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RESEARCH ARTICLE

Characteristics and outcomes of early-terminated acute electroconvulsive therapy courses: A retrospective cohort study

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ABSTRACT

Objective: Acute electroconvulsive therapy (ECT) courses may end early because of rapid clinical improvement or interruption by an adverse event. However, the determinants of early termination and the subsequent clinical course remain poorly characterized. This study examined factors associated with the number of sessions in early-terminated ECT courses and their clinical outcomes.

Method: We reviewed the records of adult psychiatric inpatients who received five or fewer bifrontal ECT sessions at a tertiary center between 2019 and 2023. After excluding non-clinical discharges, 523 patients were categorized into those receiving three or fewer sessions (n=136) and those receiving four to five sessions (n=387). Groups were compared on clinical, anesthetic, and outcome variables. Adjusted analyses and analyses stratified by diagnosis and American Society of Anesthesiologists (ASA) physical status examined the independence of the session-group effect, and missing clinical severity ratings were imputed.

Results: The groups did not differ in age, diagnosis, baseline illness severity, ASA physical status, or anesthetic parameters. Adverse-event-related termination occurred in 73.5% of patients receiving three or fewer sessions compared with 14.5% of those receiving four to five sessions, whereas rapid clinical response accounted for 85.0% of terminations in the latter group ($p<0.001$). After adjustment, receiving three or fewer sessions was associated with a sixteenfold increase in the odds of adverse-event-related termination (adjusted odds ratio: 16.18, 95% confidence interval [CI]: 9.70–26.97), independent of diagnosis and ASA status. Illness severity at ECT termination was greater in the ≤3-session group (d=1.43–1.76), but severity at hospital discharge did not differ between groups.

Conclusion: Among early-terminated ECT courses, session number primarily reflects whether treatment ended because of rapid clinical response or an adverse event, with adverse-event-related termination concentrated among the shortest courses, independent of diagnosis and medical risk. The absence of differences in clinical status at discharge suggests that, when appropriately managed, early termination due to adverse events is compatible with favorable short-term outcomes.

Keywords: Electroconvulsive therapy, treatment outcome, treatment discontinuation, psychotic disorders, bipolar disorder

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INTRODUCTION

Electroconvulsive therapy (ECT) remains one of the most effective treatments in psychiatry and continues to play a central role in managing severe mental disorders when rapid symptom control is required or when pharmacological treatments have failed (1-4). Its efficacy is well established across diagnostic categories. Meta-analyses report response rates of approximately 74% in unipolar depression and 77% in bipolar depression, with comparable remission rates and more rapid response among patients with bipolar disorder (5, 6). A decade-long national study from Scotland found response and remission rates of 73% and 51%, respectively, in patients with moderate-to-severe depressive illness (7). In schizophrenia spectrum disorders, reported remission rates range from 40% to 80%, although these patients generally require longer treatment courses (8).

The therapeutic effects of ECT emerge rapidly and are concentrated during the early phase of treatment. In the Consortium for Research in ECT cohort, more than half of responders showed an initial response by the third session, and approximately one-third achieved remission by the sixth treatment (9, 10). The first ECT session alone accounts for a substantial proportion of the overall symptomatic improvement observed during an acute course (11). In routine clinical practice, decisions to continue or discontinue ECT are largely guided by clinical response, with treatment typically ending once remission is achieved or further improvement plateaus. Consequently, the number of sessions a patient receives generally reflects the speed and completeness of therapeutic response: patients who improve rapidly require fewer treatments, whereas those with slower or incomplete improvement receive longer courses (12).

Clinical response, however, explains only part of the variation in treatment duration. Some acute ECT courses are terminated before the intended clinical endpoint because medical or neurological complications make further treatment inadvisable. Common complications include postictal confusion or agitation, transient cognitive impairment, and peri-procedural cardiovascular or respiratory events (13-15). Postictal agitation has been reported in 8%–65% of patients, depending on the definition and study population, while a systematic review involving more than 100,000 patients estimated that major adverse cardiac events occur in approximately one of every 50 patients undergoing ECT (16, 17). Although most adverse events are transient and manageable, they may necessitate interruption or premature termination of treatment (18). Unlike treatment response, these events are not strongly associated with psychiatric diagnosis or baseline symptom severity but are more closely related to seizure characteristics, anesthetic factors, advanced age, and pre-existing medical comorbidity, particularly cardiovascular disease (19, 20). Consistent with this observation, a large registry study of the oldest-old found that neither medical comorbidity nor ECT treatment parameters predicted clinical outcome (21).

