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Original Research Article

Comparison of Anaesthetics in Electroconvulsive Therapy: An Effective Treatment with the Use of Propofol and Etomidate: An Analytical Observational Study

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Abstract

Background: Electroconvulsive therapy (ECT) has become an increasingly important treatment modality in various psychiatric diseases in recent years. Various anaesthetic agents are used for electroconvulsive therapy. The most commonly used agents are propofol and etomidate.

Objectives: The objective of this study were to compare the effects of the anaesthetics (propofol and etomidate) on- motor seizure duration, hemodynamic measures (heart rate, blood pressure), recovery time and immediate side effects.

Methods: Fifty patients undergoing ECT were given propofol and etomidate in two sessions. All patients were evaluated before ECT and informed consent was taken. The patients were given the two drugs and the effects were noted.

Results: This study concluded that etomidate had longer motor seizure duration (mean 38.5s with SD 2.96) than propofol (mean 27.6s with SD 2.88), the recovery was earlier with propofol (mean recovery time 10.3min SD1.63) compared to etomidate(mean 12.8min SD2.12), there was no significant difference noted on heart rate, oxygen saturation and blood pressure with either of the two drugs. The side effects viz myoclonus and agitation were more observed with etomidate (24%) than propofol (6%).

Conclusion: This study concluded that etomidate should be used for ECT in patients requiring higher seizure threshold due to greater mean seizure duration. However in other cases due to higher incidence of side effects in etomidate the preferred drug should be propofol due to its smooth rapid recovery and lesser side effects.

Keywords: ECT, Anaesthetic agents, propofol, Etomidate.

Introduction

The first description of Electroconvulsive therapy (ECT) to provoke a generalized epileptic seizure date's back to 1938 andthis procedure was performed without anaesthesia for almost 30 years. [1] Today in the United States the number of ECT procedures performed per year under General Anaesthesia exceeds the number of procedures like coronary grafting, appendectomy, and hernia repairs [2]. In recent times, ECT has become an increasingly important modality in the treatment of severe and medication-resistant depression and mania, as well as in the treatment of schizophrenic patients with affective disorders, suicidal drive, delusional symptoms, vegetative dysregulation and catatonic symptoms [2,3]. Currently Electro convulsive therapy (ECT) is one of the most effective treatments in psychiatry. There are various anaesthetic agents used for ECT viz methohexital, propofol, thiopental, etomidate etc. Our objective in this study was to evaluate the different effects of the two anaesthetics -propofol and etomidate (commonly used in our institute for ECT) in order to suggest the preferred anaesthetic medication for this procedure. In this study we have prospectively compared effects of anaesthetics on patients who had undergone ECT and were anaesthetized with propofol and etomidate in different ECT sessions. All patients chosen were clinical responders to ECT. The outcomes measured were motor seizure duration,

hemodynamic changes, recovery from ECT and immediate side effects. The different clinical opinions concerning ECT for various psychiatric disorders are diverse, ranging from researchers who claim that there is a high probability that ECT is ineffective and causes long-term side effects1 to clinicians who claim that ECT is safe and is the most effective treatment in psychiatry [5,6].

The common indications for ECT are major depression, acute psychosis, mania and catatonia. [7] Electroconvulsive therapy is performed with short-term general anaesthesia using neuromuscular-blocking medication by placing two electrodes of machine on the temples and/or the forehead of the patient and delivering electrical pulses between the electrodes in order to induce a generalized convulsion.8 Post ECT the various physiological side effects and after effects are fatigue, generalized weakness, vertigo, amnesia, confusion, agitation, and headaches. [9]

The various hemodynamic changes include an increase in the systolic blood pressure and pulse rate, [10] and in some cases arrhythmias. [11] The generalized convulsion causes myoclonic seizures, fractures and dislocations of the spine and the long bones besides muscle and joint pain. [12] With the use of neuromuscular-blocking medication (eg, succinylcholine) the fractures and dislocations can be prevented, however this does not prevent muscle and joint pain. Besides this dental damage and lacerations of the oral cavity can occur.

