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Magnetic Seizure Therapy for Rapid Relief of Depression Symptoms and Auditory Hallucinations in an Adolescent Patient with Major Depressive Disorder: A Case Report and Literature Review

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Abstract

Major Depressive Disorder (MDD) is a prevalent and severe mental health condition, often complicated by self-harming behaviors and psychotic features in adolescents. This case report describes the successful use of Magnetic Seizure Therapy (MST) in a 17-year-old male adolescent with severe MDD. The patient exhibited depressive symptoms, self-harm behaviors, and auditory hallucinations. Following seven MST sessions over a two-week period, significant clinical improvements were observed. This case supports MST as a promising option for treating complex adolescent MDD, highlighting its potential as an effective alternative or adjunct to traditional therapies. Future research should explore the long-term effects of MST and its broader applicability in adolescent populations.

Keywords: Major Depressive Disorder; Magnetic Seizure Therapy; Adolescent Psychiatry; Auditory Hallucinations; Neuromodulation.

Introduction

Major depressive disorder (MDD) is the most common severe mental disorder, characterized by persistent feelings of sadness, loss of interest in daily activities, and functional impairment [1]. It ranks second in the overall burden of human diseases and is currently the leading single factor contributing to global disability [2,3]. In adolescents, MDD presents with added complexity, often accompanied by self-harming behaviors and psychotic features [4]. Magnetic Seizure Therapy (MST) is a therapeutic method that employs high-intensity magnetic field pulses to stimulate specific brain regions, generating electrical currents through rapid changes in the magnetic field and inducing brief therapeutic seizures to modulate neural activity [5]. MST combines the benefits of Electroconvulsive Therapy (ECT) and Transcranial Magnetic Stimulation (TMS), providing efficacy comparable to ECT while maintaining the safety profile of TMS. Compared to traditional ECT, MST offers more precise control over the seizure area and intensity, thereby reducing unnecessary side effects [6]. This report presents a case of a 17-year-old male high school student who experienced severe depressive symptoms, self-harming behaviors, and auditory hallucinations over a one-year period, leading to significant declines in academic performance and normal social functioning. After being admitted to the Department of Psychology and Sleep Medicine at The Second Affiliated Hospital of Anhui Medical University, the patient underwent evaluation and MST treatment, resulting in significant improvement in depressive and hallucination symptoms. This case report highlights the effectiveness of MST in treating severe depression and its potential as a significant treatment option for adolescent patients.

Method

The patient was treated using twin coil magnetic shock device (Yiruide NS 7000, Wuhan, China). Localization method: The center

of each circular coil was placed over F3 and F4, respectively, using the international 10–20 system for EEG electrode placement. Treatment protocol: Single stimulation trains at 100% machine output were applied at 100 Hz, with progressively escalating train durations (starting at 2 seconds and increasing by 2 seconds each time). The first train duration that induced a bilaterally generalized tonic–clonic seizure was considered the individual's seizure threshold. Subsequent treatment sessions were conducted at a train duration 4 seconds longer than the determined threshold. The stimulation length of this type was used in the first treatment session following the determination of the threshold. If, at any point during the treatment course, the patient experienced a seizure lasting less than 15 seconds, the train length was increased by 2 seconds (up to a maximum of 10 seconds) for all subsequent treatments [7]. This treatment method used in this study has been approved by the Ethics Committee of the Second Hospital of Anhui Medical University (Approval No. SL-XJS2024-097). His legal guardians provided written informed consent to participate.

Case Report

A 17-year-old male, currently in his second year of high school, was admitted to the Department of Psychology and Sleep Medicine, The Second Affiliated Hospital of Anhui Medical University on July 30, 2024. He presented with symptoms of depression and self-harming behaviors, accompanied by auditory hallucinations, which had persisted for over a year. The patient began experiencing depressive symptoms more than a year ago, following his transition to high school. He became increasingly withdrawn, showing reluctance to interact with classmates and encountering difficulties attending school. During this period, he exhibited self-harming behaviors such as biting himself and hitting his head against walls. Additionally, he reported auditory hallucinations, including hearing voices calling his name, discussing him, and making derogatory comments about him while alone in his room. This led to significant distress, pervasive pessimism, and a sense of futility. Since starting high school, his academic performance declined markedly, and he had not attended school for several months prior to his admission to our department. The patient had no history of fever, seizures, coma, or incontinence. His appetite was fair, but he had poor sleep, with early awakening. His bowel and bladder functions were normal. There were no episodes of violence or wandering. He had a history of good physical health, was born full-term via spontaneous vaginal delivery, and his mother's pregnancy was normal. No relevant family history was reported across two generations and three lineages.

