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A prospective comparative study to compare cardiovascular response to laryngoscopy and intubation after induction of anaesthesia by propofol and etomidate

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Abstract

Context: Etomidate is having more stable cardiovascular response as compared to propofol during laryngoscopy and intubation.
Aims: The present study compares the effect of propofol and etomidate on cardiovascular response to laryngoscopy and intubation.
Settings and Design: This prospective comparative study was conducted at a tertiary care hospital in central India.
Methods and Material: Hundred healthy patients of both sex aged between 18 to 45 years, ASA physical status I & II, scheduled for elective surgery under general anaesthesia were selected. Patients in group P (n=48) were induced with propofol 2.5 mg/kg i.v. and group E (n=47) were induced with etomidate 0.3 mg/kg i.v. Patients' haemodynamic and cardiovascular parameters were recorded before induction (T1), before intubation (T2) and 1, 3, 5 and 10 minutes afterwards. The haemodynamic parameters before induction i.e. T1 was taken as baseline.
Statistical analysis used: The data was collected using Microsoft Excel software and was analysed using SPSS software version17.0.
Results: There was significant difference regarding systolic blood pressure, diastolic blood pressure and mean arterial pressure among two groups. Hypotension was seen in 18.8% patients in group P after induction while there was none in group E.
Conclusions: Etomidate is having more stable cardiovascular response as compared to propofol during laryngoscopy and intubation.

Keywords: Etomidate, Hypotension, Laryngoscopy propofol.
Key Messages: A comparison of the effect of propofol and etomidate on cardiovascular response to laryngoscopy and intubation.

Introduction

Laryngoscopy is a technique used to examine, inspect and do endotracheal intubation to provide safe airway during surgery. Laryngoscopy is associated with pain and sympathetic stimulation leading to haemodynamic disturbances like tachycardia and hypertension. This sympathoadrenal response results in increased work load on heart and increased myocardial oxygen demand. This increase in cardiac work may be detrimental in susceptible patients and may in turn result in perioperative myocardial ischemia. This response is undesirable in any patient with cardiac disease undergoing surgery irrespective of the type of surgery.

An ideal inducing agent for general anaesthesia should have haemodynamic stability, minimal respiratory side effects and rapid clearance. Presently etomidate and propofol are the commonly used rapid acting inducing agents.[1,2,3]

Propofol is one of the most widely used drugs for induction of general anaesthesia. Satisfactory and fast recovery, shorter half-life, rapid elimination from the blood causing less sedation and vomiting are the reason for using this drug more commonly.[4] The most important side effects of this drug are haemodynamic instability and cardiovascular complications, such as hypotension. Propofol can lead to bradycardia.[5-7] A study conducted on 25000 patients showed that propofol lead to bradycardia in 4.2% of patients.[8] Induction of anaesthesia with propofol could lower blood pressure as much as 25 to 40% in all patients regardless of any underlying conditions.[9,10] Propofol caused hypotension due to the reduction of cardiac preload and afterload and would be intensified by high doses and high speed of injection of drug. This effect is not synchronized with heart's compensatory responses.[11,12]

Etomidate is also short acting drug, which is commonly used for induction and maintenance of anaesthesia.[13] The most important side effects seen with etomidate are nausea and vomiting that may lead to aspiration in patients.[14-16] Etomidate has a important but rare side effect that it supresses steroid production by reversible inhibition of 11 beta hydroxylase enzyme. Induction of anaesthesia by etomidate would lead to a stable haemodynamic condition.[17-22]

Brohon et al[23] studied the effect of propofol or etomidate in combination with alfentanyl or sufentanyl on lumbar spinal surgeries and showed that systolic blood pressure(SBP) decreased in etomidate in combination with sufentanyl or alfentanyl, but not changed in propofol group in combination with each of them.

This study was performed to explore the cardiovascular response during the induction of anaesthesia with etomidate and propofol in elective surgeries under general anaesthesia because of the wide range of consequences and controversies in other studies.

Material and Methods

After having approval from the institutional scientific and ethics committee, a prospective comparative clinical study on 100 patients was undertaken in the Department of Anaesthesiology of a tertiary care hospital in Central India. In this study a total of 100 patients undergoing elective surgery under general anaesthesia were divided randomly in two groups comprising 50 patients each based on a computer generated table available.

Inclusion criteria

- Age 18 to 45 yrs. of both sexes
- ASA grade I and II
- Not allergic to study drugs
- Not having any anticipated airway problems
- Haemodynamically stable

Exclusion criteria

- Patients who were Cormack-Lehane grade 4 after induction of anaesthesia and laryngoscopy.
- Laryngoscopy lasted longer than 30 seconds.
- Receiving higher doses of drugs for induction of anaesthesia than the mentioned doses.

All the patients underwent a thorough pre-anaesthetic check-up and were investigated for all the routine and special investigations. Study was carried out after taking written informed consent from the patients.

