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Neuropsychiatric Adverse Effects of Electroconvulsive Therapy: A Retrospective Study

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ABSTRACT

Introduction: Electroconvulsive therapy (ECT) is an important treatment modality in psychiatry. Despite the efficacy of ECT, its use worldwide is less than expected. Although limited access and stigma are the main factors contributing to this controversy, cognitive side effects are an important issue for clinicians who administer ECT. The present study aims to provide an assessment of the frequency of neuropsychiatric adverse effects associated with ECT.

Methods: A retrospective evaluation of 2935 files of patients who underwent ECT between January 1, 2013 and December 31, 2017 was performed. Specific data obtained from patient records, such as sociodemographic characteristics, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition diagnoses, scale scores, medical evaluations, length of hospital stay, previous ECT history and indications for ECT administration, stimulus parameters, seizure duration, and neuropsychiatric adverse effects were evaluated.

Results: A significant proportion of patients experienced no neuropsychiatric adverse effects across multiple sessions, with the proportion increasing steadily from 70.7% after one session to 97.3% after ten sessions. Additionally, the group that showed neuropsychiatric adverse effects underwent a significantly higher number of previous ECT sessions ($p<0.001$), longer duration of hospitalization after the last ECT session ($p<0.001$), and overall duration of hospitalization ($p<0.001$).

Conclusion: The fact that the majority of patients in this study did not experience any neuropsychiatric adverse effects during more than one ECT session and that the frequency of adverse effects decreased as ECT sessions progressed may contribute clinicians to approach ECT application more confidently.

Keywords: Adverse effect, electroconvulsive therapy, neuropsychiatry, cognitive

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INTRODUCTION

Electroconvulsive therapy (ECT) is widely considered a safe and effective somatic treatment for various psychiatric disorders worldwide, with recent research suggesting that its mechanism of action may involve an increase in nerve cell growth factor and hippocampal volume, despite the exact mechanisms remaining unclear (1,2). With an estimated one million patients globally undergoing the procedure annually (1), ECT offers rapid response and remission rates (3,4). Despite these benefits, ECT can induce adverse neurocognitive effects, making it crucial for clinicians to understand not only its clinical indications and potential benefits but also its neuropsychiatric implications (5). The utilization of ECT is constrained primarily due to its neuropsychiatric adverse effects, which are typically manifested during or shortly after a session. These effects stem from various factors such as anesthesia, the use of anticholinergic drugs, muscle relaxants, or electrical stimuli, and seizures. In particular, anesthetic agents used during ECT, such as propofol and succinylcholine, may contribute to complications including bradycardia, hypotension, postictal confusion, headache, and transient memory impairment, thereby complicating the neuropsychiatric risk profile of the procedure. Given the multifactorial origins of these effects, careful monitoring and individualized adjustment of ECT and anesthetic parameters remain essential to minimizing risk (6).

The neurocognitive adverse effects of ECT are characterized by temporary disorientation immediately after the procedure, as well as anterograde amnesia for recent events and retrograde amnesia for both personal and impersonal information. Additionally, ECT can impact various cognitive functions such as processing speed, attention, verbal fluency, and executive function, potentially leading to challenges in cognitive flexibility (5,6). Similar cognitive effects have also been documented in Turkish cohorts; for example, Aykut et al. (7) observed impairments in memory, orientation, and executive functions following ECT. Around 8-20% of the patients may experience postictal states after an ECT session, characterized by anxiety, restlessness, and confusion, commonly referred to as postictal agitation, confusion, or delirium (8). In a retrospective

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Highlights

- **Adverse neuropsychiatric event risk decreased as ECT sessions progressed.**
- **Cognitive adverse effects were rare and self-limiting.**
- **Seizure-related adverse effects declined with more sessions.**
- **Patients with adverse effects had longer hospital stays.**

study of 832 female patients, Özdemir et al. (9) reported a 15.4% rate of post-ECT confusion and an 11.5% incidence of prolonged seizures, aligning with international observations of postictal states (6).

In contrast to the progressive cognitive decline seen in Alzheimer's disease, the cognitive effects of ECT are typically transient, although they may persist for up to six months or longer in some cases, affecting daily functioning, treatment adherence, clinical outcomes, and relapse rates (10). Consistently, Demir et al. (11) found memory problems to be among the most frequent, though temporary, adverse effects following ECT in a sample of 759 patients. Similarly, Şengül et al. (12) identified memory difficulties as a commonly reported side effect in their study population. These findings reflect the broader variability observed in local ECT outcomes, where incidence rates and symptom duration may depend on patient characteristics, electrode placement, and monitoring protocols (7,9).

