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Transcranial Magnetic Stimulation for Treatment-Resistant Depression: An Interactive Self-Learning Module

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Abstract

Introduction: The use of transcranial magnetic stimulation (TMS) has become increasingly prevalent in psychiatry. A growing body of literature supports its use with treatment-resistant depression (TRD), and this indication has gained FDA approval. However, new psychiatry residents often have little exposure to or understanding of TMS. **Methods:** This animated, fully narrated, self-learning module (SLM) introduces learners to TMS and its use in TRD and can be completed within 30 minutes. The goal is for viewers to be proficient with the basic science, indications, contraindications, side effects, and treatment process for TMS in TRD. Self-assessment questions throughout the module highlight and reinforce key learning points falling under the educational objectives. **Results:** This SLM was deployed with PGY 1-4 training residents at the University of Minnesota during the 2016-2017 academic year as part of a study aimed at improving TMS education within our residency program. Fourteen residents participated in the study and offered feedback on the SLM's efficacy using 5-point Likert-scale surveys. Prior to the SLM's completion, the percentage of participants who disagreed or strongly disagreed with having met individual educational objectives ranged from 64% to 86%. Following completion, the percentage who agreed or strongly agreed with having met individual objectives ranged from 79% to 93%. **Discussion:** This SLM provides an introductory curriculum on TMS for TRD to medical students and psychiatry residents who otherwise might not be adequately exposed to this treatment modality. As institutions adopt TMS, the module can serve as a primer for trainees prior to hands-on experience with the technology.

Keywords

Resident Teaching, Self-Learning Module, Transcranial Magnetic Stimulation, Treatment-Resistant Depression

Appendices

- A. TMS for TRD.pptx
- B. Instructions.docx
- C. Precurriculum Survey.docx
- D. Postcurriculum Survey.docx

*All appendices are peer reviewed as
integral parts of the Original
Publication.*

Educational Objectives

By the end of the module, medical students and psychiatry residents will be able to:

1. List the basic science and scientific evidence for transcranial magnetic stimulation (TMS) in treatment-resistant depression.
2. Describe the indications and contraindications of TMS.
3. List the side effects of TMS.
4. Describe the basic TMS treatment process to patients.

Introduction

Treatment-resistant depression (TRD) continues to be a major concern in the field of psychiatry. The Star*D trial indicated current shortcomings in psychotherapy and pharmacotherapy, with three out of 10 patients failing to respond to multiple medications and psychotherapy.¹ Transcranial magnetic stimulation (TMS) has positioned itself as an FDA-approved treatment for TRD. Various studies have demonstrated response rates ranging from 24% to 48% and remission rates ranging from 14% to 37%.²⁻⁴ As of 2016, the Clinical TMS society has published an expert panel consensus on the safety and efficacy of TMS in major depressive disorder.⁵ TMS offers an alternative to electroconvulsive therapy (ECT), which has long stood as the gold-standard treatment for TRD. While ECT has greater efficacy compared to TMS, the latter offers

several advantages as it requires no anesthesia, does not negatively impact memory, and generally has more tolerable physical side effects, making it more appealing to some patients.

The Association of Directors of Medical Student Education in Psychiatry has identified brain stimulation therapies as an enhancing learning objective in the curriculum for teaching medical students about treatment and management of mental illness.⁶ However, within our residency program, residents reported that they received very little or no exposure to TMS during training in medical school. There are likely multiple reasons for this. TMS remains a relatively new technology, and adoption has been slow. Due to its cost, many major insurance companies did not cover its use until recent years despite FDA approval since 2008. Furthermore, TMS requires significant capital investment, specific training, and clinical support staff, all which represent barriers to adoption. With slow adoption, few faculty members have had firsthand experience with the technology. Finally, TMS is still met with skepticism by some psychiatrists who prefer ECT and its longer-proven record. These factors ultimately lead to limited TMS exposure and training for medical students and residents.

Considering the increasing evidence for the use of TMS in TRD, we believed that there was a need for further curriculum development in this area. Although an introductory curriculum could benefit multiple types of health care providers, psychiatry residents appeared to be a natural audience. With increasing demands on the mental health field, primary care has taken a more active role in caring for treatment-naïve depression and referring nonresponders to psychiatry. Because psychiatrists are seeing more complex patients who are likely to be treatment resistant, it will be prudent for the next generation of psychiatrists to be well versed in different options for TRD.

