A COMPARATIVE STUDY ON THE EFFECTS OF THIOPENTONE, PROPOFOL AND ETOMIDATE AS ANAESTHETIC AGENTS IN MODIFIED ELECTROCONVULSIVE THERAPY

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ABSTRACT

BACKGROUND

Modified ECT is considered to be the standard practice worldwide. An induction agent with a rapid onset, short duration of action and minimal adverse effects would be ideal.

Objective- We compared the profile and haemodynamic effects of the three intravenous induction agents Thiopentone, Propofol and Etomidate in patients undergoing modified electroconvulsive therapy.

MATERIALS AND METHODS

This is a prospective observational study among 150 patients, 50 patients in each group, in the age group of 16 to 60, who were undergoing modified electroconvulsive therapy at Government Mohankumaramankalam Medical College, Salem. After meticulous assessment and preparation, patients were shifted to ECT suite. An informed, explained and written consent was obtained. The haemodynamic parameters were recorded before induction (baseline values), immediately after induction, 1 minute after ECT, 5 minutes, 10 minutes, 15 minutes and 20 minutes after ECT. The data was entered into a proforma and statistical analysis was done using IBM SPSS version 22. P value < 0.05 was considered statistically significant. The primary outcome variables are systolic blood pressure, diastolic blood pressure, heart rate and seizure duration. One-Way ANOVA was used to assess statistical significance across the groups.

RESULTS

All the three groups were comparable in baseline characteristics. Change in systolic pressure is more with Propofol and Thiopentone than with Etomidate ($p < 0.001$). Change in diastolic pressure is also more with Propofol and Thiopentone and Etomidate ($p < 0.001$). Change in heart rate is least in Etomidate group compared with Propofol and Thiopentone ($p < 0.001$). Seizure duration is shortest in Propofol group and more in Etomidate group ($p < 0.001$).

CONCLUSION

Etomidate offers better haemodynamic stability and interferes less with the seizure activity, thereby increasing the seizure duration which is of utmost importance in Electroconvulsive therapy. Hence, Etomidate can be used in modified electroconvulsive therapy.

KEY WORDS

Thiopentone, Propofol, Etomidate, Modified Electroconvulsive Therapy.

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BACKGROUND

Modified ECT is considered to be the standard practice worldwide. Modified ECT refers to the practice of providing an anaesthetic agent and a muscle relaxant before ECT to minimise the intensity of motor seizures.¹ Before the introduction of anaesthetic agents in ECT, unmodified or direct ECT caused a variety of musculoskeletal complications, especially compression fracture of the vertebra.²

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The use of the anaesthetic agent induces sleep and prevents anxiety associated with the apnoea caused by muscle relaxant.

Since ECT is a brief procedure which is often done as outpatient procedure, an induction agent with a rapid onset, short duration of action and minimal adverse effects would be ideal.³⁻¹⁰

The other important property, which determines the choice of anaesthetic agent includes the alteration of seizure threshold and haemodynamic effects of the agent.¹¹

The objectives of our study was we compared the profile and haemodynamic effects of the three intravenous induction agents Thiopentone, Propofol and Etomidate in patients undergoing modified electroconvulsive therapy. The effect of the drugs on the seizure activity is compared by measuring the seizure duration induced during the modified electroconvulsive therapy.

MATERIALS AND METHODS

In this prospective observational study among 150 patients, the first 50 persons with each group of drugs administered for modified ECT were taken up for the study for convenience. Drug given was based on availability at various times. Convenient sampling method was used, as first 50 consented persons in each group were taken up for the study.

50 patients in each group undergoing electroconvulsive therapy with one of the anaesthetic agents (Thiopentone, Propofol and Etomidate) was chosen. The criteria for inclusion are the: (1) Age group of 16 to 60, (2) Patients with severe and drug refractory depression, schizophrenia, mania and psychosis, (3) ASA grade 1 and 2 and (4) Patients with no known risk of allergy to any of the three drugs mentioned.