Adverse events related to seizures during ECT include inadequate seizures (lasting less than 20 seconds), prolonged seizures (lasting longer than 120 seconds), and tardive seizures (13). Prolonged seizures can be detected with electroencephalography (EEG) and occur infrequently (1% to 2%); such seizures increase the risk of post-ECT confusion and memory impairment. However, some studies suggest that prolonged seizures may be more common than previously assumed, partly due to improved detection through continuous EEG monitoring. In particular, seizures lasting over 180 seconds have been reported more frequently in patients under the age of 20 (9). In rare instances, prolonged or tardive seizures may progress to convulsive or nonconvulsive status epilepticus (14). In Turkish cohorts, the reported rate of prolonged seizures ranged from 0.1% to 11.5%, with cases documented across different age groups and clinical settings (9,12).

The development of headaches after ECT is common and affects between 26% to 85% of the patients (15). These headaches typically peak within two hours post-treatment and resolve within 24 hours (16). Although they are usually mild and self-limiting, the headaches may occasionally be severe and persistent, especially in younger patients and those with a previous history of headaches. A Turkish study involving 337 patients found a 14.5% rate of post-ECT headache, which was typically bilateral, throbbing, and mild to moderate in severity, with limited need for treatment (17). Similar findings were reported in another local study, where headache was among the most common adverse effects, even in patients with chronic medical conditions (12). It is also essential to distinguish these headaches from headaches associated with depression (18).

ECT is a critical intervention for treatment-resistant psychiatric disorders, with anesthesia administration being essential to enhance patient comfort and tolerability. Nevertheless, both ECT and anesthesia carry potential risks that may increase the likelihood of neuropsychiatric adverse effects. Although previous studies from Turkey have reported various ECT-related outcomes, existing data are generally based on smaller samples or focus on limited adverse events (7,9,11,12,17). This limits the generalizability and comparability of findings across institutions. The present study addresses this need by providing current data on the prevalence and characteristics of neuropsychiatric side effects in one of the most comprehensive ECT patient cohorts to date, offering broader insight into clinical practice in large-scale psychiatric settings both within Türkiye and internationally.

METHODS

This retrospective cross-sectional study was conducted at Bakirkoy Prof. Dr. Mazhar Osman Training and Research Hospital for Psychiatry, Neurology and Neurosurgery, Türkiye's largest neuropsychiatric center, which provides services to a population of approximately 26 million people. The institution treats around 315,000 outpatients and 12,500 inpatients annually. The study included data from patients who met the specified criteria and received electroconvulsive therapy (ECT) between January 1, 2013, and December 31, 2017. The protocol was approved by Bakirkoy Dr. Sadi Konuk Training and Research Hospital, Clinical Research Ethics Committee (Date: 24 June 2024, Decision No: 206). Each patient or their legal representative received detailed information about the ECT process, and written informed consent was obtained. In emergency cases, ECT was administered with the approval of two psychiatrists.

Participants, Eligibility Criteria, and Data Collection

Patients aged 18 years and older who underwent ECT were included in the study. Cases with substantial missing data or those that did not undergo all ten consecutive ECT sessions within our institution were excluded from the analysis. Individuals with stable and managed chronic conditions such as hypertension, chronic kidney disease, diabetes, or thyroid disorders were not excluded. To ensure the accuracy of neuropsychiatric outcome assessments, patients with clinical conditions that could interfere with cognitive evaluation were excluded. These conditions included chronic headache disorders, recent head trauma, or other active neurological problems. Patients with a history of substance use disorders were also excluded if active use was documented and judged likely to compromise cognitive or psychiatric evaluations during the ECT course. Exclusion decisions were based on the physician's review of medical records and clinical documentation rather than structured patient questionnaires. A total of 2,935 unique cases met the inclusion criteria. Sociodemographic data, the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (DSM-IV) diagnoses (19), and ECT procedural details were systematically collected for each patient.

Comprehensive Assessment Protocol

A structured internal form was utilized to guide documentation. The anesthesiologist recorded the ASA (American Society of Anesthesiologists) physical status classification for each patient (ASA I: a normal healthy patient; ASA II: a patient with mild systemic disease; ASA III: a patient with severe systemic disease; ASA IV: a patient with severe systemic disease that is a constant threat to life; ASA V: a moribund patient who is not expected to survive without the operation; ASA VI: a declared brain-dead patient whose organs are being removed for donor purposes) (20). All evaluations were systematically recorded in the patient files.

