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Integrative Medicine Research

journal homepage: www.imr-journal.com

Review Article

Modern acupuncture-like stimulation methods: a literature review

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ARTICLE INFO

Article history:
Received 12 August 2015
Received in revised form
23 September 2015
Accepted 24 September 2015
Available online 3 October 2015

Keywords:
acupuncture-like stimulation devices
electrical stimulation
laser stimulation
magnetic stimulation
ultrasonic stimulation

ABSTRACT

Acupuncture therapy has been proved to be effective for diverse diseases, symptoms, and conditions in numerous clinical trials. The growing popularity of acupuncture therapy has triggered the development of modern acupuncture-like stimulation devices (ASDs), which are equivalent or superior to manual acupuncture with respect to safety, decreased risk of infection, and facilitation of clinical trials. Here, we aim to summarize the research on modern ASDs, with a focus on featured devices undergoing active research and their effectiveness and target symptoms, along with annual publication rates. We searched the popular electronic databases Medline, PubMed, the Cochrane Library, and Web of Science, and analyzed English-language studies on humans. Thereby, a total of 728 studies were identified, of which 195 studies met our inclusion criteria. Electrical stimulators were found to be the earliest and most widely studied devices (133 articles), followed by laser (44 articles), magnetic (16 articles), and ultrasound (2 articles) stimulators. A total of 114 studies used randomized controlled trials, and 109 studies reported therapeutic benefits. The majority of the studies (32%) focused on analgesia and pain-relief effects, followed by effects on brain activity (16%). All types of the reviewed ASDs were associated with increasing annual publication trends; specifically, the annual growth in publications regarding noninvasive stimulation methods was more rapid than that regarding invasive methods. Based on this observation, we anticipate that the noninvasive or minimally invasive ASDs will become more popular in acupuncture therapy.

1. Introduction

Stimulation of acupoints and meridians has been an important therapeutic modality in traditional Eastern medicine, and it has also become popular in the West, as its clinical effectiveness has been demonstrated through extensive research. Acupuncture and related modern technologies are increasing in popularity worldwide. According to a 2002 World Health Organization report, acupuncture treatment was shown to be effective in controlled trials of 29 diseases, symptoms, or conditions.[1] However, the safety of acupuncture has engendered controversy with respect to infection, inflammation, and pain management.

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http://dx.doi.org/10.1016/j.imr.2015.09.005

Clinical effectiveness of acupuncture has widely been studied during the past four decades.[2–6] In addition to the demonstrated effectiveness of traditional acupuncture practices, increased demand has arisen for the development of modern acupuncture-like stimulation devices (ASDs), which are simpler to quantify and standardize and are less dependent on the manipulation techniques of individual clinicians.

The first modern ASD dates back to the early 1950s, which was based on electrical stimulation (ES).[7,8] In addition to its long history, ES is the most extensively studied ASD.[9] Recently, however, several types of ASDs have extensively been studied for their clinical effectiveness and noninferiority to manual acupuncture, including laser stimulation (LS)[10] and magnetic stimulation (MS).[11] In this review, we summarize recent studies of popular ASDs. We first describe the most popular types of ASDs, discuss their clinical effectiveness and target symptoms, and finally, discuss the annual research trends regarding popular ASDs.

