Original Research Article

A prospective comparative study of effect of intravenous etomidate and propofol during induction of anesthesia for electroconvulsive therapy

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Abstract

Introduction: The use of electroconvulsive therapy (ECT) for the treatment of psychiatric disorders dates back to 1937. Since then, its indication has become more diversified and includes the vast majority of major depressive disorders, bipolar mood disorders, and even post-partum psychosis. Electroconvulsive therapy is considered to be one of the important treatment modalities available. It has the advantage of producing a more rapid response compared to conventional treatment, an important consideration in the management of patients with suicidal tendencies. **Materials and methods:** This prospective, comparative study was carried out at a private psychiatric set up in Bidar from January 2020 to December 2020. Written informed consent from 120 patients of the American Society of Anesthesiologists (ASA) class I and II, aged 18-60 years, scheduled for ECT therapy, included in this study. Patients with a severe systemic disorder like IDDM, uncontrolled hypertension, kidney or liver disease, severe respiratory disorder, seizure disorder, coronary artery disease or recent history of MI, patients with known hypersensitivity or allergy to drugs to be used, anticipated difficult airway, bodyweight >100 kg or obese and pregnant or breastfeeding females and in patients in whom seizures failed to occur during ECT were excluded from the study. **Results:** All the patients in both groups were comparable for a demographic profile which includes age, bodyweight which statistically showed no significant difference. Results of our study showed that the induction was rapid with propofol as compared to etomidate, which was statistically significant ($p < 0.001$). Induction time with propofol was 40.3 ± 3.65 seconds and that for etomidate was 48.63 ± 3.29 seconds (table-1). **Conclusion:** In our study, when used for acute courses of ECT, propofol and etomidate are equally well tolerated as induction agents. Patients who received propofol had longer acute courses of ECT and, consequently, longer and costlier inpatient stays. Etomidate could be a better alternative induction agent in ECT.

Key Words: Electroconvulsive therapy, Propofol, etomidate, bodyweight, seizures.

Introduction

The use of electroconvulsive therapy (ECT) for the treatment of psychiatric disorders dates back to 1937. Since then, its indication has become more diversified and includes the vast majority of major depressive disorders, bipolar mood disorders, and even post-partum psychosis[1]. Electroconvulsive therapy is considered to be one of the important treatment modalities available. It has the advantage of producing a more rapid response compared to conventional treatment, an important consideration in the management of patients with suicidal tendencies[2].The efficacy of electroconvulsive therapy is dependent on the induced seizure duration. EEG (electroencep-halograph) seizure activity is said to have optimal efficacy of treating depression when it lasts for 25 to 50 seconds. The least favorable response to ECT occurs when patients experience a seizure duration of <15 seconds or >120 seconds[3]. ECT leads to increase in brain derived neurotrophic factor (BDNF). BDNF is a protein that helps in survival and growth of new synapses and neurons thus, inducing neurogenesis and synaptogenesis in the hippocampus. Impaired neurogenesis may lead to severe depression. ECT is a useful remedy for normalization. Subconvulsive seizures may produce cognitive impairment with none therapeutic benefit.

During ECT, severe disturbances are often noted in the cardiovascular system. These changes include transient hypertension and changes in the heart rate (HR). Also, following ECT, cerebral blood flow and intracranial pressure markedly increase. ECT induces hemodynamic changes which can result in myocardial ischemia and infarction[4]. Also, cerebrovascular changes following ECT can result in cortical blindness, intracerebral hemorrhages, and transient neurologic ischemic deficits. Unmodified direct ECT has been associated with physical and psychological trauma. Hence, it has now been modified with anesthesia. Various the anaesthetic drugs used in modified ECT can alter these cardiovascular changes and use of muscle relaxants can reduce the violent muscular contractions during the convulsions[5]. Propofol has been shown to reduce cognitive dysfunction following ECT, but it also significantly shortens the seizure duration affecting the efficacy of ECT. Etomidate has good cardiovascular stability and produces rapid recovery. It has also been shown to prolong seizure duration in patients undergoing ECT, and has been suggested as an alternative anaesthetic agent for the procedure. Etomidate contains a carboxylated imidazole ring. The imidazole ring in etomidate gives the properties of lipid solubility at physiological pH and water solubility in acidic solutions. Therefore, its preparation is dissolved in a lipid emulsion or propylene glycol for injection. Etomidate acts by inhibiting the reticular activating system and mimics the action of GABA (gamma-aminobutyric acid) inhibition. The R (+) isomer of Etomidate particularly appears to bind specifically to a subunit of the GABAA receptor, thus increasing the affinity for inhibitory neurotransmitters i.e. GABA[5].In our present study, we compare the effects of injection etomidate and propofol, used for intravenous induction of anesthesia in modified Electroconvulsive therapy with respect to induction time, quality of induction of anesthesia, hemodynamic stability, seizure duration, and recovery profile.

