

# The Neurophysiological Basis for Acupuncture

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A review of modern Chinese research reveals that the Chinese have proven the following neurophysiological mechanisms for acupuncture: the roles of the paraventricular and centrolateral nuclei of the thalamus, the effects of acupuncture on the midbrain reticular formation, the increase in non-painful sensory reflexes during acupuncture, the relative specificity of acupuncture points, a specific positive correlation between certain chemical synaptic transmitters such as 5-hydroxytryptamine and the analgesic or pain relieving effect of acupuncture analgesia, electromyographic proof of a direct correlation between reflex muscular activity and the subjective sensations associated with acupuncture, the fact that vascular occlusion cannot prevent the pain relieving effect of acupuncture, the fact that the characteristic

subjective sensation during acupuncture is essential for its analgesic effect regardless of the means by which the subjective sensation is produced, the correlation in certain points of a segmental relation between the point of needling and the point where the pain threshold is most remarkably raised, the fact that there exists statistically significant similarities in the degree of elevation of pain thresholds in symmetrically located points, the fact that the alpha rhythm of the electroencephalogram is increased during acupuncture, the fact that there exists a sedative effect during acupuncture, and that a direct correlation exists between the efficacy of acupuncture anesthesia and both the functioning state of the cerebrum and the electrical stability of the skin potential.

Since the Chinese people have created new frontiers with acupuncture, it is not surprising that they would be the first in the world to develop and prove the major neurophysiological principles for acupuncture. The Chinese through practical research over the last ten years have proven many of the acupuncture theories so recently popularized in the West, for example the gate theory developed by Man and Chen in 1972 (1), and the spinal reflex theory of Felix Mann (2). Ironically, the Chinese scientists proved these theories many years before they were developed as hypotheses in the West. Dr. George Wald, the

Nobel laureate, who visited China in 1971 startled many budding theoreticians with the news that certain Shanghai physiologists had already proven the gate theory. These Chinese physiologists explained to Dr. Wald their research proving the two gate theory and the role of the thalamus in the gate theory. Dr. Wald has criticized the arrogance of certain Western scientists who debate the various theories for acupuncture without attempting to investigate Chinese research.

Through experimental research, the Chinese have proven that one gate closes the door to pain in the spinal cord and that another

may decrease the impact of the pain, in the Dejerine-Roussy thalamic syndrome, the patient suffers from spontaneous intractable central pain (8); the presence of the central pain is always associated with a severe loss of deep sensations, especially muscle sensations. On autopsy, the medial parts of the thalamus were always found intact while the other thalamic nuclei related with general non-painful body sensations were usually destroyed. These facts suggest that the ordinary activity of the thalamic center of pain is inhibited and controlled by incoming non-painful body sensations. The destruction of these inhibitory influences appears to cause the painful thalamic syndrome. Denny-Brown proved that the simple section of a cutaneous sensory nerve can lower greatly the pain threshold of the deep tissue underlying the skin innervated by that nerve, suggesting that the activity of the sensory nerve can suppress the sensation of deep pain (9). Neurophysiologists have known for some time that the conduction of large sized fibers tends to inhibit the discharge of small sized fibers in the same trunk (8, 10). The small fine fibers conduct painful impulses; however, the large fibers conduct non-painful impulses. It is felt that large fiber activity suppresses small fiber activity, thus causing an analgesic state (10).

In proving the role of the thalamus in acupuncture, Chang Hsiang-Tung at the Shanghai Institute of Physiology presented a classical paper documenting the inhibitory role of the parafascicular nucleus and the centrolateral nucleus of the thalamus in 157 albino rats and 84 rabbits (4); the Shanghai Institute of Physiology also presented another paper demonstrating the inhibitory role of the centrolateral nucleus in thirty rabbits (5). These papers have specifically proven that the decrease of pain during acupuncture is due to an inhibitory interaction in the thalamus between the incoming impulses from the points of acupuncture and the sites of pain. Experiments performed on albino rats and rabbits showed that certain neurons in the parafascicular nucleus and in the centrolateral nucleus of the thalamus would give

an understanding the gate theory, one might compare the physiological process to a race between a champion sprinter and a slow-footed weight lifter. The quickly starting sprinter races first to the gate to block the entrance of the pondering weight lifter just as the easily stimulated large myelinated fibers block the entrance of the small slow unmyelinated pain fibers. One gate functions in the substantia gelatinosa of the spinal cord (3); the other gate functions in the paraventricular and the centrolateral nuclei of the thalamus (4, 5); the medial reticular formation of the midbrain also plays an inhibitory role in acupuncture analgesia (6).

