



## A Comparative Study of Induction and Recovery Characteristics of Propofol with that of Thiopentone

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### Abstract

**Background:** Ambulatory surgery presents unique challenges for the anaesthetist. About 40- 60% of all surgical procedure could be performed in an out – patient surgery centre. Thiopentone sodium was considered as a standard drug for induction of anaesthesia. For short procedures in day care surgery which requires a quicker and smoother induction as well as smooth and rapid recovery Di-isopropyl Phenol [Diprivan] referred as Propofol is extensively used for induction of anaesthesia.

The aim of the study is to compare the merits and demerits of propofol with that of thiopentone sodium for induction and recovery.

**Materials and Materials:** This study is conducted among 60 patients who were posted for the minor gynaecological procedure – dilatation and curettage. Out of the 60 patients, 30 patients (Group I) received propofol and 30 patients (Group II) received thiopentone as induction agent. Time of induction, Effects on cardio-vascular & respiratory system, Speed of recovery, Hang over, Street fitness and other side effects were compared.

**Results:** Time for induction of anaesthesia in group I was 15 seconds at the earliest and 45 seconds as the maximum with a mean of 30.27 seconds. In group II the same was 18 seconds and 45 seconds respectively with a mean of 29.46 seconds. Apnoea lasting for less than 30 seconds was noted in 3 patients [10%] in Group I and the same was in 11 patients [36%] in group II. Incidence of cough was in 2 patients [6.6%] who received thiopentone. No such incidence was noticed in patient receiving propofol. 12 patients [40%] in the propofol group complained of pain whereas it was 5 [16%] in patients who received thiopentone. The mean increase in heart rate at the end of 3 min when compared to pre-induction value was 2 bpm in propofol group when compared to 3.71 bpm of thiopentone group. The mean decrease in mean arterial pressure in propofol group was 9.32 mm Hg and 3.66 mm Hg in thiopentone group at the end of 3 minutes. Recovery time in propofol ranged from 3-16 min with a mean of 8.67 min. In Thiopentone recovery time ranged from 5-23 min with a mean of 10.86 min.

**Conclusion:** Propofol can be used as an ideal induction agent for day care surgery, keeping in mind the respiratory depression and cardiovascular effect where a judicious and cautions approach and vigilant monitoring is required.

**Keywords:** Propofol, Thiopentone sodium, Haemodynamic changes, Induction, Recovery

## INTRODUCTION

Ambulatory surgery presents unique challenges for the anaesthetist. The variety of operative procedure performed on an outpatient basis has expanded and patients with significant medical problem are now considered acceptable surgical candidates in most out – patient units. About 40-60% of all surgical procedure could be performed in an out – patient surgery centre. Out-patient surgical care is in a sense, the newest speciality with special anaesthetic attributes. Thiopentone sodium was considered as a standard drug for induction of anaesthesia. For short procedures in day care surgery which requires a quicker and smoother induction as well as smooth and rapid recovery, Di-isopropyl Phenol [Diprivan] referred as Propofol is extensively used for induction of anaesthesia.

## AIM OF THE STUDY

The aim of the study is to compare the merits and demerits of propofol with that of thiopentone sodium with reference to

1. Time of induction.
2. Effects on cardio-vascular system
3. Effects on respiratory system
4. Speed of recovery
5. Hang over
6. Street fitness and
7. Other side effects

## MATERIALS AND METHODS

All the patients in this study were randomly selected from among the patients who were posted for the minor gynaecological procedure – dilatation and curettage. Only patients belonging to ASA physical status I were selected, as one of the parameter is, its effect on cardiovascular and respiratory status. The patients were explained the procedure and informed consent was obtained. Patients were randomly divided into 2 groups. Out of the total 60 patients included in this study, 30 patients received propofol (Group I) and 30 patients received thiopentone sodium (Group II) as induction agent. In order to avoid any influence on

the heart rate, premedication was not given to any of the patients. However injection atropine was kept ready. Laryngoscope with endotracheal tubes were kept ready. Boyle's apparatus was checked and kept ready with enough oxygen. Suction apparatus checked & kept ready. Pre-operatively Pulse rate and Blood pressure were noted.