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Materials and methods

Study design

A prospective, comparative study

Study duration

January 2020 to December 2020.

Study location

Carried out at private psychiatric set up in bidar from January 2020 to December 2020.

This prospective, comparative study was carried out at a private psychiatric setup in bidar from January 2020 to December 2020.

Inclusion Criteria

Written informed consent from 120 patients of the American Society of Anesthesiologists (ASA) class I and II, aged 18-60 years, scheduled for ECT therapy, included in this study.

Exclusion Criteria

Patients with a severe systemic disorder like IDDM, uncontrolled hypertension, kidney or liver disease, severe respiratory disorder, seizure disorder, coronary artery disease or recent history of MI, or opioids, patients with known hypersensitivity or allergy to drugs to be used, anticipated difficult airway, bodyweight >100 kg or obese and pregnant or breastfeeding females and in patients in whom seizures failed to occur during ECT were excluded from the study. Patients included in the study were randomized by a computer-operated random number table. Each study group consists of 60 patients.

Group E- 60 patients Received Inj. Etomidate at 0.2 mg/Kg for induction of anesthesia.

Group P- 60 patients Received Inj. Propofol 1% at 1.5 mg/Kg for induction of anesthesia.

In our study, all the patients planned for electroconvulsive therapy were assessed one day prior to the procedure. Patients of both the study groups were kept nil per oral for at least 6 hours prior to the procedure. Upon the arrival of the patient into the procedure room, the multi-parameter monitor was attached to a patient for continuous monitoring of Heart Rate, electrocardiogram, non-invasive blood pressure, and oxygen saturation (SpO2). Baseline values of vital parameters were noted. An IV line was established with a 20G IV cannula. Inj. glycopyrrolate 0.2 mg IV as premedication is given to all the patients. Preoxygenation is done for 3 minutes with 100% oxygen. Induction of General anaesthesia was done with IV anesthetic agent, inj. etomidate (0.2 mg/Kg) or inj. propofol (1.5 mg/Kg) as per the group allocated, till loss of eyelid reflexes. To ensure accurate registration of the motor seizure, the blood pressure cuff of the upper limb was inflated 50 mmHg above the systolic blood pressure (SBP) to isolate the circulation. Following induction, IV succinyl choline 0.5 mg/Kg was administered for neuromuscular relaxation and to avoid convulsion-induced complications among all patients. Once the fasciculations subsided and following adequate neuromuscular relaxation, a bite block of appropriate size was inserted to prevent tongue bites. A brief pulse stimulus for about 1–3 seconds, frequency of 60–90 Hz, and pulse width of 1 were given to produce seizures. Seizure duration was monitored by the isolated limb method. Subsequently, ventilation was assisted with a face mask in all patients with 100% oxygen at a rate of 12-16 breaths/min until the return of spontaneous breathing and clinical recovery of the patient from anesthesia. Patients were monitored for various hemodynamic parameters such as heart rate, systolic and diastolic blood pressure (SBP and DBP), and oxygen saturation (SpO2). Baseline values were noted before induction and changes were noted after induction at 1 min, 2 min, 3 min, 5 min, 10 min, and 20 min following ECT. Time taken for recovery from anaesthesia was recorded with respect to the time taken to achieve consciousness, obey commands, orientation, and the ability to sit unaided.

Statistical Analysis

The collected data were analyzed statistically using a one-way ANOVA test. The values were considered significant when the P-value is < 0.05.

