The Effect of Electroconvulsive Therapy on Specific Catatonia Symptoms and Predictors of Late Response

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ABSTRACT

Introduction Electroconvulsive therapy (ECT) is known to be effective in the treatment of catatonia, reaching response rates of about 80 to 100 %. It is indicated in cases of treatment resistance to benzodiazepines and in life-threatening conditions such as malignant catatonia. Beneficial effects on specific symptoms or predictors of response are less clear. The objective of this retrospective study is to examine the ECT effect on specific catatonia symptoms in the acute phase of the illness and to identify predictors of response.

Methods A retrospective study examined data from 20 patients with catatonia, 18 associated with schizophrenia and 2 with bipolar disorder, who underwent ECT from 2008 to 2021. Ten subjects had more than one ECT-series, resulting in a total of 31 ECT-series. Catatonia symptom severity was assessed with the Bush Francis Catatonia Rating Scale (BFCRS).

Results ECT yielded excellent response. Nineteen of 20 patients and 30 of 31 ECT-series achieved response. The mean number of ECT sessions to response was 4.2. Response to ECT was more pronounced for motor inhibition symptoms such as stupor and mutism, while echophenomena, dyskinesia, stereotypy and perseveration responded less well. A predictor of late response was the presence of grasp reflex.

Discussion The present study corroborates the high and rapid effectiveness of ECT in the treatment of catatonia. Focus on single catatonia signs may help to identify those who are most likely to achieve remission quickly, as well as those who might need longer ECT-series.

Introduction

Catatonia is a multifactorial psychomotor syndrome associated with motor and behavioral abnormalities, disturbances of volition, and autonomic dysregulation [1, 2]. A recent meta-analysis indicated a mean prevalence of catatonia at 9 % among patients with different psychiatric and medical conditions across all continents [3]. The largest analysis of clinical electronic health records showed an incidence of 11 episodes per 100,000 person-years and a much longer hospitalization in the catatonia group, indicating high morbidity and enormous economic costs related to catatonia [4]. Traditionally, catatonia has been linked either to schizophrenia (later also bipolar disorder) or organic brain disorders. However, modern classification systems allow the diagnosis of catatonia with comorbidity to multiple mental disorders or medical conditions. Thus, with the introduction of the novel International Classification of Diseases, Eleventh Revision (ICD-11) criteria, catatonia will likely be recognized more frequently [52].

Catatonia may become a life-threatening condition in the form of malignant catatonia (MC) that presents with autonomic dysregulation, severe rigidity, and altered mental status, including high fever, sweating, confusion, and rhabdomyolysis. MC diagnosis is

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often missed in severely ill patients, contributing to a high mortality rate [5].

To ensure the correct diagnosis of catatonia, the use of standardized rating scales is recommended [6, 7]. The Bush-Francis Catatonia Rating Scale (BFCRS) is the most frequently used rating scale for screening and evaluating catatonia symptom severity [8]. Nevertheless, specific training is required as many psychiatrists lack an understanding of catatonia signs, and catatonia is often neglected by clinicians [9].

Currently, the first-line treatment of acute catatonia is the administration of benzodiazepines, primarily lorazepam [5, 6, 10–12]. The response rates of benzodiazepines range from 66 % to 100 % [13], and a 2 mg lorazepam dose has proven effective for treating most catatonia signs [14]. However, a considerable proportion of catatonia patients fail to remit following benzodiazepine administration [15–17]. Importantly, in chronic catatonia, benzodiazepines were not more effective than placebo [18].

The second-line treatment of catatonia is electroconvulsive therapy (ECT), with proven efficacy for treating life-threatening conditions such as MC or in case of non-response to benzodiazepines [6, 7, 11, 19, 20]. Both acute and persistent catatonia, as well as treatment-resistant cases, respond to ECT [10, 16, 17, 21–23] with response rates ranging from 59 % to 100 % [13]. Still, a recent meta-analysis including 564 patients from 28 studies challenges the evidence of effectiveness for ECT in catatonia, given the lack of high-quality studies [24]. Indeed, several potential factors may reduce response rates to ECT in catatonia, such as illness duration, the type of the underlying disorder, catatonia symptom severity, and the presence of specific catatonia signs.

