

Comparison of Intravenous Etomidate and Propofol on Haemodynamic Responses and Seizure Duration during Modified Electroconvulsive Therapy: A Prospective Study

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Abstract: **Background:** Modified electroconvulsive therapy (M-ECT) is a well-established and effective therapeutic modality for severe and treatment-resistant psychiatric disorders. The introduction of general anaesthesia and neuromuscular blockade has significantly enhanced the safety and acceptability of ECT. The choice of anaesthetic induction agent plays a crucial role in determining seizure quality, haemodynamic responses, recovery characteristics, and overall procedural safety. Among the commonly used agents, propofol and etomidate exhibit distinct pharmacological profiles that may influence clinical outcomes. **Aims:** To compare Etomidate and Propofol as induction agents during M-ECT with respect to seizure duration, haemodynamic responses, and recovery parameters. **Study Design:** Prospective, randomized, crossover comparative study. **Materials and Methods:** The study was conducted at Hi-Tech Medical College & Hospital, Bhubaneswar, from December 2023 to November 2025. The study included 100 ASA I and ASA II patients aged 18-60 years, scheduled for M-ECT. Patients were randomly divided into 2 groups. Group P: Received Propofol (2 mg/kg) Group E: Received Etomidate (0.2 mg/kg). Patients received Etomidate and Propofol on separate treatment sessions. Seizure duration (motor), haemodynamic variables (SBP, DBP, MAP, HR), induction time, recovery time, and adverse effects were recorded at predefined intervals. Statistical analysis was performed using appropriate parametric and non-parametric tests. **Results:** Etomidate produced significantly longer seizure duration compared to Propofol. Propofol provided superior attenuation of the sympathetic response, with lower post-ictal increases in heart rate and blood pressure, and faster recovery. Adverse effect profiles differed, with myoclonus more common with Etomidate and hypotension and injection pain more frequent with Propofol. **Discussion:** The findings reflect the distinct pharmacological properties of both agents. Etomidate is advantageous when seizure adequacy is the primary concern, whereas Propofol is preferable in patients requiring tighter haemodynamic control and rapid recovery. **Conclusion:** Neither agent is universally ideal. Anaesthetic choice for M-ECT should be individualized, balancing seizure requirements against cardiovascular risk and recovery priorities.

Keywords: Modified Electroconvulsive Therapy; Etomidate; Propofol; Seizure Duration; Haemodynamic Response; Anaesthesia

1. Introduction

Electroconvulsive Therapy (ECT) remains one of the most effective somatic treatments for severe psychiatric illness, particularly major depressive disorder, catatonia, and acute psychosis. The transition from unmodified ECT to Modified ECT (M-ECT), incorporating general anaesthesia and neuromuscular blockade, represents a pivotal advancement that improved patient safety, comfort, and procedural control.

The induced generalized seizure is central to ECT efficacy, and its adequacy—commonly assessed by duration and morphology—is influenced by stimulus parameters and anaesthetic choice. Anaesthetic agents may alter seizure threshold, cortical excitability, and haemodynamic responses, thereby impacting therapeutic outcomes.

Among available agents, Propofol and Etomidate are most widely used. Propofol offers smooth induction, rapid recovery, and effective blunting of sympathetic responses but exhibits anticonvulsant properties that may shorten seizures. Etomidate, conversely, preserves haemodynamic stability and prolongs seizure duration but is associated with myoclonus and transient adrenal suppression.

This study was undertaken to provide a systematic comparison of these agents in the context of M-ECT, addressing a clinically relevant and unresolved question in anaesthetic practice.

2. Materials and Methods

Study Design and Setting: This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology at Hi-Tech Medical College and Hospital from December, 2023 to November, 2025 after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants.

Study Population: Adult patients aged 18 to 60 years, classified as ASA I and ASA II, of either sex scheduled to undergo Modified Electroconvulsive Therapy were included in the study. Patients with contraindications to either etomidate or propofol, significant cardiovascular instability, or other serious systemic illnesses were excluded.

Randomization and Anaesthetic Technique: Patients were randomly allocated into two groups. Group E received intravenous etomidate for induction, and Group P received intravenous propofol. All patients were pre-oxygenated and induced with the allocated study drug, followed by

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neuromuscular blockade with succinylcholine. ECT was administered using standardized stimulus parameters. Routine monitoring included electrocardiography, non-invasive blood pressure, pulse oximetry, and heart rate.

