A Systematic Review of the Utility of Electroconvulsive Therapy in Broadly Defined Obsessive-Compulsive–Related Disorders

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ABSTRACT

Objective: To assess the efficacy of electroconvulsive therapy (ECT) in *DSM-5* obsessive-compulsive–related disorders (OCRDs) and conditions subsumed under an "extended" OCD spectrum, including tic disorders and self-injurious behaviors.

Data Sources: A systematic search of the MEDLINE, Web of Science, Scopus, and LILACS databases and other sources was performed between June 6 and July 2, 2017. Search terms included (Autis*) AND (ECT OR electroconvulsive), (Self-injur*) AND (ECT OR electroconvulsive), (Tic* OR Tourette) AND (ECT OR electroconvulsive), (Body Dysmorphic Disorder OR Dysmorphophobi*) AND (ECT OR electroconvulsive), (Hoard*) AND (ECT OR electroconvulsive), (Trichotillomani*) AND (ECT OR electroconvulsive), (Skin Picking OR Excoriation) AND (ECT OR electroconvulsive), (Grooming) AND (ECT OR electroconvulsive), (Kleptomani*) AND (ECT OR electroconvulsive), and (Pyromani*) AND (ECT OR electroconvulsive). No search restrictions (ie, date, language, or document type) were used.

Study Selection: Fifty-two records that described the individual responses of OCRDs to ECT (involving 69 patients) were selected.

Data Extraction: Clinical data and responses of individual cases were recorded. Data from responders were compared to nonresponders.

Results: All records were case reports or case series; there were no randomized controlled trials. Of the 69 OCRD participants who had undergone ECT, a positive response was reported in 73.4% of the cases (including 44.0% of the BDD, 74.1% of the tic disorder, and 85.7% of the self-injurious behavior patients). At follow-up, the majority of responders who had abstained from further ECT had experienced relapse. However, a positive response was obtained in all participants who received a new course of ECT. Patients who responded positively to ECT were likely to report previous unsuccessful treatment with antipsychotics ($P < .001$) and antidepressants ($P = .007$).

Conclusions: The finding that more than 70% of the reviewed cases showed some response to ECT should not be considered unequivocal evidence of its efficacy in OCRDs. The available evidence suggests that a randomized controlled trial of ECT in OCRDs may be warranted, particularly in severe tic disorders and self-injurious behaviors.

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Obsessive-compulsive disorder (OCD) is characterized by recurrent and persistent thoughts, urges, or images that are intrusive, unwanted, and distressing (obsessions) and repetitive behaviors or mental acts that the individual performs to ignore, suppress, or neutralize the resulting anxiety or according to rigid rules.[1] OCD affects 2.3% of the general population at some point in their lives and is often chronic and disabling.[2] First-line treatments include high-dose serotonin reuptake inhibitors (SRIs) and exposure and response prevention (ERP).[3] Individuals who show partial response to SRIs are often treated with antipsychotics or, preferentially, outpatient ERP.[4] Up to 10% of patients are generally treatment refractory and are potential candidates for ERP administered in intensive residential treatments[5] or more invasive treatment measures including deep brain stimulation[6] or psychiatric neurosurgery (eg, capsulotomy).[7]

One issue that has often been raised in the literature is whether OCD patients, particularly those who are treatment refractory, will benefit from a course of electroconvulsive therapy (ECT).[8] A systematic review[9] on this topic failed to find evidence supporting the use of ECT in OCD, as the literature was restricted to case reports and series, nonrandomized trials, and cohort studies. Specifically, ECT responders were characterized by a more severe form of OCD with a later onset of OCD symptoms, less depression, and a fewer number of ECT sessions.[9] Finally, the finding that ECT responders were less likely to be treated with conventional anti-OCD treatments (ie, adequate trials of SRIs and/or ERP) suggests that ECT could have been avoided if patients were treated more conservatively.[9]

In addition to insufficient evidence supporting the use of ECT in OCD, it is still unclear whether ECT may be helpful in those affected by obsessive-compulsive–related disorders (OCRDs) other than OCD. In *DSM-5*, OCRDs include body dysmorphic disorder, hoarding disorder, trichotillomania (hair-pulling disorder), and excoriation disorder (skin-picking disorder) among others.[1] Further, despite not being officially recognized as OCRDs in *DSM-5*, some neurodevelopmental disorders have been considered part of an "extended" OCD spectrum