Despite the clinical importance of completing an acute ECT course, relatively little is known about the factors leading to early termination. Most studies have focused on treatment efficacy, remission, or cognitive outcomes, whereas the reasons why acute ECT courses end, and how these relate to the number of treatments received, have received comparatively little attention (22, 23). National audit data suggest that most courses are completed as planned and that discontinuation because of adverse events is uncommon. However, published cohorts rarely distinguish systematically between response-driven and adverse-event-driven termination or examine whether patients whose treatment ends prematurely because of complications nevertheless achieve satisfactory clinical outcomes by hospital discharge (24). Addressing this question is clinically important because it determines whether early termination should be viewed as treatment failure or as a manageable interruption that does not necessarily compromise short-term recovery.

The present study addresses this gap by examining a well-defined cohort of psychiatric inpatients whose acute ECT course ended after five or fewer sessions. Within this cohort, patients were grouped according to treatment exposure and compared across demographic, clinical, anesthetic, and outcome measures. The study had three objectives: (1) to identify the clinical factors associated with the number of ECT sessions received; (2) to determine whether the reasons for treatment termination, particularly adverse-event-related cessation, differed by session number independently of psychiatric diagnosis and medical risk; and (3) to evaluate whether differences in clinical status at the end of ECT persisted until hospital discharge.

METHODS

Study Design and Setting

This retrospective observational study was conducted at a specialized tertiary psychiatric center in Turkiye.

Data were obtained from routinely collected clinical records of patients who received ECT between January 2019 and December 2023. No experimental interventions were introduced, and all procedures reflected standard institutional clinical practice. Patient anonymity and data confidentiality were maintained throughout the study. The study was approved by the institutional clinical research ethics committee (Protocol No. 2026/197), which waived the requirement for individual informed consent because of the retrospective study design. Reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Participants

The study population comprised adults (≥18 years) who received ECT and completed five or fewer sessions during the study period. This threshold operationalized early treatment termination, defined as discontinuation of an acute ECT course before completion of the minimum six sessions recommended by major clinical guidelines for therapeutically adequate treatment exposure (1, 2).

Patients were excluded if they were younger than 18 years; received more than five ECT sessions or completed a planned acute course; had missing or unverifiable information regarding the number of sessions; or had incomplete core clinical data. Patients whose hospitalization ended through discharge against medical advice, early release to family before clinical completion, or inter-facility transfer were also excluded because these non-clinical exits reflected administrative or family-initiated decisions rather than clinician-directed treatment cessation and could therefore confound analyses of clinically determined termination patterns. One patient was excluded because of an implausible height value attributed to a data-entry error. The final analytic sample comprised 523 patients (≤3 sessions, n=136; 4–5 sessions: n=387).

Measures

Data were extracted systematically using a structured abstraction framework. Sociodemographic variables included age, sex, marital status, years of education, and substance use history (present/absent). Psychiatric diagnoses were grouped into four categories: schizophrenia spectrum disorders, bipolar disorder, depressive disorders, and other psychotic disorders (including substance-induced psychosis and other psychotic diagnoses). Medical status was assessed using the American Society of Anesthesiologists (ASA) Physical Status Classification and dichotomized as ASA I versus ASA II–III to distinguish lower from higher medical risk (25). Procedural variables included propofol dose, suxamethonium dose, and serum pseudocholinesterase activity, the latter measured because deficiency prolongs suxamethonium-induced neuromuscular blockade. Peri-procedural systolic and diastolic blood pressure, heart rate, body temperature, and oxygen saturation were recorded immediately before and after each ECT session. Delta scores were calculated as post-procedure minus pre-procedure values. Clinical severity was assessed using the Clinical Global Impression–Severity scale (CGI-S; range 1–7) at baseline, at completion of the ECT course, and at hospital discharge (26).

Grouping Variable and Outcome Definitions

Patients were categorized into those receiving three or fewer sessions and those receiving four to five sessions, representing a clinically meaningful gradient of treatment exposure within the early-termination cohort. This grouping was defined a priori based on the observed distribution of session counts. The primary outcome was the reason for ECT termination, categorized as early clinical response, adverse effect or medical complication, patient- or family-initiated discontinuation, or insufficient response/other. A binary outcome variable, adverse-event-related termination, identified patients whose ECT course ended because of a documented treatment-emergent adverse event or medical complication. This patient-level indicator reflects whether treatment was terminated because of an adverse event but does not quantify the number of events or capture adverse events that did not result in treatment discontinuation. Secondary outcomes included CGI-S at ECT termination and hospital discharge, change in CGI-S from baseline to ECT termination (CGI delta), and hospital course variables.

ECT Procedure

All ECT sessions were administered under general anesthesia with neuromuscular blockade according to established clinical guidelines (1, 2) and institutional protocols (14). Bifrontal ECT was delivered using a Thymatron IV brief-pulse device. Electrode placement and initial stimulus intensity were determined using the half-age method, a commonly employed titration approach in which the initial stimulus energy, expressed as a percentage of the device output, is set to approximately half the patient's age (e.g., 20% for a 40-year-old patient). When seizure duration was shorter than 25 seconds, stimulus intensity

was increased according to institutional guidelines. Decisions regarding continuation or termination of treatment were made within routine multidisciplinary clinical practice.