Outcome Measures: Primary outcome measures were motor seizure duration and haemodynamic parameters (SBP, DBP, MAP, HR) recorded at baseline, after induction, and at fixed intervals following ECT. Secondary outcomes included induction time, recovery time, and incidence of adverse effects such as hypotension, myoclonus, and injection pain.

Statistical Analysis: Data were expressed as mean ± standard deviation. Statistical analysis was performed using appropriate tests depending on data distribution. A p value less than 0.05 was considered statistically significant.

3. Results

Etomidate resulted in significantly longer motor seizure duration compared with Propofol. Propofol demonstrated superior haemodynamic attenuation, with significantly lower post-ictal heart rate and blood pressure elevations. Recovery

parameters favoured Propofol, with faster return of consciousness and orientation. Adverse events differed between groups, reflecting known drug profiles.

Table 1: Demographic Data of Participants

Parameter	Etomidate	Propofol	P Value
Mean Age (Years)	33.7	38.3	1.00 (insignificant)
Male (%)	66.0	50.0	1.00 (insignificant)
Female (%)	34.0	50.0	1.00 (insignificant)

Table 2: Time Interval from Induction to Loss of Consciousness (Seconds)

DRUG	MEAN ± SD (SEC)	P VALUE
ETOMIDATE	44.65 ± 5.60	< 0.001
PROPOFOL	35.10 ± 4.37	< 0.001

Table 3: Seizure Duration (Seconds)

DRUG	MEAN ± SD (SEC)
ETOMIDATE	45.66 ± 8.62
PROPOFOL	31.63 ± 6.70
P-VALUE	< 0.001 (Highly Significant)

Table 4: Haemodynamic Parameters Post Induction

PARAMETER	ETOMIDATE (MEAN ± SD)	PROPOFOL (MEAN ± SD)	P VALUE
SBP (MMHG)	140.56 ± 11.00	127.78 ± 10.73	< 0.001
DBP (MMHG)	85.22 ± 6.25	82.48 ± 7.95	< 0.001
MAP (MMHG)	103.67 ± 5.47	97.57 ± 6.43	< 0.001
HR (BPM)	94.58 ± 8.52	89.50 ± 8.55	< 0.001

Table 5: Mean Systolic and Diastolic Blood Pressure Changes Over Time (Values expressed as Mean ± SD; mmHg)

Time (minutes) After Induction	Etomidate – Systolic BP	Etomidate - Diastolic BP	Propofol – Systolic BP	Propofol – Diastolic BP	P-Value of Systolic BP	P-Value of Diastolic BP
0 min	140.56 ± 11.00	85.22 ± 6.25	127.78 ± 10.73	82.48 ± 7.95	< 0.001 (Highly significant)	0.018 (significant)
3 min	150.56 ± 1.40	95.22 ± 1.40	123.78 ± 0.20	123.78 ± 0.20	< 0.001 (Highly significant)	< 0.001 (Highly significant)
6 min	144.56 ± 0.30	89.22 ± 0.30	125.78 ± 0.50	80.48 ± 0.50	< 0.001 (Highly significant)	< 0.001 (Highly significant)
9 min	140.56 ± 0.62	85.22 ± 0.58	127.78 ± 0.12	82.48 ± 0.11	< 0.001 (Highly significant)	0.032 (significant)
12 min	140.56 ± 0.61	85.22 ± 0.64	127.78 ± 0.13	82.48 ± 0.09	< 0.001 (Highly significant)	0.032 (significant)
15 min	140.56 ± 0.59	85.22 ± 0.61	127.78 ± 0.10	82.48 ± 0.09	< 0.001 (Highly significant)	0.032 (significant)

Table 6: Mean Heart Rate (HR) Changes Over Time

Time (minutes) After Induction	Etomidate HR	Propofol HR	P-Value HR
0 min	95.34 ± 3.12	82 ± 5.3	< 0.001 (Highly Significant)
3 min	95.94 ± 3.12	82.1 ± 5.3	< 0.001 (Highly Significant)
6 min	96.12 ± 3.24	80 ± 5.34	< 0.001 (Highly Significant)
9 min	95.34 ± 3.16	82 ± 5.38	< 0.001 (Highly Significant)
12 min	95.34 ± 3.16	82 ± 5.39	< 0.001 (Highly Significant)
15 min	95.34 ± 3.17	82 ± 5.31	< 0.001 (Highly Significant)

