Abstract
OBJECTIVE: To identify global research trends in the use of acupuncture to treat cerebral infarction.
DATA RETRIEVAL: We performed a bibliometric analysis of studies on the use of acupuncture to treat cerebral infarction published during 2002–2011, retrieved from Scopus, using the key words of acupuncture and cerebral infarction or ischemic stroke.
SELECTION CRITERIA: Inclusion criteria: peer-reviewed articles on the use of acupuncture to treat cerebral infarction indexed in Scopus and published between 2002 and 2011; types of publications were original research articles, reviews, meeting abstracts, proceedings papers, book chapters, editorial material, and news items. Exclusion criteria: articles that required manual searching or telephone access; documents that were not published in the public domain; and corrected papers.
MAIN OUTCOME MEASURES: (a) Annual publication output; (b) language of publication; (c) type of publication; (d) key words of publication; (e) publication by research field; (f) publication by journal; (g) publication by country and institution; (h) publication by author; (i) most-cited papers between 2002 and 2006; and (j) most-cited papers between 2007 and 2011.
RESULTS: A total of 160 publications on the use of acupuncture to treat cerebral infarction from 2002–2011 were retrieved from Scopus. The number of publications increased gradually over the 10-year study period; most were written in Chinese or English. Articles and reviews constituted the major types. The most frequent key word used was acupuncture. The most prolific journals in this area were Zhongguo Zhen Jiu and the Chinese Journal of Clinical Rehabilitation. Of the 160 publications retrieved, half came from Chinese authors and institutions. Tianjin University of Traditional Chinese Medicine was the most prolific research institute. Two papers were cited 30 times; they were published in 2002 and 2009, respectively.
CONCLUSION: In the field of neuroscience, there is little literature on acupuncture for cerebral infarction. The most-cited papers were cited 30 times in the past 3 years. We believe that, with advances in the study of mechanisms in neurobiology, research on acupuncture will also advance and will become the concern of more scholars.

Key Words
acupuncture; cerebral infarction; ischemic stroke; cerebral ischemia; hemiplegia; collateral circulation; blood flow; glial cell; Scopus; neural regeneration

Research Highlights
(1) We performed a bibliometric analysis of studies published during 2002–2011 retrieved from Scopus on the use of acupuncture to treat cerebral infarction.
(2) We analyzed the publication year, publication language, publication types, key words, research fields, journals, countries, institutions, authors, and most-cited papers in this field.
INTRODUCTION

Cerebral infarction, also known as ischemic stroke, accounts for about 70% of strokes. Cerebral infarction involves limited necrosis or softening of brain tissue resulting from ischemia and hypoxia caused by bottlenecks in the cerebral blood supply. Cerebral infarction includes cerebral thrombosis, lacunar infarction, and cerebral embolism[1-3]. Cerebral infarction may cause central hemiplegia, hemisensory disorders, movement disorders, or aphasia. Its serious complications may endanger the patient’s life. Since ancient times, acupuncture therapy has been used to treat cerebral infarction. Its efficacy has been widely recognized and confirmed[4-5]. In recent years, researchers have revealed the mechanism of this treatment through clinical research and animal studies, providing a theoretical basis for its use.

The mechanism of treatment of cerebral infarction by acupuncture has two principle aspects. (1) Acupuncture can significantly reduce the infarcted area, accelerate the proliferation and repair of nascent capillaries and glial cells within softened necrotic foci, and reduce edema and inflammatory reactions around the necrotic area[6-8]. (2) After cerebral ischemia, cerebral blood flow rapidly decreases, K⁺ flows out, and Ca²⁺ flows in. This process causes neuronal cells to die[9-11]. Thus, the key to protecting against cerebral ischemic injury is increasing oxygen and blood supply to the brain tissue. Acupuncture is beneficial in the establishment of collateral circulation, alleviating the shortage of blood supply to the ischemic area. As the number of open blood vessels increases, the flow pattern of blood cells improves, thereby accelerating the recovery of ischemic brain tissue.

