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OCD behavior therapy before and after gamma ventral capsulotomy: Case report

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Abstract

We report the case of a patient requiring gamma ventral capsulotomy (GVC), a neurosurgical intervention to address severe refractory obsessive–compulsive disorder (OCD). GVC involves stereotactic lesions in the ventral anterior limb of the internal capsule and adjacent ventral striatum. This study details the course of an extinction-based behavioral therapy, namely exposure and response prevention (ERP). The patient experienced significant changes in motivation and ability to tolerate ERP post-surgery. Furthermore, he was better able to absorb and remember exposure sessions. GVC surgery may affect the neural mechanisms involved in the extinction learning process, the same process implicated in ERP treatment.

Keywords

Gamma ventral capsulotomy; Obsessive–compulsive disorder; Cognitive-behavioral therapy; Exposure and response prevention; Extinction learning

Obsessive–compulsive disorder (OCD) can remain severe despite aggressive pharmacotherapy and exposure and response prevention (ERP). For “intractable” OCD, neurosurgery is a therapeutic option (American Psychiatric Association, 2007). One procedure, gamma ventral capsulo-tomy (GVC), involves stereotactic lesions in the ventral anterior limb of the internal capsule and adjacent ventral striatum (Greenberg, Rauch, & Haber, 2010). The GVC procedure utilizes the Leksell Gamma Knife, a radiosurgical instrument that makes craniotomy unnecessary. GVC targets frontal-basal ganglia–thalamic connections, specifically between dorsomedial thalamus and ventral prefrontal cortex, a circuit implicated in OCD (Greenberg et al., 2003; Rauch, 2003). In open-label studies, over half of patients show a 35% or greater decrease in OCD severity (Greenberg et al., 2003) on the Yale–Brown Obsessive–Compulsive Scale (Y-BOCS; Goodman et al., 1989). A second open series preceding a sham-controlled GVC trial found similar improvement rates (Lopes et al., 2009). The neural and behavioral mechanisms of therapeutic action remain unclear. Clinical impressions hint that the ability of patients to engage in and benefit from ERP may

improve after surgery (Greenberg et al., 2006). However, such observations have not been presented in detail. Here, we detail a case where the process and outcomes of ERP for OCD were facilitated after neurosurgery.

CASE REPORT

A 19-year-old man was referred to the OCD Research Clinic at Butler Hospital/Brown Medical School for evaluation for neurosurgical treatment. He had separation anxiety as a young child, followed by development of OCD at age 13 years. Premorbid personality and functioning were relatively intact. Primary OCD symptoms included contamination obsessions, and extensive handwashing and showering compulsions. Co-occurring depressive symptoms included anhedonia, amotivation, sleep disturbance, and irritability, with long periods of isolation and considerable time spent in bed. School attendance was inconsistent, with frequent late arrivals due to compulsions eventually resulting in homeschooling. Internet gambling also developed in his teens, resulting in significant financial loss.

Course of OCD treatment prior to GVC surgery

His treating psychologist and psychiatrist referred the patient for surgical evaluation at age 18 years after aggressive, sustained but unsuccessful attempts with multiple medication combinations and therapy. Thorough record review and interviews with prior treatment providers confirmed lack of response to adequate trials of serotonin reuptake inhibitor (SRI) monotherapies including fluoxetine, fluvoxamine, clomipramine, paroxetine, sertraline, and escitalopram. Medication augmentation (combination) strategies were also used, including the addition of atypical neuroleptics and medications from other chemical classes to augment SRI therapies. These were quetiapine, lamotrigine, olanzapine, ziprasidone, aripiprazole, valproic acid, lithium, and clonazepam. In addition to numerous medication trials, he participated in individual cognitive-behavioral therapy (CBT) involving weekly ERP exercises for approximately 2 years. The patient experienced difficulty committing fully to treatment with poor treatment adherence. He exhibited a low tolerance for discomfort and avoided situations that caused him distress including planned ERP exercises. Consequently, he made minimal treatment gains during this time. At the age of 17 he attended two specialized OCD treatment programs which required participation in intensive behavioral therapy involving daily ERP sessions. Difficulties with anger, rigidity, and frustration often led to conflict with program staff members. He experienced modest gains during and directly following these intensive treatments; however, his symptoms rapidly remitted after returning to his home environment. Given his intractable illness, he and his family explored surgical interventions, namely GVC, prompted by meeting another OCD sufferer whose similarly highly refractory illness had improved after that procedure. Alternative surgeries, including anterior cingulotomy and deep brain stimulation (DBS), were also discussed and considered. They opted to pursue GVC given the relatively large experience with this intervention compared, for example, to DBS where studies were just beginning.

Pre-surgical assessment

Clinical and structured interviews with the patient and his parents confirmed disabling, chronic OCD, and recurrent major depressive disorder. Medical and neurological histories were unremarkable aside from occasional tic-like blinking. On the Y-BOCS, a structured interview assessing OCD symptom severity, he scored in the severe to extreme range (Y-BOCS = 34). At pre-surgical assessment, he had been housebound for 8 months. He was reluctant even to enter his backyard due to fear of bugs, dogs, and other potential “contamination sources.” Most waking hours were consumed by intrusive obsessions and compulsions. Handwashing alone consumed 4+ hours/day. He avoided showering since bathing rituals often lasted up to 8 hours driven by a feeling of incompleteness. TV-watching was severely compromised by obsessions that he had missed something important, leading to reviewing rituals, lasting up to 4 hours for a 1-hour show. His intractable illness, which included aggressive outbursts when he felt contaminated or frustrated by symptoms, profoundly disrupted family life.

