nail along the transversally scalloped needle holder, and the like. The patient feels them most often as painless setting on edge, tingling, creeps, pressure, traction, as a feeling of warmth especially in the face and some other parts of the body. More intensive characteristic sensations can usually be achieved by the technique corresponding with the inhibitory variant of acupuncture.

According to our experience the propagation of characteristic sensation along a large section of the meridian by acupuncture at one active point can be achieved only exceptionally in current practice. This is successful most frequently during acupuncture in P 6 point (area of the arm and thorax), LI 10 (into the forearm and arm), TH 15 (into the whole upper extremity), LI 4 (into the forearm and arm), S 36 (into the leg and foot), GB 30 (into the whole lower extremity) and GB 20 (into the optic area).

The propagation of characteristic sensations along individual meridians is achieved more often by mutual interconnection of characteristic sensations provoked during acupuncture in individual active points passing mostly in distal, sometimes even proximal directions. Several examples of the most frequent occurrence:

1) The propagation of "DEQI" phenomenon was, in principle, in accordance with the present schemes of meridian courses only in the extremities, but it was significantly different in the thoracic-abdominal region and differed entirely in the face and head. Though certain deviations recorded in experimental persons, the course was most frequently stationary and relatively stable in time (in repeated provocations). The Akabane test before and after acupuncture is also one of the objective indicators of this condition and its change.

During the last decade the research of propagated sensations along meridians achieved, mainly in China, these very interesting results:

- The propagated sensations were blocked by the application of low temperature and pressure in the course of the meridian thus reducing the therapeutic effect of acupuncture.

- The propagated sensations were provoked in the same experimental persons and with increasing number of attempts they could be induced more often over a longer length of the meridian. Thus, for example, after 30 excitations, the sensations exceeded a half of the meridian course in 97% of persons, its whole length was reached in 52% provoking significant therapeutic effect of acupuncture.

- The amplitude of propagated sensations was directly proportional to the stimulation intensity.

- The range of propagated sensations differed from the amplitude when these sensations were evoked. The significant difference was on the level of C4 — C5 segments. This can be considered one of the proofs for objective existence of propagated sensations.

There was an interesting finding of sound wave propagation at 2-15 Hz frequency, 0.5 — 1 mV amplitude and 6.5-10 cm/sec speed of propagation.
from the point of stimulation during acupuncture. Their intensity decreased with the distance and the range of their propagation was larger in individuals sensitive to the evocation of propagated sensations. Nevertheless, the coincidence of vibration spreading with the course of meridians was not significant and vibrations registered distally were not connected with the skin.

6) As to the mechanism of propagated sensation development, placebo factors or suggestion are not supposed to play an important role in their origin. In the People's Republic of China opinions on the mechanism of propagated sensations origin were given:

a) Spreading of central excitation
b) Excitation of action factors on the periphery.

The first opinion is supported by phantom sensations after a limb amputation and trials with spinal anaesthesia when, after the application of acupuncture above its level, the characteristic sensations were evoked in a part of experimental persons, while propagated sensations felt completely when acupuncture was applied below its level.

In this connection LANG's theory is interesting. According to it the chains of switching neurons in a regulatory system of the sympathetic in the spinal cord switching system are morphological substrate of meridians. Through this switching apparatus in the spinal cord the sympathetic parts of segments C5 to L2 may be interconnected, which enables the spreading of propagated sensation from one active point to the "switching point" partly in the diencephalon, partly in the nearest higher spinal cord segment to the next active point on the same meridian. The "DEQ1" phenomenon propagates in this way from the spinal cord via the diencephalon to the cerebrum where it is registered and does not run through the hypothalamic cutaneous meridian.

The second opinion supposes that the system of meridians represents, besides the somatic and vegetative nervous system, a "third equilibrium system" with its own histological structure. The knowledge of this problem has not been considered final by the supporters of both the opinions.

How can one explain the propagated sensations along meridians during acupuncture and the basic mechanisms of its action from the view of present neuroanatomical and neuro-physiological knowledge?

During acupuncture and related techniques, information linked to various kinds of energy comes from the external environment, i.e. signals or stimuli in a biological sense. Each signal that is to penetrate into the nervous system must be first transformed into an electrical form. This so-called coding means the transformation of certain signals into a signal intrinsic to the nervous system, i.e. into a nervous excitation (impulse). That is performed by receptors (recipients of information). Of course, the stimuli from the milieu and the environment must be of certain quantity, quality, time and spatial arrangement. These characteristics are probably important for the stimulus to get over a certain threshold and to provoke afferent excitation activity, that is a flow of impulses.

The essence of the origin and propagation of the impulse are rapid transfers of ions, chiefly Na +, K +, Cl - and Ca 2+ (sodium, potassium, chloride and calcium) between external and internal parts of the cellular membrane. The individual nervous cells, however, are isolated electrically. Presynaptic terminal axons are separated from dendrites of postsynaptic neurons by the synaptic cleft. The signals are received by dendrites and the cellular body and led by axons as action potentials to other nervous cells through the synapses. There are different neurotransmitters that diffuse through the synaptic cleft and provoke electrical changes in the postsynaptic cells. Small inorganic ions can penetrate through the cellular membrane only by special protein channels. These ion channels can be either open or closed and therefore they are called "gate channels". Basically they are of two types: one controlled electrically the other chemically. The first are most frequently Na + (sodium) channels responsible for the origin of the action potential based on the principle "all-or-none", the others change extracellular chemical signals into electrical ones. In the first ones the so-called Na + — K + — ATP pump is of use. Na + (sodium) is outside the cell, K + (potassium) is inside, ATP is in the cellular membrane plasma. Neurotransmitter is kept in small secretory sacs called synaptic vesicles inside the terminal axon of the presynaptic neuron. It is released by exocytosis, whose mechanism is realized by the cytoskeletal system, i.e. by microtubules and microfilaments and whose specificity is caused by signal proteins in the given membrane.