Statistical Analysis

Normality was assessed using skewness and kurtosis coefficients (27). Normally distributed continuous variables were compared using Welch's t test and summarized with Cohen's d. Non-normally distributed continuous and ordinal variables were analyzed using the Mann–Whitney U test with rank-biserial r, whereas categorical variables were compared using Pearson's chi-square test with Cramér's V. Fisher's exact test was used when expected cell counts were fewer than five. Effect sizes were interpreted according to Cohen's guidelines (28). End-of-ECT and discharge CGI-S scores were missing in 37.2% and 38.7% of patients, respectively. Missingness occurred almost exclusively among patients whose treatment ended because of early clinical response (62.6% missing in this subgroup versus ≤0.6% in all other groups), consistent with a missing-at-random mechanism conditional on termination reason. Missing values were imputed using multiple imputation by chained equations (MICE) with random forest models (20 datasets, 10 iterations), and estimates were pooled using Rubin's rules (29). Complete-case analyses are performed as a sensitivity analysis. To evaluate whether session-group effects were independent of diagnosis and medical risk, analysis of covariance (ANCOVA) was used to examine CGI delta, and logistic regression was used to examine adverse-event-related termination. Both models adjusted for diagnosis, ASA risk group, suxamethonium dose, and pseudocholinesterase activity, with additional stratified analyses by diagnosis and ASA subgroup. Age and sex were not included in adjusted models. Sex was associated with session-group assignment, introducing collinearity with the primary predictor, whereas age was considered to be adequately represented by ASA physical status. All statistical tests were two-sided with a significance level of α=0.05. Analyses were conducted using Python 3.12 (SciPy, pandas, statsmodels, and miceforest). No generative artificial intelligence tools were used to generate study data or results.

RESULTS

Sample Characteristics

The final analytic sample comprised 523 patients, including 136 (26.0%) in the ≤3-session group and 387 (74.0%) in the 4–5-session group. Baseline demographic and clinical characteristics are summarized in Table 1. The groups did not differ in age, years of education, body weight, marital status, smoking, alcohol use, or substance use (all p≥0.064). However, males were more common in the ≤3-session group than in the 4–5-session group (57.4% vs. 42.4%; $\chi^2[1]=8.49$, p=0.004, V=0.127). Diagnostic distribution was similar between groups ($\chi^2[4]=6.64$, p=0.084). Schizophrenia spectrum disorders predominated in the ≤3-session group (43.8%), whereas diagnoses were more evenly distributed among patients receiving four to five sessions. ECT indication also did not differ significantly (p=0.116), nor did the proportion of patients classified as ASA II–III (72.8% vs. 70.0%; p=0.068). Baseline CGI-S scores were equivalent between groups (both median=2.0; p=0.737).

Anesthetic parameters were likewise comparable, including propofol dose (p=0.218), suxamethonium dose (p=0.064), and pseudocholinesterase activity (p=0.605). No between-group differences were observed in peri-procedural hemodynamic measures before or after treatment or in corresponding delta values (all p≥0.194), indicating similar cardiovascular and respiratory responses to ECT. Postictal orientation scores were also comparable (p=0.737). Total length of hospitalization (p=0.905) and the interval from admission to the first ECT session (p=0.159) did not differ between groups. However, patients receiving three or fewer sessions remained hospitalized significantly longer after their final ECT treatment (median, 10.0 vs. 5.0 days; U=33.418, p<0.001, r_K=-0.299).

CGI-S Outcomes

CGI-S outcomes are presented in Table 2. In the complete-case analysis, patients receiving three or fewer ECT sessions had significantly higher CGI-S scores at ECT termination (mean 3.69±0.50) than those receiving four to five sessions (2.95±0.53; t[294]=12.33, p<0.001, d=1.43). They also exhibited significantly greater CGI delta (d=0.97), indicating substantially less clinical improvement—or greater clinical deterioration—at treatment termination. Despite these differences, CGI-S scores at hospital discharge did not differ between groups (d=0.02, p=0.897), indicating convergence of clinical status before discharge.

Missing end-of-ECT CGI-S values were concentrated almost entirely among early responders in the 4–5-session group. Imputed values reflected

Table 1: Demographic and clinical characteristics according to ECT session group (n=523)