Various side effects such as sialorrhea, nausea, and vomiting can occur due to vagal nerve stimulation. Use of anticholinergic drugs (eg, atropine) can minimize these side effects. [13] Since 1950s anaesthetics have been used in ECT. Use of anaesthesia can overcome the unpleasant feelings patients may get during convulsion inducement; it also prevents the sensation of general paralysis after the administration of neuromuscular-blocking drugs and lowers the opposition to therapy. [14] Methohexitol was the anaesthetic of choice until the mid-2000s due of its proven safety profile, effectiveness, and relatively low cost. [15] However, a lack of availability of methohexital has limited its use and led to the use of other anaesthetics.

Propofol from sedative-hypnotic group of anaesthetics agonist is administered intravenously for general anaesthesia and is widely used for procedures requiring anaesthesia. [16] It is a GABA agonist and causes a rapid and smooth induction and rapid recovery with minimal residual CNS effects. This drug has a research-based and accepted safety profile. Common side effects include cardiovascular depression, pain during injection, bradycardia, and apnea. Etomidate, a carboxylated imidazole derivative, is an anaesthetic agent that is administered intravenously for sedation and general anaesthesia. [12] It acts on GABA-A receptors to modulate fast inhibitory transmission in the central nervous system. It causes a decrease in the cerebral metabolic rate, cerebral blood flow, and intracranial pressure. In the past it has been suggested to have neuroprotective properties. [13] Etomidate causes mild decrease in systemic vascular resistance, cardiac output, transient apnea and reduced ventilator drive. However the overall effect on respiratory and cardiovascular systems is insignificant. It can cause adrenal suppression by inhibiting 11-beta- hydroxylase and 17-alpha-hydroxylase resulting in depression of cortisol and aldosterone synthesis. Nausea and vomiting during recovery from anesthesia, myoclonus and pain during injection are the additional side effects.

In a comparison between propofol and etomidate, [15] there were differences noted between motor seizure duration as observed by a clinician and as recorded by electroencephalogram (EEG). Seizure durations were shorter for patient's anaesthatised with propofol as compared to etomidate. However, the recovery time and the length of stay in the recovery room were longer for patients anaesthetized with etomidate, but these findings were statistically insignificant. Propofol was also compared to thiopental, [16] and seizure durations were also shorter for the propofol group (motor seizure duration and seizure duration on EEG). There was no evident difference in the clinical efficacy of ECT among patients anaesthetized with different anaesthetics. [15,16] In a study that compared the effects of these three anaesthetics on healthy subjects, etomidate had no influence on hemodynamic measures. [17] Propofol and thiopental caused a decrease in systolic blood pressure and an increase in pulse rate in the minutes after injection.

Aims and Objectives: Our objectives in this study were to compare the effects of the anaesthetics (propofol and Etomidate) on

1. motor seizure duration
2. hemodynamic measures (BP, heart rate),
3. recovery time,
4. Immediate effects after treatment.

Materials and Methods

This study was conducted was conducted in Department of Anaesthesiology at Sher-i-Kashmir Institute of Medical Sciences, SKIMS, Medical College, Bemina, Srinagar from 2022 to 2024. Approval was taken from Institutional Ethics Committee prior to the start of study. A proper informed consent was taken from all the patients included in the study. Fifty Patients undergoing

ECT were given propofol and Etomidate in two different sessions.

Session P: ECT session where propofol was given to patient.

Session E: ECT session where Etomidate was given to the same patient.

Study Design: Analytical observation study.

Statistical Method: The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean ± SD and categorical variables were summarized as frequencies and percentages.

Graphically the data was presented by bar diagrams. The Shapiro-Wilk test was applied to test the normality of data. Student's independent t-test or Mann-Whitney U-test, whichever feasible, was employed for comparing continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was applied for comparing categorical variables. A P-value of less than 0.05 was considered statistically significant.

Sample Size and Power: Sample size was calculated by G Power software. Sample size of studywas 50 subjects having 90% power of study.