In this study, we analyzed research trends in the use of acupuncture to treat cerebral infarction, based on a bibliometric analysis of papers indexed in Scopus and published from 2002 to 2011.

DATA SOURCES AND METHODOLOGY

Data retrieval
This study used bibliometric analysis to quantitatively and qualitatively investigate research trends in studies of acupuncture to treat cerebral infarction. We searched Scopus using the key words acupuncture and cerebral infarction or ischemic stroke. We limited the period of publication to 2002–2011 and compiled a bibliography of all articles related to the use of acupuncture to treat cerebral infarction. We downloaded the data on August 10, 2012.

Inclusion criteria
The inclusion criteria were: (1) published peer-reviewed articles on the use of acupuncture to treat cerebral infarction, including original research articles, reviews, meeting abstracts, proceedings papers, book chapters, editorial material, and news items, indexed in Scopus; (2) year of publication was between 2002 and 2011; and (3) citation database was Scopus.

Exclusion criteria
We excluded articles that required manual searching or telephone access, documents that were not published in the public domain, and several corrected papers.

The articles were assessed using the following criteria: (a) annual publication output; (b) language of publication; (c) type of publication; (d) key words of publication; (e) publication by research field; (f) publication by journal; (g) publication by country and institution; (h) publication by author; (i) most-cited papers published between 2002 and 2006; and (j) most-cited papers published between 2007 and 2011.

RESULTS

Output by year of publications relating to acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011
A total of 160 publications on acupuncture for cerebral infarction published in 2002–2011 were retrieved from Scopus. The number of relevant publications increased gradually over the 10-year study period, with four papers in 2002 increasing to 26 in 2011. The number of papers published decreased slightly in 2007, 2008, and 2010 (Figure 1).
Language of publications relating to acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011
Chinese and English constituted the major languages of publications related to acupuncture for cerebral infarction over this period (Figure 2), with 86 papers and 72 papers, respectively.

Table 1 Key words for publications on acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011

| Key word                  | No. of papers |
|---------------------------|---------------|
| Acupuncture               | 125           |
| Article                   | 121           |
| Human                     | 113           |
| Male                      | 102           |
| Controlled study          | 88            |
| Female                    | 83            |
| Brain infarction          | 78            |
| Aged                      | 77            |
| Humans                    | 71            |
| Acupuncture therapy       | 65            |

Type of publications relating to acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011
Articles and reviews constituted the major types of publication (Figure 3), with 138 articles and 14 reviews. The other types were conference papers, letters, articles in press, and short surveys.

Table 2 Research field of publications on acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011

| Research field                                      | No. of papers |
|-----------------------------------------------------|---------------|
| Medicine                                            | 135           |
| Neuroscience                                        | 18            |
| Biochemistry, Genetics and Molecular Biology        | 5             |
| Engineering                                         | 4             |
| Computer Science                                    | 2             |
| Health Professions                                  | 2             |
| Nursing                                             | 2             |
| Chemical Engineering                                | 1             |
| Mathematics                                         | 1             |
| Psychology                                          | 1             |
| Social Sciences                                     | 1             |

Output by journal of publications on acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011
In the period of interest, Zhongguo Zhen Jiu published 28 papers, followed by the Chinese Journal of Clinical Rehabilitation, which published 27 papers. Other prolific journals were the Journal of Acupuncture and Tuina Science, the Journal of Traditional Chinese Medicine, and Acupuncture Research (Table 3).
Output by country and institution of publications on acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011

Analysis of the contributions of different countries/states to publications was based on journal articles in which the address and affiliation of at least one author were provided. A total of 160 articles were analyzed by country and institution. Most papers on acupuncture for cerebral infarction were published in China (88 papers), followed by South Korea (six papers) and the USA (six papers) (Figure 4). Tianjin University of Traditional Chinese Medicine was the most prolific research institute, publishing 13 papers (Table 4). Twelve of the top 13 research institutes publishing in this field were in China; one was in South Korea.