Premedication with inj. glycopyrrolate 0.2 mg intravenous (i.v.) was done half an hour before induction.

After the patient was taken in operation theatre an electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximeter were attached. Preoxygenation was done with 100% oxygen for 3 minutes.

Patients were divided into 2 groups of 50 each.

Group P: Induced with propofol 2.5mg/kg i.v.

Group E: Induced with etomidate 0.3mg/kg i.v.

All patients were premedicated with inj. glycopyrrolate 0.2 mg half an hour before induction. After receiving the patient in operation theatre (OT), an intravenous line (IV) was secured with 18G cannula and Ringer lactate drip was started. Thereafter vital parameters of the patient were recorded; including NIBP, pulse rate and oxygen saturation. In OT patient received IV midazolam 0.03 mg/kg and IV fentanyl 2mcg/kg five minutes before induction, and preoxygenated with 100% oxygen for 3 minutes. Injection lignocaine 2% (preservative free) at a dose of 1mg/kg was given and anaesthesia was then induced with propofol at the dose of 2.5mg/kg body weight, and etomidate 0.3 mg/kg body weight, for group P and E respectively. The drug was injected over 30 seconds IV using peripheral vessel cannula until the patient's verbal response was lost. After confirmation of bag and mask ventilation, IV succinylcholine 1.5 mg/kg was used as muscle relaxant in both the groups.

A Macintosh laryngoscope was then used to intubate and an appropriate size endotracheal tube was inserted and cuff inflated immediately. Simultaneously the time taken for laryngoscopy and Cormack-Lehane grade was recorded and after confirmation of the correct placement of the tube it was connected to anaesthesia machine with the help of close circuit. Manual inflation of lungs was continued with nitrous oxide and oxygen mixture (70:30) and inhalational agent isoflurane was used to maintain the anaesthesia. Later on as soon as the spontaneous respiration returned an intermediate relaxant was administered i.e. inj. atracurium 0.5mg/kg and intermittent positive pressure ventilation was continued manually on close circuit. After completion of surgery the patient was reversed with injection neostigmine and injection glycopyrrolate. The patient's haemodynamic and cardiovascular indicators such as systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR) and oxygen saturation (O_2 sat) , end tidal carbon dioxide ETCO2 were recorded before induction (T1), before intubation (T2) and 1(T3), 3 (T4), 5 (T5), and 10 (T6) minutes after intubation.

The haemodynamic parameters before induction i.e. T1 were taken as baseline.

Hypertension was defined as increase in baseline SBP>20%, hypotension <20% of baseline, tachycardia as HR>20% of baseline and bradycardia defined as <60/ minute. Patient with oxygen saturation <90% was considered to be desaturating. The induction was done by the primary investigator and data was recorded by the second investigator who was blinded for the type of induction agent used as he didn't knew the study drug used. The statistical analysis was done using student t test and chi square test.

Results

In this study comprising of 100 patients, 48 were from group P and 47 belonged to group E, five of the patients were excluded as their time for laryngoscopy exceeded 30 seconds. The demographic variables among the two groups were comparable and there was no statistical difference.

The mean time for laryngoscopy for group E was 17.4 ± 3.23 seconds and for group P it was 17.13 ± 2.92 seconds (p=0.66) showing no significant difference. (See Table 2) Laryngoscopy grades among the two groups were not significantly different (p=0.35). In group E 29 patients (61.7%) were Cormack-Lehane grade 1 and 18 patients (38.3%) were grade 2, while in group P 34 patients (70.8%) had grade 1 and 14 patients (29.2%) were grade 2. So it can be said that the haemodynamic parameters were unaffected from these

variables and results would reveal the effect from the drugs.

Table 1: Demographic data in two groups

	Group E	Group P
Gender [M/F]	18/29	29/19
Age [yrs]	32.51±9.13	32.06±9.69
Weight [Kgs]	56.77±6.29	57.98±5.76

Table 2: Time of laryngoscopy in both groups

	Group E	Group P
Time for laryngoscopy (mean±SD) (in sec)	17.40±3.23	17.13±2.92

The observation showed that there was a significant difference among two groups regarding SBP, DBP and MAP (See Table 3, 4, 5) after induction and post intubation period. Hypotension was seen in the group P in 9 patients (18.8%) after induction i.e. at T2 while there was none in group E (P=0.001) which is significant. (See Table 3)

Table 3: SBP at different time in both groups

SBP (mm Hg)	Group E (mean±SD)	Group P (mean±SD)	p value
T_1	109.9±8.6	111.3±7.5	0.42
T_2	107.4±11.6	95.1±7.8	<0.001
T_3	123.2±12.6	110.8±10	<0.001
T_4	115.6±11.7	105.1±10.3	<0.001
T_5	109.5±10.6	100.7±9	<0.001
T_6	105.7±11	97.5±10.9	<0.001