Inclusion Criteria:

1. patients treated in the ECT unit between 2022 and 2024
2. patients expected to have a good response to the treatment asevaluated clinically by the staff of the hospitalizing ward (ie, the patient were categorized as responsive to ECT by psychiatry department of SKIMS MC)
3. anaesthetized during ECT with propofol and etomidate in two sessions;
4. Age of patient >18 years
5. treated during hospitalization (because there was more available information on hospitalized patients)

Exclusion Criteria:

1. Age <18 years
2. Raised ICP and intracranial space occupying lesions
3. Recent MI

All needed data was recorded in the patient's medical file. All the patients were shifted from wards after a complete pre- anaesthetic check-up before the ECT. This work-up included routine blood tests, chest X-ray, ECG and neurological examination. Patients with existing health problems underwent clearance from the concerned specialists in order to undergo ECT. After pre-anaesthesia checkup and clearance, consent was taken and patients were kept fasting as per guidelines before the ECT. ECT was performed according to criteria from The Practice of Electroconvulsive Therapy: Recommendations for Treatment, Training, and Privileging. [4] Fifty patients were given propofol and etomidate in two different sessions of ECT. Propofol was given1.5-2mg per kg body weight, and etomidate 0.2-0.3mg per kg body weight of the patient. All patients were given intravenous succinylcholine (50-100 mg according to the patient's weight and the anaesthesiologist's considerations). The primary outcome measured was motor seizure duration. The effectiveness of the seizure was defined as minimum 25 seconds of clinical seizure. The secondary outcomes noted were the effects on heart rate and blood pressure. Besides this the other things noted were the amount of time until transfer to the recovery room and any side effects noticed immediately after ECT. For each patient, the above data was gathered after each ECT session.

Observations and Results

In this study the mean age of patients was 43.8years. The largest group of patients (about 30%) were in the age group of 31-40 years. Ten percents of patients were aged more than 60 years.

Table 1: Age distribution of patients

Age (years)	Number	Percentage
21-30 Years	8	16
31-40 Years	15	30
41-50 Years	13	26
51-60 Years	9	18
> 60 Years	5	10
Total	50	100
Mean±SD (Range)=43.8±13.12 (21-68 Years)		

As regards gender distribution, the majority of patients were females(N=31) forming 62% of patients whereas men formed 38% of cases (N- 19). Table 2 below shows gender distribution of our study.

Table 2: Gender distribution of study patients

Gender	Number	Percentage
Male	19	38
Female	31	62
Total	50	100

The table below shows American Society of Anaesthesiology (ASA) status of the patients. Forty-two (84%) patients were ASA I while 8patients (16%) were ASA II.

Table 3: ASA status of study patients

ASA Status	Number	Percentage
ASA I	42	84
ASA II	8	16
Total	50	100

The majority of our patients in the study were treatment resistant depression, OCD and BPAD forming about 68% of the patients, this was followed by patients with bipolar reflective disorder with suicidal tendency forming 14% of patients, OCD with predominantly compulsive act were 12% of cases and patients with recurrent depressive disorder formed 6% of the cases. The table 4 shows distribution of study patients as per diagnosis.

Table 4: Distribution of study patients as per psychiatric diagnosis

Psychiatric diagnosis	Number	Percentage
Treatment resistant depression(depression, OCD andBPAD)	34	68
Bipolar reflective disorder with suicidal tendency	7	14
OCD with predominantly compulsive act	6	12
Recurrent depressive disorder	3	6
Total	50	100

In our study the patients on etomidate had a motor seizure duration of 38.5 seconds with SD of 2.88 whereas patients on propofol had a mean of 27.6 seconds motor seizure duration with SD of 2.96. The comparison is statistically significant (P value<0.05). The table 5 below gives reflects the comparison among the two groups.

Table 5: Comparison based on motor seizure duration (seconds) in twosessions

Session	N	Mean	SD	95% CI For Mean	P-value
Session P	50	27.6	2.96	26.7-28.4	<0.001*
Session E	50	38.5	2.88	37.7-39.3	

***Statistically Significant Difference (P-value<0.05); CI: Confidence Interval**

On comparing the recovery of patients in the two groups the session P had a mean recovery time of 10.3 minutes with SD of 1.63 whereas mean recovery time was 12.8 minutes with SD 2.12 during session E. The comparison between the two is statistically significant (P value <0.05).

Table 6: Comparison based on recovery time (minutes) in two sessions

Session	N	Mean	SD	95% CI For Mean	P-value
Session P	50	10.3	1.63	9.8-10.7	<0.001*
Session E	50	12.8	2.12	12.2-13.4	

***Statistically Significant Difference (P-value<0.05); CI: Confidence Interval**

The study showed both drugs used for respective sessions in patients had no difference in heart rate changes during the procedure, immediate post procedure and during recovery periods. Both drugs used during this study had no significant difference upon changes in heart rate as evident from table 7 below the difference being statistically insignificant (P<0.05).

