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The hemodynamic effects of intravenous etomidate (0.3mg/Kg) versus propofol (2mg/Kg) during induction of anaesthesia and endotracheal intubation

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Abstract
The changes in heart rate and blood pressure are of no consequence and are well tolerated by healthy individuals. But in patients with hypertension, heart disease and coronary artery disease, the pressor response can result in an increase in the cardiac work load. The pressor response also assumes a higher significance in neurosurgical patients. This study was conducted on 100 patients. They were allotted into two groups, comprising of 50 patients in each group. IV line secured for all patient. All patients were premeditated with injection fentanyl 1µg/kg and glycopyrrolate 0.2mg iv 10min before induction. The mean baseline SBP of the etomidate group was 124.48 ± 13.75 and the mean baseline SBP in the propofol group was 127.14 ± 8.77. The p value after inter-group comparison is 0.0990, which is statistically insignificant suggesting that both groups were comparable at the start of study.

Keywords: Hemodynamic effects, etomidate, propofol

Introduction
The induction of general anaesthesia is known to induce clinically marked changes in haemodynamic variables probably generated by direct laryngoscopy and endotracheal intubation. The history of airway control and the importance of breathing for maintenance of life dates back to thousands of years. Laryngoscopy and endotracheal intubation, being the most invasive stimuli in anaesthesia, produce a marked cardiovascular response with an elevation in blood pressure, heart rate and rise in serum catecholamine levels, which are most evidently seen during manipulation of epiglottis [1].

Although the response is transient, it is significant and detrimental especially in patients with hypertensive, cardiac and cerebrovascular co-morbidities. The introduction of a foreign body into the trachea is almost always associated with cardiovascular disturbances. The sympathoadrenal response to laryngoscopy and intubation has been observed and frequently interpreted. These changes are quite common in easy atraumatic intubation even in the absence of coughing, straining, hypoxemia or hypercarbia. These include a significant elevation in arterial pressure and ventricular premature beats. Although these cardiovascular manifestations during anaesthesia are recognized, there is less documented evidence on the mechanism of their production. Alpha and beta adrenergic blockers have been used to minimize these changes and successful results have been reported following ganglion blockade [2, 3].

It has been established that the haemodynamic response during laryngoscopy and intubation is due to sympathoadrenal stimulation evoked by mechanical stimulation of upper respiratory tract. The average rise in blood pressure was about 45mm of Hg, peak rise in blood pressure was maintained for one or two minutes followed by a gradual return to pre-laryngoscopic levels within 5 minutes. These sympathetic response have been objectively proven by a significant rise in epinephrine and norepinephrine levels on laryngoscopy and intubation. The sudden rise in heart rate and blood pressure due to this sympatho-adrenal stimulation, prove hazardous in susceptible patients. The various complications reported include left ventricular failure, hypertensive crisis, myocardial ischemia, myocardial necrosis, pulmonary edema and cerebral haemorrhage. Convulsions may be precipitated in pre-eclamptic patients [4].

The changes in heart rate and blood pressure are of no consequence and are well tolerated by healthy individuals.

But in patients with hypertension, heart disease and coronary artery disease, the pressor response can result in an increase in the cardiac work load. The pressor response also assumes a higher significance in neurosurgical patients. Most of these patients suffer from decreased intracranial compliance due to the presence of a tumour or a recent intracranial haemorrhage. Sudden increase in the blood pressure, as is seen during laryngoscopy and intubation, can result in a sudden steep rise in intracranial pressure and consequently, acute cerebral edema and herniation of brain parenchyma. The pressor response is also known to be exaggerated in patients with pregnancy induced hypertension that can result in increased morbidity and mortality in both mother and child [5, 6].

There have been many attempts in the last 3 decades to attenuate the sympathetic response to endotracheal intubation. The first clinical trial was conducted in 1950 when Burstein tried the blockade of sensory peripheral receptors and the afferent input by topical application and infiltration of the nerves with tetracaine 1% and 2% and cocaine 4%. However Abou Modi reported that this was ineffective in preventing the cardiovascular response to laryngoscopy and intubation. Various drugs and induction agents like thiopentone, propofol, esmolol, lignocaine, magnesium, vasodilators and opioids etc. have been tried to attenuate haemodynamic response of endotracheal intubation but each drug had its own limitations.

