The Physiology of Acupuncture

David Bowsher

Most physicians able to view acupuncture either without irrational prejudice in its favor or inexplicable antipathy founded only in bigotry would now agree that it undoubtedly has a role in symptomatic pain relief. Such an opinion is cautiously expressed in the recent review by Richardson and Vincent (1986). However, the recognition of its therapeutic usefulness does not necessarily entail the belief that it works by the principles of YING and YANG, the FIVE ELEMENTS, and/or CHING-LO (Cheng, 1959).

Man may be defined as a justifying animal; that is to say, having empirically found something which works, he is subsequently impelled to construct theories which explain the phenomenon. In accordance with this precept, the following pages attempt to explain acupuncture analgesia, at least in part, in terms of modern neuro-physiology.

Acupuncture Points

Superposition of a map of acupuncture points on an illustration of the course and termination of peripheral nerves taken from a standard textbook of anatomy shows that they coincide more often than not — particularly the (anatomically) unnamed branchlets. Chan (1984) cites two Chinese studies which showed that 309 acupuncture points are situated on or very close to nerves, while a further 286 are on or very close to major blood vessels surrounded by their perivascular plexus of nervi vasorum. The neural nature of the points is confirmed by the fact that local anesthesia of points or the nerve trunks to which they are afferent blocks the acupuncture effect (Chiang et al., 1973). Goulden (1921) first described lowered skin impedance over acupuncture points along the course of the sciatic nerve and its branches, and this was generalised over 224 points covering the whole body by Tseng et al. (1958). Similarly, Japanese Ryodoraku points also show low impedance (or high conductivity) at points or the nerve trunks to which they are afferent.

Many acupuncture points are deep to the skin, and are situated in muscle, Melzack et al. (1977) have shown how closely they correlate with trigger points and Liu et al. (1977) with motor points.

There has been much unnecessary debate about the afferent fibre category implicated in acupuncture. Two simple facts should be considered:

(i) TNS is known to activate Aβ fibres. Electroacupuncture is performed at considerably higher intensity (and lower frequency) than TNS (Holmgren, 1975). It must therefore recruit cutaneous fibres of smaller calibre than Aβ. Wang et al. (1985) state that they are in fact Aδ (Group III).

(ii) Manual acupuncture is usually carried out with a needle; sometimes intense pressure (acupressure) is used, though it is recognised to be less effective. Both these high-intensity stimuli are unpleasant, and activate cutaneous Aδ fibres, or the equivalent Group III fibres in muscle (Bowsher, 1976). More recently, Cervero et al. (1981) have shown in experimental animals that somatic Aδ stimulation diminishes transmission of noxious information from viscera through C fibres.

Thus it may be concluded that the acupuncture effect is produced by stimulation of the axons or terminals of small myelinated (Aδ) fibres.

Mechanisms of Acupuncture Analgesia

The key to the understanding of acupuncture analgesia is that it is naloxone-reversible (Mayer et al., 1977; Sjölund and Eriksson, 1979; Cheng and Pomeranz, 1980), whereas TNS is not (Sjölund and Eriksson, 1979), and thus probably depends upon an endogenous opioid mechanism. The case is further strengthened by the fact that opiate-resistant neurogenic pain, such as post-herpetic neuralgia (Lewith et al., 1984) and thalamic syndrome (personal observations), is unaffected by acupuncture. It is known that there are enkephalinergic interneurons in the superficial dorsal horn of the cat (Bennett et al., 1982): identical cells, in the same position, though of unproven transmitter content, exist in the human dorsal horn (Bowsher & Abdel-Maguid, 1984). These inhibitory interneurons are able to block the transmission of nociceptive messages arriving along peripheral polymodal nociceptive (C) primary afferents to cells of origin of the (crossed) anterolateral funiculus (Ruda et al., 1984) (Fig. 1). These superficial enkephalinergic inhibitory “stalled cells” are contacted by fine myelinated (Aδ) primary afferents in the cat (Gobel et al., 1980) — and also presumably in man. Thus there is an excellent anatomico-physiological basis for segmental acupuncture.

A delta (pinprick) peripheral afferents also make contact with projection cells in the superficialmost layer (lamina I) of the dorsal horn (Kumazawa and Perl, 1978). These (Waldreyer) cells project directly through the (contralateral) anterolateral funiculus, to the ventrobasal thalamus and thence to the somatosensory cortex to subserve the conscious appreciation of pinprick sensation; but on the way collaterals are given off to the periaqueductal grey matter (PAG) in the midbrain (Price et al., 1978; Mantyh 1982). The PAG, of course, stands at the head of a descending analgesic system, stimulation of which in man gives rise to naloxone-reversible analgesia (Hosobuchi et al., 1977). PAG projects to the nucleus raphe magnus (nRM) in the midline of the
lower brainstem reticular formation, whence serotonergic fibres descend in the dorsolateral funiculus (DLF) of the spinal cord to end in the superficial dorsal horn of the spinal grey (Basbaum et al., 1978). Some of these 5-HT terminals make synaptic contact with the enkephalergic inhibitory stalked cells mentioned above (Lanerolle and Lamotte, 1983). This provides a circuit for naloxone-reversible extrasegmental acupuncture (Bowsher, 1976). (Fig 1). Additional credence is lent to this proposed circuit by the reported observation that section of either its central afferent limb (the anterolateral funiculus) or its central efferent limb (the dorsolateral funiculus) abolishes extrasegmental acupuncture analgesia (Shen et al., 1978).

