Original Research Article

Indian Journal of Anesthesia and Analgesia
January – February 2020; 7(1) (Part - I): 143-149
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.7120.20

A Comparative Study between Thiopental Sodium and Etomidate on Hemodynamic Response in Adult Treated Hypertensives Scheduled for Elective Surgery

V Praveen Kumar[1], J Hymavathi[2]

[1,2]Assistant Professor, Department of Anesthesiology, Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana 500055, India.

Abstract

Context: Ideal drugs used for anesthesia for induction should counter the response to stress at the same time not affecting the changes in the hemodynamics of the patient. This is required because induction is an important part in anesthesia. *Aim:* To compare hemodynamic response to induction of anesthesia with thiopentone or etomidate in adult treated hypertensive patients. *Settings and Design:* Present hospital based comparative study was carried out at Adichunchanagiri Institute of Medical Sciences, BG Nagar, Bellur. *Methods:* 60 adult treated hypertensive patients of either sex, aged between 29 and 61 years, belonging to ASA I and II who were randomly allotted to Two Groups of 30 each. Group T received 5 mg/kg of thiopentone sodium and Group E received Etomidate 0.3 mg/kg. Pulse rate, systolic, diastolic and mean arterial pressures both after premedication (level 0) and at every minute for five minutes (levels 1–5) postinduction with both drugs were recorded. *Statistical Analysis:* The data was analyzed using *t*-test for comparing mean values between Two Groups. *Results:* SBP fell to 120 ± 28.8 from 131.70 ± 16.03 (level 0) in Group T and fell to 120.80 ± 20.05 from 131.23 ± 16.03 (level 0) in Group E. DBP had a slight fall to 77.73 ± 17.00 at 4 minutes in Group T. MAP fell from 94.52 ± 12.10 (level 0) to 91.72 ± 21.34 in Group T and fell from 96.96 ± 12.96 (level 0) to 90.37 ± 17.51 in Group E. Comparison of variations in heart rate, SBP, DBP and map from level 0 to postinduction recordings at 1–5 levels between Two Groups was insignificant ($p > 0.05$). Patients in both Groups did not have any side effects. *Conclusion:* Both drugs are comparable in efficacy and safety. Thiopentone comparatively has better cost effectiveness and ease of availability.

Keywords: Thiopental sodium; Etomidate; Hemodynamic response; Hypertension; Surgery.

How to cite this article:
V Praveen Kumar, J Hymavathi. A Comparative Study between Thiopental Sodium and Etomidate on Hemodynamic Response in Adult Treated Hypertensives Scheduled for Elective Surgery. Indian J Anesth Analg. 2020;7(1 Part -I):143–149.

Introduction

Hypertension is extremely common, affecting over one billion people worldwide, and is responsible for over seven million deaths annually. In 2000, total number of hypertensive patients were 972 million and by 2025, 1.6 billion will be suffering from hypertension.[1]

When the cause for the hypertension is not known, it is called the essential hypertension. It is a

Corresponding Author: J Hymavathi, Assistant Professor, Department of Anesthesiology, Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana 500055, India.

E-mail: hymajakki@gmail.com

Received on 22.10.2019, **Accepted on** 28.11.2019

well-known fact that hypertension is an important risk-factor for cardiovascular diseases. During anesthesia such patients are prone to develop a lot of variations in the blood pressure. During induction the arterial blood pressure falls drastically. They are also prone to hyperresponsiveness to intubation and laryngoscopy.[2]

Ideal drugs used for anesthesia for induction should counter the response to stress at the same time not affecting the changes in the hemodynamics of the patient. This is required because induction is an important part in anesthesia. Thiopentone was the first agent which acts very fast and also aids in increasing the oxygen concentration.[3]

Etomidate is also a fast-acting hypnotic agent but not a barbiturate like thiopentone. It does not cause side effects related to respiratory system and also the cardiovascular system. Studies have proved that it has few adverse effects.

It is a relatively new agent.[4] In routine practice the anesthetic agent of choice is desired which will have minimum adverse effects especially with known cases of hypertension.[5]

Hence, study was undertaken to compare hemodynamic response to induction of anesthesia with thiopentone or etomidate in adult treated hypertensive patients. A note was also made of costeffectiveness of each drug.

Materials and Methods

Study Design

A hospital based comparative study with 60 adult elective surgical hypertensive patients, 30 in Group T (Thiopental) and 30 patients in Group E (Etomidate) was undertaken to study the hemodynamic response to induction of anesthesia with thiopentone or etomidate between January 2011 to September 2012. The number of patients was 22 in general surgical category, 18 in orthopedic and 20 in gynecological category.