Methodology

This study was conducted on 100 patients. They were allotted into two groups, comprising of 50 patients in each group. IV line secured for all patient. All patients were premeditated with injection fentanyl 1µg/kg and glycopyrrolate 0.2mg iv 10min before induction.

Group 1 patient following premedication received injection Propofol 2mg/kg i.v. and group 2 patient following premedication received inj. Etomidate 0.3mg/kg i.v. for induction of anaesthesia. Required parameters in haemodynamics and side effects were compared with the help of proforma data analysis.

Allocation of Cases

1. Group 1: (Inj.Propofol)- 2mg/kg Intravenous.
2. Group 2: (Inj.Etomidate)- 0.3mg/kg Intravenous.

Hemodynamic parameters were recorded on the study chart. At the end of the study data analysis was done.

Anaesthesia Technique

Subsequent to the arrival of patient in the operation theatre, systolic, diastolic blood pressure, oxygen saturation and baseline heart rate was checked after a resting period of 10 minutes. Three minute of pre-oxygenation was done after premedicating the patient with injection fentanyl 1µg/kg and glycopyrrolate 0.2mg iv. Patients will receive either Inj. Propofol (2mg/kg Intravenous) or Inj. Etomidate (0.3mg/kg Intravenous). Both the drugs was injected intravenously slowly over one minute and the patient was ventilated by Oxygen, Nitrous oxide & Isoflurane (1.2 MAC).

Intubation with appropriate size endotracheal tube following muscle relaxation with Inj Suxamethonium 2mg/kg intravenous was done. Bilateral air entry was confirmed and the endotracheal tube was secured. If intubation is not accomplished in the initial 25 seconds, or in any difficulty in intubation occurs, patient was withdrawn from the study. Anaesthesia was maintained with 50% Oxygen & 50% Nitrous oxide & Isoflurane using positive pressure ventilation. Injection Vecuronium was used for muscle relaxation. The parameters like heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and SpO2 was monitored and compared with the pre-laryngoscopic levels and recorded as per protocol.

Efficacy of the study drugs was measured by recording the change in systolic blood pressure and heart rate (primary parameters) compared to the patient's baseline readings. Also diastolic blood pressure, mean arterial pressure, rate pressure product and SpO2 (secondary parameters) was monitored and compared immediately after giving the study drugs, at 1, 3, 5, 10 & 15 minutes post intubation. At the end of surgery, the patient was reversed from neuromuscular blockade with Inj. Neostigmine (0.05mg/kg) & Inj. Glycopyrrolate (0.01mg/kg). All patients was monitored in post-operative recovery room for pulse rate, blood pressure & SpO2 and any side effects like sedation, hypotension, bradycardia, respiratory depression and nausea, vomiting for 6 hours, at 30 minutes interval.

Results

Table 1: Intergroup heart rate variation

Baseline HR	**Etomodate**	**Propofol**	
Mean ± St-dev	83.76 ± 14	85.66 ± 12.61	0.163
Median	82	90	
HR After Giving Drug			
Mean ± St-dev	79.58 ± 12.32	88 ± 13.88	0.004
Median	80	86	
Post Intubation 1min			
Mean ± St-dev	86.52 ± 12.46	92.52 ± 13.21	0.043
Median	88	90	
Post Intubation 3min			
Mean ± St-dev	84.64 ± 14.38	88.76 ± 11.68	0.198
Median	86	90	
Post Intubation 5min			
Mean ± St-dev	84.68 ± 12.25	87.56 ± 9.47	0.033
Median	82	88.5	
Post Intubation 10 min			
Mean ± St-dev	81.72 ± 10.11	84.36 ± 8.94	0.022
Median	80	84	

Post Intubation 15 min			0.006
Mean ± St-dev	79.4 ± 10.41	83.52 ± 8.13	
Median	78	82	

Table 1 shows the mean basal heart rate and the mean heart rate at different time interval after induction and intubation. The mean basal heart rate in the etomidate group was 83.76±14 and the mean basal heart rate in the propofol group was 85.66±12.61. The minimum baseline heart rate in the etomidate group was 67bpm and maximum baseline heart rate was 122bpm, whereas the minimum baseline heart rate in the propofol group was 64bpm and maximum baseline heart rate was 114bpm. Intergroup analysis showed that there was no statistical difference between the two groups. (P value- 0.163).