Table 7: Heart rate (beats/min) of study patients in two sessions at variousintervals of time

Time interval	Session P		Session E		P-value
	Mean	SD	Mean	SD	
Pre procedure	80.4	8.84	78.6	8.75	0.330
During procedure	112.5	9.34	115.8	8.85	0.169
Immediate post procedure	89.8	9.36	91.0	9.48	0.540
During recovery	82.6	9.49	84.1	9.76	0.432

The effect on systolic blood pressure during procedure, immediately after procedure and during recovery

periods were similar for both drugs with no major fluctuation observed with use of either drug. The tablebelow (table 8) shows no significant alterations with use of either drugs.

Table 8: Systolic blood pressure (mmHg) of study patients in two sessions atvarious intervals of time

Time interval	Session P		Session E		P-value
	Mean	SD	Mean	SD	
Pre procedure	118.3	9.63	116.9	9.55	0.467
During procedure	139.8	9.62	143.6	9.90	0.058
Immediate post procedure	130.5	10.54	133.6	9.83	0.134
During recovery	119.7	10.75	121.5	10.67	0.413

The effect on diastolic blood pressure was similar as observed for systolic blood pressure with no statistically significant changes observed asshown in table 9

Table 9: Diastolic blood pressure (mmHg) of study patients in two sessions atvarious intervals of time

Time interval	Session P		Session E		P-value
	Mean	SD	Mean	SD	
Pre procedure	76.6	6.59	74.6	7.14	0.141
During procedure	93.8	7.01	95.6	7.31	0.212
Immediate post procedure	84.8	6.62	86.2	7.34	0.340
During recovery	78.7	7.10	79.8	7.62	0.465

With use of both drugs in either sessions there was no major difference observed inoxygen saturation measured in patients in various intervals of time.

Table 10: Oxygen saturation (%) of study patients in two sessions at variousintervals of time

Time interval	Session P		Session E		P-value
	Mean	SD	Mean	SD	
Pre procedure	97.72	1.341	97.42	1.341	0.266
During procedure	99.22	0.679	99.26	0.664	0.766
Immediate post procedure	99.18	0.720	99.10	0.735	0.584
During recovery	99.30	0.678	99.16	0.710	0.316

In this study a significant percentage of patients (24%) on etomidate had developed agitation compared to only 6% of patients on propofol. similarly myoclonus was observed with etomidate only in the study. This highlighted the safety profile in favor of propofol with lesser side effects as shown below in table 11.

Table 11: Side effects of study patients in two sessions

Side Effects	Session P		Session E		P-value
	No.	%age	No.	%age	
Agitation	3	6	12	24	0.025*
Myoclonus	0	0	4	8	0.117

***Statistically Significant Difference (P-value<0.05)**

Discussion:

This study scrutinized the effects of two commonly used drugs viz propofol and etomidate in patients undergoing ECT. This study included 50 patients undergoing ECT in different sessions. In our study most of the patients were in the age group of 31-40 years. Most of the patients were female as compared to males, reason being social and economic factors (gender inequality, earning disparities and exposure to violence), hormonal differences such as estrogen and progesterone have been shown to affect neurotransmitter, neuroendocrine and circadian systems that have been implicated in mood disorders [38]. Most of the patients in our study had no underlying comorbidities (80% belonging to ASA 1 and 16% belonging to ASA 2). Hypertension and diabetes mellitus being the most common comorbidities. Majority of our patients were diagnosed as treatment resistant depression (depression, OCD, BPAD) forming about 68% of patients under study.

In our study on Comparing the motor seizure duration and recovery time in two sessions, the patients on etomidate had statistically significant higher mean motor seizure duration and longer recovery time compared to propofol. This is due to known anticonvulsant effect of propofol leading to shorter motor seizure duration and hence early recovery compared to etomidate which has no such effect. Besides propofol has rapid induction and rapid recovery due to its pharmacokinetic profile. This is in concordance with the research done by Preet Mohinder Singh et al. [24] on evaluation of etomidate for seizure duration as compared to propofol and thiopental. In this study authors

concluded etomidate better in terms of motor seizure duration. Another prospective study by Lavan Sagar Pragada [37] comparing effect of propofol and etomidate in ECT, longer seizure duration was found with etomidate. They concluded that propofol has the advantage of smooth induction, stable hemodynamics and rapid recovery as compared to etomidate. However, it was associated with shorter seizure duration. These results are partially in concordance with our study where we had etomidate having longer seizure duration and rapid recovery time of propofol. However contrary to our finding of no alteration in hemodynamic measures between two drugs, this study found propofol having stable hemodynamic parameters compared to etomidate. In a study by Rosa et al. [23] the drugs –propofol, etomidate and thiopental were studied comparing post anaesthesia recovery time of the three drugs. They found no significant difference in recovery time for the three drugs. This is contrary to our research observations where the patients on etomidate were found to take longer periods for recovery.