On examination, the patient's vital signs were as follows: temperature 36.3°C, heart rate 96 beats per minute, respiratory rate 18 breaths per minute, blood pressure 147/97 mmHg, height 190 cm, weight 126.4 kg, and body mass index 35.01 kg/m^2. He was alert but passively cooperative and spoke minimally. Auditory hallucinations were elicited, with reports of hearing voices calling his name, discussing him, and making negative remarks about him. His thought processes were slightly slowed, with evidence of delusions of reference. He displayed a depressive mood accompanied by anxiety, negative thought patterns, and self-harming behavior. Psychomotor activity was reduced, but no bizarre behavior was observed. Orientation and partial insight were intact.

Upon admission, comprehensive laboratory tests were performed, including complete blood count, urinalysis, stool analysis, liver function tests, renal function tests, electrolytes, coagulation profile, thyroid function tests, and cortisol levels. Apart from mild elevations in alanine aminotransferase (51 U/L) and uric acid (449 μmol/L), all other results were within normal ranges. Cranial MRI, thyroid ultrasound, abdominal ultrasound of the liver, gallbladder, pancreas, and spleen, and cardiac ultrasound were unremarkable. The Hamilton Depression Rating Scale (HAMD) score was 28.

After excluding contraindications for anesthesia, the patient underwent a total of seven sessions of MST on August 1, August 2, August 5, August 6, August 8, August 12, and August 14, 2024. Following the initial two MST sessions, there was a noticeable improvement in depressive symptoms. After four sessions, the auditory hallucinations were resolved, and after seven sessions, the depressive symptoms were significantly alleviated. During hospitalization, the patient was treated with sertraline, starting at 50 mg and gradually increased to 75 mg until discharge, and aripiprazole at a continuous dose of 5 mg. The patient was discharged on August 16. HAMD scores recorded at one and two weeks after admission were 15 and 7, respectively. Aside from mild pharyngeal discomfort after the first MST session, no other adverse effects were reported throughout the MST treatment course.

Discussion

This case highlights the efficacy of MST in treating MDD in adolescents. Adolescent patients with MDD often present with complex symptoms, including self-harming behaviors and psychotic features [8]. By inducing controlled therapeutic seizures, MST has demonstrated rapid and significant symptom relief, particularly in the reduction of depressive symptoms and the disappearance of auditory hallucinations, suggesting that MST is an effective alternative to ECT [9].

In this case, the patient experienced relief from depressive symptoms after two MST sessions, complete resolution of hallucinations after four sessions, and a significant alleviation of depressive symptoms after seven sessions. This rapid response underscores that MST can achieve therapeutic effects comparable to ECT while reducing cognitive side effects and providing more precise control over seizure induction [9]. The combination of

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sertraline and aripiprazole further contributed to sustained symptom relief, as evidenced by the gradual reduction in HAMD scores.

The safety profile of MST was also validated in this case. Compared to traditional ECT, MST is associated with fewer cognitive side effects while offering similar efficacy [10], thus supporting its applicability in adolescents and other susceptible populations. Throughout the MST treatment, the patient experienced only mild oropharyngeal discomfort following the initial session, which is likely related to intubation rather than the MST procedure itself [11]. This discomfort was transient and resolved with the removal of the endotracheal tube and the metabolism of anesthetic agents, as confirmed in this case. This case provides evidence for MST as a valuable treatment option for adolescents with complex MDD, particularly those with psychotic features and suicidal tendencies.

Conclusion

This case report highlights the effectiveness of MST in rapidly alleviating severe depressive symptoms and psychotic features. Future research should explore the long-term effects of MST in adolescent populations and its potential as an alternative or adjunct to existing treatment modalities such as ECT and pharmacotherapy. Additionally, longitudinal studies will help determine whether the relief induced by MST is sustainable and investigate its clinical application in treatment-resistant adolescent MDD patients.

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