As physicians, scientists, and students of acupuncture, it is incumbent that we investigate the past and current Chinese research. For example, this writer discovered at the Workers, Peasants, and Soldiers' hospital in Peking that acupuncture decreases the frequency of the electroencephalogram, increases capillary blood flow, increases leukocytosis or the white blood cell count, intensifies phagocytosis, and that injecting Xylocaine at the acupuncture sites prevents the pain relieving effects of acupuncture.

In China, numerous acupuncture research experiments are frequently performed on animals (7); the data derived from this research is readily available to Western researchers in current Chinese scientific and popular publications; acupuncture has played a significant role in Chinese veterinary medicine since 1965. Electroencephalographic changes in the cerebral cortex from needling certain points can completely suppress or markedly weaken the electroencephalographic changes caused by pain stimuli (6). As the world leader in acupuncture research, the Chinese have proven many neurophysiological mechanisms for acupuncture.

The foundation of Chinese research rests on neurophysiological principles well known in the West. Physical therapists frequently relieve musculoskeletal pain by rubbing, pressing, or massaging the tissue around the painful sites; severe pain may cause reflex acts of tooth and fist clenching and of tensing

rise to characteristic unit discharges\* in response to painful stimuli, and these discharges could be abolished by morphine. Evidence was presented to show that these characteristic discharges were only seen with painful stimuli (4).

The painful responses of the parafascicular and the centrolateral neurons could be inhibited by electrical needling of certain acupuncture points, squeezing the Achilles tendon, or by weak electrical stimulation of a sensory nerve. Too strong of an electrical stimulation tended to exaggerate the responses to pain, probably by means of increasing the activation of small nerve fibers. One type of spontaneous rhythmic discharges from parafascicular neurons was caused by the constant inflow of pain impulses from the surgical wounds of experimental animals. Spontaneous discharges of this type, like the experimentally evoked pain discharges, could be increased by painful stimuli and inhibited by non-painful stimuli, the mechanical squeeze of the Achilles tendon, or the needling of acupuncture points. The duration of the inhibition of the spontaneous rhythmic discharges of the parafascicular neurons, caused by the non-painful stimuli, varied with the frequency of the progressing discharges at the moment of stimulation, or in other words, with the excitability level of the neuron. This suggests that the efficacy of acupuncture for analgesia may be determined to an extent by the state of brain excitability (4).

It is well known that the mental state exercises certain influences on reactions to stimuli from sensory organs; excellent mental stability in a patient can enhance the results during acupuncture anesthesia. This is often cited in

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\* These are a prolonged latency, a higher discharge rate with a more prolonged after-discharge which means a long train of rhythmic fairly high frequency after discharges, and a lack of adaptation to repeated stimuli which means no decrease in either rate or frequency of discharge from repeated stimuli. The sustained high frequency discharges were only evoked by strong stimuli, for the small sized fibers in the peripheral nerves have a higher threshold than the large fibers.

current Chinese literature (4, 11, 12); for example:

We know that a person's mental state exercises a certain influence on the stimuli from the sensory organs. If he is in excellent spirits, sensitivity to stimuli may be reduced and hence the pain threshold is raised. Mental stability on the part of a patient coupled with his subjective dynamic role can bring better results to anesthesia by acupuncture.

However, the patient's initiative alone can not replace acupunctural anesthesia in carrying out an operation...(11).

In addition to proving the integrative inhibitory role of the thalamus in acupuncture, research workers in Shanghai have proven the role of the midbrain reticular formation in acupuncture from experiments carried out on 45 guinea pigs (6). Pain stimuli applied to the skin of the abdomen and toes caused the characteristic unit discharges which were a latent period and prolonged after-discharges. Intravenous morphine could suppress these characteristic responses which were different in pattern from the responses of painless tactile stimuli; this demonstrates the presence of pain-reacting cells in the medial reticular formation of the midbrain. The responses of the midbrain reticular formation to pain stimuli applied to various parts of the body were entirely or partially inhibited by electrical acupuncture at the Tsusanli (St-36) and the Yanglingchuan (Gb-34) points. These findings suggest that the medial reticular formation of the midbrain plays a role in producing acupuncture analgesia.