In our study both drugs used for respective sessions in patients had no significant difference in heart rate, systolic Bp, diastolic Bp and oxygensaturation during procedure, immediate post procedure and during recovery period. The study by Rosa et al. [22] comparing cardiovascular effects of anaesthetic agents- propofol, etomidate and thiopental in ECT. They observed no significant difference on cardiovascular system. This finding is in concordance with our research.

In our study a significant percentage of patients on etomidate session had developed agitation compared to propofol. Probable reason being higher incidence of mean motor seizure in etomidate session which leads to the higher incidence of agitation in recovery period.

Similarly myoclonus was observed with etomidate session only whereas no such finding was observed with propofol session. The possible cause of myoclonus during anaesthesia induction using etomidate is subcortical disinhibition. Etomidate exposure in central nervous system causes a transient disequilibrium which may lead to myoclonus39. In the study by Ozge canbak [28] the authors comparing the drugs propofol, thiopental and etomidate concluded that there was no significant difference in terms of safety and efficacy. There were no significant differences among the groups in terms of effects on cardiovascular system variables, seizure variables, and cognitive functions. The clinical response to ECT was good in all groups, without any significant differences. This is partially in accordance with our study where the drugs had similar cardiovascular effects. In our study etomidate had clearly higher mean motor seizure duration and was observed to have more side effects (myoclonus and agitation) compared to propofol. The recovery time was more with etomidate in our study. In the randomized blind study by Jeanett et al. [29] comparing propofol and thiopental for ECT the study concluded Propofol significantly decreases seizure duration without significant difference in the clinical outcome similar to our study where propofol had decreased mean motor seizure duration compared to etomidate and with lesser side effect profile too.

In the retrospective study by Daniel et al. [21] the anaesthetic agents were studied with respect to the influence of anaesthetic medication on safety, tolerability and clinical effectiveness of ECT. Anaesthetics were chosen according to clinical reasons and comprised of thiopental, methohexital, propofol and etomidate. They found that Seizure duration was significantly affected by the anaesthetic medication with longest seizure activity (thiopental). The clinical effectiveness was significantly better during propofol and thiopental anaesthesia. In contrast, the overall safety did not differ between the anaesthetic groups. This study supported the hypothesis that inducing anaesthetic agents have a different impact on seizure duration, ictal and postictal electrophysiological indices and clinical efficacy of ECT. Compared to thiopental, which has been established as a standard anaesthetic during ECT, also the modern anaesthetic propofol is a suitable inducting agent. In our study the the two anaesthetic agents differed in seizure duration time, time taken for recovery and side effect profiles whereas no significant effects were not on cardiovascular system and oxygen saturation.

Summary and Conclusion

In recent years ECT has assumed an increasingly important role in treatment of severe and medication-resistant depression and mania, as well as in the treatment of schizophrenic patients with affective disorders, suicidal drive, delusional symptoms, vegetative dysregulation and catatonic symptoms. The two most commonly used drugs in our institute are propofol and etomidate. Our objective in this study was to evaluate the different effects of these two anaesthetics used in ECT in order to suggest the preferred anaesthetic medication for this procedure.

The main results obtained from this study were

- Etomidate based session's induced longer duration of seizures compared to propofol.
- The recovery time was more with etomidate compared to propofol.
- There was no significant difference in heart rates measured during the procedure, immediate post procedure and during recovery

with both drugs.
- The effect on blood pressure measured in different stages of treatment was unremarkable for both drugs reflecting cardiovascular safety of the drugs.

Based on these findings we conclude that Etomidate should be given to patients who require higher seizure threshold. For rest of patients propofol is the preferred drug due to its smooth and rapid post procedural recovery and better safety profile.

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