2. Methods

To analyze the popularity and features of methods for stimulation of acupoints, we searched for studies in the Medline, PubMed, Cochrane Library, and Web of Science electronic databases from their inception to June 2014. First, we searched for studies related to acupuncture or acupoint stimulation, which yielded > 22,000 studies, of which approximately 20,000 were redundant. Among the latter studies, approximately 3000 were related to moxibustion, 1600 to massage (or acupressure), 200 to the cupping method, 5400 to ES, 900 to LS, 700 to MS, and 300 to ultrasound stimulation (US). To narrow the search scope to ASDs, we refined the search to [(acupoint* or "acupuncture point*" or meridian*) and (stimul* or irritat* or excit* or response or respon* or react* or reflex or measur* or diagnos*) and (electric* electro* or magnet* or infrared or IR or laser or ultraviolet or UV or ultraso*) not (rat or monkey or dog or pig or cat or mouse or mice or rabbit or rodent*)]. We excluded laboratory experiments on animals, studies that were not written in English, and reviews. We searched 728 articles obtained from the electronic databases, excluding 489 articles that included studies on animals, manual acupuncture-only clinical trials, non-English-language articles, and review articles by screening the titles and abstracts. A total of 44 studies were excluded from the selected 239 articles because of duplication. Finally, 195 studies met the inclusion criteria and were evaluated in detail. The topics of these 195 articles were ES (133), LS (44), MS (16), and US (2), as shown in Fig. 1. Prior to describing the results of the detailed analysis, we introduce the features and research history of ES, LS, MS, and US in the following sections.

2.1. *Electrical stimulation*

Low electrical impedance and high conductance are recognized as typical electrical properties of acupoints and meridians.[12–14] In the Western hemisphere, the electrical properties of acupoints and meridians have been investigated since the 1950s. In 1958, Niboyet and Mery[15] reported the points with low skin impedance using the Wheatstone bridge, whereas in 1962, Kramar[16] showed that acupoints have high capacitance compared with neighboring points. Voll[7] devised an ES device to apply to acupoints and meridians, thereby establishing a method that was called "electroacupuncture according to Voll." This method of Voll[7] greatly stimulated clinical and research activities associated with ES at acupoints and meridians. In the East in 1956, Nakatani[8] reported that electrical pathways connected the points with low skin resistance and named them "Ryodoraku." Today, ES can be classified into five types: electroacupuncture (EA), transcutaneous electrical acupoint stimulation (TEAS), auricular electroacupuncture (AEA), transcutaneous electrical nerve stimulation (TENS), and electrical heat acupuncture (EHA). EA is an electrical, minimally invasive stimulation technique applied to acupoints. TEAS is an electrical, noninvasive stimulation technique applied to acupoints. AEA is a subtype of EA applied to acupoints of the ear. TENS is an electrical, noninvasive stimulation technique applied to the nervous system (nonacupoints). EHA is similar to EA with the exception that a needle heated by an electric current is used at acupoints. Of the 133 articles on ES, 54 pertained to EA, 69 to TEAS, six to AEA, three to TENS, and one to EHA. To simplify the discussion, we categorized ES into EAs and TEASs, where EAs represented

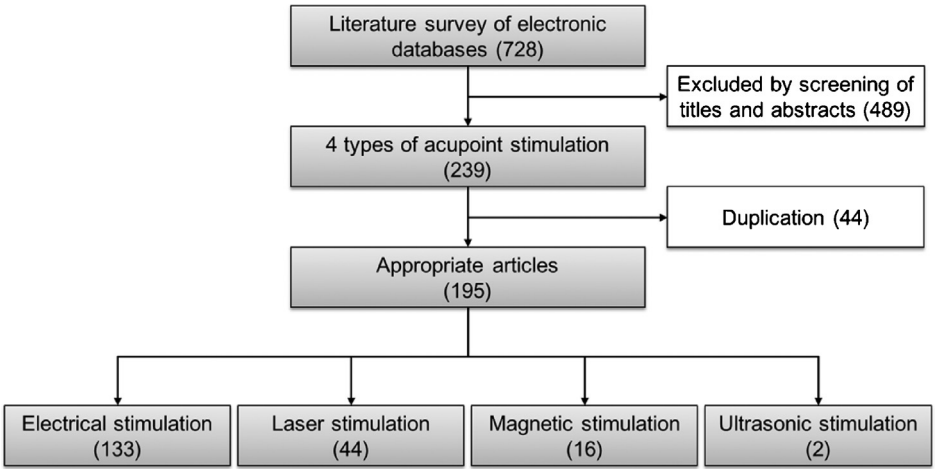

Fig. 1 – Flow diagram of literature survey.