18 G IV cannula started on non-surgical limb. Monitors such as pulse oximetry, NIBP and ECG were connected. Then the patients were induced with thiopentone sodium or propofol as the case may be. Immediately after induction heart rate and blood pressure were noted at intervals of 1 minute for the first 3 minutes. The Presence of apnoea or respiratory depression, laryngospasm, abnormal muscle movements. pain at the site of injection, cough were also made a note of. Any variation in the above parameters were also noted.

The time of onset of anaesthesia was noted by the loss of eye-lash reflex. Anaesthesia was maintained with N<sub>2</sub>O, Oxygen and halothane. The duration of surgery and the duration of anaesthesia were also noted. The recovery characteristics were observed by the steward scoring system. Upon recovery the following parameters were observed

Level of consciousness	Score
Awake	- 2
Responds to stimuli	- 1
Not responding	- 0
The maintenance of airway	
Cough on command or crying	- 2
Maintains good airway	-2
Airway requires maintenance	- 0
Movement during recovery	
Moving limbs purposefully	- 2
Non purposeful movement	- 1
No movement	-0
Total	-6

In the post operative period the incidence of any one of the following were noted.

- Nausea or vomiting
- Headache
- Drowsiness
- Thrombosis at the site of injection

The road worthiness was checked by asking the patients to initially get-up, sit for sometime, stand

up and then walk without support.

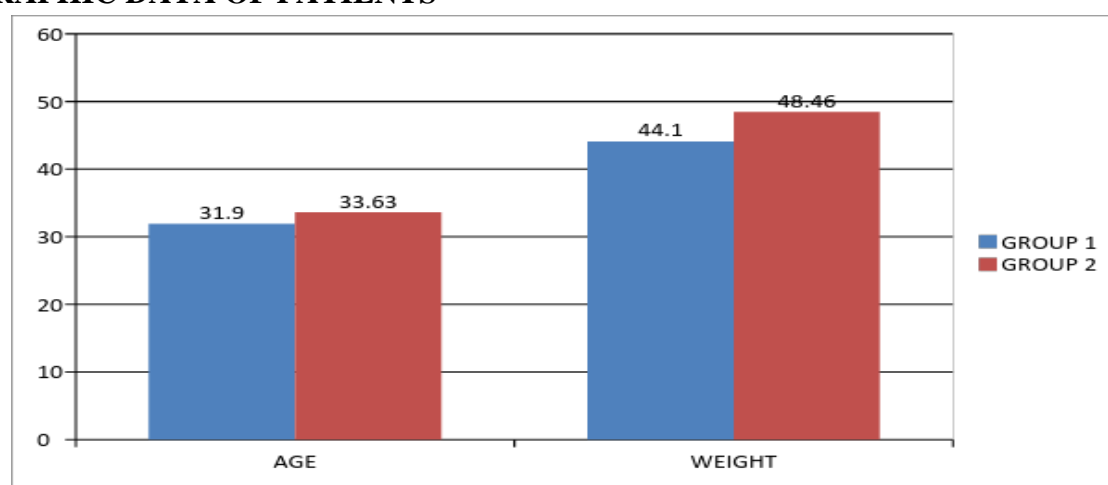
**RESULTS AND OBSERVATIONS**

Out of total size(60 pts), Group I(n-30) received propofol & group II(n-30) received thiopentone sodium.

**TABLE I**

	Group I		Group II	
	Range	Mean	Range	Mean
Age [Years]	25-55	31.9	25-55	33.63
Weight[KGS]	35-60	44.1	38-62	48.46

**DEMOGRAPHIC DATA OF PATIENTS**



**Induction Time**

Time for induction of anaesthesia in group I was 15 seconds at the earliest and 45 seconds as the maximum with a mean of 30.27 seconds. In group II the same was 18 seconds and 45 seconds respectively with a mean of 29.46 seconds. [Table II]

The dose requirement for reliable induction of anaesthesia in patients receiving propofol ranged between 2-2.5 mgm/kg with a mean total

induction dose of 98.27 mgms and a mean dose per kilogram body weight of 2.053 mgm. In thiopentone group induction dose requirement varied from 3-5 mgms/kg body weight with a mean total inuction dose of 246.86 mgm and a mean dose per kilogram body weight of 4.59 mgm [table III]. Two patients [6.6%] in propofol group and a patient [3.3] in thiopentone group required an additional dose of the respective drugs.