Table 4: DBP at different time in both groups

DBP (mm Hg)	Group E (mean±SD)	Group P (mean±SD)	p value
T_1	66.7±6.9	69.1±6.3	0.072
T_2	62.7±6.9	59.9±5.6	0.032
T_3	78.4±10.9	68.9±7.5	<0.001
T_4	71.5±9.5	64.3±6.8	<0.001
T_5	66.7±9.9	60.8±7.0	0.001
T_6	63.5±9.1	58.3±7.1	0.003

Table 5: MAP at different time in both groups

MAP (mm Hg)	Group E (mean±SD)	Group P (mean±SD)	p value
T_1	80.6±7.0	82.5±6.4	0.18
T_2	76.8±7.8	71.0±5.8	<0.001
T_3	92.7±10.5	82.0±8.2	<0.001
T_4	85.3±8.9	77.5±7.3	<0.001
T_5	78.7±13.1	73.5±6.6	0.017
T_6	77.3±8.6	70.6±7.1	<0.001

Table 6: Heart rate at different time in both groups

HR (per minute)	Group E (mean±SD)	Group P (mean±SD)	p value
T_1	83.9±10.4	83.0±12.0	0.72
T_2	81.0±11.1	76.8±13.1	0.11
T_3	96.6±11.2	90.5±15.1	0.29
T_4	90.5±13.2	83.3±12.7	0.008
T_5	84.6±12.6	77.3±11.4	0.04
T_6	80.2±12.4	72.7±11.3	0.03

Post intubation hypertension i.e. at T3 was seen among both groups, 5 patients in group E (10.6%) and 1 patient (2.1%) in group P which was insignificant (p=0.086).

Baseline heart rate was comparable between two groups, and only one patient of group P had bradycardia. Post intubation tachycardia was seen in 13 patients (27.7%) among group E, and in 8 patients among group P (16.7%) but there was no significant difference between the groups (p=0.19). (See Table 6)

There was no significant difference regarding blood oxygen saturation in two groups. (See Table 7) Pain during injection was seen in two patients of group P. Myoclonus was not seen.

Table 7: Oxygen saturation of both groups

	Group E	Group P
Saturation (as percentage)	98.6±0.6	98.8±0.7

Discussion

We found that etomidate provide more stable haemodynamic conditions as compared to propofol during induction.

The main aim of the study was to compare the cardiovascular response after laryngoscopy and endotracheal intubation following propofol and etomidate induced anaesthesia. Results showed that there was no significant difference regarding age, weight, laryngoscopy time and grades among the two groups.

After observing the results it can be said that there was a significant difference regarding SBP, DBP and MAP among the two groups and patients of group P showed more hypotension and patients of group E showed more stable blood pressure.

Studies by Hiller et al, Reves JG et al and Billard V et al in the past have shown that inducing anaesthesia with propofol at a dose of 2-2.5 mg/kg body weight could lower blood pressure as much as 25 to 40%: this hypotension would occur in all the patients regardless of any underlying conditions.[9,10,24] In our study also we found hypotension in 18.8% of the patients after induction with propofol.

Propofol caused hypotension is due to reduction of preload and afterload which is not synchronized with cardiac compensatory responses such as increased cardiac output and increased HR as seen by Schmidt C

et al in their study.[11] This haemodynamic drop would be intensified by high doses of the drug and high speed of injection of the drug.[12]

Brohon et al[23] studied the effect of propofol or etomidate in combination with Alfentanyl or sufentanyl on lumbar spinal surgeries and showed that SBP decreased when etomidate was used in combination with sufentanyl or alfentanyl, but not changed in propofol group in combination with each of them.

Bradycardia was reported in only one patient (2.1%) in current study belonging to propofol group but was statistically not significant. In the study of Hug et al[8] that was conducted on 25,000 patients, 4.2% patient showed bradycardia with propofol and hypotension in 15.7% of patients. At 5 and 10 minutes after induction HR was decreased significantly which was similar with the findings seen in the study by Ko YK et al.[25]

Tachycardia was seen among both the groups after intubation but it was not significant (p=0.19).

Sarkar M et al, Eames WO et al and Zed PJ et al reported that effect of etomidate on the haemodynamic condition of the patients is better than propofol.[14-16]

In the previous studies done by Shah SB et al and Kaushal RP et al it was shown that etomidate had more haemodynamic stability,[26,27] in our study also we found that there was less variation in haemodynamic parameters with etomidate as compared to propofol and etomidate had better haemodynamic profile.

Our study had a smaller sample size which was a major limitation of our study. A larger sample size will help in making a stronger correlation. Further studies are going on hemodynamic effect of the study drugs and their effect on insertion of laryngeal mask airways. All procedures entertaining general anesthesia can be considered in future.

Conclusion

Etomidate was found to be more stable and cardiovascular responses were more controlled as compared to propofol during laryngoscopy and intubation.

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