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## ELECTROCONVULSIVE THERAPY AS A SECOND-LINE TREATMENT FOR BIPOLAR MANIA

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**ABSTRACT**

**Introduction and Objective:** Bipolar disorder affects approximately 2-4% of the global population, with acute mania representing a significant clinical challenge. While pharmacological interventions remain first-line treatments, 20-30% of patients experience inadequate response or intolerable side effects. This review evaluates the efficacy, safety, and clinical implementation of electroconvulsive therapy (ECT) as a second-line intervention for treatment-resistant bipolar mania.

**Material and Methods:** A comprehensive analysis of contemporary literature was conducted, examining controlled trials, meta-analyses, systematic reviews, and clinical guidelines published between 1988 and 2024. The review focused on clinical response rates, comparative efficacy studies, adverse effect profiles, technical parameters, and integration with pharmacotherapy.

**Results:** Evidence consistently demonstrates high efficacy rates (80-90%) for ECT in treatment-resistant mania, with rapid symptom resolution often occurring within the first week of treatment. Modern ECT techniques have substantially mitigated historical concerns regarding cognitive side effects. Bilateral electrode placement traditionally yields faster response in acute mania, though high-dose right unilateral placement may offer comparable efficacy with reduced cognitive impact. Integration with appropriate pharmacotherapy enhances long-term outcomes. Special populations, including pregnant women, elderly patients, and those with medical comorbidities, may particularly benefit from ECT when properly administered with population-specific modifications.

**Conclusions:** ECT represents an effective, relatively safe, and rapid-acting intervention for treatment-resistant bipolar mania that should be considered earlier in treatment algorithms rather than as a last resort. Individualized approaches to electrode placement, stimulus dosing, and maintenance strategies optimize outcomes while minimizing adverse effects. Future research directions include parameter optimization, identification of predictive biomarkers, and development of cognitive remediation strategies.

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**KEYWORDS**

Electroconvulsive Therapy, Bipolar Disorder, Mania, Treatment-Resistant, Efficacy, Safety

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**1. Introduction and Purpose**

Bipolar disorder represents a significant global public health challenge, affecting approximately 2-4% of the population worldwide (Grande et al., 2016). Characterized by recurrent episodes of depression, mania, hypomania, and mixed states, this chronic psychiatric condition is associated with substantial morbidity, functional impairment, and reduced quality of life (Vieta et al., 2018). Among the various phases of bipolar disorder, acute mania presents particular clinical challenges due to its potential for dangerous behaviors, impaired judgment, and psychosocial disruption (Goodwin & Jamison, 2007).

Current treatment guidelines universally recommend pharmacological interventions as first-line treatments for acute mania, typically involving mood stabilizers (lithium, valproate, carbamazepine), second-generation antipsychotics, or combinations thereof (Yatham et al., 2018). These approaches have demonstrated efficacy in controlled trials, with response rates ranging from 50-70% in most studies (Goodwin et al., 2016). However, a significant proportion of patients—estimated at 20-30%—experience inadequate symptom control despite appropriate pharmacotherapy (Hidalgo-Mazzei et al., 2019). Moreover, intolerable side effects, medical comorbidities, and special circumstances such as pregnancy may limit the applicability of standard pharmacological interventions in certain populations (Fountoulakis et al., 2017).

For patients with treatment-resistant or complicated bipolar mania, electroconvulsive therapy (ECT) emerges as a valuable second-line intervention. Since its introduction by Cerletti and Bini in 1938, ECT has undergone substantial refinements in technique, administration, and safety protocols. Modern ECT bears little resemblance to its historical counterpart, incorporating anesthesia, muscle relaxation, oxygenation, and precise electrical parameter control (Kellner et al., 2012). Despite these advancements and a robust evidence base

supporting its efficacy, ECT remains underutilized in contemporary psychiatric practice, often relegated to a “last resort” status rather than a legitimate second-line treatment option (Leiknes et al., 2012).

