https://doi.org/10.48047/AFJBS.6.16.2024.3489-3496

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Emerging Trends in Psychiatric Treatment: Integrating Neuroscience with Mental Health Care

Dr. Mahrukh Ansar, Dr. Lojain, Dr. Nwokeocha Ngozi Vanessa, Dr. Junaid Rasool, Dr. Nazish Khalid, Dr. Noman Johnson, Dr. Farah Naz Tahir

1. MBBS, FCPS (Psychiatry), Senior Registrar, Imran Idrees Teaching Hospital, Sialkot, mahrukh.khan90@gmail.com
2. MBBS, Resident Psychiatrist, Sir Ganga Ram hospital, Lahore, Lojainmaq94@gmail.com
3. MBBS, Changsha Medical University, ngozivanessa76@gmail.com
4. MBBS, FCPS, Assistant Professor of Psychiatry, FMH College of Medicine and Dentistry, Lahore, junaid_sheikh80@yahoo.com
5. Assistant Medical Director, Shalamar Hospital, Lahore, MBBS, MHA, DMRD, nazishkhalid777@gmail.com
6. Assistant Medical Director, Shalamar Hospital, Lahore MBBS, MHA, DMRD nomansardar777@gmail.com
7. Associate Professor
MBBS, MPhil, PhD, Biochemistry Department, Central Park Medical College, Lahore
Email: tahirnazfarah@gmail.com

Volume 6, Issue 16, Dec 2024

Received: 10 Sep 2024

Accepted: 25 Oct 2024

Published: 29 Dec 2024

doi:10.48047/AFJBS.6.16.2024.3489-3496

Abstract

Treatment-resistant depression (TRD) represents a significant challenge in mental health, with limited efficacy from standard therapeutic interventions. This study examines the comparative efficacy of repetitive transcranial magnetic stimulation (rTMS) and a pharmacological combination of mirtazapine and venlafaxine in TRD patients in a low-resource setting. A cross-sectional study was conducted among 500 patients diagnosed with TRD at specialized centers in Pakistan. Patients were assigned to two groups: rTMS (Group A) and pharmacotherapy (Group B). The primary outcomes were changes in Hamilton Depression Rating Scale (HDRS) and Generalized Anxiety Disorder Scale (GAD-7) scores, adherence, and patient satisfaction over six weeks. Results revealed that rTMS resulted in a significantly greater reduction in HDRS (mean change: 14.2 ± 2.5) and GAD-7 (mean change: 8.5 ± 1.8) scores compared to pharmacotherapy (HDRS: 10.1 ± 2.9, GAD-7: 5.9 ± 2.1; $p < 0.001$). Adherence and satisfaction rates were also higher in the rTMS group. These findings underscore the potential of rTMS as a transformative intervention for TRD in resource-constrained environments, providing superior outcomes in symptom relief and adherence. This study highlights the clinical relevance of neuroscience-informed interventions and offers a foundation for future research into scalable, evidence-based solutions for underserved populations.

Keywords: Treatment-resistant depression, repetitive transcranial magnetic stimulation, combination pharmacotherapy

Introduction

Mental health disorders are a leading cause of global disability, with depressive disorders accounting for a substantial proportion of the disease burden worldwide (Vos et al., 2021). Despite advancements in psychopharmacology and psychotherapy, approximately 30% of patients diagnosed with major depressive disorder (MDD) fail to achieve symptom remission, resulting in treatment-resistant depression (TRD) (Berlim et al., 2021). TRD poses significant challenges for healthcare systems, not only due to its complex neurobiological underpinnings but also because of the limited efficacy of traditional treatment modalities in alleviating symptoms.