Patients with- 1) A history of recent cerebrovascular accident, cardiovascular conduction defects and high-risk pregnancy with history of epilepsy, 2) History of receiving lithium prior to ECT therapy and 3) Patients and relatives not willing to sign informed consent were excluded from the study.

Procedure

After meticulous preoperative assessment and adequate fasting status, patients were shifted to ECT suite. An informed explained and written consent is obtained from the relatives of the patient. All the standard monitors were connected including ECG, non-invasive blood pressure monitoring, pulse oximetry and the baseline values were noted.

All patients were given injection Glycopyrrolate 0.2 mg intramuscularly one hour before treatment. All patients were pre-oxygenated for three minutes. Anaesthesia is induced by using either 1% Propofol (1 mg/kg) or 2.5% Thiopentone (3 mg/kg) or Etomidate (0.2 mg/kg) given over 20 seconds, through an 18-gauge cannula in a vein on the dorsum of the hand. The induction dose will be considered adequate if the eyelash reflex lost after 30 seconds.

Following the onset of anaesthetic effect, depolarising muscle relaxant Succinylcholine 0.5 mg/kg will be administered. Muscle fasciculations or fine twitching movements indicate its action. The disappearance of these movements indicates that maximal relaxation has occurred. The patient's lungs will be ventilated manually with oxygen via a face mask. When adequate neuromuscular relaxation is obtained, an adequate-sized Guedel's airway is inserted.

The bitemporal electrodes are placed in the bifrontotemporal region and a brief pulse stimulus will be given for about 2m sec (Voltage 90-120) to produce a seizure. Patients will be ventilated with 100% oxygen at a rate of 12 breaths per minute until spontaneous breathing returns and patients are fully recovered clinically.

The haemodynamic parameters i.e. systolic blood pressure, diastolic blood pressure, heart rate and also seizure duration was recorded before induction (baseline values), immediately after induction, 1 minute after ECT and 5 minutes, 10 minutes, 15 minutes and 20 minutes after ECT.

Ethics

The study was initiated after obtaining approval from the Institutional Ethics Committee, Government Mohan Kumaramangalam Medical College, Salem. Consent was

obtained from the patients or their relatives before procedure.

Statistics

The data was entered into a proforma and statistical analysis was done using IBM SPSS version 22. P-value < 0.05 was considered statistically significant.

The primary outcome variables are systolic blood pressure, diastolic blood pressure, heart rate and seizure duration.

Other relevant variables are age, height, weight and gender. Primary explanatory variable: Study group (Thiopentone, Propofol, Etomidate).

The association between study group and systolic blood pressure, diastolic blood pressure, heart rate, age, height and weight was assessed by comparing the mean values at each stage using One-Way Analysis of Variance (ANOVA) to assess statistical significance.

RESULTS

A total of 150 subjects were included in final analysis. Among the study population, 50 (33.33%) patients were included in Thiopentone group, 50 (33.33%) in Propofol group and 50 (33.33%) in Etomidate. Among the study population, 50.67% were males. The mean age was 33.83 ± 10.37 years in the study population.

Parameter	Mean $\pm$ SD	Median	Min	Max	95% C.I. for EXP (B)	
					Lower	Upper
Height	159.27 $\pm$ 5.7	159.00	145.00	174.00	158.35	160.19
Weight	64.19 $\pm$ 10.08	65.00	39.00	82.00	62.56	65.81

Table 1. Descriptive Analysis for Height, Weight in Study Population (N= 150)

The mean age in Thiopentone group was 30.26 ± 10.33 years, 33.46 ± 8.19 years in Propofol group and 33.44 ± 6.65 years in Etomidate group. Considering Thiopentone as baseline, the mean difference of age (3.20) in Propofol group was statistically not significant (P value > 0.05) and also statistically not significant in Etomidate group (3.18) (P value > 0.05).

The mean height was 159.27 ± 5.7 cms in the study population. The minimum height was 145 cms and maximum height was 174 cms in the study population (95%, CI=158.35 to 160.19). The mean weight was 64.19 ± 10.08 kgs in the study population. Minimum level was 39 kgs and maximum level was 82 kgs in the study population (95%, CI= 62.56 to 65.81) (Table 1).

