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Original Research Article

A COMPARATIVE STUDY BETWEEN THIOPENTONE, PROPOFOL AND MIDAZOLAM IN MODIFIED ELECTROCONVULSIVE THERAPY

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ABSTRACT

Background: The present study was designed to compare the effects of thiopentone, propofol and midazolam in patients undergoing modified electroconvulsive therapy.

Materials and Methods: Patients were randomly divided into three groups of 35 each: Group A = inj. Sodium thiopentone (2.5%) 5mg/kg, Group B = inj. Propofol 2mg/kg and Group C = inj. Midazolam 0.2mg/kg.

Results and Conclusion: We concluded from our study that, propofol in dosage of 2 mg/kg body weight intravenously can be safely used for modified ECT because of rapid induction, early recovery, better hemodynamic, fewer side effects, uncompromised therapeutic outcome without much rise in serum potassium makes propofol as an agent of choice for the procedure.

Keywords: Thiopentone, Propofol, Midazolam, Modified Electroconvulsive Therapy.

INTRODUCTION

ECT (electroconvulsive therapy) consists of programmed electrical stimulation of the CNS to initiate seizure. Concept of convulsive therapy in psychiatric disorders was originated in 1785 by Oliver. ECT was performed without anaesthesia for almost 30 years. In 1938, the use of electroconvulsive therapy (ECT) to provoke a generalized epileptic seizure was first described. Modified ECT started with the use of IV induction agent and muscle relaxant in 1963.

ECT is very effective for many psychiatric disorders, such as severe depression, schizophrenia, and bipolar disorder. During ECT, the aim of general anaesthesia is to get an unconscious patient with amnesia and muscle paralysis. ECT leads to hyperdynamic responses due to release of catecholamines. Increase in catecholamine causes an acute rise in heart rate and blood pressure. These acute hyperdynamic responses may lead to cardiac dysrhythmias, myocardial ischemia and infarction. Many pharmacological agents such as beta blockers, calcium channel blockers, α2-agonists, direct-acting vasodilators and local anaesthetics have been tried to attenuate this acute hyperdynamic responses.

For general anaesthesia during ECT, anaesthetics that are used should have rapid onset, rapid emergence, not interfering with seizure activity and promote longer seizure duration. Several anaesthetic agents such as ketamine, propofol, etomidate, methohexital, thiopental and enflurane are used for this purpose. Many anaesthetic drugs used for ECT have anticonvulsant properties and may decrease duration of ECT-induced seizure activity, which could adversely affect the efficacy of the ECT treatments. A delicate balance needs to be maintained to achieve an adequate anaesthetic state along with an optimal duration of EEG seizure activity.

Thiopentone sodium a barbiturate, a cerebral-protective drug, has rapid smooth induction, good anticonvulsant activity, less effect on seizure duration but has effects like prolonged awakening time, arrythmia and laryngeal spasm and post ECT nausea and vomiting.

Propofol an alky,[1] phenol, has rapid smooth induction, better hemodynamic stability, antiemetic and bronchodilator property. Propofol causes rapid

recovery as its metabolism exceeds hepatic blood flow which leads to 10 times faster metabolism than thiopentone.

Midazolam is water soluble, potent, short acting benzodiazepines, which like other benzodiazepines, acts through effect on GABA 1 (which is main inhibitive mediator of brain). Midazolam could be selected as better option since it is secure and safe, it has short term effect, and it reduces anxiety.

The purpose of the study was to compare the effectiveness of thiopentone, propofol and midazolam as an intravenous agent for modified ECT in view of hemodynamic parameters, induction time, seizure duration, recovery characteristics, side effects and change in serum potassium.

Aims and objectives

The present study was designed to compare the effects of thiopentone, propofol and midazolam in patients undergoing modified electroconvulsive therapy.

The aims and objectives of the study were to evaluate and compare three groups for

- Hemodynamic responses
- Induction time
- Motor seizure duration
- Changes in serum potassium level
- Side effects
- Recovery characteristics - Spontaneous breathing time
  - Opening of eye time
  - Time to respond to oral commands.

MATERIALS AND METHODS

After getting approval from Institutional Ethical Committee, written informed consent was obtained from all the patients before ECT.

Patients of ASA physical status I & II of both sexes aged between 18 to 60 years undergoing ECT were included in this study.

Inclusion criteria:

- **AGE:** 18 to 60 years
- **SEX:** male or female
- ASA (American society of anaesthesiologists): Grade I or II

Exclusion Criteria

- Serious physical diseases such as cardiovascular diseases, cerebrovascular disorder, intracranial hypertension, respiratory tract diseases or a previous fracture.
- Glaucoma, arterial aneurysm or cerebrovascular malformations.
- Presence of pacemaker
- History of seizures
- ASA 3-5 physical status
- History of allergy to study drugs
- Pregnancy

Sample size

Sample size was calculated using open EPI software, by taking variable mean heart rate at basal time in Propofol and Midazolam group of previous study by Shah PJ,[19] with power of 80% and level of confidence 95%. For the present study, total of 105 patients were selected, 35 patients in each group.

