International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 5, May 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.5.2025.73

Original Research

Comparative Study Between Thiopental And Etomidate On Haemodynamic Characteristics During Modified Electroconvulsive Therapy

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Received: 27 March, 2025 Accepted: 22 April, 2025 Published: 10 May, 2025

ABSTRACT

Introduction: Adequate sedation/anaesthetic effect, good haemodynamic control as well as maintenance of seizure duration are the key aspects for selection of the anesthesia of choice for ECT procedures.

Methods: A total of 110 ASA I/II patients aged 18 to 60 years (Mean age 29.10±9.94 years, 52.7% males) scheduled for ECT were enrolled and were randomly allocated to two equal groups, Group E received 0.2 mg/kg Etomidate (0.2%) i.v. and Group T received 5 mg/kg (2.5%) Thiopental sodium. Clinicodemographic details were noted and baseline hematological assessment was done. Patients underwent ECT as per their group protocol. Hemodynamics were recorded at 0 min to till end of ECT, and thereafter every 15 minutes for up to 1 hour following ECT. Induction time, duration of clinical seizure, and adverse effects, if any, were recorded. MMSE scores were also assessed for cognitive function.

Results: The two groups were matched statistically for demographics, baseline clinical and hematological profile. Hemodynamic variations were seen in both the groups, however, generally they were comparable, but blood pressure control was better in Etomidate as compared to that in Thiopental group. In Group E as compared to that in Group T induction time (27.84±1.70 vs. 25.12±3.54 seconds) as well as duration of clinical seizure (47.71±1.46 vs 43.36±2.35 seconds) was longer. Recovery was earlier in Group E as compared to that in Group T. Incidence of myoclonic jerks and arrhythmia was also significantly higher in Group E as compared to that in Group E (12.7% vs 0% and 10.9% vs 0% respectively). MMSE scores were comparable.

Conclusion: Both Etomidate and Thiopental were effective and safe. Of the two, Etomidate had a better performance as it prolonged seizure activity and had better hemodynamic control but with higher incidence of adverse effects.

Keywords: Electroconvulsive therapy (ECT), Etomidate, Thiopental, Clinical seizure, adverse effects

INTRODUCTION

Electroconvulsive therapy (ECT) is a therapeutic intervention primarily used for severe psychiatric conditions, such as treatment resistant depression, schizophrenia, acute mania, schizoaffective disorder, catatonia, neuroleptic malignant syndrome, bipolar disorder and certain psychotic disorders[19]. It involves the induction of controlled seizures through the application of electrical currents to the brain while the patient is under general anesthesia and muscle relaxants.[1, 2]

The procedure is typically administered 2–3 times per week over 6–12 sessions, depending on the individual's clinical response. Electroconvulsive therapy exerts its therapeutic effects by modulating neural activity and enhancing neuroplasticity, though the precise mechanisms remain under investigation. The anesthetic goals during Electroconvulsive therapy are: (1) achieving adequate anesthesia while allowing rapid recovery, (2) minimizing interference with seizure induction and duration, (3) attenuating cardiovascular responses to electrical stimulation, and (4) providing optimal muscle relaxation to prevent physical injury during seizures.[3, 4]

Methohexital, that has very low anticonvulsant properties in comparison to other barbiturates, occupied the seat of 'gold standard' induction agent for anaesthesia during Electroconvulsive therapy. It carries the risk of hypotension; it has become unavailable commercially and hence a number of other anaesthetic agents have found their place in Electroconvulsive therapy.Ketamine, Sevoflurane, Thiopental and Etomidate are some of the other alternatives to Methohexital for use as induction

DOI: 10.69605/ijlbpr_14.5.2025.73

agents in Electroconvulsive therapy. Thiopental, despite having a relatively better hemodynamic control shortens the duration of Electroconvulsive therapy seizure whereas Etomidate preserves seizure duration and has minimal hemodynamic effects, making it suitable for patients with cardiovascular instability. Its disadvantage includes adrenal suppression with prolonged use[5-7]

The present study is being proposed to compare the efficacy of Thiopental and Etomidate in electroconvulsive therapy at a tertiary care teaching hospital in North India.

