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A Comparative Study between Propofol and Etomidate for Induction During General Anaesthesia

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Abstract

Background: Propofol and Etomidate are non-barbiturate inducing agents. These drugs have different induction characteristics and recovery profiles. Propofol causes pain at the injection site, and hypotension but has clear-headed recovery whereas Etomidate is cardio-stable but can cause myoclonus.

Objective: The purpose of this study is to compare Propofol and Etomidate on induction characteristics i.e. loss of eyelash reflex, pain at the injection site, myoclonus, hemodynamic parameters and recovery profile.

Methods: 60 patients of ASA grade I and II, age group 18-55 years scheduled for the elective surgical procedure under general anaesthesia were randomly divided into two groups of 30 patients each. Patients in the group -I was induced with inj. Propofol (3mg/kg) i.v and patient of the group -II were induced with inj. Etomidate (0.3 mg/kg) i.v.

Onset time i.e. time to the disappearance of eyelash reflex, pain at the injection site and myoclonus, were noted. Continuous hemodynamic monitoring i.e. HR, SBP, DBP, MAP and recovery profile was done. All the results were tabulated and statistically analysed.

Result: Patients in the etomidate group showed little change in mean arterial pressure (MAP) and heart rate (HR) compared to propofol ($p > 0.05$) from baseline value. Pain on injection was higher in the propofol group while myoclonus activity was higher in the etomidate group.

Conclusion: This study concludes that etomidate is a better agent for induction than propofol because of hemodynamic stability and less pain on injection.

Keywords: Propofol, Etomidate, Mean arterial pressure; Heart rate; Pain; myoclonus; loss of eyelash reflex; recovery profile.

Introduction

Since the introduction of general anaesthesia, no ideal induction agent has yet been discovered in terms of providing stable haemodynamics during endotracheal intubation. All methods used for induction of anaesthesia, it is aimed to preserve the haemodynamic balance and to provide optimal conditions for the patient by reducing side effects.(1)

Traditionally anaesthesia was induced by inhalational anaesthetic agents i.e. Ether and chloroform, later some other inhalation agents were also introduced i.e. Halothane, Isoflurane and Sevoflurane. Inhalational

agents have slower onset and longer residual effects . Some cause irritation to respiratory mucosa, coughing, bronchospasm and marked haemodynamic changes.[2]

These effects can be overcome by using intravenous anaesthetic agents. The introduction of intravenous anaesthetic agents in the 1930s caused a major shift in the concept of anaesthesia by replacing the inhalation anaesthetic agents with intravenous anaesthetic agents.[3]

The Thiopentone sodium developed and researched by John Lundy and was clinically introduced in 1934 by Ralph M. Water at the University of Wisconsin Medical School (Madison, USA) was the first licensed intravenous anaesthetic induction agent used for induction of anaesthesia. [4]

Thiopentone sodium was the leading inducing agent of choice for the next 50 years. It causes bronchospasm and apnea. For these reasons, Thiopental is less commonly used nowadays.

Gradually newer intravenous anaesthetic induction agents were introduced such as Ketamine, Propofol and Etomidate. [2]

Propofol and Etomidate are non-barbiturates and are the most popular, acting and smooth intravenous-inducing agents. [5]

Propofol (2,6-diisopropyl phenol) is the most commonly used induction agent in general anaesthesia, due to its rapid onset and short duration of action. Propofol decreases blood pressure, cardiac output and systemic vascular resistance due to inhibition of sympathetic vasoconstriction and impairment of baroreceptor reflex regulatory system. Hypotension and pain on injection are the major drawbacks. [6]

Etomidate is a carboxylated imidazole-containing compound characterized by haemodynamic stability, minimal respiratory depression and cerebral protective effects. Its lack of effect on the sympathetic nervous system, baroreceptor reflex regulatory system and increase in coronary perfusion even in patients with moderate cardiac dysfunction makes it an induction agent of choice in cardiac patients.[7]

The most important side effect of Etomidate is myoclonus. Myoclonus is a serious problem in patients with open globe eye injury and nonfasting condition. One of the most important, but rare side effects of this drug is the suppression of steroid production by reversible inhibition of the 11-beta-hydroxylase enzyme.[8]