PREANAESTHETIC PREPARATION

- Patient kept NBM for 6-8 hours.
- Chronic antidepressant medications were continued.
- Patients were encouraged to empty their bladder before ECT.
- Intravenous line was secured and 1ml blood in heparinized syringe was taken for baseline serum potassium measurement.

PREMEDICATION

- After taking patient into operation theatre, premedication was given by intravenous route as following.
- Inj. Glycopyrrolate 0.2 mg IV.

IN OPERATION THEATRE

- Monitor was attached for monitoring heart rate, NIBP, RR, SpO2 and the psychiatrist was allowed to place bitemporal ECT electrodes on forehead.
- Preoxygenation was done with 100% O2 for 3 minutes. General anesthesia was induced with intravenous anesthetic agent as per the group allocated till loss of eyelid reflex.
- One arm was isolated by inflating the tourniquet to a pressure 20% more than SBP for visual confirmation of motor seizure duration.
- Then inj. Succinylcholine 0.5 mg/kg iv was administered to all the patients for neuromuscular relaxation. When fasciculations subside and adequate neuromuscular relaxation obtained, adequate size Guedel's airway was inserted to prevent tongue bite and brief pulse stimulus (90-120 volts MECT) for about 2 msec was given to produce seizure.
- Subsequently, all the patients were ventilated with 100% oxygen at the rate of 12 breaths per minute until spontaneous breathing returned and patients were fully recovered clinically. Second blood sample was obtained 2 minutes after ECT for serum potassium measurement.
- All the patients were monitored for changes in hemodynamics HR, SBP, DBP, ECG changes throughout the procedure.
- Besides induction time (i.e., from time of injecting intravenous anesthetic agent to loss of eyelash reflex), seizure duration, side effects, complications and change in serum potassium from baseline was also recorded in all the three groups. Duration of recovery (Cognitive, orientation and neuromuscular co-ordination) was recorded from injection of Intravenous anesthetic agent to time taken to obey verbal commands opening of eye.

Hemodynamic parameters monitoring at various time intervals.

The statistical analysis was done using ANOVA and t-test using Open Epi and SPSS software. Data were analysed using post hoc analysis method.

Significance of P value was suggested as follows:

'P' Value was >0.05 insignificant.

'P' Value was <0.05 significant.

'P' Value was < 0.001 highly significant.

RESULTS

Patients were randomly divided into three groups of 35 each:

- Group A = inj. Sodium thiopentone (2.5%) 5mg/kg
- Group B = inj. Propofol 2mg/kg
- Group C = inj. Midazolam 0.2mg/kg

Mean age of patients in group A was 30.34±4.71 years, Group B was 31.51±5.35 years and in Group C was 31.60 ± 4.79 years. There was no statistically significant difference in mean age of three groups (p>0.05).

Mean weight of patients in group A was 50.20 ± 5.98 kg, in Group B was 51.77 ± 4.97 kg and in Group C was 50.69 ± 5.66 kg.

The mean weight of the patients in three groups was statistically comparable (p>0.05).

Thus, the demographic profile was comparable in three groups.

In Group A, 71.43% of the patients were male and 28.57% of the patients were female (25:10).

In Group B, 74.29% of the patients were male and 25.71% of the patients were female (26:9). In Group C, 77.14% of the patients were male and 22.86% of the patients were female (27:8). In three groups male female ratio was comparable.(p>0.05)

In Group A, 34.29 % of the patients were of ASA Grade I and 65.71% of the patients were of ASA Grade II (12:23).

In Group B, 34.29 % of the patients were of ASA Grade I and 65.71% of the patients were of ASA Grade II (12:23).

In Group C, 31.43 % of the patients were of ASA Grade I and 68.57% of the patients were of ASA Grade II (11:24).

In three groups ASA Grade ratio was comparable. (p>0.05).