If acupuncture depends on the neurosecretion of opioids, there is at least some explanation, however incomplete, of the observations that acupuncture analgesia has a delayed onset (unlike analgesia from TNS) and subsequently outlasts stimulation. More difficult is the question of why particular acupuncture points supposedly relieve pain at other (remote) particular points. A topical organisation within PAC, described by Soper and Melzack (1982) may be a possible explanation. However the very recent review by Richardson and Vincent (1986) casts some doubt on the specificity of acupuncture points; neurophysiologists would be very much happier if it eventually turns out that any point is as effective as any other in extrasegmental acupuncture. Lastly, since segmental acupuncture would activate both of the circuits described above, it ought to be more effective and more certain than extrasegmental acupuncture, which only activates one of the two circuits; and such indeed is our (subjective) experience.

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Figure 1. Diagram to show circuits involved in acupuncture analgesia

(a) Pathway for tissue-damage pain: Peripheral polymodal nociceptor primary afferents (C) terminate in the substantia gelatinosa (SG) (lamina II); their axon terminals secrete Substance P (SP) or vasoactive intestinal polypeptide (VIP), according to whether they come from skin or viscera respectively. The substantia gelatinosa indirectly excites transmission cells (T) deep in the spinal grey matter, whose axons form one component of the crossed anterolateral funiculus (ALF) which ascends to the brain, eventually to give rise to conscious sensation of tissue-damage (second pain).

(b) Segmental acupuncture: Small myelinated primary afferents (Aδ) bring pinprick information to the spinal cord. One central branch of the Aδ axon excites an inhibitory enkephalinergic interneuron (E) on the borders of laminae I and II, employing enkephalin (Enk) as a transmitter, and thus prevents the onward transmission of noxiously-generated information arriving along peripheral C nociceptors.

(c) Extrasegmental acupuncture: Waldeyer cells (W) in lamina I of the spinal grey matter are excited by pinprick-generated impulses in arriving along another central branch of Aδ primary afferents. The axons of Waldeyer cells form (another) component of the crossed anterolateral funiculus, conveying pinprick information to consciousness through the ventrobasal thalamic and somatosensory cortex; a collateral branch of these spinothalamic axons ends in the periaqueductal grey matter (PAG) of the midbrain. The PAG in its turn projects to the nucleus raphe magnus (nRM) in the midline of the lower brainstem reticular formation. Serotoninergic (5-HT) axons of nRM cells descend through the dorsolateral funiculus (DLF) of the spinal cord to synapse eventually with the enkephalinergic stalked cells (E) described above, and so block the transmission of noxiously-generated information in the same way as does segmental acupuncture.

References Continue over
Easy Needling of Acupuncture Points

Dr. Nagi N. Iskander

This little phenomenon that I have noticed in my Private Practice in Alexandria has been observed over the last three years. I noticed that Acupuncture points are easily needled when they are indicated for therapy so that the needle will be easily introduced into the skin without pain.

This phenomenon was noticed when a study was done using scalp points according to the Chinese Chart compared with that of Dr. Yamamoto of Japan who uses body presentation on the frontal hair line of the scalp. Needle insertion was tried repeatedly until it slipped in easily.

In most cases the site which accepted the needle most easily matched with the clinical condition. Such points were successful therapy points. The same phenomenon easily matched with the clinical condition. Such points were successful therapy points. The same phenomenon easily matched with the clinical condition. Such points were successful therapy points. The same phenomenon applied to ear and body acupuncture most of the time as well.

The phenomenon may be explained by a “Viscero-cutaneous reflex” that can be accompanied by microscopic oedema in the skin at the acupuncture points. This allows easy needle introduction. In summary:

1. Using this objective sign helped both diagnosis and the localisation of therapy points.
2. It is a single procedure for the practitioner not requiring the use of a “Neurometer” detector, which anyway has limited value when used on the scalp as the scalp is electro-permeable.
3. Skin resistance recovery is an indicator of improvement in the patient’s condition.
4. This phenomenon relies on a viscerocutaneous reflex and thus the therapeutic effect of the needle will depend on a cutaneous-visceral reflex.

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Acupunct Med 1987 4: 12-14
doi: 10.1136/aim.4.2.12

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