Case Report

High-frequency Repetitive Transcranial Magnetic Stimulation for Treatment-resistant Social Anxiety Disorder: A Case Report and Literature Review

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ABSTRACT

Objective: Social anxiety disorder (SAD) is characterized by an intense fear of social evaluation and marked avoidance of social situations.

Methods: We report a 25-year-old woman with a two-year history of diagnostic and statistical manual of mental disorders, 5th edition (DSM-5)–diagnosed, treatment-resistant SAD who declined psychotherapy and did not respond to pharmacotherapy. She received 15 sessions of high-frequency (10 Hz) repetitive transcranial magnetic stimulation (rTMS) to the left dorsolateral prefrontal cortex (DLPFC) (100% motor threshold; 40 trains; 2,000 pulses per session).

Results: Symptom severity measured by the social phobia inventory (SPIN), decreased from 59 (baseline) to 27 (post-treatment) and remained at 33 at the three-month follow-up. Clinician-rated clinical global impression (CGI) scores corroborated this substantial improvement. No adverse events were observed.

Conclusion: We place this case in the context of prior reports that used different targets and polarities (e.g. inhibitory medial prefrontal protocols) and discuss the possible mechanisms by which excitatory left DLPFC stimulation may modulate fronto-limbic circuits involved in social threat processing. This single case is hypothesis-generating: while the results are encouraging, limitations include the uncontrolled design, reliance on a primary self-report outcome, and limited follow-up. Controlled trials with standardized clinician ratings and multimodal imaging are required to confirm efficacy and elucidate mechanisms.

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Highlights

- Excitatory stimulation approach contrasts with prior inhibitory methods, suggesting targeted circuit modulation may improve outcomes in treatment-resistant SAD.

- High-frequency rTMS over left DLPFC significantly reduced symptoms in treatment-resistant SAD.

- Sustained symptom improvement after 3 months with no adverse events allow further investigation of rTMS for refractory cases.

Plain Language Summary

In this study, a young woman with severe social anxiety that did not improve with medication or therapy received a non-invasive brain stimulation treatment called rTMS. After 15 sessions targeting a brain region involved in managing emotions, her anxiety symptoms improved dramatically and stayed better for three months with no side effects. While these results are encouraging, larger studies are needed to confirm if high-frequency rTMS works for others with treatment-resistant social anxiety.

Introduction

Social anxiety disorder (SAD), also known as social phobia, is a common anxiety disorder. A recent systematic review and meta-analysis estimated the pooled prevalence of SAD to be approximately 2.1% (95% confidence interval [CI]: 1.2%, 3.8%), indicating a substantial burden across populations (Tang et al., 2022). SAD is characterized by clinically significant fear and anxiety in social situations, particularly when individuals perceive themselves to be evaluated by others. Common autonomic symptoms include palpitations, sweating, tremors, nausea, dyspnea, and blushing. SAD can markedly impair social, academic, and occupational functions. Both genetic and learning factors contribute to the etiology of SAD; heritability estimates in some studies have been as high as 56% (Isomura et al., 2015). Symptom onset often occurs in adolescence and may increase the risk of comorbid conditions, such as depression and substance use disorders (Sadock & Sadock, 2014).

Approximately one-quarter of patients with SAD do not respond adequately to standard treatments (Wittchen & Fehm, 2003), contributing to persistent functional impairment and societal costs (Singleton et al., 2002). Given this treatment gap, novel interventions warrant investigation. Neuroimaging studies suggest altered blood flow and metabolism in the dorsolateral prefrontal cortex (DLPFC) of patients with SAD, with lower DLPFC activity correlating with greater symptom severity (Glassman et al., 2017; Månsson et al., 2013; Qiu et al., 2011). Likewise, reduced activation of parietal and prefrontal regions has been implicated in severe anxiety during socially evaluative tasks. These findings suggest that neuromodulation may alleviate symptoms by targeting dysregulated prefrontal control mechanisms (Pujol et al., 2013).

Transcranial magnetic stimulation (TMS) is a noninvasive method that induces focal electromagnetic fields via a coil placed on the scalp, which generates intracerebral electric currents that can modulate neuronal activity, cerebral blood flow, metabolism, and neurotransmission (McNamara et al., 2001). Repetitive TMS (rTMS) is an established treatment for depression and has been explored for a variety of neuropsychiatric conditions, including anxiety disorders (Jolfaei et al., 2016; Martin et al., 2003; Wassermann & Lisanby, 2001).

Although case reports and small studies have described rTMS for SAD using various targets and polarities, the literature remains heterogeneous and largely uncontrolled. This report contributes to the field by describing (1) a young adult with treatment-resistant SAD who had failed more than two years of pharmacotherapy and declined psychotherapy; (2) an excitatory high-frequency (10 Hz) protocol applied to the left DLPFC (a target commonly used in mood disorders but less frequently reported in SAD); and (3) sustained clinical improvement at three-month follow-up. By contrasting target and polarity choices and documenting functional gains, this case study helps generate hypotheses about optimal neuromodulation strategies for SAD.

Patient Information and Case Presentation

The patient was a 25-year-old single woman who met diagnostic and statistical manual of mental disorders, 5th edition (DSM-5) criteria for SAD based on structured clinical interviews conducted by two board-certified psychiatrists. The symptom duration was approximately two years. Functionally, the disorder prevented her from continuing university studies because she avoided group classes and oral examinations, markedly limited her ability to participate in job or academic interviews, and produced pervasive social avoidance that interfered with daily activities. She had no other psychiatric comorbidities.

