

# Acupuncture Is All Placebo and Here Is Why

Brian E. McGeeney, MD, MPH

**Background.**—Alternative and complementary medicines such as acupuncture remain popular with the general public and many clinicians. The term “integrative medicine” is often now used to describe this type of non-science-based medicine, which has become more of a faith-based method of practice, making it harder to challenge. Acupuncture is commonly used to treat headache along with just about any other symptom and condition known to man.

**Discussion.**—Physicians regularly fall into many misunderstandings when erroneously believing a real effect from acupuncture, when there is none. A perfunctory and poorly informed media contribute to the misinformation. Sixteen logical traps are identified which together explain most of the false reasoning behind the alleged effect of acupuncture.

**Conclusion.**—Practitioners need to do a better job of discerning truth from information and data available on acupuncture.

*Key words:* acupuncture, placebo, placebo effect, bias, alternative medicine

*Abbreviations:* fMRI functional magnetic resonance imaging, NCCAM National Center for Complementary and Alternative Medicine, NHST null hypothesis significance testing

Despite over 3500 clinical studies on acupuncture, there is still debate over a true effect.<sup>1,2</sup> That factor alone should alert the reader to the shaky ground upon which acupuncture rests. The term acupuncture covers not just needling, but may also refer to the application of pressure, electrical stimulation, heat, laser, and, possibly, more variations in the future. Colquhoun and Novella discuss why acupuncture is theatrical placebo in their 2013 article and provide a much-needed critique.<sup>2</sup> An earlier editorial in *Pain* concludes similarly.<sup>3</sup> There is now a wasteful and alarming trend of subjecting many alternative medicine disciplines with no scientific rationale to randomized controlled trials, the results of which are of little value.<sup>4</sup> Much federal tax money has been spent on acupuncture studies because of popularity, despite the absence of a good scientific rationale. An uncritical and sensationalist media only furthers the misinformation with regular specious reporting. Practitioners should adjudicate acupuncture by the totality of evidence, and not with isolated clinical studies.

Acupuncture works by placebo mechanisms only.<sup>2,4</sup> What is left to decide is whether this effect is large enough to be clinically useful and whether there are ethical barriers for clinicians when

recommending acupuncture. Safe treatment modalities are needed to coax along clinical improvement, and that may include acupuncture, particularly if patients desire this approach. However, there is no role for the cruel practice of acupuncture on children (at least below the age of understanding) or on animals.<sup>5</sup> Disturbing numbers of physicians advocate for acupuncture with the belief that there is an effect above placebo.

In explaining why acupuncture is just placebo, it is important to go further than just stating reasons why. One should explain how to deconstruct the arguments from acupuncture proponents. The following logical traps may help to achieve both these aims.

## DISCUSSION OF LOGICAL TRAPS

### Scientific Basis for Acupuncture

The acupuncture explanatory narrative is focused on linear pathways on the body known as meridians where life energy, known as Chi, flows.<sup>2</sup> This is prescientific gobbledygook. There is no scientific rationale from which meridians and Chi arise, so one cannot attempt to refute as a true scientific hypothesis. Such theory becomes an issue of faith, which has no place in science. The logical trap, then, is to be at least undecided on meridians and Chi, when it does not deserve even an agnostic position. Unfortunately, this lack of biological plausibility is often lost in assessing the meaning of acupuncture clinical studies.

## POPULARITY

### Argument From Antiquity

Protean arguments and manuscripts on acupuncture are quick to voice the argument from antiquity, namely that acupuncture has been around for thousands of years. Although this is a fascinating historical point, it does not constitute an argument for proof of a true effect at all. Blood-letting was the most common medical practice performed by surgeons from antiquity until the late 19th century, when it went out of favor. Interestingly, acupuncture was in decline for 1000 years in China, and even banned from the Imperial Medical Academy by Emperor Dao Guang in 1822.<sup>2</sup> We are familiar with it today because of Chairman Mao Zedong's revival of acupuncture from 1966 on, instigated primarily for nationalistic reasons and to address a physician shortage.<sup>2</sup>

### Personal Testimony

Individual subject experiences are useful to generate hypotheses, always taking into account prior probabilities. The mistake is to interpret individual responses as constituting a strong argument in favor of acupuncture. Further, the prior probability of a true effect is negligibly low. No matter what treatment is

From the Department of Neurology, Boston Medical Center, Boston University School of Medicine, Boston, MA, USA.