GVC surgery

Lorazepam and local anesthesia (Lidocaine 1%) were administered preoperatively prior to the attachment of a Leksell stereotactic frame to the skull. A preoperative stereotactic MRI was obtained. Dose planning and target selection used a dedicated software platform (Leksell GammaPlan). Bilateral “double shots” were targeted at the ventral half of the anterior limb of the internal capsule in a coronal plane 8 mm anterior to the posterior border of the anterior commissure. Converging gamma beams from [60]Co sources using 4-mm collimators were targeted to place two shots on each side covering the ventral half of the internal capsule within the 50% isodose line, which included the adjacent dorsal part of the ventral striatum. A dose of 180 Gy was prescribed per shot at 100% for a total exposure time of 543.92 minutes. He tolerated the treatment without complications.

Course post GVC surgery

Psychotropic medications fluoxetine 80 mg/day and lamotrigine 300 mg total/day were continued, as before surgery. Three months following GVC he returned to active CBT with his previous therapist (FP). Notably, he described his post-surgery experience of behavioral therapy as qualitatively different than prior to the GVC procedure. He was clearly more motivated to confront OCD-symptom-triggering situations that he had previously avoided in ERP. For example, he allowed his therapist to conduct a large-scale home-based exposure session to address fears of contamination. He described changes in both his ability to do therapeutic exposures and in his memory of successfully completing them:

Before, I felt like I could not handle the exposures. I had a lot more trouble forcing myself to do it. I had times where I could do the ERP, but I could not keep what I had learned in my head. After, I felt more determined. I felt like I could handle the exposures. I felt like I could keep them in my head and remember them. The surgery helped in that it made ERP easier to do, easier to hold onto, and easier to keep doing. It seemed like it sunk in more. It was easier to process and understand.

OCD symptoms gradually decreased over 36 months. The pre-surgical Y-BOCS score of 34 (consistent with his prior course), decreased successively to scores of 26, 20, and 11, at 6,

12, and 36 months, respectively. During this period, a typical shower routine that would have lasted 7 hours at baseline (due to washing compulsions) gradually decreased to 15 minutes 3 years after surgery. Although residual handwashing and checking symptoms remained, these were relatively minor and not impairing, as reflected by a YBOCS of 11, below the typical severity threshold of 16 for patients meeting OCD diagnostic criteria.

Co-morbid depressive symptoms also decreased markedly. His Beck Depression Inventory (BDI) score at pre-surgical baseline was 32, indicating severe depression, decreased to 4 (below diagnostic threshold) 3 years after the GVC procedure. Daily functioning also improved substantially. He enrolled in college, began to socialize with classmates, and re-engaged in sports and other activities he had enjoyed before his OCD had worsened dramatically in his mid-teens.

COMMENT

This case study highlights the importance of behavioral interventions, namely ERP, as an essential component following GVC surgery, a neurosurgical intervention for severe treatment-refractory OCD. There were notable changes in the patient's motivation to engage in and ability to tolerate ERP. The patient described both a new ability to benefit from the therapy and also a better memory for his experience of mastering the exposures after GVC. One could speculate that this surgery may affect neural mechanisms involved in extinction learning and extinction memory, a process thought to underlie, at least in part, therapeutic benefit after ERP treatment. Research has consistently implicated ventromedial prefrontal cortex (vmPFC) and the amygdala in extinction learning and recall. Convergent evidence suggests the vmPFC and amygdala play distinct roles in the learning and extinction of conditioned fear. Amygdala activation is implicated in acquisition and expression of conditioned fear and the enhancement of emotional memory. The vmPFC, in contrast, mediates fear extinction and particularly recall of extinction learning. "Top-down" control of the amygdala by the vmPFC is theorized to facilitate extinction learning and retention (e.g., Milad, Rauch, Pitman, & Quirk, 2006; Milad et al., 2007; Phelps, Delgado, Nearing, & LeDoux, 2004). Although the effects of GVC on neurocircuitry implicated in OCD remain to be elucidated, the procedure targets projections to ventral prefrontal cortex, as well as dorsomedial thalamus and other nodes in this putative circuitry. Of course, this case report, while vivid, is essentially anecdotal. Systematic collection of data on patients' abilities to engage in and benefit from ERP before and after neurosurgery are needed to establish whether the observations here are a consistent feature of surgical interventions across individuals. And it is possible that symptom improvement may have occurred without resumption of formal behavioral therapy. It is also likely that improvement along affective dimensions more generally (in nonspecific anxiety, depression, and/or anhedonia) played a role (Greenberg et al., 2010). Brain mechanisms associated with therapeutic change could therefore include changes in the roles of ventral versus dorsal prefrontal-basal ganglia-thalamic networks, and in neurotransmitter mechanisms including dopaminergic systems implicated in reward, attention and approach behaviors. Such possibilities must remain speculative. However, this case more directly raises the possibility that ERP is also essential to symptom improvement following other surgical interventions for intractable OCD (e.g., anterior cingulotomy and DBS), which has important implications for clinical trial design

(Denys et al., 2010). Systematic studies of responses to ERP post surgery, including potential mechanisms underlying efficacy of this extinction-based treatment would provide a unique window on the brain and behavioral underpinnings of therapeutic improvement in OCD.

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