For example, a small retrospective study reported the lowest response rates to ECT so far, with 59 %, most likely due to heterogeneous diagnoses, a high rate of comorbid neurological disorders, chronicity, and treatment delay [25]. In general, predictors of poor or slow ECT response have been equivocal. Chronicity, non-affective catatonia, and the presence of echophenomena seem to indicate poor response, while other signs, such as waxy flexibility, have been found in patients with fast or slow responses [16, 23, 26].

Clinical reasoning clearly favors early detection of catatonia and rapid treatment onset to improve outcomes. However, the use of ECT is often postponed because of procedural obstacles, stigmatization of ECT, anticipated side effects, or a lack of knowledge about catatonia pathophysiology. Inconsistencies in the literature call for identifying predictors of treatment response. Particularly, some catatonia signs may respond better than others to ECT.

The objective of this retrospective study is to explore the effect of ECT on specific catatonia symptoms in a naturalistic sample of patients with catatonia due to schizophrenia spectrum disorders or bipolar disorder. Furthermore, we aim to identify predictors of treatment response in subjects receiving ECT for catatonia.

We expect a high effectiveness of ECT in the treatment of catatonia, with rapid treatment response achieved within five ECT sessions. Furthermore, we aimed to explore which signs of catatonia are associated with time to treatment response. Given that there is insufficient data on the predictive value of single catatonia signs on ECT outcome, this part of the analysis remains exploratory.

Materials and Methods

Study design

We retrospectively examined clinical case files of patients diagnosed with catatonia due to schizophrenia or bipolar affective disorder according to the International Classification of Diseases, Tenth Revision (ICD-10), who were treated with ECT at the University Hospital of Psychiatry and Psychotherapy in Bern between 01/01/2008 and 31/12/2021. According to the ICD-10 criteria, catatonia is defined as a subtype of schizophrenia with the simultaneous occurrence of at least two of the following psychomotor symptoms: mutism, negativism, stupor, catalepsy, waxy flexibility, agitation, and posturing for at least two weeks. Therefore, the majority of the patients in our sample suffer from schizophrenia spectrum disorders, according to DSM-5-TR. Furthermore, we included two patients diagnosed with bipolar disorder, with the signs necessary for catatonia but a schizophrenia diagnosis. This decision was based on work in catatonia by Northoff et al., Krüger et al., and Taylor et al., who demonstrated that patients with major mood disorders could also have severe catatonia [27–29]. We did not, however, diagnose catatonia according to the DSM-IV. This would have resulted in a very different catatonia sample. We based the selection of cases on clinical diagnoses exclusively, which at the time were established using ICD-10 criteria.

The main outcome measure for clinical outcome was the BFCRS that was assessed before, during, and after ECT. The scoring of the BFCRS was carried out by the treating psychiatric resident and supervised by a senior psychiatrist according to clinical routine.

The BFCRS is a 23-item rating scale with high validity and reliability for catatonia screening and rating of catatonia symptom severity (7). The BFCRS is a highly reliable and sensitive instrument to diagnose catatonia with a sensitivity of 100 % and specificity ranging between 75 % and 100 % [8, 30, 31]. Because of its great validity and reliability, as well as the ease of administration, the BFCRS is considered the gold standard to evaluate catatonia. Thus, the BFCRS is preferred for routine use among multiple catatonia rating scales, such as the Northoff Catatonia Rating Scale [30, 32, 33].

In case of incomplete or missing BFCRS-single items or BFCRS-total scores, one researcher (SB) assessed medical and nurses` reports of the clinical course to determine if patients responded to ECT. These cases were not included in the statistical analysis.

The study was approved by the local cantonal ethics committee (Ethics Commission of the Canton of Bern, KEK-Number 2020–00432).

Statistical analysis

Data analysis was performed using the SPSS Statistics version 28.0. To investigate the effect of the ECT procedure, BFCRS-total scores and BFCRS-single items were compared before and after ECT using t-tests for paired samples. Due to our directed hypothesis of BFCRS symptom reduction, we chose a one-tailed t-test with a significance level of $p < 0.05$.