Address all correspondence to B.E. McGeeney, Department of Neurology, 715 Albany Street, Boston, MA 02118, USA.

Accepted for publication January 7, 2015.

Headache

© 2015 American Headache Society

*Conflict of Interest:* None.

*Financial Support:* None.

administered, it is impossible in individual cases to separate natural history and the placebo influences from any purported medical benefit.

### Argument From Popularity

There is no doubt that acupuncture has been very popular for a number of decades and may be increasingly popular. Acupuncture is available in many academic medical centers, alongside science-based medicine. In no way does availability constitute evidence of effectiveness, just of popularity. Natural history and placebo mechanisms will do the rest.

### More Patient Centered

The argument that acupuncture is more “holistic” or patient centered, and therefore inherently better and more likely to work than traditional medicine, is false. As Colquhoun and Novella point out, this is an insult to good physicians everywhere who are always empathetic and patient centered.<sup>2</sup>

## STUDY INTERPRETATION

Many clinicians have limited ability to scrutinize and interpret scientific articles, a problem increasingly important in the acupuncture debate. Factors responsible for a clinical outcome beside a true biological effect of an intervention are underappreciated. This challenge pervades science, as readers of manuscripts are often unable to properly balance study strengths and weaknesses and recognize unwarranted assumptions and conclusions. Unctuous complementary and alternative medicine academic journals have also proliferated. Only properly controlled studies can legitimately be considered as evidence. All else does not constitute proof but may be hypothesis generating. Within the controlled studies, there remain many potential biases and random effects that can obfuscate truth.<sup>6</sup> Opinion should be drawn from the totality of evidence about acupuncture and not selected studies.

Particularly in recent years, proponents of acupuncture have used positive controlled studies as their main evidence of true effect, where a necessary understanding of biases and random effects are needed for refutation.<sup>1</sup> Furthermore, misinterpretations of null hypothesis significance testing (NHST) tend to favor the therapy under investigation.<sup>7</sup> Strictly NHST cannot prove that an effect from acupuncture is precisely zero, but can only demonstrate non-significant results.

### Underestimating the Placebo Response

A clinical outcome is the summary result of any direct true physiological effect of an active intervention, natural history of what would have happened without the intervention (including regression to the mean), and the influence of expectations and conditioning, along with biases on the part of physicians and the subjects/patients. The term placebo response is often used to collectively refer to effects other than the direct biologically active mechanism. The placebo effect generally refers to the outcome

due to the meaning of the intervention, that is, the expectations and conditioning in a subject who is aware of the intervention, and excludes natural history. The scope and extent of these mechanisms is underappreciated.<sup>6</sup> Of note, many authors do interchangeably use the terms placebo effect and placebo response.<sup>6</sup> Outcome in uncontrolled and controlled but not properly blinded studies can all be explained by these mechanisms. Linde and colleagues performed randomized controlled trials with acupuncture in migraine and tension-type headache, as well as other pain studies.<sup>8</sup> Subjects with higher expectations from acupuncture had larger clinical improvements, regardless of their allocation to real or sham acupuncture. In 2005, Linde and colleagues published a high-quality randomized controlled trial with acupuncture, sham acupuncture, or no acupuncture for prevention of migraine.<sup>9</sup> Sham acupuncture involved needling non-acupuncture sites. Both acupuncture groups had a robust decline in migraine frequency and were not significantly different. The hefty improvement with acupuncture can be put down to placebo factors. This study has been replicated.<sup>10</sup> Acupuncture proponents will point out that there are similar studies where real acupuncture was better than sham, both improving notably, such as Li and colleagues, but when differences were found, they were minor only.<sup>11</sup> The outcomes here are placebo also.<sup>12</sup>

Recently, Zheng and colleagues in their article “Is acupuncture a placebo therapy?” published in *Complimentary Therapies in Medicine* concluded that current research data convincingly show that most of acupuncture’s observed clinical benefit is mediated by placebo effects.<sup>13</sup> They regard placebo effects as clinically relevant, possibly due to the elaborate and invasive nature of acupuncture.