Emerging neuroscience-based interventions such as repetitive transcranial magnetic stimulation (rTMS) have shown promise in addressing these challenges by targeting dysfunctional cortical circuits implicated in mood regulation (George et al., 2023). rTMS is a non-invasive modality that modulates neural activity through electromagnetic stimulation of the dorsolateral prefrontal cortex (DLPFC). This region plays a critical role in emotional and cognitive control, and its dysregulation has been strongly associated with depressive symptomatology (Lefaucheur et al., 2022). The neuroplasticity hypothesis suggests that rTMS promotes functional connectivity within disrupted neural networks, thereby restoring normal affective and cognitive processing.

While rTMS has demonstrated efficacy in reducing depressive symptoms in high-income settings, its adoption in low-resource environments remains limited due to logistical, financial, and infrastructural barriers (Lee et al., 2023). In Pakistan, where mental health services are already constrained, introducing innovative modalities like rTMS necessitates careful evaluation of their clinical feasibility and cost-effectiveness. Additionally, the absence of standardized protocols and trained practitioners further complicates its implementation in such contexts.

In parallel, combination pharmacotherapy involving agents such as mirtazapine and venlafaxine remains a cornerstone for TRD treatment in resource-limited settings. Mirtazapine, a noradrenergic and specific serotonergic antidepressant, and venlafaxine, a serotonin-norepinephrine reuptake inhibitor, have complementary mechanisms that enhance serotonergic and noradrenergic neurotransmission (Fitzgerald et al., 2023). However, pharmacotherapy is often associated with

side effects that compromise adherence and patient satisfaction, particularly in populations with pre-existing vulnerabilities.

Despite the potential advantages of rTMS and combination pharmacotherapy, direct comparisons of their efficacy in low-resource settings are scarce. Most existing studies focus on high-income countries, where infrastructural and economic conditions differ significantly from those in developing regions. This research seeks to bridge this gap by evaluating the comparative efficacy, adherence, and satisfaction associated with rTMS and mirtazapine-venlafaxine combination therapy among TRD patients in Pakistan.

The study hypothesizes that rTMS will demonstrate superior efficacy in symptom reduction, adherence, and patient satisfaction compared to combination pharmacotherapy. By providing evidence for the clinical utility of rTMS in a low-resource setting, this research aims to inform mental health policies and practices, paving the way for more equitable access to innovative treatments.

Methodology

A cross-sectional study was conducted from January 2022 to December 2023 at Imran idrees teaching hospital sialkot tertiary care centers in Pakistan, focusing on patients diagnosed with treatment-resistant depression (TRD). TRD was defined as failure to achieve a ≥50% reduction in depressive symptoms following trials of at least two antidepressant medications at adequate doses. A total of 500 patients, aged 18–65 years, were recruited via non-probability consecutive sampling. Patients were divided into two groups:

- **Group A:** 250 patients receiving repetitive transcranial magnetic stimulation (rTMS).
- **Group B:** 250 patients on combination pharmacotherapy (mirtazapine and venlafaxine).

Patients with comorbid psychotic disorders, substance use disorders, neurological conditions, or contraindications to rTMS or the prescribed medications were excluded. Inclusion criteria were individuals diagnosed with TRD as per DSM-5 criteria, capable of providing informed consent. Sample size was calculated using Epi Info software, assuming a 95% confidence level, 80% power, and a 10% difference in efficacy rates between groups.

Interventions:

Group A underwent rTMS therapy targeting the left dorsolateral prefrontal cortex (DLPFC), delivered at 10 Hz with a total of 20 sessions over four weeks. Group B received mirtazapine (15–45 mg/day) combined with venlafaxine (75–225 mg/day) for six weeks. Primary outcomes included changes in the Hamilton Depression Rating Scale (HDRS) and Generalized Anxiety Disorder Scale (GAD-7) scores at baseline and after six weeks. Secondary outcomes included adherence (assessed by self-reported completion rates) and satisfaction (measured using a Likert scale). Verbal and written informed consent were obtained from participants. The study was approved by the institutional ethics review boards of participating centers. Data were analyzed using SPSS version 25. Paired t-tests compared pre- and post-intervention scores within groups, while independent t-tests and chi-square tests assessed differences between groups. Statistical significance was set at $p < 0.05$.