**TABLE II**

	Group I		Group II	
	Range	Mean	Range	Mean
Onset of Action [SEC]	15-45	30.27	18-45	29.46
Induction Dose [Mg]	70-120	98.27	200-300	246.86
Dose [Mg/Kg Wt]	2-2.5	2.053	3-5	4.59

**Respiratory effects**

Periods of apnoea ranging from less than 30 seconds to more than 60 seconds were noted. In the patients receiving propofol. Apnoea lasting for less than 30 seconds was noted in 3 patients [10%] and the same was in 11 patients [36%] in group II patients receiving thiopentone. Apnoea ranging from more than 30 seconds but less than 60 seconds was noted in 10 patients [33.33%] in

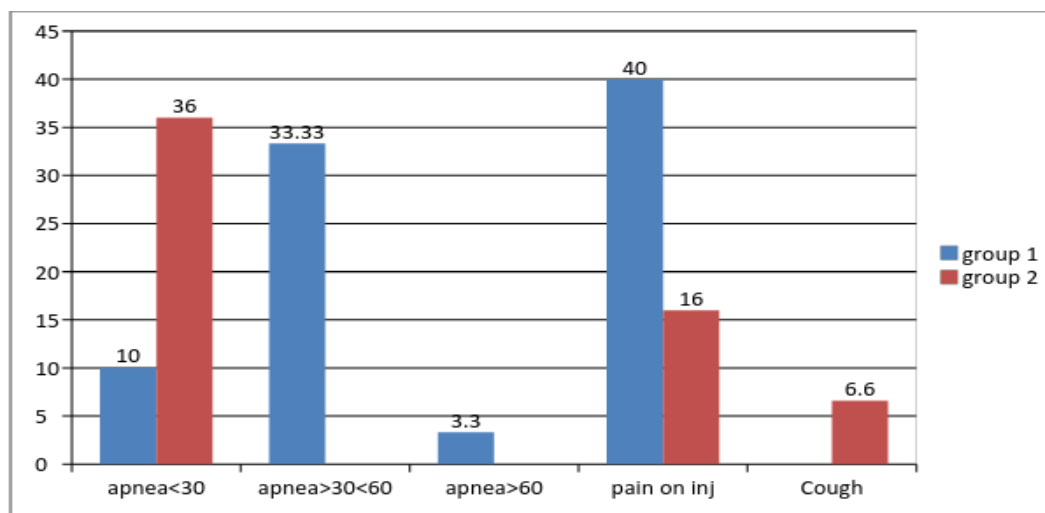
propofol group only. Likewise apnoea > 60 seconds occurred in 1 patient [3.3%] in propofol group only [Table III] None of the patients in both groups exhibited any laryngospasm.

**Cough:** Incidence of cough was in 2 patients [6.6%] who received thiopentone. No such incidence was noticed in patient receiving propofol [Table III]

**TABLE III**

	Group I		Group II	
	n	%	n	%
APNOEA < 30 S	3	10	11	36
APNOEA > 30 s <60 s	10	33.33	-	-
APNOEA > 60 S	1	3.3	-	-
PAIN ON INJECTION	12	40	5	16
LARYNGOSPASM	-	-	-	-
COUGH	-	-	2	6.6

**RESPIRATORY EFFECTS OF PROPOFOL AND THIOPENTONE**



**Pain on injection**

12 patients [40%] in the propofol group complained of pain whereas it was 5 [16%] in patients who received thiopentone.

**Haemodynamics**

**Varations in pulse rate:** Out of the 30 cases under propofol group 17 patients [ 56.67%]

showed an increase upto 10 beats/ mt, 4 patients [13.33%] showed an increase in the range of 11-20 bpm and 3 patients[10%] showed an increase of 21-30 bpm and there was no change in 2 patient 6.6% at the end of 3 minutes.

