

# Pain Management ROUNDS

FROM GRAND ROUNDS AND OTHER CLINICAL CONFERENCES OF  
THE MGH PAIN CENTER, MASSACHUSETTS GENERAL HOSPITAL

## Acupuncture in Pain Management

BY LUCY CHEN, M.D.

Acupuncture is one of the most ancient of the healing arts and has been a significant component of the healthcare system in China for at least 3000 years. In 1993, the United States Food and Drug Administration (FDA) estimated that Americans make 9 to 12 million visits per year to acupuncture practitioners and spend >500 million dollars annually on acupuncture treatments.<sup>1</sup> In 1997, there were 385 million recorded patient visits to primary care physicians, but 630 million recorded visits to alternative medicine practitioners.<sup>2</sup> In a nationwide survey published in 1998, Eisenberg et al reported that office visits for alternative therapy were twice those for primary care and that money spent on alternative medicine was nearly equal to the out-of-pocket expenditures for conventional medical care.<sup>2</sup> As summarized in a document published by the World Health Organization (WHO) in 2002,<sup>3</sup> many medical conditions may be effectively treated by acupuncture.

In keeping with an ever-growing demand for alternative medicine, the FDA classified acupuncture needles as medical equipment in 1996, subject to the same strict standards as medical needles, syringes, and surgical scalpels. Given the dramatic increase in the use of acupuncture as an alternative treatment modality, the National Institutes of Health (NIH) organized a Consensus Development Conference on Acupuncture in 1997. It ascertained that acupuncture is extensively practiced by medical physicians, dentists, non-MD acupuncturists, and other practitioners, because, at least in part, the incidence of adverse effects is substantially lower with acupuncture than with many drugs and other commonly accepted medical procedures for the same conditions.

### WHAT IS ACUPUNCTURE?

Acupuncture involves the insertion of fine sterilized needles through the skin at specific points (called acupoints) and is one of the key components of traditional Chinese medicine. In this ancient system, maintaining human health is considered achievable via a delicate balance between two opposing, but inseparable, principle elements, “*yin*” and “*yang*.” *Yin* represents “cold, slow, and passive elements,” whereas *yang* represents “hot, exciting, and active elements.” Accordingly, the internal organs in humans are also divided into the *yin* and *yang* system. Thus, this ancient theory of Chinese medicine suggests that health can be achieved by maintaining *yin* and *yang* in a balanced state in the human body and that an internal imbalance between these 2 elements is responsible for a state of disease.

Furthermore, traditional Chinese medicine believes that “*qi*” (ie, vital energy, pronounced as “chee”) is the life force or energy that influences health. In this regard, maintaining a balance between the opposing forces of *yin* and *yang* is considered to be the basis for the healthy flow of *qi*. Therefore, any disturbance in the *yin* and *yang* system would disrupt the flow of *qi*, thereby becoming the basis for a state of disease or pain. Acupuncture treats a state of disease or pain by adding *qi* or releasing the excessive flow of *qi* in order to restore the normal balance between *yin* and *yang*. Because *qi* is thought to flow through specific pathways (ie, meridians consisting of 12 main meridians and 8 secondary meridians) in the human body, an effective acupuncture treatment demands that acupuncture needles be placed into acupoints located along the meridians as shown in lines in Figure 1.

### CLINICAL ISSUES OF ACUPUNCTURE

#### Pre-acupuncture evaluation

Evaluating patients for acupuncture includes the following:

- observing the patient's appearance by examining the tongue (shape, color, texture)
- asking about the predominant complaints, symptoms, and general medical condition
- feeling radial pulses.



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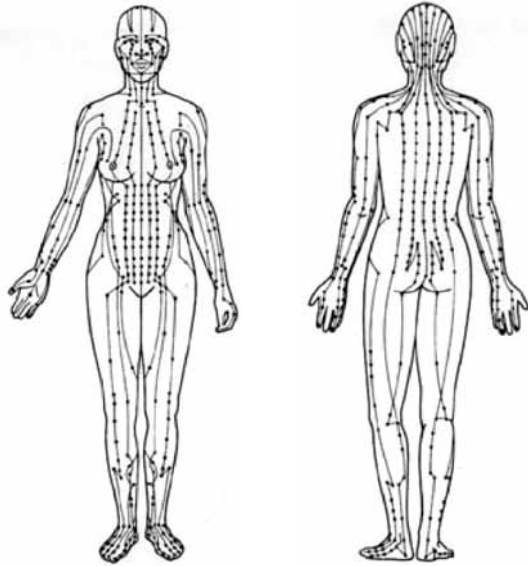
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**FIGURE 1: Location of the meridians and acupoints in the human body**



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Conventional medical examinations such as inspection, palpation, auscultation, percussion, range of motion of the extremities, reflexes, and neurological examinations are also used.