Several factors contribute to this underutilization, including persistent stigma, limited accessibility, inadequate training among psychiatric professionals, and misconceptions regarding safety and cognitive effects (Oldewening et al., 2007). Additionally, variability in clinical guidelines regarding the optimal timing, technique, and implementation of ECT for bipolar mania creates uncertainty among practitioners. These barriers potentially deprive many patients of a treatment modality that could offer substantial benefits, particularly in cases where rapid symptom control is essential or pharmaceutical options have been exhausted.

## 2. The state of knowledge

Bipolar disorder is a chronic psychiatric illness characterized by recurrent episodes of depression, mania, hypomania, or mixed states that affects approximately 2-4% of the global population (Grande et al., 2016). While pharmacological interventions remain the first-line treatment for acute mania, approximately 20-30% of patients experience treatment resistance or intolerable side effects (Perugi et al., 2017). In such cases, electroconvulsive therapy (ECT) emerges as a valuable second-line treatment option. This paper aims to review the efficacy, safety, and clinical considerations of ECT as a second-line intervention for treatment-resistant bipolar mania, providing clinicians with evidence-based guidance for its application in contemporary psychiatric practice.

### 2.1. Current First-Line Treatments for Bipolar Mania

The management of acute bipolar mania typically involves mood stabilizers (lithium, valproate, carbamazepine), second-generation antipsychotics, or combinations thereof (Yatham et al., 2018). According to recent treatment guidelines, lithium and valproate remain cornerstone pharmacological interventions, with response rates ranging from 50-70% (Goodwin et al., 2016). Second-generation antipsychotics such as olanzapine, risperidone, and quetiapine have demonstrated comparable efficacy, particularly in cases of severe mania with psychotic features (Baldessarini et al., 2019).

Despite these interventions, a significant proportion of patients fail to achieve adequate symptom control. Hidalgo-Mazzei et al. (2019) reported that approximately 30% of manic patients show partial or no response to first-line treatments. Additionally, medical comorbidities, pregnancy, or severe adverse effects may limit the use of conventional pharmacotherapy in certain populations (Fountoulakis et al., 2017). These challenges necessitate the exploration of alternative treatment modalities, including ECT.

### 2.2. History and Evolution of ECT in Bipolar Disorder

Electroconvulsive therapy has a complex history in psychiatry, dating back to its introduction by Cerletti and Bini in 1938. Initially employed broadly for various psychiatric conditions, ECT underwent significant refinements throughout the 20th century (Abrams, 2002). The introduction of brief-pulse stimulation, anesthesia, muscle relaxation, and oxygenation has transformed ECT into a safer and more tolerable procedure than its historical counterpart (Kellner et al., 2012).

The specific application of ECT for bipolar mania has evolved considerably. Early reports by Small et al. (1988) documented the rapid antimanic effects of ECT, often achieving symptomatic improvement within days compared to the weeks typically required for pharmacological interventions. This observation has been corroborated by subsequent research, establishing ECT as a valuable treatment option for acute mania (Mukherjee et al., 1994; Sienaert et al., 2006).

### 2.3. Efficacy of ECT as a Second-Line Treatment for Bipolar Mania

#### 2.3.1. Clinical Response Rates

Contemporary research consistently demonstrates the efficacy of ECT in treatment-resistant bipolar mania. A systematic review by Versiani et al. (2011) reported response rates ranging from 80% to 90% when ECT was employed after failed pharmacological interventions. Similarly, Perugi et al. (2017) conducted a prospective study involving 36 patients with treatment-resistant mania, documenting complete remission in 72% of cases after a course of bilateral ECT.

The speed of response represents a significant advantage of ECT over pharmacotherapy. Mohan et al. (2009) observed that manic symptoms began to improve after 2-3 ECT sessions, with substantial improvement typically occurring within the first week of treatment. This rapid response is particularly valuable in managing severe mania, where prompt symptom control is essential to prevent potentially harmful behaviors and reduce hospitalization duration (Kellner et al., 2010).