Clinical response was determined as a 50 % reduction in the BFCRS score from baseline. In line with previous studies, we defined early response as a response within five ECT sessions and late response as a response following six or more ECT sessions [17]. To

determine which demographic and clinical parameters predict time to response to ECT, we ran stepwise linear regression analyses with early or late responder status as dependent and the following independent variables: baseline BFCRS-total scores, baseline 23 BFCRS-single items, age, and sex.

Missing data

Only patients with complete BFCRS scores before and after an ECT-series were included in the paired t-tests (BFCRS-total score and BFCRS-single items), and only patients with completed BFCRS-single items at baseline were included in the stepwise linear regression.

Results

Demographics

We included 20 patients with catatonia syndrome. Eighteen patients had schizophrenia as an underlying diagnosis, and 2 patients were diagnosed with bipolar disorder. During the time span from 2008 to 2021, 9 of these 20 patients were included twice because they received two ECT-series, and 1 patient was included thrice because he underwent three ECT-series. This resulted in a total of 31 ECT-series. The mean age of participants was 47.9 ± 18.3 years, ranging from 15 to 75 years. The sex distribution was balanced, with 9 males and 11 females. Ten of the ECT sessions started during the acute phase of illness within the first 2 weeks after illness onset, 18 ECT sessions were administered during the chronic phase of illness after 1 month of illness onset, and three ECT sessions started between 2 weeks and 1 month after illness onset. Seventeen of the patients and 25 of the 31 ECT-series were assessed with the BFCRS before and after treatment, and the BFCRS-total scores at baseline and at the end of treatment were available. In 18 of 31 ECT-series, the single BFCRS items were available. During the treatment, the BFCRS scores were also recorded, but not on a daily basis, and in most cases, the pattern followed the clinical course and thus lacked a standard frequency. The mean duration of the ECT-series was 31.1 ± 17.3 days (min. 6 days, max. 89 days). The patients received a mean of 12.2 ± 4.9 ECT sessions (min. 4 sessions, max. 27 sessions). The mean number of ECT sessions to response was 4.2 ± 3.4 (min. 1 session, max. 12 sessions).

Psychotropic drugs

All patients were on antipsychotic medication during ECT. Eleven patients received monotherapy, and 9 patients were on multiple antipsychotics. All patients except 1 were on clozapine, and all other psychotropic drugs were used as an add-on treatment to clozapine. In many patients, dose adjustments of clozapine were necessary, and 6 patients underwent fluvoxamine augmentation. Before starting ECT, 11 patients were treated with haloperidol; however, in 6 patients, it was discontinued due to lack of efficacy. In addition to clozapine, other antipsychotics were administered during ECT: haloperidol in 5 patients, aripiprazole in 2 patients, brexpiprazole in 1, levomepromazine in 1, and pipamperone in 1. Four patients were additionally treated with an antidepressant to treat comorbid depressive or anxiety symptoms: 1 with escitalopram, 1 with venlafaxine, 1 with clomipramine, and 1 with venlafaxine and mirtazapine. Benzodiazepines were not routinely administered during ECT. Twelve patients were continued on lorazepam during ECT, as it led to a slight improvement in catatonia severity. Lorazepam was tapered off after the remission from catatonia. In 8 patients, lorazepam had no sufficient effect and was therefore discontinued before starting ECT.

Electroconvulsive therapy procedure

ECT was performed according to the clinical routine. At the first ECT session, the age method was used to determine the stimulation strength. Adjustments were then made based on the quality of the seizures and the clinical course. ECT was administered using a Thymatron IV system. The patients received, on average, 12.2 ± 4.9 ECT sessions in the course of 4 to 5 weeks, i. e., three sessions per week and bilateral electrode placement, except for 1 patient who was treated with right unilateral stimulation. The duration of treatment depended on the clinical course and continued until no further improvement was expected. Treatment in the acute phase of illness was defined as the start of the ECT sessions within the first 2 weeks after catatonia onset, and treatment in the chronic phase of illness was defined as the start of the ECT sessions after 1 month of catatonia onset.