Various other studies have been done in the past to compare the different anaesthetic agents for induction of general anaesthesia. When Propofol is used alone causes pain at the injection site and hypotension. When Etomidate is used alone is haemodynamically stable but causes myoclonus. So in search of an ideal induction agent, we conducted the study to evaluate Propofol, and Etomidate for induction, haemodynamic stability and their side effects.[9]

Material and Method

The present study entitled **"A comparative study between Propofol and Etomidate for induction during general anaesthesia"** was carried out in the Department of Anaesthesiology, S.S. Medical College and associated Sanjay Gandhi and Gandhi Memorial Hospitals, Rewa (MP) from April 2016 to March 2018. After approval from the institutional ethical committee, the study was conducted on ninety patients of ASA grade I and II between 18 to 55 years of age of either sex posted for elective surgery under general anaesthesia.

Pre anaesthetic checkup of all patients was done. A thorough preoperative evaluation was done including history, general physical examination, systemic examination, airway assessment and relevant laboratory investigations of all patients.

Inclusion criteria: All the surgical patients of ASA grade I and II between 18 to 55 years of age of either sex posted for elective surgery under general anaesthesia.

Exclusion criteria: Patients with Mallampatti grade III-IV, known hypersensitivity to in. Propofol or Etomidate, Cardiovascular dysfunction, were excluded from the study.

Patients fulfilling the selection criteria were briefly explained about the nature of the study and anaesthetic procedure. A written informed consent was obtained from all the patients and was kept nil orally for at least 6 hrs before surgery.

Ninety patients were randomly divided into three groups of thirty patients each depending on the study drug given.

Group I (n-30) were given Inj. Propofol 2.5mg/kg body weight I.V.

Group II(n-30) were given Inj. Etomidate 0.3mg/kg body weight I.V.

The study drugs were prepared in coded syringes by another resident to make the study blind and unbiased.

After shifting the patients to the operation table, NIBP, ECG and pulse oximeter were attached. Baseline parameters were recorded. An IV line was secured with an 18G IV cannula for fluids and other drug administration.

All the patients were uniformly premedicated with inj Glycopyrrolate 0.01mg/kg body weight, Inj. Midazolam 0.3mg/kg body weight, Inj. Fentanyl 2mcg/kg body weight and injection ondansetron 0.08mg/kg body weight intravenously 15 min before induction.

Pre-oxygenation was done with 100% oxygen for three minutes. The study drugs were provided in coded syringes which were prepared by another resident. Patients were induced by the study drug according to the Group.

After giving the study drug, induction time (from the start of injection to the disappearance of eyelash reflex) was recorded. Pain at the injection site and myoclonus were noted in all the patients. After the loss of eyelash reflex in. Succinylcholine 1.5 mg/kg, was given to facilitate muscle relaxation 60 seconds after injection of succinylcholine endotracheal intubation was done using an appropriate size endotracheal tube Anaesthesia was maintained with O2:N2O (30:70), Sevoflurane 2% and Inj. Atracurium intermittently.

Induction time: The induction time was noted in seconds from the start of injection to the disappearance of the eyelash reflex.

Pain at injection site: Pain at the injection site was assessed in all the patient Groups. The score was noted immediately before the patient lost consciousness.

Myoclonus: The severity of the myoclonus was recorded.

Heart rate, and non-invasive blood pressure (systolic blood pressure, diastolic blood pressure and mean arterial pressure) were recorded at 1 min before induction and 1min after induction, just after intubation and at 2 min, 5min, 10min, 15min, 20min, 30min, 45min,60min at end of surgery.

After surgery, patients were reversed with Inj. Glycopyrrolate 0.5mg and Inj. Neostigmine 2.5 mg and were extubated.