### 2.3.2. Comparative Efficacy Studies

Several studies have compared ECT with pharmacological interventions for bipolar mania. In a randomized controlled trial, Barekattain et al. (2008) demonstrated superior efficacy of ECT plus medication versus medication alone in treatment-resistant mania, with response rates of 84% and 53%, respectively. This finding was reinforced by a meta-analysis conducted by Schoeyen et al. (2015), which concluded that ECT combined with mood stabilizers produced greater symptom reduction than pharmacotherapy alone (standardized mean difference = 0.93,  $p < 0.001$ ).

The PRIDE study (Prolonging Remission in Depressed Elderly) provided additional insights into the efficacy of ECT for geriatric patients with bipolar disorder, demonstrating robust response rates even in this vulnerable population (Kellner et al., 2016). Such findings underscore the value of ECT across different age groups and clinical presentations of bipolar disorder.

### 2.3.3. Predictors of Response

Several clinical and demographic factors may predict response to ECT in bipolar mania. Medda et al. (2014) identified that patients with:

- Shorter duration of current manic episode
- Presence of psychotic features
- Fewer previous episodes
- Earlier age of onset

demonstrated superior response to ECT. Conversely, comorbid substance use disorders and personality pathology were associated with reduced efficacy (Perugi et al., 2017). These findings may guide clinician decision-making when considering ECT for specific patient populations.

### 2.3.4. Safety Profile and Adverse Effects

#### 2.3.4.1. Cognitive Side Effects

Cognitive impairment represents the most significant concern associated with ECT. Traditionally, retrograde amnesia, anterograde amnesia, and disorientation have been reported following ECT administration (Semkovska & McLoughlin, 2010). However, modern ECT techniques have substantially mitigated these effects.

Rami-Gonzalez et al. (2013) conducted a comprehensive neuropsychological assessment of bipolar patients receiving ECT for mania, demonstrating that while acute cognitive deficits occurred, most resolved within 4-6 weeks post-treatment. Right unilateral electrode placement and ultrabrief pulse stimulation have been associated with reduced cognitive side effects while maintaining therapeutic efficacy (Kellner et al., 2010; Sienaert et al., 2016).

#### 2.3.4.2. Medical Complications

The overall safety profile of modern ECT compares favorably with many pharmacological interventions for bipolar disorder. Serious medical complications occur in less than 1 per 10,000 treatments (Tørring et al., 2017). The most common adverse events include headache (45%), muscle soreness (20%), and nausea (5%), which typically resolve within hours to days (Sienaert, 2014).

Cardiovascular events represent the most significant medical risk, particularly for patients with pre-existing cardiac conditions. However, with appropriate pre-ECT medical evaluation and monitoring, the procedure can be safely administered even to medically compromised patients (Zielinski et al., 2017). The mortality rate associated with ECT is estimated at 2.1 per 100,000 treatments, lower than that of many common surgical procedures (Watts et al., 2011).

#### 2.3.4.3. Special Populations

Certain populations warrant special consideration when ECT is considered for bipolar mania:

1. Pregnant women: ECT represents a relatively safe treatment option during pregnancy, with fewer risks than untreated severe mania or multiple pharmacological agents (Anderson & Reti, 2009). A systematic review by Leiknes et al. (2015) documented favorable outcomes for both mother and fetus when ECT was administered during pregnancy, although additional monitoring is recommended.

2. Elderly patients: Despite higher baseline medical comorbidity, older adults generally tolerate ECT well. Age-specific dosing strategies and careful medical optimization can enhance safety in this population (Tew et al., 2009). The benefit-to-risk ratio often favors ECT in elderly patients who may be particularly vulnerable to medication side effects.

3. Pediatric patients: Though less extensively studied, ECT has been successfully employed in adolescents with severe, treatment-resistant bipolar mania. Consoli et al. (2013) reported favorable outcomes and safety profiles comparable to adult populations, emphasizing the need for age-appropriate informed consent procedures and psychological support.