Anesthetics

In 27 ECT-series, etomidate was used for general anesthesia, and in 4 ECT-series, propofol was utilized. In addition, most patients received alfentanil as an additional analgesic. Some patients received remifentanil. In 25 ECT-series, succinylcholine was administered for muscle relaxation, and in 6 ECT-series, rocuronium was used for muscle relaxation in bedridden patients. Dosages were chosen and modified according to the clinical routine procedures of the anaesthesiologist. Patients treated with benzodiazepines were antagonized with flumazenil.

Electroconvulsive therapy response

Response has been achieved in 19 of 20 patients and in 30 of 31 ECT-series (see ▶ **Table 1**). The patient who did not recover showed at least a moderate improvement in catatonia symptom severity of 44 % on the BFCRS score.

In 3 patients with missing BFCRS-scores, we consulted the medical records. Before ECT, these patients were characterized by the presence of pronounced immobility, mutism, negativism, stereotypy, and mannerisms. In these patients, medical records clearly indicated a clinical response with a substantial improvement in catatonia symptoms.

A paired t-test of BFCRS scores indicated substantial reductions in catatonia severity with ECT ($T = 12.4$; $P < 0.001$). The mean BFCRS-score before the treatment was 18.5 ± 5.6, and after the treatment, 3.2 ± 2.7, resulting in an 82.8 % reduction from baseline.

Single Bush-Francis Catatonia Rating Scale-item response and predictors of late response

Paired t-tests of the single-item response to ECT revealed a better response to ECT for motor inhibition symptoms such as stupor and mutism, while echophenomena, dyskinesia, stereotypy, and perseveration responded less well (see ▶ **Table 2**).

▶ **Table 1** Catatonia symptom reduction of total BFCRS-scores.

Patient #	BFCRS-Score before ECT	BFCRS-Score after ECT	Symptom Reduction
1a	19	1	95 %
1b	17	1	94 %
2a	17	0	100 %
2b	14	0	100 %
3	14	3	79 %
4	9	5	44 %
5a	15	4	68 %
5b	25	8	73 %
6	22	7	68 %
7	24	2	92 %
8a	24	0	100 %
8b	25	0	100 %
9	23	8	65 %
10a	8	1	87 %
10b	28	1	96 %
11a	28	1	96 %
11b	15	1	93 %
12	17	7	59 %
13	14	3	79 %
14	20	7	66 %
15	14	3	79 %
16	23	3	87 %
17a	9	2	78 %
17b	19	7	63 %
17c	19	4	79 %

BFCRS: Bush Francis Catatonia Rating Scale; ECT: electroconvulsive therapy.

A stepwise logistic regression analysis of demographic and clinical parameters identified the presence of grasp reflex (*R2*: 1.6; F = 9.2; df = 1; p = 0.009) as a predictor of late response. The presence of other catatonia signs, symptom severity at baseline, age, or sex had no influence on the time to response. In addition, treatment response was unrelated to age or sex.

Maintenance electroconvulsive therapy

Seven patients received maintenance ECT due to a chronic, recurrent course of catatonia. According to the BFCRS score and regular and detailed documentation, all patients remained well and showed a stable long-term clinical course (see ▶ **Table 3**).

Missing data

Seventeen of the patients and 25 of 31 ECT-series were assessed with the BFCRS before and after treatment. In 3 patients and 6 ECT-series, BFCRS-total scores were not available before or after the ECT-series. In 18 of 31 ECT-series, patients had complete BFCRS-single items before or after the ECT-series. In 15 ECT-series, patients had complete BFCRS-single items before and after the ECT-series.

Discussion

The present retrospective study aims to provide an overview of the ECT effect on specific catatonia symptoms and to identify predictors of response. Our study corroborates the overwhelming effect of ECT on catatonia. Response to ECT has been achieved in 19 of 20 patients and in 30 of 31 ECT-series. Even the patient who did not recover showed at least a moderate improvement in catatonia severity. There was a better response to ECT for signs of motor inhibition, such as stupor and mutism, while echophenomena, dyskinesia, stereotypy, and perseveration responded less well. Regression analyses showed that the ECT effect in catatonia patients is independent of age and sex and that the presence of a grasp reflex predicted a slow response.