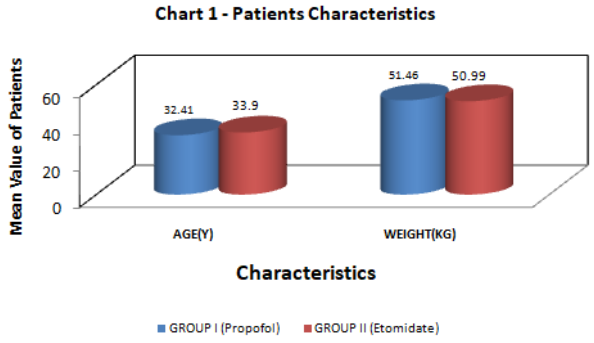
Recovery profile: To assess recovery characteristics after intubation in Propofol, Etomidate and admixture of Propofol-Etomidate Groups, we observed drowsiness, excitement, PONV and cough.

More than 20% fall in MAP below baseline was considered as hypotension and was treated by decreasing Sevoflurane and in. Mephentermine 6mg intravenously. More than a 30% rise in MAP above baseline was considered hypertension. A heart rate less than 60 bpm

was considered bradycardia and a heart rate less than 50 bpm was treated with inj. Atropine 0.6mg intravenously. Heart rate greater than 100 bpm was considered as tachycardia.

At the end of the study, the observation was decoded, tabulated and statistically analysed by using mean, standard deviation, p-value, ANOVA test Chi-square test and student t-test. For comparison, p value less than 0.05 was taken to be statistically significant and less than 0.0001 was taken to be highly significant.

Observation



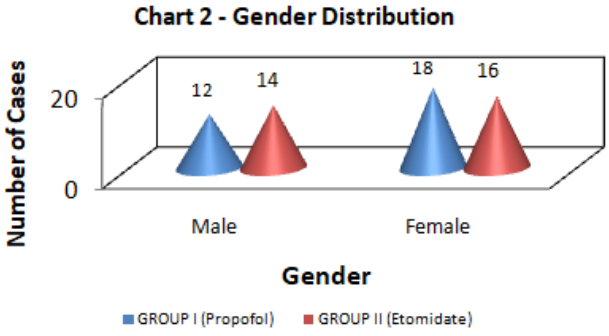
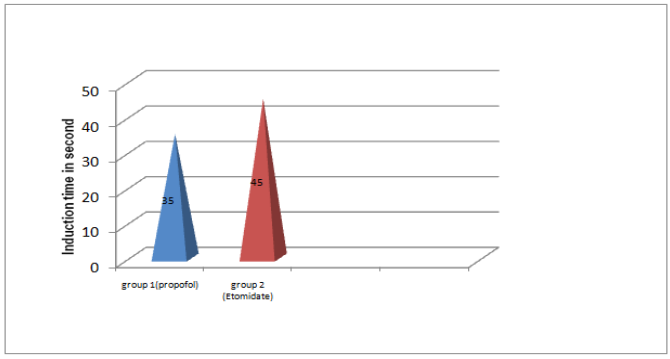
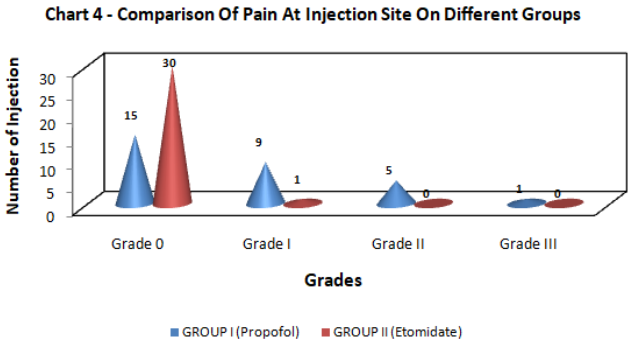
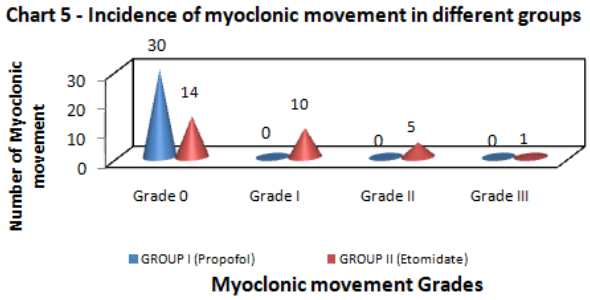


