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Comparative Study of Hemodynamic Effect, Recovery Pattern and Seizure Activity of Propofol and Etomidate in Electroconvulsive Therapy

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ABSTRACT

During ECT, the hemodynamic effects include an elevation in systolic blood pressure, pulse pressure, pulse rate and in certain cases arrhythmias. Present study was aimed to compare hemodynamic effect, recovery pattern and seizure activity of propofol and etomidate in electroconvulsive therapy. Present study was prospective, randomized, double-blind, comparative study, conducted in patients with age 18- 60 year, belonging to either sex, ASA grade I and II, undergoing ECT. By computer generated randomized schedule, patients were randomized to receive Group 1 (Etomidate 0.2 mg/kg) and Group 2 (Propofol 1 mg/kg). There were significant changes in the heart rate in group 2 from 1 minute after ECT till five minutes while there was no statistically significant difference between the mean heart rate of patients in group 1. There was significant fall in the SBP in group 2 as compared to group 1 from 1 minute after ECT till 20 minutes. (p = 0.0001). There were significant changes in the SBP in group 2 from 1 minute after ECT till 20 minutes while there was no statistically significant difference between the mean SBP of patients in group 1. There was significant fall in the DBP in group 2 as compared to group 1 from after ECT till 15 minutes. (p = 0.0001). There were significant changes in the DBP in group 2 from after ECT applying till 15 minutes while there was statistically significant difference between the mean DBP of patients in group 1 at 1 minute after ECT, five minute and 10 minutes after ECT. Nausea (3) and vomiting (4) was observed more in Group 1, which was also statistically significant. Respiratory depression and Hypotension were more compared with Group 2 patient than group1 (p-0.001) As an inducing agent, etomidate(0.1mg/kg) has better hemodynamic stability in ECT procedure in comparison with propofol.

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Key Words
Inducing agent, etomidate, hemodynamic stability, ect, propofol

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INTRODUCTION

Electro-Convulsive Therapy (ECT) is a well-established treatment for severe depression in patients who do not respond to pharmacotherapy, bipolar disorders, schizophrenia etc. Almost all ECT procedures are performed under general anaesthesia with muscle paralysis. During ECT, the hemodynamic effects include an elevation in systolic blood pressure, pulse pressure, pulse rate and in certain cases arrhythmias[1]. Propofol is an anaesthetic that is administrated intravenously for general anaesthesia of phenol derivative[2]. Propofol causes rapid and smooth loss of consciousness and associated with rapid regaining of consciousness. Propofol has shown distinct advantage of improved hemodynamics, early recovery and with shorter seizure activity duration. Propofol decreases post-operative nausea and vomiting and causes early recovery from cognitive function[3]. Etomidate is an imidazole derivative, newer anaesthetic that is administrated intravenously for general anaesthesia[4]. It has rapid onset of action and shorter duration of action. It enters central nervous system rapidly and is cleared rapidly, which makes it effective for short term anaesthesia[5]. Studies has shown that it provides with longer duration of ECT induced seizure activity and prolonged recovery of cognitive functions[6]. Present study was aimed to compare hemodynamic effect, recovery pattern and seizure activity of propofol and etomidate in electroconvulsive therapy.

MATERIAL AND METHODS

Present study was prospective, randomized, double-blind, comparative study, conducted in department of anaesthesiology at Psychiatry ward, Hinduhridaysamrat Balasaheb Thackeray Medical college and Dr. R. N. Cooper Hospital, Mumbai, India. Study duration was of 1 year (August 2018-July 2019). Study approval was obtained from institutional ethical committee.

Inclusion Criteria:

- Patients with age 18-60 year, belonging to either sex, ASA grade I and II, undergoing ECT and Patients and/or legal guardians consenting for the study

Exclusion Criteria:

- Patient/legal guardian who decline consent
- Patients with ASA grade III and IV
- Allergy to study drugs
- Raised intra cranial pressure due to any cause

Study was explained to patients in local language and written consent was taken for participation and study One day prior to procedure a careful history was obtained. A thorough general and systemic examination were carried out. Routine investigations like blood grouping, complete hemogram, routine sugar, and other relevant investigations were done. On the day of surgery, patients were re-evaluated in the preoperative holding area. Starvation status was confirmed. By computer generated randomized schedule, patients were randomized to receive