Acupuncture research workers at the Hsu Yi County People's Hospital in the Kiangsu province presented evidence to support the thesis that during acupuncture the stimulation of large myelinated sensory fibers, the A fibers, suppresses the slower traveling fine pain fibers, the C fibers (10). During acupuncture anesthesia on patients, they found an increase in Hoffman's reflex, a sensory reflex carried by large fibers. This increase in sensory reflex was directly proportional to the analgesia or the decrease in fine pain fiber conduction. The exaggeration of Hoffman's reflex during acupuncture anesthesia suggests there exists an inhibitory interrelation-

ship between the small and large nerve fiber activities. The Chinese first postulated and researched the theory, "that large fiber activities under acupuncture anesthesia may result in suppression of small fiber activities, thus giving rise to an analgesic state under which surgical operations can be performed." (10).

Acupuncture research workers at the Shenyang Medical College correlated the spinal reflex theory with the human anatomy of the spinal cord (3). Utilizing the degenerative technique\* with electron microscopy, they proved that a nerve impulse stimulated by needling certain points on the lower limb could be transmitted both up and down the spinal cord as much as six segmental vertebrae. The transmission was accomplished by the ascending and descending collateral branches of the large sensory fibers. The large endings of the collateral branches synapse or connect with numerous small cells in the substantia gelatinosa.\*\* Electron microscopy shows that these synapses are of the Gray II or inhibitory type.

To be more specific, after transection of the posterior root of the third segment of the lumbar spinal cord, degenerative collateral branches of the large fibers in the posterior funiculus\*\*\* could be traced upward to the eleventh thoracic segment and downward to below the fifth lumbar segment. Some arched backward to reach layers of the substantia gelatinosa; many degenerative large fibers were seen in the medial parts of the dorsal nucleus, the column of Clark, and the poster-

ior commissural nucleus. However, only a few degenerative fine fibers were observed in the medial part of the dorsolateral fasciculus, Lissaur's tract.

The dorsolateral fasciculus† connects with collateral branches of the large sensory fibers via inhibitory synapses in the substantia gelatinosa (see diagram Fig. 1). Since the fine fibers of the dorsolateral fasciculus are of an intraspinal origin, these fine fibers can only connect with the large fibers through inhibitory synapses in the substantia gelatinosa. The dorsolateral fasciculus plays a significant role in carrying impulses, produced by needling certain points on the lower limb, to the various vertebral segments.

In defining the presence of an inhibitory synapse, inhibitory regulating activity is established in the posterior horn of the spinal cord. Since these inhibitory synapses in the posterior horn of the spinal cord regulate activity within the segmental reflexes, this explains the reason why needling certain points on the lower limb induces analgesic action on the abdominal vertebral segments. Thus, the Shenyang Acupuncture Research Unit has demonstrated anatomically and physiologically the role played by spinal reflexes during acupuncture. Without investigating this research, spinal reflex theories were postulated in the West; however, these theories have now turned out to be a thesis already proven by Chinese physiologists.

Utilizing 159 health volunteers and 25 patients with various neurological disorders,

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\* In dividing a nerve fiber, the fiber severed from its cell degenerates; the portion still connected with the cell usually remains intact. In a transection of the spinal cord, all the ascending fibers whose cells are located below the cut will degenerate above the cut, while those descending fibers whose cells of origin are located above the cut will degenerate below the lesion (13).