Table 1: Comparison of mean pulse rate

Pulse	Group A Mean(SD)	Group B Mean(SD)	Group C Mean(SD)	p-value overall	A vs B	A vs C	B vs C
Baseline	82.17(4.86)	82.63(3.46)	82.23(1.8)	0.8447	0.8544	0.9948	0.8877
Induction	86.51(3.57)	82.69(3.07)	84(1.45)	<0.001	<0.001	0.001	0.1364
after end of seizure	118.97(3.98)	108.74(3.66)	111.03(2.72)	<0.001	<0.001	<0.001	0.0196
5 min	121.77(4.17)	106.4(3.59)	108.8(2.53)	<0.001	<0.001	<0.001	0.0137
10 min	117.54(3.18)	102.34(4.48)	105.43(2.81)	<0.001	<0.001	<0.001	0.0013
20 min	100.51(4.29)	90.69(2.87)	93.03(3.23)	<0.001	<0.001	<0.001	0.0174
30 min	92.8(3.67)	84.23(4.17)	86.97(2.29)	<0.001	<0.001	<0.001	0.0037
40 min	84.29(2.62)	81.71(3.57)	82.29(2.57)	0.0011	0.0012	0.0153	0.691
50 min	82.23(2.51)	82.51(2.54)	82.57(3.01)	0.8536	0.9013	0.8581	0.9948

After induction, pulse rate increased in all the three groups, but rise in group A was significant compared to group B and group C and remained elevated till end.

Overall, increase in pulse rate with propofol group was significantly low as compared to midazolam and thiopentone group. (p<0.001).

Table 2: comparison of mean systolic blood pressure changes

SBP	Group A Mean(SD)	Group B Mean(SD)	Group C Mean(SD)	p-value	A vs B	A vs C	B vs C
Baseline	124(3.85)	122.63(3.25)	122.23(2.37)	0.09	0.22	0.1	0.92
Induction	126.22(3.75)	120(2.83)	121.14(2.18)	<0.001	<0.001	<0.001	0.25
after end of seizure	145.54(2.91)	134.06(2.3)	136.11(1.60)	<0.001	<0.001	<0.001	0.001
5 min	141.94(3.09)	130.4(2.42)	133.14(2.57)	<0.001	<0.001	<0.001	0.0001
10 min	136.86(3.89)	123.94(2.4)	125.42(1.78)	<0.001	<0.001	<0.001	0.0784
20 min	130.69(3.63)	122.29(2.83)	125.2(3.13)	<0.001	<0.001	<0.001	0.0007
30 min	126.34(2.4)	122.29(2.53)	123.65(2.84)	<0.001	<0.001	0.0001	0.075
40 min	123.94(2.2)	120.17(2.44)	121.14(2.83)	<0.001	<0.001	0.0001	0.2415
50 min	121.43(2.13)	120.40(2.51)	121.14(2.15)	0.1525	0.1444	0.8546	0.3638

At the time of induction, systolic blood pressure decreased in propofol and midazolam group however it increased in thiopentone group, which was highly stastically significant (p<0.001).

After induction, systolic blood pressure increased in all the three groups, but in thiopentone group it increased more than the propofol and midazolam group. It was statistically highly significant between three groups (p<0.001).

Table 3: comparison of mean diastolic blood pressure changes

DBP	Group A Mean(SD)	Group B Mean(SD)	Group C Mean(SD)	p-value	A vs B	A vs C	B vs C
Baseline	79.31(3.85)	78.46(3.18)	79.37(2.1)	0.39	0.48	0.99	0.44
Induction	84(1.81)	81.03(3.12)	82.69(1.94)	<0.001	<0.001	0.006	0.01
after end of seizure	100.29(3.85)	90.06(3.41)	93.49(2.13)	<0.001	<0.001	<0.001	0.059
5 min	92(2.87)	84.97(2.8)	87.71(2.01)	<0.001	<0.001	<0.001	<0.001
10 min	87.26(3.76)	80.97(2.88)	83.2(2.23)	<0.001	<0.001	<0.001	0.01
20 min	83.94(2.89)	78.91(2.92)	81.14(1.83)	<0.001	<0.001	<0.001	0.34
30 min	80.91(3.12)	78.11(2.99)	78.06(1.85)	<0.001	<0.001	<0.001	>0.99
40 min	77.49(3.04)	76.34(3.31)	76.74(2.01)	0.24	0.22	0.52	0.83
50 min	76.06(2.93)	75.14(3.57)	76.29(2.12)	0.231	0.40	0.94	0.24

After induction, diastolic blood pressure increased in all the three groups, however it was significantly increased in thiopentone group as compared to propofol and midazolam group. (p<0.001).