Methods

We reviewed *MedEdPORTAL* for current TMS curricula but were unable to find any. Therefore, we developed an interactive, 30-minute, self-learning module (SLM; Appendix A) using Microsoft PowerPoint to further expose psychiatry residents at our institution to this treatment modality. Based on a literature review and our firsthand experience using TMS for TRD, we identified core content we believed would be pertinent for trainees to be able to comfortably make TMS referrals. This content included a basic understanding of how TMS works, the evidence behind TMS, the indications and contraindications of TMS, the side effects associated with TMS, and the basic TMS treatment process.

We used Microsoft PowerPoint to develop the module given its availability in the academic setting. We chose to implement an interactive SLM format as this delivery method affords flexibility to educators and learners alike. While the SLM can be completed as a small-group learning activity within a classroom setting, it also can be deployed as an independent learning resource accessible anywhere at any time without the strict need for a facilitator. In place of a facilitator is a fully narrated presentation with embedded self-assessment checkpoints. These checkpoints consist of multiple-choice or true/false questions that are meant to maintain attention while reviewing, emphasizing, and solidifying key learning points.

We disseminated this SLM to postgraduate year (PGY) 1-4 training residents at the University of Minnesota during the 2016-2017 academic year as part of a study aimed at improving TMS education within our residency program. We offered the SLM both to individual residents as an independent learning resource and to a group that was present during our residency's weekly PGY 1-2 didactics. Residents were not required to have any prerequisite knowledge regarding TMS prior to participating. For the didactic session, we requested that participants complete a physical survey (see Appendix C), which asked them to report their comfort with the four educational objectives on a 5-point Likert scale prior to viewing the SLM. We chose a Likert scale as it could be completed quickly while affording quantitative insight into the participants' confidence with the educational objectives. After completion of the survey, we projected the SLM onto a large screen in conjunction with computer speakers and allowed the module to play to completion. When checkpoint questions appeared, we asked the group to come to a consensus on the

correct answer. After completion of the SLM, we asked participants to complete a postcurriculum survey (see Appendix D), which again asked them to report their comfort with the four educational objectives. In addition, we included two questions to gauge the overall usefulness of having embedded questions and to assess whether the module was of appropriate breadth and depth for the participants' level of training. Lastly, the survey provided space to allow participants to offer any additional comments or feedback. For participants recruited by word of mouth or email, we delivered the SLM electronically along with an instruction file (see Appendix B); pre- and postcurriculum survey responses were collected through Google Forms. These individuals completed the module independently at a time of their own choosing.

Results

In total, 14 psychiatry residents ranging from PGY 1-4 agreed to participate in the study. Participants were skewed toward earlier training years, with 11 of 14 participants being PGY 1-2 residents. Seven of the 11 PGY 1-2 participants completed the SLM during the didactic session. Seven residents were recruited by word of mouth or e-mail, of whom three were PGY 3-4. Prior to viewing the SLM, participants generally reported low confidence in their ability to meet the four educational objectives listed above (see Figure). Seventy-nine percent of participants disagreed or strongly disagreed that they were able to describe the basic science behind TMS, its efficacy, and the basic treatment process. Similarly, 64% of participants reported an inability to describe the side effects associated with TMS, and 86% reported an inability to describe the indications and contraindications of TMS in TRD. Notably, with the exception of one participant who reported having knowledge of TMS side effects, all other participants indicated neutrality or disagreement about having attained the educational objectives prior to viewing the SLM.

Figure. Survey exploring residents' ($n = 14$) comfort with the four learning objectives before and after viewing the self-learning module. Overall self-reported knowledge of TMS for TRD was markedly increased following completion of the module. Abbreviations: TMS, transcranial magnetic stimulation; TRD, treatment-resistant depression.

Following completion of the SLM, participants overall reported increased confidence with meeting each educational objective. Over 90% of participants either agreed or strongly agreed that they were able to describe the basic treatment process, the scientific principle behind TMS, its efficacy, and its side effects. Similarly, participants reported an improvement in ability to describe indications and contraindications, with 79% reporting agreement or strong agreement that they had attained this educational objective. Additionally, the postcurriculum survey showed a favorable attitude toward the embedded questions, with 100% of participants agreeing or strongly agreeing that they were helpful in reinforcing learning. Similarly, 100% of participants reported agreement or strong agreement that the breadth and depth of the module

were appropriate for the participants' level of training. Following completion of the study, additional individuals across all levels of training, including medical students, residents, and faculty, have utilized the module and offered positive verbal feedback, although this has not been specifically tracked.