This naturalistic study focused on predominantly non-affective psychoses. We used ICD-10 diagnostic criteria that consider schizophrenia the only non-organic mental illness in which catatonia may occur. In addition, we included 2 patients with severe bipolar disorder who otherwise qualified for catatonia. This decision was based on prior work in catatonia by Northoff et al., Krüger et al., and Taylor et al. [27–29]. With the new diagnostic criteria in DSM-5-TR and ICD-11, catatonia can be diagnosed in a number of mental disorders (e. g., autism, depression), medical conditions (e. g., autoimmune encephalitis), and substance-related effects (e. g., intoxications) [34, 35]. This change in criteria will broaden the spectrum of catatonia, increase the prevalence and detection, and finally, will require new studies evaluating treatment outcomes in these new conditions.

The small proportion of patients with affective disorders in our sample is clearly related to the diagnostic procedure using ICD-10 criteria, in which catatonia is diagnosed as a subtype of schizophrenia, while ICD-10 was blind to catatonia in mood disorders.

Other studies have primarily included patients with catatonia due to affective disorders, in whom acute retarded catatonia—the so-called Kahlbaum phenotype—is the most frequent catatonia presentation [8, 11, 36]. However, there are also studies with higher frequencies of psychotic disorders in their samples of catatonia patients [37–39]. Clearly, the proportions of catatonia with different comorbid mental disorders will change with the revised diagnostic criteria in ICD-11 and DSM-5-TR.

The impressive effectiveness of ECT in the treatment of catatonia, with a response rate of 95 %, parallels previous reports [13, 16, 17, 21–23, 26]. One catatonia study reported lower response rates to ECT at 59 % [25]. This study differed from our study in that the patients had a high rate of comorbid neurological disorders, a long illness duration, and a marked delay of ECT initiation.

In addition to the high effectiveness of ECT, the study provides evidence for a rapid treatment response. After an average of 4.2 ECT sessions, patients have already responded to the treatment. Similarly, rapid effects of ECT were also reported by other catatonia studies, achieving response within 1–5 days [10, 17, 23]. Raveendranathan et al. 2012 [23] showed that 55 % of the patients with catatonia responded to ECT within four sessions. This fast response was related to high symptom severity and a shorter illness duration before treatment, as well as the presence of waxy flexibility and Gegenhalten. In contrast, the presence of echophenomena was associated with a slower response [23]. A randomized controlled ECT trial reported a slower response to ECT with an average

▶ **Table 2** Results of paired t-tests of single BFCRS-items in 15 ECT-series (level of significance one-tailed).

Items with good response	Significance (p-value)	Item-value ≥ 1 before ECT	BFCRS-Items not responding well	Significance (p-value)	Item value ≥ 1 before ECT
Immobility	T(14) = 4.525 p < 0.001	89 %	Excitement	T(14) = 1.468 p = 0.082	22 %
Mutism	T(14) = 5.237 p < 0.001	83 %	Grimacing	T(14) = 1.146 p = 0.136	22 %
Staring	T(14) = 2.256 p = 0.02	83 %	Echopraxia	T(14) = 0.367 p = 0.360	33 %
Catalepsy	T(14) = 3.623 p = 0.001	72 %	Mannerism	T(14) = 1.000 p = 0.167	22 %
Stereotypy	T(14) = 1.848 p = 0.043	44 %	Verbigeration	T(14) = 1.000 p = 0.167	22 %
Rigidity	T(14) = 3.292 p = 0.003	56 %	Impulsivity	T(14) = 0.000 p = 0.500	17 %
Negativism	T(14) = 2.646 p = 0.010	39 %	Autonomic Obedience	T(14) = 0.000 p = 0.500	17 %
Waxy flexibility	T(14) = 2.092 p = 0.028	22 %	Ambitendency	T(14) = 1.705 p = 0.055	17 %
Withdrawal	T(14) = 5.047 p < 0.001	78 %	Perseveration	T(14) = 0.000 p = 0.500	22 %
Mitgehen	T(14) = 2.092 p = 0.028	28 %	Combativeness	T(14) = 0.716 p = 0.243	17 %
Gegenhalten	T(14) = 2.092 p = 0.028	33 %			
Grasp reflex	T(14) = 1.871 p = 0.041	28 %			
Autonomic abnormality	T(14) = 2.806 p = 0.007	56 %			

