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EDITORIAL

Acupuncture: The Search for Biologic Evidence with Functional Magnetic Resonance Imaging and Positron Emission Tomography Techniques

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The subject of acupuncture is surrounded, in some circles, with notions of mysticism and movements of energy through meridian channels invisible to the naked eye and a nomenclature for the internal organs that perplexes many Western-trained scientists confronted with the Chinese literature. While a large number of randomized controlled trials provides growing evidence of the clinical efficacy of acupuncture for treating a variety of medical conditions (National Institutes of Health, 1997; Ernst and White, 1999; Stux and Hammerschlag, 2001) a reliance on apparently unverifiable concepts of energy gives rise to considerable skepticism of this alternative medical modality. Anecdotal reports of patient improvement may be sufficient to persuade the health care consumer but failure to completely demonstrate the relationship of Oriental Medicine to known physiologic systems limits the acceptance of acupuncture in mainstream medicine.

Physicians who practice medical acupuncture often provide considerable benefit to patients who have reportedly "failed" to respond to contemporary Western medicine. Thus, these physicians appreciate the enormous clinical value of acupuncture. Nonetheless, historical accounts in Europe and America of such supposedly effective medical cures as "bloodletting" and "mysterious elixirs" led Western physicians to doubt medical procedures not grounded in well-researched, biologic mechanisms and continue to fuel Western cynicism toward Oriental Medicine. However, advances in sophisticated technology utilized in the fields of neuroscience and molecular biology have the potential to lead to greater understanding of the mechanisms underlying the effects of acupuncture.

In their paper "A Pilot Study of Functional Magnetic Resonance Imaging of the Brain During Manual and Electroacupuncture Stimulation of Acupuncture Point (LI-4 Hegu) in Normal Subjects Reveals Differential Brain Activation Between Methods" (pages 411–419), Jian Kong et al. demonstrate the complexity of researching even the basic process of needling a major acupuncture point, Large Intestine 4 (LI 4). Nevertheless, their endeavor to explore the centrally mediated effects of acupuncture using functional magnetic resonance (fMRI) brain imaging techniques takes advantage of an opportunity that Chinese doctors from the past

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could never have imagined. Their belief in the complementary interaction of *yin* and *yang* and their efforts to harmonize the *qi* of the patient may well be metaphorical explanations for fundamental physical processes that we are only now beginning to observe in medical research laboratories. The availability of the technology developed for brain imaging in the neurosciences (Cho et al., 1976; Cho et al., 2002; Toga and Mazziotta, 2000) may begin to resolve contentious discussions regarding such questions as: "Is acupuncture real or simply a placebo effect?"; "If it is real, is acupuncture really point specific?"; and "How does it work?" Cho et al. (1998; 2001) demonstrate selective changes in cortical fMRI following needling at acupuncture points. Stimulation of specific acupoints on the Bladder meridian or on the Gall Bladder meridian in the lower extremities led to differential fMRI changes in the brain. More recent research by Alimi et al (2002) demonstrates that needle stimulation of the auricular acupuncture point for the hand leads to selective fMRI changes in the somatosensory region of the postcentral gyrus that responds to stimulation of the actual hand.

The point specificity of acupuncture stimulation, however, is not entirely supported (Cho et al., 2002, unpublished, ongoing research). Sham acupuncture stimulation of nonacupuncture points leads to a reduction of fMRI activation in the same brain areas that are affected by needling acupuncture points defined by the traditional acupuncture meridians. Both acupuncture stimulation and sham needling reduce activation in the brain areas that are involved in pain perception, including the somatosensory thalamus, the anterior cingulate gyrus, and the premotor cortex. These findings may provide scientific support for the neurobiologic bases of acupuncture analgesia and for the clinical rationale for treating chronic pain with acupuncture.

Ongoing neuroscience-based studies in other areas of clinical medicine suggest that it is time to launch a major systematic study of the neural bases of acupuncture utilizing fMRI and PET technologies. Such neurobiologic evidence may provide the sort of scientific evidence that will encourage more physicians to incorporate acupuncture into standard practice, whether or not they concur with the energetic concepts used in Oriental medicine. The same Western medical community (that largely still suspects that acupuncture is scientifically ungrounded) is already incorporating more acupuncture into practice.

Finally, a presentation of currently ongoing research endeavors in Dr. Cho's laboratory that are

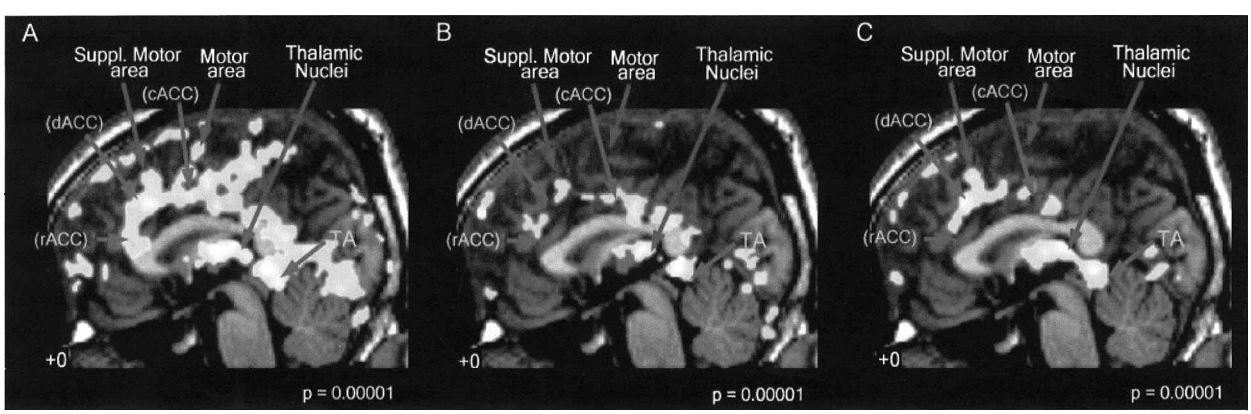

FIG. 1. Comparison of the cortical activations of the three sets of experiments, namely the activations observed as a result of: **(A)** "Pain" stimulation (alone); **(B)** "Meridian-Acupuncture + Pain" stimulation; and **(C)** "Sham-Acupuncture + Pain" stimulation, respectively. Note the markedly decreased activations in (B) and (C) compared to (A), especially in the anterior cingulate cortex (dACC, cACCI, and rACC), the supplementary motor areas, and the thalamic areas. This result implies that those cortical centers are involved in pain "perception," attention "riveting," "modulation," and "relay." In both (B) and (C), the only areas that remain activated are the much-reduced supplementary motor and primary motor areas (Magistretti PJ, Pellerin L. Cellular bases of brain energy metabolism and their relevance to functional brain imaging: Evidence for a prominent role of astrocytes. Cereb Cortex 1996;6:50–61). Note also that the pineal gland and tectal areas are also decreased substantially with acupuncture stimulation. dACC, dorsal anterior cingulate cortex; rACC, rostral anterior cingulate cortex; cACC, caudal anterior cingulate cortex; PG, pineal gland; TA, tectal area.

related to fMRI activity and acupuncture is shown in Figure 1. Data obtained by fMRI following "Pain Stimulation," "Meridian-Acupuncture + Pain," and "Sham-Acupuncture + Pain" is shown. These sagittal images demonstrate clear differences between pure pain stimulation to that of the acupuncture modulated-pain responses by either traditional meridian-based acupuncture needling and by acupuncture needling at sham points.

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