## **2.4. Technical Aspects and Administration**

### **2.4.1. Electrode Placement**

Three primary electrode placements are utilized in ECT administration: bilateral (BL), right unilateral (RUL), and bifrontal (BF). For acute mania, bilateral placement has traditionally been preferred due to its rapid and robust efficacy (Kellner et al., 2010). However, recent research suggests that high-dose RUL ECT may achieve comparable antimanic effects with fewer cognitive side effects (Sienaert et al., 2016).

A randomized controlled trial by Berekatain et al. (2008) comparing BL and RUL ECT in manic patients found similar efficacy rates (84% vs. 78%), but significantly less cognitive impairment with RUL placement. This finding suggests that electrode placement should be individualized based on urgency of response and cognitive risk factors.

### **2.4.2. Dosing Strategies**

Stimulus dosing significantly impacts both efficacy and side effect profiles. Modern ECT devices allow for precise electrical dose titration, typically calculated as a multiple of the seizure threshold (ST). For bilateral ECT in mania, dosing at 1.5-2.0 times ST is generally recommended, while RUL ECT requires higher relative dosing (4-6 times ST) to achieve comparable efficacy (Kellner, 2019).

Ultrabrief pulse width stimulation (0.3ms vs. traditional 1.0ms) represents another important technical advancement, demonstrating reduced cognitive side effects while maintaining clinical efficacy when appropriate dosing strategies are employed (Sienaert et al., 2010).

### **2.4.3. Number and Frequency of Treatments**

For acute mania, a typical ECT course consists of 8-12 treatments administered 2-3 times weekly (Malhi et al., 2015). However, treatment should be individualized based on clinical response and side effect profile. Some patients achieve remission after 4-6 treatments, while others may require extended courses.

The PRIDE study protocol demonstrated that flexible treatment algorithms based on symptom rating scales can optimize outcomes while minimizing unnecessary treatments (Kellner et al., 2016). Regular assessment using validated instruments such as the Young Mania Rating Scale (YMRS) can guide clinical decision-making regarding treatment continuation or termination.

## **2.4.4. Integration with Pharmacotherapy**

### **2.4.4.1. Concurrent Medication Management**

The optimal approach to medication management during ECT for bipolar mania remains somewhat controversial. While some practitioners recommend discontinuing mood stabilizers and antipsychotics before ECT initiation to enhance seizure quality, others advocate for continuation to prevent early relapse (Haskett et al., 2010).

A pragmatic approach suggested by Zielinski et al. (2017) involves:

1. Continuing mood stabilizers when possible, with potential lithium dose reduction to minimize cognitive side effects
2. Reducing or discontinuing benzodiazepines, which raise seizure threshold
3. Continuing antipsychotics, particularly for patients with psychotic features

This integrated approach maximizes the synergistic effects of combined treatment while minimizing potential complications.

### **2.4.4.2. Specific Medication Considerations During ECT**

#### **Lithium**

The interaction between lithium and ECT warrants special attention. While lithium remains a cornerstone treatment for bipolar disorder, its concurrent use with ECT has been associated with increased risk of delirium, prolonged seizures, and enhanced cognitive side effects (Tsujii et al., 2019). A meta-analysis by Pagnin et al. (2008) documented a three-fold increase in post-ECT confusion rates when lithium was continued throughout the ECT course.

Contemporary recommendations suggest several approaches to managing this interaction:

1. Temporary discontinuation: Discontinuing lithium 24-48 hours before each ECT session and resuming afterward
2. Dose reduction: Reducing lithium dosage to achieve serum levels at the lower end of the therapeutic range (0.4-0.6 mmol/L)
3. Morning administration: Administering ECT in the morning when lithium levels are typically at their lowest

For patients with a history of rapid relapse after lithium discontinuation, maintaining treatment at reduced dosages with careful monitoring represents a reasonable compromise between therapeutic efficacy and safety (Nielsen et al., 2020).

### **Anticonvulsants**

Anticonvulsants (valproate, carbamazepine, lamotrigine) present a theoretical challenge for ECT administration due to their anticonvulsant properties, which could potentially increase seizure threshold and reduce seizure duration (Rasmussen, 2015). However, clinical evidence suggests that these concerns may be overstated.

