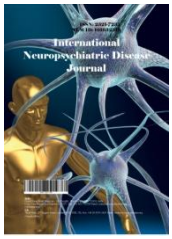

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Transcranial Magnetic Stimulation: New Sapience into How Brain Stimulation Palliates Symptoms of PTSD

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Posttraumatic stress disorder (PTSD) is a chronic, often debilitating psychological state disorder that may develop after a traumatic life event. Most patients get over the initial symptoms naturally, but those that experience persistent symptoms require standard treatment approaches such as 1: 1 psychotherapy, psychotropic medications, or both whichever have relevance. However, there are secondary hindrances such as drug safety and drug tolerability associated with these psychotropic medications, that interdict an appropriate course of treatment. The upshot of those events is that it creates a breach in our potential to properly manage PTSD in a significant number of patients, leaving them endangered to surfacing complications like employment-related incapacities, suicidal ideations, co-morbid medical disorders, and illicit drug abuse. Thus, there is a need for more worthwhile, tolerable, and long-standing approaches. Transcranial magnetic stimulation may be a safe and non-invasive treatment technique used to treat various psychiatric and neurological disorders. This neuromodulation technique involves stimulation of specific deep brain regions by the assembly of high and low-intensity magnetic fields thus filling the therapeutic void. This text mainly focuses on the results of controlled and pragmatic trials for efficacy, safety, and tolerability of patients affected by PTSD. The alternative treatment for PTSD currently is psychotherapy and antidepressant medications.Despite receiving these alternatives, there are about 50% of patients who continue to experience major symptoms..That is, the reason why TMS came out as another suitable option. Atleast 5 directories such as MEDLINE, CINAHL, Psych INFO, SCOPUS and EMBASE were probed to pinpoint pragmatic studies and randomized controlled trials that were

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designed for the treatment of PTSD with TMS. A total of 28 studies were found worthy for this review, out of which 5 are mentioned in this article. Although, so far it looks propitious in spite of the manifoldness as far as its outcomes and its clinical importance are concerned. Hence, still researches involving stimulation constraints are to be conducted in the near future.

Keywords: Antipsychotics; post-traumatic stress disorder; psychotherapy; efficacy; brain stimulation.

ABBREVIATIONS

PTSD: Posttraumatic Stress Disorder (PTSD)
TMS : Transcranial Magnetic Stimulation

1. INTRODUCTION

1.1 Pathophysiology of PTSD

"The development of posttraumatic stress disorder in an individual is linked to a large number of factors. These include experiencing a traumatic event, like a severe threat or a physical injury, a bad experience, combat-related trauma, sexual abuse, interpersonal conflicts, maltreatment, or after a medical illness. Chronic PTSD occurs in patients who are unable to get over the trauma due to maladaptive responses" [1].

"The risk factors for the development of PTSD include biological and psychological factors such as gender (more prevalent in women), childhood adversities, pre-existing mental disease, low socioeconomic status, less education, and lack of social support. Nature and therefore the severity of the trauma is also accountable while determining the risk factors for PTSD" [2-4]. "The pathophysiology of posttraumatic stress disorder involves alterations within the neurotransmitters and neurohormonal functioning" [5]. "Individuals with PTSD have been shown to possess normal to low levels of cortisol and elevated levels of corticotropin-releasing factor (CRF) despite their ongoing stress. CRF stimulates the discharge of norepinephrine by the anterior cingulate cortex, which results in an increased sympathetic response, which manifests as increased pulse, vital signs, increased arousal, and a startle reaction" [6]. Also, some studies have shown altered functioning of other neurotransmitter systems like GABA, glutamate, serotonin, neuropeptide Y, and other endogenous opioids in patients with PTSD. there is a decrease in GABA activity and an increase in glutamate, which stimulates dissociation and derealization. Serotonin concentration is additionally decreased in the dorsal/median raphe, which likely changes the dynamic between the amygdala and hippocampus.

1.2 Pharmacotherapy for PTSD

As per the guidelines of the Australian Center for Posttraumatic Mental Health (ACPMH), consistent with NICE, recommended that pharmacological interventions should not be used in preference to trauma-focused psychological treatment. Other reviews have been more positive about pharmacological treatment, grouping selective serotonin reuptake inhibitors (SSRIs) together and rating them as equivalent to trauma-focused psychological treatments" [7-10]. "A Cochrane review reported strong benefits, but the Institute of Medicine found inadequate evidence to determine the efficacy of pharmacological treatment for PTSD" [11]. However, "there are major differences between the methodological quality of these reviews, making direct comparison problematic" [12]."Given the inconsistent findings of previous meta-analyses and the increasing number of randomized controlled trials (RCTs) of pharmacological treatments, the World Health Organization (WHO) commissioned an update of the information obtained by the most methodologically robust systematic reviews published to date: those by NICE, ACPMH, and the Cochrane Collaboration" [13,14].

1.3 Focal Brain Stimulation for Posttraumatic Stress Disorder

"This technique offers a unique alternative to psychotherapeutic and pharmacologic treatments for psychiatric disorders. Focal brain stimulation interventions are based on a standard that views psychiatric disorders as resulting from dysfunction within a structurally and functionally connected network of brain regions. The most common focal brain stimulation approaches used for the treatment and study of psychiatric disorders include transcranial magnetic stimulation, transcranial direct current stimulation, and deep brain stimulation [15].