Table 4: comparison of mean arterial pressure changes

MAP	Group A Mean(SD)	Group B Mean(SD)	Group C Mean(SD)	p-value	A vs B	A vs C	B vs C
Baseline	94.21(2.49)	93.18(2.55)	93.66(1.6)	0.17	0.14	0.56	0.65
Induction	98.08(1.81)	94.02(2.31)	95.5(1.39)	<0.001	<0.001	<0.001	<0.001
after end of seizure	115.37(2.81)	104.72(2.09)	107.7(1.44)	<0.001	<0.001	<0.001	<0.001
5 min	108.65(1.89)	100.11(1.72)	102.86(1.45)	<0.001	<0.001	<0.001	<0.001
10 min	103.79(2.63)	95.3(1.97)	97.28(1.57)	<0.001	<0.001	<0.001	<0.001
20 min	99.52(2.59)	93.37(2.14)	95.83(1.37)	<0.001	<0.001	<0.001	<0.001
30 min	96.06(2.46)	92.84(1.97)	93.26(1.63)	<0.001	<0.001	<0.001	0.67
40 min	92.97(2.25)	90.95(2.17)	91.54(1.73)	<0.001	<0.001	0.01	0.46
50 min	91.31(2.14)	90.23(2.37)	91.24(1.44)	0.05	0.07	0.99	0.10

Overall mean arterial pressure increased in all the three groups after induction and it was significantly increased in thiopentone group as compared to propofol and midazolam groups. (p<0.001).

Table 5: comparison of duration of induction

Variables	Group A Mean (SD)	Group B Mean (SD)	Group C Mean (SD)	p-value Overall	A vs B	A vs C	B vs C
Duration of induction	52.91(1.96)	42.46(1.82)	77.49(3.12)	<0.001	<0.001	<0.001	<0.001

Overall mean duration of induction was statistically highly significant (p<0.001) between the three study groups A, B, and C.

Mean duration of induction was significantly shorter with group B (propofol) (42.46±1.82 s) as compared to group A (sodium thiopentone) (52.9±1.96 s) and group C (midazolam) (77.49±3.12 s). (p<0.001)

Table 6: comparison of motor seizure duration(s)

Variables	Group A Mean(SD)	Group B Mean(SD)	Group C Mean(SD)	p-value Overall	A vs B	A vs C	B vs C
Motor seizure duration(s)	36.23(2.04)	26.34(1.53)	19.89(1.32)	<0.001	<0.001	<0.001	<0.001

Overall mean motor seizure duration was statistically highly significant (p<0.001) between the three study groups A, B, and C.

Mean motor seizure duration observed significantly shorter with group C (midazolam) (19.89±1.32 s) in comparison with other two groups, group B (propofol) (26.34±1.53 s) and group A (sodium thiopentone) (36.23±2.04 s).

Table 7: recovery parameters

Variables	Group A Mean(SD)	Group B Mean(SD)	Group C Mean(SD)	p-value Overall	A vs B	A vs C	B vs C
Spontaneous breathing time(min)	4.89(0.9)	3.69(0.8)	6.31(0.58)	<0.001	<0.001	<0.001	<0.001
Eye opening time(min)	6.6(0.98)	4.77(0.81)	8.2(0.63)	<0.001	<0.001	<0.001	<0.001
Respond to oral commands(min)	7.54(0.89)	5.54(0.51)	9.34(0.64)	<0.001	<0.001	<0.001	<0.001

Mean spontaneous breathing time, (4.89±0.9 min) versus (3.69±0.8 min) versus (6.31±0.58 min) for group A (sodium thiopentone), group B (propofol) and group C (midazolam) respectively.

It was statistically significantly shortest with group B (propofol) among all the three groups. (p<0.001)
Eye opening time in thiopentone group (group A) was (6.6±0.98 min), in propofol group (group B) was (4.77±0.81 min) and in midazolam group (group C) was (8.2±0.63 min).
The difference was statistically highly significant among all three groups. (p<0.001)

Patients induced with inj. Propofol (group B) (5.54±0.51 min) responded to oral commands faster than the other two groups' patients, who were induced with inj. Thiopentone (group A) (7.54±0.89 min) and with inj. Midazolam (group C) (9.34±0.64 min).
Difference was statistically highly significant. p(<0.001)

Table 8: rise in serum k+ level

Variables	Group I Mean(SD)	Group II Mean(SD)	Group III Mean(SD)	p-value Overall	I vs II	I vs III	II vs III
Rise in S. K+ level(mmol/l)	0.24(0.08)	0.21(0.07)	0.2(0.07)	0.10	0.29	0.12	0.88

Serum potassium level was increased in all the three groups. It was insignificant (p>0.05) and comparable.
In group A 8 patients had gag reflex, 6 patients had nausea, 2 patients had tears and 4 patients had vomiting.
In group B (propofol) 12 patients had pain on injection.
In group C 8 patients had nausea and 1 patient had vomiting.
Overall, there was few side effects with propofol.