Characteristic	≤3 sessions (n=136)	4–5 sessions (n=387)	Test	p	Effect size
Continuous variables					
Age (years), M (SD)	39.65 (12.78)	39.91 (13.03)	t(521)=-0.20	0.839	d=-0.02
Education (years), M (SD)	7.09 (3.69)	6.96 (3.64)	t(521)=0.35	0.724	d=0.04
Body weight (kg), M (SD)	76.74 (20.82)	73.86 (16.75)	t(521)=1.46	0.147	d=0.16
Propofol dose (mg), M (SD)	65.51 (17.77)	63.41 (15.03)	t(521)=1.23	0.218	d=0.13
Pseudocholinesterase (U/L), M (SD)	8.379 (2.493)	8.254 (2.186)	t(521)=0.52	0.605	d=0.06
Hospital stay (days), M (SD)	25.10 (14.48)	24.94 (10.91)	t(514)=0.12	0.905	d=0.01
Time from last ECT to discharge, Mdn [IQR]	10.0 [4.0–17.0]	5.0 [1.0–10.0]	U=33.418	**<0.001**	r_K=-0.30
Baseline CGI-S, Mdn [IQR]	2.0 [2.0–3.0]	2.0 [2.0–3.0]	U=26.751	0.737	r_K=-0.02
Categorical variables					
Male sex, n (%)	78 (57.4)	164 (42.4)	$\chi^2(1)$=8.49	**0.004**	V=0.13
Single marital status, n (%)	85 (62.5)	234 (60.5)	$\chi^2(1)$=0.10	0.752	V=0.01
Current smoking, n (%)	87 (64.0)	236 (61.0)	$\chi^2(1)$=0.26	0.607	V=0.02
Substance use, n (%)	32 (23.5)	73 (18.9)	$\chi^2(1)$=1.09	0.296	V=0.05
Diagnosis, n (%)[a]			$\chi^2(3)$=6.64	0.084	V=0.12
Schizophrenia spectrum disorders	56 (43.8)	119 (32.6)			
Bipolar disorder	29 (22.7)	116 (31.8)			
Depressive disorders	32 (25.0)	89 (24.4)			
Other psychotic disorders	11 (8.6)	41 (11.2)			
ASA physical status II–III, n (%)	99 (72.8)	271 (70.0)	$\chi^2(1)$=3.34	0.068	V=0.08

M: Mean; SD: Standard deviation; Mdn: Median; IQR: Interquartile range; CGI-S: Clinical Global Impression–Severity; ASA: American Society of Anesthesiologists physical status classification. Continuous variables were compared using Welch's t test (Cohen d), ordinal variables using the Mann–Whitney U test (rank-biserial r_K), and categorical variables using the chi-square test (Cramér's V). [a]n=128/365; after excluding cases with missing data.

Table 2: Clinical Global Impression–Severity (CGI-S) outcomes according to ECT session group: complete-case and multiple imputation (MICE) analyses (n=523)

Outcome	≤3 sessions M (SD)	4–5 sessions M (SD)	t	p	d	Analysis
End-of-ECT CGI-S	3.69 (0.50)	2.95 (0.53)	12.33	**<0.001**	1.43	Complete-case
End-of-ECT CGI-S	3.69 (0.50)	2.81 (0.50)	17.54[a]	**<0.001**	1.76	MICE
Discharge CGI-S	2.42 (0.54)	2.41 (0.51)	0.13	0.897	0.02	Complete-case
Discharge CGI-S	2.43 (0.55)	2.42 (0.50)	0.33[a]	0.745	0.03	MICE
Change in CGI-S (end of ECT – baseline)	1.25 (0.80)	0.57 (0.61)	8.12	**<0.001**	0.97	Complete-case
Change in CGI-S (end of ECT – baseline)	1.24 (0.81)	0.41 (0.56)	11.13[a]	**<0.001**	1.32	MICE

CGI-S: Clinical Global Impression–Severity (range 1–7). Change in CGI-S was calculated as the end-of-ECT score minus the baseline score. Complete-case analyses included n=135/161 patients for end-of-ECT CGI-S and n=134/153 for discharge CGI-S. MICE: m=20 datasets; Rubin's rules (n=523). Effect size: Cohen's d. [a]Pooled t statistic calculated using the Barnard–Rubin method. SD. Standard deviation; ECT: Electroconvulsive therapy; CGI-S: Clinical Global Impression–Severity; MICE: Multiple imputation by chained equation.

this distribution (71.6% CGI-S=3, 28.4% CGI-S=2). Following multiple imputation, the mean end-of-ECT CGI-S score for the 4–5-session group decreased from 2.95 to 2.81, increasing the between-group effect size (d=1.76). The comparison at discharge remained non-significant (d=0.03, p=0.745), confirming the robustness of the null finding.

