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Electroconvulsive Therapy as Maintenance Treatment in Psychiatric Disorders

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Abstract

Purposeof Review Following symptom remission with acute electroconvulsive therapy (ECT), maintenance ECT (M-ECT) is often used to prevent relapse. This review provides a concise summary of the evidence for M-ECT in various psychiatric disorders, outlines the cognitive adverse effects of M-ECT, and discusses clinical considerations while using M-ECT.

Recent Findings Adjunctive M-ECT has considerable evidence for relapse prevention efficacy in depressive and psychotic disorders, preliminary evidence for efficacy in bipolar disorders, and insufficient evidence in other disorders such as obsessive–compulsive disorder. Careful selection of candidates for M-ECT may yield better results. Older adults represent a subgroup where M-ECT may be a safe and effective option for maintaining clinical remission. No significant cognitive adverse effects have been observed with M-ECT in controlled trials. Because no guidelines exist to inform decision-making on the duration and frequency of M-ECT sessions, clinicians may be better off using a symptom-driven, risk–benefit approach with periodic reassessment of the need for M-ECT every 3–6 months and following a tapering schedule for stopping M-ECT. Major gaps in available evidence include a lack of controlled observations and heterogeneity in sampling and ECT administration parameters that limit the generalizability of findings.

Summary Adjuvant M-ECT is a safe and effective treatment option for maintaining clinical remission and improving patient-reported outcomes in depressive and psychotic disorders. For other disorders, insufficient evidence exists. There is a need for more rigorous, controlled efficacy and cost-effectiveness trials comparing M-ECT against maintenance pharmacotherapy, across contexts and indications, to inform clinical recommendations.

Keywords Electroconvulsive therapy · Maintenance electroconvulsive therapy · Continuation electroconvulsive therapy · Psychiatric disorders · Mental illness · Effectiveness

Introduction

Electroconvulsive therapy (ECT) refers to the induction of seizures via the passage of electric current for therapeutic purposes. It is a well-established treatment modality for treating acute episodes of psychoses or affective disorders. It has demonstrated benefits in various other psychiatric as well as neurological conditions. ECT is proven to be efficacious in case of failure of pharmacotherapy maintenance [1]. While the efficacy is unchallenged, relapse after a successful course of treatment in the acute episode has been challenging. The rates of relapse after discontinuation of ECT are high [2]. This warrants some form of treatment for prophylaxis to prevent relapse or recurrence of episodes. Continuation ECT (C-ECT) and maintenance ECT (M-ECT) has become a common psychiatric practice worldwide [3].

The current review was done to synthesize the literature on M-ECT in the management of psychiatric disorders. Specifically, our objectives were (1) to describe the evidence for M-ECT in major psychiatric illnesses and (2) to explore the literature on M-ECT in special populations.

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Definitions

It is common practice in psychiatry to continue using the form of treatment used in acute symptom control to prevent relapses and recurrences. After acute-phase ECT is completed, the continuation of ECT for the first 6 months is known as C-ECT. Beyond 6 months, it is called M-ECT [4]. Thus, while C-ECT intends to reduce the relapse risk, M-ECT is used to reduce the risk of recurrence of further episodes (Fig. 1). This 6-month dividing line is only by convention [5]. Often, the terms M-ECT and C-ECT are used interchangeably. In this paper, the term M-ECT will be used to refer to any use of ECT beyond the acute phase treatment.

Relapse After Index ECT: a Problem Statement

ECT is highly effective in treating acute psychiatric illnesses. However, patients often relapse after the acute phase ECT. Studies have reported that more than 50% of patients experience relapse following a successful short-term course of ECT treatment [6]. Almost half of the patients with depression on continuation pharmacotherapy relapse within a year, with maximum risk in the first 6 months [7]. A follow-up study in depressed patients found an overall relapse rate of 53% in 1 year regardless of parameters used for index ECT [8]. The relapse rate for patients with schizophrenia ranges from 42.7 to 63.6%, with most recurrences happening within 6 months after treatment [9, 10•]. These findings suggest that an illness with a natural course severe enough to warrant ECT for acute management tends to have a high relapse without adequate long-term treatment. The discontinuation of M-ECT has been shown to be associated with significant clinical deterioration and re-hospitalization [2, 11–13]. The COVID-19 pandemic was an exceptional situation that further buttressed this argument. Studies examining the clinical outcome of patients in whom M-ECTs and C-ECTs were discontinued due to the COVID-19 pandemic showed high relapse rates after discontinuation [6, 14–17].

Methods

Search Strategy

An electronic search of MEDLINE and Google Scholar databases was done (till June 2023) for articles on M-ECT and C-ECT. The searches were done by two independent reviewers who were qualified psychiatrists. The search strategy used for MEDLINE was (((continuation[Title/Abstract]) OR (maintenance[Title/Abstract])) AND (((ECT[Title/Abstract]) OR (Electroconvulsive therapy[Title/Abstract])) OR (electroconvulsive therapy[MeSH Terms]))) AND ((((((((((((((psychiatr*[Title/Abstract]) OR (mental disorder[Title/Abstract])) OR (schizophrenia[Title/Abstract])) OR (psychosis[Title/Abstract])) OR (psychotic disorder[Title/Abstract])) OR (schizo*[Title/Abstract])) OR (bipolar[Title/Abstract])) OR (mania[Title/Abstract])) OR (depressi*[Title/Abstract])) OR (obsessive compulsive disorder[Title/Abstract])) OR (mental disorder[MeSH Terms])) OR (disorder, psychotic[MeSH Terms])) OR (affective psychosis, bipolar[MeSH Terms])) OR (depressive disorders[MeSH Terms])) OR (mania[MeSH Terms])) OR (disorder, obsessive compulsive[MeSH Terms])). Manual searches from the references of the generated articles were also done to include any articles that were missed in the electronic search.

Study Selection and Data Extraction

There were 725 results in the initial search. Only articles in English were included. We included original research such as controlled trials and observational studies in psychotic and affective disorders and case reports in areas where evidence of M-ECT is otherwise lacking such as Obsessive Compulsive Disorder (OCD). We focused on

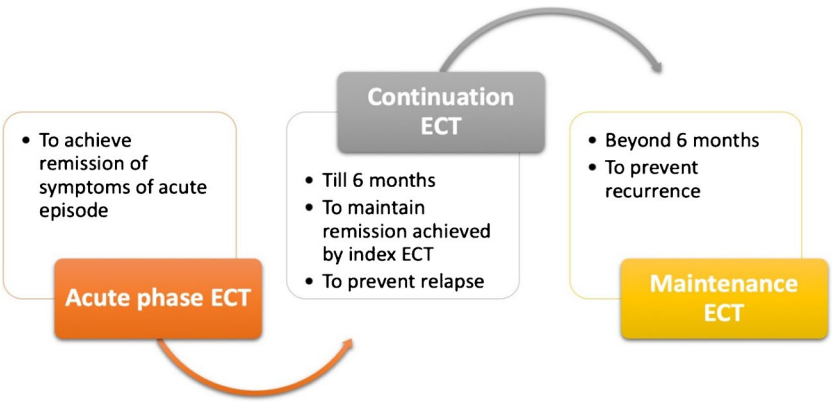

Fig. 1 Phases of electroconvulsive therapy

research pertaining only to clinical efficacy and outcomes and excluded articles focusing on other parameters such as cost-effectiveness, cognitive outcomes, and side effect profile. Review articles, viewpoints, and commentary papers were not included as they did not contain any original data. With these criteria, we included 175 articles for initial title/abstract screening. Following this screen, 96 articles were selected for full-text review. After excluding articles that were not relevant to the objectives, 45 articles remained and were included for the final review. Two independent reviewers were involved in the study selection process, and both agreed regarding the included papers.