DISCUSSION

ECT is one of the most effective though less understood treatment for psychiatric illnesses. ECT is grossly underused because of misconceptions and biases as it requires use of electricity and production of a seizure. So, many laymen, patients and patient's families are understandably frightened by the procedure.
ECT induces generalised tonic–clonic epileptic seizure. An electric current is applied transcutaneously to the brain via two electrodes positioned either bilaterally or unilaterally. A variety of adverse physiological and physical effects occur. Cardiovascular and central nervous system responses are potentially most dangerous. In the central nervous system, there is an increase in intracranial pressure, cerebral blood flow, blood–brain permeability, cerebral oxygen consumption and glucose utilisation. Headache, confusion and transient memory loss are also observed after ECT. In the cardiovascular system (CVS), the initial brief parasympathetic response lasts for 10–15 sec causing bradycardia, hypotension or even asystole. This initial response is followed by a sustained sympathetic response peaking at 3–5 min associated with the release of catecholamine, rise in systolic blood pressure (30–40%) and rise in heart rate (> 20%). All this predisposes to cardiac dysrhythmias, myocardial ischaemia and infarction. Even in a normal heart, ventricular dysfunction has been noted up to 6 Hrs after ECT.[4]
This study was conducted to compare the effects of sodium thiopentone, propofol and midazolam in modified ECT. 105 patients of ASA –I and II were randomly divided in three groups.

Group A patients were induced with inj. Sodium thiopentone (2.5%) 5mg/kg, Group B patients were induced with inj. Propofol 2mg/kg and group C patients were induced with inj. Midazolam 0.2 mg/kg.

Demographic parameters

Patient's characteristics like age, sex and body weight are important factors which can influence pharmacologic therapy.

- Mean age of patients in group A was 30.34±4.71 years, Group B was 31.51±5.35 years and in Group C was 31.60 ± 4.79 years. Mean weight of patients in group A was 50.20 ± 5.98 kg, in Group B was 51.77 ± 4.97 kg and in Group C was 50.69 ± 5.66 kg. There was statistically no significant difference in mean age and weight of three groups (p > 0.05).
- In Group A, 71.43% of the patients were male and 28.57% of the patients were female (25:10). In Group B, 74.29% of the patients were male and 25.71% of the patients were female (26:9). In Group C, 77.14% of the patients were male and 22.86% of the patients were female (27:8). Hence, male female ratio was comparable in all the groups.

So, three groups were comparable in terms of age, sex and weight distribution.

Duration of induction

The duration of induction was calculated from the time of injection to the loss of eyelid reflexes.
In our study, duration of induction was shorter with propofol group (42.46±1.82 s) as compared to thiopentone group (52.91±1.96 s) and midazolam group (77.49±3.12 s) which was highly significant (p<0.001).

- **Shah PJ, Dubey KP, Watti C, Lalwani J in 2010,**[5] compared the sodium thiopentone (5 mg/kg), propofol (2 mg/kg) and midazolam (0.2 mg/kg) for modified ECT. Intravenous succinylcholine 0.5 mg/kg was administered to all the patients for neuromuscular relaxation. They observed that duration of induction was shorter with propofol group (41.03±6.11 s) as compared to thiopentone group (50.6±6.82 s) and midazolam group (77.3±6.67 s).
- **Arvind arya, Manpreet Sing, A.K. Gurwara in 2008,**[6] compared the effect of sodium thiopentone (5 mg/kg), propofol (2mg/kg) and

midazolam (0.2mg/kg) for ECT. They studied that duration of induction was shorter with propofol group (41.13±6.11 s) as compared to thiopentone group (51.06±6.82 s) and midazolam group (77.86±6.67 s).

- **Dr. Arvind Arya, Dr. Veena Gupta, Dr. A.K. Gurvara in 2010,[7]** studied the effect of propofol (2mg/kg) and midazolam (0.2 mg/kg) for ECT. Duration of induction was shorter with propofol group (42.2±6.2 s) as compared to midazolam group (78.8±6.68 s).
- **Mir AH, Shah NF, Din MU, Langoo SA, Reshi FA in 2017,[8]** compared the thiopentone (2.5% 5 mg/kg), propofol (1% 1.5mg/kg) and etomidate (0.2 mg/kg) for modified ECT. They had resulted that mean induction time in propofol group was 41.9 s (which was shortest among three groups), in etomidate group 50.9 s and in thiopentone group 48 s.

From above study we can say that duration of induction was shorter with propofol group as compared to thiopentone and midazolam group.

Motor seizure duration

The duration of the motor seizure was defined as the time from the beginning of ECT to cessation of tonic–clonic motor activity in the 'isolated' arm.

Efficacy of the ECT depends on the seizure duration. Duration of the seizure is usually affected by anaesthesia. So, it is necessary to monitor all seizures to assure minimum seizure duration for each application.