### Not Appreciating That Procedures Have a Superior Placebo Effect

Various studies demonstrate that on average, placebo responses to procedures are larger than placebo responses to oral medications. Famous examples include ligation of the internal mammary arteries for angina, and arthroscopic surgery for osteoarthritis of the knee.<sup>14,15</sup> Both procedures eventually had sham surgery-controlled trials demonstrating robust improvement in both the true intervention and sham intervention. Without the properly controlled trials, few physicians would believe that such a beneficial effect could be the result of a placebo intervention. The placebo response in subcutaneous sumatriptan trials for migraine was higher than the placebo response in trials of oral medications, and this difference was statistically significant in a meta-analysis of 22 clinical studies.<sup>16</sup> Comparing acupuncture to non-procedure therapies in clinical studies is not useful, as blinding is absent.

### Not Appreciating the Extra Biases in Subjective Outcomes

Subjective outcomes such as headache are notoriously vulnerable to influence, whereas harder clinical outcomes such as death or blood test parameters are more stable.

### The Blinding Problem

Randomized placebo-controlled studies attempt to hide assignment status from subjects. If a participant can guess more likely than not their assignment, then outcomes can and are driven in part, at least, by patient expectations and conditioning, in addition to any biological effect of the active intervention.<sup>17</sup> A positive controlled study of an inert intervention such as acupuncture may purely be the result of less than perfect blinding. To address this, investigators should be required to assess participants' perceived assignment, and analyze based on perceived assignment and not just allocated assignment. Concealment of assignment is assessed in some of the better acupuncture studies. Even with that, the practitioner administering the acupuncture may not be blinded, depending on the sham used, and that alone can influence results. Procedures are harder to properly blind, although there are plenty of techniques now used in acupuncture.

### "P" Worship

Those unaccustomed to statistical methods tend to gravitate to the *P* value as the determinant in a study, de-emphasizing the effect measure and methods, oblivious of prior probabilities, wrongly interpreting the *P* value as a measure of the strength of the relationship, and not least wrongly interpreting the *P* value in a positive study as the probability that the association is incorrect (in order to calculate the *P* value the probability of the null hypothesis is taken as 1).<sup>7,18</sup> The seductive false certainty of significance draws attention away from more fundamental concepts and gives a positive result more meaning than it deserves. This point ties in with the next logical trap.

### Misinterpretation of Positive Acupuncture Studies

The logical trap here is to believe that if acupuncture has no true effect, there cannot be positive controlled studies. There are many positive studies with acupuncture, and many negative. The more scientifically rigorous the study, the more likely it is not to favor acupuncture. Practitioners are trained to take the results of studies in isolation, and the importance of prior probability is minimized, when the best approach is to compute the known information collectively. It is critical and vastly underappreciated that practically all positive studies of improbable events are false.<sup>19</sup> The reasons are a mixture of biases and random effects, powerfully explored in the Ioannidis paper "Why Most Published Research Findings Are False."<sup>19</sup>

### Meta-Analysis Shortcomings

Summarizing large amounts of varied clinical data is controversial but can be helpful.<sup>20</sup> A worthy goal of meta-analyses is to produce a more precise and reliable result, as random effects are reduced. Unfortunately, non-random variation or bias contained in included studies (favoring one direction) can become statistically significant in the summary result. Sun and Gan meta-analyzed 14 sham-controlled studies of acupuncture for chronic headache after careful selection of the best quality studies.<sup>21</sup> Only 3 of those

studies were positive, but adding the results together resulted in a positive (statistically significant) outcome. The relative risk of 1.19 (confidence interval: 1.08-1.30) is not impressive and can be accounted for by small biases in favor of acupuncture. Vickers performed separate meta-analyses of acupuncture for various chronic pains including chronic headache, again with careful inclusion of only the best quality studies.<sup>22</sup> The results of interest compare acupuncture with sham, which was positive in favor of real acupuncture (acupuncture vs non-acupuncture studies are meaningless). The effect measure used is uninterpretable to the general reader and familiar only to statisticians; hence, one is not able to gauge how much of an effect is demonstrated.

### Surrogate Outcomes

The logical trap here is to accept the surrogate outcome as a proxy for true acupuncture beneficial effect. Examples include functional magnetic resonance imaging (fMRI) changes, endorphin release, or connective tissue changes in the region of acupuncture sites among many others. A study will demonstrate that acupuncture is associated with one of these changes (true), as if this was proof that acupuncture has a real clinical beneficial effect. Many interventions can result in such changes, such as slapping you hard across the face. So do placebos! Surrogate outcomes are pointless in the absence of evidence that acupuncture works. This fundamental point is unfortunately lost on many clinicians, as surrogate outcome studies now flow into the literature like a raging torrent.