Data were manually extracted from the patient files by trained researchers. Extracted variables included age, sex, DSM-IV psychiatric diagnoses, ASA status, number of ECT sessions, hospitalization duration, time from admission to first ECT, and time from final ECT to discharge. Additional variables such as history of previous ECT, seizure duration, stimulus parameters, total number of hospitalizations, and average days of inpatient care were also recorded. ECT usage rates among all hospitalized patients during the study period were calculated.

To ensure data integrity, patient records were reviewed in detail to minimize extraction errors. Cases with significant missing data on clinical

outcomes were excluded using a listwise deletion strategy. All extracted data were organized into an electronic database for subsequent analysis.

Electroconvulsive Therapy Protocol

Electroconvulsive therapy is administered according to the ECT regulation, in accordance with the guidelines of the American Psychiatric Association and the Royal College of Psychiatrists (21,22). All procedures, evaluations, and monitoring steps described here reflect routine clinical practice as recorded in the hospital's documentation system during the study period.

Initial pre-ECT evaluations included a physical examination by an anesthesiologist, after which ECT application and observation forms were completed. Patients fasted for at least 6 hours prior to the procedure. The Thymatron IV brief-pulse ECT device was used, with bitemporofrontal electrode placement. In the preparation room, baseline patient information, such as weight, heart rate (HR), systolic and diastolic blood pressure (SBP and DBP), and body temperature, were recorded. Cardiovascular monitoring was continuously performed with a noninvasive digital monitor, and oxygen saturation was measured via pulse oximetry. Stimulus dosage was determined by the "half-age method." If seizure duration was recorded as less than 20 seconds, a dose increase protocol was implemented.

Anesthesia and Monitoring

All ECT sessions used propofol (1.0 mg/kg IV over 5 seconds) as the anesthetic, followed by either 0.5 mg/kg succinylcholine or 0.3 mg/kg rocuronium as muscle relaxants, with 100 mg sugammadex administered post-seizure for rocuronium cases to reverse neuromuscular blockade. Electrical stimulation was applied via bifrontotemporal electrodes using a brief-pulse square-wave ECT device (Thymatron IV; Somatics, Inc., Lake Bluff, IL), and EEG seizure duration and motor activity were recorded, with patients ventilated using 100% oxygen until spontaneous breathing resumed. In addition to surface EEG, electromyography (EMG) and electrocardiography (ECG) monitoring were performed continuously. Stimulus intensity was determined by the half-age method in the initial session, and adjusted in subsequent sessions based on seizure quality, seizure duration, and clinical response. If seizure duration was less than 20 seconds, the patient was restimulated with a higher intensity stimulus as per institutional protocol.

Vital signs (HR, mean arterial pressure, SpO_2, ECG, respiratory rate) were recorded at multiple points: before induction, after relaxant administration, post-ECT, and every 5 minutes throughout the procedure, while cardiovascular parameters (SBP, DBP, HR) were noted during preparation and at the 15th postictal minute. Although intra-ictal hemodynamic recordings were not obtained, seizure quality was continuously assessed via EEG by the psychiatrist and anesthesiologist present during the session. Patients meeting the criteria for spontaneous breathing were subsequently transferred back to the ward. All sedative/hypnotic agents and anticonvulsants not used for epilepsy were discontinued prior to ECT to avoid confounding seizure threshold. However, antipsychotics and antidepressants (e.g., SSRIs, SNRIs) were allowed to continue.

Adverse effects were jointly monitored by the psychiatrist and the anesthesiologist throughout each session. These effects were identified through continuous physiological monitoring and clinical observation and were not assessed using standardized scales. However, adverse effects were systematically documented using a structured institutional form during each session (Form Code: PS-FR-003). On the structured documentation form, the anesthesiologist recorded medical effects associated with general anesthesia (such as post-anesthesia recovery issues, tachycardia, bradycardia, hypertension, hypotension, hypersalivation, dental fracture or avulsion, rash/flushing, and hypoglycemia). The psychiatrist was responsible for evaluating psychiatric and cognitive effects of ECT, including seizure-related phenomena (absence of seizures, prolonged seizures, inadequate seizures, tardive seizures, tonic/myoclonic contractions) and other neuropsychiatric symptoms (confusion, agitation, amnesia, anxiety, and headache). All evaluations were systematically recorded in the patient files.