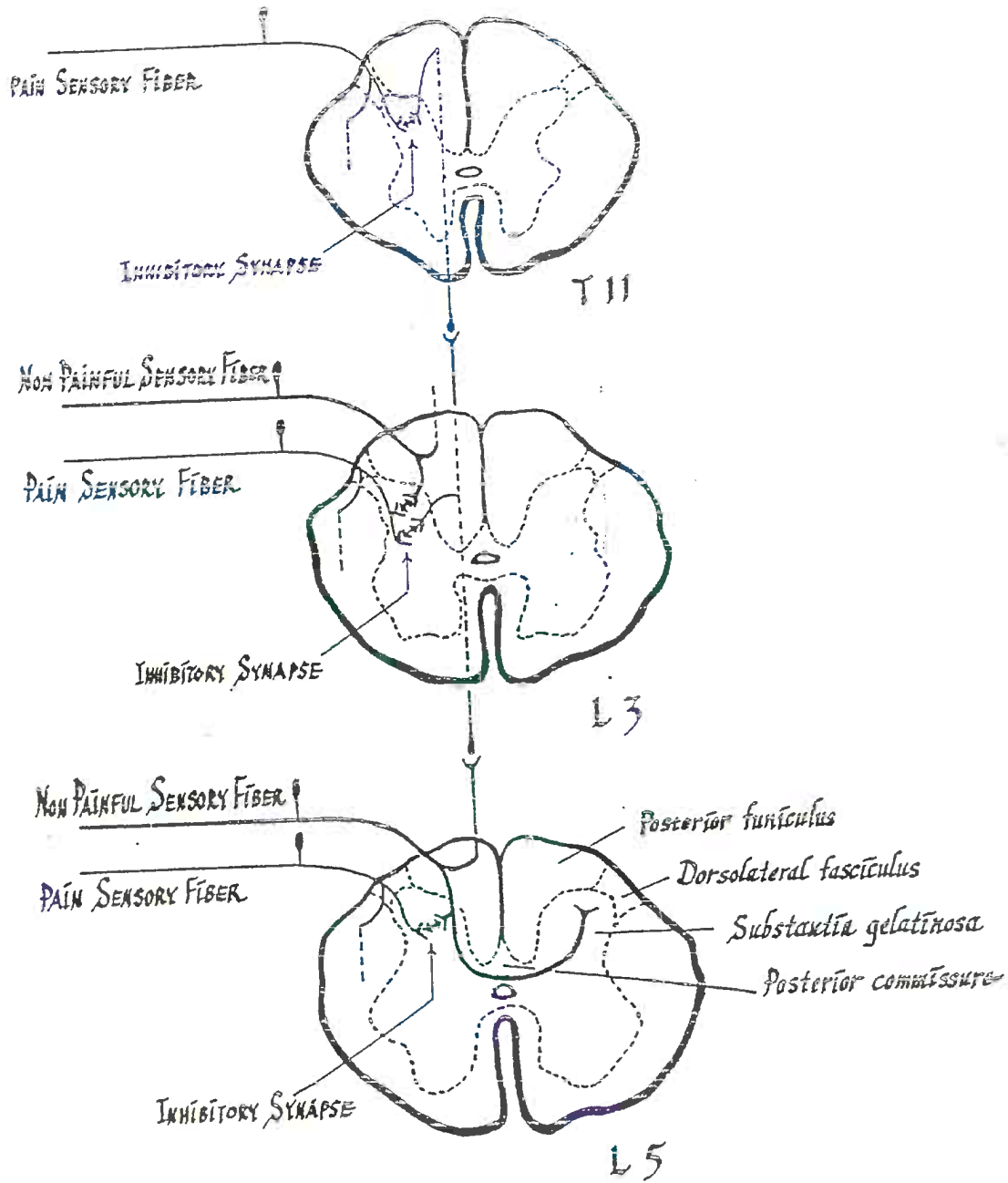
\*\* Substantia Gelatinosa: The apex of posterior column consists of a special variety of gray substance which is gelatinous in the fresh condition. The substantia gelatinosa of the spinal cord is continuous with change of structure with the nucleus of the spinal tract of the fifth nerve (13).

\*\*\* Posterior Funiculus: Consists of the ascending branches of the fibers of the medial division of the

dorsal root. They run for considerable but varying distances in the posterior funiculus; some from each root reach the medulla oblongata; others terminate at different levels in the gray matter of the spinal cord (13).

† Dorsolateral Fasciculus: Also called the tract of Lissaur, it lies between the apex of the posterior column and the periphery of the cord, and varies greatly in size and shape at the different levels. It is composed of unmyelinated and fine myelinated fibers, which are derived in part from the lateral division of the dorsal root and in part arise from cells in the neighboring gray matter. Although called a tract, most of its fibers end within a segment or two from their point of entrance into the cord (13).

Fig. 1. Inhibitory synapses in the substantia gelatinosa of the spinal cord.



acupuncture research workers at the Peking Medical College proved that acupuncture increases the pain threshold of human skin, the importance of the nervous system in acupuncture, and the relative specificity of the acupuncture points (14).