ECT Cessation Patterns

ECT cessation characteristics are summarized in Table 3a. Both termination type and termination reason differed markedly between groups, with large effect sizes. Disease- or adverse-event-related termination occurred in 66.9% of patients receiving three or fewer sessions compared with 14.2% of those receiving four

Table 3a: ECT termination characteristics according to session group (n=523)

Characteristic	≤3 sessions (n=136) n (%)	4–5 sessions (n=387) n (%)	χ^2(df)	p; Effect size
Termination type			$\chi^2(3)=225.05$	**<0.001**; V=0.66
Remission	1 (0.7)	162 (41.9)		
Partial remission	23 (16.9)	168 (43.4)		
Natural termination	21 (15.4)	2 (0.5)		
Disease- or adverse-event-related termination	91 (66.9)	55 (14.2)		
Termination reason			$\chi^2(3)=181.84$	**<0.001**; V=0.59
Early clinical response	31 (22.8)	329 (85.0)		
Adverse event or medical complication	100 (73.5)	56 (14.5)		
Patient- or family-initiated discontinuation	3 (2.2)	1 (0.3)		
Insufficient response/other	2 (1.5)	1 (0.3)		
Adverse-event-related termination	100 (73.5)	56 (14.5)	$\chi^2(1)=164.89$	**<0.001**; V=0.56

ECT: Electroconvulsive therapy; V: Cramér's V. Patients with non-clinical discharges were excluded from the analytic sample (see Participants); therefore, unauthorized discharge is not represented. Adverse-event-related termination is a binary outcome derived from the documented reason for ECT cessation.

Table 3b: Medical complications leading to adverse-event-related ECT termination (n=523)

Variables	≤3 sessions (n=136) n (%)	4–5 sessions (n=387) n (%)	χ^2(df)	p; Effect size
Medical complication, n (%)	100 (73.5)	56 (14.5)	$\chi^2(1)=164.89$	**<0.001**; V=0.56
Postictal confusion	11 (11.0)	32 (57.0)		
Cardiovascular instability	27 (27.0)	6 (10.0)		
Infection	15 (15.0)	5 (9.0)		
Bronchoconstriction	25 (25.0)	4 (7.0)		
Other complications	22 (25.0)	9 (17.0)		

ECT: Electroconvulsive therapy. Cardiovascular instability included tachycardia, bradycardia, hypertension, and hypotension. Other complications included agitation, headache, hypersalivation, and rash/flushing.

to five sessions, whereas remission or partial remission accounted for 85.3% of terminations in the latter group (χ^2[3]=225.05, p<0.001, V=0.656). Analysis of specific termination reasons showed an even stronger contrast. Among patients receiving three or fewer sessions, 73.5% discontinued because of an adverse effect or medical complication and 22.8% because of early clinical response. In contrast, among patients receiving four to five sessions, 85.0% discontinued because of early response and only 14.5% because of adverse events (χ^2[3]=181.84, p<0.001, V=0.590). Insufficient therapeutic response accounted for fewer than 2% of terminations in either group, indicating that differences between groups were not explained by treatment efficacy. The binary adverse-event-related termination outcome confirmed this marked contrast (73.5% vs. 14.5%; χ^2[1]=164.89, p<0.001, V=0.561). The specific medical conditions leading to treatment discontinuation are summarized in Table 3b. Among patients receiving three or fewer sessions, cardiovascular instability (tachycardia, bradycardia, hypertension, or hypotension) was the most common reason for discontinuation (27%), followed by bronchoconstriction (25%). In contrast, among patients receiving four to five sessions, postictal confusion was the leading cause of adverse-event-related termination (57%).

Adjusted and Stratified Analyses

Results of the adjusted analyses are presented in Tables 4a and 4b. In the analysis of covariance (ANCOVA), session group was the strongest predictor of CGI delta (B=-0.798, 95% confidence interval [CI]: -0.927 to -0.670, p<0.001), indicating approximately 0.80 additional CGI-S units of worsening (or reduced improvement) among patients receiving three or fewer sessions after adjustment for diagnosis, ASA status, and anesthetic variables. No diagnostic category differed from the schizophrenia spectrum reference group (all p≥0.312), indicating that the

Table 4a: Adjusted analysis of change in Clinical Global Impression–Severity (CGI-S): analysis of covariance (ANCOVA)

Predictor	B or aOR	95% CI	p
ANCOVA — CGI delta (MICE, m=20)			
≤3 vs. 4–5 sessions (main effect)	-0.798	[-0.927, −0.670]	**<0.001**
Bipolar disorder vs. schizophrenia spectrum disorders	+0.022	[-0.118, +0.161]	0.761
Depressive disorders vs. schizophrenia spectrum disorders	-0.076	[-0.222, +0.071]	0.312
Other psychotic disorders vs. schizophrenia spectrum disorders	+0.002	[-0.196, +0.199]	0.985
Suxamethonium dose (per mg)	<0.001	[-0.006, +0.007]	0.892
Pseudocholinesterase (per U/L)	<0.001	—	**0.045**

ANCOVA: Analysis of covariance; B: Unstandardized coefficient. Reference categories: 4–5 sessions, schizophrenia spectrum disorders, and ASA physical status I. Age and sex were excluded from the model (see Method). MICE: Multiple imputation by chained equations (m=20; Rubin's rules). aOR: Adjusted odds ratio; CI: Confidence interval.