Table 2: Systolic blood pressure variation

Baseline BP systolic	**Etomidate**	**Propofol**	
Mean ± St-dev	124.48 ± 13.75	127.14 ± 8.77	
Median	120	128	0.0990
Systolic BP After Giving Drug			
Mean ± St-dev	120.48 ± 9.98	116.2 ± 10.04	
Median	120	120	0.014
Post Intubation 1min			
Mean ± St-dev	123.12 ± 8.72	124.76 ± 9.31	
Median	123	128	0.483
Post Intubation 3min			
Mean ± St-dev	121.68 ± 9.03	123.92 ± 9.4	
Median	120	124	0.115
Post Intubation 5min			
Mean ± St-dev	118.24 ± 8.44	119.8 ± 10.58	
Median	120	120	0.686
Post Intubation 10 min			
Mean ± St-dev	120.84 ± 8.52	121.76 ± 11.9	
Median	120	122	0.549
Post Intubation 15 min			
Mean ± St-dev	122.76 ± 9.57	121.84 ± 10.77	
Median	120	120	0.617

Table 2 shows the mean baseline systolic blood pressure and systolic blood pressure at different time intervals. The mean basal SBP in the etomidate group was 124.48 ±13.75 and the mean basal SBP in the propofol group was 127.14±8.77. The minimum baseline SBP in the etomidate group was 100mmHg and maximum baseline SBP was 160mmHg, whereas the minimum baseline SBP in the propofol group was 110mmHg and maximum baseline SBP was 144mmHg. Intergroup analysis showed that there was no statistical difference between the two groups. (p value- 0.099)

Table 3: Diastolic Blood Pressure Variation

Baseline BP Diastolic	**Etomidate**	**Propofol**	
Mean ± St-dev	77.48 ± 8.8	78.06 ± 6.16	0.621
Median	80	80	
Diastolic BP After Giving DRUG			
Mean ± St-dev	75.88 ± 7.32	71.68 ± 8.84	0.002
Median	78	70	
Post Intubation 1min			
Mean ± St-dev	77.56 ± 4.9	75.64 ± 6.97	0.129
Median	80	78	
Post Intubation 3min			
Mean ± St-dev	74.52 ± 6.83	75.88 ± 6.12	0.433
Median	78	78	
Post Intubation 5min			
Mean ± St-dev	73.4 ± 5.69	71.94 ± 6.59	0.207
Median	72	70	
Post Intubation 10 min			
Mean ± St-dev	74.56 ± 6.01	73.72 ± 6.91	0.425
Median	70	73	
Post Intubation 15 min			
Mean ± St-dev	75.6 ± 7.26	73.44 ± 6.33	0.058
Median	76	71	

Table 3 shows the mean baseline diastolic blood pressure and diastolic blood pressure at different time intervals. The mean basal DBP in the etomidate group was 77.48 ±8.8 and the mean basal DBP in the propofol group was 78.06±6.16. The minimum baseline DBP in the etomidate group was 60mmHg and maximum baseline DBP was 90mmHg,

whereas the minimum baseline DBP in the propofol group was 65mmHg and maximum baseline DBP was 90mmHg. Intergroup analysis showed that there was no statistical difference between the two groups. (p value- 0.621)

