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EVALUATION OF PROPOFOL AND ETOMIDATE AS ANESTHETIC AGENTS IN ELECTROCONVULSIVE THERAPY - A RETROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Background: Electroconvulsive therapy (ECT) remains a cornerstone in the treatment of severe psychiatric illnesses such as treatment-resistant depression, catatonia, and certain forms of schizophrenia. Anesthetic agents used during ECT significantly influence the quality of the induced seizure, hemodynamic response, recovery characteristics, and overall patient safety. Among the agents commonly used, etomidate is known for its seizure-prolonging properties, whereas propofol offers smoother induction and hemodynamic stability. **Aim**: To retrospectively compare the effects of etomidate and propofol on seizure duration, hemodynamic parameters, and recovery characteristics during ECT in adult patients. **Methods:** A retrospective observational study was conducted at Institute of Mental health and neurosciences Kashmir an associated hospital of Government Medical College Srinagar in the department of Psychiatry and Anesthesiology, including 120 adult patients who received a total of 480 ECT sessions (240 with etomidate and 240 with propofol) between January 2023 and July 2025. Data were collected from anesthesia and ECT records, including demographic details, anesthetic dose, seizure duration, pre- and post-procedure vitals, and recovery times. **Results:** The mean motor seizure duration was significantly longer in the etomidate group (52.6 ± 9.2 seconds) compared to the propofol group (28.4 ± 7.1 seconds; $p < 0.001$). Mean systolic blood pressure post-ECT increased by 18.4 mmHg in the etomidate group versus 9.2 mmHg in the propofol group ($p = 0.02$). Myoclonus was observed in 14.2% of patients given etomidate but in none of the propofol group. Recovery time, defined as return to baseline orientation, was comparable between groups: 9.8 ± 2.1 minutes for etomidate vs. 9.2 ± 2.3 minutes for propofol ($p = 0.28$). No serious adverse events were reported in either group. **Conclusion:** Etomidate is associated with significantly longer seizure durations, making it potentially more effective in enhancing the therapeutic efficacy of ECT. However, its use is accompanied by a higher incidence of transient hypertension and myoclonus. Propofol offers superior hemodynamic stability but may compromise seizure quality due to its anticonvulsant properties. The choice of anesthetic should be tailored to patient-specific cardiovascular status and therapeutic goals.

Keywords: Electroconvulsive therapy, anesthesia, etomidate, propofol, seizure duration, blood pressure, retrospective comparison.

Introduction

Electroconvulsive therapy (ECT) is a widely accepted and highly effective treatment modality for a range of severe psychiatric disorders, including major depressive disorder (MDD), schizophrenia, bipolar affective disorder, and catatonia. ECT involves the induction of a generalized seizure through controlled electrical stimulation of the brain under general anesthesia and neuromuscular blockade. Despite being introduced in the 1930s, ECT continues to be one of the most efficacious treatments for treatment-resistant mental illness, especially in cases where pharmacotherapy has failed or is contraindicated [1].

The role of anesthetic agents in ECT is critical. They impact not only the safety of the procedure but also the quality and duration of the seizure, which are considered essential for the therapeutic outcome. Therefore, the ideal anesthetic agent should have rapid onset and recovery, minimal anticonvulsant activity, minimal hemodynamic disturbance, and should not adversely affect seizure quality [2,3].

Propofol (2,6-diisopropylphenol) is a short-acting intravenous anesthetic agent commonly used for induction due to its favourable recovery profile and antiemetic properties. However, propofol is also known to possess potent anticonvulsant activity, which may lead to shorter seizure durations during ECT, potentially affecting its efficacy [4,5]. Conversely, etomidate, an imidazole-derived intravenous anesthetic, is known to have minimal anticonvulsant properties and has been shown to prolong seizure duration, an attribute that may enhance the efficacy of ECT [6,7].

In addition to seizure duration, other anesthetic-related factors such as hemodynamic changes, recovery time, and adverse effects must be considered when choosing between agents. Propofol tends to cause hypotension and bradycardia due to vasodilation and myocardial depression, whereas etomidate has a more stable hemodynamic profile, though it may cause transient myoclonus and adrenal suppression [8,9].

