Comparative study between transcranial direct current and repetitive transcranial electromagnetic stimulation in the rehabilitation of primary fibromyalgia

Thesis

Submitted for Partial Fulfillment of Master Degree in Physical Medicine, Rheumatology and Rehabilitation

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2020

بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgment

First and foremost, thanks to ALLAH, the Most Merciful.

I wish to express my deep appreciation and sincere gratitude to ***Prof. Dr. Mervat Abd-ELHamid Reda,*** *Professor of Physical Medicine, Rheumatology & Rehabilitation, Ain Shams University, for her close supervision, valuable instructions, continuous help, patience, advices and guidance. She has generously devoted much of her time and effort for planning and supervision of this study. It was a great honor to me to work under her direct supervision.*

I wish to express my great thanks and gratitude to ***Dr. Dalia Mohamed Ezz-Eldin,*** *Ass. Professor of Physical Medicine, Rheumatology & Rehabilitation, Ain Shams University, for her kind supervision, indispensable advice and great help in this work.*

I wish to express my great thanks and gratitude to ***Dr. Mohja Ahmed Abdel-Fattah,*** *Ass. Professor of Physical Medicine, Rheumatology & Rehabilitation, Ain Shams University, for her kind supervision, indispensable advice and great help in this work.*

Last and not least, I want to thank all my family, for their valuable help and support.

Finally, I would present all my appreciations to my patients without them, this work could not have been completed.

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List of Abbreviations

Abb.	Full term

1H-MRS ..... Single-voxel proton magnetic resonance spectroscopy
5-HT3 ..... Serotonin
ACR..... American College of Rheumatology
AMPA .....α amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid
BDI..... Beck depression inventory
BDNF..... Brain-derived neurotrophic factor
CBT..... Cognitive-behavioral therapy
CCK..... Cholecystokinin
CNS..... Central nervous system
COMT ..... Catechol-O-methyl transferase
CSS..... Central sensitivity syndrome
DLPFC..... Dorsolateral prefrontal cortex
DNIC..... Diffuse noxious inhibitory control
EAA..... Excitatory amino acids Treatment
EEG..... Electroencephalogram
FIQ……..Fibromyalgia Impact Questionnaire
EMG..... Electromyography
FDA..... Food and Drug Administration
FM..... Fibromyalgia syndrome.
fMRI..... Functional magnetic resonance imaging
FMS..... Fibromyalgia syndrome
GABA..... γ-aminobutyric acid
GH ..... Growth hormone
HBOT..... Hyperbaric Oxygen Therapy
HD-tDCS ..... High-density transcranial direct current stimulation
HADS……. Hospital Anxiety and Depression Scale

List of Abbreviations Cont...

Abb.	Full term
HPA	Hypothalamic-pituitary-adrenal
IBS	Irritable bowel syndrome
ICD	The International Classification of Diseases
IGF	Insulin-like Growth Factor
LTD	Long-term depression
LTP	Long term potentiation
M1	PRIMARY motor cortex
MADD	Myoadenylate deaminase deficiency
MDD	Major depressive disorder
MEP	Motor evoked potential
NIBS	Non-invasive stimulation
NMDA	N-methyl-D-aspartate
NSAIDs	Non-Steroidal Anti- Inflammatory Drugs
rCBF	Regional cerebral blood flow
RCTs	Randomized Controlled Trials
rTMS	Repetitive transcranial magnetic stimulation
SNRIs	Serotonin-norepinephrine reuptake inhibitors
SPECT	Single photon emission computed tomography
SSRIs	Selective serotonin reuptake inhibitors
SSS	Symptom severity scale
tDCS	Transcranial direct current stimulation
TENS	Transcutaneous electrical nerve stimulation
tES	Transcranial electric stimulation
TMD	Temporomandibular disorder
TMS	Transcranial magnetic stimulation
tRNS	Transcranial random noise stimulation
VAS	Visual Analogue Scale
WPI	Widespread pain index

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INTRODUCTION

Fibromyalgia syndrome (FM) is a common chronic musculoskeletal disorder characterized by the presence of widespread pain and multiple tender points on physical examination Other important accompanying symptoms of FM are fatigue, sleep disturbance, psychological distress, and cognitive disturbance ***(Clauw, 2014).***

Several factors are associated with the pathophysiology of FMS, but the causal relationship is still unclear. This includes alterations of central pain pathways, hyporeactivity of the hypothalamus-pituitary-adrenal axis, increased systemic pro-inflammatory, and reduced anti-inflammatory cytokine profiles, and disturbance in the dopaminergic and serotonergic system ***(McBeth et al., 2007).***

The treatment recommendations were classified as non-pharmacological therapies, pharmacological treatments, and complementary non-pharmacological therapies ***(Macfarlane et al., 2017).***

Drug combinations may be administered in FM patients, who do not respond to monotherapy, under careful observation and with consideration of the adverse effects and majority of patients recommended to use combination of both pharmacological and non-pharmacological therapies ***(Macfarlane et al., 2017).***

Non-pharmacological therapies include patient education, exercises, physical therapy modalities, hydrotherapy, and Cognitive-behavioral therapy (CBT) ***(Nuesch et al., 2013).***

New alternative therapies have been advanced in latest years, one of these new treatments is noninvasive brain stimulation involving transcranial direct current stimulation (tDCS) and transcranial magnetic stimulation (TMS) ***(Castillo et al., 2016).***

Transcranial direct current stimulation (tDCS) is the application of weak electrical currents (1–2 mA) to modify the activity of neurons in the brain. Neuronal firing differs according to the pole located near the cell body and it increases when the positive pole (anode) is located near it and inhibited when cathode stimulation is applied ***(Nitsche et al., 2008).***

The suggested mechanisms of neurophysiological effects induced by tDCS include improvements in regional cerebral blood flow (rCBF), facilitation of synaptic efficacy and expression of neurotrophic factors ***(Fritsch et al., 2010).***

TMS is a non-invasive brain stimulation technique that uses changes in magnetic felids to increase or decrease neuronal activity and Its application is delivered through a magnetic coil placed over the head that transforms electrical current into a magnetic field, which can be focalized to different areas of the brain ***(Lefaucheur et al., 2014).***

The rapidly changing magnetic field travels across the scalp and skull and induces an electric field within the brain

Therefore, induces current to flow in the brain by creating a transmembrane potential and depolarizes underlying superficial neurons, which then induces electrical currents in the brain ***(Horvath et al., 2014).***

The effects of TMS can be acute, intermediate or prolonged depending on the mode of stimulation and area stimulated ***(Amit et al., 2018).***

Repeated low frequency stimulation of a single neuron in culture produces long-lasting inhibition of cell communication while high frequency stimulation can improve communication so we can consider low frequencies (≤1 Hz) can induce neuronal inhibitory function, whereas high frequencies (≥5 Hz) are typically associated with increased cortical excitability ***(Alberto et al., 2018).***

A systematic review of the transcranial electric stimulation (tES) studies on treatment of FM showed that anodal tDCS of motor cortex, that represent the most studied stimulation target, is able to induce significant therapeutic effects on pain measures and/or life quality in FMS patients, as compared to placebo sham tDCS ***(Brighina et al., 2019).***

It was also found in a Systematic review which evaluated the pain reduction effect of rTMS in chronic pain a significant decrease in fibromyalgia pain ***(Hamid et al., 2019).***

AIM OF THE WORK

The aim of the study is to assess the effect of tDCS and rTMS stimulation as Non-invasive brain stimulation techniques in the rehabilitation of 1ry fibromyalgia in order to recommend the best line of rehabilitation.