As regards receptors: The body surface involves the greatest number of receptors with simple receptors prevailing. Going deeper their number is decreasing but the number of more complicated ones is increasing.

During acupuncture and most related techniques the non-nociceptive afferent excitation activity originates, particularly due to stimulation of mechanoreceptors, both in depth and skin. From mechanoreceptors in the depth this flow of impulses is carried mainly by A alpha fibres, from cutaneous mechanoreceptors through A beta and A delta fibres (the last carry not only pain but even warmth, cold and tickling).

This aimed afferent activity spreads along preformed paths:

1) into the dorsal horn of the spinal cord where, by the activation of the gate mechanism, the inhibition of cells of the dorsal horn lamina I and V occurs. Typical for the gate mechanism is:

a) presynaptic inhibition, where an important role is played by the suppression of ionic character originating due to changes in concentration of extracellular potassium during the activity of neurons. The essence of this suppression is the fact that in the activity of neurons evoked by acupuncture stimulation the potassium ions get into the extracellular space and the change in their concentration evokes depolarization of less myelinated and non-myelinated nervous fibres of primary afferents (i.e. those primarily carrying pain) with reduced quantity of an eliminated mediator in synapses. Thus the effect of activation of respective synapses decreases and the transmission of afferent activity is reduced. If the afferent excitation activity originating during acupuncture delays the activity of neurons leading the nociceptive excitations in lamina I and V, then the passage of non-nociceptive activity already on the level of the spinal cord, is enabled.

b) Postsynaptic inhibition is also of use in the gate mechanism. Its essence is the fact that, when inhibiting synapses and/or their more expressive activity prevail, the neuron need not respond to the activation of excitation synapses by the generation of stimuli.

2) The acupuncture signals, however, penetrate supraspinally through the ventrolateral thalamus, where the mul-
Multiple mechanisms of pain modulation with various thresholds of individual components of the so-called anti-nociceptive system are activated. These signals gradually reach the level of the lower brain stem, diencephalon, limbic system and the 2nd somatosensory area of the cerebral cortex. According to the experimental works of Han Jishen and others the lower brain stem is the most important structure responsible for the analgesic acupuncture effect. The brain cortex, however, exerts a complex modulation influence on the function of subcortical structures including the perception of pain and analgesia. Intentional and directed flow of afferent signals during acupuncture acts on the functional condition of central neurons, which can be also proved clinically by the study of evoked potentials (Duranjan et al). The possibility of aimed response to acupuncture performed correctly is based, besides others, on the principle of spatial organization of the somatovisceral innervation. The different horizontal and vertical topi
city of the spinal cord projection of neurons, particularly from the main effective structures of active points, is the basic presumption for the specificity of acupuncture effect already on the spinal cord level, which is true in a high degree also for the topicity of projection of propagated sensations, i.e. for the course of afferent excitation activity on the level of the 1st sensitive neuron.

However, it should be noted that the sensitive nerve fibres with afferent function are also a part of those structures marked as the vegetative nervous system, even though the proportional-

ity of their representation in each part of the vegetative nervous system has not been yet precisely investigated. However, this could explain generally the knowledge of Chinese and other authors that the propagated sensations need not have a relation only to the arrangement and localization of the somatic sensitive system, but also, for example, to the blood, lymphatic vessels and to the intestinal tissue (fascial spaces) where the humoral changes brought about by, for example, pressure or cold can influence the afferent excitation activity in the sensitive nervous elements given.

The objective of acupuncture is, of course, to maintain the optimal level of function in the organism, that is, in the complex system, where each subsystem has its own specific regularities in hierarchy. In the case of the human organism the regularities of cybernetics must be considered, i.e. the regularities of function in a complex system, then the biological law of homeostasis — the organism always tries to maintain the stable condition or to return to it, then the principle of dominant reflex responses from various sites of the body which dominate in certain focus and, finally, the law of feedback: The controlling subsystem, i.e. the CNS receives information on the condition of the controlled system through a feedback channel and, on this basis, it issues new information that is to maintain the required condition or behaviour of the system controlled.

Concluding, it can be stated that the propagated sensations along the meridians originating in the main effective structures of active points during acupuncture applied correctly are a flow of nervous excitations as a manifestation of non-nociceptive stimulation on the level of the first sensitive neuron. Both peripheral and central components, peripheral and central mechanisms of action conditioned and supplemented reciprocally are here in use. Only in this way can scientific explanation be given to the results of hitherto experimental works and to the clinical experience that acupuncture which was carried out correctly partly normalizes the process of carrying nervous excitations, partly maintains and restores the optimal level of regulating functions in such a complex system as the human organism.

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