Group 1: Etomidate 0.2 mg/kg

Group 2: Propofol 1 mg/kg

Serial number given by computer generated randomization chart were checked and accordingly study drug was planned. The study drug was prepared by the anaesthesiologist who was not a part of the study. The patients were taken on procedure table. Monitors were attached and basal parameters were noted. After starting intravenous line, all patients received pre-anaesthetic medications with Inj. glycopyrrolate 0.2 mg IV just before the start of the procedure. All patients were pre-oxygenated with 100% oxygen for 5 minutes. Patient were given with either propofol (1%) at the dose of 1mg/kg or etomidate at the dose of 0.2mg/kg. The vital parameters were recorded again. The blood pressure tourniquet was applied to the arm needed to be isolated from the effect of muscle relaxation, for observing localized seizures. The blood pressure tourniquet was inflated 100 mmHg above systolic blood pressure and then succinylcholine was administered in the dose of 1 mg/kg body weight after isolating the arm by a blood pressure tourniquet. All the patients were ventilated with 100% oxygen with facemask using AMBU till fasciculations subsides and muscle relaxation achieved. A mouth gag (Roberto's mouth gag) was inserted inside the oral cavity separating tongue, teeth and buccal mucosa, to prevent any damage to the soft tissue of the oral cavity, tongue and teeth during the procedure. The electroconvulsive therapy was applied to the head through two electrodes kept at both sides of the temporo-frontal regions (bi-temporal ECT) after applying ECT gel on to the electrodes.

Electroconvulsive therapy was given to all patients in the study using a pulse of 60 Hz of 1 sec duration with total stimulus time not exceeding 4 seconds, by BPE-791 machine. The mouth gag was changed to Guedel airway after the seizure activity subsides and patients were ventilated with 100% oxygen till

regaining of spontaneous respiration. The heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), SpO2 were recorded before induction of anaesthesia (To), after administration of the study drug (Ti), after succinylcholine (Ts), after applying ECT (Te), at one minute (T1), three minute (T3), five minute (T5), ten minute (T10),15 minute (T15) and 20 minutes (T20). The duration of seizure activity where be recorded in seconds by clinical method (tourniquet method) from the start of electrical impulse to the end of the clonic contraction using a hand-held stopwatch. The assessment of recovery was done by Aldrete score. Probable side effects including nausea, vomiting, respiratory depression, hypoxemia was noted after the electrical stimulus till the patient was discharged from the post-anesthetic care to the psychiatry ward. patients were discharged to ward after assessing recovery parameter by Aldrete score is equal or more than 9/10.

All the collected data was entered in Microsoft Excel sheet and then transferred to SPSS software version 17 for analysis. Qualitative data was presented as frequency and percentages and analysed using chi-square test. Quantitative data was presented as mean and standard deviation and compared by t-test. P-value < 0.05 was taken as level of significance.

RESULTS AND DISCUSSIONS

60 patients were randomly allocated to group 1 (n = 30) and group 2 (n = 30). Both the groups were comparable in terms of age, weight, height, gender ratio, ASA physical status and seizure duration. Statistically, there was no significant difference between the groups (p>0.05). seizure duration. Statistically, there was no significant difference between the groups (p>0.05).

At preoperative, the systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR) and peripheral oxygen saturation (SpO2) of the patients in both groups were compared statistically using unpaired student 't' test. Both the groups were comparable and there was no statistically significant difference in the preoperative SBP, DBP, HR and SpO2 in patients of both the groups. The changes in heart rate in patients of group 1 and group 2 at different time interval were studied. There were significant changes in the heart rate in group 2 from 1 minute after ECT till five minutes while there was no statistically significant difference between the mean heart rate of patients in group 1.

After induction, there was fall in systolic blood pressure in patients of both groups with statistically not significant difference. There was significant fall in the SBP in group 2 as compared to group 1 from 1 minute after ECT till 20 minutes. (p=0.0001). There were significant changes in the SBP in group 2 from 1 minute after ECT till 20 minutes while there was no statistically significant difference between the mean SBP of patients in group 1. After induction, there was statistically no significant difference in diastolic blood pressure in patients of both groups. There was significant fall in the DBP in group 2 as compared to group 1 from after ECT till 15 minutes. (p=0.0001). There were significant changes in the DBP in group 2 from after ECT applying till 15 minutes while there was statistically significant difference between the mean DBP of patients in group 1 at 1 minute after ECT, five minute and 10 minutes after ETC. After induction, there was statistically no significant difference in mean arterial pressure in patients of both groups. There was significant fall in the mean arterial pressure in group 2 as compared to group 1 from after ECT till 15 minutes. (p = 0.0001).