Each session was followed by a standard physical and psychiatric examination to identify adverse outcomes and evaluate clinical response, based on physician judgment and medical documentation. ECT was discontinued if no improvement was observed after four to six sessions or earlier in cases of severe complications. In our clinic, continuation and maintenance ECT protocols were implemented when needed, with continuation ECT lasting up to six months post-acute treatment and maintenance ECT scheduled weekly or monthly depending on clinical response.

Statistical Analysis

Data analysis was conducted using SPSS version 25. The Shapiro–Wilk test was carried out to assess the normality of the variables. Descriptive statistics were computed for continuous and categorical variables, including means, standard deviations, frequencies, and percentages. Comparative analyses utilized chi-square(χ^2) tests for categorical data and Student t-tests for continuous data within a normal distribution, with statistical significance set at $p < 0.05$.

RESULTS

The analysis included a total of 29,350 ECT sessions, with each of the 2,935 patients receiving 10 consecutive sessions. Since the number of sessions was fixed per patient, descriptive statistics such as mean, median, minimum, and maximum were not applicable.

The sociodemographic and clinical characteristics of the 2935 patients undergoing ECT are summarized in Table 1. Participants had an age of 35.1 ± 11.7 years (mean ± SD), 59.6% were male, and 70.2% were unmarried. Smoking was reported by 59.6% of patients, with 12% reporting alcohol use and 16.5% substance use. Anesthesia history was noted in 8% of cases, and 19.3% had a prior medical condition. According to the ASA classification, most patients were classified as ASA I or II. Primary ECT indications included treatment non-responsiveness (85%) and risk of suicide/homicide with agitation (10.8%). Patients had undergone an average of 7.5 ± 3.2 ECT sessions before this admission, and the mean length of hospital stay during the current admission was 30.6 ± 14.5 days.

A detailed analysis of post-ECT session adverse effects is presented in Table 2. A large proportion of patients experienced no adverse effects, increasing from 70.7% after the first session to 97.3% by the tenth session. Similarly, the rate of 'no seizures' decreased from 5% after the first session to 1.7% after the tenth session. Inadequate seizures (lasting under 20 seconds) showed a steady decline from 12.5% in the first session to 0.6% by the tenth session. Prolonged seizures (over 120 seconds) varied, peaking at 7.3% initially and reducing to 0.1% by the tenth session. Other adverse effects, such as tardive seizures, myoclonic/tonic contractions, and confusion, were rare, each peaking at under 0.5% per session.

A comparison of variables associated with the patients who showed adverse effects after ECT and those who did not is shown in Table 3. Of the total sample, 1,706 patients (58.1%) experienced at least one adverse effect during ECT, while 1,229 patients (41.9%) had no recorded adverse effects. Patients who received ECT within the first two weeks of hospitalization had a significantly lower rate of adverse effects (81.1%) compared to those who started after two weeks (85.4%) ($p = 0.002$) (Table 3).

Table 1. Descriptive data of the samples studied (n=2935)

Variables		Data
Age, (Mean±SD)		35.14±11.72
Education (in years), (Mean±SD)		7.5±3.63
Weight (kg) (Mean±SD)		74.11±15.93
Sex, n (%)	Male	1749 (59.6)
	Female	1186 (40.4)
Marital Status, n (%)	Not married	2061 (70.2)
	Married	874 (29.8)
Smoking (yes) n (%)		1749 (59.6)
Alcohol use (yes) n (%)		352 (12)
Substance use (yes) n (%)		484 (16.5)
History of Anaesthesia (yes) n (%)		234 (8)
Medical History (yes) n (%)		566 (19.3)
ASA n (%)	I	918 (31.3)
	II	1919 (65.4)
	III	95 (3.2)
	IV	1 (0.03)
	V	2 (0.1)
How soon was ECT administered after hospitalization? n (%)	Within 2 weeks	2434 (82.9)
	After 2 weeks	501 (17.1)
Diagnosis n (%)	Psychotic Disorder, Not Otherwise Specified	411 (14)
	Schizophrenia	983 (33.5)
	Mania (bipolar disorder)	754 (25.7)
	Catatonia	76 (2.6)
	Major Depressive Disorder	544 (18.5)
	Other	167 (5.7)
Indications for ECT n (%)	Unresponsive to other treatments (Failure of pharmacotherapy)	2495 (85)
	Failure of pharmacotherapy+Elevated suicide/homicide risk, agitation	317 (10.8)
	Failure of pharmacotherapy +Catatonia	110 (3.7)
	Poor oral intake	13 (0.6)
Additional Diagnosis n (%)	Psychosis	65 (2.2)
	Depression	1 (0.0)
	Mania	425 (14.5)
	Poor oral intake	90 (3.1)
History of ECT (yes) n (%)		1034 (35.2)
Adverse Effects with ECT (yes) n (%)		1706 (58.1)
Number of Prior ECT Sessions (Before This Admission) n (%)		7.53±2.95
Duration of Hospitalization (days) (Mean±SD) (min-max)		30.65±14.53 (2-253)
Duration of hospitalization before first ECT (days) (Mean±SD) (min-max)		10.62±8.89 (0-65)
Duration of hospitalization after last ECT (days) (Mean±SD) (min-max)		5.67±7.97 (0-131)