MATERIAL & METHODS

The study was done at Department of Anesthesiology in collaboration with Department of Psychiatry, Hind Institute of Medical Sciences (HIMS), Ataria, Sitapur.Patients scheduled to undergo electroconvulsive therapy (MECT) were enrolled. ASA I/II Patients scheduled to undergo Modified Electroconvulsive therapy for various indications. Patients of age 18 years and above of either sex.Haemodynamically stable at the time of Electroconvulsive therapy.The study was conducted on 110 patients. Demographic details and indications for Electroconvulsive therapy were noted. Prior to procedure, body weight of the patients was measured in order to determine the accurate amount of anaesthetic drug to be used. All the patients were kept fasting for 6 h and continued antipsychotic treatment until the day of the procedure. After entering the procedure room, patients were attached to the baseline monitor for continuous monitoring of vitals (heart rate, noninvasive blood pressure and oxygen saturation SpO_2). An IV line was established, and all the patients were premedicated with IV glycopyrrolate 0.2 mg. Patients were preoxygenated with 100% oxygen for 3 min. General anesthesia was induced with IV anesthetic agent as per the group allocated, based on the calculated induction agent dose. Another NIBP cuff was applied to second arm ensuring limb isolation from mucle relaxant and IV succinylcholine 0.5 mg/kg was administered to all the patients for neuromuscular relaxation. When fasciculations subsided and adequate neuromuscular relaxation was obtained, an adequate sized bite block was inserted to prevent tongue bite. A brief pulse stimulus for about 1–3 s, frequency 60–90 Hz and pulse width of 1 was given to produce seizures. Seizure duration was monitored in the isolated limb. Subsequently, all the patients were ventilated with face mask with 100% oxygen at a rate of 14–18 breaths/min until spontaneous breathing returns and patient recovered clinically from the state of anesthesia. All the patients were monitored for changes in HR, respiratory rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), and SpO2 at baseline, after induction, hemodynamic parameters were recorded every minute until recovery from Electroconvulsive therapy. In the post-procedure room, they were monitored every 15 minutes for up to 1 hour. following Electroconvulsive therapy. Duration of recovery was recorded from injection of anesthetic agent to time taken to obey vocal commands such as opening of eyes, time for ability to sit unaided and time taken to meet discharge criteria. Adverse drug reactions, if any were also noted. In post-operative ward patients were followed for next 60 minutes and cognitive assessment was done after 6 hours of Electroconvulsive therapy by mini mental state examination [MMSE].

RESULTS

Table 1: Group wise Distribution of Study Population

SN	Group	Description	No.	%
1-	Group E	Administered inj. 0.2 mg/kg Etomidate (0.2%) i.v. over 30-60 sec.	55	50.0
2-	Group T	Administered inj. 5 mg/kg Thiopental sodium i.v. over 30-60 sec.	55	50.0
			110	100.0

Out of 110 patients enrolled in the study, 55 (50.0%) were administered injection 0.2 mg/kg Etomidate (0.2%) over 30-60 seconds, these patients were categorized as Group E, rest 55 (50.0%) were administered injection 5 mg/kg Thiopental sodium i.v. over 30-60 seconds, these patients were categorized as Group T **(Table 1)**

Table 2: Between Group Comparison of Demographic Profile

SN	Characteristics	Group E (n=55)		Group T (n=55)		Total (N=110)	
		No.	%	No.	%	No.	%
1-	**Age Group**						
	18-25 years	29	52.7	30	54.5	59	53.6
	26-40 years	21	38.2	19	34.5	40	36.4
	41-60 years	5	9.1	6	10.9	11	10.0
		χ^2=0.208; p=0.901					
	Mean age±SD (Range)	29.07±9.85 (18-58)		29.13±10.12 (18-60)		29.10±9.94 (18-60)	
		't'=0.029; p=0.977					

DOI: 10.69605/ijlbpr_14.5.2025.73

2-	Gender						
	Female	25	45.5	27	49.1	52	47.3
	Male	30	54.5	28	50.9	58	52.7
		χ^2=0.146; p=0.702					

