Clinical Efficacy of Transcranial Magnetic Stimulation for the Treatment of Major Depression in an Outpatient Setting

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ABSTRACT

Background: Transcranial Magnetic Stimulation (TMS) to the dorsolateral prefrontal cortex (DLPFC) continues to gain traction as an efficacious treatment for patients suffering from treatment-resistant unipolar Major Depressive Disorder (MDD).

Objectives: The purpose of this study is to assess clinical efficacy of TMS on a severely depressed population via the Beck Depression Inventory (BDI-II) and Patient Health Questionnaire - 9 items (PHQ9) scores. An additional goal is to describe distinctions between remitters, responders, and non-responder groups.

Design: 109 patients with treatment-resistant MDD received TMS, administered via the NeuroStar TMS Therapy system in 2015. PHQ9 and BDI-II questionnaires were administered at baseline and weekly throughout treatment.

Results: Patients included 56 females and 53 males with an average age of 45. Average baseline BDI-II score was 38.6 and PHQ-9 score was 19.7. Patients received on average 41 treatments. Overall response rate was 76% (males had a 72% response rate, while females had an 80% response rate); remission rate was 56%. Average BDI-II and PHQ9 point decreases were 23.9 and 12.4, respectively. Even among non-responders, average BDI-II and PHQ9 decline was 9.8 and 4.6, respectively. Differentiating characteristics between remitters, responders, and non-responders were few. Remitters presented with lower average baseline BDI-II scores (36.0 versus 40.5 and 37.6) and underwent higher average number of treatments than responders and non-responders (42.2 sessions versus 31.3 and 37.3, respectively). Response as measured by PHQ-9 was statistically significantly correlated to sex (p=0.01) and number of treatments (p=0.005). BDI-II response rate also correlated with number of treatments (p=0.04). Chi-square analysis demonstrated a statistically significant difference between males and females in response measured with PHQ-9 (p=0.04).

Discussion: TMS demonstrates effectiveness in clinical practice as evidenced by high remission and response rates, as well as large declines in BDI-II and PHQ-9 scores among a severely depressed patient population. Female sex, increased number of treatments, and lower baseline BDI-II may correlate with higher response rate.

INTRODUCTION

Since its FDA approval in 2008, Transcranial Magnetic Stimulation (TMS) to the dorsolateral prefrontal cortex (DLPFC) has effectively and safely treated unipolar depression in diverse patient populations with few complications. Access to and monetary coverage of such treatments continues to be limited, even as the societal burden of depression continues to heighten. As such, it is necessary to continue investigating the efficacy of TMS on patients with major depressive disorder who present in a naturalistic clinical setting. Key factors that may modulate treatment success must also be identified.

METHODS

Within a multi-site outpatient clinic setting, 109 treatment-resistant MDD patients received TMS in 2015 over a period of at least 3 weeks. TMS was administered via the NeuroStar TMS Therapy system, which utilizes an iron core figure-8 coil. Individualized treatment prescriptions for each patient were determined by the attending physician. Each treatment session delivered from 3000 to 5000 total pulses at a maximum of up to 140% of the standard motor threshold (SMT). No seizures occurred among patients. The Patient Health Questionnaire - 9 items (PHQ9) and Beck Depression Inventory (BDI-II) questionnaires were administered prior to the first treatment and then weekly throughout treatment course. Efficacy endpoints include remission and response rates, as well as average point decreases in BDI-II and PHQ-9 questionnaire scores, which were calculated and reviewed retrospectively after treatment conclusion. Remission was defined as a BDI-II score of </= 13 or a PHQ-9 score of </= 4 at any time during the treatment course, while response was defined as at least a 50% reduction in baseline BDI-II or PHQ-9 scores. Average BDI-II and PHQ-9 point decreases were calculated by comparing baseline versus lowest BDI-II and PHQ-9 scores. Additionally, correlation coefficients were generated for the following relationships – achievement of remission or response and age, sex, SMT, and number of treatments. Correlations were also calculated for average psychometric test point decreases (both BDI-II and PHQ9) and age, sex, SMT, and number of treatments. Chi-square analysis was applied to explore any differences in remission/response rates between groups such as male versus female patients and also between age categories. All analysis was completed with Stata version 12 (StataCorp LP, College Station, Texas).
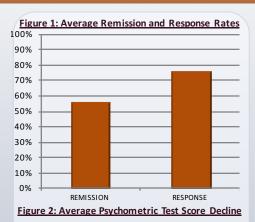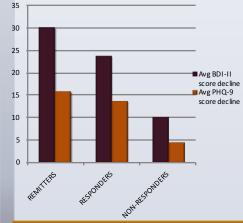
RESULTS

Patient demographics and treatment averages are described in Table 1. Average baseline BDI-II score was 38.6 (range of 10 to 60) and PHQ-9 score was 19.7 (range of 6 to 27), placing the majority of patients within the moderately severe to severely depressed categories. Also, at 0.94 (range of 0.54 to 1.59), average SMT was below the standard median of 1.0. The majority of patients (54%) received bilateral treatment, meaning to both the left and right DLPFC. Overall, response rate was 76% and remission rate was 56% as measured by lowest BDI-II or PHQ-9 score (Figure 1). Average BDI-II point decrease was 23.8 and average PHQ-9 point decrease was 12.5. Even among non-responders, there were average BDI-II and PHQ-9 score decreases of 9.8 and 4.6, respectively (Figure 2). Regarding differentiating characteristics among remitters versus responders and non-responders, there was a lower average baseline BDI-II score (36.0) and higher average number of treatments (42.1) among remitters (Table 1). The correlation coefficient between response as measured by PHQ-9 and sex was significant (p=0.01) and the chi-square analysis also showed a significant difference in PHQ-9 response between males and females (p=0.04). Male response rate (includes remitters and responders) was 72%, while female remission rate was 80%. Additionally, there was a significantly positive correlation between remission/response rate (as measured by both PHQ-9 and BDI-II) and number of treatments (p=0.04 for BDI-II and p=0.005 for PHQ-9). All other chi-square analyses and correlation coefficients were non-significant.

Figure 1: Average Remission and Response Rates

Figure 2: Average Psychometric Test Score Decline

Table 1: Characteristics of Patient Population

	Avg Age	Avg SMT	Avg no. of Tx	Avg Baseline BDI-II	Avg Baseline PHQ9	Avg BDI score decline	Avg PHQ9 score decline
All patients (n =109)	44.6	0.94	40.7	38.6	19.7	23.8	12.4
Females (n=56)	47.7	0.92	42.2	39.3	20.1	24.9	13.2
Males (n=53)	41.5	0.96	39.6	37.8	19.35	23.02	11.89
Remitters (n =61)	45.7	0.93	42.1	36.0	19.0	29.4	15.4
Responders (n =22)	40.6	0.95	40.5	43.5	21.5	25.0	13.5
Non-responders (n =26)	45.6	0.96	37.6	40.3	19.8	9.8	4.6

CONCLUSIONS

Patients treated with TMS achieved high remission and response rates, which translated into large declines in BDI-II and PHQ-9 scores among a primarily severely depressed population. Lack of seizures suggests a relatively safe alternative to medication. TMS efficacy was not differentially modified by factors such as age, SMT, or laterality of treatment. Among this outpatient subset, female sex, number of treatments, and baseline BDI-II score may correlate with treatment success but further analysis and a larger sample size is necessitated for results replication. Higher response rates among females may be explained by higher average number of treatments. TMS has the potential to successfully treat an ever-growing number of patients suffering from treatment-resistant depression, especially when coupled with a high number of treatment sessions.