Clinical Points

- Despite the lack of randomized controlled trials supporting the efficacy of electroconvulsive therapy in obsessive-compulsive–related disorders, it is still being prescribed to patients with severe forms of repetitive behaviors.
- Maintenance electroconvulsive therapy in obsessive-compulsive–related disorders may be warranted, particularly in cases showing more severe tic disorders and self-injurious behaviors, due to the high relapse rate.

on the basis of clinical and biological commonalities with OCD behaviors, including tic disorders and Tourette's disorder, autism spectrum disorders, and stereotypic movement disorders such as self-injurious behaviors.[10] These neurodevelopmental conditions have been noted to co-occur with each other and to be overrepresented among early onset OCD cases.[11–13]

In contrast to OCD patients, for whom the usefulness of ECT remains elusive, there is good reason to suspect that OCRDs may be responsive to ECT. First, body dysmorphic disorder and hoarding disorder are frequently delusional[14,15] and associated with greater severity of depression.[15,16] Second, symptoms of catatonia (the quintessential "ECT-responsive" neuropsychiatric disorder) overlap substantially with tic disorders and Tourette's disorder[17,18] (eg, echopraxia and echolalia, staring, and grimacing), autism[19–21] (eg, negativism, mutism/verbigeration, and stereotypies/mannerisms), and self-injurious behaviors[22] (eg, impulsivity and aggressiveness). Also, both cognitive[23,24] and motor OCRDs[25–28] can reach extreme levels of severity, occasionally involving life-threatening behaviors that can result in severe tegumentary lesions,[23] trichobezoars (mass of hairs blocking the bowel),[25] or even sepsis, thus prompting clinicians to consider ECT for some forms of OCRDs.

Despite the reasons for predicting positive responses of OCRD cases to ECT, there also have been negative experiences. For instance, Kalinowsky and Hippius[29] noted that tic disorder patients who "learned" to suppress tics might be unable to do so and deteriorate as a consequence of the detrimental effects of ECT on their ability to focus attention. Worsening of OCD after ECT has been reported in a few cases,[8] but it is unclear whether a similar phenomenon occurs in other OCRDs. To shed light on this poorly understood phenomenon and its treatment, we systematically reviewed studies reporting the effect of ECT in individuals with an official *DSM-5* diagnosis of an OCRD, including body dysmorphic disorder, hoarding disorder, trichotillomania, and excoriation disorder, as well as conditions under an "extended" OCD spectrum including tic disorders, autism spectrum disorders, and self-injurious behaviors. This review was based partly on the patient, intervention, comparator, and outcome model[30] and aimed to answer the following questions:

1. Has the effectiveness of ECT in OCRD patients been compared to any sham or active treatment?
   a. If yes, what is the effectiveness of ECT compared to sham or active treatment?
   b. If not, what is the highest level of evidence regarding the effectiveness of ECT in OCRD patients?
2. How do baseline features of OCRD patients who respond to ECT differ from OCRD patients who do not respond to ECT?

METHODS

Study Selection Criteria

Type of studies. We searched for randomized controlled trials (RCTs), observational studies, retrospective investigations, case series, and single case reports describing ECT effects on the core repetitive behaviors across the full range of *DSM-5* OCRDs (ie, body dysmorphic disorder, hoarding disorder, trichotillomania, and excoriation disorder), as well as tic disorders, autism spectrum disorders, self-injurious behaviors, kleptomania, and pyromania. Studies that, despite including the targeted populations, reported just the effects of ECT on other syndromes or behaviors (ie, depression in autism spectrum disorders) were preliminarily excluded from our research protocol. Editorials, letters, and reviews were included if sufficiently detailed original data were provided.

Types of ECT interventions. We selected all studies reporting the use of modified, unmodified, multiple-monitored, bilateral, and unilateral ECT with any dose, frequency, or level of stimulus. Studies that reported individuals receiving ECT who were also under current or previous pharmacologic treatments (eg, SRIs and antipsychotics) or different forms of psychotherapy (including cognitive-behavioral therapy [CBT] such as ERP, habit reversal, or behavior modification) were also included. Studies describing individuals treated with other brain stimulation techniques such as transcranial magnetic stimulation (TMS), transcranial direct-current stimulation (tDCS), deep brain stimulation (BDS), and vagus nerve stimulation were also included if the patients' response to ECT was also reported.