Table 4b: Logistic regression for adverse-event-related termination

Predictor	B or aOR	95% CI	p
Logistic regression model — adverse-even-related termination (n=466)			
≤3 vs. 4–5 sessions	16.18	[9.70, 26.97]	**<0.001**
ASA II–III vs. ASA I	1.39	[0.79, 2.45]	0.254
Suxamethonium dose (per mg)	1.00	[0.97, 1.03]	0.962
Pseudocholinesterase (per U/L)	1.00	[1.00, 1.00]	0.513
Nagelkerke R^2	0.264	—	—

Logistic regression: B: unstandardized coefficient. Reference categories were 4–5 sessions and ASA physical status I. aOR: Adjusted odds ratio; N=466 after listwise deletion for missing suxamethonium dose. Age and sex were excluded from the model (see Method). MICE: Multiple imputation by chained equations (m=20; Rubin's rules). CI: Confidence interval; ASA: American Society of Anesthesiologists.

Table 5: Stratified change in CGI-S according to diagnosis and ASA physical status: ≤3 versus 4–5 ECT sessions (MICE-pooled estimates)

Diagnosis | ASA physical status	≤3 sessions (n)	4–5 session (n)	p	Note
Schizophrenia spectrum disorders | ASA I	1.31 (13)	0.38 (43)	**<0.001**	
Schizophrenia spectrum disorders | ASA II–III	1.19 (43)	0.42 (76)	**<0.001**	
Bipolar disorder | ASA II–III	1.33 (21)	0.41 (77)	**<0.001**	
Depressive disorders | ASA I	1.25 (4)	0.42 (19)	0.094	n_1<10
Depressive disorders | ASA II–III	0.96 (28)	0.38 (70)	**0.001**	
Other psychotic disorders | ASA II–III	1.56 (9)	0.49 (30)	**<0.001**	n_1<10

Values are MICE-pooled mean change in CGI-S, calculated as end-of-ECT minus baseline. ASA: American Society of Anesthesiologists physical status classification. Between-group comparisons were performed using the Mann–Whitney U test. Strata with fewer than 10 patients in the ≤3-session group should be interpreted with caution. ECT: Electroconvulsive therapy.

session-group effect was not moderated by diagnosis. Pseudocholinesterase activity showed a statistically significant but clinically negligible association (p=0.045; B<0.001), whereas suxamethonium dose was not associated with CGI delta (p=0.892). In the logistic regression model, patients receiving three or fewer sessions had a sixteenfold increase in the adjusted odds of adverse-event-related termination (adjusted odds ratio [aOR]=16.18, 95% CI: 9.70 to 26.97, p<0.001). ASA risk group (aOR=1.39, p=0.254), suxamethonium dose, and pseudocholinesterase activity were not significant predictors. The model explained 26.4% of the variance (Nagelkerke R^2=0.264).

Stratified analyses (Tables 5 and 6) demonstrated that the session-group effect was consistent across diagnostic and ASA subgroups. Stratified analyses of CGI-S change were significant in all adequately powered strata (Table 5), with the ≤3-session group showing greater worsening (or less improvement) across schizophrenia spectrum disorders, bipolar disorder, and depressive disorders, as well as across both ASA physical status categories. Likewise, stratified rates of adverse-event-related termination (Table 6) ranged from 67% to 75% in the ≤3-session group and from 6% to 18% in the 4–5-session group across all adequately powered strata. This pattern persisted across diagnostic

Table 6: Stratified rates of adverse-event-related termination according to diagnosis and ASA physical status: ≤3 versus 4–5 ECT sessions

Diagnosis | ASA physical status	≤3 sessions (n)	4–5 sessions (n)	p	Note
Schizophrenia spectrum disorders | ASA I	69% (13)	14% (43)	**<0.001**	
Schizophrenia spectrum disorders | ASA II–III	73% (41)	18% (68)	**<0.001**	
Bipolar disorder | ASA I	75% (8)	6% (36)	**<0.001**	$n_1<10$
Bipolar disorder | ASA II–III	71% (21)	18% (74)	**<0.001**	
Depressive disorders | ASA I	75% (4)	16% (19)	0.068	$n_1<10$
Depressive disorders | ASA II–III	73% (26)	12% (67)	**<0.001**	
Other psychotic disorders | ASA II–III	67% (9)	8% (26)	**0.002**	$n_1<10$

Values are the percentage of patients with adverse-event-related termination. ASA: American Society of Anesthesiologists physical status classification. Between-group comparisons were performed using the chi-square test. Strata with fewer than 10 patients in the ≤3-session group should be interpreted with caution. ECT: Electroconvulsive therapy.

groups and ASA physical status categories, supporting the independence of the observed association from psychiatric diagnosis and medical comorbidity. Results from strata containing fewer than 10 patients in the ≤3-session group are reported for completeness but should be interpreted cautiously.