This review aimed to synthesize the existing literature on the efficacy of M-ECT on various psychiatric disorders. Although there are prior systematic reviews on ECT for disorders such as depression and psychosis, we favored a narrative review for two reasons: first and more importantly, it did not constrain us from including evidence in the form of case reports in areas where original articles were lacking (such as OCD and special populations such as pregnant women), and second, it permitted us to provide a broader perspective on a topic where controlled studies are limited.

The articles included in the review were categorized into the following themes: trials that evaluated the efficacy of M-ECT in major psychiatric disorders (depression, bipolar illness, obsessive–compulsive disorder). Information regarding the effect of M-ECT on cognition and cost-effectiveness of M-ECT and the effectiveness of ECT in special populations such as children, pregnant women, and older adults is also discussed.

Results

Among the 45 articles included in the review, 37 were original articles and 8 were case reports. Of the 37 original articles, there were only 8 randomised Controlled Trials (RCTs), out of which only one was published in the last 5 years. This indicates that controlled trials are lacking in this area.

Evidence for Maintenance ECT

Since the inception of ECT, the use of C-ECT and M-ECT has been well-documented [18]. However, it is reserved only for the most resistant cases in clinical practice. It is pertinent to note that the American Psychiatric Association (APA) Task Force in 1974 reported a role for ECT in treating depression, intractable mania, and treatment-resistant schizophrenia; however, they did not mention C-ECT in the report [19]. Later, the 2001 task force report by APA established indications for C-ECT and M-ECT in patients responding to an acute ECT course when (1) pharmacotherapy has been ineffective in treating acute episodes or preventing relapse or recurrence.; (2) administering pharmacotherapy safely is not possible; or (3) the patient or their designated representative has expressed a preference for ECT [4]. Table 1 summarizes the evidence for M-ECT in psychotic and affective disorders.

Maintenance ECT in Major Depressive Disorder

There is extensive literature covering the use of M-ECT following index ECT for depression. A systematic review in 2014 concluded that the combination of C/M-ECT and pharmacotherapy outperforms monotherapy in preventing the recurrence of unipolar depressive episodes [20•]. Three RCTs [21–23] and one quasi-experimental study [24] were included in the review. Elias et al. (2017) conducted a meta-analysis of RCTs on the efficacy of M-ECT in unipolar and bipolar depression in 436 subjects [21, 22, 25, 26]. They found that M-ECT was associated with significantly less relapses when compared with pharmacotherapy alone at 6 months and 1 year [27•]. One of the latest systematic reviews on M-ECT in depression conducted by Rowland et al. (2023) also suggested reduced relapse rates in patients receiving C/M-ECT with no effect on global cognitive function [28••]. Introduction of M-ECT also reduces mean hospital days and illness days/year along with overall relapse rates and increases chances of clinical remission [29–35].

Several other reviews provide an exhaustive discussion of this area [20•, 36–38]. An RCT randomly assigned remitted depressed patients after ECT to maintenance pharmacotherapy (M-Pharm) consisting of lithium plus venlafaxine versus this combination plus four-weekly ECT treatments followed by "as needed" supplemental treatments for the return of depressive symptoms. This method of using M-ECT was termed "STABLE" ("symptom-titrated, algorithm-based longitudinal ECT"). The follow-up period was 6 months, at the end of which the combined modality group had a lower mean Hamilton Rating Scale for Depression (HAM-D) scores [25]. Combined M-ECT and pharmacotherapy has been shown to be associated with significantly lesser relapses/recurrences when compared with maintenance pharmacotherapy alone [39–43].

In conclusion, patients with intractable, recurrent mood disorders and associated psychotic symptoms often benefit more from M-ECT. Specifically, it can be considered in patients who had multiple hospitalizations in the past, multiple medication trials and who needed ECT to remit from the acute episode. However, patients with comorbid personality disorders may do less well. Clinicians must use their own judgment to make decisions on a case-by-case basis.

Maintenance ECT in Bipolar Disorder

Not only depression but M-ECT has also been reported to reduce occurrences of mania/hypomania in bipolar patients

Table 1 Characteristics of included studies on psychotic and affective disorders

Author, year	Type of study	Sample size and characteristics	Main findings
Kellner et al., 2006 [21]	RCT	C-ECT ($n=89$) vs C-Pharm ($n=95$) in unipolar depression	• No statistically significant difference among groups in the outcome (relapse, no relapse, and dropout)
Serra et al., 2006 [23]	RCT	C/M-ECT + TCA ($n=6$) vs TCA ($n=13$) in elderly psychotic unipolar depression	• Relapse/recurrence rates were significantly higher in the TCA-only subgroup after 2 years
Navarro et al., 2008 [22]	RCT	C/M-ECT + TCA ($n=16$) vs TCA ($n=17$) in elderly psychotic unipolar depression	• The TCA group presented a higher rate of relapse and a shorter time until relapse ($p=0.009$)
Nordenskjold et al., 2013 [26]	RCT	$n=56$ patients (unipolar or bipolar depression) were randomly assigned (1:1) to receiving either M-ECT with pharmacotherapy or pharmacotherapy alone	• 61% in the pharmacotherapy group relapsed within 1 year versus 32% of the patients treated with ECT plus pharmacotherapy ($P=0.036$)
Petrides et al., 2015 [36]	RCT	M-ECT + Clozapine ($n=20$) vs Clozapine ($n=19$)	• 50% of the M-ECT plus clozapine patients met the response criterion. None of the patients in the clozapine group met the criterion
Kellner et al., 2016 [25]	RCT	Geriatric depression: medication only ($n=59$) vs M-ECT with medication ($n=61$)	• At 24 weeks, the M-ECT plus medication group had statistically significantly lower HAM-D scores than the medication only group
Yang et al., 2016 [55]	RCT	C/M-ECT + Risperidone ($n=31$) vs Risperidone ($n=31$)	• Patients receiving M-ECT with risperidone had lower relapse rate and longer relapse-free survival compared to risperidone alone ($p=0.003$)
Mishra BR et al., 2022 [57]	RCT	M-ECT vs clozapine in TRS ($n=60$)	• PANSS scores changes at 6 months were significant in both M-ECT and clozapine groups ($P<0.001$), with comparatively better reduction with M-ECT ($P<0.001$)
Swoboda et al., 2001 [43]	Quasi-experimental	21 patients (13 depression and 8 schizoaffective disorder) who underwent M-ECT were compared with controls who received maintenance pharmacotherapy (M-pharm) alone after 1 year follow-up	Combined M-ECT/pharm ($n=21$) vs M-pharm ($n=21$): • Re-hospitalization rates: 3.3% vs 66.7% • Mean hospital days: 61 vs 76 (p-0.02)
Rapinesi et al., 2013 [39]	Quasi-experimental	7 elderly patients with major depression with M-ECT compared with controls who received maintenance pharmacotherapy after acute ECT	• The M-ECT group had significantly less mean relapses/recurrences (0 vs 1.57) and hospitalizations (0 vs 1)
Chanpattana, 1999 [53]	Open-label trial	C/M-ECT + pharm vs C- pharm alone vs C-ECT alone in TRS	• 6/15 (40%) of patients who received M-ECT + pharm relapsed compared to 14/15 (93%) of patients who received M-ECT alone or C-pharm alone
Vanelle et al., 1994 [33]	Prospective	$N=22$ patients with intractable mood disorders	• Reduction in hospital days—44% of the year spent in hospital with at least three episodes a year prior to M-ECT vs 7% of the year during M-ECT ($p<0.001$)
Suzuki et al., 2006 [58]	Prospective	$N=12$ patients of schizophrenia	• The difference in the time to relapse during C-pharm alone was significantly lower than combined C-pharm and ECT (63.7 ± 55.7 days vs 153.0 ± 30.0 days; $P<0.01$)