Authors of publications on acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2011

Hongxing Zhang published five papers on acupuncture for cerebral infarction—more than any other author (Table 5). SeokKeun Choi, Ming Liu, Samjin Choi, Xuemin Shi, and Jie Xiong ranked second with four papers. Of these six authors, two were from Kyung Hee University, two from Tianjin University of Traditional Chinese Medicine, and one each from China Agricultural University and Sichuan University.

Highly cited papers on acupuncture for cerebral infarction indexed in Scopus and published from 2002 to 2006 (Table 6)

Of the 60 papers on acupuncture for cerebral infarction cited in Scopus during 2002–2006, the 2002 paper “Intracranial dural arteriovenous fistulas: Analysis of 60 patients” was cited 30 times, more than any other paper. It was published in Cerebrovascular Diseases. Of the 11 most-cited papers, two were published in Zhongguo Zhen Jiu and the remaining nine were published in nine different journals; of these 11 papers, four were published in 2006, three in 2005, and two each in 2002 and 2003.
Highly cited papers on acupuncture for cerebral infarction indexed in Scopus and published from 2007 to 2011

Of the 100 papers on acupuncture for cerebral infarction cited in Scopus, 2007–2011, the 2009 paper “Pretreatment with electroacupuncture induces rapid tolerance to focal cerebral ischemia through regulation of endocannabinoid system”[23] was cited 30 times, more than any other paper. It was published in Stroke. Of the 11 most-cited papers, two were published in Neurological Research and the remaining nine were published in nine different journals; of these 11 papers, four were published in 2008, three in 2009, and two each in 2007 and 2010 (Table 7).

DISCUSSION

This bibliometric analysis, based on Scopus, identified several research trends over the past 10 years in studies of the use of acupuncture to treat cerebral infarction. The number of publications increased gradually over the 10-year study period, but the number was still very little in 2011. Most papers were written in Chinese or English. Articles and reviews constituted the major types. The most frequently used key word was acupuncture. Most papers were in the field of medicine. The most prolific journals in this area were Zhongguo Zhen Jiu and the Chinese Journal of Clinical Rehabilitation. Of the 160 publications retrieved from Scopus from 2002–2011, half came from Chinese authors and institutions. Tianjin University of Traditional Chinese Medicine was the most prolific research institute. Hongxing Zhang from China Agricultural University published five papers—more than any other author. Two papers were cited 30 times; they were published in 2002 and 2009, respectively.

As a traditional Chinese medicine therapy, acupuncture has been used in the treatment of stroke since ancient times[34]. Experiments have proved that acupuncture has a positive impact on the morphology, energy metabolism, and nerve function recovery of rat brain tissue[35-38]. Researchers have investigated the biochemical and morphological mechanisms in recent years[39-41], though the biological basis of these mechanisms is not yet entirely clear. The pathological changes involved in cerebral infarction are extremely complex and our current knowledge is only preliminary and superficial.
Many important components remain to be understood, to strengthen the basis for the use of acupuncture in the prevention and cure of cerebral infarction. Problems in studies of this use of acupuncture include the arbitrariness of the chosen acupoints, the blindness of needling approach, improper application of research methods, and the unilateral of research target, all of which need to be solved in the future[42-45]. Neurobiology, molecular biology, and other basic disciplines are developing and modern medical technology is increasingly involved. We believe that breakthroughs are bound to be made in our understanding of the mechanisms of acupuncture therapy in cerebral infarction in humans, and will improve patients’ recovery.

Author contributions: Jiajun Chen retrieved the references, extracted the data, conceived and designed the study, and wrote the manuscript. Min Yao, Yunhua Zhao, Xiya Jin, and Yuanbing Li retrieved the references, extracted the data, and conceived and designed the study. Lihong Huang contributed to the review, conception and design, paper revision, and study instruction. All authors approved the final version of the paper. 

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