### Selection of acupoints

Acupoints are usually chosen based on the practitioner's assessment of the particular imbalance between *yin* and *yang* that needs to be restored. The formulation of an acupuncture treatment is often highly individualized and largely based on the practitioner's philosophical constructs and subjective and intuitive impression about the patient's condition. Therefore, a practitioner may select different acupoints at each treatment session that are based on the patient's particular complaints, symptoms, and presentations at the time of treatment. This explains why a repeat evaluation of the patient's condition is needed at each session to formulate an acupuncture treatment plan.

### Acupuncture techniques

After the needle is inserted into an acupoint, the sensation of "*de-qi*" – a feeling of aching, swelling, tingling, numbness and/or heaviness at the insertion site – is thought to be necessary to obtain a therapeutic effect. An acupuncture needle may remain in place for 15–30 minutes through manual or electrical stimulation. In some cases, radiant heat from a lamp or moxa (burning herbs) can be applied to the top of an acupuncture needle to obtain additional effect. Interestingly, there are many different acupuncture techniques, including traditional Chinese acupuncture, Korean hand acupuncture, and Japanese acupuncture, scalp and ear acupuncture, and each remains in practice in different parts of the world.

## NEUROBIOLOGICAL MECHANISMS OF ACUPUNCTURE

Although acupuncture has been used for many thousands of years, its mechanisms remain largely elusive. A large number of

studies in humans and animals have demonstrated that acupuncture produces diverse biological effects on the peripheral and central nerve system (CNS) and the production and release of humoral factors, neurotransmitters, and other chemical mediators.

**Peripheral nervous system:** Consistent with the meridian system mentioned earlier, an intact peripheral nerve system is necessary for the analgesic effects of acupuncture to be effective. These analgesic effects can be abolished (or diminished) if the acupuncture site is affected by herpetic neuralgia or intervened with local anesthetics.<sup>4,5</sup>

**Humoral factors:** In the mid-1970s, Mayer and colleagues revealed that acupuncture resulted in a significant increase in endogenous endorphin production and that its effect was blocked by the opioid receptor antagonist, naloxone.<sup>6</sup> It is believed that humoral factors may mediate acupuncture analgesia by releasing substances into the cerebrospinal fluid after acupuncture. This notion was supported by a cross-perfusion experiment, in which acupuncture-induced analgesic effects were replicated in a recipient rabbit that received cerebrospinal fluid from a donor rabbit that had undergone acupuncture.<sup>7</sup> Electric acupuncture (EA) has been shown to alter polycystic ovaries induced by steroids through regulation of ovarian nerve growth factors.<sup>8</sup>

**Central nervous system:** Early studies reveal that EA at different frequencies can have different effects on the synthesis and release of neuropeptides in the CNS. For example, EA, at frequencies of 2 Hz and 100 Hz, had differential effects on preproenkephalin mRNA expression in the brain.<sup>9</sup> EA at 100 Hz markedly increased preprodynorphin mRNA levels, while EA at 2 Hz had no such effect.<sup>8</sup> Moreover, a  $\mu$ -opioid receptor antagonist or antiserum against endorphin blocked acupuncture analgesia induced by EA at 2 Hz, but not at 100 Hz.<sup>10</sup> In addition, EA induced an increase in cholecystokinin-like immunoreactivity within the medial thalamic area after EA<sup>11</sup> and enhanced and restored the activity of natural killer cells suppressed by the hypothalamic lesion.<sup>12</sup>

The application of neuroimaging techniques (eg, functional magnetic resonance imaging [fMRI] and positron emission tomographic [PET] scans) makes it possible to further understand the effects of acupuncture on human brain activity. Pain activates neuronal activity in the periaqueductal gray, thalamus, hypothalamus, somatosensory cortex, and prefrontal cortex regions of the human brain,<sup>13</sup> which is attenuated by the sensation of *de qi* after acupuncture.<sup>14</sup> Compared to manual acupuncture, EA – particularly at low frequencies – produces more widespread fMRI signal changes in the anterior insula area, as well as the limbic and paralimbic structures.<sup>15</sup> These findings are further supported by data indicating that stimulation of different acupoints evokes both signal increases or decreases in different areas within the CNS.<sup>16</sup> This suggests that there may be correlations between the effects of acupuncture and neuronal changes within the brain.