Table 1 (continued)

Author, year	Type of study	Sample size and characteristics	Main findings
Minnai et al., 2011 [49]	Prospective naturalistic follow-up study	Rapid cycling bipolar disorder, $n=14$	Before and after M-ECT administered over a 2-year period: • Episodes/year: 6.1 vs 0.9 ($p<0.0001$) • Illness days/year: 303.9 vs 23.9 ($p<0.0001$) • Relapse rate: 42% ($n=6$) had one relapse per year
Huuhka et al., 2012 [63]	Prospective	One-year follow-up after discontinuing M-ECT in 45 patients of schizophrenia	• 44% relapsed after discontinuation of M-ECT on average after 3.5 months
Van de Velde et al., 2021 [17]	Prospective naturalistic follow-up study	Outcome of discontinuation of M-ECT during the COVID-19 pandemic	• Relapse after discontinuation was 60.6%
Methfessel I et al., 2021 [6]	Prospective	Outcome of discontinuation/modification of M-ECT at 6 months: n = 7 without modification, n = 12 reduced frequency of sessions, n = 34 discontinued	• Both reduced frequency and discontinuation of C-/M-ECT were associated with significant clinical deterioration as measured by CGI-I • Increased re-hospitalization rates
Gagne et al., 2000 [40]	Retrospective	Unipolar depression, $n=46$ Bipolar depression, $n=3$	M-ECT/pharm ($n=29$) vs M-pharm ($n=29$) • 2-year relapse rates: 7% vs 48% • 5-year relapse rates: 27% vs 82% • Mean time to relapse: 6.9 years vs 2.7 years ($p<0.001$)
Russell et al., 2003 [29]	Retrospective	Unipolar nonpsychotic depression:19, unipolar psychotic depression:15, bipolar disorder: 4, schizoaffective disorder: 5	Mean hospital days per patient in the year before and during M-ECT initiation 3.23 vs. 18.76 ($p<0.001$)
Odeberg et al., 2008 [42]	Retrospective	$N=40$ Unipolar depression ($n=25$) Bipolar depression ($n=10$) Mixed/mania($n=5$)	Before vs during C-ECT/pharmacotherapy • Total number of admissions 81 vs 19, ↓ 64% ($p<0.001$) • Total no. days in hospital 2976 vs 712, ↓ 79% ($p<0.001$)
Gupta et al., 2008 [24]	Retrospective	Comparison of number of hospital admissions and duration of hospital stay of $n=19$ patients: 2 years before ECT, during M-ECT, and up to 4 years after cessation of M-ECT	• Significant reduction in mean admission rates from the pre-MECT to the MECT period but not between M-ECT and post-M-ECT phases
Lévy-Rueff M et al., 2010 [59]	Retrospective	$N=19$ patients of schizophrenia or schizoaffective	• 80% reduction in the mean duration of yearly hospitalization
O'Connor et al., 2010 [41]	Retrospective	Age group: 65 to 92 years RDD, $n=50$ BPAD, Current depression, $n=3$	Days of hospitalization before vs after – 87.8 vs 19.9; ↓ 79% ($p<0.001$)
Nordenskjold et al., 2011 [30]	Retrospective	$n=27$ patients of severe depression	• Hospital day quotient was lower (HDQ = 15) during C-ECT than during the 3 years prior to C-ECT (HDQ = 26)
Shelef et al., 2015 [60]	Retrospective	42 older patients with severe mental illness	• Average 1.88 admissions before M-ECT and 0.38 admissions in the M-ECT period ($P<0.001$) • Duration of mean hospitalization stay decreased from 215.9 to 12.4 days during M-ECT ($P<0.01$)

Table 1 (continued)

Author, year	Type of study	Sample size and characteristics	Main findings
Post T et al., 2015 [32]	Retrospective	$N=19$ treatment-resistant affective disorders	• Significant decline in the mean number of hospitalizations per year (0.87 vs. 0.28, $p<0.001$) after M-ECT • Reduction in average number of inpatient days per year (30.8 vs. 4.5 days, $p<0.001$), • Reduction in mean duration of hospital stays (30.5 vs. 16.7 days, $p=0.02$)
Youn et al., 2019 [54]	Retrospective	38 patients were followed up retrospectively for 2 years and classified into three groups: (1) clozapine alone (CZP, $n=15$), (2) acute ECT only (A-ECT, $n=11$), and (3) acute ECT with M-ECT (M-ECT, $n=12$)	• M-ECT maintained acute ECT-induced improvements in psychotic symptoms, which could be reduced to a level observed in patients using clozapine alone during a long-term observation period • Psychotic symptoms gradually deteriorated to pre-ECT levels if additional ECT sessions were not administered
Krepela et al., 2019 [61]	Retrospective	$N=19$ patients with TRS	• M-ECT beneficial ($p<0.001$) in removing chronic serious symptoms
Hausmann et al., 2019 [31]	Retrospective	$N=27$ with mood disorders	• Significant decline in the mean number of hospitalizations per year (0.64 vs 0.32, $P=0.031$) after M-ECT • Reduction in average number of inpatient days per year (23.7 vs 6.1 days, $P<0.001$), • Reduction in mean duration of hospital stays (41.6 vs 22.1 days, $P=0.031$)
Martínez-Amorós et al., 2020 [2]	Retrospective	Retrospective evaluation of $n=73$ patients discontinued from c/m-ECT at 1 year	• Thirty-six patients (49.3%) relapsed after discontinuation of M-ECT • 61.1% of them relapsed during the first year and 36.1% during the first 6 months of discontinuation • The estimated time to recurrence was 38.67 months
Isserles et al., 2020 [62]	Retrospective	$N=62$ M-ECT courses reviewed with schizophrenia or schizoaffective disorder	• Clinical response in 48 (77%)
Atashnama et al., 2020 [34]	Retrospective	$N=22$ patients of MDD on M-ECT	• In 16 out of 22 patients, more than 70% of the visits/consultations were charted as being in remission
Luccarelli et al., 2020 [35]	Retrospective	$N=100$ patients who received 50 or more sessions of M-ECT	• 36% continued to be on M-ECT at the end of the study period • 64% stopped M-ECT. Most common reason of stopping M-ECT was clinical remission (54.6%)
Kocamer Şahin et al., 2021 [11]	Retrospective	$N=70$ patients who had undergone M-ECT were compared with a control group of 70 patients who received only acute ECT	• Mean number of patients hospitalized in the M-ECT group: 0.55 ± 0.87 • Control group:1.13 ± 1.31

Table 1 (continued)