In recent years, there have been greatly increasing numbers of fMRI studies characterizing changes with acupuncture, some controlled with sham acupuncture. Huang and colleagues reviewed this very heterogeneous literature, involving multiple comparisons (brain regions), demonstrating some variable differences between acupuncture and sham acupuncture.<sup>23</sup> Brain response to acupuncture is identified in somatosensory, affective, and cognitive processing regions. The variability and inconsistent results limit conclusions. Further, a sham with a different sensory or physiological experience or with imperfect blinding can be expected to have differences in fMRI characteristics. Studies using fMRI are used by acupuncture proponents as evidence for a real effect of acupuncture. These surrogate outcomes are not a proxy for a clinical effect.

## ECONOMIC

### Funding

It is a mistake to think that if a study or investigators have external funding, especially federal government funding, they must be doing true science. The National Center for Complementary and Alternative Medicine (NCCAM, a National Institutes of Health Center), formed by advocates for alternative medicine and not for scientific need, has managed to squander over a billion dollars of tax money with practically nothing to show for it.<sup>24,25</sup> The NCCAM was created by a few proponents

who believed in implausible or disproved health claims and felt that the scientific “establishment” was unfairly silencing them. NCCAM is, in effect, an advocacy organization at the taxpayers’ expense. In comparison, the Alliance for Headache Disorders Advocacy helps physicians and patients lobby for increased National Institutes of Health funding for headache medicine, which is underfunded. As an example, cluster headache research has received no federal funding.

### Investigators

Most researchers are dispassionate pursuers of truth. Unfortunately, this is often not the case for acupuncture researchers. Acupuncture is not just a discipline but also a faith, a cultural identity, and a career. These reasons, and possibly the need to challenge skepticism, often result in pervasive bias in acupuncture study manuscripts, such as in the discussion and conclusions. Vickers looked at acupuncture trials from Medline 1966-1995, and 99% of Chinese acupuncture trials showed acupuncture superior to controls!<sup>26</sup> A 1996 report by the World Health Organization on acupuncture periodically rises from the dead by acupuncture proponents and needs to be staked.<sup>27,28</sup> The report was positive and uncritical. Those trusted with writing the report were notably biased Chinese acupuncture proponents, heavily influenced by the Chinese research.

### FINAL TRAP

#### Hidden Giant Cognitive Leap

Despite what we know about acupuncture, clinicians still have a shocking proclivity to accept that for some people, acupuncture works above and beyond just placebo mechanisms. Possibly intended as a conciliatory stand, it is not appreciated that such a position is an enormous cognitive leap, turning the points mentioned above on their head. Reaching a conclusion about the effectiveness of acupuncture should be based on the totality of the evidence as stated. Acceptance of a true biological effect, however small, would be like saying that most sightings of fairies at the end of the garden are false, but uncommonly there are true sightings.

### CONCLUSIONS

Practitioners continue to fall into logical traps, believing that acupuncture has a real effect. Further reasons why practitioners would be favorably disposed to acupuncture include consumerism, giving patients what they want, and magical thinking, where one believes that science is not the only explanatory narrative of the world. This problem is not unique to acupuncture and is seen in other non-scientific alternative medicine therapies which can ride on the coat tails of real science in clinical practice, conferences, and academic journals, the epitome of quackademic medicine.

Responsible clinicians need to speak up and not allow non-scientific medicine to go unchallenged. Journal editors need to

insist on more equitable acupuncture manuscripts. On a conciliatory note, acupuncture research has broadened our understanding of the placebo response. It has been nearly 60 years since Henry Beecher warned of the powerful placebo, which can have “remarkable therapeutic power.”<sup>29</sup> The general population, unaccustomed to the discipline of clinical study and of science itself, will continue to pursue alternative therapies, especially for chronic pain conditions, for which scientific medicine often has limited offerings.