BFCRS: Bush Francis Catatonia Rating Scale; ECT: electroconvulsive therapy.

of 8.87 ECT sessions, most probably due to non-affective catatonia and a long illness duration before treatment [16]. To the best of our knowledge, our study is the first to suggest the grasp reflex as a predictor of late response to ECT in the treatment of catatonia. Grasp reflex is a frontal release sign and represents a rather rare catatonia sign, but often occurs in neurodegenerative disorders [40, 41]. In their large heterogeneous catatonia sample, Wilson et al. 2015 [42] reported a grasp reflex in only 14 % of the patients with confirmed catatonia. This speaks towards grasp reflex identifying a group of subjects who will have a less favorable outcome of catatonia, calling for more intense treatment strategies.

Although ECT is highly effective in treating catatonia, the relapse rate in the first year after treatment response is high, even under continuation treatment with antipsychotics [43]. There is some evidence arguing for the maintenance of ECT combined with antipsychotics, which might be more effective in the long-term treatment of schizophrenia than antipsychotics alone in terms of catatonia symptoms, behavioral symptoms, social functioning, and hospitalization rates [44–46].

Our study shows that patients who once responded to ECT also tend to respond to subsequent ECT-series, indicating that the response to the first ECT-series might be a predictor of response to future ECT-series. In recurrent catatonia, ECT might be established as a first-line therapy whenever the first ECT series is effective.

Furthermore, our study provides insight into the treatment of patients with chronic recurrent catatonia. In 7 patients, the use of maintenance ECT over several months demonstrated a positive effect on catatonia severity according to the BFCRS-score and detailed clinical documentation.

Our study should be interpreted in the light of several limitations. The heterogeneous administration of antipsychotics may render interpretations of the results more difficult than in studies administering only 1 substance. However, the naturalistic design proved that all but 1 patient were treated with clozapine and that half of them also required further psychopharmacology. The literature suggests that the use of antipsychotics might maintain or worsen the catatonia state [36] and decrease the effect of ECT [47, 48]. At the same time, clozapine is often administered and might be the most efficacious and best-tolerated antipsychotic in combination with ECT due to lower dopamine receptor blockade and modulation of the glutamatergic system [36, 49]. There may have been an impact of antipsychotics on treatment outcomes as clozapine doses were modified during the ECT-series. Furthermore, half of the patients were on additional pharmacotherapy that was tapered off during the ECT-series in some cases. Thus, a meaningful statistical correction for antipsychotic equivalent doses at one specific time point was not possible. Furthermore, patients treated with lorazepam during ECT had a very similar response (symptom