After induction, there was statistically no significant difference in SpO2 in patients of both groups. There was statistically no significant difference in SpO2 in patients of both groups. Nausea (3) and vomiting (4) was observed more in Group 1 as compared to group 2, which was also statistically significant. Respiratory depression and Hypotension were more compared with Group 2 patient than group1 (p-0.001) There was statistically no significant difference in Aldrete Score in patients of both groups from T0 to T30 except at the interval of T10 (10 minute after ECT).

Electro-Convulsive Therapy (ECT) is a well-established treatment for severe depression in patients who do not respond to pharmacotherapy, bipolar disorders, schizophrenia etc. In this procedure, electrical stimulus is applied to brain through transcutaneous electrode which induce generalised motor seizure.

The anaesthetic requirements for ECT include control of hemodynamic changes and its related complications, along with the primary requirements of amnesia and muscle relaxation. Although these are essential, the level of anaesthesia should not be so deep as to overly suppress the seizure activity which is the goal of the treatment. The clinician must be well versed on the anaesthetic management of patients undergoing ETC. In the current health-care environment, use of general anaesthetic techniques with a rapid onset and recovery is essential to facilitate the discharge of the patients within 1-2 hours after the ECT. Since the half-life of propofol is shorter than that of anaesthetic barbiturates and due to its better hemodynamic stability, propofol is universally becoming the induction agent of choice, in spite of

Table 1: General characteristics

Parameters	Group 1	Group 2	p-value
Age (years)	41.77±5	40.27±4.4	0.227
Weight (kg)	59.17±9	60.43±9.4	0.599
Height(cm)	159.97±6.5	160.83±9.4	0.681
Gender (M/F)	18/12	21/9	0.417
ASA (I/II)	24/6	23/7	0.754
Seizure Duration	23.25 ± 3.71	24.79±3.88	0.451

Table 2: Preoperative systolic blood pressure, diastolic blood pressure, heart rate and SpO2

Parameters	Group 1	Group 2	P-value
Systolic BP (mm of Hg)	134.4±5.8	133.4±4.8	0.504
DBP (mm hg)	77.87±2	77.2±3.9	0.421
Heart rate (beats/min)	98.64±13.21	97.88±11.7	0.202
SpO2 (%)	98.9±0.89	99.00±0.87	0.884

Table 3: Comparison of mean Heart rate between study group at various time intervals

	Group 1			Group 2		
Heart rate	Mean	SD	p-value	Mean	SD	p-value
Before induction of anaesthesia (To)	87.6	7.01		87.96	7.08	
After administration of the study drug (Ti)	86.16	7.4	0.44	86.32	7.47	0.38
After succinylcholine (Ts)	85.6	7.61	0.24	86.16	7.4	0.33
After applying ECT (Te)	84.4	8.22	0.11	87.6	7.01	0.84
At one minute (T1)	85.32	7.71	0.23	83.84	5.12	0.01
Three minutes (T3)	85.76	7.66	0.33	83.4	5.32	0.01
Five minutes (T5)	86.92	7.07	0.7	84.04	5.28	0.01
Ten minutes (T10)	87.96	7.08	0.84	86.32	5.43	0.31
15 minutes (T15)	86.32	7.47	0.49	85.14	5.1	0.45
20 minutes (T20)	87.96	7.08	0.84	85.75	5.6	0.54

Table 4: Comparison of mean SBP between different study group at various time interval.