Three methods of monitoring were available:

I. EEG
II. Isolated Arm technique
III. EMG

EEG provides clear record of onset, duration and pattern of sustained cerebral electrical seizure activity. Isolated arm technique prevents paralysis of distal limb musculature and allows visual confirmation of seizure. EMG records motor discharges through electrodes applied to the ipsilateral limb or masseter muscle. In our study we measured seizure duration by the Isolated Arm technique.

An adequate motor seizure is defined as the one that lasts more than 25–30 s. Too short (<10 s) or too long (>120 s) can reduce clinical efficacy of seizure.[i]

In our study, Motor seizure duration was prolonged in sodium thiopentone group (36.23±2.04 s) compared to propofol group (26.34±1.53 s) and midazolam group (19.89±1.32 s) which was highly significant ($p < 0.001$).

- **Arvind arya, Manpreet Sing, A.K. Gurwara in 2008,[6]** compared the effect of sodium thiopentone (5 mg/kg), propofol (2mg/kg) and midazolam (0.2mg/kg) for ECT. For neuromuscular relaxation intravenous succinylcholine 0.5 mg/kg given. Total seizure duration was significantly longer in sodium thiopentone group (37.63±5.83s) as compared to propofol group (28.76±3.38s) and midazolam group (21.6±4.23s).
- **Shah PJ, Dubey KP, Watti C, Lalwani J in 2010,[5]** compared the sodium thiopentone (5 mg/kg), propofol (2 mg/kg) and midazolam (0.2 mg/kg) for modified ECT. Intravenous succinylcholine 0.5 mg/kg was administered to all the patients for neuromuscular relaxation. Total seizure duration was significantly longer in sodium thiopentone group (36.26±4.83s) as compared to propofol group (26.36±2.79s) and midazolam group (19.73±3.63s).
- **Sonali Joshi, Prabhat Khare in 2018,[10]** compared the thiopentone sodium (2.5 mg/kg) and propofol (1.5 mg/kg) for modified ECT. Succinylcholine 0.5 mg/kg intravenously given as muscle relaxant. They observed that total seizure duration was significantly longer in sodium thiopentone group (40±6 s) as compared to propofol group (28±4 s).
- **Dr. Arvind Arya, Dr. Veena Gupta, Dr. A.K. Gurvara in 2010,[7]** studied the effect of propofol (2mg/kg) and midazolam (0.2 mg/kg) for ECT. 0.5 mg/kg succinylcholine given intravenously for neuromuscular relaxation. Total seizure duration was significantly longer with propofol group (28.86±3.42 s) as compared to midazolam group (21.4±4.2s).
- **Mir AH, Shah NF, Din MU, Langoo SA, Reshi FA in 2017,[8]** compared the thiopentone (2.5% 5 mg/kg), propofol (1% 1.5mg/kg) and etomidate (0.2 mg/kg) for modified ECT. Intravenous succinylcholine 0.5 mg/kg were given to all the patients for neuromuscular relaxation. Mean seizure duration was 27.6 s in propofol group (which was shortest among three groups), 56.5 s in etomidate group and 30.2s in thiopentone group.
- **Nadeem A Zaidi, Fauzia A. Khan in 2000,[11]** studied the effect of thiopentone sodium (2.5 mg/kg) and propofol (1.5 mg/kg) for electroconvulsive therapy. Suxamethonium was given as muscle relaxant in a dose of 0.5 mg/kg. Mean duration of seizure with propofol was significantly shorter (23.7±3.38 seconds) as compared to thiopentone (31.08±4.13 seconds).

From comparison of above studies, we can say that total seizure duration with sodium thiopentone was longer than propofol followed by midazolam.

- **Kumar A, Sharma DK, Mani R in 2012,[12]** studied the effect of sodium thiopentone (3 mg/kg) and propofol (1.5 mg/kg) on electroconvulsive therapy. Succinylcholine 0.4 mg/kg intravenously given for neuromuscular blockade. In this study total duration of seizure was significantly longer in propofol group (94±21s) as compared to thiopentone group(83±34s).
- The duration of seizure was longer in propofol group possibly because higher shock energy was

delivered to patients of this group and low dose of scholine given.

- **Hamid Kayalha, Asgar Karbord, in 2020,[13]** compared the effect of thiopentone sodium (2mg/kg) and propofol (1 mg/kg) for electroconvulsive therapy. Intravenous succinylcholine 0.5 mg/kg given as muscle relaxant. Resulted that total seizure duration was significantly longer with propofol group (53±28 s) as compared to thiopentone group (25±13 s).
- The duration of seizure was longer in propofol group possibly due to low induction dose of propofol and higher energy required to produce seizures in this group.