**Neurotransmitters:** A large body of evidence indicates that acupuncture significantly affects the production and release of neurotransmitters, including epinephrine, norepinephrine, dopamine, and 5-hydroxytryptamine.<sup>17</sup> Stress-induced increases in norepinephrine, dopamine, and corticosterones, specifically, were inhibited by EA, a process blocked by the opioid receptor

antagonist, naloxone, suggesting that EA effects on the release of neurotransmitters are likely to be mediated through endogenous opioids.<sup>18</sup> Similar results were observed in a number of animal studies examining acupuncture analgesia.<sup>19-23</sup> It is interesting to note that using the so-called “bi-digital o-ring test imaging technique,” researchers found that each meridian was connected to a representative area in the cerebral cortex,<sup>24</sup> suggesting that the meridian system, as defined in the theories of Chinese medicine, might overlap with distinct brain regions.

The functional significance of acupuncture-induced changes in neurotransmitters has been clearly indicated in a number of studies. For instance, EA at different frequencies (2, 10, or 100 Hz) elicited reliable analgesic effects and such effects could be at least partially blocked by a serotonin receptor antagonist (SRA).<sup>25</sup> The effects of acupuncture on neurotransmitter release may depend on EA frequency because many brainstem regions can be selectively activated by EA at both 4 Hz and 100 Hz, whereas other regions can only be activated by EA at 4 Hz. Interestingly, the analgesic effect of EA at 4 Hz is mediated through endogenous opioids,<sup>26</sup> while the analgesic effect of EA at 2 Hz may involve substance P as its mediator.<sup>27</sup>

Besides its effect on acupuncture analgesia, EA-induced modulation of neurotransmitter release may also mediate other therapeutic effects of acupuncture. There is evidence that EA at 100 Hz protects axotomized dopaminergic neurons from degeneration by suppressing axotomy-induced inflammatory responses,<sup>28</sup> raising the possibility that acupuncture may be used to treat certain neurological disorders such as Parkinson’s disease.<sup>29</sup> Another study revealed that the excitatory effects on gastrointestinal motility following EA or moxibustion in rats was abolished by serotonin inhibitors,<sup>30</sup> indicating that serotonin may be a critical mediator of many acupuncture effects such as gastric emptying and analgesia. Similarly, the reduced production of nitric oxide within the gracile nucleus after acupuncture has been shown to reverse bradycardia.<sup>31</sup>

## CURRENT CLINICAL DATA ON ACUPUNCTURE FOR PAIN CONDITIONS

Although acupuncture has gained much public and medical professional recognition over the last several decades, its application and overall efficacy remains a subject of debate. Clinical trials on the efficacy of acupuncture have unique issues such as individualization, placebo controls, and the crossover design. Nevertheless, an increasing number of clinical trials has provided positive information, particularly on its role in clinical pain management. It is encouraging that more randomized, controlled clinical studies have replaced anecdotal case reports. Some of the trials examining clinical pain conditions (eg, low back pain, neck and shoulder pain, and headache) are discussed below.

### *Low back pain*

Chronic low back pain is a common health problem associated with high medical expenses and disability. Although there are many medical treatment options, their long-term effects remain limited. Recently, acupuncture became one of the most frequently used alternative therapies for treating low back pain. In a randomized, placebo-controlled, clinical trial with a 9-month follow-up period, Leibing et al recruited 131 patients

who had non-radiating low back pain for at least 6 months. They were divided into 3 groups (control, acupuncture, or sham acupuncture). Patients in the control group received only physical therapy for 12 weeks, while those in the other 2 groups received 20 sessions of either acupuncture or sham acupuncture, in addition to physical therapy over 12 weeks. The results indicated that acupuncture was superior to physical therapy for reducing pain intensity, pain-related disability, and psychological distress. When compared with sham acupuncture, acupuncture was also superior in reducing psychological stress.<sup>32</sup> A similar outcome was observed in a prospective, randomized, controlled study involving 124 patients over a 3-month follow-up period.<sup>38</sup>

Another study demonstrated that orthopedic patients treated with acupuncture for chronic low back pain had long-term benefits. Fifty patients were observed during 8 weeks of acupuncture. The benefits observed included the return to work, improved quality of sleep, and reduced use of analgesics, lasting up to 6 months.<sup>33</sup> Both acupuncture and transcutaneous electrical stimulation (TENS) had significant effects on pain management, but acupuncture was more effective than TENS in improving lumbar spine range of motion.<sup>34</sup> In addition, the duration of acupuncture in a single session appears to be an independent parameter critical to treatment outcome. For example, a 30-minute session was more effective than a 15-minute session; however, a 45-minute session did not further improve outcome.<sup>35</sup>