Results

All the patients in both groups were comparable with respect to demographic profiles like age, body weight statistically showed no significant difference. Results of our study showed that the induction was rapid with propofol as compared to etomidate, which was statistically significant ($p < 0.001$). Induction time with propofol was 40.20 ± 3.65 seconds and that for etomidate was 48.10 ± 3.29 seconds.The mean duration of seizure activity between both the groups was comparable and was found significantly longer in the etomidate group (57.8 ± 11.91 sec) as compared to the propofol group (22.06 ± 5.48 sec). The mean heart rate (HR) between the two groups at various time intervals was compared. It was found that there was no statistically significant difference in mean heart rate between the two groups at baseline (p=0.301), 1 minute (p=0.063), 10 minutes (p=0.362), and at 20 minutes (p=0.859). Heart Rate was comparable in both the group and statistically significant at time intervals 2 min, 3 min, and at 5 min ($p<0.001$, at all-time intervals) following ECT with propofol the HR change was 15-17 beats/min above the baseline values in the first 2 min, whereas with etomidate group HR varied from 35 to 38 beats/min above baseline values. Systolic blood pressure at baseline was similar in both groups (p=0.153). In our study, results showed that an increase in the systolic blood pressure (SBP) following ECT, with propofol, was comparatively less than that with etomidate. Change in the mean SBP, in the propofol group was 20-24 mmHg above the baseline value in the first 2 min, while with etomidate, mean SBP raised by 38-42 mmHg above the baseline value in the first 2 min following ECT. After 2 min of ECT, the SBP of both groups gradually declined to reach baseline values. SBP in the propofol group reached the baseline values after 10 min following ECT, but in the etomidate group it is beyond 20 min post ECT. Diastolic blood pressure at baseline was similar in both groups (p=0.618). Results showed a statistically significant difference in mean diastolic blood pressure at various other time intervals ($p<0.05$). Propofol caused a little increase in mean diastolic blood pressure (DBP), around 10–13 mmHg above the baseline value in the first 2 min following ECT. With etomidate, the mean DBP increased by 15-17 mmHg above the baseline value in the first 2 min post-ECT was observed. After 2 min of ECT, the DBP of both groups gradually declined to reach baseline values. DBP in both group reached close to baseline values by 10 min following ECT. The mean arterial pressure between the two groups at various time intervals was compared. At baseline, the mean arterial pressure was similar in both the groups (p=0.250). The mean arterial pressure (MAP) values were less raised in propofol in comparison to the etomidate group post ECT. After 2 min of ECT, MAP of both groups gradually declined to reach baseline values. MAP in the propofol group reached the baseline values after 10 min following ECT, but in the etomidate group, it is beyond 20 min post ECT. Although both the study drugs showed a very short time for recovery, patients of the propofol group achieved consciousness earlier than those of the etomidate group following induction (7.1 ± 1.23 min and 8.5+1.14 min respectively with $p<0.001$), but other parameters of recovery such as obeying commands, orientation and able to sit unaided were not significant between two groups.

Table 1: Comparison of Induction and Seizure Time (Secs) between the Two Groups

Variable	Group E(n=60)		Group P(n=60)		P-Value
	mean	SD	mean	SD	
Induction	48.10	3.29	40.20	3.65	<0.001
Seizure	57.80	10.80	21.10	5.41	<0.001

Table 2: Comparison of Mean Heart Rate between the Two Groups at Various Time Intervals

HR (bpm)	Group E(n=60)		Group P(n=60)		P-Value
	mean	SD	mean	SD	
Baseline	75.60	7.32	77.85	7.80	0.301, NS

1 min	95.80	7.47	91.95	8.29	0.063, NS
2 min	111.76	6.27	93.92	7.59	<0.001, S
3 min	108.86	6.30	91.02	7.27	<0.001, S
5 min	101.36	6.42	83.42	7.18	<0.001, S
10 min	81.33	5.67	77.82	7.37	0.362, NS
20 min	75.66	5.20	76.05	7.39	0.859, NS

Table 3: Comparison of Mean Systolic Blood Pressure between the Two Groups at Various Time Intervals

SBP (mm hg)	Group E(n=60)		Group P(n=60)		P-Value
	mean	SD	mean	SD	
Baseline	121.23	6.34	118.20	8.78	0.153, NS
1 min	156.10	5.61	138.10	7.36	<0.001, S
2 min	161.20	5.38	140.25	7.14	<0.001, S
3 min	150.10	5.37	130.13	7.12	<0.001, S
5 min	144.80	6.51	125.15	6.85	<0.001, S
10 min	132.20	6.08	120.18	7.94	<0.001, S
20 min	126.30	6.12	118.23	8.15	<0.001, S

Table 4: Comparison of Mean Diastolic Blood Pressure between the Two Groups at Various Time Intervals

DBP (mm Hg)	Group E(n=60)		Group P(n=60)		P-Value
	Mean	SD	Mean	SD	
Baseline	75.20	8.67	73.58	7.42	0.618 NS
1 min	92.13	8.34	83.19	6.87	<0.001 S
2 min	91.40	8.41	86.83	6.45	0.017, S
3 min	87.30	8.70	78.18	6.21	<0.001 S
5 min	81.30	7.24	76.13	6.15	0.047, S
10 min	76.60	6.50	73.25	5.46	0.032, S
20 min	74.46	6.42	70.31	5.40	0.006, S

Table 5: Comparison of Mean Arterial Pressure between the Two Groups at Various Time Intervals

MAP (mm hg)	Group E(n=60)		Group P(n=60)		P-Value
	Mean	SD	Mean	SD	
Baseline	91.20	7.19	88.14	7.12	0.250 NS
1 min	113.25	5.86	101.43	5.83	<0.001 S
2 min	115.15	5.75	104.60	5.46	<0.001 S
3 min	108.46	5.83	95.65	5.36	<0.001 S
5 min	100.56	5.18	92.36	5.15	<0.001 S
10 min	95.18	4.81	89.12	5.17	<0.001 S
20 min	92.10	4.68	86.26	5.15	<0.001 S