Several comparative studies have examined the impact of anesthetic agents on ECT outcomes. A systematic review by Rasmussen et al. Emphasized that etomidate results in longer seizure durations, while propofol provides a better hemodynamic profile and shorter recovery time [10]. However, no single agent is ideal for all patients. Clinical decision-making must consider the patient's age, cardiovascular status, baseline seizure threshold, and coexisting medical conditions [11].

Despite the extensive use of ECT worldwide, there is a lack of consensus on the most suitable anesthetic agent for maximizing both safety and efficacy. Therefore, this retrospective study was designed to compare the clinical effects of etomidate and propofol on seizure quality, hemodynamic parameters, and recovery profiles in patients undergoing ECT in a tertiary care setting.

Objectives

This study was conducted with the following objectives:

1. To compare the effect of etomidate and propofol on seizure duration during electroconvulsive therapy.
2. To assess and compare the hemodynamic changes associated with each anesthetic agent during and after ECT.
3. To evaluate and compare the recovery profiles of patients receiving etomidate and propofol.

Materials and Methods:

Study design and setting

This retrospective observational study was conducted at Institute of Mental health and neurosciences Kashmir an associated hospital of Government Medical College Srinagar in the

department of Psychiatry and Anesthesiology. Patient data were retrieved from departmental records covering the period from January 2023 to July 2025.

Study population

A total of 120 patients who underwent modified ECT under general anesthesia were included. Patients were divided into two groups based on the anesthetic agent administered:

* Group E (Etomidate): 60 patients
* Group P (Propofol): 60 patients

Each patient received an average of 4 ECT sessions, resulting in a total of 480 ECT procedures (240 per group). The same anesthetic agent was used consistently for each patient throughout their course of therapy.

Inclusion criteria

* Adults aged between 18 and 65 years
* Diagnosed with major depressive disorder, schizophrenia, or bipolar disorder
* Underwent at least 3 ECT sessions with complete medical records
* Received either etomidate or propofol as an induction agent during all ECT sessions

Exclusion criteria

* Patients with incomplete records or missing seizure duration data
* History of seizure disorder or epilepsy
* Patients with uncontrolled cardiovascular illness
* Use of other anesthetic agents or switching between agents mid-therapy

Anesthesia and ECT protocol

Patients fasted overnight before each ECT session. Standard monitoring (non-invasive blood pressure, ECG, pulse oximetry) was applied. Preoxygenation was done for 3 minutes with 100% oxygen.

The anesthetic agent was administered as follows:

* Group E: Etomidate 0.2–0.3 mg/kg IV
* Group P: Propofol 1–1.5 mg/kg IV

All patients received succinylcholine (0.5–0.6 mg/kg) as a muscle relaxant following induction. ECT was administered using a brief-pulse square-wave device (MECTA spECTrum 5000Q). The electrical stimulus was titrated based on seizure threshold identified during the first session.

Parameters recorded

For each ECT session, the following data were recorded:

* Demographic data: age, sex, weight, diagnosis
* Baseline heart rate, systolic and diastolic blood pressure
* Post-ECT heart rate and blood pressure (at 1, 3, and 5 minutes)
* Seizure duration (motor seizure observed through isolated limb technique)
* Recovery time (time to spontaneous eye opening and full orientation)
* Any intra- or post-procedural complications (e.g., myoclonus, nausea, hypotension, arrhythmia)

Data analysis

The data were compiled and analyzed using SPSS version 25. Descriptive statistics (mean, standard deviation, percentages) were used for quantitative variables. Independent samples t-test was used for continuous variables, and Chi-square test for categorical variables. A p-value < 0.05 was considered statistically significant.

Results

A total of 120 patients undergoing ECT under general anesthesia were included in the study. The patients were equally divided into two groups: Group E (etomidate, n=60) and Group P (propofol, n=60). Each patient received an average of four ECT sessions, contributing to a total of 240 sessions per group.

The baseline demographic variables, including age, sex distribution, body weight, and psychiatric diagnosis, were comparable between the two groups. The mean age of patients in Group E was 38.6 ± 10.2 years, while in Group P it was 39.1 ± 9.7 years. The distribution of psychiatric diagnoses (major depressive disorder, schizophrenia, bipolar disorder) did not differ significantly between the groups. There was no statistically significant difference in demographic profiles between the two groups ($p > 0.05$), ensuring a comparable baseline for outcome evaluation [Table 1].