Sources of data

Data was randomly collected from 60 ASA II adult treated hypertensive patients aged between 29–61 years scheduled for elective surgeries at Adichunchanagiri Institute of Medical Sciences, BG Nagar, Bellur for a period of two years September (2010–2012).

Inclusion criteria

1. Patients of age 29–61 years;
2. Patients with controlled essential hypertension.

Exclusion criteria

- Patients not willing to participate, ASA III and above;
- End organ damage, emergency surgeries;
- Co-morbid conditions like epilepsy, COPD etc. Obstetric, Pediatric and obese patients;
- Patients with shock;
- Drug allergies.

Methods

Institutional ethical committee permission was taken. Written informed consent was taken from all eligible patients included in the study. Sample size was 60 patients undergoing elective surgeries. This was a prospective comparative study. The patients were divided into Two Groups as follows:

Group E - Inj. Etomidate: 30 patients;

Group T - Inj. Thiopental sodium: 30 patients.

Patients found fit on preanesthetic examination were posted for surgery. A detailed history was obtained. Thorough clinical examination of each and every patient was carried out. Surgical profile was also carried out for all patients. Tablet alprazolam as well as tablet ranitidine was given in the night before surgery. Patients were also advised to continue their antihypertensive drugs.

Hemodynamic parameters before surgery were noted. Then, after giving drugs like glycopyrrolate, midazolam and fentanyl and after giving oxygen and once the patient stabilized, hemodynamic parameters were again recorded and marked as level 0 recording. Group E patients were given general anesthesia with etomidate 0.3 mg/kg body weight. Group T patients were given general anesthesia with thiopentone 5 mg/kg body weight. Both Group patients received vecuronium afterwards.

Later all hemodynamic parameters were observed and noted down at 1, 3, 4, and 5 minutes after induction. Routine ECG monitoring was carried out for all patients. Complications were observed and noted down from induction of anesthesia till 24 hours after.

Statistical Methods

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented

on Mean ± SD (Min./Max.) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance.

Results

Table 1 shows distribution of all the patients as per type of surgery done. Majority of the patients underwent general surgery followed by gynecology surgery and rest orthopedic surgery.

Table 1: Distribution of all the patients as per type of surgery done

Type of surgery	Nos.	Percentage (%)
General surgery	22	36.7
Orthopedic surgery	18	30
Gynecology surgery	20	33.3
Total	60	100

Table 2 shows comparison of Two Groups of patients on different variables. There were 14 male (46.7%) and 16 females (53.3%) in Group –T. There were 14 male (46.7%) and 16 females (53.3%) in Group –E. The mean age, mean weight were comparable in Two Groups of patients. Both the Groups were also comparable in terms of duration of hypertension and also in terms of various age Groups.

Table 2: Comparison of two groups of patients on different variables

Variables		Group T		Group E		Chi-square/ *t*-value	*p*-value
		%	Nos.	%	Nos.		
Gender	Male	14	46.7	14	46.7	0.06696	0.7958
	Female	16	53.3	16	53.3		
Duration of hypertension	< 6 months	22	73.3	26	86.7	3.476	0.4815
	6 months 1 year	4	13.3	3	10.0		
	1–2 years	2	6.7	0	0.0		
	3–5 years	1	3.3	1	3.3		
	> 5 years	1	3.3	0	0.0		
Age (years)	< 30	01	3.3	01	3.3	1.111	0.8925
	31–40	05	16.7	04	13.3		
	41–50	11	36.7	11	36.7		
	51–60	13	43.3	13	43.3		
	> 60	0	0.0	1	3.3		
Mean Weight (kg)		52.43 ± 9.53		50.63 ± 9.40		0.7365	0.4644
Mean Age (years)		48.93 ± 7.80		49.90 ± 8.83		0.4509	0.6537

Table 3 shows comparison of Two Groups of patients for treatment received. 14 patients in the group T and 17 in group E received Calcium channel blockers. Four patients in group E received Calcium channel blockers with Beta blockers. Six patients in each group received beta blockers. Two patients in each group received ACE inhibitors.