Type of measures. Given the dearth of instruments employed across and within the target disorders of our review, the primary outcome of interest was the authors' categorical description of clinically meaningful benefits of ECT on repetitive behaviors that characterize *DSM-5* OCRDs and the extended OCD spectrum. However, we were also interested in evaluating how frequently reports of ECT use in broadly defined OCRDs described valid instruments for the assessment of severity of repetitive behaviors in each disorder of interest (including, but not restricted to, the Yale-Brown Obsessive-Compulsive Scale [YBOCS] modified for body dysmorphic disorder,[31] the YBOCS modified for neurotic excoriation,[32] the Saving Inventory-Revised,[33] the Massachusetts General Hospital Hairpulling Scale,[34,35] the Yale Global Tic Severity Scale,[36] and the Children's Yale-Brown Obsessive Compulsive Scale modified for autism spectrum disorders[37] among others[38]).

Table 1. Online Search Features

Database	Search Field	Search Terms
Scopus	Article title, abstract, keywords	- (Autis*) AND (ECT OR electroconvulsive)
Web of Science	Topic	- (Self-injur*) AND (ECT OR electroconvulsive)
PubMed	All fields	- (Tic* OR Tourette) AND (ECT OR electroconvulsive)
LILACS	All indexes	- (Body Dysmorphic Disorder OR Dysmorphophobi*) AND (ECT OR electroconvulsive)
		- (Hoard*) AND (ECT OR electroconvulsive)
		- (Trichotillomani*) AND (ECT OR electroconvulsive)
		- (Skin Picking OR Excoriation) AND (ECT OR electroconvulsive)
		- (Grooming) AND (ECT OR electroconvulsive)
		- (Kleptomani*) AND (ECT OR electroconvulsive)
		- (Pyromani*) AND (ECT OR electroconvulsive)

Search Methods for Identification of Studies

Electronic searching. A systematic search was performed between June 6 and July 2, 2017, in the following databases: MEDLINE, Web of Science, Scopus, and LILACS. The keywords used for the search are listed in Table 1.

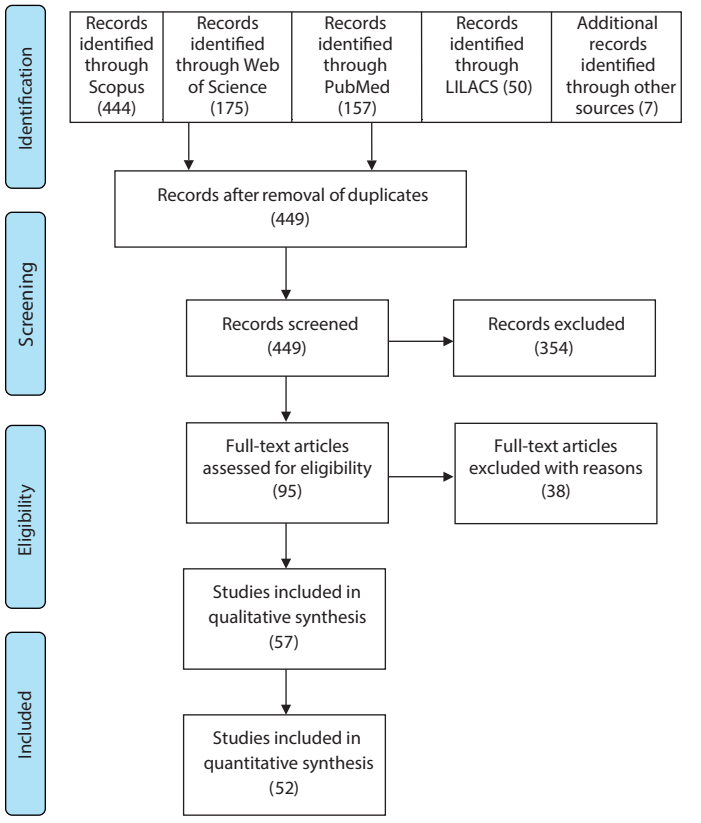
Other sources. The reference lists of studies that fulfilled inclusion criteria and textbooks deemed relevant for our research question[29,39–45] were also examined for possible new studies. Further, complete and in-progress clinical trials still not published in clinicaltrials.gov and WHO clinical trials registry platforms were also considered for inclusion. No search restrictions (eg, date, language, or document type) were used.

