Review Article

Positive Effects of Extracorporeal Shock Wave Therapy on Spasticity in Poststroke Patients: A Meta-Analysis

Peipei Guo, MM,*[,1] Fuqiang Gao, MD,†[,1] Tingting Zhao, MM,†[,1] Wei Sun, MD,† Bailiang Wang, MD,† and Zirong Li, MD†

Background: Spasticity is a common and serious complication following a stroke, and many clinical research have been conducted to evaluate the effect of extracorporeal shock wave therapy (ESWT) on muscle spasticity in poststroke patients. This meta-analysis aimed to evaluate the therapeutic effect on decreasing spasticity caused by a stroke immediately and 4 weeks after the application of shock wave therapy. *Methods:* We searched PubMed, Embase, Web of Science, and Cochrane Library databases for relevant studies through November 2016 using the following item: (Hypertonia OR Spasticity) and (Shock Wave or ESWT) and (Stroke). The outcomes were evaluated by Modified Ashworth Scale (MAS) grades and pooled by Stata 12.0 (Stata Corp, College Station, TX, USA). *Results:* Six studies consisting of 9 groups were included in this meta-analysis. The MAS grades immediately after ESWT were significantly improved compared with the baseline values (standardized mean difference [SMD], –1.57; 95% confidence intervals [CIs], –2.20, –.94). Similarly, the MAS grades judged at 4 weeks after ESWT were also showed to be significantly lower than the baseline values (SMD, –1.93; 95% CIs, –2.71, –1.15). *Conclusions:* ESWT for the spasticity of patients after a stroke is effective, as measured by MAS grades. Moreover, no serious side effects were observed in any patients after shock wave therapy. Nevertheless, our current study with some limitations such as the limited sample size only provided limited quality of evidence; confirmation from a further systematic review or meta-analysis with large-scale, well-designed randomized control trials is required. **Key Words:** Extracorporeal shock wave therapy—muscle spasticity—stroke—meta-analysis.

From the *The Graduate School of Peking Union Medical College, Beijing; and †Centre for Osteonecrosis and Joint-Preserving & Reconstruction, Department of Orthopedic Surgery, Beijing Key Laboratory of Arthritic and Rheumatic Diseases, China-Japan Friendship Hospital, National Health and Family Planning Commission of the People's Republic of China, Beijing, China.

Received March 25, 2017; revision received July 20, 2017; accepted August 13, 2017.

This study was supported by the Beijing Natural Science Foundation (7174346), National Natural Science Foundation of China (81372013, 81672236), and the Research Fund of China-Japan Friendship Hospital (2014-4-QN-29), China-Japan Friendship Hospital Youth Science and Technology Excellence Project (2014-QNYC-A-06).

Address correspondence to Wei Sun, MD, Department of Orthopedics, China-Japan Friendship Hospital, Beijing 100029, China. E-mail: 18901267995@163.com.

[1] Joint first authors.

1052-3057/$ - see front matter

https://doi.org/10.1016/j.jstrokecerebrovasdis.2017.08.019

Introduction

Spasticity is a neurological symptom frequently appearing in patients after a stroke and is defined as a velocity-dependent increase in tonic stretch reflexes with exaggerated tendon jerks due to the hyperexcitability of the stretch reflex.[1] The prevalence of spasticity was reported to be approximately 42%,[2] and permanent contracture and skeletal deformities may occur in a certain group of hypertonic muscles suffering from sustained contraction,[3] leading to a tougher life and a higher medical fee for poststroke patients. Therefore, how to control and treat spasticity after a stroke has been an increasingly essential problem. There were various options for the management of spasticity including physical therapy (cryotherapy, thermotherapy, vibration, and electrical stimulation), oral antispastic drugs (baclofen, tizanidine, dantrolene, and benzodiazepines), chemical nerve blocks (phenol and alcohol), and botulinum toxin injections.[4] But considerable adverse effects of the existing treatments have been found during or after the treatments. For example, systemically administered antispastic drugs may reduce the force of normal muscles and their value may diminish with prolonged use; nerve blocks like phenol often cause skin sensory loss and dysesthesia.[5] In addition, repetitive injections of botulinum toxin may stimulate the formation of neutralizing antibodies, and the inappropriate dosage and incorrect injection sites also challenge the efficacy of this treatment.[6] The previously reported physical modalities either needed a further evaluation of effectiveness or lacked long-term effects.[7,8] Compared with these conventional treatments, extracorporeal shock wave therapy (ESWT) is considered as a safe, effective, practical, and noninvasive method for reducing spasticity. The shock wave is defined as a sequence of single sonic pulses characterized by high peak pressure (sometimes more than 100 MPa), fast pressure rise (<10 ns), and short duration (10 us) and is conveyed by an appropriate generator to a specific target area.[9] ESWT was first introduced in the early 1980s to break up kidney stones.[10] In recent years, shock wave therapy has been reported as the leading choice for the treatment of musculoskeletal diseases such as calcific tendinitis of the shoulder,[11] nonunion of a long-bone fracture,[12] plantar fasciitis,[13] and lateral epicondylitis of the elbow.[14]

Several recent clinical trials have been performed to evaluate the effect of ESWT on muscle spasticity in poststroke patients. Those research adopted different clinical scales, and the follow-up time varied from each other, so it was insufficient to draw a definite conclusion on the effectiveness. Up to now, we only found 1 similar review article published in 2016 by Dymarek et al.[15] This article arrived at the conclusion that the application of extracorporeal shock wave was safe and effective on upper- and lower-limb spasticity in poststroke patients, which was also similar to our conclusion. However, they did not use a meta-analysis, and the date of retrieval was 1 year ago. Therefore, we conducted this meta-analysis to provide a more prudential and convincing conclusion, hoping to bring some evidence to the application of extracorporeal shock wave for spasticity in poststroke patients.

Material and Methods

This meta-analysis was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[16] reporting guidelines for conducting a meta-analysis of intervention trials. In this meta-analysis, we unified the clinical grades using the Modified Ashworth Scale (MAS), which was extensively used and proved to have good validity when evaluating spasticity in patients with stroke.[17,18] The MAS is a velocity-independent clinical method that manually assesses the resistance during a passive movement of a joint with varying degrees of velocity using a 6-grade scale, ranging from 0 (normal muscle tone) to 4 (limb rigid in flexion or extension).[19]

Data Sources and Searches

We searched PubMed, Embase, Web of Science, and Cochrane Library databases to identify relevant studies using ESWT to relieve spasticity in patients after a stroke. The following search terms were used for the initial literature search: (Hypertonia or Spasticity) and (Shock Wave or ESWT) and (Stroke). Articles were not limited to any particular study design, but the language of the publications was restricted to English. The study selection was then independently performed by 2 of the authors, and any different opinions were resolved through discussion. In addition, we checked the reference lists of the articles manually to identify other potentially relevant publications.

Study Selection

Studies were considered eligible if they met the following criteria: (1) the study enrolled patients with muscle spasticity because of ischemic stroke or hemorrhagic stroke; (2) the language of the publications was English; (3) the results of the study were at least evaluated by the MAS, and the baseline and post-treatment results were all provided by or could be transformed into a mean and standard deviation. Studies were excluded if they were animal studies or used ESWT in combination with any other treatments such as botulinum toxin injection and chemical nerve blocks. Articles that reported at least 1 outcome were included, and those without the outcome measures of interest were excluded. Letters, comments, editorials, and practice guidelines were excluded.