Table 6: Comparison of Recovery Time (min) between the Two Groups

Recovery	Group E(n=60)		Group P(n=60)		P-Value
Times (secs)	mean	SD	mean	SD	
Consciousness	7.40	1.15	7.15	1.21	<0.001, S
Obey command	8.11	1.13	8.40	1.32	0.364, NS
Oriented	10.20	1.25	10.13	1.35	0.052. NS
Site unaided	13.10	2.17	14.23	2.52	0.360, NS

Discussion

ECT has a well-established role in the management of patients who have not responded to psychopharmacological treatment. Many studies documenting the efficacy of ECT for depressive illness have been published, finding ECT superior to 'sham' ECT and to medications in the treatment of patients with severe depressive illness3, particularly those with psychotic and suicidal symptoms.

In our study, the mean duration of seizure activity was found significantly longer in the etomidate group ($p < 0.001$). Our results were comparable to the study conducted by Avramov et al who compared the effects of methohexitate, propofol, and etomidate in ECT. Their study results showed the durations of EEG and motor seizures duration was longer with etomidate as compared to propofol and the difference was statistically significant ($P < 0.001$). Propofol increases the seizure threshold and this may explain the lower duration of the seizure. Etomidate reduces the seizure threshold and is associated with longer seizure duration.

In our study propofol seemed to be superior to etomidate in attenuating the cardiovascular stress response to ECT with minimal hemodynamic changes[7]. Similar, results were noted in a study conducted by Gazdag et al who compared propofol and etomidate for ECT in patients with schizophrenia. Their results showed, when using propofol, the increase in MAP was significantly lower than when etomidate was used (8.1 ± 10.2 mm Hg, 18.3 ± 11.2 mm Hg, $P = 0.001$)[8]. Zgola et al also found similar results with propofol and etomidate in patients undergoing implantable cardioverter-defibrillator testing.

In other study results showed that propofol significantly decreased the values of all measured hemodynamic parameters[9]. In our study patients of the propofol group achieved consciousness earlier than those of the etomidate group following induction ($p<0.001$).

Results could be correlated with the study conducted by Rosa et al who studied recovery after ECT among three study groups (propofol, etomidate, and thiopental). In their study, recovery time for propofol was 7.4 ± 1.9 min, whereas for etomidate it was 10.7 ± 3.6 min, thus the results showed that recovery time for propofol is less than etomidate in patients undergoing ECT[10].

Conclusion

Propofol and etomidate are equally well tolerated as induction agents. Propofol has advantage of smooth induction and rapid recovery but is associated with shorter seizure duration. Etomidate had longer seizure duration and hence better clinical outcome over propofol. Patients who received propofol had longer acute courses of ECT and,

consequently, longer and costlier inpatient stays. Etomidate could be a better alternative induction agent in ECT.

References

1. Selvin BL. Electroconvulsive therapy. Anesthesiology 1987; 67:367-387.
2. Potter WZ, rudorfer MV. Electroconvulsive therapy – a modern medical procedure. N Engl J Med 1993; 328:882-883.
3. Fink M, Taylor MA. Electroconvulsive therapy: evidence and challenges. JAMA 2007; 298:330-332.
4. Lisanby SH. Electroconvulsive therapy for depression. N Engl J Med 2007; 357:1939-1945.
5. Dettling M, Anghelescu I, Bajbouj M, Guevara-Cuellar CA, Pineda-Canar CA, Torri A et al. Electroconvulsive therapy for depression. N Engl J Med 2008; 358:645-646.
6. American Psychiatric Association Task Force on ECT. The practice of electroconvulsive therapy. recommendations for treatment, training and privileging, 2nd ed. American Psychiatric Press, Washington, DC 2002.
7. Fredman B, d'Etienne J, Smith I, Husain MM, White PF. Anesthesia for electroconvulsive therapy: effects of propofol and methohexital on seizure activity and recovery. Anesth Analg 1994; 79:75-79.
8. Geretsegger C, rochowanski E, Kartnig C, Unterrainer AF. Propofol and methohexital as anesthetic agents for electroconvulsive therapy (ECT): a comparison of seizure-quality measures and vital signs. J ECT 1998; 14:28-35.
9. Rasimas JJ, Stevens SR, Rasmussen KG. Seizure length in electroconvulsive therapy as a function of age, sex, and treatment number. J ECT 2007; 23:14-16.
10. Ilivicky H, Caroff SN, Simone AF. Etomidate during ECT for elderly seizure-resistant patients. Am J Psychiatry 1995; 152:957-958.

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