Table 1. A compendium of various studies on effects of TMS on PTSD

Sl. No.	Name of Author	Study design	No. of Participants	Duration	Outcome	Side effects	References
1.	K. Leong et al. (2020)	Randomized sham controlled trial	31 p atients	2 weeks	There is much improvements in PTSD symptoms	Suicidal ideations	34
2.	F.A. Kozel et al. [30]	A randomized clinical trial	44 patients	6 weeks	There is a significant improvements in PTSD symptoms	Nil	35
3.	M.-J. Ahmadizadeh, M. Rezaei [31]	A randomized controlled study	384 males patients	4 weeks	There is a significant improvements in PTSD symptoms	Headache	36
4.	D.H. Nam, et al. [32]	A doubleblind, sham controlled study	18 patients	3 weeks	It is an effective and tolerable option for the treatment of PTSD.	Headache, Dizziness	37
5.	E.A. Osuch et al. (2009)	A doubleblind, placebo controlled study	24 patients	2 weeks	Therapeutic effects were positive	Headache	29

Transcranial magnetic stimulation (TMS) is a noninvasive technique that uses a rapidly changing magnetic field, delivered at the scalp surface, to induce an electric current in the underlying cerebral cortex" [16]. "Depending on stimulation location and parameters, TMS can depolarize cortical neurons and have inhibitory or excitatory effects" [17]. "Typically, stimulation is limited to a 2–3 centimeter area of cortex, allowing for stimulation of discrete neural regions; however, due to the rapid decay of the magnetic field strength with distance from the coil, functionally relevant stimulation of deeper cortical and subcortical structures is not feasible with most available devices. Transcranial direct current stimulation (tDCS) is a noninvasive technique that applies a low-intensity electrical current to the brain via an anode and cathode" [18]. "This approach does not directly depolarize neurons but may alter the likelihood that groups of neurons will activate with subsequent provocation. Deep brain stimulation (DBS) is an invasive technique involving the neurosurgical placement of stimulation electrodes within the brain, with the delivery of focal electrical stimulation to a specific deep brain region" [19]. "With DBS, stimulation is controlled by an implanted pulse generator that can be tuned via an external programming wand" [20].

1.4 Role of TMS in the Treatment of PTSD

"TMS is a non-invasive neuromodulatory tool that stimulates neural activity by the use of rapidly alternating magnetic fields. TMS works upon Faraday's law of electromagnetic induction, where the rapidly alternating electric current in the stimulating coil placed over the scalp generates a magnetic field that moves across the skull and produces electric currents in the neural tissue nether. It is able to penetrate the bone of the skull to stimulate activity in the cortical neurons underneath. It was Anthony Berker who primordially introduced TMS in the year 1985 as a sheltered method of examining the central nervous system to stimulate the motor cortex and to assess the human central motor pathways" [21].

Whereas, "repetitive transcranial magnetic stimulation (rTMS) is a newer approach that amends brain activity through a number of repeated changes of the coil's magnetic field both with high (>1 Hz) or low (1 Hz) frequency" [21]. "This leads to fluctuations in the cortical

excitability" [22,23]. "It has been investigated extensively that TMS is a crucial therapeutic tool for many psychiatric disorders, such as bipolar disorders, psychotic disorders, anxiety disorders, obsessive-compulsive disorders and PTSD" [24]. "The role of rTMS in PTSD was explored in the early 1998 [25]. A number of research studies have been conducted since then to support the potential effectiveness of this technique in the treatment of PTSD" [26-29].

2. METHODS

"The study methods have been published previously in a related paper" [27]. In summary, an operationalized search strategy was employed to electronically search five research databases (MEDLINE, CINAHL, Psych INFO, SCOPUS, and EMBASE) using identified keywords and index terms across all the databases to identify evidence-based studies and randomized controlled trials. The key findings are summarized from the various studies and presented in Table 1.

3. RESULTS

All 5 studies revealed that there is a significant positive sequel in PTSD symptoms improvement. These studies also evaluated the effectiveness of various frequencies used in TMS therapy. This method was adroitly tolerated amongst the participants with a few side-effects such as headache, and dizziness. Thus, the therapeutic potential of TMS for treating PTSD as verified from the studies seems sturdy and fruitful.

4. CONCLUSION

Transcranial Magnetic Stimulation (TMS) is a noninvasive procedure that uses magnetic fields to stimulate nerve cells in the brain to improve the cortical function of the brain [33]. TMS is typically used when other treatments haven't been effective. Approximately 50%-60% of PTSD patients who have tried and failed to benefit from SSRI experience a clinically meaningful response with TMS [34].

About one-third of these individuals experience complete remission, and their symptoms completely disappear [35]. Most TMS patients feel better for many months after treatment stops, with the average length of the response being little more than one year [36].The previous research studies have brought tremendous victories by showing a reduction in symptoms and a broad therapeutic effect in PTSD patients [31,37]. A parallel or concurrent use of psychotropic medications also needs to be explored which is considered as one of the SOPs for PTSD [30,32]. The current review suggests researchers to find a more fineness in the various methodologies so as to find more appropriate results to support the therapeutic effects of TMS.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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