Needling produced pain relieving effects of varying degrees at eight points representatively distributed on the head, thorax, back, abdomen, and leg. Acupuncture at the point Hoku (LI-4) in 66 tests demonstrated a gradual elevation of the skin pain threshold,

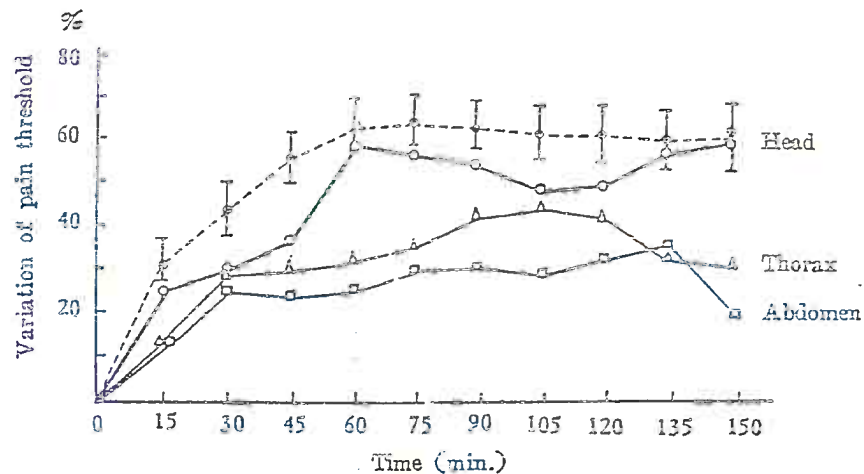


Fig. 2. Variation of pain threshold in continuous needling of point Hoku. [The dotted line shows the average of pain threshold variation after intermittent needling. The longitudinal line shows the standard error].

reaching a value of 65% to 95% at the end of the acupuncture period. Measurements were taken every 10 minutes for 100 minutes. The pain threshold was raised during the acupuncture session. Similar results were obtained in 32 tests at the Tsusanli point (St-36), although to a lesser degree. When the Hoku and the Tsusanli points were stimulated simultaneously in 20 tests, a more potent analgesia was obtained than with the point Tsusanli alone. In addition, the effects of trial needling done a day before surgery were similar to the effects of acupuncture analgesia during the operations. In the journal *Scientia Sinica*, the Peking Acupuncture Anesthesia Coordinating Group also found that the pain threshold measured by potassium ion algometer was increased in normal volunteers after needling as shown in Fig. 2 (12).

In addition to proving that acupuncture increases the pain threshold, the Peking research workers noted that the specificity of acupuncture points is relative. In 24 tests (14), they stimulated a new point, midway between the second and third metacarpals outside of the 14 classical meridians. The results showed that the cutaneous sensation and the analgesic effect were the same as those produced by the needling of the point Hoku (LI-4), thus demonstrating that the specificity of acu-

puncture points is relative. To quote Chang Hsiang-Tung (4):

.. On the other hand, the needling at any point may alleviate somewhat pains in any other part of the body, but there are definitely regional differences in effectiveness. Therefore, it is appropriate to make a general proposition that acupuncture needling of any "point" can relieve somewhat the pain from any other part of the body, but the needling of certain specific points is definitely more effective than the other. In the language of neurophysiology, excitation of any somatic sensory nerve may have some inhibitory effect on pain; but the effect would be more prominent if the point of needling and the site of pain are innervated by the nerves which enter the spinal cord at the same or adjacent segments.

The relative specificity of acupuncture points would discount the validity of the research method of placebo testing with controls such as the 1973 University of California, S.F. (15) arthritic clinic's series and the current placebo testing at Massachusetts General Hospital (16).

Acupuncture research workers in Shanghai also verified certain segmental and even symmetrical relationships during the acupuncture of patients. Their experiments suggested that segmental relations exist between the point of needling and the point where the pain threshold is most remarkably raised. For example, after needling the Hoku point,