Table 4: Mean Arterial Pressure Variation

Baseline MAP	**Etomidate**	**Propofol**	
Mean ± St-dev	92.88 ± 10.52	94.42 ± 6.65	0.2970
Median	93.3	96.7	
Map After Giving Drug			
Mean ± St-dev	90.75 ± 7.59	86.52 ± 8.87	0.002
Median	92	86.67	
Post Intubation 1min			
Mean ± St-dev	92.75 ± 5.43	92.01 ± 7.32	0.855
Median	93.33	94.67	
Post Intubation 3min			
Mean ± St-dev	90.24 ± 7.06	91.89 ± 6.92	0.185
Median	91.33	92.67	
Post Intubation 5min			
Mean ± St-dev	88.35 ± 6.17	87.89 ± 7.65	0.748
Median	86.67	86.67	
Post Intubation 10 min			
Mean ± St-dev	89.99 ± 6.42	89.73 ± 8.32	0.926
Median	88	91.33	
Post Intubation 15 min			
Mean ± St-dev	91.32 ± 7.55	89.57 ± 7.41	0.143
Median	92.67	86.67	

Table 4 shows the mean baseline MAP and MAP at different time intervals. The mean baseline MAP in the etomidate group was 92.88±10.52 and the mean baseline MAP in the propofol group was 94.42±6.65. The minimum baseline MAP in the etomidate group was 70mmHg and maximum baseline MAP was 113mmHg, whereas the minimum baseline MAP in the propofol group was 80mmHg and maximum baseline MAP was 106.7mmHg. Intergroup analysis showed that there was no statistical difference between the two groups. (p value- 0.297)

The mean MAP in the etomidate group after giving the drug was 90.75.± 7.59 and the mean MAP in the propofol group after giving the drug was 86.52±8.87. The minimum MAP in the etomidate group was 73.3mmHg and maximum MAP was 102.67mmHg, whereas the minimum MAP in the propofol group was 73.33mmHg and maximum MAP was 114mmHg. In the etomidate group there was statistically significant change in MAP after giving the drug when compared with baseline MAP (p-value of 0.033), similarly in the propofol group also there was statistically significant change in MAP at after giving the drug when compared with baseline DBP (p-value of <0.0001). Intergroup analysis showed that there was significant statistical difference between the two groups after giving the drug. (p value- 0.002).

The mean diastolic blood pressure in the etomidate group after giving the drug was 75.88.± 7.32 and the mean DBP in the propofol group after giving the drug was 71.68± 8.84. The minimum DBP in the etomidate group was 60mmHg and maximum DBP was 90mmHg, whereas the minimum DBP in the propofol group was 68mmHg and maximum DBP was 98mmHg. In the etomidate group there was statistically significant change in DBP after giving the drug when compared with baseline DBP (p-value of 0.045), similarly in the propofol group also there was statistically significant change in DBP after giving the drug when compared with baseline DBP (p-value of 0.001). Intergroup analysis showed that there was significant statistical difference between the two groups after giving the drug. (p value- 0.002).

Discussion

In our study the mean baseline heart rate and the mean heart rate at different time intervals from baseline were noted and analyzed.

The mean baseline heart rate of the etomidate group was 83.76 ± 14 and the mean baseline heart rate in the propofol group was 85.66 ± 12.61. The p value after inter-group comparison is 0.163 which is statistically insignificant suggesting that both groups were comparable at the start of study. This was similar to the study by Govardhane *et al.* [7] where the baseline values of heart rate, systolic blood pressure and mean arterial pressure were comparable.

In the etomidate group the mean heart dropped to 79.58 ± 12.32 after induction and then reached near baseline value of 86.52±12.46 after 1 minute post intubation and showed stable haemodynamics at 3 minutes, 5 minutes and 10 minutes. At 15 minutes the mean heart rate was 79.4±10.41 which was lower than mean baseline heart rate. Hence in our study with etomidate there was statistically significant change in heart rate when compared to baseline heart rate after giving the drug and at 15 minutes post intubation, however there was no significant change in heart rate at 1minute, 3 minutes, 5 minutes and 10 minutes post intubation. Thus it can be assumed that etomidate was better able to attenuate the haemodynamic responses associated with laryngoscopy and intubation.