Out of 110 patients enrolled in the study 58 (52.7%) were male and 52 (47.3%) were females. Dominance of males was observed in both the groups (54.5% & 50.9%). Proportion of females in Group T (49.1%) was higher as compared to Group E (45.5%). Difference in gender ratio between the two study groups was not found to be significant statistically **(Table 2)**

Table 3: Between Group Comparison of Anthropometric Parameters

SN	Anthropometric Parameters	Group E (n=55)		Group T (n=55)		Statistical significance	
		Mean	SD	Mean	SD	't'	'p'
1-	Weight (kg)	51.71	4.79	50.53	5.47	1.205	0.231
2-	Height (cms)	157.53	7.83	155.49	8.56	1.301	0.196
3-	BMI (kg/m²)	20.86	1.56	20.91	1.74	-0.167	0.868

Table 4: Between Group Comparison of baseline Hemodynamic Parameters

SN	Hemodynamic parameters	Group E (n=55)		Group T (n=55)		Statistical significance	
		Mean	SD	Mean	SD	't'	'p'
1-	Heart rate (bpm)	77.93	5.83	77.82	5.42	0.102	0.919
2-	Resp rate (per min)	16.98	1.30	17.05	1.31	-0.292	0.771
3-	Systolic BP (mmHg)	121.49	8.78	121.38	8.89	0.065	0.949
4-	Diastolic BP (mmHg)	73.53	7.36	74.36	8.46	-0.553	0.581
5-	MAP (mmHg)	89.48	6.09	90.06	6.84	-0.471	0.639
6-	SpO2 (%)	100.0	0.00	100.0	0.00	–	–

At baseline Group E and Group T had comparable hemodynamic parameters i.e. Heart rate, Respiratory rate, Systolic BP, Diastolic BP, MAP. All the patients had 100% oxygen saturation.
ECG findings at baseline of all the patients were within normal limits.

Table 5: Between Group Comparison of Time taken for Induction (Seconds)

Group	N	Min	Max	Mean	SD
Group E	55	25	32	27.84	1.70
Group T	55	20	32	25.12	3.54
Total	110	20	32	26.48	3.08

t'=5.120; p<0.001

Table 6: Between Group Comparison of Duration of Clinical Seizure (Seconds)

Group	N	Min	Max	Mean	SD
Group E	55	46	50	47.71	1.46
Group T	55	40	50	43.36	2.35
Total	110	40	50	45.54	2.93

't'=11.638; p<0.001

Table 7: Between Group Comparison of Recovery Parameters

SN	Recovery Parameters	Group E (n=55)		Group T (n=55)		Statistical significance	
		Mean	SD	Mean	SD	't'	'p'
1-	Regain consciousness	5.75	0.64	7.15	1.27	-7.299	<0.001
2-	Respond to command	7.51	1.48	7.45	1.32	0.204	0.838
3-	Achieve Orientation	11.27	2.49	11.18	2.44	0.193	0.847
4-	Sit unaided	51.51	8.56	50.69	9.36	0.479	0.633

Table 8: Between Group Comparison of Adverse Drug Reactions

SN	Characteristics	Group E (n=55)		Group T (n=55)		Total (N=110)		'p' (Fisher's test)
		No.	%	No.	%	No.	%	
1-	Hypotension	0	0.0	0	0.0	0	0.0	–
2-	Nausea	2	3.6	3	5.5	5	4.5	1.000

DOI: 10.69605/ijlbpr_14.5.2025.73

3-	Bradycardia	0	0.0	0	0.0	0	0.0	–
4-	Vomiting	0	0.0	0	0.0	0	0.0	–
5-	Arrhythmia for 1 min	0	0.0	6	10.9	6	5.5	0.027
6-	Myoclonic jerks	7	12.7	0	0.0	7	6.4	0.013

Table 9: Between Group Comparison of MMSE Score at Before Procedure and at 6 hrs post procedure

SN	MMSE	Group E (n=55)		Group T (n=55)		Statistical significance	
		Mean	SD	Mean	SD	't'	'p'
1-	Pre-procedure	22.26	1.69	22.22	1.79	0.109	0.913
2-	6hr post procedure	20.02	1.47	20.36	1.42	-1.253	0.213
	Change in pre-procedure MMSE	-2.28	0.30	-2.37	0.32		
	% Change in pre-procedure MMSE	-10.23%		-10.66%			
	Paired 't' test	't'=-7.284; p<0.001		't'=5.808; p<0.001			