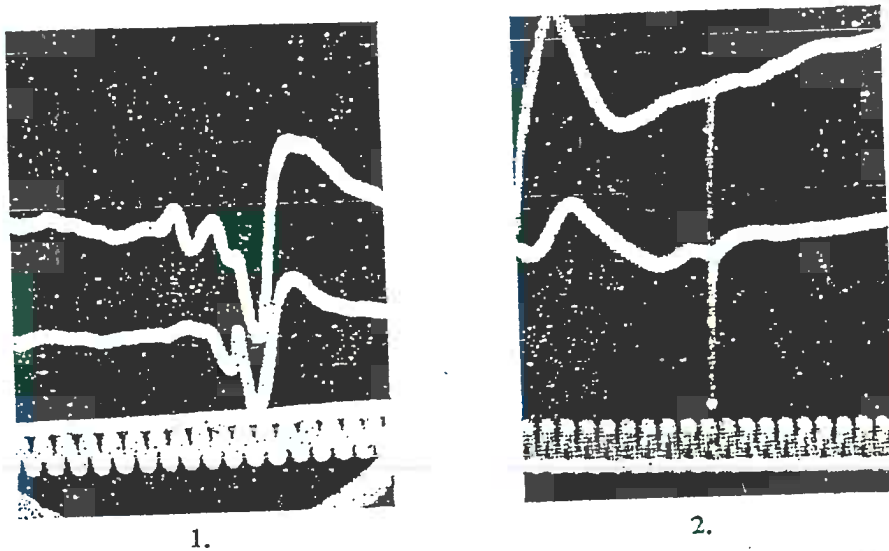


Fig. 3. The inhibitory effect of electroacupuncture of points Hoku and Nei Kuan on the evoked potential induced by electrical stimulation of nervous cutaneous colli on the sensory cortex.  
 1. Cortex evoked potential induced by electrical stimulation of nervous cutaneous colli.  
 2. The cortex evoked potential induced by pain stimulation significantly suppressed by needling the points Hoku and Nei Kuan.

which is innervated by cervical nerves, the pain thresholds of the test points innervated by the trigeminal nerve and the cervical nerves were raised much higher than those of the points innervated by the thoracic and lumbar nerves (17); even though their experiment showed that the pain thresholds were raised for all points tested with no significant difference between the points on the meridian lines compared with the points selected according to the principle of segmental innervation. However, they found significant similarities in pain threshold between the symmetrically located points. In testing five pairs of symmetrical points, the differences in pain thresholds between symmetrical points were of no statistical significance. This agreed with their clinical findings; for example, in the case of a semilunar valvulotomy, the acupuncture needling of points on the intact leg could result in lessening the pain sensibility of the opposite leg to such a degree that the operation could be performed satisfactorily without drugs.

The Peking research group also verified clinically the importance of the nervous system in acupuncture analgesia (14). In 10 patients, 2% procaine injected deep under

the Hoku point prior to acupuncture blocked the local sensations of dullness, swelling, distention, and numbness and also blocked the analgesic effects. In addition, when the affected limbs of 12 hemiplegics and 13 paraplegics were treated by acupuncture, no effect on pain threshold was observed. The Peking Acupuncture Anaesthesia Coordinating Group (12), using the points Hoku and Tsusanli in 12 cases of either hemiplegic or paraplegic patients, also found that acupuncture could raise the pain threshold in the normal extremity but not in the paralyzed extremity; they also found that novocaine at the site of the needling would block the elevation of pain threshold.

The Peking Acupuncture Anaesthesia Coordinating Group, in experiments mimicking clinical thyroidectomy on 70 cats and rabbits, observed an evoked potential on the sensory cortex which was induced by electrical stimulation of the nervous cutaneous colli. Needling the points Hoku and Nei Kuan (P-6) suppressed or weakened the potential evoked by the painful stimulation (12), as shown in Fig. 3. In another group of experiments on 77 cats and rabbits, the cortical evoked potential and

contraction of the submaxillary muscle induced by electrical stimulation of tooth pulp were suppressed by needling the point Hoku.

The Peking Acupuncture Anaesthesia Coordinating Group (12) also found a certain relationship between the clinical efficacy of acupuncture anesthesia and the electrical skin potential. The more stable the skin potential is, the better is the efficacy of acupuncture anesthesia, and vice versa (Table 1). In studying the electroencephalogram in normal adults, they found that during needling, the alpha-wave predominated and its amplitude increased (Fig. 4).

The Peking Acupuncture Anaesthesia Coordinating Group also noted that needling exerts a clinically therapeutic effect in treating insomnia. In animal experiments with cats, they demonstrated that when the stimulation of needling at certain acupuncture points reached an appropriate intensity, the cat dropped its head, closed its eyes, and kept quiet. This illustrates that acupuncture has a sedative effect in addition to an analgesic effect.

Physiologists in Shanghai performed experiments on 21 normal adults to demonstrate that vascular occlusion of the upper arm could not prevent the analgesic effect of acupuncture (17). Vascular occlusion could not prevent the effects of needling of a point on the hand from being mediated to other regions of the body as manifested by raising the thresholds of pain at these regions; how-

ever, infiltration of procaine in the deep tissues around the point of acupuncture abolished entirely the analgesic effect. This suggests that the nervous system mediates the analgesic effects of acupuncture.