Data Collection and Analysis

Selection of studies. Repeated titles across databases were removed, and the remaining articles were checked and analyzed individually by our team, which comprised 2 psychiatrists (L.F.F. and J.N.Q.), 2 biomedical scientists (S.S.R. and J.B.S.A.), and 1 psychology student (K.B.B.). During weekly meetings that took place between June 2017 and February 2018, titles and abstracts were analyzed to exclude articles that clearly did not meet the inclusion criteria; then, the full text of selected articles was read for extraction of the data of interest. Eligibility was defined according to inclusion and exclusion criteria for each diagnostic group. When doubts or disagreement between authors regarding the characteristics of the collected variables occurred, a consensus was reached. If the doubts persisted, then corresponding authors of the articles in question were contacted for clarification. If no response was obtained, than the study was excluded from the analysis.

Data management. The authors of this review conducted the entire process. If a study fulfilled all of the criteria for inclusion, then its information was entered into a SPSS file (SPSS Inc, Chicago, Illinois). We evaluated experimental and group studies and individual cases. In terms of experimental and group studies, we specifically selected RCTs,

Figure 1. PRISMA Flow Diagram



the quality of which we planned to assess according to Cochrane criteria[46] including (1) random sequence generation; (2) allocation concealment; (3) blinding of participants, personnel, and outcome assessors; (4) selective reporting; and (5) incomplete outcome data. In terms of individual cases, whenever possible, demographic and clinical data, alleged indications for ECT use, treatment history before ECT administration, information related to ECT, and clinical efficacy (including follow-up) were collected.

Relevant demographic and clinical data included age, sex, age at OCRD symptom onset, target diagnosis, patterns of comorbidities (eg, OCD/obsessive-compulsive symptoms, other OCRDs, major depressive disorder, bipolar disorder, or schizophrenia), and whether patients were examined with valid assessment tools. Possible indications for ECT were categorized into OCRDs secondary

Table 2. Description of Demographic, Clinical, and Therapeutic-Related Variables in Main Obsessive-Compulsive–Related Disorder Groups[a]

Variable	Tourette's Disorder or Tics (n = up to 30)	Self-Injurious Behavior (n = up to 30)	Body Dysmorphic Disorder (n = up to 9)
Age, mean (SD), y	30.8 (15.3)	21.5 (12.6)	31.4 (11.6)
Sex			
Female	11 (36.7)	9 (30)	3 (60)
Male	19 (63.3)	21 (70)	2 (40)
Age at onset of repetitive behavior, mean (SD), y	12.6 (14.6)	12.3 (9.3)	26 (19)
Course of main repetitive behavior disorder			
Chronic	24 (96)	20 (87)	5 (100)
Episodic	1 (4)	3 (13)	0
Major comorbidities			
Obsessive-compulsive symptoms	20 (66.7)	5 (16.7)	1 (20)
Major depressive disorder	12 (40)	8 (27.6)	5 (100)
Autism	8 (26.7)	15 (50)	0
Bipolar disorder	3 (10)	8 (26.7)	0
Schizophrenia-related disorders	2 (6.7)	8 (26.7)	0
Treatment history			
Antipsychotic prescribed	24 (80)	23 (76.7)	3 (33.3)
SRI prescribed	17 (56.7)	17 (56.7)	3 (33.3)
Psychotherapy	7 (23.3)	18 (60)	1 (11.1)
CBT	3 (10)	15 (50)	1 (11.1)
No. of ECT indications			
> 1	20 (66.7)	25 (83.3)	1 (11.1)
1	5 (16.7)	2 (6.7)	2 (22.2)

[a]Values shown as n (%) unless otherwise noted.
Abbreviations: CBT = cognitive-behavioral therapy, ECT = electroconvulsive therapy, SRI = serotonin reuptake inhibitor.

to other conditions known to be treatable with ECT (eg, depression); treatment-resistant OCRDs; severe OCRDs (ie, conditions resulting in self-injury or risks for patients' physical health); severe major depressive disorder with suicidality or psychosis; catatonia; severe mania, psychosis, or agitation; previous response to ECT or seizures; and the presence of drug side effects or other indications.