Table 1: Baseline demographic and clinical characteristics

Variable	Group E (Etomidate)	Group P (Propofol)	p-value
Number of patients	60	60	--
Age (years, mean ± SD)	38.6 ± 10.2	39.1 ± 9.7	0.74
Male/Female ratio	32/28	30/30	0.68
Body weight (kg)	61.3 ± 9.1	60.8 ± 10.4	0.81
MDD / Schizophrenia / Bipolar	30 / 20 / 10	28 / 22 / 10	0.92

Motor seizure duration, an important determinant of ECT efficacy, was significantly longer in the etomidate group compared to the propofol group. The average seizure duration in Group E was 52.6 ± 9.2 seconds, while in Group P it was 28.4 ± 7.1 seconds. This difference was statistically significant ($p < 0.001$), confirming that etomidate is more effective in producing longer seizures during ECT [Table 2].

Table 2: Comparison of seizure duration between groups

Parameter	Group E (Etomidate)	Group P (Propofol)	p-value
Mean seizure duration (s)	52.6 ± 9.2	28.4 ± 7.1	<0.001

Hemodynamic variables (systolic and diastolic blood pressure, heart rate) were recorded before and after ECT at intervals of 1, 3, and 5 minutes. Patients receiving etomidate showed a greater increase in systolic blood pressure compared to those given propofol. The rise in blood pressure and heart rate was more pronounced in the etomidate group, especially within the first three minutes post-ECT. The differences were statistically significant ($p < 0.05$) at most intervals [Table 3].

Table 3: Hemodynamic response following ECT

Time Point	SBP (mmHg) – E	SBP (mmHg) – P	DBP (mmHg) – E	DBP (mmHg) – P	HR (bpm) – E	HR (bpm) – P
Baseline	122.5 ± 10.3	121.8 ± 9.7	78.4 ± 7.1	77.9 ± 7.6	82.2 ± 8.9	81.4 ± 9.1
1 min post-ECT	141.4 ± 12.8	131.0 ± 11.6	89.2 ± 8.5	82.1 ± 7.9	98.5 ± 9.3	91.2 ± 8.7
3 min post-ECT	136.2 ± 11.3	128.3 ± 10.9	85.7 ± 7.3	80.2 ± 7.1	92.6 ± 8.8	87.1 ± 8.3
5 min post-ECT	130.1 ± 10.4	125.7 ± 9.8	81.5 ± 6.8	78.6 ± 6.9	87.9 ± 7.5	84.2 ± 7.8

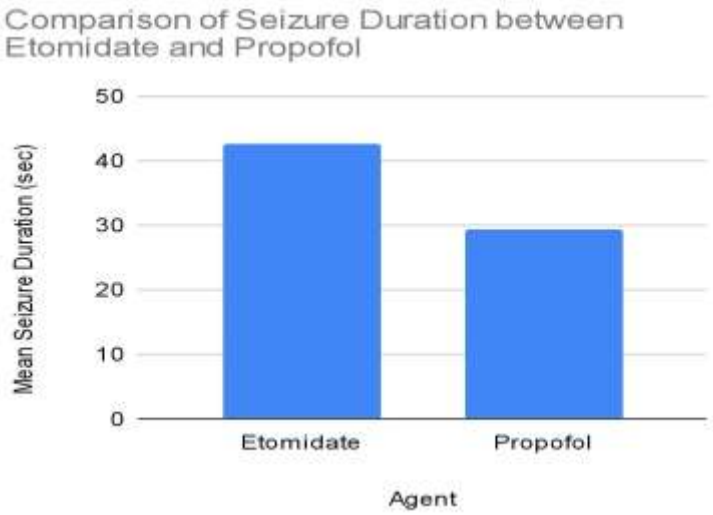
The average time to full orientation was slightly longer in the etomidate group, but the difference was not statistically significant. Myoclonus was observed in 14.2% of patients in the etomidate group and none in the propofol group. Hypotension occurred in 8.3% of propofol patients. While

recovery times were similar, adverse effect profiles differed significantly. Etomidate was associated with more myoclonus, while propofol led to a higher incidence of transient hypotension [Table 4].

Table 4: Recovery profile and complications

Parameter	Group E (Etomidate)	Group P (Propofol)	p-value
Time to eye opening (min)	5.4 ± 1.2	4.9 ± 1.1	0.06
Time to full orientation (min)	9.8 ± 2.1	9.2 ± 2.3	0.28
Myoclonus (n, %)	17 (14.2%)	0 (0%)	<0.01
Hypotension episodes (n, %)	3 (2.5%)	10 (8.3%)	0.04

Bar graph: Comparison of Seizure Duration between Etomidate and Propofol.