Author, year	Type of study	Sample size and characteristics	Main findings
Madero et al., 2022 [73]	Retrospective	$N = 43$ patients with bipolar disorder	• Effectiveness of 62.2% for preventing psychiatric hospitalizations ($p < 0.01$) • Comparison of the 3-year period before/during M-ECT showed a reduction in mean annual days (RR = 0.14; 95%CI: 0.07–0.29) and mean annual number (RR = 0.24; 95%CI: 0.13–0.43) of psychiatric hospitalizations
Stegmann et al., 2023 [13]	Retrospective	$N = 14$ patients on M-ECT	■ • Duration of time in hospital during M-ECT, compared with pre-ECT, was reduced by 52% for all patients • Greater reductions for patients with mood disorders compared with those with schizophrenia
Schwartz T et al., 1995 [12]	Cross-sectional comparative	Comparison of M-ECT patients ($N = 21$) with controls	• Rate of rehospitalization lesser by 67% in M-ECT group

BPAD, bipolar affective disorder; *C-ECT*, continuation ECT; *CGI-I*, clinical global impression – global improvement; *C-Pharm*, continuation pharmacotherapy; *CI*, confidence Interval; *CZP*, clozapine; *ECT*, electroconvulsive therapy; *HAM-D*, Hamilton depression; *MDD*, major depressive disorder; *M-ECT*, maintenance ECT; *M-Pharm*, maintenance pharmacotherapy; *PANSS*, Positive and Negative Syndrome Scale; *RCT*, randomized controlled trial; *RDD*, recurrent depressive disorder; *RR*, relative risk; *TCA*, tricyclic antidepressant; *TRS*, treatment resistant schizophrenia.

[44, 45]. Most research has consisted of naturalistic, retrospective, and prospective follow-up studies and case reports. The patient numbers are generally very small, with heterogeneity in outcome measures and use of concomitant medications. Observational studies suggest that M-ECT is useful in reducing the number of psychiatric hospitalizations and hospitalization days in bipolar disorder [13, 31]. Several case reports exist of patients with refractory bipolar disorder whose illness was stabilized with M-ECT [46–48]. Positive evidence of the effectiveness of M-ECT in decreasing morbidity in rapid cyclers was found in a pre-post study design [49]. Data also supports the prophylactic role of M-ECT in bipolar disorders [33, 50]. We could not find any RCTs assessing M-ECT specifically in bipolar disorder. However, studies on resistant depression have included bipolar depression as well.

Despite the lack of robust evidence in the form of controlled trials, M-ECT seems useful in treating refractory bipolar disorder and rapid cyclers. It can also be used as a maintenance treatment to prevent relapse in bipolar patients. Continuation of mood stabilizers and other psychotropics along with M-ECT can be left to the clinician's discretion as deemed necessary.

Maintenance ECT in Psychotic Disorders

Patients with schizophrenia also experience a rapid relapse of symptoms after abruptly discontinuing ECT, similar to patients with affective disorders [25, 51]. M-ECT is recommended for treating patients with treatment-resistant schizophrenia (TRS) since additional ECT sessions after acute ECT can maintain mood improvement or prevent mood disorders from relapsing [52]. The first RCT of continuation or maintenance ECT for schizophrenia observed combining M-ECT with high-dose neuroleptic treatment is more effective than either treatment alone in patients with ECT-responsive TRS [53]. The improvement observed was sustained and even decreased to the level of the symptoms in the clozapine alone group at the end of 2 years in a retrospective study of TRS patients [54]. Several other studies have replicated the same findings [55–58]

Ward et al. (2018) systematically reviewed three RCTs, five retrospective studies, nine open-label trials, and 18 case reports, suggesting that M-ECT is effective for preventing relapse in schizophrenia along with continued antipsychotic treatment [10•]. Not only in schizophrenia but also in schizoaffective disorder, the time to re-hospitalization in patients receiving M-ECT and drugs was observed to be longer when compared with patients receiving maintenance pharmacotherapy alone [43, 59, 60].

Evidence suggests that M-ECT efficiently maintains the improvement in psychotic symptoms [61–63]. Some poor predictors of M-ECT response in schizophrenia include

higher brief psychiatric rating scale (BPRS) scores, lower percentage reduction in BPRS scores, lower Global Assessment of Functioning (GAF) scores at baseline, earlier onset of illness, more hospitalization, and lower education levels [64]. Patients with good prognostic features may benefit even with more spacing between ECT sessions.

Maintenance ECT in Obsessive–Compulsive Disorder (OCD)

M-ECT is not an approved treatment for OCD but has been reported effective in treatment-refractory cases of OCD. A total of 8 case reports on the effect of M-ECT in OCD have been reported till date (Table 2). The cases described are mostly treatment-refractory OCD [65–68] or comorbid OCD and schizophrenia/schizoaffective/mood disorder [69, 70]. M-ECT in a patient of OCD with Asperger syndrome has been reported [71]. Apart from these, it has also been used in antipsychotic-induced OCD [72]. No controlled trials evaluating the efficacy of M-ECT in OCD are available.

Cost-Effectiveness

Studies on cost analyses of M-ECT are unavailable yet. Regarding direct costs, M-ECT might be costlier than maintenance pharmacotherapy, depending on the setting. However, hospitalization rates, which can be considered a proxy marker of cost-effectiveness, are reduced consistently in the follow-up period during M-ECT [12]. M-ECT has been shown to reduce time spent in depression from 50 to 34% of life-years in a western study; the authors found that M-ECT may be a cost-effective treatment option for drug-resistant depression [74]. It reduces the indirect costs related to illness-related unemployment, absenteeism, lost wages, and other disabilities [75].

Impact of Maintenance ECT on Cognition

Cognitive problems have been demonstrated with acute ECT but are limited to the first few days post-treatment. Interestingly, information processing speed, working memory, anterograde memory, and some aspects of executive function are improved beyond baseline levels after 15 days [76]. In phase 2 of the Consortium for Research in ECT (CORE) trial, no significant differences in Mini Mental State Examination (MMSE) scores were observed between M-ECT and maintenance pharmacotherapy groups. Interestingly, in this study, the relapse rate in the C-ECT group was higher than the maintenance pharmacotherapy group, although the difference was not statistically significant [21]. Similar findings of the superiority of M-ECT over maintenance pharmacotherapy were noted in prospective studies of other affective and psychotic disorders [22, 43, 53]. At 6 months, extensive neuropsychological assessment did not find evidence of cognitive decline with M-ECT and no significant differences in cognitive functioning between M-pharm and M-ECT groups [77]. One of the latest systematic reviews including nine studies suggested no detrimental effect of M-ECT on cognitive functioning [78]. In individual cases where concerns of cognitive side effects arise, high-dose unilateral ECT can be preferred over bilateral ECT due to its superior cognitive effect profile [8].