### References

1. Wang SM, Harris RE, Lin YC, Gan TJ. Acupuncture in 21st century anesthesia: Is there a needle in the haystack? *Anesth Analg.* 2013;116:1356-1359.
2. Colquhoun D, Novella SP. Acupuncture is theatrical placebo. *Anesth Analg.* 2013;116:1360-1363.
3. Hall H. Acupuncture’s claims punctured: Not proven effective for pain, not harmless. *Pain.* 2011;152:711-712.
4. Gorski DH, Novella SP. Clinical trials of integrative medicine: Testing whether magic works? *Trends Mol Med.* 2014;20:473-476.
5. Raith W, Urlesberger B, Schmolzer GM. Efficacy and safety of acupuncture in preterm and term infants. *Evid Based Complement Alternat Med.* 2013;2013:739414.
6. Benedetti F, ed. *Placebo Effects.* New York, NY: Oxford University Press; 2009.
7. Kline RB. What’s wrong with statistical tests— and where we go from here. In: Kline RB, ed. *Beyond Significance Testing. Reforming Data Analysis Methods in Behavioral Research.* Washington, DC: APA Books; 2004:61-917.
8. Linde K, Witt CM, Streng A, et al. The impact of patient expectations on outcomes in four randomized controlled trials of acupuncture in patients in patients with chronic pain. *Pain.* 2007;128:264-271.
9. Linde K, Streng A, Jurgens S, et al. Acupuncture for patients with migraine: A randomized controlled trial. *JAMA.* 2005;293:2118-2125.
10. Diener HC, Kronfeld K, Boewing G, et al. Efficacy of acupuncture for the prophylaxis of migraine: A multicentre randomized controlled clinical trial. *Lancet Neurol.* 2006;5:310-316.
11. Li Y, Zheng H, Witt CM, et al. Acupuncture for migraine prophylaxis: A randomized controlled trial. *CMAJ.* 2012;184:401-410.
12. Diener HC. Acupuncture prophylaxis of migraine no better than sham acupuncture for decreasing frequency of headaches. *Evid Based Med.* 2013;18:33-34.
13. Zheng YC, Yuan TT, Liu T. Is acupuncture a placebo therapy? *Complement Ther Med.* 2014;22:724-730.
14. Cobb LA, Thomas GI, Dillard DH, Merendino KA, Bruce RA. An evaluation of internal mammary artery ligation by double-blind technique. *N Engl J Med.* 1959;260:1115-1118.
15. Moseley JB, O’Malley K, Petersen NJ, et al. A controlled trial of arthroscopic surgery for osteoarthritis of the knee. *N Engl J Med.* 2002;347:81-88.
16. De Craen AJM, Tijssen JGP, de Gans J, Kleijnen J. Placebo effect in the acute treatment of migraine: Subcutaneous placebos are better than oral placebos. *J Neurol.* 2000;247:183-188.

17. Hrobjartsson A, Boutron I. Blinding in randomized clinical trials: Imposed impartiality. *Clin Pharmacol Ther.* 2011;90:732-736.
18. Nuzzo R. Scientific method: Statistical errors. *Nature.* 2014;506:150-152.
19. Ioannidis JPA. Why most published research findings are false. *PLoS Med.* 2005;2:e124.
20. Walker E, Hernandez A, Kattan M. Meta-analysis: Its strengths and limitations. *Cleve Clin J Med.* 2008;75:431-439.
21. Sun Y, Gan TJ. Acupuncture for the management of chronic headache: A systemic review. *Anesth Analg.* 2008;107:2038-2047.
22. Vickers AJ. Acupuncture for chronic pain: Individual patient data meta-analysis. *Arch Intern Med.* 2012;172:1444-1453.
23. Huang W, Pach D, Napadow V, et al. Characterizing acupuncture stimuli using brain imaging with fMRI – a systematic review and meta-analysis of the literature. *PLoS ONE.* 2012;7:e32960.
24. Atwood KC. The ongoing problem with the National Center for Complimentary and Alternative Medicine. *Skeptical Inquirer.* 2003;27:3-11. Retrieved on 10/10/2014 from [www.csicop.org](http://www.csicop.org).
25. Kavoussi B. Foolishness or Fraud? Bogus Science at NCCAM. Retrieved 10/10/2014 from [www.sciencebasedmedicine.org](http://www.sciencebasedmedicine.org).
26. Vickers A. Do certain countries produce only positive results? A systematic review of controlled trials. *Control Clin Trials.* 1998;19:159-166.
27. Acupuncture: Review and analysis of reports on controlled clinical trials. World Health Organization 2003. Retrieved on 10/10/2014 from [www.who.int](http://www.who.int).
28. Novella S. The 1996 WHO Acupuncture Report. Neurologica blog. Retrieved on 10/10/2014 from [www.theness.com](http://www.theness.com).
29. Beecher HK. The powerful placebo. *JAMA.* 1955;159:1602-1606.