	Group 1			Group 2		
SBP	Mean	SD	p-value	Mean	SD	p-value
Before induction of anaesthesia (To)	134	9.9		136	9.2	
After administration of the study drug (Ti)	131	10.7	0.26	132	10	0.11
After succinylcholine (Ts)	132	7.6	0.34	133	7.4	0.16
After applying ECT (Te)	133	8.2	0.43	134	7.0	0.34
At one minute (T1)	133	6.4	0.56	124	6.2	0.001
3 minutes (T3)	130	7.8	0.08	122	7.2	0.001
5 minutes (T5)	129	7.6	0.03	123	7.3	0.001
10 minutes (T10)	131	6.2	0.29	121	7.4	0.001
15 minutes (T15)	133	7.1	0.45	123	6.5	0.001
20 minutes (T20)	133	6.4	0.49	124	6.2	0.001

Table 5: Comparison of mean DBP between study group at various time intervals.

	Group 1			Group 2		
DBP	Mean	SD	p-value	Mean	SD	p-value
Before induction of anaesthesia (To)	81.8	7.8		82.73	7	
After administration of the study drug (Ti)	84.2	8.7	0.26	83.47	7.7	0.69
After succinylcholine (Ts)	83.6	7.61	0.36	80.16	7.4	0.17
After applying ECT (Te)	80.27	7.8	0.45	72.4	6.9	0.001
At one minute (T1)	77.27	7.8	0.02	71.4	6.9	0.001
3 minutes (T3)	78.31	8.2	0.09	72.33	6.2	0.001
5 minutes (T5)	77.73	6.3	0.01	72.87	6.1	0.001
10 minutes (T10)	77.53	7.2	0.01	73.9	6.1	0.001
15 minutes (T15)	77.03	8	0.02	73.73	6.6	0.001
20 minutes (T20)	80.96	7.08	0.66	82.75	5.6	0.24

Table 6: Comparison of mean MAP between different study group at various time interval.

	Group 1		Group 2		
MAP	Mean	SD	Mean	SD	p-value
Before induction of anaesthesia (To)	99.2	8.5	100.5	7.7	0.892
After administration of the study drug (Ti)	99.8	9.4	99.6	8.5	0.239
After succinylcholine (Ts)	99.7	7.6	97.8	7.4	0.498
After applying ECT (Te)	97.8	7.9	92.9	6.9	0.0001
At one minute (T1)	95.8	7.3	88.9	6.7	0.0001
3 minutes (T3)	95.5	8.1	88.9	6.5	0.0001
5 minutes (T5)	94.8	6.7	89.6	6.5	0.0001
10 minutes (T10)	95.4	6.9	89.6	6.5	0.0001
15 minutes (T15)	95.7	7.7	90.2	6.6	0.0001
20 minutes (T20)	98.3	6.9	96.5	5.8	0.472

Table 7: Comparison of mean SpO2 between study group at various time intervals.

	Group 1			Group 2		
SpO2	Mean	SD	p-value	Mean	SD	p-value
Before induction of anaesthesia (To)	98.93	1		98.83	0.9	
After administration of the study drug (Ti)	98.93	0.9	1	98.8	0.9	1
After succinylcholine (Ts)	98.87	0.9	1	98.63	0.8	1
After applying ECT (Te)	99.03	1	1	98.63	0.8	1
At one minute (T1)	98.97	0.9	1	98.57	0.9	1
3 minutes (T3)	98.83	1	1	98.53	0.8	1
5 minutes (T5)	98.8	0.9	1	98.5	0.8	1
10 minutes (T10)	98.87	0.9	1	98.47	1	1
15 minutes (T15)	98.77	1	1	98.6	0.9	1
20 minutes (T20)	98.87	1	1	98.67	0.9	1

Table 8: Comparison of various complications amongst different study groups.

Side effect	Group 1	Group 2	p-value
Nausea	3	0	0.0001
Vomiting	4	0	0.0001
Respiratory depression	0	2	0.0001
Hypotension	0	2	0.0001

Table 9 Comparison of Aldrete Score amongst different study groups.