ECT (Electroconvulsive therapy)/ ASA (American Society of Anesthesiologists)/Other (Other diagnoses in The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition)

Table 2. Descriptive data on adverse effects following electroconvulsive therapy

	Number of sessions n (%)									
Adverse effects	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
None	2075 (70.7)	2392 (81.5)	2531 (86.2)	2549 (86.8)	2608 (88.9)	2627 (89.5)	2684 (91.4)	2779 (94.7)	2841 (96.8)	2856 (97.3)
No seizures	148 (5)	60 (2)	25 (0.9)	25 (0.9)	11 (0.4)	13 (0.4)	5 (0.2)	1 (0.0)	2 (0.1)	51 (1.7)
Inadequate seizures (<20sec)	368 (12.5)	329 (11.2)	282 (9.6)	226 (7.7)	206 (7)	190 (6.5)	159 (5.4)	98 (3.3)	55 (1.9)	18 (0.6)
Prolonged seizures (>120 Sec)	213 (7.3)	85 (2.9)	54 (1.8)	73 (2.5)	58 (2)	60 (2)	40 (1.4)	26 (0.9)	16 (0.5)	2 (0.1)
Tardive Seizures	1 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.1)	0 (0)	1 (0.0)	0 (0)	0 (0)
Myoclonic/Tonic Contractions	1 (0.0)	1 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Confusion	8 (0.3)	4 (0.1)	3 (0.1)	9 (0.3)	6 (0.2)	9 (0.3)	8 (0.3)	7 (0.2)	5 (0.2)	2 (0.1)
Agitation	12 (0.4)	8 (0.3)	2 (0.1)	10 (0.3)	5 (0.2)	6 (0.2)	5 (0.2)	1 (0.0)	1 (0.0)	1 (0.0)
Amnesia	1 (0.0)	1 (0.0)	0 (0)	0 (0)	00 (0)	0 (0)	1 (0.0)	1 (0.0)	0 (0)	0 (0)
Headache	4 (0.1)	1 (0.0)	0 (0)	0 (0)	00 (0)	3 (0.1)	0 (0)	0 (0)	1 (0.0)	0 (0)
Anxiety	0 (0)	0 (0)	0 (0)	2 (0.1)	00 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Others*	104 (3.5)	55 (1.9)	38 (1.3)	41 (1.4)	41 (1.4)	24 (0.8)	33 (1.1)	22 (0.7)	14 (0.5)	7 (0.2)

*Others refer to non-neuropsychiatric adverse effects such as hypersalivation, rash, hypotension, bradycardia, nausea, and post-anesthesia recovery issues.

Table 3. Comparison of potential variables associated with the presence of adverse effects following electroconvulsive therapy