In the thiopentone group 18 patients showed an increase up to 10 bpm. 4 patients [13.3%] showed

an increase in range of 11-20bpm, and yet another patient [3.3%] showed an increase ranging from 31-40 bpm. There was no change in 2 patients [6.6%] at the end of 3 minutes.

As regards the reduction in pulse rate 2 patients [6.6%] showed a reduction in pulse rate upto 10 bpm, 2 patients[6.6%] had a decrease ranging from 11-20 bpm at the end of 3 minutes in the propofol group.

In the thiopentone group, a decrease in pulse rate upto 10 bpm was noted in 2 patient [6.6%] and a decrease ranging from 11-20bpm was noted in 1 patient [3.3%]and in one patient [3.3%] the reduction was upto 30 bpm at the end of 3 minutes.

**Variations in blood pressure:-**

**Systolic pressure**

At the end of 3 minutes, in the propofol group, 1 patient [3.3%] had an increase upto 10mm/mg. There was no change in 2 patients [6.6%].

As regards the fall of B.P at the end of 3 minutes 13 patients [26%] in the propofol group showed a decrease of upto 10mm Hg, 20 patients [40%] showed a fall ranging from 11-20 mm Hg and in one patient [2%] it was in the range of 31-40mm Hg.

In the thiopentone group at the end of 3 minutes no increase in systolic pressure was noted.

In the thiopentone group, the fall in systolic pressure upto 10mm Hg was noted in 19 patients [63%] at the end of 3 minutes, 5 patients [16.7%] showed a fall of upto 20mm Hg.

There was no change in the systolic pressure in 6 patients [20%] at the end of 3minutes.

**Diastolic Blood Pressure**

In the propofol group at the end of 3 minutes. 1 patient [2%] showed an increase upto 10mm Hg.16 patients [53.33%] belonging to propofol group showed a increase upto 10mm Hg, 5 patients[16.6%] between 11-20 mm Hg patients [6.6%] had a fall ranging from 21-30mm Hg at the end of 3 minutes.

**Mean Arterial Pressure: [MAP]**

At the end of 3 minutes 1 patient [3.33%] upto 40mm Hg in the propofol group at the end of 3 minutes.

No change in MAP was noted in 2 patients 6.66% at the end of 3 minutes in the propofol group.

In the thiopentone group at the end of 3 minutes 2 patients[6.66%] showed an increase in MAP upto 10mm Hg.

The decrease seen in this group at the end of 3 minutes was in 23 patients [76.6%] 10mm Hg and in another 2 patients [6.66%] a decrease in the range of 11-20 mm Hg.

No change in MAP was noted in 3 patients [10%] under thiopentone group of patients.

**TABLE IV**

PROPOFOL																								
mmHg			INCREASE						DECREASE															
Bpm																								
PULSE			SAP			DAP			MAP			PULSE			SAP			DAP			MAP			
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
0-10	18	18	17	1	1	1	1	1	1	3	2	2	10	8	7	16	10	16	12	12	14			
11-20	2	2	4			1			1	1	2	8	13	14	7	11	5	12	13	12				
21-30	1	3	3						1				6	3	5	1	2	2	5	3	1			
31-40	1															4	2	1			1			
41-50																0	2							
No Change	3	3	2	1		2	6	7	7	1	2	2												

TABLE V

THIOPENTONE																						
mmHg			INCREASE						DECREASE													
Bpm																						
PULSE			SAP		DAP		MAP		PULSE			SAP		DAP		MAP						
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3		
0-10	19	19	18	2	1	2	1	1	1	2	4	2	2	20	19	19	18	14	16	25	23	23
11-20	3	6	4		1				1	1	1			5	6	5			2	2	2	
21-30		1	1											1		1						
31-40				1																		
41-50		1																				
No																						
Change	2	1	2	3	3	6	12	14	13	2	4	3										

**Overall hemodynamic changes**

The mean increase in heart rate at the end of 3 minutes when compared to preinduction value was 2 bpm in propofol group when compared to 3.71 bpm of thiopentone group

The mean decrease in systolic arterial pressure was 14.28 mm Hg in propofol group when