Table 2 Characteristics of included studies on obsessive–compulsive disorder (OCD)

Author, year	Type of study	Sample size and characteristics	Main findings
Husain et al., 1993 [66]	Case report	65 years, female, refractory OCD	Maintained well with M-ECT for 1 year
Casey DA & Davis MH, 1994 [67]	Case report	84 years, female, refractory OCD	Maintained well with M-ECT for 1 year
Nilsson BM & Ekselius L., 2009 [71]	Case report	38 years, male, OCD with Asperger syndrome	Maintained well with M-ECT for 18 months
Rao et al., 2011 [72]	Case report	40 years, female, schizophrenia with clozapine associated OC symptoms	• No improvement with addition of SSRI • Response to acute ECT • Relapse of OC symptoms on stopping ECT, maintained well on M-ECT
Raveendranathan et al., 2012 [68]	Case report	36 years, female, refractory OCD	YBOCS dropped from 40 to 25 with M-ECT at 6 months
Hanisch et al., 2012 [70]	Case report	48 years, female, schizo-obsessive	Remitted with M-ECT fortnightly with sertindole and mirtazapine
Bulbul et al., 2013 [69]	Case report	33 years, male, OCD with bipolar disorder	Remitted with combination of pharmacotherapy and M-ECT
Agrawal et al., 2018 [65]	Case report	18 years, male, refractory OCD	YBOCS dropped from 35 to 6 with M-ECT

M-ECT, maintenance ECT; *SSRI*, selective serotonin reuptake inhibitor; *YBOCS*, Yale Brown Obsessive Compulsive Scale

Clinical Considerations

Dosing

There is a lack of established guidelines for the duration and frequency of M-ECT. In clinical practice, M-ECT is tailored to individual patient's needs, usually given for the duration of the natural course of illness. The prolonging remission in depressed elderly (PRIDE) study followed a symptom-titrated algorithm-based longitudinal ECT (STABLE) approach that included an initial fixed treatment schedule of four ECT treatments in the first month followed by a symptom-driven, individualized treatment algorithm [51]. Clinicians also follow a fixed-interval schedule with treatments every 1–4 weeks and an "as-needed" approach with 1–2 additional treatments each time there are signs of relapse. The APA recommends reassessing the need for M-ECT at least every 3 to 6 months [36]. Clinicians are encouraged to assess the benefits and risks of the procedure at each session, as well as the need for greater or lesser spacing of treatment.

Stopping of Maintenance ECT

If remission has been sustained long enough, M-ECT can be stopped and symptoms monitored. Rescue ECT can be given if relapse signs appear [20•, 64]. A tapering schedule of weekly sessions of 2 to 4 weeks followed by a gradual decrease to once per month has been described [79].

Maintenance ECT in Special Population

Older Adults

Continuation-maintenance ECT is also an effective option in geriatric patients, in whom pharmacotherapy has its own risks [41]. ECT is generally safe in geriatric population with medical comorbidities, intolerability, or poor response to pharmacotherapy [80]. Second phase of the PRIDE study found that remitted older patients randomized to receive continuation ECT plus pharmacotherapy (venlafaxine and lithium) showed significantly lower depressive symptoms during a 6-month period when compared to patients treated with pharmacotherapy alone [81••].

A large systematic review of M-ECT in depressed elderly patients by van Schaik et al. (2012) concluded that M-ECT is as effective as continuing pharmacotherapy in geriatric depression after a successful course of ECT in the acute stage [82]. Acute ECT, followed by M-ECT, also reduced readmission rates and duration of hospital stay in elderly patients with schizophrenia [60]. Although the risk of cognitive side effects has been raised, data suggests using newer ECT techniques, like right unilateral ultra-brief pulse ECT can minimize adverse ECT-related cognitive effects [83]. Thus, M-ECT can be considered a safe and effective treatment in geriatric patients with medical comorbidities, where pharmacotherapy is considered risky.

Children and Adolescents

Data regarding the efficacy of M-ECT in this age group is scarce. Case reports and case series of M-ECT for patients with autism presenting with catatonia and self-injurious behaviors not responding to medications have been described; notably, a reduction in the frequency of M-ECT sessions led to relapse [84, 85]. Unspecified catatonia has been reported in a cohort of patients with Down's syndrome maintaining well on M-ECT [86]. A retrospective study on the effectiveness of M-ECT in children with schizophrenia spectrum disorder showed that a combination of M-ECT and pharmacotherapy resulted in significantly lower positive and negative symptoms of schizophrenia (PANSS) scores at 6 months following the acute ECT course. Furthermore, when the frequency of ECT was reduced, two out of seven patients experienced a relapse [87]. Section 95 of the Mental Health Care Act in India mandates the consent of guardians and the Mental Health Review Board for the use of ECT in minors [88]. Thus, M-ECT in children should be considered based on a careful risk–benefit assessment.

Pregnant Women

Only case reports are available for M-ECT in pregnant women. In one of the case reports, a patient with depression received 18 sessions in the second and third trimesters of pregnancy, and 13 sessions were administered post-elective cesarean delivery as maintenance treatment. The patient was shifted successfully to pharmacotherapy 6 months postpartum [89]. A similar case has also been reported in another pregnant female with psychotic depression [90]. No controlled trials of M-ECT are available in this population.

Discussion

The primary purpose of this review was to examine the evidence of M-ECT in various psychiatric disorders and psychiatric subpopulations. Our findings point to M-ECT being a safe and effective option for prolonging remission in certain patients such as those non-responsive/intolerant to pharmacotherapy, elderly, and patients with comorbidities in whom potential for drug interactions limit pharmacological options. Reduced relapse rates and recurrences have been observed in mood and psychotic disorders [10•, 20•, 27•].

M-ECT has considerable evidence for preventing relapses and recurrences in mood disorders, with greater

evidence for unipolar depression. No study has found M-ECT to be inferior to pharmacotherapy. The majority of the RCTs on depression are conducted in geriatric population and depression with psychotic symptoms. Consistent evidence suggests that combined pharmacotherapy and M-ECT outperform either of these treatments administered alone [20•]. M-ECT in bipolar disorder has been shown to stabilize the illness course in rapid cyclers, with a significantly lesser number of episodes and more illness-free days [91]. Similar to major depressive disorder (MDD), evidence on bipolar disorder suggests using concomitant medications, often mood stabilizers, along with M-ECT for relapse prevention [42].

Studies on psychosis also have found M-ECT to be beneficial in maintaining remission. Further, it also prevents rehospitalization and improves the quality of life in patients with psychosis [10•, 92]. Most studies have allowed the use of concomitant antipsychotics, which aligns with the real-world practice. Electrode placement may have a significant effect on cognitive dysfunctions; however, studies comparing the effects of electrode placements are rare.

However, the evidence should be taken with a pinch of salt as most of the available studies are either observational or non-randomized in nature. Various factors may limit the overall interpretation of the results such as sample heterogeneity, differences in the type of wave and electrode placement, and variations in concomitant psychotropics and periods of follow-up. In addition, there is a clear lack of evidence for M-ECT in other psychiatric disorders, such as OCD, and in vulnerable populations, such as children and pregnant women. There is a dearth of data to formulate recommendations for M-ECT administration. A tapered approach tailored to individual patient needs is usually practiced. Decisions regarding when to taper and when to stop the sessions may be taken based on symptom improvement, functional recovery, and adverse effects. More research is needed on the ideal schedules of M-ECT in various psychiatric disorders. It is important to address issues related to dosing of stimulus, electrode placement, and simultaneous pharmacotherapy. There is a need to expand the use of ECT clinical registries because RCTs in this area are difficult to accomplish.

There are a few limitations to the present review. Only two databases were searched, and only English-language articles were included in the review. Due to a lack of studies with robust evidence, case reports and observational studies were included. Further, given the wide breadth of articles included, concerns remain regarding external validity. Future reviews focusing on mechanism, differences in dosing, frequency of administration, electrode placement, and adverse events can add to the current understanding.

Conclusion

Psychotic and affective disorders represent conditions with the most evidence for M-ECT in maintaining clinical remissions and preventing hospitalizations. However, more randomized clinical trials are required to build clear evidence and inform recommendations for M-ECT in these disorders. Although evidence has extended to other psychiatric disorders such as OCD, data is not robust. Further, studies exploring the best strategies in terms of dosing schedule and frequency for delivering M-ECT are also required to guide clinicians in everyday practice.