Shah *et al* in 2015 got similar results; they concluded that propofol causes sustained increase in heart rate throughout induction and intubation while etomidate keeps the heart rate stable for the complete duration of induction and intubation. These results were slightly different from what Muriel *et al*, found in 1991 where there was an increase in heart rate after etomidate induction and decrease in heart rate after induction with propofol[8] In another study by Meena *et al* there was significant increase in heart rate with both etomidate and propofol.

In the propofol group the mean heart increased to 88.66 ±

12.61 after induction and then further increased to 92.52±13.21 after 1 minute post intubation and showed near baseline values at 3 minutes, 5 minutes and 10 minutes. At 15 minutes the mean heart rate was 83.52 ± 8.94 which was slightly lower than mean baseline heart rate. Hence in our study with propofol there was statistically significant change in heart rate when compared to baseline heart rate at 1 minute post intubation; however there was no significant change in heart rate after giving the drug, at 3 minutes, 5 minutes and 10 minutes post intubation. Thus it can be assumed that though propofol was unable to attenuate the haemodynamic responses immediately after intubation, stable haemodynamics were maintained from 3 minutes to 15 minutes post intubation.

These results were slightly different from what Hug *et al* [9] found in 1993, in his study with propofol among 2500 patients. He found 4.2% patients had bradycardia during induction and 15.7% patients had hypotension. In another study by Meena *et al* there was significant increase in heart rate with both etomidate and propofol

The inter-group comparisons at different time intervals showed that there is statistically significant difference between both drug groups with respect to mean heart rate at induction (p value-0.004), 1 minute (p value-0.043), 5 minute (p value-0.033), 10 minute (p value-0.022) and 15 minute (p value- 0.006).

The mean baseline SBP of the etomidate group was 124.48 ± 13.75 and the mean baseline SBP in the propofol group was 127.14 ± 8.77. The p value after inter-group comparison is 0.0990, which is statistically insignificant suggesting that both groups were comparable at the start of study. This was similar to the study by Govardhane *et al.* [7] where the baseline values of heart rate, systolic blood pressure and mean arterial pressure were comparable.

In the etomidate group the mean SBP dropped to 120.48 ± 9.98 after induction and then reached near baseline value of 123.12±8.72 after 1 minute post intubation and then showed gradual fall in SBP at 3 minutes (121.68) and 5 minutes (118.24) post intubation. At 10 minutes post intubation there was slight rise in SBP (120.84) which reached near baseline value at 15 minutes post intubation (122.76). Hence in our study with etomidate, there was statistically significant change in SBP when compared to baseline SBP after giving the drug and at 15 minutes post intubation; however there was no significant change in SBP at 1 minutes, 3 minutes, 5 minutes, and 10 minutes post intubation. Thus it can be assumed that etomidate was better able to attenuate the rise in blood pressure associated with laryngoscopy and intubation.

In the propofol group the mean SBP dropped to 116.2 after induction and then reached near baseline value of 124.76 at 1 minute post intubation and then showed gradual fall in SBP at 3 minutes (123.92) and 5 minutes (119.8) post intubation. At 10 minutes post intubation there was slight rise in SBP (121.76) which further increased to 121.84 at 15 minutes post intubation. Hence in our study with propofol there was a significant fall in SBP after giving the drug which was followed by a significant rise in SBP at 1 minute post intubation. Thus it can be assumed that propofol is associated with significant fall in SBP during induction and was unable to attenuate the rise in blood pressure associated with laryngoscopy and intubation.

The inter-group comparisons at different time intervals showed that there is statistically significant difference between both drug groups with respect to mean SBP at induction (p value-0.014) of anaesthesia. Though the SBP after giving the drug in our study did not show statistical significance at 1, 3, 5, 10 and 15 minutes post intubation, the etomidate group had better BP control than the propofol group which had large fluctuations in BP during induction as well as post intubation.

Diastolic blood pressure and the mean arterial pressure were comparable in both groups at baseline. The DBP and MAP values after giving the drug were significant in both groups, whereas at 1, 3, 10 and at 15 minutes were found to be statistically insignificant. Hence in our study it can be concluded that at induction, etomidate provided a better control of DBP and MAP than the propofol group. Our results are comparable to the study done by Meena *et al*, 2016 which showed significant decrease in arterial blood pressure, after induction with propofol which did not increase above baseline value after intubation, while with etomidate there was slight increase in blood pressure following intubation [10].