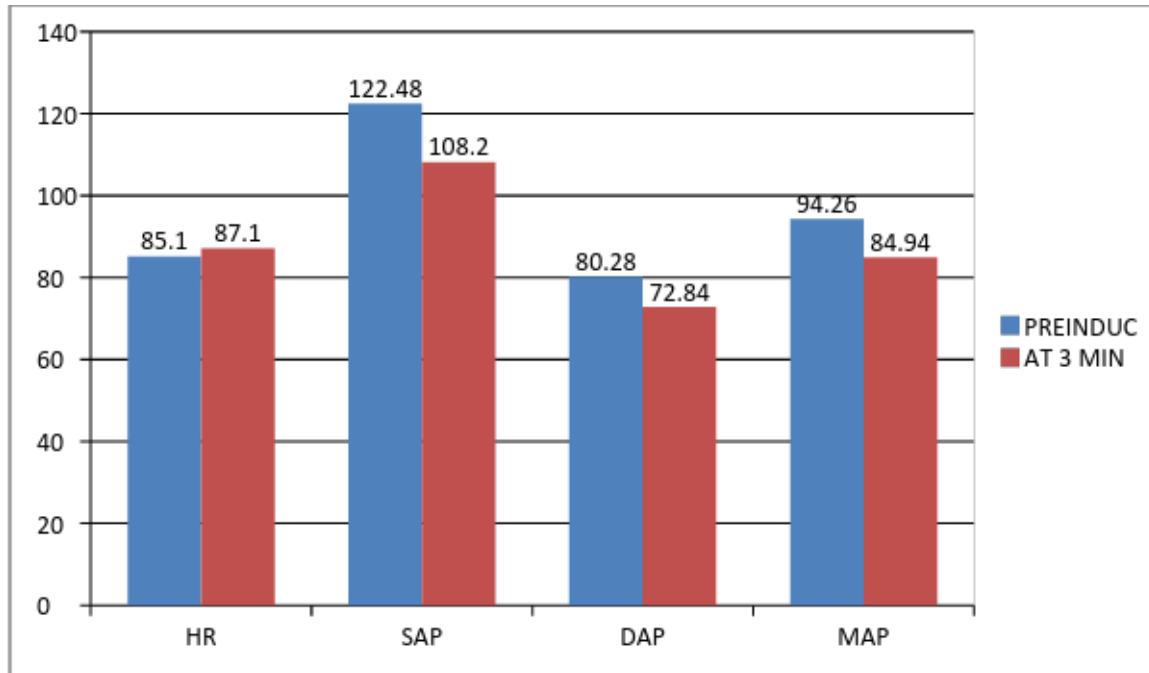
compared to thiopentone group it was 5.9 mm Hg at the end of 3 minutes

The mean decrease in MAP in propofol group was 9.32 mmHg & 3.66 mm Hg in thiopentone group at the end of 3 minutes