In terms of negative feedback, it was apparent that there were significant audio issues throughout the learning module, with multiple individual participants reporting too much variation in volume from section to section. This audio was rebalanced prior to submission to *MedEdPORTAL*.

Discussion

This SLM is the first *MedEdPORTAL* publication aimed at addressing a knowledge gap in the growing use of TMS for TRD. We had evidence to suggest that residents were not well versed in this topic based on informal discussions prior to construction of the SLM. However, the extent of this knowledge gap became far more apparent after formal data collection from the precurriculum survey showed discomfort with each of the four identified educational objectives. Although we did not expect trainees necessarily to be experts in TMS, we did believe that these educational objectives represented a foundation of knowledge necessary for psychiatric providers to have informed discussions with patients and to make appropriate referrals for optimal care. The reported weakness in the objectives reaffirmed the need for a basic TMS curriculum.

In implementing this curriculum, we found that the SLM format afforded great flexibility as it could be used independently or in a group session. During our group didactic session, we projected the SLM onto a single screen and solicited group participation, partly as a matter of practicality, because not all participants had immediate access to a computer. Furthermore, having multiple copies of the SLM running with audio narration would likely have become distracting in the conference room used for didactics. Although the curriculum is primarily formatted to be an SLM, this didactic session showed that it can be readily implemented as a small-group teaching tool. Because much of the facilitation is automated, there is no strict requirement to have an instructor present who is knowledgeable in TMS. This can be especially useful for institutions that do not have expertise in TMS. The implementation of the module was not without setbacks. With automated resources, there is a higher likelihood for technical issues, and a common problem that arose was complaints of large variations in narration volume throughout the module. This likely can be attributed to the audio being recorded within PowerPoint over multiple sessions in different settings. The audio difficulties were eventually remedied by rebalancing all recorded audio within Audacity, a free audio-editing software. Future SLM creators wishing to narrate within PowerPoint may want to consider directly recording within Audacity and importing audio files into PowerPoint for optimal sound quality and balance.

In evaluating the SLM, the postcurriculum survey indicated that the module was quite effective in meeting all educational objectives and appeared to be at the appropriate level for the target audience. During the construction of this module, it was not immediately clear whether the embedded checkpoint questions would benefit or detract from the overall learning experience. However, our survey indicated that this technique was well received by all study participants. This style of embedding questions can be considered by other authors creating SLMs to highlight key learning points and to maintain viewer engagement. In the future, it would be interesting to see a formal study objectively measure differences in knowledge acquisition and retention over time when using embedded questions as part of an SLM.

A major limitation for this SLM is the rapid rate at which the field of neuromodulation is expanding. It is highly probable that superior forms of treatment will emerge with time, making currently approved devices and protocols obsolete. Additional modules will be needed to address newer modalities as evidence for these treatments becomes apparent. Another limitation with our study was that our collected data were limited to residents' subjective perceptions of improved knowledge. This was purposeful as it minimized the time burden on participants for the study. However, assessment with pre- and posttest questions would be helpful in future studies to demonstrate knowledge acquisition objectively. Lastly, we also

acknowledge that there are limitations with our study design. The total number of study participants was relatively low and skewed toward residents in earlier years of training. This skew likely occurred because of two reasons. One coauthor of this SLM was a PGY 1 resident at the time of the study. As PGY 1 residents frequently interfaced with PGY 2 residents in our program, the coauthor could remind trainees that the SLM was available, which helped to improve participation. In addition, the SLM was offered during a scheduled PGY 1-2 didactic session, which minimized the time burden for residents to complete the SLM and helped to improved participation. We primarily attempted to recruit PGY 3-4 trainees via email, and this likely translated into lower participation rates.

Overall, this module has been favorably received by residents within our department. It has served to fill a knowledge gap for trainees who otherwise might not receive exposure to TMS. Looking forward, we believe that the module can be used as part of medical student education and hope that trainees at other institutions can also benefit from it. Lastly, as academic institutions begin to adopt TMS, we anticipate that the module can serve as a primer for trainees prior to a hands-on experience with this treatment modality.

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Disclosures

None to report.

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None to report.

Ethical Approval

The University of Minnesota Institutional Review Board approved this study.

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