Among the thiopentone group, 25 (50%) were males and remaining 25 (50%) were females. Among the propofol group, 23 (46%) were males and remaining 27 (54%) were females. Among the etomidate group, 28 (56%) were males and remaining 22 (44%) were females. The difference in the proportion of study group across gender was statistically not significant (P value 0.602).

Figure 1. Comparison of Mean Height across Study Groups (N= 150)

Systolic Blood Pressure	Thiopentone Mean $\pm$ SD	Propofol Mean $\pm$ SD	Etomidate Mean $\pm$ SD	P value
Before induction	122.88 $\pm$ 8.9	119.12 $\pm$ 13.11	120.14 $\pm$ 11.62	0.214
Immediately after induction	116.04 $\pm$ 10.28	113.12 $\pm$ 13.73	121.76 $\pm$ 10.41	<0.001
1 min after ECT	142.1 $\pm$ 7.34	129.44 $\pm$ 9.46	135.98 $\pm$ 9.4	<0.001
5 minutes	134.76 $\pm$ 6.99	124.02 $\pm$ 8.82	133.98 $\pm$ 9.16	<0.001
10 minutes	129.86 $\pm$ 7.54	116.96 $\pm$ 9.45	129.66 $\pm$ 8.53	<0.001
15 minutes	126 $\pm$ 7.47	111.72 $\pm$ 8.66	125.48 $\pm$ 9.02	0.605
20 minutes	125.14 $\pm$ 7.82	111.46 $\pm$ 7.78	120.4 $\pm$ 9.39	0.020

Table 2. Comparison of Systolic Blood Pressure between Three Groups at Different Time Periods (N= 150)

The mean systolic blood pressure in Thiopentone group before induction was 122.88 $\pm$ 8.9 mmHg, it was 116.04 $\pm$ 10.28 mmHg immediately after induction, it was 142.1 $\pm$ 7.34 mmHg in 1 minute after ECT, it was 134.76 $\pm$ 6.99 mmHg in 5 minutes, it was 129.86 $\pm$ 7.54 mmHg in 10 minutes, it was 126 $\pm$ 7.47 mmHg in 15 minutes and 125.14 $\pm$ 7.82 in 20 minutes.

The mean systolic blood pressure in Propofol group before induction was 119.12 $\pm$ 13.11 mmHg, it was 113.12 $\pm$ 13.73 mmHg immediately after induction, it was 129.44 $\pm$ 9.46 in 1 minutes after ECT, it was 124.02 $\pm$ 8.82 in 5 minutes, it was 116.96 $\pm$ 9.45 in 10 minutes, it was 111.72 $\pm$ 8.66 in 15 minutes and 111.46 $\pm$ 7.78 in 20 minutes.

The mean systolic blood pressure before Etomidate group within induction was 120.14 $\pm$ 11.62, it was 121.76 $\pm$ 10.41 immediately after induction, it was 135.98 $\pm$ 9.4 in 1 minute after ECT, it was 133.98 $\pm$ 9.16 in 5 minutes, it was 129.66 $\pm$ 8.53 in 10 minutes, it was 125.48 $\pm$ 9.02 in 15 minutes and 120.4 $\pm$ 9.39 in 20 minutes.

In each group, value measured before induction is considered as baseline (Table 2). We observed the initial fall in systolic blood pressure after induction in all the groups. But the fall in blood pressure is more in propofol group, which is statistically significant except at 15 minutes.