### *Chronic neck and shoulder pain*

The results of treating chronic neck and shoulder pain using acupuncture are promising. In recent studies, acupuncture had a prolonged effect (for at least 3 years) on reducing chronic pain in the neck and shoulder, with a concomitant improvement in pain-related activity impairment, depression, anxiety, sleep quality, and quality of life.<sup>36,37</sup> These results are supported by other clinic trials (with sample sizes of 115 to 177 patients), in which acupuncture was used to treat chronic neck pain. These trials demonstrated that acupuncture was superior to controls in reducing neck pain and improving range of motion.<sup>39-43</sup> Acupuncture has been shown to be effective in treating balance disorders caused by cervical torsion after whiplash injury.<sup>44</sup> Since whiplash is often associated with chronic neck and shoulder pain, these data suggest that acupuncture may be a promising alternative approach for these injury-related conditions.

### *Headache*

Despite recent advancements in the diagnosis and treatment of different headache disorders, they are still a common reason for patients to seek medical assistance. Although selective SRAs (eg, sumatriptan) have effectively treated millions of migraine sufferers, 30% do not respond to SRAs. Alternatively, acupuncture has become a new modality of treatment for patients suffering from tension headache, migraine, and other types of headaches.<sup>45</sup> For many, acupuncture provides similar, if not better, efficacy than sumatriptan in preventing a full migraine attack and also has unique benefits over SRAs because there are minimal side effects.<sup>46</sup> As a prophylactic treatment for migraine without aura, repeated acupuncture treatments for 2-4 months

result in a significantly lower number of attacks than oral therapy with flunarizine.<sup>47</sup> These clinical outcomes appear to be well-supported in a comprehensive review that included 27 clinical trials evaluating the efficacy of acupuncture in the treatment of primary headaches (migraine headache, tension headache, and mixed forms). It concluded that the majority of these clinical trials (23 of 27 trials) showed acupuncture to be favorable in the treatment of headaches.<sup>48</sup>

### Other pain conditions

Several studies have demonstrated that patients receiving acupuncture prior to surgery have a lower level of pain, reduced opioid requirement, a lower incidence of post-op nausea and vomiting, and lower sympatho-adrenal responses.<sup>49-52</sup> Acupuncture also has been used for pain management during labor. Parturients (90 patients in one study) who received acupuncture during labor had a significantly reduced need for epidural analgesia and better relaxation and there were no negative effects on delivery as compared to the control group.<sup>53,54</sup>

Another active area of clinical acupuncture is the treatment of knee osteoarthritis. Acupuncture has been shown to provide some improvement in function and pain relief as compared to sham acupuncture or controls.<sup>55</sup> In addition, acupuncture was beneficial in treating fibromyalgia and rheumatoid arthritis in several clinical trials (albeit with small numbers), suggesting that large-scale clinical trials on these pain conditions may be warranted.<sup>56</sup> Similarly, chronic lateral epicondylitis (tennis elbow) may benefit from acupuncture treatment, in part due to its effect on improving range of motion and reducing pain on exertion. In some cases, the effects of acupuncture on tennis elbow lasted up to 1 year after 10 sessions of acupuncture.<sup>57,58</sup> Table 1 lists the recommended clinical pain conditions treatable by acupuncture.<sup>3</sup>

### OTHER USES OF ACUPUNCTURE

Acupuncture has been used for the treatment of many conditions in addition to pain. For example, a number of clinical trials strongly support its therapeutic role (either needle acupuncture or applying acupressure to relevant acupoints) in postoperative nausea and vomiting, as compared to antiemetics (eg, droperidol and zofran).<sup>59</sup> An increasing number of patients are turning to acupuncture, either to supplement, or replace conventional treatment for depression, anxiety, obesity, spinal cord injury, insomnia, premenstrual syndrome, menopause symptoms, infertility, allergy, smoking cessation, and detoxification from opioids or other drug addictions, as summarized in a document published by the WHO in 2002.<sup>3</sup>

### COMPLICATIONS RELATED TO ACUPUNCTURE

The NIH consensus panel on acupuncture states that the documented occurrence of adverse events in the practice of acupuncture is extremely low. The most commonly reported complication is bruising or bleeding at the needle insertion site, followed by the incidence of a transient vaso-