Chart 3: Comparison of induction time in different groups







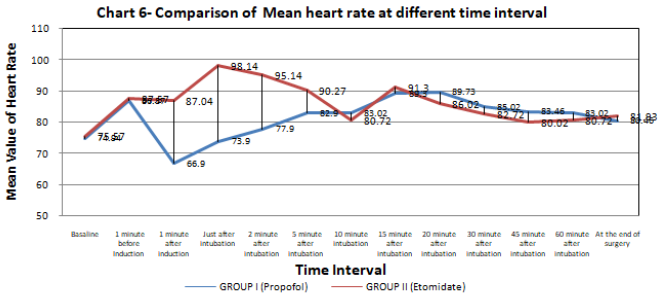


Table 1: Comparison of heart rate at different time interval

Time Interval	Group I (Propofol)	Group II (Etomidate)	p-value
Baseline	74.94 ± 5.78	75.57 ± 4.47	0.5867
1 minute before Induction	86.87 ±5.74	87.57 ± 4.47	0.6004
1 minute after induction	66.9 ± 5.76	87.04 ± 4.40	0.0001
Just after intubation	73.9 ± 5.76	98.14 ± 4.20	0.0001
2 minute after intubation	77.9 ±5.76	95.14 ± 4.20	0.0001
5 minute after intubation	82.9 ±5.78	90.27±4.21	0.0001
10 minute	83.02±9.78	80.72 ± 7.92	0.062

intubation			
15 minute after intubation	89.3 ± 6.32	91.3 ± 3.07	0.124
20 minute after intubation	89.73 ± 9.70	86.02 ± 8.85	0.127
30 minute after intubation	85.02 ± 9.78	82.72 ± 7.92	0.062
45 minute after intubation	83.46 ± 9.78	80.02 ± 7.81	0.138
60 minute after intubation	83.02 ± 9.78	80.72 ± 7.92	0.062
End of surgery	80.46 ± 5.76	81.93 ± 5.81	0.329

Table 2: Comparison of Systolic Blood Pressure at Different Time Interval

Time Interval	Group I (Propofol)	Group II(Etomidate)	P-value
Baseline	120.3 ± 6.12	122.26 ± 4.48	0.1597
1 minute before Induction	119.63 ± 5.33	121.86 ± 4.62	0.089
1 minute after induction	98.6 ± 6.12	119.26 ± 4.48	0.0001
Just after intubation	109.6 ± 6.13	135.26 ± 4.4	0.0001
2 minute after intubation	113.6 ± 6.123	131.26 ± 5.48	0.0001
5 minute after intubation	119.6 ± 6.14	127.26 ± 4.48	0.0001
10 minute intubation	124.7 ± 6.17	124.2 ± 4.52	0.722
15 minute after intubation	123.7 ± 6.57	123.2 ± 4.02	0.723
20 minute after intubation	124.8 ± 6.17	124.2 ± 6.52	0.716
30 minute after intubation	125.7 ± 6.09	125.2 ± 4.52	0.719
45 minute after intubation	125.8 ± 5.18	125.5 ± 5.57	0.813
60 minute after intubation	125.5 ± 6.09	124.6±4.62	0.522
At the end of surgery	126.4 ± 6.22	125.2 ± 4.52	0.396

Table 3: Comparison of Diastolic Blood Pressure at Different Time Interval

Time Interval	Group I (Propofol)	Group II (Etomidate)	P-value
Baseline	77.45 ± 3.99	79.86 ± 5.38	0.052
1 minute before induction	75.51 ±3.99	77.82 ± 5.32	0.062
1 minute after induction	62.2 ± 3.96	75.46 ± 7.08	0.0001
Just after intubation	65.63 ± 3.72	77.00 ± 4.29	0.0001
2 minute after intubation	67.37 ± 3.28	73.00 ± 3.83	0.0001
5 minute after intubation	72.40 ± 2.95	71.43 ± 2.27	0.305
10 minute intubation	72.13 ± 6.25	70.53 ± 5.25	0.287
15 minute after intubation	72.8 ± 5.93	70.73 ± 5.65	0.172
20 minute after intubation	72.06 ± 6.29	70.33 ± 5.99	0.261
30 minute after intubation	74.13 ± 6.25	72.53 ± 5.25	0.287
45 minute after intubation	76.33 ± 4.46	74.46 ± 6.43	0.196
60 minute after intubation	78.60 ± 6.11	76.54 ± 6.56	0.189
At the end of surgery	78.87 ± 5.82	78.16 ± 6.62	0.661

