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H-Coil Repetitive Transcranial Magnetic Stimulation Induced Seizure in an Adult with Major Depression: A Case Report

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Dear Editor

We report a seizure induced by repetitive transcranial magnetic stimulation (rTMS) using an FDA-approved protocol for treating depression. The patient was a 27 year-old man with long-standing severe recurrent major depressive disorder. He had co-morbid generalized anxiety disorder and four remote head injuries. At age 17 he was punched and fractured his nasal bone and nasal septum. A head CT showed pneumocephalus without intracranial injury. At age 21 he was assaulted and a head CT showed a fractured orbital bone without intracranial injury. He also played college football and was pulled from practice on two occasions for possible concussion. His only medication was vortioxetine 20 mg/day. He had no personal or family history of seizures and had a normal neurological exam. On the day of the event he reported drinking up to 6 beers over 5 hours at a social event the night before with difficulty sleeping.

We were delivering TMS using the H1-coil (Brainsway Deep TMS) to the left dorsolateral prefrontal cortex according to the FDA-approved protocol [1]: 18-Hz stimulation for 2 s per train with 20 s between trains, with 55 trains (1980 pulses) delivered over 20 minutes. The intensity of the stimulation was 120% of our patient's motor threshold (53% of machine output). The stimulation was performed in a large academic center that specializes in noninvasive brain stimulation. The patient tolerated the first 2 weeks of daily treatments using this protocol without any adverse events.

The event occurred mid-way through the 12th session. The patient recalled experiencing “numbness” and an inability to control the right side of his face, followed by a similar sensation of his right arm before losing consciousness. The TMS technician noted when the patient had facial grimacing and the rTMS was stopped immediately. The facial grimacing rapidly evolved to generalized tonic clonic movements with bladder incontinence. The treating neurologist (A.D.B.) and psychiatrist (A.P.S.) were both on-site and, along with two nurses, were able to assist the technician within one minute of the onset of convulsions. The patient was put in a lateral decubitus position and closely monitored until the seizure

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spontaneously resolved 1–2 minutes later. An emergency crash cart was available but not needed.

After the seizure, the patient was breathing spontaneously with a regular pulse. He was sweating profusely and vomited in the post-ictal period. He was sitting up at the time of vomiting and avoided aspiration. He was poorly responsive to verbal stimuli initially and became increasingly coherent over the next 10–20 minutes, at which point he was asking appropriate questions. He was transferred to the Emergency Department where he was monitored and labs were drawn, including a complete blood count and metabolic panel. These were notable for a mild leukocytosis 12.9 (4–10 K/μL), which is often seen after a generalized seizure. After he returned to his cognitive baseline and was medically cleared, he was discharged home. An MRI of the brain with and without contrast was normal. The assessment was that he experienced an rTMS-provoked focal seizure that secondarily generalized.

Discussion

This patient had at least three possible risk factors for seizures, as reviewed by Rossi et al [2]: prior head trauma [3], alcohol use the night before the seizure [1,4–6] and poor sleep [7,8]. To our knowledge, this is the third reported case of an induced seizure using an H-coil, with one occurring in a patient undergoing treatment for depression and the other in a patient being treated for bipolar disorder [1,9]. A recent review found 9 total rTMS-induced seizures associated with depression treatment reported in the literature, and 25 rTMS-induced seizures overall [10]. The addition of an adverse event report by Brainsway [1] and the current case brings the total to 11 rTMS-induced seizures occurring in patients undergoing treatment for depression, with two from an H-coil.

In our Center, this is the first seizure experienced by a patient receiving rTMS for the treatment of depression. We have experience treating at least 280 patients with >6,000 rTMS treatment sessions since the approval of TMS devices for the treatment of patients with medication-resistant depression. This includes treatments using three devices: 88 patients (3821 sessions) on NeuroStar (Neuronetics, Malvern, PA), 181 patients (2022 sessions) on MagStim (The Magstim Company Ltd., Whitland, UK), and 11 patients (237 sessions) with Brainsway Deep TMS (Brainsway LTD, Jerusalem, Israel). To our knowledge, there is no formal data showing a difference in seizure risk from the Brainsway Deep TMS device relative to the more conventional figure of eight coils, but continued reporting of such adverse events will be important to further evaluate this possibility.

An important point of practical significance is that the design of the H-coil may obscure the technician's view of the patient's facial expression if being operated from behind. In the above case, in keeping with our standard operating procedures, our technician was visually checking on the patient frequently and noted the facial grimacing at the seizure onset and stopped the TMS immediately. As such, a system for constant monitoring of the patient and allowing for a rapid response in the event of a focal motor seizure onset may be warranted. This event was also reported to the manufacturer and the FDA.

References

1. Brainsway Deep TMS 510(k)K122288. 2013. http://www.accessdata.fda.gov/cdrh_docs/pdf12/k122288.pdf
2. Rossi S, Hallett M, Rossini PMM, Pascual-Leone A. Safety, ethical considerations, and application guidelines for the use of transcranial magnetic stimulation in clinical practice and research. Clin Neurophysiol. 2009; 120:2008–2039. DOI: 10.1016/j.clinph.2009.08.016 [PubMed: 19833552]
3. Bernabeu M, Orient F, Tormos JM, Pascual-Leone A. Seizure induced by fast repetitive transcranial magnetic stimulation. Clin Neurophysiol. 2004; 115:1714–1715. DOI: 10.1016/j.clinph.2004.02.021 [PubMed: 15203073]
4. Chiramberro M, Lindberg N, Isometsä E, Kähkönen S, Appelberg B. Repetitive transcranial magnetic stimulation induced seizures in an adolescent patient with major depression: a case report. Brain Stimul. 2013; 6:830–831. DOI: 10.1016/j.brs.2013.02.003
5. Wall C, Croarkin P, Bandel L, Schaefer K. Response to repetitive transcranial magnetic stimulation induced seizures in an adolescent patient with major depression: a case report. Brain Stimul. 2014; 7:337–338. DOI: 10.1016/j.brs.2013.12.001 [PubMed: 24629832]
6. Gómez L, Morales L, Trápaga O, Zaldívar M, Sánchez A, Padilla E, et al. Seizure induced by sub-threshold 10-Hz rTMS in a patient with multiple risk factors. Clin Neurophysiol. 2011; 122:1–1058. DOI: 10.1016/j.clinph.2010.09.007 [PubMed: 20580310]
7. Prikryl R, Kucerova H. Occurrence of epileptic paroxysm during repetitive transcranial magnetic stimulation treatment. J Psychopharmacol. 2005; 19:313.doi: 10.1177/0269881105051545 [PubMed: 15888504]
8. Oberman LM, Pascual-Leone A. Report of seizure induced by continuous theta burst stimulation. Brain Stimul. 2009; 2:246–247. DOI: 10.1016/j.brs.2009.03.003 [PubMed: 20160904]
9. Harel EV, Zangen A, Roth Y, Reti I, Braw Y, Levkovitz Y. H-coil repetitive transcranial magnetic stimulation for the treatment of bipolar depression: an add-on, safety and feasibility study. World J Biol Psychiatry. 2011; 12:119–126. DOI: 10.3109/15622975.2010.510893 [PubMed: 20854181]
10. Dobek CE, Blumberger DM, Downar J, Daskalakis ZJ, Vila-Rodriguez F. Risk of seizures in transcranial magnetic stimulation: a clinical review to inform consent process focused on bupropion. Neuropsychiatr Dis Treat. 2015; 11:2975–2987. DOI: 10.2147/NDT.S91126 [PubMed: 26664122]