DISCUSSION

Efficacy and safety remain the two key points while selecting any drug for inducing anesthesia for various purposes. In the electroconvulsive therapy, the purpose of induction agents is to facilitate seizure activity while at the same point ensuring faster recovery, a better hemodynamic control and minimal adverse effects. Over the years, Etomidate and Thiopental have come up as alternatives to Methohexital and Propofol for this purpose, however, their relative efficacy remains a bone of contention and needs to be elaborated further with various drug dose combinations in electroconvulsive therapy.[8- 10]

With this backdrop, the present study was proposed to compare the efficacy of Thiopental and Etomidate in electroconvulsive therapy at a tertiary care teaching hospital in North India. As such there are only few studies in the recent years that have compared these two drugs with or without an additional group for comparison[11- 13], incidentally, all these studies had group sample sizes smaller than ours and, in that context, our study has the largest sample size. With respect to dose selection, although all these studies have used 0.2 mg/kg Etomidate, however, with respect to Thiopental there are slight variations. Mir *et al.*[7] and Vansola*et al.*[12] used 5 mg/kg dose as in the present study. Interestingly, Gupta *et al.*[3] used 2-3 mg/kg dose of thiopental.

In the present study, patients aged 18 to 60 years were enrolled. Mean age of patients was 29.10 years and 52.7% were males. Mean age of patients in the study of Mir *et al.*[7] and Gupta *et al.*[3]was slightly higher (35 years) while male-female proportion was 50% each. However, almost all the studies were carried out in young adults in approximately 20-40 years age group with no significant sex predilection.

Also, time taken for induction was 27.84 and 25.12 seconds respectively in the Ethomidate and Thiopental groups, though the mean difference between two groups was just 2.72 seconds which is nominal from the point of view of their clinical value yet it was significant statistically. Rathinam *et al.*[8]and Gupta *et al.*[5] did not report the induction time at all. As such, the induction times reported in the present study were thus shortest among all these studies.

In the present study, clinical seizure duration was found to be significantly longer in etomidate as compared to thiopental group (47.71±1.46 vs 43.36±2.35 seconds- 4.35 seconds) , Mir *et al.*[7] and Vansola*et al.*[12] in their studies however found this to be 56.5 and 30.2± seconds respectively and found the difference to be much larger (26.3 seconds). The findings of the present study could be considered to be more reliable owing to a larger sample size, ruling out the role of chance variations. Hemodynamic variations were seen in both the groups, however, most of the changes were within 10-15% range and were comparable. There was no major hemodynamic event in either of two groups. The results in the present study are comparable to those reported by Donthu*et al.*[2], Rathinam[8] and Vansola*et al.*[12]who similar to the present study found Etomidate to be more stable than Thiopental.

Patients in Etomidate group regained consciousness significantly earlier than that in Thiopentane group. Donthu*et al.*[2] in their study reported the recovery in one single characteristic and found it to be shorter by almost 1.14 minutes in Etomidate as compared to that in Thiopental group. We observed that associated side effects of Myoclonic jerks were significantly higher in Etomidate than in Thiopentane group (12.7% vs. 0.0%) while Arrhythmia (for 1 min) was significantly higher in Thiopentane as compared to that in Etomidate group patients (10.9% vs. 0.0%). Adverse effects in 6 to 12% of Etomidate and 0 to 8% of Thiopental group patients in the study by Donthu*et al.*[2]. The findings of the present study are thus comparable to that reported by Donthu*et al.*[2]

LIMITATIONS

The present study was limited with respect to absence of another reference comparative group such as Propofol or Methohexital. Moreover, limitation of follow-up was also faced particularly with respect to time to attain pre-intervention cognitive function.

DOI: 10.69605/ijlbpr_14.5.2025.73

CONCLUSION

Both the drugs (Etomidate and Thiopental sodium) bring in almost similar change in pre-Electroconvulsive therapy MMSE score, but Etomidate had slightly lesser hemodynamic variability as compared to Thiopental.

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