Chart 7: Comparison of Mean Arterial Pressure At Different Time Interval

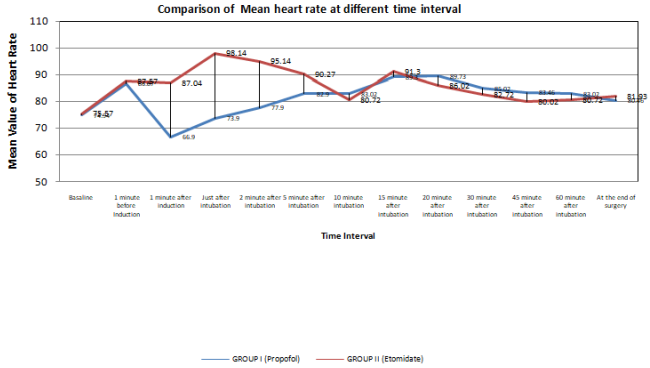
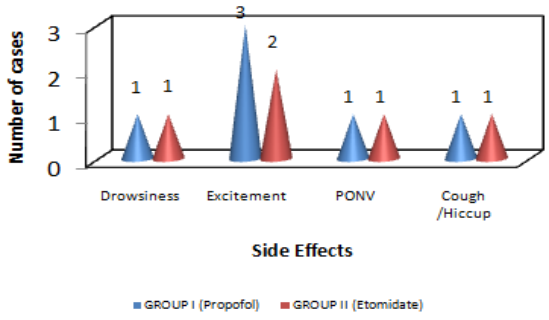


Table 4: Comparison of Mean Arterial Pressure at Different Time Interval

Time Interval	Group I (Propofol)	Group II (Etomidate)	P value(I vs. II)
Baseline	89.26 ± 4.71	88.2 ± 7.47	0.514
1 minute before Induction	85.76 ± 4.72	85.2 ± 7.47	0.730
1 minute after induction	70.26 ± 4.12	83.7 ± 5.94	0.0001
Just after intubation	77.26 ± 4.71	89.36 ± 6.57	0.0001
2 minute after intubation	77.12 ± 4.89	87.86 ± 6.63	0.0001
5 minute after intubation	82 ± 4.89	86.36 ± 7.24	0.014
10 minute intubation	82.13 ± 6.25	80.53 ± 5.25	0.287
15 minute after intubation	84.45 ± 3.37	86.15 ± 5.13	0.135
20 minute after intubation	84.17 ± 5.47	87.62 ± 6.55	0.031
30 minute after intubation	85.73 ± 9.70	82.02 ± 8.85	0.127
45 minute after intubation	85.99 ± 7.51	85.42 ± 4.73	0.726
60 minute after intubation	85.60 ± 6.11	83.54 ± 6.56	0.189
At the end of surgery	85.60 ± 6.11	83.54 ± 6.56	0.189

Chart 08 : Recovery characteristics



Discussion

Induction is a critical step in general anaesthesia. All anaesthetic agents used for induction of anaesthesia aim to maintain stable haemodynamics. Various anaesthetic agents have been used in the past i.e. Inhalational agents,

Thiopantone sodium, Ketamine. Presently Propofol and Etomidate are popular non-barbiturate inducing agents. Due to rapid onset and short duration of action, they are a drug of choice for induction. In recent years combination of various anaesthetic agents has been used to reduce the dose and side effects of individual agents.(9) The present study entitled " A comparative study between Propofol and Etomidate for induction during general anaesthesia " was carried out in the Department of Anaesthesiology, S.S. Medical College and associated Sanjay Gandhi and Gandhi Memorial Hospitals, Rewa (MP) from 2016 to 2018. To find out a better-inducing agent for general anaesthesia. We compare Propofol and Etomidate to the induction characteristics, haemodynamic parameters and recovery profile.