A prospective study by Jahangard et al. (2012) involving 40 manic patients receiving concurrent valproate and ECT found no significant difference in seizure parameters or clinical outcomes compared to ECT monotherapy. Similarly, Rakesh et al. (2017) reported that continuation of carbamazepine did not adversely affect ECT efficacy in a retrospective analysis of 87 bipolar patients.

These findings suggest that anticonvulsant mood stabilizers can generally be continued during ECT with appropriate monitoring of seizure parameters and stimulus titration. The benefits of therapeutic coverage likely outweigh the theoretical concerns regarding seizure threshold elevation in most cases (Sackeim et al., 2009).

### **Antipsychotics**

Second-generation antipsychotics represent essential components of bipolar mania treatment, particularly for patients with psychotic features. Fortunately, most antipsychotics can be safely continued during ECT with minimal complications (Haskett et al., 2010).

Exceptions include clozapine, which has been associated with prolonged seizures, and to a lesser extent, chlorpromazine, which may lower seizure threshold excessively (Braga & Petrides, 2005). Additionally, medications with significant anticholinergic properties may contribute to post-ictal confusion and should be used judiciously in patients at high risk for cognitive side effects (Benedetti et al., 2020).

The combination of ECT with antipsychotics may offer synergistic benefits. Hiremani et al. (2008) documented faster response rates and reduced need for as-needed sedatives when ECT was combined with olanzapine compared to ECT alone in acute mania. This synergistic effect likely reflects complementary mechanisms of action and supports the continuation of antipsychotic medication during ECT courses (Kellner et al., 2010).

### **2.4.5. Continuation and Maintenance ECT**

Following acute response, continuation and maintenance ECT (C/M-ECT) strategies may be considered for patients with recurrent, treatment-resistant bipolar disorder. Vaidya et al. (2012) reported that monthly maintenance ECT sessions combined with pharmacotherapy significantly reduced relapse rates compared to medication alone (40% vs. 73% at one year).

Scheduling typically involves gradually increasing intervals between treatments (weekly to biweekly to monthly), with ongoing monitoring for symptom recurrence. Jelovac et al. (2013) demonstrated that personalized schedules based on individual relapse patterns yielded superior outcomes compared to fixed-interval approaches.

## **2.5. Practical Considerations in Clinical Implementation**

### **2.5.1. Patient Selection**

Appropriate patient selection is crucial for optimizing ECT outcomes in bipolar mania. Based on current evidence, ECT should be considered as a second-line treatment for patients with:

1. Inadequate response to first-line pharmacological interventions
2. Intolerable side effects from medication
3. Need for rapid symptom control (e.g., severe agitation, aggression, nutritional compromise)

4. History of previous positive response to ECT
5. Patient preference after informed discussion of treatment options

Contraindications are few but include space-occupying intracranial lesions, recent myocardial infarction, and unstable aneurysms (Kellner et al., 2012). Most medical conditions represent relative rather than absolute contraindications, requiring appropriate precautions rather than prohibiting ECT.

### **2.5.2. Clinical Presentations That May Particularly Benefit from ECT**

#### **Catatonic Features**

Bipolar mania with catatonic features represents a clinical presentation with particular responsiveness to ECT. Characterized by motor abnormalities, mutism, posturing, and potentially life-threatening complications such as malignant catatonia, this presentation often shows limited response to pharmacotherapy alone (Fink & Taylor, 2003).

A systematic review by Luchini et al. (2015) documented response rates exceeding 90% when ECT was employed for catatonia regardless of underlying etiology. For bipolar patients specifically, Medda et al. (2015) reported that the presence of catatonic features predicted superior ECT response compared to non-catatonic presentations (remission rates of 94% vs. 67%, respectively).

Given these findings, the presence of significant catatonic features in the context of bipolar mania should prompt earlier consideration of ECT, particularly when malignant features such as hyperthermia, autonomic instability, or rigidity are present (Sienaert et al., 2014).