Her medication history included fluoxetine 40 mg daily for at least eight months and sertraline 100 mg daily for at least ten months; propranolol 40 mg was used as needed, and short-term alprazolam 1 mg was prescribed for situational anxiety. The treating clinicians considered these regimens insufficient, and the medications were discontinued two months prior to the initiation of rTMS. The patient was offered cognitive behavioral therapy, but she declined psychotherapy.

Written informed consent was obtained for the off-label, experimental rTMS intervention. The baseline clinician global severity rating (clinical global impression–severity [CGIS]) was documented as 6 (markedly severe) in the clinical record.

The patient was informed about the experimental nature and uncertain efficacy of rTMS for SAD and consented to proceed. She had no contraindications to rTMS and was medication-free for two months prior to stimulation.

rTMS Protocol and Outcome Measures

Treatment was delivered using a MagVenture MagPro X100 system (MagVenture A/S, Farum, Denmark) with a figure-of-eight, double 70 mm coil. The left DLPFC was localized using the international 10–20 EEG system (F3). Motor threshold was determined according to standard practice, and stimulation intensity was set at 100% of the resting motor threshold.

Each session consisted of 40 trains of 10 Hz stimulation, resulting in 2000 pulses per session. A total of 15 sessions were administered.

Symptom severity was assessed using the Persian version of the social phobia inventory (SPIN), a 17-item self-report instrument with established reliability in Persian-speaking populations (Abdi, 2003). The baseline SPIN score was 59. The score decreased to 27 at the end of treatment and 33 at the three-month follow-up. Retrospective clinician-rated CGI scores, derived from clinical records and follow-up interviews, supported notable clinical improvement (baseline CGIS=6; post-treatment clinical global impression-improvement [CGII], indicating marked improvement). No adverse events or tolerability issues were reported.

The choice of a 10 Hz excitatory protocol targeting the left DLPFC (100% motor threshold; 40 trains; 2000 pulses/session) was pragmatic and informed by clinical practice in mood and anxiety disorders, where high-frequency left-DLPFC stimulation is commonly used. Reported HF protocols typically range from approximately 1200 to 3000 pulses per session, and treatment courses vary in the number of sessions; we selected a 15-session course as a feasible initial regimen while acknowledging that some trials, particularly in depression, employ longer courses. We present this regimen as hypothesis-generating and consistent with accepted safety and dosing ranges (Oostra et al., 2025).

Discussion

Neurobiologically, SAD has been associated with hyperresponsivity of limbic structures, particularly the amygdala, to social threats and with impaired top-down regulation by lateral prefrontal regions, such as the DLPFC. Excitatory high-frequency rTMS over the left DLPFC may enhance prefrontal control networks, normalize dysregulated fronto-limbic connectivity, and facilitate extinction and learning processes that reduce avoidance in socially threatening contexts. Evidence from TMS–fMRI and resting-state connectivity studies in mood and anxiety disorders supports the capacity of left-DLPFC stimulation to modulate fronto-limbic circuits and reconfigure functional networks (Buhle et al., 2014; Kreifelts et al., 2014; Ritter et al., 2015).

Prior reports of rTMS for SAD have shown heterogeneity in stimulation targets and polarities; some case reports have applied inhibitory protocols to medial or ventromedial prefrontal regions, whereas others have targeted lateral prefrontal areas using excitatory stimulation. The present case contrasts with inhibitory medial prefrontal protocols employing an excitatory left-DLPFC approach and documents clinical and functional improvement that was sustained at three months. These findings are preliminary and suggest that target selection and stimulation polarity are important variables to be explored in future trials (Goldin et al., 2009; Paes et al., 2013; Prater et al., 2013).

The clinical improvement observed in this patient, reflected by large reductions in SPIN score and corroborated by clinician ratings and functional reports, supports the potential of excitatory left-DLPFC rTMS as a therapeutic option for selected cases of treatment-resistant SAD. However, mechanistic conclusions remain speculative without concurrent neuroimaging or neurophysiological measurements.

Recommendations for future research

To determine efficacy and elucidate mechanisms, randomized controlled trials are needed that (1) compare stimulation targets (e.g. left DLPFC vs medial PFC) and polarities (excitatory vs inhibitory); (2) include standardized clinician-rated scales and objective functional measures in addition to self-report instruments; (3) incorporate multimodal imaging or neurophysiologic biomarkers to link clinical response to network-level changes; and (4) assess durability with longer follow-up periods (≥6 months).

Limitations

This study has several limitations. This study described a single case without a sham or control comparison. The primary outcome relied on a self-report measure (SPIN), although findings were corroborated by retrospective clinician ratings and self-reported functional gains. Follow-up was limited to three months, which restricted conclusions about long-term durability. Finally, no neurophysiological or imaging biomarkers were collected for investigation.

Ethical Considerations

Compliance with ethical guidelines

This study was conducted according to the principles outlined in the Declaration of Helsinki and adhered to all relevant ethical guidelines and regulations.

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Authors' contributions

All authors contributed to the design and implementation of the research, analysis of the results, and writing of the manuscript.

Conflict of interest

The authors declared no conflict of interest.

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