Variables	Adverse Effects		p	
	Yes, n (%) 1706 (58.1)	No, n (%) 1229, (41.9)		
Age (Mean±SD)	35.3±12.23	34.91±10.96	0.366	s
Gender (male) n (%)	1016 (59.6)	733 (59.6)	0.962	X^2
Weight(kg)(Mean±SD)	74.38±16.29	73.75±15.43	0.284	s
ASA(Mean±SD)	1.73±.53	1.72±.50	0.534	s
Smoking (yes), n (%)	997 (58.4)	752 (61.2)	0.135	X^2
Alcohol use (yes), n (%)	210 (12.3)	142 (11.6)	0.534	X^2
Substance use (yes), n (%)	291 (17.1)	193 (15.7)	0.330	X^2
History of Anaesthesia (yes,) n (%)	129 (7.6)	105 (8.5)	0.333	X^2
History of ECT (yes), n (%)	599 (35.1)	435 (35.4)	0.874	X^2
Medical History (yes), n (%)	347 (20.3)	219 (17.8)	0.094	X^2
ECT administration within 2 weeks (yes) n (%)	1384 (81.1)	1050 (85.4)	**0.002**	X^2
Number of Prior ECT Sessions (Before This Admission)(Mean±SD)	7.84±3.19	7.11±2.53	**<0.001**	s
Duration of hospitalization before first ECT session (day)(Mean±SD)	10.44±8.69	10.86±9.17	0.205	X^2
Duration of hospitalization after last ECT session (day)(Mean±SD)	6.10±8.85	5.06±6.49	**<0.001**	X^2
Duration of Hospitalization (day), (Mean±SD)	31.71±15.61	29.17±12.73	**<0.001**	X^2
Diagnosis, n (%)			0.137	X^2
Psychotic Disorder, Not Otherwise Specified	249 (14.6)	162 (13.2)		
Schizophrenia	582 (34.1)	401 (32.6)		
Mania (bipolar disorder)	427 (25)	327 (26.6)		
Catatonia	34 (2)	42 (3.4)		
Major Depressive Disorder	321 (18.8)	223 (18.1)		
Other	93 (5.5)	74 (69.9)		
Indications for ECT, n (%)			0.798	X^2
Unresponsive to other treatments	1459 (85.5)	1036 (84.3)		
Elevated suicide/homicide risk, agitation	177 (10.4)	140 (11.4)		
Catatonia	62 (3.6)	48 (3.9)		
Poor oral intake	8 (0.5)	8 (0.4)		
Psychotropic medications discontinued before ECT, n (%)			0.708	X^2
Benzodiazepines	287 (16.8)	250 (20.3)		
Anticonvulsants	58 (3.4)	50 (4.1)		
Benzodiazepines and Anticonvulsants	11 (0.6)	8 (0.7)		
Chlorpromazine	5 (0.3)	3 (0.2)		
Lithium	23 (1.3)	14 (1.1)		
Clozapine	9 (0.5)	1 (0.1)		
None	1313 (77)	903 (73.5)		

[s] Student's t-test / [X^2] Chi-square test /ECT (Electroconvulsive therapy)/ p<0.05 statistically significant (bold) /ECT (Electroconvulsive therapy)/ ASA (American Society of Anesthesiologists)

Table 4. The method of discharge from the hospital

	Data (n=2935)
Discharge Method	**n (%)**
Discharged by a relative	73 (2.5)
Died	2 (0.1)
Prolonged Hospital Stay	221 (7.5)
Discharged him/herself	20(0.1)
Discharge without permission	53 (1.8)
Partial remission	906 (30.9)
Full remission	1666 (56.8)
Referral due to medical necessity	12 (0.4)

Patients who experienced adverse effects during ECT had undergone more ECT sessions before this admission (7.84 ± 3.19 vs. 7.11 ± 2.53, p < 0.001). They also had longer hospitalization durations related to the current admission, both after the last ECT session (6.10 ± 8.85 vs. 5.06 ± 6.49 days, p < 0.001) and in total (31.71 ± 15.61 vs. 29.17 ± 12.73 days, p < 0.001). Other variables, including age, gender, weight, ASA classification, and diagnosis, showed no statistically significant association with the presence of adverse effects (p > 0.05) during ECT.

The method of discharge from the hospital is shown in Table 4. The majority of patients were discharged upon remission (56.8%); however, a substantial portion of patients achieved partial remission (30.9%). Some of the patients were discharged by a relative (2.5%), while a small percentage died during hospitalizations (0.1%). 7.5% of the patients experienced prolonged hospital stays. A small number of patients discharged themselves (0.1%), and a slightly larger percentage left without permission (1.8%). A very small percentage of patients were referred due to medical necessity (0.4%).