After giving the study drug, induction time (from the start of Injection to the loss of eyelash reflex), pain at the Injection site, myoclonus, haemodynamic parameter and recovery profile were noted in all the patients.

Heart rate and non-invasive blood pressure (systolic blood pressure, diastolic blood pressure and mean arterial pressure) were recorded at regular intervals. All data were recorded, tabulated and statistically analysed using ANOVA, t-test and chi-square test whichever was applicable.

Induction characteristic

Induction time- In our study shows the mean induction time of Group I is 35 ± 10 second, and Group II 45 ± 9 second. The induction time is faster in Group I and Group II (I > II).

Pain at Injection site:-

The incidence of pain at the injection site was higher in Group I as compared to Group II and Group III. The difference in pain at the Injection site was clinically as well as statistically significant ($p < 0.0003$)

The incidence of myoclonus was more in Group II as compared to Group I.

Heart Rate

The baseline mean Heart Rate (HR) in Groups I& II, was 74.94 ± 5.78, and 75.57 ± 4.47 respectively. The baseline heart rate of both Groups is almost equal and the difference in HR was statistically insignificant in all the two Groups. ($P>0.05$)

After induction, the mean HR in Groups I, & II were 66.9± 5.76, 87.04 ± 4.40 respectively. The HR was decreased in patients of both Groups from baseline value. The decrease in HR was more in Group I as compared to Group II. Inter-group comparison of mean HR shows significant differences among both Groups. ($P<0.05$)

Just after intubation as well as after 2 min. of intubation, the mean HR was 73.9 ± 5.76 & 98.14 ± 4.20 and just after intubation and 77.9 ± 5.762, & 95.14 ± 4.20, 2 min after intubation in Group I, Group II, respectively. There was an increase in HR in both Groups from baseline value. However, this increase in HR was more in Group II as compared to Group I. The inter-group comparison shows the difference in the increase in HR was statistically significant in both Groups ($p <0.05$).

After 5 min of intubation, the mean HR was 82.9 ± 5.78, & 90.27 ± 4.21 in Group I, and Group II respectively. There was an increase in HR in both Groups from baseline value. The inter-group comparison shows the difference in increase in HR was statistically significant between Group I &II.

After 10 minutes of intubation and up to the end of surgery, the changes in mean HR were statistically insignificant ($p >0.05$).

Systolic blood pressure

The baseline mean SBP was 120.3 ± 6.12 mmHg, & 122.26 ± 4.48 mmHg in Groups I, and II respectively. The baseline SBP of both Groups are almost equal and

the difference in SBP was statistically insignificant in both Groups. (P> 0.05).

After induction, the mean SBP was 98.6 ± 6.12mmHg,& 119.26±4.48mmHg in Groups I, and II respectively. The SBP was decreased in patients of both Groups from baseline value. The decrease in SBP was more in Group I as compared to Group II. The inter-group comparison shows the difference of decrease in SBP was statistically significant between Group I &II ($p < 0.05$).

After intubation, the mean SBP was 109.6±6.13mmHg, & 135.26 ± 4.4 mmHg in Groups I, and II respectively. There was an increase in SBP in both Groups from baseline value. However, this increase in SBP was more in Group II as compared to Group I. The inter-group comparison shows the difference in increase in SBP was statistically significant in both Groups. ($p < 0.05$).

After 2min as well as after 5 min of intubation, the mean SBP was 113.6 ± 6.12 mmHg, and 131.26 ± 5.48mmHg at 2min after intubation and

119.6 ± 6.14, and 127.26 ± 4.48 mmHg, at 5 min after intubation in Group I, and Group II, respectively.

There was a slight increase in SBP in both Groups from baseline value. The inter-group comparison shows the difference in increase in SBP was statistically significant in Groups I &II.

After 10 min of intubation up to the end of surgery, the changes in mean SBP were statistically insignificant ($p >0.05$).

Diastolic blood pressure

The baseline mean DBP was 77.45 ± 3.99 mmHg, and 79.86 ± 5.38 mmHg, in Groups I, and II respectively. The baseline DBP of both Groups are almost equal and the difference in DBP was statistically insignificant in both Groups. (P> 0.05).