The results in our study were comparable with another study done in 2015 by Shah *et al*, in which it was observed that the magnitude of variations in SBP, DBP and MAP from baseline were greater when propofol was used as induction agent versus etomidate in comparable doses.

Similar results were also obtained by Saricaoglu *et al* after studying the hemodynamic effects of an induction dose of propofol and etomidate [11].

They found that propofol was associated with significant decreases in SBP and mean blood pressure. They attributed this hypotension to the negative inotropic effect of propofol. Larsen *et al*, examined the effects of propofol upon myocardial function by measuring changes in left ventricle function using trans-thoracic tissue- doppler echocardiography and concluded that a decrease in MAP with propofol is secondary to reduce cardiac filling or a consequence of a direct negative inotropic action of propofol.

The results in our study were comparable with another study done in 2012 by Ghafoor *et al* where there was transient fall of MAP in both groups, however it was statistically more pronounced in the propofol group [12].

Conclusion

- Etomidate provides better haemodynamic attenuation during laryngoscopy and intubation in terms of changes in heart rate and blood pressure.
- It also has faster recovery after anaesthesia, with minimal post-operative sedation which can be specially useful in day care surgeries.

References

1. Burstein CL, Lopinto FJ, Newman W. Electrocardiographic studies during endotracheal intubation. I. Effects during usual routine technics. Anesthesiology 1950;11(2):224–37.
2. Siedlecki J. Disturbances in the function of cardiovascular system in patients following endotracheal intubation and attempts of their prevention by pharmacological bloackade of sympathetic system. Anaesthesia Resusc Intensive Therapy 1975;3(2):107-23.
3. Forbes AM, Dally FG. Acute hypertension during induction of anaesthesia and endotracheal intubation in

normotensive man. Br J Anaesth 1970;42(7):618-24.
4. King BD, Harris LC, Greifenstein FE, Elder JD, Dripps RD. Reflex circulatory responses to direct laryngoscopy and tracheal intubation performed during general anesthesia. Anesthesiology 1951;12(5):556-66.
5. Derbyshire DR, Smith G. Sympathoadrenal responses to anaesthesia and surgery. Br J Anaesth 1984;56(7):725-39.
6. Abou-Madi M, Keszler H, Yacoub O. A method for prevention of cardiovascular reactions to laryngoscopy and intubation. Can Anaesth Soc J. 1975;22(3):316-329.
7. GovardhAne BT, Basantwani SN, Pal A, Magar JS, Tendolkar BA. Comparison of Induction Characteristics of two Anaesthetic Agents: Etomidate-lipuro and Propofol for Day Care Surgery. Journal of Clinical & Diagnostic Research 2018;12(3).
8. Muriel C, Santos J, Espinel C. Comparative study of propofol with thiopental and etomidate in anesthetic induction. Rev Esp Anestesiol Reanim. 1991;38(5):301-304.
9. Hug JC, McLeskey CH, Nahrwold ML, Roizen MF, Stanley TH, Thisted RA *et al*. Hemodynamic effects of propofol: data from over 25,000 patients. Anesthesia and analgesia 1993;77(4):S21-9.
10. Meena K, Meena R, Nayak SS, Prakash S, Kumar A. A Comparative Study of Effect of Propofol, Etomidate and Propofol Plus Etomidate Induction on Hemodynamic Response to Endotracheal Intubation: A RCT. J Anesth Clin Res 2016;7(622):2.
11. Saricaoglu F, Uzun S, Arun O, Arun F, Aypar U. A clinical comparison of etomidate-lipuro, propofol and admixture at induction. Saudi J Anaesth. 2011;5(1):62-6.
12. Ghafoor HB, Afshan G, Kamal R. General anesthesia with laryngeal mask airway: etomidate vs propofol for hemodynamic stability. Open J Anesth. 2012;2(4):161-5.