We also collected data on individuals' treatment history including previous use of SRIs, antipsychotics, any form of psychotherapy, and concomitant use of antidepressants and psychotherapy during ECT. Information on ECT parameters such as type of electrode placement (unilateral or bilateral), total number of ECT sessions, and weekly frequency of administration was also registered. Finally, data related to patterns of ECT response were collected, including positive versus negative response of OCRDs or associated depression to ECT, whether this response was based on a valid assessment tool or simply the authors' subjective clinical impression, whether patients have been followed up (reassessed) in the absence of ECT use, whether there was a relapse during follow-up, whether a second course of ECT was required, and, if a second course of ECT was required, whether the patient responded.

Statistical analysis. As previously reported,[9] a priori analyses of ECT responders versus nonresponders were planned on the basis of the following variables: age, sex, age at OCRD symptom onset, main OCRD, course of illness, major comorbidities, previous exposure to SRIs or antipsychotics, previous psychotherapy (including CBT), indication for ECT, and number of different indications for ECT. Categorical variables were described in frequencies and compared using χ^2 square and Fisher exact test, and continuous variables were compared using the Mann-Whitney *U* test. Correction for multiple comparisons was performed using the Benjamini-Hochberg test[47] with a false discovery rate set at 0.25.

RESULTS

The search resulted in 833 articles, of which 384 represented repeated references. After initial selection, the titles and abstracts of the remaining 449 articles were further screened, leaving 95 articles for eligibility assessment according to the selection criteria. Eventually, 57[18,45,48–102] articles included OCRD individuals treated with ECT allowing qualitative analysis, and 52[18,45,48–97] articles included information allowing quantitative analysis. The studies by Ghaziuddin et al,[71] Yero et al,[98] Larkin,[99] Bailine and Petraviciute,[100] and Thuppal and Fink[101] were excluded from the quantitative analysis for lacking report of the effects of ECT on repetitive behaviors. We also included studies that did not focus primarily on ECT response but that, nevertheless, allowed collection of data related to response of OCRDs to ECT.[48–53] Figure 1 shows the PRISMA diagram of the research steps.

We were unable to find any RCTs, controlled before and after studies, interrupted time series studies, historically controlled studies, cohort studies, case control studies, or cross-sectional studies. All identified articles were case reports or series. Supplementary Table 1 lists the included studies, their design and number of enrolled participants, and the primary indication for ECT administration. A total of 69 OCRD individuals were treated with ECT, of whom 69.2% presented self-injurious behaviors of different etiologies (autism spectrum disorders, tic disorders or Tourette's disorder, and delusions), 35.4% Tourette's disorder

Table 3. Comparison Between Sociodemographic, Clinical, and Therapeutic Features of Patients Who Responded Versus Those Who Did Not Respond to ECT[a]

Variable	Responded (n = up to 47)	Did Not Respond (n = up to 17)	Statistics
Age, mean (SD), y	25.5 (13.2)	27.2 (14.8)	$Z = -0.431$, $P = .66$
Sex			$P = .13$*
Female	15 (31.9)	7 (53.8)	
Male	32 (68.1)	6 (46.2)	
Age at onset of repetitive behavior, mean (SD), y	14.4 (14.4)	13 (10.6)	$Z = -0.098$, $P = .92$
Main repetitive behavior disorder			$P = .08$*
Self-injurious behavior	23 (48.9)	5 (29.4)	
Tourette's disorder or tics	20 (42.6)	7 (41.2)	
Body dysmorphic disorder	4 (8.5)	5 (29.4)	
Course of main repetitive behavior disorder			$P = .21$*
Chronic	36 (94.7)	9 (81.8)	
Episodic	2 (5.3)	2 (18.2)	
Major comorbidities			
Obsessive-compulsive symptoms	18 (38.3)	7 (53.8)	$\chi^2_1 = 1.013$, $P = .31$
Major depressive disorder	17 (36.2)	5 (41.7)	$P = .48$*
Autism	17 (36.2)	4 (30.8)	$P = .49$*
Bipolar disorder	8 (17)	1 (7.7)	$P = .36$*
Schizophrenia-related disorders	7 (14.9)	2 (15.4)	$P = .63$*
Treatment history			
Antipsychotic prescribed	40 (85.1)	6 (35.3)	$P < .001$*
SRI prescribed	29 (61.7)	4 (23.5)	$\chi^2_1 = 7.284$, $P = .007$
Psychotherapy	21 (44.7)	5 (29.4)	$\chi^2_1 = 1.207$, $P = .27$
CBT	17 (36.2)	2 (11.8)	$\chi^2_1 = 3.562$, $P = .05$
Indication for ECT			
Treatment resistance	35 (77.8)	6 (85.7)	$P = .53$*
Severe repetitive behavior	35 (77.8)	4 (50)	$P = .11$*
Severe major depressive disorder with suicidality or psychosis	14 (31.1)	2 (28.6)	$P = .63$*
Severe mania, psychosis, or agitation	15 (33.3)	1 (14.3)	$P = .29$*
Catatonia symptoms	13 (28.9)	2 (28.6)	$P = .68$*
Drug-related side effects	8 (17.8)	1 (14.3)	$P = .65$*
Secondary repetitive behavior	5 (11.1)	2 (28.6)	$P = .23$*
Previous response to ECT or seizure	1 (2.2)	0	$P = .86$*
No. of ECT indications			$P = .06$*
> 1	40 (88.9)	4 (57.1)	
1	5 (11.1)	3 (42.9)	