Hemodynamic parameters:

In our study hemodynamic parameters like pulse rate, systolic blood pressure and diastolic blood pressure was increased significantly in all the three groups after induction. However, rise in thiopentone group was significantly high as compared to propofol and midazolam group. ($p<0.001$)

Pulse rate, systolic blood pressure and diastolic blood pressure decreased towards the end and reached back to baseline values.

- **Arvind arya, Manpreet Sing, A.K. Gurwara in 2008,[6]** compared the effect of sodium thiopentone (5 mg/kg), propofol (2mg/kg) and midazolam (0.2mg/kg) for ECT. Observed that during induction, blood pressure and pulse rate variability was least with propofol followed by midazolam. There was no compensatory increase in heart rate with propofol and midazolam as seen with thiopentone sodium. The variation in mean blood pressure were least with propofol and midazolam.
- **Shah PJ, Dubey KP, Watti C, Lalwani J in 2010,[5]** compared the sodium thiopentone (5 mg/kg), propofol (2 mg/kg) and midazolam (0.2 mg/kg) for modified ECT. Increase in heart rate, SBP and DBP after ECT was observed in all the three groups but it was statically highly significant in thiopentone group.
- **Nadeem A Zaidi, Fauzia A. Khan in 2000,[11]** studied the effect of thiopentone sodium (2.5 mg/kg) and propofol (1.5 mg/kg) for electroconvulsive therapy. Observed that changes in systolic blood pressure, diastolic blood pressure and heart rate were more pronounced with thiopentone compared to propofol at one minute ($p<0.001$) after ECT. Diastolic blood pressure changes were also significant at two minutes ($p<0.001$) and three minutes ($p<0.001$) interval after ECT. Similarly, heart rate changes were most pronounced at two ($p<0.005$) and 3 minutes ($p<0.001$) interval following ECT.
- **Dr. Arvind Arya, Dr. Veena Gupta, Dr. A.K. Gurvara in 2010,[7]** studied the effect of propofol (2mg/kg) and midazolam (0.2 mg/kg) for ECT. Observed that during induction, blood pressure and pulse rate variability was less with propofol. There was no compensatory increase in heart rate with propofol.
- **Mir AH, Shah NF, Din MU, Langoo SA, Reshi FA in 2017,[8]** compared the thiopentone (2.5% 5 mg/kg), propofol (1% 1.5mg/kg) and etomidate (0.2 mg/kg) for modified ECT. There was significant change in heart rate, systolic and diastolic blood pressure from the baseline values in all the three groups, after the administration of ECT ($p<0.05$). HR, SBP and DBP increased for up to 2 minutes after ECT, followed by decreasing trend and reaching back to baseline values. However, with propofol there was less rise with HR, SBD and DBP compared to thiopentone and etomidate group.
- **Sonali Joshi, Prabhat Khare in 2018,[10]** compared the thiopentone sodium (2.5 mg/kg) and propofol (1.5 mg/kg) for modified ECT. It was observed that heart rate of the thiopentone group increased significantly after ECT as compared to propofol group ($p<0.05$). The increase in systolic blood pressure, diastolic blood pressure and mean arterial pressure after ECT were more with thiopentone group compared to propofol group ($p<0.05$).

Recovery parameters

During modified ECT application, the recovery parameters are monitored by calculating the time from the end of succinylcholine administration to the recovery of spontaneous breathing, eye opening, and time to obey verbal command.

In our study, Spontaneous breathing time (4.89±0.9 min versus 3.69±0.8 min versus 6.31±0.58 min), eye-opening time (6.6±0.98 min versus 4.77± 0.81 min versus 8.2±0.63 min), and time to respond to verbal command (7.54±0.89 min versus 5.54±0.51 min versus 9.34±0.64min) were reported in sodium thiopentone group, propofol group and midazolam group respectively. Recovery parameters were highly significantly ($p<0.001$) shorter in propofol group compared to thiopentone group and midazolam group.

- **Arvind arya, Manpreet Sing, A.K. Gurwara in 2008,[6]** compared the effect of sodium thiopentone (5 mg/kg), propofol (2mg/kg) and midazolam (0.2mg/kg) for ECT. In this study, time for the ability to obey vocal commands like opening of eyes were significantly shorter in propofol group (4.28±0.89 min) followed by thiopentone group (6.06±1.36 min) and midazolam group (8.67±1.47min).
- **Shah PJ, Dubey KP, Watti C, Lalwani J in 2010,[5]** compared the sodium thiopentone (5 mg/kg), propofol (2 mg/kg) and midazolam (0.2 mg/kg) for modified ECT. In this study, time for the ability to obey vocal commands like opening of eyes were significantly shorter in propofol group (11.59 min) as compared to thiopentone group (15.31 min) and midazolam group (22.25 min).