**TABLE 1: Pain conditions that may or may not benefit from acupuncture**

#### Acupuncture has been shown to be effective for these conditions in controlled trials

- Headaches
- Knee pain
- Low back pain
- Neck pain
- Dental pain and temporomandibular dysfunction
- Facial pain and craniomandibular dysfunction
- Postoperative pain
- Rheumatoid arthritis
- Arthritis of the shoulder
- Renal colic
- Tennis elbow
- Sciatica
- Sprain

#### The therapeutic effect of acupuncture has not been confirmed for these pain conditions

- Abdominal pain (acute gastroenteritis or acute gastrointestinal spasm)
- Cancer pain
- Earache and pruritus
- Eye pain due to sub-conjunctival injection
- Fibromyalgia and fasciitis
- Labor pain
- Pain due to endoscopic examination
- Pain due to thromboangiitis obliterans
- Chronic prostatitis
- Radicular and pseudoradicular syndrome
- Reflex sympathetic dystrophy
- Acute spine pain and stiff neck

vagal response. Other complications include infection, dermatitis, and broken needle fragments. It is estimated that the average occurrence of adverse consequences with acupuncture treatment is about 50 cases per year in a 20-year period. However, since acupuncture is an invasive medical intervention, serious complications such as pneumothorax, hemothorax, organ puncture, and pericardial effusion, may occur if the treatment is not properly administered. These more serious complications often occur in older and debilitated patients with complex co-morbidities or in the hands of less skilled practitioners. Thus, it is important to follow the standards for acupuncture training that include the strict requirement of a knowledge of anatomy and sterile techniques.

### PERSPECTIVES AND FUTURE DIRECTIONS

In recent years, an increasing number of physicians have integrated acupuncture into their practices. Many medical schools in the United States have already added courses on integrated (alternative) medicine. Third-party reimbursements for alternative therapies also have increased because of the increasing demand from patients. To face the ever-growing healthcare cost in the United States, more health insurance providers have begun to emphasize preventive measures and alternative therapies. Moreover, the National Center for Complementary and

Alternative Medicine (NCCAM) has funded a good number of research projects related to acupuncture.

Despite positive developments in the use of acupuncture as an alternative treatment modality, current clinical research into this treatment still faces a number of challenges. First, although many studies on acupuncture treatment have been published, the scientific merits of some are limited by study design and nonstandardized acupuncture practices. Second, it may be difficult to maintain true blinding to patients in a clinical trial. Non-specific needling (ie, placing an acupuncture needle at an acupoint not intended for the treatment) or sham needling may elicit responses similar to responses to active acupuncture treatment, making it difficult to interpret the trial results. Furthermore, it will be difficult to exclude a placebo effect in many clinical acupuncture trials. Third, a clinical acupuncture treatment plan is often highly individualized for a given condition, which varies from one practitioner to another. As such, it is rather difficult to compare the treatment outcomes if a given clinical condition is treated according to various parameters, including the choice of acupuncture points, needling techniques (eg, EA versus manual), duration of acupuncture in one session, and between-session intervals. Nonetheless, efforts should be made to standardize acupuncture clinical trials in order to improve their scientific merits. It is anticipated that complementary medicine, including acupuncture, is likely to play a growing and positive role in pain management.

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## Upcoming Scientific Meetings

11-14 January 2006

### The 7<sup>th</sup> International Conference on Pain and Chemical Dependency

International Medical Press

Brooklyn, New York

CONTACT: Shameeka Ayers

Organizing Secretariat

Tel.: 404/443-1532

Fax: 404/506-9393

Website: [www.painandchemicaldependency.org](http://www.painandchemicaldependency.org)

3-4 March 2006

### The Sixteenth Annual HCNE Headache Symposium

Headache Cooperative of New England

Stowe, Vermont.

CONTACT: Dr. Sheldon Gross

Tel.: 860-232-4344

Fax: 860-242-7725

Website: [www.hacoop.org](http://www.hacoop.org)

4-5 April 2006

### AAMA Review Course

(American Academy of Medical Acupuncture)

Marriot Wardman Park Hotel, Washington, DC

CONTACT: Tel.: 323- 937-5514

E-mail: [jdowden@prodigy.net](mailto:jdowden@prodigy.net)

Website: <http://www.medicalacupuncture.org/events/eventscalendar.html>

3-6 May 2006

### American Pain Society – 25<sup>th</sup> Annual Scientific Meeting

San Antonio, TX

CONTACT: Website: [www.ampainsoc.org](http://www.ampainsoc.org)

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