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Declarations

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Competing Interests The authors declare no competing interests.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Heijnen WT, Birkenhäger TK, Wierdsma AI, Van Den Broek WW. Antidepressant pharmacotherapy failure and response to subsequent electroconvulsive therapy: a meta-analysis. J Clin Psychopharmacol. 2010;30:616–9.
2. Martínez-Amorós E, Serra P, Goldberg X, Urraca L, Palao DJ, Urretavizcaya M, Cardoner N. Clinical outcome after discontinuation of maintenance electroconvulsive therapy. A retrospective follow-up study. Rev Psiquiatr Salud Ment Engl Ed. 2020;13:5–10.
3. Gupta S, Hood C, Chaplin R. Use of continuation and maintenance electroconvulsive therapy: UK national trends. J ECT. 2011;27:77–80.
4. Weiner RD (2001) The practice of electroconvulsive therapy: recommendations for treatment, training, and privileging : a task force report of the American Psychiatric Association. American Psychiatric Association
5. Andrade C, Kurinji S. Continuation and maintenance ECT: a review of recent research. J ECT. 2002;18:149–58.
6. Methfessel I, Besse M, Belz M, Zilles-Wegner D. Effectiveness of maintenance electroconvulsive therapy—evidence from modifications due to the COVID-19 pandemic. Acta Psychiatr Scand. 2021;144:238–45.

7. Jelovac A, Kolshus E, McLoughlin DM. Relapse following successful electroconvulsive therapy for major depression: a meta-analysis. Neuropsychopharmacology. 2013;38:2467–74.
8. Sackeim HA, Prudic J, Devanand DP, Nobler MS, Lisanby SH, Peyser S, Fitzsimons L, Moody BJ, Clark J. A prospective, randomized, double-blind comparison of bilateral and right unilateral electroconvulsive therapy at different stimulus intensities. Arch Gen Psychiatry. 2000;57:425–34.
9. Shibasaki C, Takebayashi M, Fujita Y, Yamawaki S. Factors associated with the risk of relapse in schizophrenic patients after a response to electroconvulsive therapy: a retrospective study. Neuropsychiatr Dis Treat. 2015;11:67–73.
10.• Ward HB, Szabo ST, Rakesh G. Maintenance ECT in schizophrenia: a systematic review. Psychiatry Res. 2018;264:131–42. **This was a large systematic review that showed the effectiveness of M-ECT for relapse prevention in schizophrenia with minimal cognitive adverse effects.**
11. Kocamer Şahin Ş, Demir B, Elboğa G, Altındağ A, Elmalı E. The effects of maintenance electroconvulsive therapy on hospitalization rates. J Nerv Ment Dis. 2021;209:155–8.
12. Schwarz T, Loewenstein J, Isenberg KE. Maintenance ECT: indications and outcome. Convuls Ther. 1995;11:14–23.
13. Stegmann B, Gale C, Glue P. Maintenance ECT treatment in New Zealand: local and national data. Australas Psychiatry. 2023;31:90–4.
14. Ghaziuddin N, Yaqub T, Shamseddeen W, Reddy P, Reynard H, Maixner D. Maintenance electroconvulsive therapy is an essential medical treatment for patients with catatonia: a COVID-19 related experience. Front Psychiatry. 2021;12:670476.
15. Lambrichts S, Vansteelandt K, Crauwels B, et al. Relapse after abrupt discontinuation of maintenance electroconvulsive therapy during the COVID-19 pandemic. Acta Psychiatr Scand. 2021;144:230–7.
16. Martínez-Amorós E, Serra P, Bassa A, Palao DJ, Cardoner N. Discontinuation of maintenance electroconvulsive therapy: lessons learned from the COVID-19 pandemic. Rev Psiquiatr Salud Ment Engl Ed. 2022;15:154–5.
17. Van de Velde N, Geerts P-J, Tandt H, Vanderhasselt M-A, Titeca K, Lemmens G. Discontinuation of continuation or maintenance electroconvulsive therapy caused by the COVID-19 pandemic: a naturalistic study investigating relapse in patients with major depressive disorder. J ECT. 2021;37:230–7.
18. Kerman EF. Electroshock therapy: with special reference to relapses and an effort to prevent them. J Nerv Ment Dis. 1945;102:231–42.
19. Taylor PJ. Electroconvulsive therapy. Report of the task force of the American Psychiatric Association. Washington D.C. 1978. Pp 200. Br J Psychiatry. 1980;136:103–103.
20.• Brown ED, Lee H, Scott D, Cummings GG. Efficacy of continuation/maintenance electroconvulsive therapy for the prevention of recurrence of a major depressive episode in adults with unipolar depression: a systematic review. J ECT. 2014;30:195–202. **This was a systematic review supporting the combined use of C-ECT or M-ECT and pharmacotherapy over pharmacotherapy alone in the prevention of relapse and recurrence in adults with unipolar depression.**
21. Kellner CH, Knapp RG, Petrides G, et al. Continuation electroconvulsive therapy vs pharmacotherapy for relapse prevention in major depression: a multisite study from the consortium for research in electroconvulsive therapy (CORE). Arch Gen Psychiatry. 2006. https://doi.org/10.1001/archpsyc.63.12.1337.
22. Navarro V, Gastó C, Torres X, et al. Continuation/maintenance treatment with nortriptyline versus combined nortriptyline and ECT in late-life psychotic depression: a two-year randomized study. Am J Geriatr Psychiatry. 2008;16:498–505.
23. Serra M, Gastó C, Navarro V, Torres X, Blanch J, Masana G. Maintenance electroconvulsive therapy in elderly psychotic unipolar depression. Med Clin (Barc). 2006;126:491–2.
24. Gupta S, Tobiansky R, Bassett P, Warner J. Efficacy of maintenance electroconvulsive therapy in recurrent depression: a naturalistic study. J ECT. 2008;24:191–4.
25. Kellner CH, Husain MM, Knapp RG, et al. A novel strategy for continuation ECT in geriatric depression: phase 2 of the PRIDE study. Am J Psychiatry. 2016;173:1110–8.
26. Nordenskjöld A, von Knorring L, Ljung T, Carlborg A, Brus O, Engström I. Continuation electroconvulsive therapy with pharmacotherapy versus pharmacotherapy alone for prevention of relapse of depression: a randomized controlled trial. J ECT. 2013;29:86–92.
27.• Elias A, Phutane VH, Clarke S, Prudic J. Electroconvulsive therapy in the continuation and maintenance treatment of depression: systematic review and meta-analyses. Aust N Z J Psychiatry. 2018;52:415–24.**This was a meta-analysis showing the superiority of adjunctive C-ECT and M-ECT over pharmacotherapy in reducing the risk of relapse and recurrence of depression at 1 year following ECT-induced remission.**
28.•• Rowland T, Mann R, Azeem S. The efficacy and tolerability of continuation and maintenance electroconvulsive therapy for depression: a systematic review of randomized and observational studies. J ECT. 2023;39:141. **This was one of the latest systematic reviews showing reduced relapse rates in patients of depression receiving C/M-ECT with no effect on global cognitive function.**
29. Russell JC, Rasmussen KG, O'Connor MK, Copeman CA, Ryan DA, Rummans TA. Long-term maintenance ECT: a retrospective review of efficacy and cognitive outcome. J ECT. 2003;19:4–9.
30. Nordenskjöld A, von Knorring L, Engström I. Rehospitalization rate after continued electroconvulsive therapy–a retrospective chart review of patients with severe depression. Nord J Psychiatry. 2011;65:26–31.
31. Hausmann A, Post T, Post F, Dehning J, Kemmler G, Grunze H. Efficacy of continuation/maintenance electroconvulsive therapy in the treatment of patients with mood disorders: a retrospective analysis. J ECT. 2019;35:122–6.
32. Post T, Kemmler G, Krassnig T, Brugger A, Hausmann A. Efficacy of continuation and maintenance electroconvulsive therapy (c/m ECT) in the treatment of patients with therapy-resistant affective disorders: a retrospective analysis. Neuropsychiatr. 2015;29:133–8.
33. Vanelle J-M, Loo H, Galinowski A, de Carvalho W, Bourdel M-C, Brochier P, Bouvet O, Brochier T, Olie J-P. Maintenance ECT in intractable manic-depressive disorders. J ECT. 1994;10:195.
34. Atashnama A, Aly H, Krishnan V, Howari R, Mayur P. Naturalistic outcomes of continuation right unilateral ultrabrief ECT in major depression: a retrospective chart review. Australas Psychiatry Bull R Aust N Z Coll Psychiatr. 2020;28:286–90.
35. Luccarelli J, McCoy TH, Seiner SJ, Henry ME. Maintenance ECT is associated with sustained improvement in depression symptoms without adverse cognitive effects in a retrospective cohort of 100 patients each receiving 50 or more ECT treatments. J Affect Disord. 2020;271:109–14.
36. Petrides G, Tobias KG, Kellner CH, Rudorfer MV. Continuation and maintenance electroconvulsive therapy for mood disorders: review of the literature. Neuropsychobiology. 2011;64:129–40.
37. Rabheru K, Persad E. A review of continuation and maintenance electroconvulsive therapy. Can J Psychiatry. 1997;42:476–84.
38. Van Schaik AM, Comijs HC, Sonnenberg CM, Beekman AT, Sienaert P, Stek ML. Efficacy and safety of continuation and maintenance electroconvulsive therapy in depressed