- **Nadeem A Zaidi, Fauzia A. Khan in 2000,[11]** studied the effect of thiopentone sodium (2.5 mg/kg) and propofol (1.5 mg/kg) for electroconvulsive therapy. They found that recovery parameter like opening of eyes were significantly shorter with propofol group (3.28±0.89min) as compared to thiopentone group (5.04±1.36 min).
- **Dr. Arvind Arya, Dr. Veena Gupta, Dr. A.K. Gurvara in 2010,[7]** studied the effect of propofol (2mg/kg) and midazolam (0.2 mg/kg) for ECT. They found out that the ability to obey vocal commands like opening of eyes were significantly shorter with propofol group (4.42±0.88 min) as compared to midazolam group (8.68±1.62 min).
- **Sonali Joshi, Prabhat Khare in 2018,[10]** compared the thiopentone sodium (2.5 mg/kg) and propofol (1.5 mg/kg) for modified ECT. Observed that the eye-opening time on verbal command was significantly shorter with propofol group (424±64 s) as compared to thiopentone group (547±41 s).

From comparison of the above study, we can say that recovery parameters were shorter with propofol group followed by sodium thiopentone group and midazolam group.

Rise in serum potassium level

1st blood sample of 1ml was taken in heparinized syringe for baseline serum potassium measurement before the procedure. Second blood sample was obtained 2 minutes after ECT for serum potassium measurement.

Rise in serum potassium level may be due to synchronous contraction of all the voluntary muscles of the body which are rich in potassium secondary to succinylcholine induced fasciculations which pump out potassium into general circulation causing greater increase in plasma potassium concentration.[10]

In our study, there was increase in serum potassium level in all the three groups after ECT which was not statistically significant.

- **Shah PJ, Dubey KP, Watti C, Lalwani J in 2010,[5]** compared the sodium thiopentone (5 mg/kg), propofol (2 mg/kg) and midazolam (0.2 mg/kg) for modified ECT. They observed statistically insignificant rise in serum potassium level in all the three groups.

SIDE EFFECTS

In our study, no patient experienced respiratory depression, hypoxaemia, bradycardia, hypotension, or hypertension. None of the patients complained of awareness during anaesthesia. In sodium thiopentone group seven patients had gag reflex, six patients had nausea and four patients had vomiting. In propofol group twelve patients had pain on injection. In midazolam group eight patients had nausea and one patient had vomiting.

- **Arvind arya, Manpreet Sing, A.K. Gurwara in 2008,[6]** compared the effect of sodium thiopentone (5 mg/kg), propofol (2mg/kg) and midazolam (0.2mg/kg) for ECT. Observed that in thiopentone group 4 patients had headache, 8 had nausea, 2 had vomiting, 1 had pyrexia and 2 had delirium. In propofol group 2 had headache, 1 had nausea and 8 had pain on injection. In midazolam group 6 had headache, 2 had nausea and 6 had delirium.
- **Shah PJ, Dubey KP, Watti C, Lalwani J in 2010,[5]** compared the sodium thiopentone (5 mg/kg), propofol (2 mg/kg) and midazolam (0.2 mg/kg) for modified ECT. Observed that in thiopentone group 36 had gag reflex, 13 had coughing, 25 had tachycardia, 7 had headache, 23 had nausea, 7 had vomiting, 3 had pyrexia and 13 had delirium. In propofol group 20 had pain on injection, 20 had gag reflex and 24 had tachycardia. In midazolam group 23 had gag reflex, 26 had coughing, 26 had tachycardia, 23 had headache and 20 had delirium.
- **Nadeem A Zaidi, Fauzia A. Khan in 2000,[11]** studied the effect of thiopentone sodium (2.5 mg/kg) and propofol (1.5 mg/kg) for electroconvulsive therapy. Discomfort upon intravenous administration of drug occurred in 20 patients with propofol and none with thiopentone. Twelve patients had laryngo-bronchospasm while 14 had hiccoughs with thiopentone while none with propofol had this problem.
- **Dr. Arvind Arya, Dr. Veena Gupta, Dr. A.K. Gurvara in 2010,[7]** studied the effect of propofol (2mg/kg) and midazolam (0.2 mg/kg) for ECT. Observed that in propofol group 2 had headache, 2 had pyrexia and 15 had pain on injection. In midazolam group 10 had headache, 4 had nausea, 3 had vomiting and 10 had delirium.

From above studies we can say that propofol showed fewer side effects as compared to thiopentone and midazolam group.

CONCLUSION

We concluded from our study that, propofol in dosage of 2 mg/kg body weight intravenously can be safely used for modified ECT because of rapid induction, early recovery, better hemodynamic, fewer side effects, uncompromised therapeutic outcome without much rise in serum potassium makes propofol as an agent of choice for the procedure.

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