Table 7: Adverse Effects Observed in Both Drug Sessions

Adverse Effect	Etomidate (N)	Propofol (N)	P-Value	Significance
Hypotension	0	6	0.029	Significant
Injection Pain	0	11	< 0.001	Highly Significant
Myoclonus	7	0	0.007	Significant
Nausea	3	0	0.083	Not Significant

4. Discussion

The present study compared etomidate and propofol as induction agents for Modified Electroconvulsive Therapy with emphasis on seizure duration, haemodynamic responses, recovery profile, and adverse effects. The findings demonstrate distinct pharmacodynamic differences between the two agents, supporting the need for individualized anaesthetic selection rather than a uniform approach for all patients undergoing M-ECT.

In this study, etomidate produced a significantly longer motor seizure duration compared with propofol. Seizure adequacy, particularly seizure duration, is considered an important determinant of therapeutic efficacy in ECT, especially in patients with high seizure thresholds or treatment-resistant illness. The seizure-prolonging effect of etomidate is attributable to its minimal anticonvulsant activity and preservation of cortical excitability. Similar findings have been reported by Avramov et al. [1], who demonstrated longer EEG and motor seizure durations with etomidate compared to propofol and methohexital. Jindal et al. [2] and Mansuri and Dave [3] also observed significantly prolonged seizure duration with etomidate, reinforcing its role as a seizure-facilitating induction agent.

Propofol, in contrast, resulted in shorter seizure durations in the present study, consistent with its known anticonvulsant properties mediated through potentiation of GABA-A receptor activity. This seizure-shortening effect remains the principal limitation of propofol in M-ECT and has been consistently reported in previous literature.

Haemodynamic stability is a key consideration during ECT due to marked autonomic fluctuations associated with the induced seizure. In the present study, etomidate maintained stable haemodynamics during induction, with minimal reductions in blood pressure and heart rate; however, a more pronounced post-ictal sympathetic surge was observed. Propofol caused greater reductions in blood pressure following induction but provided superior attenuation of the post-ictal sympathetic response. Similar haemodynamic patterns have been described by Lee and Kong [4], as well as by Mahesh et al. [5] and Mehta et al. [6], who reported lower heart rate and blood pressure responses with propofol in the immediate post-ECT period. These findings highlight a clinically relevant trade-off between induction stability and post-seizure sympathetic modulation.

Recovery was faster with propofol in the present study, with earlier eye opening and orientation, attributable to its rapid redistribution and short context-sensitive half-time. Comparable observations have been reported by Mansuri and Dave [3] and by Pragada et al. [7]. Injection pain was more common with propofol, whereas myoclonic movements were more frequent with etomidate—findings consistent with established adverse-effect profiles and previous studies by Jindal et al [2]. and Mahesh et al. [5]. No serious complications were observed with either agent.

Overall, the findings of this study are consistent with existing literature and confirm that no single induction agent is ideal for all patients undergoing M-ECT. Etomidate is advantageous when preservation of seizure duration is the

primary concern, whereas propofol is preferable when haemodynamic attenuation and rapid recovery are prioritized. These results support an individualized, patient-centred approach to anaesthetic selection in Modified Electroconvulsive Therapy.

5. Limitations of the Study

- Single-centre design
- Limited assessment of long-term psychiatric outcomes
- EEG seizure parameters were not uniformly analysed
- Cumulative endocrine effects of repeated Etomidate exposure were not evaluated

6. Conclusion

The present study demonstrates that both etomidate and propofol are effective and safe induction agents for Modified Electroconvulsive Therapy, each offering distinct clinical advantages. Etomidate was associated with significantly longer seizure duration and stable haemodynamics during induction, making it particularly suitable for patients with inadequate seizures, high seizure thresholds, or suboptimal therapeutic response during ECT. In contrast, propofol provided superior attenuation of the post-ictal sympathetic response and faster recovery, favouring its use in patients with cardiovascular comorbidities or where rapid post-procedure neurological assessment and turnover are desired.

These findings highlight that the choice of anaesthetic agent in M-ECT should not be uniform but tailored to individual patient characteristics, seizure requirements, and haemodynamic considerations. An individualized, patient-centred approach to anaesthetic selection can help optimize both therapeutic efficacy and procedural safety. Further large-scale, multicentric studies incorporating EEG seizure monitoring and long-term clinical outcomes may provide additional insights to refine anaesthetic strategies for Modified Electroconvulsive Therapy.

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