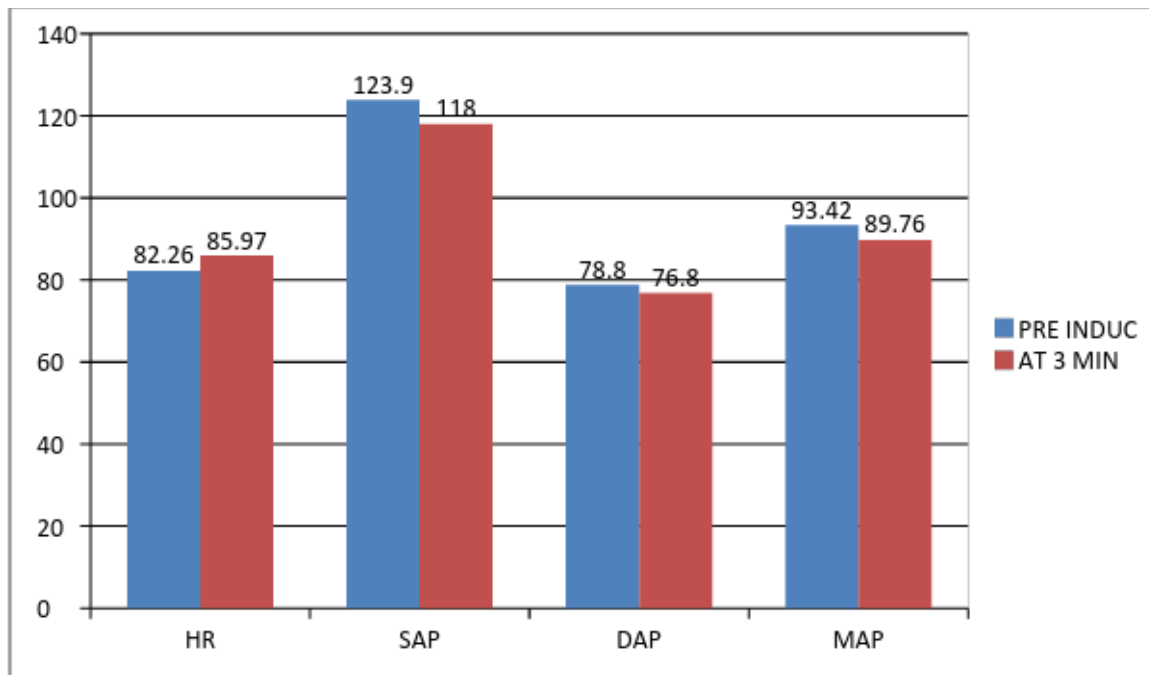
TABLE VI

	PROPOFOL	THIOPENTONE
<b>HR MIN</b>		
PREINDUCTION	85.1	82.26
AT 1 MIN	88.1	87.24
AT 2 MIN	89.9	89.00
AT 3 MIN	87.1	85.97
<b>SAP mm Hg</b>		
PREINDUCTION	122.48	123.9
AT 1 MIN	105.68	118.2
AT 2 MIN	104.172	116.88
AT 3 MIN	108.2	118.0
<b>DAP mm Hg</b>		
PREINDUCTION	80.28	78.8
AT 1 MIN	72.36	76.56
AT 2 MIN	71.32	76.36
AT 3 MIN	72.84	76.8
<b>MAP mm Hg</b>		
PREINDUCTION	94.26	93.42
AT 1 MIN	83.78	89.68
AT 2 MIN	82.68	89.3
AT 3 MIN	84.94	89.76

**OVERALL HEMODYNAMIC CHANGES IN PROPOFOL**



**OVERALL HEMODYNAMIC CHANGES IN THIOPENTONE**



**Side Effects :- Post – operative**

In group I patients receiving propofol headache was noted in 1 patient [3.3%] post- operatively and in group II patients receiving thiopentone headache was noted in 3 patients [10%].

Nausea and Vomiting was noted in 1 patient [3.3%] of propofol group and 2 patients [6.6%] in thiopentone group.

Post – operatively, drowsiness was noted in 1 patient 3.3% [6%] in propofol group and 17 patients [56%] in thiopentone group.