DISCUSSION

This study conducted a detailed examination of neuropsychiatric adverse effects observed after ECT applications in a large patient population at Bakirkoy Prof. Dr. Mazhar Osman Training and Research Hospital for Psychiatry, Neurology and Neurosurgery, one of the largest psychiatry hospitals in Türkiye. This single-center study, which implemented high-volume ECT procedures, is one of the first of its kind in Türkiye, involving a large sample size of 2,935 patients, and it provides a broad perspective on the adverse effects associated with ECT. The consistency in protocol implementation and minimization of variability have enhanced the reliability and generalizability of the findings. In our study, no serious

adverse effects were recorded following ECT applications, and it was observed that there were no side effects requiring advanced medical intervention. Additionally, it was noted that the rates of adverse effects, which were higher during the initial ECT sessions, significantly decreased as the sessions progressed, dropping to as low as 2.7% by the tenth session. These results are consistent with the literature regarding the self-limiting nature of adverse effects and suggest that the safety profile of treatment can be optimized through the use of individualized anesthesia and ECT procedures (14).

As with any medical procedure involving anesthesia, ECT carries inherent risks of complications. Despite its historical stigma, controversy, and limited accessibility, ECT has proven to be beneficial and efficient in severe cases of depression where medication fails (23). The development of titration tables based on evidence-based medicine has improved the safety of ECT, sometimes making it the preferred treatment option (24). However, the hospitalization process for ECT may be prolonged due to various treatment-related complications (25). These can include adverse reactions to anesthesia such as respiratory or cardiovascular issues, as well as cognitive side effects such as confusion or memory impairment (14). Additionally, unforeseen medical conditions may arise during treatment, requiring extended monitoring or treatment, which can further extend the hospital stay. Accordingly, we observed that the presence of neuropsychiatric complications prolonged the duration of hospital stay, presumably to effectively manage the complications.

ECT has been associated with transient impairments in cognitive performance, including short-term memory function, deficits in orientation, speech fluency, attention, and executive functions, lasting from hours to even months post-treatment (14,26,27). These adverse effects are often subjectively reported by patients and limit ECT's use as an acute treatment option for conditions such as treatment-resistant depression (28). While some studies suggest that ECT has no impact on memory and implicit learning, others have observed various adverse effects on cognitive functions; for example, notable memory loss is associated with bitemporal ECT, while verbal memory impairment is linked to bifrontal ECT (29,30). Objective data indicate that ECT-related cognitive impairments are typically short-lived, often resolving within weeks post-treatment (5). Additionally, studies report that nearly half of ECT cases show no recorded side effects or complications, though approximately 3% of patients may experience significant memory loss after multiple courses of treatment (31-33). The patient's pre-treatment status can influence the risk of memory loss due to ECT (31). Factors such as female gender, concurrent lithium treatment, and failure to achieve remission are associated with an increased risk of memory impairment, with the duration of these effects varying from weeks to months (34). Techniques like brief pulse stimulation and unilateral electrode placement have been reported to reduce side effects, becoming the standard practice (35). Among the cognitive side effects, confusion and agitation have also been reported in the literature, often emerging acutely following ECT sessions. Regional studies highlight post-ECT confusion as one of the most common adverse effects, with reported rates up to 15.4%, while orientation disturbances and amnesia have also been documented, albeit at lower frequencies (7,9). These symptoms are typically short-lived and resolve within 10 to 30 minutes, particularly when managed with short-acting sedatives such as midazolam or propofol (36). In our study, we observed that the likelihood of cognitive side effects such as confusion, agitation, and anxiety after ten ECT sessions was less than 1%, and the incidence of amnesia was below 0.01%. These low rates suggest that suitable anesthetic preparation, along with the personalized adaptation of ECT procedures, may help reduce the incidence of memory impairment. In particular, the use of propofol, known for its favorable hemodynamic profile and lower association with cognitive side effects, may have contributed to this reduced incidence.

Headache is one of the most frequently reported adverse effects of ECT, with incidence rates varying widely across studies (33,37). For instance, one study reported a session-based headache incidence ranging from 9.4% to 12.1% (37), while Turkish studies such as those by Selçuki et al. (17) and Demir et al. (11) noted rates of 14.5%, identifying headache and memory impairment as the most common mild and transient side effects. Similarly, Şengül et al. (12) highlighted headache, amnesia, and myalgia as the most prevalent complications. These discrepancies may result from methodological variations including electrode placement, anesthetic protocols, patient age, and stimulus parameters. In our analysis, however, the incidence of post-ECT headache remained below 0.5%, markedly lower than in prior reports and other cognitive complications. This may be attributed to the consistent use of propofol, known for its sedative and anti-nociceptive properties, and bifrontal electrode placement, which likely minimizes stimulation of pericranial muscles such as the temporalis, thereby reducing headache risk.