Table 3: Comparison of two groups of patients for treatment received

Treatments	Group T (n = 30)		Group E (n = 30)	
	Nos.	%	Nos.	%
Calcium channel blockers	14	46.7	17	56.7
Calcium channel blockers with Beta blockers	0	0.0	4	13.3
Beta blockers	6	20.0	6	20.0
ACE inhibitors	2	6.7	2	6.7
ARB with Diuretics	2	13.3	1	3.3
ARB	3	10.0	0	0.0
Alpha blockers	1	3.3	0	0.0

Table 4 shows comparison of Two Groups of patients on fundus changes. The number of patients with normal study of funds Group T – 5 (16.7%); Group E – 3 (10.0%). The number of patients with hypertensive changes on fundus study – Group-T – 25 (83.3%); Group-E – 27 (90.0%).

Table 4: Comparison of two groups of patients on fundus changes

Fundus	Group T (*n* = 30)		Group E (*n* = 30)	
	Nos.	%	Nos.	%
No change	5	16.7	3	10.0
Change present	25	83.3	27	90.0
Fundus I	11	36.7	9	30.0
Fundus II	14	46.7	18	60.0

Table 5 shows comparison of two Groups of patients on complications. The number of patients with Grade I hypertensive change Group-T – 11 (36.7%); Group –E – 9 (30.0%). The number of patients with Grade II hypertensive changes Group-T – 14 (4.7%); Group –E – 18 (60.0%)

Table 5: Comparison of two groups of patients on complications

Complications	Group T (*n* = 30)		Group E (*n* = 30)	
	Nos.	%	Nos.	%
No complication	30	100.0	29	96.7
Complication present	0	0.0	1	3.3
Vomiting	0	0.0	1	3.3

Table 6 shows comparison of Two Groups of patients on pulse rate. No patient in group T had any complication while one patient in group E had post-operative nausea and vomiting.

Table 6: Comparison of two groups of patients on pulse rate

Pulse rate	Group T	Group E	*p*-value
Level – 0	82.03 ± 15.32	81.47 ± 11.56	0.872
1 minute	90.00 ± 19.24	84.00 ± 14.02	0.173
2 minutes	89.03 ± 19.64	86.83 ± 9.70	0.584
3 minutes	88.43 ± 19.12	87.13 ± 10.22	0.744
4 minutes	87.47 ± 18.43	86.60 ± 11.91	0.829
5 minutes	85.90 ± 17.15	84.03 ± 12.28	0.630

Table 7 shows comparison of Two Groups of patients on Systolic Blood Pressure (SBP). The mean values of SBP in both the Groups were comparable i.e. similar at all levels. Thus, both the drugs exerted similar effect on the SBP in both the group patients.

Table 7: Comparison of two groups of patients on systolic blood pressure (SBP)

SBP mm Hg	Group T	Group E	*p*-value
Level – 0	131.70 ± 20.73	131.33 ± 16.03	0.939
1 minute	122.83 ± 22.5	124.17 ± 21.04	0.813
2 minutes	120.43 ± 25.64	120.80 ± 20.05	0.951
3 minutes	120.67 ± 28.16	126.50 ± 25.67	0.405
4 minutes	120.63 ± 28.8	126.73 ± 22.97	0.368
5 minutes	120.00 ± 28.8	127.47 ± 22.08	0.264

Table 8 shows comparison of Two Groups of patients on Diastolic Blood Pressure (DBP). The mean values of DBP in both the Groups were comparable i.e. similar at all levels. Thus, both the drugs exerted similar effect on the DBP in both the group patients.

Table 8: Comparison of two groups of patients on diastolic blood pressure (DBP)

DBP mm Hg	Group T	Group E	*p*-value
Level – 0	78.30 ± 11.00	79.77 ± 9.76	0.587
1 minute	79.43 ± 18.87	80.07 ± 18.74	0.897
2 minutes	79.67 ± 17.48	77.30 ± 14.53	0.571
3 minutes	78.90 ± 17.99	81.73 ± 17.50	0.539
4 minutes	77.73 ± 17.00	81.80 ± 15.51	0.337
5 minutes	80.13 ± 24.91	81.73 ± 13.07	0.756

Table 9 shows comparison of Two Groups of patients on Mean Arterial Blood Pressure (MAP). All the variations in heart rate, SBP, DBP and MAP remained within acceptable range and tended to return towards level-0 at the end of study period in both Groups. All changes were self-corrective without the need for intervention on our part.