Aldrete score	Group 1	Group 2	p-value
T0	1	1	1
T1	2.64±0.41	2.31±0.32	0.452
T3	5.65±0.59	5.17±0.45	0.476
T5	7.98±1.08	6.91±0.71	0.562
T10	9.12±1.17	7.88±0.76	0.001
T15	9.31±1.32	8.99±1.01	0.251
T20	9.63±1.45	9.37±1.2	0.234
T30	9.81±1.72	9.86±1.4	0.173

higher cost. It is also considered as reference agent due to its wider use and advantages over others[7,8]. Because of 'smoother' anaesthesia experience and relatively greater anticonvulsant action than other induction agents, it may be the agent of choice for ECT in children and adolescents, many of whom may have prolonged seizures duration in their early treatment course[9]. Etomidate is an imidazole non barbituric derivate, with rapid onset, short time of action and fast metabolization. It has not analgesic properties and induces minimal cardio-respiratory effects[10]. Therefore, it is the drug of choice for patients with cardiac insufficiency[11]. In the present study, heart rate was then compared within the group at different time intervals with the base line heart rate. There were significant changes in the heart rate in group 2 from 1 minute after ECT till five minutes while there was no statistically significant difference between the mean heart rate of patients in group 1.

This is also in settlement with randomized controlled trial done by Shah *et al*.,[12] in which post induction there was rise in heart rate, in patients allocated in etomidate group. Harris *et al.,*[13] observed that there were significant increases in heart rate in both groups ($p < 0.01$) but there was greater increase in those who received etomidate. 77 Ko YK *et al.,*[14] observed that patients induced with propofol had significant decrease in heart rate and concluded that propofol precipitates vascular dilatation, decreases preload and afterload and impairs myocardial contractility. After induction of anaesthesia, there was fall in systolic blood pressure in patients of both groups with statistically not significant difference. One minute after ECT, there was significant fall in the SBP in group 2 as compared to group 1 from 1 minute after ECT till 20 minutes. (p=0.0001).

This is in agreement with study done by Ebert *et al.,*[15] in which both systolic and diastolic blood pressures were well maintained with Etomidate but were decreased after induction with propofol. This is also in settlement with the study done by Harris CE *et al.,*[13] observed that there was significant decrease in arterial pressures after induction with propofol and just prior to intubation was highly significantly lower than the baseline values as compared to etomidate. Aggarwal Supriya *et al.,*[16] also concluded in their study on 100 patients that etomidate is better for its hemodynamic stability as compared to propofol.

There were significant changes in the DBP in group 2 from after ECT applying till 15 minutes while there was statistically significant difference between the mean DBP of patients in group 1 at 1 minute after ECT, five minute and 10 minutes after ECT. Similarly, A. Pandey *et al.,*[17] noted that SBP and DBP were significantly lower post induction in propofol group as compared to etomidate group suggesting that etomidate was associated with more hemodynamic stability on induction of anaesthesia than propofol. Study done by Fatma S *et al.,*[18] also recorded that etomidate is associated with hemodynamic stability of very high degree as compared to propofol. After induction of anaesthesia, there was statistically no

significant difference in mean arterial pressure in patients of both groups. After applying ECT, there was significant fall in the mean arterial pressure in group 2 as compared to group 1 from after ECT till 15 minutes. (p = 0.0001). Similarly in the study conducted by Gazdag G *et al.,*[19] reported that the seizure- induced increase in MAP was reduced by propofol to a significantly greater degree than by etomidate. In the present study, there was statistically no significant difference in seizure duration in patients of both groups. On the contrary study conducted by Gazdag G *et al.,*[19] reported that propofol was found to reduce seizure duration to a significantly greater extent than etomidate.

In the present study, there was statistically no significant difference in Aldrete Score in patients of both groups from T0 to T30 except at the interval of T10 (10 minute after ECT). On the contrary, study conducted by Rosa *et al.,*[20] reported that propofol seemed to have the better recovery profile as compared to etomidate and thiopental though statistically insignificant. In the present study, nausea and vomiting was observed more in Group 1 as compared to group 2, which was also statistically significant. Respiratory depression and Hypotension were more compared with Group 2 patient than group1 (p-0.001). Similarly, in the study by Kumar A *et al.,*[21] PONV were more in group Propofol group 15 (30%) cases as compare to 11 (22%) of cases in group Etomidate group.

Limitations of present study were, as patients were on multiple antipsychotic drugs, possibility of drug interactions with the inducing agents could not be denied. Hence, the hemodynamic parameters and recovery scores can be affected. Fasciculations produced by intravenous succinylcholine can lead to difficulty in measurement of blood pressure.

CONCLUSION

As an inducing agent, etomidate(0.1mg/kg) has better hemodynamic stability in ECT procedure in comparison with propofol. No significant difference was observed in seizure duration and recovery score in both etomidate and propofol.

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