Diastolic Blood Pressure	Thiopentone Mean $\pm$ SD	Propofol Mean $\pm$ SD	Etomidate Mean $\pm$ SD	P value
Before induction	79.18 $\pm$ 6.56	77.44 $\pm$ 6.89	74.8 $\pm$ 9.62	0.210
Immediately after induction	76.66 $\pm$ 6.14	71.28 $\pm$ 7.36	72.84 $\pm$ 9.14	<0.001
1 min after ECT	84.48 $\pm$ 5.92	82.78 $\pm$ 7.48	91 $\pm$ 7.53	<0.001
5 minutes	82.96 $\pm$ 5.45	79.28 $\pm$ 7.26	84.96 $\pm$ 6.3	<0.001
10 minutes	80.58 $\pm$ 5.2	78 $\pm$ 6.91	80.52 $\pm$ 8.16	<0.001
15 minutes	77.62 $\pm$ 4.44	76.82 $\pm$ 6.54	78.78 $\pm$ 8.4	0.130
20 minutes	76.32 $\pm$ 4.93	75.88 $\pm$ 6.59	75.74 $\pm$ 9.57	0.007

Table 3. Comparison of Diastolic Blood Pressure across Three Groups at Different Time Periods (N= 150)

The mean diastolic blood pressure Thiopentone group within before induction was 79.18 $\pm$ 6.56, it was 76.66 $\pm$ 6.14 immediately after induction, it was 84.48 $\pm$ 5.92 in 1 minute after ECT, it was 82.96 $\pm$ 5.45 in 5 minutes, it was 80.58 $\pm$ 5.2 in 10 minutes, it was 77.62 $\pm$ 4.44 in 15 minutes and 76.32 $\pm$ 4.93 in 20 minutes.

The mean diastolic blood pressure Propofol group within before induction was 77.44 $\pm$ 6.89, it was 74.28 $\pm$ 7.36 immediately after induction, it was 82.78 $\pm$ 7.48 in 1 minute after ECT, it was 79.28 $\pm$ 7.26 in 5 minutes, it was 78 $\pm$ 6.91 in 10 minutes, it was 76.82 $\pm$ 6.54 in 15 minutes and 75.88 $\pm$ 6.59 in 20 minutes.

The mean diastolic blood pressure in Etomidate group before induction was 74.8 $\pm$ 9.62 mmHg, it was 72.84 $\pm$ 9.14 mmHg immediately after induction, it was 91 $\pm$ 7.53 in 1 minute after ECT, it was 84.96 $\pm$ 6.3 in 5 minutes, it was 80.52 $\pm$ 8.16 in 10 minutes, it was 78.78 $\pm$ 8.4 in 15 minutes and 75.74 $\pm$ 9.57 in 20 minutes.

Maximum fall in Diastolic blood pressure after induction is seen with propofol group and least fall in etomidate group, which is statistically significant (P value < 0.01) except at 15 minutes.

Heart Rate	Thiopentone Mean $\pm$ SD	Propofol Mean $\pm$ SD	Etomidate Mean $\pm$ SD	P value
Before induction	86.18 $\pm$ 9.05	88.78 $\pm$ 9.11	91.36 $\pm$ 13.19	0.156
Immediately after induction	93.96 $\pm$ 13.05	95.88 $\pm$ 10.77	92.14 $\pm$ 11.92	<0.001
1 min after ECT	115.4 $\pm$ 9.89	114.5 $\pm$ 9.75	94.24 $\pm$ 12.32	<0.001
5 minutes	101.4 $\pm$ 8.63	101.4 $\pm$ 8.63	94.9 $\pm$ 11.03	<0.001
10 minutes	96.4 $\pm$ 7.05	95.74 $\pm$ 7.5	93.94 $\pm$ 10.97	<0.001
15 minutes	93.32 $\pm$ 8.05	92.92 $\pm$ 7.74	94.08 $\pm$ 11.72	<0.001
20 minutes	86.04 $\pm$ 7.05	85.78 $\pm$ 6.8	91.36 $\pm$ 12.97	0.174

Table 4. Comparison of Heart Rate across Three Groups at Different Time Periods (N= 150)

The mean heart rate in Thiopentone group before induction was 86.18 ± 9.05 , it was 93.96 ± 13.05 immediately after induction, it was 115.4 ± 9.89 in 1 minute after ECT, it was 101.4 ± 8.63 in 5 minutes, it was 96.4 ± 7.05 in 10 minutes, it was 93.32 ± 8.05 in 15 minutes and 86.04 ± 7.05 in 20 minutes.