Table 9: Comparison of two groups of patients on mean arterial blood pressure (MAP)

MAP mm Hg	Group T	Group E	*p*-value
Level – 0	94.52 ± 12.10	96.96 ± 12.96	0.396
1 minute	93.22 ± 19.30	93.07 ± 19.72	0.976
2 minutes	92.90 ± 19.97	90.37 ± 17.51	0.604
3 minutes	93.19 ± 21.70	94.50 ± 20.36	0.810
4 minutes	91.06 ± 19.35	94.23 ± 17.71	0.513
5 minutes	91.72 ± 21.34	95.00 ± 15.96	0.503

Discussion

We found that the HR increased from 82.03 ± 15.32 to 90.00 ± 19.24 immediately after induction with thiopentone. These findings are in accordance with those studies done by Roberts CP et al.[6], Arnow JT et al.[7] and Gauss A et al.[8], but not in accordance with the study of Singh R et al.[9] This may be due to peripheral vasodilation leading to reflex tachycardia.

The HR decreased from 81.47 ± 11.56 to 87.13 ± 10.22 with etomidate. These findings are in accordance with those studies done by Singh R et al.[9] but not in accordance with the study of Criado A et al.[10], Gooding JM et al.[11] and Colvin MP et al.[12]

We observed that in terms of heart rate at all levels, both the Groups were not much difference from each other. These findings are in accordance with those studies done by Joyce JT et al.[13], Robert JF et al.[14] and Arnow JT et al.[7] but not in accordance with the study of Arnow JT et al [7] study. In the present study, the SBP ranged from 110–180 mm Hg. None of the patients with an SBP of > 180 mm Hg or DBP of > 110 mm Hg was included in the study.

But Howell SJ et al. study state that a systematic review and meta-analysis of 30 observational studies has shown that patients with preoperative systolic blood pressure of > 180 mm Hg or diastolic blood pressure of > 110 mm Hg, are more prone for perioperative ischemia, arrhythmias and cardiovascular lability.[15]

Hence, the results of our study cannot be extended to a group of population where SBP is > 180 mm Hg or DBP is > 110 mm Hg. In our study, the SBP in both the Groups decreased from 131 ± 20.73 to 120 ± 28.8 in Group T and from 131.23 ± 16.03 to 120.80 ± 20.05 in Group E.

In our study, DBP varied as follows: In group the increase was from 78.30 ± 11.00 to 80.13 ± 24.91 at level 5 and also showed decrease from 78.30 ± 11.00 to 77.73 ± 17.00 at level 4. In Group E, it is increased from 79.77 ± 9.76 to maximum of 81.73 ± 13.07 at level 5 and showed decrease from 79.77 ± 9.76 to 77.30 ± 14.53. These findings are in accordance with

those studies done by Roberts CP et al.[6] and Gauss A et al.,[8] Colvin MP et al.[12] and Criado A et al.[10] but not in accordance with that of Gooding JM et al.[11], and Gauss A et al.[8]

In our study, the MAP decreased from 94.52 ± 12.10 at level zero to 91.72 ± 21.34 at 5 minutes in Group T and from 96.96 ± 12.96 at level zero to 90.37 ± 17.51 at 2 minutes in Group E. These findings are in accordance with those studies done by Singh R et al.,[9] Cradio A et al.[10], Colvin MP et al.[12] and Singh R et al.[9] but not in accordance to Gooding JM et al.[11]

We found that HR, SBP, DBP and MAP were similar in both the groups. These findings are in accordance with those studies done by Joyce JT et al.[13], Robert JF et al.[14] and Arnow JT et al.[7] but not in accordance to Gauss A et al.[8] In our study patients in either group did not complain of any pain on injection. This is probably because of use of etomidate Lipuro - an advanced formulation (etomidate in lipid emulsion). Doenicke AW et al.[16] study has shown that lipid formulation of etomidate is associated with much lower incidence of pain on injection, thrombophlebitis and histamine release on injection. Van Eeden AF et al.[17] study has shown that there was 20–25% incidence of pain on injection with etomidate. However, propylene glycol formulation of etomidate has been used in this study.

Hence, our study correlates with that of Doenicke MW et al.[18] However, a comparative study between etomidate in lipid emulsion with etomidate in propylene glycol has to be carried out. One patient in Group E had vomiting which was amenable to treatment. The postoperative nausea and vomiting which is being attributed to etomidate can also be due to fentanyl premedication. Gregory G et al.[19] study showed that among 105 children who received etomidate for rapid sequence intubation, three patients vomited within 10 minutes of injection. Hence, our study correlates with that of Gregory et al. All the patients in the present study were followed up for 24 hours postoperatively and no hemodynamic instability have been noted. The major and well-known side effect of etomidate, adrenocortical suppression has not been studied in the present work.