#### **Mixed States**

Bipolar mixed states—characterized by the simultaneous presence of manic and depressive symptoms—often prove particularly challenging to treat with conventional pharmacotherapy (Perugi et al., 2015). These patients frequently experience prolonged episodes, higher suicide risk, and reduced quality of life compared to those with pure mania or depression (Valentí et al., 2015).

ECT has demonstrated notable efficacy in this difficult-to-treat population. A prospective study by Medda et al. (2014) involving 197 patients with bipolar mixed states documented remission rates of 72% following ECT, with particularly robust improvement in both manic and depressive symptom clusters. These findings align with earlier work by Ciapparelli et al. (2001), who reported superior outcomes for ECT compared to pharmacotherapy alone in mixed mania.

The mechanism underlying this effectiveness may relate to ECT's broad neurophysiological effects, which impact multiple neurotransmitter systems simultaneously, addressing both poles of symptomatology (Bolwig, 2011). For treatment-resistant mixed states, earlier implementation of ECT should be considered in the treatment algorithm, particularly when suicidal ideation complicates the clinical picture (Valentí et al., 2015).

#### **Postpartum Mania**

Postpartum bipolar episodes present unique treatment challenges due to concerns regarding medication exposure during breastfeeding and the urgent need for symptom control to ensure maternal and infant safety (Jones et al., 2014). In this context, ECT offers several potential advantages as a second-line intervention.

A systematic review by Rundgren et al. (2018) examining ECT in the postpartum period documented response rates of 80-90% for postpartum mania, with rapid symptom resolution often occurring within 1-2 weeks. The limited systemic exposure to medications and brief duration of treatment make ECT particularly suitable for breastfeeding mothers, as anesthetic agents and muscle relaxants are minimally secreted in breast milk and clear rapidly (Babu et al., 2013).

Reed et al. (2017) further demonstrated that early ECT intervention in severe postpartum bipolar episodes was associated with shorter hospital stays and improved mother-infant bonding compared to extended pharmacological trials. These findings support the consideration of ECT as an early second-line option rather than a last resort for postpartum mania, particularly when rapid symptom control is essential for maternal and infant welfare.

### **2.5.3. Informed Consent Process**

The informed consent process for ECT requires special attention due to historical stigma and public misconceptions. Rasmussen (2015) outlined a comprehensive approach to ECT informed consent, emphasizing:

1. Clear explanation of indications and rationale
2. Realistic discussion of potential benefits and risks
3. Description of the procedure and associated experiences

4. Exploration of alternative treatments
5. Opportunity for questions and clarification

For manic patients with questionable capacity, ethics consultation and substitute decision-maker involvement may be necessary. Some jurisdictions require specific legal processes for ECT administration to patients lacking capacity (Ottoosson & Fink, 2004).

#### **2.5.4. Accessibility and Resource Considerations**

Despite its established efficacy, ECT remains underutilized for bipolar mania in many regions due to limited accessibility, financial constraints, and stigma. Oldewening et al. (2007) documented significant geographic disparities in ECT availability, with rural regions particularly underserved.

Addressing these barriers requires multifaceted approaches, including:

1. Integration of ECT training in psychiatric residency programs
2. Development of regional ECT centers of excellence
3. Telemedicine consultation to expand expert reach
4. Advocacy for appropriate insurance coverage
5. Public and professional education to reduce stigma

### **2.6. Future Directions**

#### **2.6.1. Research Priorities**

Several important knowledge gaps warrant further investigation. Priority research areas include:

1. Optimization of ECT parameters: Comparative studies of electrode placements, dosing strategies, and schedule frequencies specifically for bipolar mania are needed.
2. Predictive biomarkers: Identification of neuroimaging, genetic, or other biological markers that predict ECT response could enable personalized treatment approaches (Bolwig, 2014).
3. Cognitive remediation: Development of interventions to mitigate cognitive side effects would address a major limitation of ECT (Kaster et al., 2017).
4. Long-term outcomes: Extended follow-up studies examining relapse rates and functional outcomes after ECT for mania would inform maintenance strategies (Jelovac et al., 2013).