These Shanghai physiologists also set up an experiment to find out whether the analgesia was due to superficial cutaneous nerves or deep muscular nerves. They used the Hoku point and selective nerve blockage of the superficial peripheral nerves innervated by the superficial branch of the radial nerve and the deep nerves innervated chiefly by deep branches of the ulnar nerve as well as the median nerve. Utilizing 15 subjects, when they blocked the superficial branch of the radial nerve, acupuncture still raised the pain threshold. However, when they blocked the deep muscular tissue without interfering with the cutaneous sensation, acupuncture failed to raise the pain threshold. The patients also failed to feel the characteristic subjective sensations of acupuncture needling: numbness, swelling, distention and/or soreness.

The Shanghai Acupuncture Anaesthesia Group measured the electromyographic activity produced locally by acupuncture manipulation (18) to correlate subjective acupunctural sensations with muscular activity. During acupuncture, the patient often describes a combined deep sensation of soreness, heaviness, tightness, and swelling; the manipulator frequently feels some resistance to the palpable motions of the needle in the tissue, during the maneuver, in which the needle is felt to be caught or sucked in by something in the tissue. It is assumed that the manual feeling experienced by the manipulator and probably some of the subjective feelings of the patient are produced by the contraction of the muscles in the punctured region.

Independent and double-blind experiments were performed on 32 healthy adults who were prevented from seeing the electromyographic changes on the cathode ray oscillograph. In 249 trials, a statistically significant relationship existed between the patient's muscle activity and the intensity of the manipulator's manual feelings; a similar relationship was found between the patient's

Table 1.

Comparison Between the Efficacy of Acupuncture Anesthesia and Skin Potential. [108 Cases of Thoracic Operation, Thyroidectomy, and Appendectomy].

Complete correspondence between efficacy of acupuncture anesthesia and skin potential by grade mark.	33 cases
Grade mark of efficacy of acupuncture anesthesia and that of skin potential different from each other less than 1 grade	48 cases
Complete inconstancy between efficacy of acupuncture anesthesia and skin potential by grade mark.	27 cases



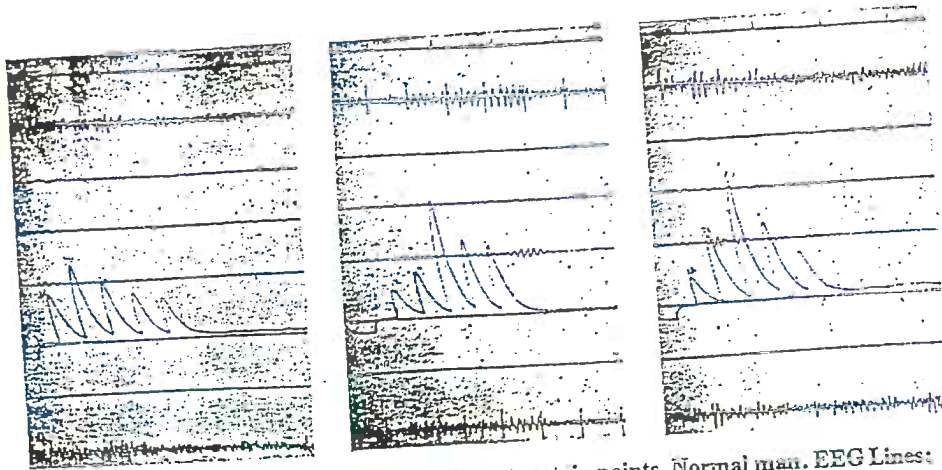


Fig. 4. Alterations in EEG after needling at certain points. Normal man. EEG Lines: 1. Time Marker. 2. Bi-occipital lead. 3-7. Instantaneous potential of occipital lead by frequency analyzer. 8. Bi-temporal lead. Waves superimposed on the sixth line show the integration of the 5 frequency bands.

muscle activity and the intensity of the patient's subjective feeling. By cross correlation, it may be assumed that the subjective feeling of the patient and the manual feeling experienced by the needle manipulator are most likely parallel processes closely related to muscle activity.