[a]Values shown as n (%) unless otherwise noted.
*Fisher exact test.
Abbreviations: CBT = cognitive-behavioral therapy, ECT = electroconvulsive therapy, SRI = serotonin reuptake inhibitors.

or tics (not explicitly involving self-injurious behaviors), 13% body dysmorphic disorder, and 2% trichotillomania (see patient features in Table 2).

The final sample included 64 patients for whom it was possible to establish a positive response to ECT, which was observed in 73.4% of the total cases, including 44.0% of the body dysmorphic disorder, 74.1% of the tic disorder, and 85.7% of the self-injurious behavior patients. Nevertheless, only 12 (17.4%) cases had formal assessments of the severity of their OCRDs before and after the treatment. Further, follow-up was described in only 27 individuals (39.1%), ranging from 1 week to 48 months. Although relapse was noted in more than half (55.6%) of individuals who were followed up, positive responses were reported in all individuals (n = 12) who received a second course of ECT.

We could establish the stimulus electrode placement in 45 OCRD cases: ECT was bilateral in 36 (80.0%), unilateral in 6 (13.3%), and unilateral followed by bilateral or vice versa in 3 (6.7%) patients. In 24 cases, mode of ECT placement was unclear. The mean (SD) number of ECT sessions administered in the first course of ECT, based on a total of 51 available cases, was 11.27 (5.73). Frequency of ECT administration was established in 21 patients. The mean (SD) number of ECT sessions per week was initially 2.95 (0.50). There was a reduction in the frequency of ECT in the first treatment course in 20 (37.0%) cases.

Individuals who did and did not respond to ECT were compared and contrasted (Table 3). Groups did not differ in terms of age, sex, age at OCRD onset, course and pattern of comorbidity, indication for ECT, electrode placement, total number of sessions, and frequency of administration. However, there was a trend for higher frequency of self-injurious behaviors between responders ($P = .08$). Articles describing ECT responders were more likely to report previous unsuccessful treatment with antipsychotics ($P < .001$), SRIs ($P = .007$), and CBT ($P = .05$). However, after the Benjamini-Hochberg procedure was applied, only differences in antipsychotic and SRI exposure remained significant. Publication bias was investigated by comparing the positive responses described in case reports (68.1%) to those reported in case series (n > 1) (31.9%), but no significant differences emerged ($\chi^2_1 = 2.3$, $P = .12$).

DISCUSSION

In this systematic review, we were unable to find any RCT on the use of ECT in OCRD patients. As such, it is not possible to provide unequivocal evidence of the efficacy of ECT in this group of individuals. Although a positive response was reported in 73.4% of published patients, all records were case reports and series, whose ability to provide reliable evidence of treatment benefits are generally undermined by a high probability of selection, information, and, frequently, publication biases.[102,103] Accordingly, case reports and series lie at the penultimate level in the hierarchy of evidence of treatment benefits, being only superior to mechanistic reasoning.[104] However, reviews of such cases have been reported as alternative "clinician-friendly methods" to test hypothetical therapeutic models.[103,105] This theory is consistent with the finding that up to 22% of cases published in a high-impact journal have been followed by trials after a period of sometimes only 5 years.[106] Thus, the available evidence does suggest that an RCT of ECT in OCRDs may be warranted, particularly in more severe tic disorder and self-injurious behavior cases.