The mean heart rate in Propofol group before induction was 88.78 ± 9.11 , it was 95.88 ± 10.77 immediately after induction, it was 114.5 ± 9.75 in 1 minute after ECT, it was 101.4 ± 8.63 in 5 minutes, it was 95.74 ± 7.5 in 10 minutes, it was 92.92 ± 7.74 in 15 minutes and 85.78 ± 6.8 in 20 minutes.

The mean heart rate in Etomidate group before induction was 91.36 ± 13.19 , it was 92.14 ± 11.92 immediately after induction, it was 94.24 ± 12.32 in 1 minute after ECT, it was 94.9 ± 11.03 in 5 minutes, it was 93.94 ± 10.97 in 10 minutes, it was 94.08 ± 11.72 in 15 minutes and 91.36 ± 12.97 in 20 minutes.

Values measured before induction is considered as baseline (Table 4).

Seizure Duration (In Secs)	Thiopentone Mean $\pm$ SD	Propofol Mean $\pm$ SD	Etomidate Mean $\pm$ SD	P value
Duration (In Secs)	32.96 ± 6.24	25.82 ± 3	45.38 ± 7.78	<0.001

Table 5. Comparison of Seizure Duration (in seconds) across Three Groups at Different Time Periods (N= 150)

The mean seizure duration thiopentone group was 32.96 ± 6.24 , Propofol group was 25.82 ± 3 and Etomidate group was 45.38 ± 7.78 . The difference across three groups was statistically significant (P value < 0.001) (Table 5).

DISCUSSION

Electroconvulsive therapy was administered in patients without anaesthesia or muscle relaxation, which caused many adverse effects like fracture of vertebra etc. But with the advent of hypnotic drugs and muscle relaxants, the aforesaid problems were avoided. We chose to compare the effects of Propofol, Thiopental and Etomidate in a tertiary care facility such as our institution. The patients in all the three groups were comparable in terms of age (P= 0.064) and gender distribution (P= 0.602). The mean height across all the three groups was comparable (P= 0.168). The mean weight across the three groups was comparable (P= 0.497).

We measured the change in haemodynamic parameters such as systolic blood pressure, diastolic blood pressure and heart rate. We also measured the duration of seizures in all three groups. The monitoring of haemodynamic parameters were studied immediately after induction, 1 minute, 5 minutes, 10 minutes, 15 minutes and 20 minutes after ECT.

We observed the initial fall in systolic blood pressure after induction in all the groups. But the fall in blood pressure is more in Propofol group. This is supported by the results conducted by Altaf Hussain Mir et al.² The fall in blood pressure with Thiopentone is moderate. The fall in blood pressure is least in the Etomidate group.³⁻⁶ The change in blood pressure across the groups is statistically significant.

Same trend is observed with diastolic blood pressure also with maximum fall in blood pressure after induction is seen with Propofol group and least fall in Etomidate group. The

change in diastolic blood pressure across the three groups is statistically significant (P value < 0.001).

The change in heart rate across three groups also is statistically significant with maximum change seen in Thiopentone group than Propofol group (P value < 0.001). The change in heart rate is least with Etomidate group. This similar study is conducted by Carolyn Hoyer et al.⁹

Regarding seizure duration, the duration of seizures is shorter with Propofol group (25.82 ± 3 s) than with Thiopentone group (32.96 ± 6.24 s). But maximum duration of seizures is seen in Etomidate group (45.38 ± 7.78 s). This is supported by the study conducted by the study conducted by Geretsegger et al.⁷ and Altaf Hussain Mir et al.²

CONCLUSION

From our study, we can conclude that out of the three drugs studied, Etomidate offers better haemodynamic stability causing less change in blood pressure and heart rate compared with Propofol and Thiopentone. Also, Etomidate interferes less with the seizure activity, thereby increasing the seizure duration which is of utmost importance in electroconvulsive therapy.

Hence, Etomidate can be used as an alternative for Propofol and Thiopentone in modified electroconvulsive therapy.

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