The local muscular activity during acupuncture is believed to be a reflex activity rather than a direct result of mechanical irritation by the needle; for both the subjective feelings and the manipulator's manual feeling as well as the electrical activity disappear entirely in patients under lumbar anesthesia. They again confirmed the fact that the presence of the characteristic subjective sensation during acupuncture is essential for the analgesic effect regardless of the means by which the sensation is produced. In fact, acupuncture anesthesia has been produced by such diverse ways as needling, electrical stimulation, the injection of distilled water, and by simply pressing a point with a finger (19).

The physiology department of the Shanghai First Medical College studied the relations between acupuncture sensations and the electromyograms in patients with nervous diseases (20). Since during acupuncture the patient has the typical acupuncture sensations of soreness, swelling, heaviness, and numbness, accompanied by electrical activity in the adjacent muscles, therefore, an acu-

puncture needle, inserted into a specific acupuncture point, also served as an electrode for recording the muscular electrical activity brought on by needling. They found that patients suffering from diseases of the muscles or spinal neurones, such as infantile paralysis, amyotrophic lateral sclerosis, and myasthenia gravis, could feel acupuncture sensations while their diseased limbs were needled. However, acupuncture sensations were absent or diminished in the limbs with impairment of the pain and temperature sensations such as syringomyelia. These results suggest that the conduction pathway of acupuncture sensations in the spinal cord is closely related to that of pain and temperature sensations.

The Acupuncture Research Group at the Hunan Medical College in Changsha investigated the relation between acupuncture analgesia and neurotransmitters in rabbit brains (21), for nerve conduction depends on the chemical neurotransmitters at the synaptic sites of contact. Electrical needling at the points Feng Lung (St-40 and Yangfu (GB-38) produced marked analgesia which was demonstrated in two groups of rabbits before respective decapitation at 15 minutes and 30 minutes. The needling caused a statistically significant increase of 5-hydroxytryptamine in both the medulla and the thalamus as well as a decrease of glutamic acid in the thala-

mus. Intraventricular injection of 5-hydroxytryptamine, norepinephrine, gamma-aminobutyric acid, and sodium glutamate respectively resulted in variable pain-threshold raising effects in rabbits. These effects were more marked and definite with the injections of either 5-hydroxytryptamine or of sodium glutamate. This experiment suggests that the increased amount of 5-hydroxytryptamine in the brain stem probably plays a certain role in the analgesic effect of acupuncture. The decrease in the amount of glutamic acid in the thalamus depends upon an increased metabolic activity in the brain.

Since the broad masses of Chinese research workers have created new frontiers in acupuncture, it is not surprising that they should be the first in the world to develop and prove the neurophysiological basis for acupuncture. Chinese physiologists have performed scientific acupuncture experiments on non-hypnotized guinea pigs, rabbits, and cats at the same time that many Western scientists considered acupuncture a form of hypnosis (22). Veterinary surgeons at the Peking Municipal Veterinary Hospital have performed abdominal operations on animals as large as a mule (7); acupuncture plays a wide role in veterinary medicine in China (23). Chinese health practitioners have enriched the science of acupuncture by discovering new points through experimenting on themselves (23, 24) and on laboratory animals, not by experimenting on their patients.

#### Conclusion

The data derived from Chinese research efforts are readily available to Western investigators in current Chinese scientific and popular publications.

It is ironic that this late in the twentieth century, while Western scientists still debate over the role of the nervous system in acupuncture, the Chinese have already proven its role.

The Chinese have proven the following neurophysiological mechanisms for acupuncture: The roles of the paraventricular and centrolateral nuclei of the thalamus; the effects of acupuncture on the midbrain reticular formation; the increase in non-painful sensory reflexes during acupuncture; the relative specificity of acupuncture points; the correlation in certain points of a segmental relation between the points of needling and the point where the pain threshold is most remarkably raised; a statistically significant similarity in the degree of elevation of pain thresholds in symmetrically located points; the fact that vascular occlusion cannot prevent the pain relieving effect of acupuncture; electromyographic proof of a direct correlation between reflex muscular activity and the subjective sensations associated with acupuncture; the fact that there exists a sedative effect during acupuncture; the fact that the alpha rhythm of the electroencephalogram increases during acupuncture, the fact that a direct correlation exists between the efficacy of acupuncture anesthesia and both the functioning state of the cerebrum and the electrical stability of the skin potential; the fact that the characteristic subjective sensation during acupuncture is essential for its analgesic effects regardless of the means by which the subjective sensation is produced; and the fact that there exists a specific positive correlation between certain chemical synaptic transmitters such as 5-hydroxytryptamine and the pain relieving effect of acupuncture.

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