We also found that less than 40% of all OCRD patients treated with ECT were evaluated after administration of the index course of ECT (ie, followed up). However, when these follow-up assessments were reported, relapses were noted in more than half of individuals. Similarly high rates of post-ECT relapse in the first year have been described in depression (51% in 1 year)[107] and schizophrenia (42.7 to 63.6%).[108,109] Fortunately, all OCRD individuals who relapsed responded favorably to a repeated course of ECT. High relapse rates coupled with prompt remission after treatment resumption are consistent with an ability of ECT to keep symptoms suppressed until spontaneous remission occurs.[110] As many OCRDs follow a chronic course, future studies should examine the role of maintenance ECT in this specific population. Maintenance ECT has been used safely for up to 12 years[111] and proved effective in depression,[112,113] bipolar disorder,[114] and schizophrenia.[115] However, the cost of sessions and concerns of patients and families about the side effects of prolonged ECT may contribute to withdrawal and discontinuation of maintenance ECT.[116]

Although ECT responders and nonresponders did not differ in most parameters, there was a trend for higher frequency of self-injurious behaviors and greater exposure to unsuccessful trials with antipsychotics and SRIs among the former group. These findings are in sharp contrast to our previous review,[8] in which ECT responders were less likely to have been treated with SRIs or CBT in the past. It is difficult to speculate on the significance of these findings, but they suggest that either (1) ECT is more effective as an augmentation strategy for patients under existing anti-OCRD treatments compared to patients who are not using antipsychotics or SRIs or (2) authors who describe response of OCRD patients to ECT are more likely to emphasize or report previous resistance to antipsychotics or SRIs. We tend to favor the second interpretation, as it may be difficult to support the use of ECT in an atypical population that is not usually seen as responsive to ECT.

Our study has a number of limitations. First, it partly consisted of an analysis of individual cases of OCRDs treated with ECT as reported in the literature, which are subject to missing data. Second, reviewed cases comprised a heterogeneous sample with self-injurious behaviors (69.2%), tic disorders and Tourette's disorder (35.4%), body dysmorphic disorder (13%), and trichotillomania (2%). However, our study should be considered consistent with contemporary models (eg, Research Domain Criteria) suggesting that OCRDs may respond to treatments that cut across traditional diagnostic boundaries. Third, only 12 (17.4%) cases had formal assessments of severity, and no transdiagnostic measure of efficacy was available, so we had to rely on authors' descriptions of treatment response to report efficacy and compare responders to nonresponders. Finally, although it would be interesting to investigate whether risk factors for relapse reflect features related to the underlying OCRD or the initial ECT course,[117] low numbers precluded us from comparing patients that did versus did not relapse.

CONCLUSIONS

The finding that more than 70% of the reviewed cases (including body dysmorphic disorder, tic disorders, autism, and self-injurious behaviors) have shown some response to ECT should not be considered unequivocal evidence of its efficacy in OCRDs. The primary limitation to forming any firm conclusions is that there is currently a total lack of RCTs on the efficacy of ECT in different OCRDs. An additional limitation is that there is an absence of valid transdiagnostic tools for the assessment of treatment response across different OCRDs. Nonetheless, the available evidence does suggest that an RCT of ECT in OCRDs may be warranted, particularly in more severe tic disorders and self-injurious behavior cases in which maintenance ECT may be advisable due to the high relapse rate. The reported association between OCRD response to ECT and previous treatment with antipsychotics and antidepressants suggests that either (1) ECT is more effective as an augmentation strategy for existing anti-OCRD treatments or (2) authors who describe response to ECT are more likely to emphasize or report previous resistance to antipsychotics or antidepressants.

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Supplementary material: See accompanying pages.

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Supplementary material follows this article.