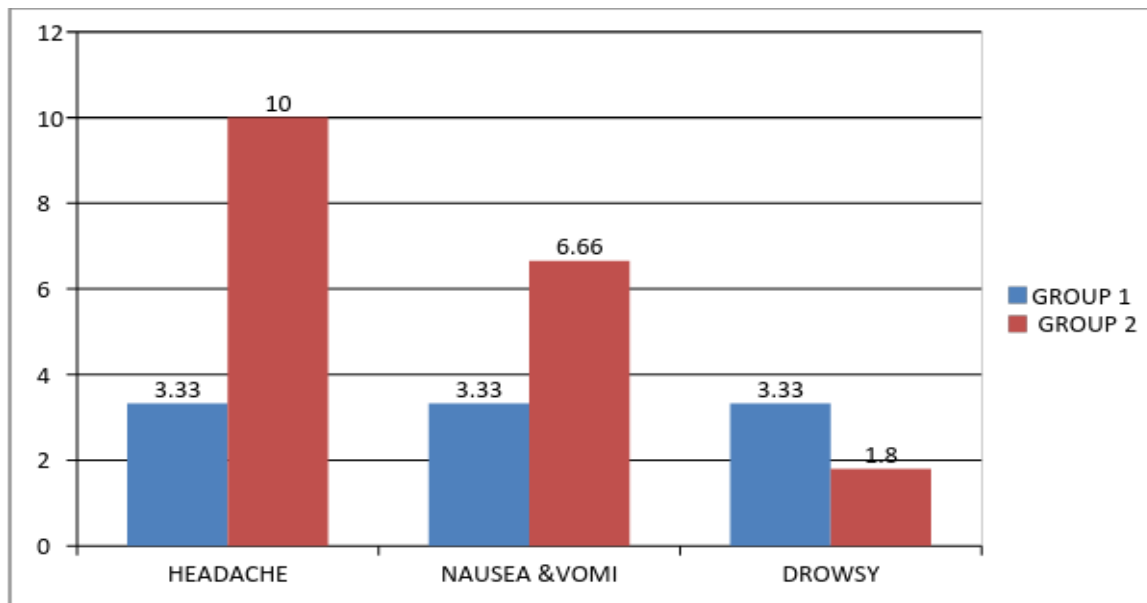
**TABLE VII**

	PROPOFOL		THIOPENTONE	
	n	%	n	%
HEAD ACHE	1	3.33	3	10
NAUSEA AND VOMITING	1	3.33	2	6.66
DROWSINESS	1	3.33	17	56
THROMBOSIS AT THE SITE OF INJECTION	-	-	-	-

As regards to recovery, it was assessed with steward score in both groups. The group I patients receiving propofol, the score ranged from 4-6 with a mean of 5.86. The same ranged from 3-6 with mean score of 4.6 in thiopentone group. Recovery time in propofol group ranged from 3-16 minutes

with a mean recovery time of 8.67 minutes. Recovery time in thiopentone group ranged from 5-23 minutes with a mean recovery time of 10.86 minutes. Thrombosis at the site of injection was not noted in both the groups.

**SIDE EFFECTS OF PROPOFOL AND THIOPENTONE**



**TABLE VIII**

	PROPOFOL	THIOPENTONE
RECOVERY TIME [MIN]	8.67	10.86
STEWARD SCORE	5.86	4.6

**DISCUSSION**

An ideal induction agent should have the following characteristics.

1. Smooth induction and recovery.
2. Should produce the effect in one arm brain circulation.
3. Should have a dependable cardio vascular stability.

4. Should be free from side effects like nausea, vomiting, abnormal muscle movement and headache.

5. Should have a rapid recovery without any hangover.

Inspite of the advent of so many intravenous anaesthetics for e.g., Propomid, etomidate, Althesin, diazepam, Ketamine and midazolam etc,



thiopentone has stood the test of time for so many years and still continues to reign supreme as an ideal induction agent. But thiopentone is not without side effects. In search for suitable alternative one of the drug which has come into the arena is propofol. An attempt is to compare both drugs namely thiopentone and propofol with an aim of evaluating, the beneficial effects or otherwise which may be possessed by propofol over thiopentone. Taking into consideration of the above ideal requisites one by one, the following were made.

Both the drugs produced a smooth loss of consciousness in a comparable time 31.70 seconds of propofol and 30.60 seconds of thiopentone and in this aspect they do not differ from each other. This goes well with the findings of that of Paul F White [1988] adapted from Frapen and Avram 1986.

#### **Local Tissue reactions**

Even though no tissue necrosis was observed in both the groups, the incidence of pain at the site of injection was significantly higher in propofol group [40%] when compared to an incidence of [16%] in the thiopentone group. The higher incidence of pain at the site of injection coincides with the findings of D.N. Stokes et al 1989 who have reported as incidence of 45% and also that Paul.F. White 1988. This also occurs with the findings of John W. Dundee 1989 who reported an incidence of 39%.

As regards the alteration in the pulse rate, the increase shown in both groups did not show a significant difference as it was 2 bpm with propofol and 3.71 bpm with thiopentone. In this respect both the agents produced similar effects. Likewise two [6.6%] patients in propofol group and 2 patients [6.6%] showed almost equal reduction in pulse rate which is not statistically significant. This goes very well with the findings of Milligar et al 1987, but not with that of gold et al 1989 who have reported a lower heart rate in propofol group throughout the induction time.