elderly patients: a systematic review. Am J Geriatr Psychiatry. 2012;20:5–17.
39. Rapinesi C, Kotzalidis GD, Serata D, et al. Prevention of relapse with maintenance electroconvulsive therapy in elderly patients with major depressive episode. J ECT. 2013;29:61–4.
40. Gagné GG, Furman MJ, Carpenter LL, Price LH. Efficacy of continuation ECT and antidepressant drugs compared to long-term antidepressants alone in depressed patients. Am J Psychiatry. 2000;157:1960–5.
41. O'Connor DW, Gardner B, Presnell I, Singh D, Tsanglis M, White E. The effectiveness of continuation-maintenance ECT in reducing depressed older patients' hospital re-admissions. J Affect Disord. 2010;120:62–6.
42. Odeberg H, Rodriguez-Silva B, Salander P, Mårtensson B. Individualized continuation electroconvulsive therapy and medication as a bridge to relapse prevention after an index course of electroconvulsive therapy in severe mood disorders: a naturalistic 3-year cohort study. J ECT. 2008;24:183–90.
43. Swoboda E, Conca A, König P, Waanders R, Hansen M. Maintenance electroconvulsive therapy in affective and schizoaffective disorder. Neuropsychobiology. 2001;43:23–8.
44. Chanpattana W. Combined ECT and clozapine in treatment-resistant mania. J ECT. 2000;16:204–7.
45. Kramer BA. ECT in elderly patients with schizophrenia. Am J Geriatr Psychiatry. 1999;7:171–4.
46. Gupta S, Austin R, Devanand DP. Lithium and maintenance electroconvulsive therapy. J ECT. 1998;14:241–4.
47. Nascimento AL, Appolinario JC, Segenreich D, Cavalcanti MT, Brasil MAA. Maintenance electroconvulsive therapy for recurrent refractory mania. Bipolar Disord. 2006;8:301–3.
48. Tsao CI, Jain S, Gibson RH, Guedet PJ, Lehrmann JA. Maintenance ECT for recurrent medication-refractory mania. J ECT. 2004;20:118–9.
49. Minnai GP, Salis PG, Oppo R, Loche AP, Scano F, Tondo L. Effectiveness of maintenance electroconvulsive therapy in rapid-cycling bipolar disorder. J ECT. 2011;27:123–6.
50. Petrides G, Dhossche D, Fink M, Francis A. Continuation ECT: relapse prevention in affective disorders. Convuls Ther. 1994;10:189–94.
51. Lisanby SH, Sampson S, Husain MM, Petrides G, Knapp RG, McCall WV, Young RC, Prudic J, Kellner CH. Toward individualized post-electroconvulsive therapy care: piloting the Symptom-Titrated, Algorithm-Based Longitudinal ECT (STABLE) intervention. J ECT. 2008;24:179–82.
52. Weiner RD, Reti IM. Key updates in the clinical application of electroconvulsive therapy. Int Rev Psychiatry Abingdon Engl. 2017;29:54–62.
53. Chanpattana W, Chakrabhand ML, Sackeim HA, Kitaroonchai W, Kongsakon R, Techakasem P, Buppanharun W, Tuntirungsee Y, Kirdcharoen N. Continuation ECT in treatment-resistant schizophrenia: a controlled study. J ECT. 1999;15:178–92.
54. Youn T, Jeong SH, Kim YS, Chung IW. Long-term clinical efficacy of maintenance electroconvulsive therapy in patients with treatment-resistant schizophrenia on clozapine. Psychiatry Res. 2019;273:759–66.
55. Yang Y, Cheng X, Xu Q, Li R, Liu Z, Wang L, Zhang Y, Ren G, Liu J. The maintenance of modified electroconvulsive therapy combined with risperidone is better than risperidone alone in preventing relapse of schizophrenia and improving cognitive function. Arq Neuropsiquiatr. 2016;74:823–8.
56. Petrides G, Malur C, Braga RJ, et al. Electroconvulsive therapy augmentation in clozapine-resistant schizophrenia: a prospective, randomized study. Am J Psychiatry. 2015;172:52–8.
57. Mishra BR, Agrawal K, Biswas T, Mohapatra D, Nath S, Maiti R. Comparison of acute followed by maintenance ECT vs clozapine on psychopathology and regional cerebral blood flow in treatment-resistant schizophrenia: a randomized controlled trial. Schizophr Bull. 2022;48:814–25.
58. Suzuki K, Takano T, Ebina Y, Takamatsu K, Awata S, Matsuoka H. Continuation electroconvulsive therapy to prevent relapse of schizophrenia in relapse-prone patients. J ECT. 2007;23:204–5.
59. Lévy-Rueff M, Gourevitch R, Lôo H, Olié J-P, Amado I. Maintenance electroconvulsive therapy: an alternative treatment for refractory schizophrenia and schizoaffective disorders. Psychiatry Res. 2010;175:280–3.
60. Shelef A, Mazeh D, Berger U, Baruch Y, Barak Y. Acute electroconvulsive therapy followed by maintenance electroconvulsive therapy decreases hospital re-admission rates of older patients with severe mental illness. J ECT. 2015;31:125–8.
61. Krepela J, Hosak L, Pachlova B, Hrdlicka M. Maintenance electroconvulsive therapy in schizophrenia. Psychiatr Danub. 2019;31:62–8.
62. Isserles M, Remington J, Kaster TS, Daskalakis ZJ, Blumberger DM. Clinical effectiveness of maintenance electroconvulsive therapy in patients with schizophrenia: a retrospective cohort study. J ECT. 2020;36:42–6.
63. Huuhka K, Viikki M, Tammentie T, Tuohimaa K, Björkqvist M, Alanen H-M, Leinonen E, Kampman O. One-year follow-up after discontinuing maintenance electroconvulsive therapy. J ECT. 2012;28:225–8.
64. Chanpattana W, Chakrabhand ML. Factors influencing treatment frequency of continuation ECT in schizophrenia. J ECT. 2001;17:190–4.
65. Agrawal A, Das S, Thirthalli J. When obsessive compulsive disorder responds only to electroconvulsive therapy: a rare case for maintenance electroconvulsive therapy? J Neurosci Rural Pract. 2018;9:450–1.
66. Husain MM, Lewis SF, Thornton WL. Maintenance ECT for refractory obsessive-compulsive disorder. Am J Psychiatry. 1993;150:1899–900.
67. Casey DA, Davis MH. Obsessive-compulsive disorder responsive to electroconvulsive therapy in an elderly woman. South Med J. 1994;87:862–4.
68. Raveendranathan D, Srinivasaraju R, Ratheesh A, Math SB, Reddy YCJ. Treatment-refractory OCD responding to maintenance electroconvulsive therapy. J Neuropsychiatry Clin Neurosci. 2012;24:E16-17.
69. Bülbül F, Copoglu US, Alpak G, Unal A, Tastan MF, Savas HA. Maintenance therapy with electroconvulsive therapy in a patient with a codiagnosis of bipolar disorder and obsessive-compulsive disorder. J ECT. 2013;29:e21-22.
70. Hanisch F, Friedemann J, Piro J, Gutmann P. Maintenance electroconvulsive therapy for comorbid pharmacotherapy-refractory obsessive-compulsive and schizoaffective disorder. Eur J Med Res. 2009;14:367–8.
71. Nilsson BM, Ekselius L. Acute and maintenance electroconvulsive therapy for treatment of severely disabling obsessive-compulsive symptoms in a patient with Asperger syndrome. J ECT. 2009;25:205–7.
72. Rao NP, Antony A, Raveendranathan D, Venkatasubramanian G, Behere RV, Varambally SS, Gangadhar BN. Successful use of maintenance electroconvulsive therapy in the treatment of clozapine-associated obsessive-compulsive symptoms in schizophrenia: a case report. J ECT. 2011;27:e37-38.
73. Madero S, Anmella G, Sagué-Vilavella M, et al. Evaluating maintenance electroconvulsive therapy in Bipolar Disorders: 3-year mirror-image study. J Affect Disord. 2022;298:58–64.
74. Ross EL, Zivin K, Maixner DF. Cost-effectiveness of electroconvulsive therapy vs pharmacotherapy/psychotherapy for treatment-resistant depression in the United States. JAMA Psychiat. 2018;75:713–22.