After induction, the mean DBP was 62.2 ± 3.96 mmHg, and 75.46 ± 7.08 mmHg in Groups I, and II respectively. The DBP was decreased in patients of both Groups from baseline value. The decrease in DBP was more in Group I as compared to Group II.

The inter-group comparison shows the difference of decrease in DBP was statistically significant between Group I &II($p < 0.05$).

After intubation, the mean DBP was 65.63 ± 3.728 mmHg, and 77.00 ± 4.29 mmHg, respectively in Group I and II. There was an increase in DBP in both Groups from baseline value. But this increase in DBP was more in Group II as compared to Group I. In the inter-group comparison, the difference in increase in DBP was statistically significant in both Groups. ($p < 0.05$).

After 2 minutes of intubation, mean DBP was 67.37 ± 3.285 mmHg and 73.00 ± 3.833 in Group I, and Group II, respectively. There was a slight increase in DBP in both Groups from the baseline value. The inter-group comparison shows the difference of increase in DBP was statistically significant in Group I &II ($p < 0.05$).

After 5 minutes of intubation, mean DBP was 72.40 ± 2.95 mmHg, and 71.43 ± 2.27 mmHg in Group I, and Group II, respectively. There was a slight increase in DBP in both Groups from the baseline value. The inter-group comparison shows the difference of increase in DBP was insignificant between Group I & II and Group II ($p >0.05$).

After 10 min of intubation up to the end of surgery, the changes in mean SBP were statistically insignificant in patients of both Groups. ($p >0.05$).

Mean arterial pressure

The baseline mean MAP was 89.26 ± 4.71, and 88.2 ± 7.47, in Groups I and II respectively. The baseline MAP of both Groups are almost equal and the difference in MAP was statistically insignificant in both Groups. (P> 0.05).

After induction, the mean MAP was 70.26 ± 4.12 mmHg and 83.7 ± 5.94 mmHg in Groups I, and II respectively. The MAP was decreased in patients of both from baseline value. The decrease in MAP was more in Group I as compared to Group II. The inter-group comparison shows the difference of decrease in MAP was statistically significant between Group I &II ($p < 0.05$).

After intubation, the mean MAP was 77.26 ± 4.71 mmHg and 89.36 ± 6.57 mmHg, respectively in Group I, and II. There was an increase in MAP in both Groups from baseline value. However, this increase in MAP was more in Group II as compared to Group I. The inter-group comparison shows the difference in increase in MAP was statistically significant in both Groups. ($p < 0.05$).

After 2min as well as after 5 min of intubation, mean MAP was 77.12 ± 4.89 mmHg, 87.86 ± 6.63, at 2min after intubation and 82±4.89 mmHg, 86.36 ± 7.24 mmHg at 5 min after intubation in Group I, and Group II respectively. There was a slight increase in MAP in both Groups from baseline value. The inter-group comparison shows the difference in increase in MAP was statistically significant in Groups I &II ($p < 0.05$).

After 10 min of intubation up to the end of surgery, the changes in mean SBP were statistically insignificant in patients of both Groups. ($p >0.05$).

Decreases in HR, SBP, DBP and MAP by Propofol are due to inhibition of the sympathetic nervous system and impairment of the baroreceptor reflex regulatory system.

Minimal changes in HR, SBP, DBP and MAP by Etomidate are due to a lack of effect on the sympathetic nervous system and baroreceptor reflex regulatory system.

Recovery characteristics

In our study, we observed recovery characteristics after intubation. The incidence of drowsiness was found to be equal (3%) in patients of both Groups i.e. Group I, and II respectively.

The incidence of excitement was found to be 3% and 6% in Groups I, and II respectively.

The incidence of PONV & cough/hiccups was found to be 3%, 3%, in Group I, II respectively.

Conclusion

This study concludes that etomidate is a better agent for induction than propofol because of hemodynamic stability and less pain on injection. The only drawback was a high incidence of myoclonus. Therefore we concluded that etomidate is a better drug in patients with hemodynamic fluctuation at Induction. like uncontrolled hypertension, severe illness, septic, and patients with heart disease.

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