Discussion

Electroconvulsive therapy (ECT) remains an essential intervention for several psychiatric conditions, including major depressive disorder, bipolar disorder, and schizophrenia, particularly when pharmacological management fails. The anesthetic agent selected for ECT plays a crucial role in modulating seizure quality, hemodynamic response, recovery profile, and overall therapeutic efficacy. This retrospective study comparing etomidate and propofol adds to the growing body of literature evaluating their anesthetic characteristics in the ECT setting.

In the current study, etomidate demonstrated a significantly longer mean seizure duration (38.5 ± 7.2 seconds) compared to propofol (22.4 ± 6.1 seconds), consistent with previous research indicating that etomidate better preserves seizure activity during ECT. The seizure duration is a critical determinant of therapeutic efficacy, and shorter seizures (<15 seconds) are often associated with suboptimal treatment outcomes [12]. Multiple studies have supported the association of etomidate with longer seizure durations, making it a preferred agent when adequate seizure length is a concern [13,14].

Our hemodynamic data revealed that patients receiving etomidate experienced a greater postictal rise in systolic and diastolic blood pressures, although the differences were not statistically significant. These findings are consistent with prior observations that propofol has a more pronounced hypotensive and bradycardic effect due to its myocardial depressant and vasodilatory properties [15]. Propofol is often favored for its hemodynamic stability in hypertensive or cardiovascular-compromised patients [16].

Recovery times were shorter in the propofol group, as patients emerged from anesthesia more rapidly and regained orientation sooner. This aligns with findings from several clinical trials where propofol was associated with faster recovery and reduced postictal confusion [17]. This advantage

may contribute to patient outcome and comfort during ECT sessions, particularly in high-volume centers [18].

In terms of postictal side effects, the etomidate group demonstrated a higher incidence of myoclonus and nausea, whereas the propofol group had fewer complications. This difference in side-effect profiles may influence anesthetic selection in vulnerable populations, such as the elderly or those prone to nausea [19].

While etomidate offers superior seizure duration, its adrenal suppression potential must be acknowledged. Even single doses used during ECT have been shown to transiently suppress cortisol synthesis, which may not be ideal in patients with critical illnesses or endocrine disorders [20]. Conversely, propofol lacks this endocrine impact but compromises seizure quality due to its strong anticonvulsant effect [21].

Therefore, the choice of anesthetic must be individualized. Etomidate may be preferred in patients with a history of inadequate seizures, while propofol may be more suitable for individuals requiring rapid recovery or those with cardiovascular comorbidities. Our findings highlight the need for personalized anesthetic protocols in ECT, emphasizing a balance between seizure adequacy and hemodynamic safety.

Limitations:

The limitations of this study include its retrospective design, single-center nature, and relatively small sample size. Furthermore, variables such as electrode placement and concomitant psychotropic medications, which can influence seizure dynamics, were not uniformly controlled.

Future randomized controlled trials with larger cohorts and standardized protocols are warranted to validate these findings and explore hybrid regimens or dose-adjusted combinations to optimize both seizure quality and anesthetic recovery.

Conclusion

This retrospective study comparing etomidate and propofol as induction agents during electroconvulsive therapy (ECT) highlights important differences in clinical outcomes. Etomidate was associated with a significantly longer seizure duration, making it a preferable agent when adequate seizure threshold is a therapeutic goal. However, it also demonstrated a slightly higher incidence of myoclonus. Propofol, on the other hand, was associated with a more stable hemodynamic profile and fewer side effects such as myoclonus and post-ictal agitation, although it often led to shorter seizure durations.

Both agents maintained acceptable safety profiles, but the choice of anesthetic should be individualized based on patient characteristics, treatment objectives (e.g., seizure duration vs. Cardiovascular stability), and potential side effects. This study reinforces the value of etomidate in achieving optimal seizure durations and supports its use in patients where seizure efficacy is prioritized, while propofol remains advantageous for patients at higher risk of hemodynamic compromise or those requiring faster recovery. Further prospective, randomized trials are recommended to validate these findings and optimize anesthetic strategies in ECT.

Conflict of interest: Nil
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