75. Fitzgibbon KP, Plett D, Chan BCF, Hancock-Howard R, Coyte PC, Blumberger DM. Cost–utility analysis of electroconvulsive therapy and repetitive transcranial magnetic stimulation for treatment-resistant depression in Ontario. Can J Psychiatry Rev Can Psychiatr. 2020;65:164–73.
76. Semkovska M, McLoughlin DM. Objective cognitive performance associated with electroconvulsive therapy for depression: a systematic review and meta-analysis. Biol Psychiatry. 2010;68:568–77.
77. Vothknecht S, Kho KH, van Schaick HW, Zwinderman AH, Middelkoop H, Blansjaar BA. Effects of maintenance electroconvulsive therapy on cognitive functions. J ECT. 2003;19:151–7.
78. Yoldi-Negrete M, Gill L-N, Olivares S, Lauzière A, Désilets M, Tourjman SV. The effect of continuation and maintenance electroconvulsive therapy on cognition: a systematic review of the literature and meta-analysis. J Affect Disord. 2022;316:148–60.
79. Kerner N, Prudic J. Current electroconvulsive therapy practice and research in the geriatric population. Neuropsychiatry. 2014;4:33–54.
80. Rhebergen D, Huisman A, Bouckaert F, Kho K, Kok R, Sienaert P, Spaans H-P, Stek M. Older age is associated with rapid remission of depression after electroconvulsive therapy: a latent class growth analysis. Am J Geriatr Psychiatry. 2015;23:274–82.
81.•• Lisanby SH, McClintock SM, McCall WV, et al. Longitudinal neurocognitive effects of combined electroconvulsive therapy (ECT) and pharmacotherapy in major depressive disorder in older adults: phase 2 of the PRIDE study. Am J Geriatr Psychiatry. 2022;30:15–28. **This was the first report of long-term outcomes with unilateral ECT, followed by M-ECT and pharmacotherapy, in older adults with acute depression. The key finding was that neurocognitive functions improved over a 6-month follow-up period.**
82. van Schaik AM, Comijs HC, Sonnenberg CM, Beekman AT, Sienaert P, Stek ML. Efficacy and safety of continuation and maintenance electroconvulsive therapy in depressed elderly patients: a systematic review. Am J Geriatr Psychiatry. 2012;20:5–17.
83. Geduldig ET, Kellner CH. Electroconvulsive therapy in the elderly: new findings in geriatric depression. Curr Psychiatry Rep. 2016;18:40.
84. González-Romero MF, Avina-Galindo AM, Elbe D, Friedlander R, Vila-Rodriguez F. Lifesaving electroconvulsive therapy for a child with autism spectrum disorder, severe self-injurious behavior, and neuroleptic malignant syndrome. J ECT. 2019;35:e55–6.
85. Wachtel LE, Hermida A, Dhossche DM. Maintenance electroconvulsive therapy in autistic catatonia: a case series review. Prog Neuropsychopharmacol Biol Psychiatry. 2010;34:581–7.
86. Miles JH, Takahashi N, Muckerman J, Nowell KP, Ithman M. Catatonia in Down syndrome: systematic approach to diagnosis, treatment and outcome assessment based on a case series of seven patients. Neuropsychiatr Dis Treat. 2019;15:2723–41.
87. Baeza I, Flamarique I, Garrido JM, Horga G, Pons A, Bernardo M, Morer A, Lázaro ML, Castro-Fornieles J. Clinical experience using electroconvulsive therapy in adolescents with schizophrenia spectrum disorders. J Child Adolesc Psychopharmacol. 2010;20:205–9.
88. Rajkumar MG, Srinivasa RP, Harish P. Concept of electroconvulsive therapy in India: a narrative review. J Clin Biomed Sci. 2023;13:25–8.
89. O'Reardon JP, Cristancho MA, von Andreae CV, Cristancho P, Weiss D. Acute and maintenance electroconvulsive therapy for treatment of severe major depression during the second and third trimesters of pregnancy with infant follow-up to 18 months: case report and review of the literature. J ECT. 2011;27:e23.
90. Bozkurt A, Karlidere T, Isintas M, Ozmenler NK, Ozsahin A, Yanarates O. Acute and maintenance electroconvulsive therapy for treatment of psychotic depression in a pregnant patient. J ECT. 2007;23:185–7.
91. Rabheru K. Maintenance Electroconvulsive Therapy (M-ECT) After acute response: examining the evidence for who, what, when, and how? J ECT. 2012;28:39–47.
92. Choi KM, Choi S-H, Hong JK, Lee MH, Jung JH, Oh SH, Jung DC, Kim SN. The effects of continuation-maintenance electroconvulsive therapy on reducing hospital re-admissions in patients with treatment-resistant schizophrenia. Clin Psychopharmacol Neurosci. 2018;16:339–42.