Results

Table 1: Demographic Data of Study Participants

Variable	**Group A (rTMS)**	**Group B (Pharmacotherapy)**	**p-value**
Age (years, mean ± SD)	38.6 ± 10.2	39.1 ± 11.1	0.721
Gender (% Male/Female)	56/44	54/46	0.821
Education (% >High School)	72	68	0.564

Explanation: The groups were comparable in terms of age, gender distribution, and educational background, ensuring homogeneity.

Table 2: Efficacy Outcomes

Outcome Measure	**Group A (rTMS)**	**Group B (Pharmacotherapy)**	**p-value**
HDRS Change (mean ± SD)	14.2 ± 2.5	10.1 ± 2.9	<0.001
GAD-7 Change (mean ± SD)	8.5 ± 1.8	5.9 ± 2.1	<0.001

Outcome Measure	Group A (rTMS)	Group B (Pharmacotherapy)	p-value
Adherence Rate (%)	92	78	<0.001

Explanation: Group A demonstrated significantly greater improvements in depressive and anxiety symptoms, as well as higher adherence rates.

Table 3: Satisfaction Levels

Satisfaction Category	Group A (rTMS)	Group B (Pharmacotherapy)	p-value
Highly Satisfied (%)	78	58	<0.001
Moderately Satisfied (%)	18	30	0.002
Dissatisfied (%)	4	12	0.011

Explanation: Patient satisfaction was markedly higher in the rTMS group, supporting its potential as a preferred treatment option.

Discussion

The findings of this study demonstrate that repetitive transcranial magnetic stimulation (rTMS) is significantly more effective than combination pharmacotherapy in alleviating symptoms of treatment-resistant depression (TRD). These results align with emerging evidence from recent studies conducted in diverse clinical settings (Chen et al., 2023 et al; Zhu et al., 2022).

rTMS operates by directly targeting dysfunctional neural circuits in the dorsolateral prefrontal cortex (DLPFC), fostering neuroplasticity and restoring emotional regulation. This mechanistic specificity may account for the greater reduction in HDRS and GAD-7 scores observed in this study. Conversely, pharmacotherapy exerts systemic effects on serotonergic and noradrenergic pathways, which, while effective, may be less precise in modulating cortical dysregulation (George et al., 2023).

A notable aspect of this research is its focus on a low-resource setting, where the implementation of advanced interventions like rTMS faces unique challenges. However, this study underscores the feasibility of rTMS in such environments, supported by high adherence and satisfaction rates. The simplicity of rTMS protocols and their non-invasive nature likely contribute to these outcomes, as also highlighted in global meta-analyses (Fitzgerald et al., 2023).

The findings carry important implications for the mental health policy landscape in developing countries. rTMS represents a promising addition to the therapeutic arsenal for TRD, addressing not only symptom reduction but also patient-centric outcomes such as adherence and satisfaction. Future research should prioritize cost-effectiveness analyses and the development of context-specific implementation strategies to scale up this intervention in resource-constrained settings.

Conclusion

This study highlights the superior efficacy of rTMS over combination pharmacotherapy for TRD in a low-resource setting. It bridges critical gaps in the evidence, demonstrating rTMS's potential to improve depressive and anxiety symptoms, adherence, and patient satisfaction. Future research should explore scalable models for rTMS implementation to ensure equitable access in underserved populations.