A word about cost – effectiveness

Thiopentone

500 mg vial of thiopentone (Neon lab) costs about a maximum retail price of ₹40/-. Recommended dose for induction of anesthesia is 5 mg/kg which implies that a two 500 mg vials can be used for 3 patients weighing about 60 kg after reconstitution and storage. Hence, for a total of 30 patients, 20 vials which costs about ₹800/- have been consumed.

Etomidate

Etomidate Lipuro (B Braun) is supplied in a 20 mg (2 mg/ml) ampoule. Each ampoule costs ₹490/. Recommended dose being 0.3 mg/kg which implies one ampoule can be used for only one patient weighing about 60 kgs. Hence, for a total of 30 patients, 30 vials, costing to about ₹14,700/- have been consumed. In our study, considering the number of patients (30 in each Group), we found thiopentone to have better cost effectiveness and ease of availability when compared to etomidate.

Conclusion

We conclude from our study that both thiopentone and etomidate have similar and safe hemodynamic profile when used in adult treated hypertensive patients. Thiopentone comparatively has better cost effectiveness and ease of availability.

Key Messages

Thiopentone due to its costeffectiveness and easy availability should be used in adult treated hypertensives scheduled for elective surgery.

References

1. Sapkota S, Sherpa M, Bhattarai B. Incidence of hypertension in patients undergoing surgery at Dhulikhel Hospital: Kathmandu University Hospital. Kathmandu Univ Med J 2011;34(2):40–43.
2. William B Kennel. Hypertension update, heart disease epidemiology study, National Institute of Health Framingham, Massachussets 1978 June, 1. Dundy.
3. Forman SA. Clinical and Molecular Pharmacology of Etomidate. Anesthesiol 2011; 114(3):695–707.
4. Saddler JM, Devon R, Hospital E. Anesthesia and Hypertension. UK page 11–13.
5. Lundy JS. Intravenous anesthesia: Preliminary report of the use of two new thiobarbiturates. ProcMayo Clinic 1935;10:536–43.
6. Roberts CP, Greene LT, Meloche R, et al. Studies of anesthesia in relation to hypertension II: Hemodynamic consequences of induction and endotracheal intubation. Br J Anesth 1971;43:531–46.
7. Arnow JT, Hess W, Klein W. Etomidate,

alfathesinin and thiopentone as induction agents for coronary artery surgery. Canadian Anesth Soc 1980 July;27(4):338–44.

8. Gauss A, Heinrich H, Wilder-Smith OHG. Echo cardio-graphic assessment of the hemodynamic effects of propofol: A comparison with etomidate and thiopentone. Anesth 1991 Feb;46(2):99–105.
9. Singh R, Choudhary M, Kapoor PM, et al. A randomized trial of anesthetic induction agents in patients with coronary artery disease and left ventricular dysfunction. Ann Cardiac Anesth 2010;13(3):217–23.
10. Criado A, Maseda J, Navarro E, et al. Induction of anesthesia with etomidate:hemodynamic study of thirty-six patients. Br J Anaesth. 1980 Aug;52(8):803–805.
11. Gooding JM, Corssen G. Cardiovascular effects of etomidate. Anesth Analg. 1977 Sep-Oct;56(5):717–19.
12. Colvin MP, Savage TM, Newland PE, et al. Cardio respiratory effects of etomidate in patients with cardiac disease. Br J Anesth 1979;51:551.
13. Joyce JT, Roizen MF, Eger EI. Effects of thiopentone induction onsympathetic activity. Anesthesiol 1983;59(1):19–22.
14. Robert JF, Nancy C. Comparison of a newer formulation of etomidate with thiopentone: Side effects and awakening times. Anesthesiol 1979;50:242–44.
15. Howell SJ, Sear JW, Foex P. Hypertension, hypertensive heart disease and perioperative cardiac risk. Br J Anesth 2004;92(4):570–83.
16. Doenicke AW, Roizen MF, Hoernecke R, et al. Solvent for etomidate may cause pain and adverse effects. Br J Anesth 1999;83(3):464–66.
17. Van Eeden AF. Etomidate and; or Anesthetic Induction A Clinical Comparison between Methohexitone. S Afr Med J 1980;57(8):278–79.
18. Mayer M, Doenicke A, Nebauer AE, et al. Propofol and etomidate-Lipuro for induction of general anesthesia. Hemodynamics, vascular compatibility, subjective findings and postoperative nausea. Anesthetist 1996 Nov;45(11):1082–84.
19. Guldner G, Schultz J, Sexton P, et al. Hemodynamic effects and adverse events following etomidate for rapid: Sequence intubation in young children. Acad Emer Med 2003;10:134–39.