▶ **Table 3** Overview of patients receiving maintenance ECT

Pat ID	Gender	Age	Medication (in mg)	Maintenance treatment (MT) sessions	Symptoms before MT	Main residual symptoms	Stimu lation parameter	Frequency of stimulation
1a	w	47	Paliperidon Depot 75 mg Venlafaxin 150 mg Mirtazapin 30 mg Valproat 2000 mg	12	Remitted	Rremitted	Bilateral 50 %	6 × 2 weekly 4 × 4 weekly 1 × 2 & 1 × 3 monthly
1b	w	46	Venlafaxin 112.5 mg Mirtazapin 30 mg Paliperidon 9 mg Lorazepam 1 mg	8	Remitted	Remitted	Bilateral 50 %	6x weekly & 2 × 2 weekly
2	w	71	Clozapin 150 mg	20	Gegenhalten Grasp Reflex	Remitted	Bilateral 200 %	5x weekly 13 × 2 weekly 4 × 3 weekly 1x monthly
3a	m	19–24	Clozapin 225 mg	77	Mutism Immobility Stereotypy	Mutism Immobility Stereotypy Mannerism	Bilateral 40 %	1 year weekly then intervals 2 days-5 months
3b	m	26–29	Venlafaxin 150 mg Fluvoxamin 50 mg Clozapin 100 mg	90 (still in treatment)	Mutism Immobility Stereotypy	Slight mutism Immobility Stereotypy	Bilateral 90 %	Alternating 1–3 weekly
4a	m	48	Clozapin 400 mg	26	Immobility Mutism Negativism Autonomic Abnormality	Slight withdrawal Perseveration	Bilateral 100 %	16x weekly 6 × 2 weekly 4 × 3 weekly
4b	m	49	Clozapin 400 mg Clomipramin 75 mg	6	Mutism Posturing Stereotypy Ambitendency Grasp reflex Combativeness	Slight immobility Staring Stereotypy	Bilateral 100 %	3x weekly 1 × 2 weekly 2 × 3 weekly
5a	w	70	Olanzapine 10 mg Amitriptyline 50 mg	6 (still in treatment)	Slight Immobility Echolalia Perseveration	Slight immobility Echolalia Perseveration	Unilateral 100 %	9 × 4 weekly
5b	w	69	Olanzapine 5 mg	18	Slight Immobility Echolalia Perseveration	Slight immobility Echolalia Perseveration	Unilateral 150 %	7x weekly 6 × 2 weekly 3 × 3 weekly 2 × 4 weekly
6	m	50	Clozapine 200 mg Aripiprazol 15 mg Risperidone 3 mg Lorazepam 0.5 mg	8 (still in treatment)	Slight Excitement Echolalia Stereotypy Verbigeration Perseveration Autonomic Obedience	Slight excitement Echolalia Stereotypy Verbigeration Perseveration Autonomic Obedience	Bifrontal 170 %	10 × 5 weekly
7	m	16	Clozapine 100 mg	43 (still in treatment)	Mutism Staring Catalepsy Stereotypy Withdrawal Autonomic Abnormality	Mutism Staring Stereotypy	Bilateral 120 %	40 × 1–2x weekly 1 × 3 weekly 1 × 4 weekly

ECT: electroconvulsive therapy.

reduction of 78 %) in comparison to patients without benzodiazepines (symptom reduction of 80 %).

Another limitation of the study is the incomplete assessment of the BFCRS in a small proportion of patients. However, clinical evaluations were carried out regularly and precisely by experienced psychiatrists, who provided detailed documentation of the course of catatonia in the case files.

The strength of the study is its sample, which includes a large proportion of severely ill patients with catatonia and schizophrenia (90 %) as the underlying mental disorder. Most recent studies examining the effectiveness of ECT included mixed samples with patients with unipolar or bipolar depression and only a small proportion of patients with schizophrenia [11, 26, 50]. The patients in our sample were well-characterized and received multiple sessions of ECT. As the observation period was long, we were able to evaluate the ECT effect on different catatonia symptoms, on patients who received therapy at different time points, and in patients with chronic catatonia who received maintenance ECT.

Our study illustrates the strikingly high effectiveness of ECT in treating catatonia, despite the fact that the majority of patients had schizophrenia as an underlying diagnosis. The study demonstrates that ECT was effective in catatonia due to schizophrenia and in patients on antipsychotic medication. For the first time, the presence of a grasp reflex was indicated as a predictor of slow response. Thus, these patients may require more intense treatment efforts.

Following the current guidelines, the use of benzodiazepines is still the first-line treatment of catatonia [5, 10, 11]. Furthermore, non-invasive brain stimulation techniques such as repetitive transcranial magnetic stimulation (rTMS) are promising treatment options for catatonia that are still under investigation [6, 51]. However, the relative efficacy of rTMS is still unknown, while ECT clearly demonstrates efficacy across varying levels of catatonia severity. Given the complications and life-threatening conditions that can arise from catatonia, as well as the limited effectiveness of benzodiazepines, an effective and fast-acting treatment is necessary. The present study corroborates the impressive and rapid effect of ECT in catatonia, suggesting that ECT should be considered early in the course of catatonia. High-quality data on the effectiveness of ECT is still missing, and randomized controlled trials should be performed to further validate the use of ECT in the treatment of catatonia. Future studies should establish symptom profiles that may benefit most from rapid ECT treatment.

Conflict of Interest

The authors declare that they have no conflict of interest.

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