References

1. Smith K, Brown J, Thompson L. Advances in the treatment of depression: emerging trends in 2023. J Psychiatry Res. 2023;145:12–19.
2. George MS, Lisanby SH, Avery D. Transcranial magnetic stimulation for depression: state of the evidence. Curr Psychiatry Rep. 2022;24(2):45–55.
3. Fitzgerald PB, Daskalakis ZJ. Revisiting the neurobiology of depression: insights from rTMS. Neuropsychopharmacol Rev. 2023;48:77–90.
4. Zhu H, Sun Z, Zhang Y. Comparative efficacy of rTMS and pharmacotherapy for depression: a meta-analysis. Psychol Med. 2022;52(11):1925–34.
5. Chen W, Zhao Y, Li Q. Targeting the prefrontal cortex: Mechanisms of rTMS in treating depression. Neurosci Bull. 2023;39(8):1045–56.

6. Kim J, Park J, Lee H. Sociocultural barriers to mental health interventions in low-income regions. World Psychiatry. 2022;21(1):25–33.
7. Kumar R, Singh A, Desai V. Evaluating treatment options for TRD in South Asia. Asian J Psychiatry. 2023;65:102921.
8. Blumberger DM, Vila-Rodriguez F, Thorpe KE. Efficacy of different rTMS protocols for depression: a randomized controlled trial. Lancet Psychiatry. 2022;9(1):31–40.
9. Olmos LM, Rocha RB, da Silva FH. Augmentation strategies for treatment-resistant depression: a systematic review. CNS Spectr. 2023;28(3):345–53.
10. Park SH, Lee JY. The role of patient-centered outcomes in evaluating mental health interventions. BMC Psychiatry. 2022;22(1):531.
11. Ramírez FF, Hernandez AM. Cost-effectiveness analysis of rTMS versus pharmacotherapy for TRD. Econ Mental Health. 2022;8(4):235–40.
12. Thomas L, Griffiths R, Jones B. Novel approaches to managing TRD in resource-limited settings. Psychiatric Serv. 2023;74(5):432–40.
13. George MS, Avery DH, Fitzgerald PB. Brain stimulation techniques in depression: from innovation to clinical practice. Trends Neurosci. 2023;46(6):445–55.
14. Fitzgerald PB, Hoy KE, Reynolds J. rTMS: addressing neuroplasticity in TRD. Neurobiol Dis. 2022;170:105711.
15. Chen W, Liu H, Zhang Y. Neuroimaging insights into the efficacy of rTMS in depression. Am J Psychiatry. 2023;180(9):765–75.
16. Tang Y, Li G, Zhang T. Factors influencing patient satisfaction with rTMS. J Affect Disord. 2023;328:234–42.
17. Smith K, Jones L, Patel V. Closing the mental health treatment gap in low-resource settings. Lancet Psychiatry. 2022;9(5):374–81.
18. Pan Z, Liu C, Zhao H. Comparing adherence rates between rTMS and pharmacotherapy: A systematic review. Psychiatry Clin Neurosci. 2023;77(7):475–82.
19. Wong S, Lam R, Chan A. Long-term outcomes of rTMS for TRD. CNS Neurosci Ther. 2023;29(2):198–204.
20. Alavi M, Ghaffari H, Yazdani N. Psychosocial outcomes of brain stimulation therapies in TRD patients. Behav Brain Res. 2023;442:114237.

21. Zhou J, Xie W, Yu T. Cost-effectiveness of implementing rTMS in middle-income countries. Soc Psychiatry Psychiatr Epidemiol. 2023;58(1):25–32.
22. García JR, Hernández V, Alvarez F. Sociocultural factors influencing adherence to mental health treatments. Int J Soc Psychiatry. 2023;69(3):250–60.
23. Wu W, Yang X, Zhao X. Role of rTMS in alleviating anxiety comorbidities in depression. J Psychosom Res. 2023;165:111–20.
24. Fitzpatrick C, Sheehan JD, Mulhern T. Innovations in TRD treatments: Moving beyond pharmacotherapy. Clin Psychiatry Rev. 2023;18(2):78–89.
25. Ahmed F, Khan S, Malik T. Exploring the feasibility of rTMS in low-income settings. Psychiatry Res. 2023;320:114048.