#### **Systolic arterial pressure**

Variations were significant only with reference to its decrease, as the increase in the quantum and the number of patients were almost similar in both the groups. The patients induced with propofol showed a mean decrease in SAP of 14.28mm Hg as compared to 5.9mm Hg in thiopentone group, which is significant.

#### **Diastolic arterial pressure**

Reduction in the diastolic arterial pressure at the end of 3minutes in the propofol group was to the tune of 7.44mm Hg, when compared to only 2 mm Hg with the thiopentone group. This is of significant value.

#### **Mean arterial pressure**

Here again the reduction in mean arterial pressure was noted as the overall cardio-vascular effect, where propofol showed a decrease of 9.32 mm Hg as compared to 3.66mm Hg with regard to thiopentone. This again is a significant difference to show that propofol produces a higher decrease in mean arterial pressure on a comparison with thiopentone. The above findings accord with the observations of gold M.I et al 1989 and also Paul F. White. 1988.

#### **Respiratory effects**

A period of apnoea lesser than 30 seconds showed a higher incidence in thiopentone group [36%] when compared to propofol [10%], whereas the incidence of apnoea to a greater extent 30 seconds to 60 seconds was seen with propofol 33.33% when compared to thiopentone i.e., by 10% and prolonged period of apnoea was a significant feature of propofol. This favourably coincides with the findings of John W.Dundee 1989. The incidence of apnoea were also mentioned by skues M.A and prys Robert 1989 and Paul F.White 1988.

#### **Post- Operative Side effects**

A comparison of the side effects showed the following findings.

**Nausea and Vomiting:** found in 3.33% of the cases belonging to propofol group where as it was 6.66% in the thiopentone group. This difference in the incidence of nausea and vomiting is a

significant finding though the incidence of vomiting was reported to be absent in the study of Skues M.A and Pyre Robert 1989 and Craig J.Coopet et al 1982.

**Headache:** The incidence of headache was comparable in both the groups to the extent of 3.33% with propofol and 10% with thiopentone. The incidence of headache in this study concurred with the findings of Craig et al 1982 with respect to thiopentone alone. There was also positive findings of incidence of headache with propofol which was not reported by the same authors, in this aspect it differs from the observation of the same authors.

**Recovery Characteristics:** The recovery score by steward score showed a higher value for propofol 5.86 on a comparison with thiopentone 4.6 which is statistically significant. As regards the recovery time, not much of difference is seen between both the groups namely 8.67 minutes and 11.3 minutes with thiopentone. A significant difference in recovery time was noted by Craig J.Cooper et al 1982 namely 7.2 minutes with thiopentone and 2.8 minutes with propofol which do not accord with the observation of our study. The observations regarding the recovery time concurs with findings of K.Kortilla et al 1984 which was 15.9 minutes for propofol and 21 minutes for thiopentone.

Post-operative drowsiness has a valid relevance in this study because this decides the street fitness of the patients after anaesthesia. Propofol had a significant edge over thiopentone in this respect because of the fact that 56% of patient exhibited drowsiness with thiopentone as against 3.33% with respect to propofol. This favourably concurs with the views of Crag J.Cooper et al 1982. K.Kartilla et al 1987, gold M.I et al 1989 and Paul F.White 1989 who reported the clear headedness and alertness of the patients. The above said authors employed sophisticated measurement of the psychomotor functions namely choice reactions time. P-deletion test, post box test to denote the less residual effect of propofol.

## CONCLUSION

The induction time and its smoothness, the incidence of cardiovascular, respiratory effects and post-operative incidence of headache, nausea, vomiting and drowsiness were studied. A special study on the recovery characteristics were made with an idea of the suitability as an induction agent for day care surgery. It was found that the induction times were almost equal. The Cardiovascular effects were significant with propofol with regards to mean arterial pressure. Respiratory depression for a longer period in more number of patients were observed in propofol group. Other complications were almost equal. The significant fact was the negligible incidence of drowsiness.

Based on the above facts it is concluded that propofol can be used as an ideal induction agent for day care surgery, keeping in mind the respiratory depression and cardiovascular effect where a judicious and cautious approach and vigilant monitoring is required.

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