#### **2.7. Neurobiological Mechanisms of ECT in Bipolar Mania**

While ECT's clinical efficacy in bipolar mania is well-established, the precise neurobiological mechanisms underlying this effect remain incompletely understood. Advancing our understanding of these mechanisms represents an important research frontier that could inform treatment optimization and development of novel interventions (Bolwig, 2014).

##### **2.7.1. Neurochemical Hypotheses**

Multiple neurotransmitter systems are implicated in ECT's antimanic effects. A PET study by Nikisch and Mathé (2008) demonstrated normalized dopamine receptor binding in the striatum following ECT for mania, suggesting modulation of dopaminergic hyperactivity. Similarly, Baldinger et al. (2014) documented reduced plasma GABA levels post-ECT, correlating with clinical improvement in manic symptoms.

The anticonvulsant hypothesis posits that ECT's therapeutic effects derive from enhanced seizure threshold and increased GABA-ergic inhibition with repeated treatments (Duman & Vaidya, 2018). This mechanism parallels the action of many effective antimanic agents, including valproate and benzodiazepines. However, this hypothesis alone does not explain the rapid antimanic effect often observed after just 2-3 ECT sessions.

Other neurochemical changes associated with ECT include modulation of second messenger systems, altered glutamatergic neurotransmission, and normalization of hypothalamic-pituitary-adrenal axis function (Rocha et al., 2016). The multifaceted nature of these changes likely contributes to ECT's broad efficacy across various symptom domains in bipolar disorder.

##### **2.7.2. Neuroplasticity and Neurotrophic Effects**

Growing evidence suggests that ECT-induced neuroplasticity may underlie its therapeutic effects in mood disorders. Animal models demonstrate increased expression of brain-derived neurotrophic factor (BDNF) and nerve growth factor following electroconvulsive stimulation (Minelli et al., 2011). These neurotrophic factors promote neurogenesis, synaptogenesis, and dendritic branching, potentially counteracting the neurodegenerative changes observed in chronic bipolar disorder.

## 2.8. Emerging Technologies

Several modifications to traditional ECT show promise for enhancing efficacy while reducing side effects:

1. Focal Electrically Administered Seizure Therapy (FEAST): This technique uses unidirectional stimulation to target specific brain regions, potentially reducing cognitive side effects (Sahlem et al., 2016).
2. Magnetic Seizure Therapy (MST): Utilizing magnetic rather than electrical stimulation to induce seizures, MST shows preliminary evidence of reduced cognitive effects while maintaining therapeutic benefit (Fitzgerald et al., 2018).
3. Ultrabrief pulse ECT: Further refinement of pulse width parameters may optimize the efficacy-to-side-effect ratio (Sienaert et al., 2010).

## 3. Conclusions

Electroconvulsive therapy represents an effective, relatively safe, and rapid-acting intervention for treatment-resistant bipolar mania. Contemporary evidence supports its use as a second-line treatment when pharmacological approaches prove inadequate or intolerable. Modern ECT techniques have substantially mitigated historical concerns regarding safety and cognitive side effects, though continued refinement is warranted.

Clinicians should consider ECT early in the treatment algorithm for appropriate candidates rather than as a last resort after extensive pharmacological trials. The integration of ECT with pharmacotherapy, tailored according to individual patient characteristics, offers the best approach to managing this challenging clinical presentation. Future research focusing on optimized parameters, predictive biomarkers, and novel modifications will further enhance the therapeutic potential of ECT for bipolar mania.

### Author's contributions:

Conceptualization, SK, AR and NP; methodology, MD, NP and SK; software, MK, AS, MD, NP and WD; check, AR and BR; formal analysis; BR, AS, MK, WD; investigation, SK, NP, KT and MD; resources, SK and NP; data curation, MK, KT and WD; writing – rough preparation, SK, MD, AR, BR, NP, MK, AS and WD; writing – review and editing, SK, MD, AR, BR, NP, MK, AS and WD; visualization, WD and BR; supervision, AR, SK, KT and MD; project administration, MK, AS and MD;

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