ECT can lead to neurological adverse effects, including prolonged seizures (>120 seconds) and myoclonic/tonic contractions (18). Prolonged seizures occur in 1-2% of patients, which increases the risk of post-ECT confusion and memory impairment. Such seizures are best terminated with intravenous anesthetics such as midazolam or lorazepam, while propofol is preferred for subsequent treatments (14). Risk factors for post-ECT seizures include medications that may lower the seizure threshold, such as β-lactam antibiotics. Although tardive seizures are rare, they may necessitate the cessation of ECT until the predisposing agent is removed. Importantly, ECT is not associated with an elevated risk of developing epilepsy. In rare instances, seizures may persist as status epilepticus, which can be managed with intravenous benzodiazepines. Optimization of treatment protocols, including the identification of risk factors and adjustments to anesthetic drugs, can mitigate neurological adverse effects. Our observations indicated that the incidence of such complications decreased from 24.9% after the first session to 2.4% after the tenth session, likely due to improvements in the application procedure over time (38). Notably, the rate of prolonged seizures in our study was 7.3% during the first session and decreased sharply to 0.1% in subsequent sessions, consistent with findings from regional studies, where prolonged seizures were reported in the range of 5.88% to 11.5% (9). Additionly, the 17.5% incidence of inadequate or absent seizures during the first session can likely be explained by the relatively young mean patient age (35.14 ± 11.72 years), which, through the application of the half-age method, resulted in lower initial stimulus intensities. This suboptimal stimulation, potentially compounded by the seizure-threshold–raising effects of propofol, may have contributed to insufficient seizure induction. Furthermore, the higher initial complication rate may have resulted from the acute application of ECT at our clinic, highlighting the necessity for clinicians to become familiar with patient-specific factors and to optimize treatment parameters.

ECT is primarily used for severe depression but can also be used for conditions such as bipolar disorder, schizophrenia, schizoaffective disorder, catatonia, and neuroleptic malignant syndrome. It is considered to be relatively safe and low-risk, beneficial for treating depression, suicidality, severe psychosis, food refusal secondary to depression, and catatonia (39). We did not observe any correlation between diagnosis, treatment indications and ECT adverse effects. This suggests that the safety and efficacy of ECT were consistent across various parameters, reinforcing its utility as a treatment option for a range of psychiatric disorders. In a study of 230 patients with major depression, over 90% achieved remission with nine or fewer ECT treatments (30), aligning with our findings of a remission rate of 56.8% and partial remission rate of 30.9%. ECT-related mortality is rare and comparable to minor procedures under general anesthesia, with rates ranging from 2 to 4 deaths per 100,000 treatments, possibly even lower as seen from recent studies (14).

Although we did not observe any direct ECT-related deaths, 0.06% of patients died during the study duration. Our data is thus consistent with literature indicating few serious medical events in ECT patients (23).

This study offers valuable findings regarding the safety profile and clinical tolerability of ECT; however, several limitations must be acknowledged. Due to its retrospective nature, the analysis was dependent on the accuracy and completeness of existing clinical records, which may have led to underreporting or missing details, particularly concerning adverse effects. Cognitive side effects such as memory loss, confusion, and headache were not assessed using standardized scales, limiting the objectivity and reproducibility of these findings. Furthermore, information regarding the management and duration of these effects was not consistently available, which restricts the depth of interpretation. The lack of long-term follow-up precludes conclusions about the persistence of either therapeutic benefits or delayed side effects. Although exclusion criteria were applied to increase internal validity, the heterogeneity in diagnoses and comorbid conditions among participants may have introduced variability in outcomes. Additionally, the absence of a control group or comparator treatment arm limits the ability to evaluate relative efficacy or risk.

The main finding of this retrospective study is that most patients experienced no neuropsychiatric adverse effects across multiple ECT sessions, with adverse effect frequency significantly decreasing to as low as 2.7% as sessions progressed. Notably, observed adverse effects were self-limiting, requiring no extensive intervention, underscoring ECT's safety and tolerability. Despite inherent risks, most patients benefit from ECT without adverse sequelae, and personalized approaches can further minimize these effects and optimize outcomes. To enhance the clinical applicability of these results, future research should employ prospective designs incorporating standardized cognitive assessments and more advanced statistical modeling across diagnostic and demographic subgroups.

Ethics Committee Approval: The protocol was approved by University of Health Sciences, Bakirkoy Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee (24/06/2024/206)

Informed Consent: Each patient or their legal representative received detailed information about the ECT process, and written informed consent was obtained.

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