THE PRIMARY CARE COMPANION FOR CNS DISORDERS

Supplementary Material

Article Title: A Systematic Review of the Utility of Electroconvulsive Therapy in Broadly Defined Obsessive-Compulsive–Related Disorders

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List of Supplementary Material for the article

1. Supplementary Table 1. List of Studies Included in the Systematic Review

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This Supplementary Material has been provided by the author(s) as an enhancement to the published article. It has been approved by peer review; however, it has undergone neither editing nor formatting by in-house editorial staff. The material is presented in the manner supplied by the author.

Supplementary Table 1. List of Studies Included in the Systematic Review

Study first author and year	Country	Design	ECT patients, N	Main indication for ECT
Corbella, 1967[1]	France	Case series	2	Unclear
Araneta, 1975[2]	USA	Case report	1	Treatment resistance
Bates, 1982[3]	USA	Case report	1	More than one
Guttmacher, 1988[4]	USA	Case series	1	More than one
Swerdlow, 1990[5]	USA	Case report	1	More than one
Larkin, 1992[6]	UK	Case report	1	Unclear
Phillips, 1993[7]	USA	Case series	4	Unclear
Carroll, 1994[8]	USA	Case report	1	Severe Major depression
Cizadlo, 1995[9]	USA	Case report	1	More than one
Rapoport, 1998[10]	Canada	Case report	1	Severe Major depression
Thuppal, 1999[11]	USA	Case series	1	Severe Major depression
Dean, 2000[12]	USA	Case report	1	More than one
Godart, 2000[13]	France	Case report	1	Unclear
Myers, 2002[14]	USA	Case report	1	More than one
Friedlander, 2002[15]	Canada	Case series	1	More than one
Trivedi, 2003[16]	USA	Case report	1	More than one
Kessler, 2004[17]	USA	Case series	1	Severe Major depression
Strassning, 2004[18]	Germany	Case report	1	Previous response to ECT or convulsion
Kelly, 2004[19]	USA	Case report	1	More than one
Karadenizeli, 2005[20]	Turkey	Case report	1	More than one
Houeto, 2005[21]	France	Case report	1	Unclear
Ghaziuddin, 2005[22]	USA	Case report	1	More than one
Yero, 2006[23]	USA	Case series	1	Others
Morais, 2007[24]	Brazil	Case report	1	More than one
Okada, 2007[25]	Japan	Case report	1	More than one
Bailine, 2007[26]	USA	Case series	1	More than one
Dehning, 2008[27]	Germany	Case report	1	More than one
Sperling, 2008[28]	Germany	Case report	1	Treatment resistance
Fisher, 2008[29]	USA	Case report	1	More than one
Arora, 2008[30]	India	Case report	1	More than one
Wachtel, 2008[31]	USA	Case report	1	More than one
Kakooza-Mwesige, 2008[32]	-	Case report	1	More than one
Wachtel, 2009[33]	USA	Case report	1	More than one
Fink, 2009[34]	USA	Case report	1	More than one
Dhossche, 2010[35]	USA	Case series	2	More than one
Watchel, 2010[36]	USA	Case report	1	More than one
Dehning, 2011[37]	Germany	Case series	4	Unclear
Dehning, 2011[38]	Germany	Case report	1	More than one
Watchel, 2011[39]	USA	Case report	1	More than one

Ghaziuddin, 2011[40]	USA	Case series	2	More than one
Duits, 2012[41]	Netherlands	Case report	1	More than one
Siegel, 2012[42]	USA	Case report	1	More than one
Rapinesi, 2013[43]	Italy	Case report	1	Treatment resistance
Consoli, 2013[44]	France	Case series	4	More than one
Navinés, 2013[45]	Spain	Case report	1	Unclear
Watchel, 2013[46]	USA	Case report	1	More than one
Rajashree, 2014[47]	India	Case report	1	More than one
Watchel, 2014[48]	USA	Case report	1	More than one
Haq, 2014[49]	USA	Case series	1	More than one
Okazaki, 2015[50]	Japan	Case report	1	Severe Catatonia
Watchel, 2015[51]	USA	Case report	1	More than one
Dhossche, 2015[52]	USA	Case report	1	More than one
Mahato, 2016[53]	USA	Case report	1	More than one
Guo, 2016[54]	USA	Case report	1	More than one
Clinebell, 2016[55]	USA	Case series	1	More than one
Katz, 2017[56]	USA	Case report	1	More than one
Sajith, 2017[57]	Singapore	Case series	2	More than one

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