DISCUSSION

In this retrospective cohort of 523 psychiatric inpatients whose acute ECT courses ended after five or fewer sessions, the number of sessions received was associated with a distinct and clinically coherent pattern. The ≤3-session and 4–5-session groups did not differ in age, education, body weight, diagnostic distribution, ECT indication, baseline severity, anesthetic parameters, hemodynamic responses, or postictal orientation. Instead, the groups differed primarily in why treatment ended. Nearly three-quarters of courses in the ≤3-session group were terminated because of an adverse effect or medical complication, whereas most courses in the 4–5-session group ended because of early clinical response. After adjustment for diagnosis, medical risk, and anesthetic parameters, receiving three or fewer sessions was associated with a sixteenfold increase in the odds of adverse-event-related termination. Despite a large difference in clinical severity at ECT cessation, the groups had com-parable severity at hospital discharge.

The principal finding—that session number within an early-terminated course primarily reflects whether treatment ended because of clinical improvement or an adverse event—is consistent with the established clinical course of acute ECT. Because therapeutic response is often rapid and concentrated in the early phase of treatment (9-11), patients who improve quickly may require relatively few sessions before treatment is concluded on clinical grounds. The 4–5-session group closely followed this pattern, with early response accounting for 85% of terminations. By contrast, the ≤3-session group represented a different clinical pathway, in which treatment was interrupted by medical or neurological complications before a longer course could be delivered. The finding that insufficient response accounted for fewer than 2% of terminations in either group is also informative: early cessation generally reflected either rapid benefit or treatment intolerance rather than therapeutic failure. This is consistent with clinical practice, in which inadequate response typically leads to continuation or modification of treatment rather than immediate discontinuation (30).

The operational definitions of early termination and early clinical response, as well as the distinction between ≤3 sessions and 4-5 sessions, warrant clarification. Early termination was defined as discontinuation of an acute ECT course before completion of six sessions, the minimum treatment exposure generally recommended by major clinical guidelines for an adequate therapeutic trial. Within this cohort, treatment cessation was further classified according to its primary underlying reason: interruption because of an adverse event or other non-response-related factor versus planned termination following achievement of a clinical endpoint (early clinical response). Early clinical response was defined as substantial and sustained improvement that led the treating team to conclude the ECT course on clinical grounds, based on clinical judgment and supported by favorable CGI-S ratings. The dichotomization of patients into the ≤3- and 4–5-session groups was based on both established clinical timelines and the empirical distribution of our data. The ≤3-session threshold represents an acute safety-driven window. The earliest sessions of an ECT course are often

accompanied by acute neurobiological changes and may represent the period of greatest vulnerability to severe, treatment-limiting cognitive or medical adverse effects. Our findings support the clinical relevance of this cutoff, with the ≤3-session group showing a sixteenfold increase in the adjusted odds of adverse-event-related termination (aOR=16.18, 95% CI: 9.70 to 26.97); 73.5% of patients in this subgroup discontinued treatment because of an adverse event or medical complication. The 4–5-session threshold captures a phase in which cumulative neuroplastic effects may begin to stabilize and transient influences, such as nonspecific effects of hospitalization or the initial effects of anesthesia, are less likely to contribute to the observed clinical response. Our findings support the clinical relevance of this group as a distinct treatment pattern, with 85.0% of courses ending because of early clinical response.

An important feature of the study design should be emphasized. Because the cohort was restricted to early-terminated courses, session number and reason for termination were not fully independent. Response-driven termination tended to occur after four or five sessions, whereas adverse-event-related termination often occurred earlier by necessity. Thus, part of the association between the shortest courses and adverse-event-related cessation is inherent in the cohort definition rather than representing a wholly independent empirical relationship. The adjusted and stratified analyses should be interpreted accordingly. They do not indicate that receiving fewer sessions causes adverse events. Rather, they demonstrate that the association between very short treatment exposure and adverse-event-related termination was consistent across diagnostic and ASA subgroups and was not explained by measured differences in case mix. The sixteenfold adjusted odds ratio therefore reflects the magnitude and consistency of this association, not an independent causal effect.

The adverse events leading to early termination were broadly consistent with the recognized medical morbidity of ECT. Neurological complications, principally postictal confusional states, were prominent, alongside respiratory and cardiovascular events. This pattern is consistent with the broader literature, in which postictal confusion and agitation are among the most frequently reported neuropsychiatric complications, while cardiovascular instability represents an important source of serious medical morbidity (13–17). The transient autonomic response to ECT, characterized by an initial parasympathetic surge followed by sympathetic activation, provides a plausible physiological basis for peri-procedural cardiovascular events (1, 17). The concentration of treatment-limiting complications among patients receiving the fewest sessions suggests that, in susceptible patients, intolerance may become evident early in the treatment course.

A notable finding was that the association between session number and adverse-event-related termination persisted independently of psychiatric diagnosis and medical risk as measured by ASA physical status. In the adjusted models, no diagnostic group differed from the schizophrenia spectrum reference category, and ASA risk group was not a significant predictor of adverse-event-related termination. Stratified analyses similarly showed that the elevated termination rate in the ≤3-session group was present across schizophrenia spectrum, bipolar, and depressive disorders and across both ASA categories. These findings are consistent with previous evidence suggesting that ECT-related adverse events may be more closely associated with physiological, seizure-related, and anesthetic factors than with psychiatric diagnosis or baseline illness severity (19-21). They also accord with evidence that somatic comorbidity, although relevant to general perioperative risk, does not consistently predict ECT outcomes (21). Susceptibility to treatment-limiting adverse events may therefore be difficult to anticipate from psychiatric presentation or a broad medical-risk classification alone, underscoring the importance of close monitoring during the initial sessions for all patients.

The clinical course after ECT cessation was among the most reassuring findings. Patients in the ≤3-session group were substantially more severely ill at treatment termination, and this difference remained large after multiple imputation. However, the difference was no longer evident at hospital discharge. Patients in the ≤3-session group also had a longer interval between their final ECT session and discharge, suggesting that additional inpatient management may have allowed further stabilization after the abbreviated course. However, the dataset did not capture the nature of post-cessation care, and the longer interval before discharge should not be interpreted as evidence of a specific stabilizing intervention. It may instead reflect recovery from the adverse event itself, adjustments to pharmacotherapy, or administrative factors influencing the timing of discharge. Although the existing literature provides no direct comparator for this finding, the results suggest that adverse-event-related early termination, while disrupting the expected treatment trajectory, does not necessarily preclude a satisfactory outcome when followed by

appropriate inpatient care. This observation should be considered hypothesis-generating and requires confirmation in prospective studies.

The groups also differed in sex distribution, with men overrepresented in the ≤3-session group. This finding should be interpreted cautiously. Although some studies have reported a higher incidence of postictal agitation among men, this association has not consistently remained significant after multivariate adjustment, and large multisite studies suggest that ECT efficacy is not meaningfully influenced by sex (31, 32). The observed sex difference should therefore be interpreted as an incidental finding requiring replication rather than as evidence of a sex-specific susceptibility to early treatment termination.

Several limitations should be considered. First, the retrospective design is susceptible to information bias and precludes causal inference. Termination reasons were based on the treating team's contemporaneous clinical judgment rather than standardized adjudication. Second, the cohort was restricted to patients whose courses ended after five or fewer sessions and did not include a comparison group that completed a full acute course, limiting generalizability to the broader ECT population. Third, the adverse-event-related termination indicator is a patient-level binary measure that does not capture the number or timing of adverse events, nor events that did not lead to treatment termination. In addition, complication categories could not be stratified by a session group using the available data. Fourth, end-of-ECT and discharge CGI-S ratings were missing for a substantial proportion of patients, almost exclusively among early responders. Although this pattern was consistent with a missing-at-random assumption and was addressed using multiple imputation, residual bias cannot be excluded. The high proportion of missing CGI-S ratings likely reflects routine clinical practice rather than incomplete documentation, particularly the accelerated outpatient management and discharge of patients who achieved an early clinical response. Fifth, the study period (2019–2023) included the coronavirus disease 2019 (COVID-19) pandemic, during which ECT and anesthesia services were disrupted in many settings. Changes in case mix or ECT service availability during this period may have influenced treatment termination patterns, but calendar-year effects were not examined. Sixth, all treatments were administered using bifrontal electrode placement at a single center, which may limit generalizability to other electrode configurations and clinical settings. Finally, age and sex were excluded from adjusted models because of concern regarding collinearity. Alternative specifications that include these variables may yield different estimates.

CONCLUSION

Among early-terminated ECT courses, the number of sessions delivered is determined primarily by whether treatment ends because of an early clinical response or an adverse event. Adverse-event-related termination was concentrated among patients receiving the shortest ECT courses, independently of psychiatric diagnosis and medical risk, whereas the greater clinical severity observed at the time of ECT cessation was no longer evident by hospital discharge. These findings support close medical monitoring during the earliest ECT sessions and provide preliminary reassurance that adverse-event-related early termination, when followed by continued inpatient management, can be compatible with a favorable short-term clinical outcome. Prospective studies incorporating standardized adverse-event ascertainment and a comparison group completing a full ECT course are needed to confirm these findings and to clarify post-cessation recovery. Although our findings suggest that favorable short-term outcomes may be achievable after adverse-event-related early termination when followed by continued inpatient care, the mechanisms underlying this recovery remain unclear.

Ethical Approval: This study was approved by The Clinical Research Ethics Committee of the University of Health Sciences Bakirkoy Dr. Sadi Konuk Training and Research Hospital (2026-11-26 - 2026/197).

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	Data analysis/Interpretation	C.O.
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	Critical revision of manuscript	C.O.
Category 3	Final approval and accountability	C.O., O.A.
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