Original Research Article

Attenuation of haemodynamic response to laryngoscopy and endotracheal intubation: A comparative study between fentanyl and esmolol

Rajiv Aggarwal[1], Manjula Sudhakar Rao[2*], Alok Basu Roy[3], Ravindra Kumar Arora[4]

[1]Consultant, Department of Anesthesiology, Regency Hospital, Kanpur, INDIA.
[2]Senior Resident, Department of Anesthesiology, Father Mullers Medical College Hospital, Kankanady, Mangalore, Karnataka, INDIA.
[3,4]Senior Consultant, Department of Anesthesiology, Max Superspeciality Hospital, Vaishali, Ghaziabad, Uttar Pradesh, INDIA.
Email: manjularao1010@gmail.com

Abstract

Background: Laryngoscopy and endotracheal intubation have become the integral part of general anaesthesia and critical care of patients. It has been practiced since its description by Rowbothom and Magill in 1921. These are noxious stimuli which provoke a transient but marked sympathetic response manifesting as hypertension and tachycardia, more severe in hypertensive patients. **Materials and methods:** This prospective study was conducted in the Department of Anaesthesiology, Max Hospital Vaishali Gaziabad during the period of 12 months from December 2014 to December 2015. A total of 100 normotensive patients between 18 and 60 years of age with ASA grade 1 and 2 risk, undergoing elective surgical procedures under general anaesthesia were included. Patients undergoing emergency surgical procedures, anaesthesia with non-invasive airway devices haemodynamically unstable patients, patients on beta blockers and calcium channel blockers and patients with difficult airway were excluded. **Results:** In the fentanyl group, the average heart rate increased by 1.85 bpm during laryngoscopy and intubation. In the esmolol group, the rise in heart rate was 3.1bpm which is higher than that of fentanyl group. The increase in heart rate in the esmolol group as a response to intubation was statistically significant. Hence our study showed that Fentanyl is a better drug to control the tachycardia as a response to laryngoscopy and intubation. Both fentanyl and esmolol effectively prevented rise of SBP as a response to intubation. **Conclusion:** [1]Fentanyl is better than esmolol in controlling tachycardia in response to laryngoscopy and endotracheal intubation. [2]Both fentanyl and esmolol are effective in controlling the rise in SBP as a response to laryngoscopy and endotracheal intubation. [3]Esmolol is more effective than fentanyl in controlling SBP and RPP. In conclusion, both fentanyl and esmolol are effective in attenuation of hemodynamic response to laryngoscopy and intubation. Fentanyl is more effective in preventing tachycardia while esmolol is more effective in controlling rise in systolic blood pressure and rate pressure product.

Key Word: haemodynamic.

***Address for Correspondence:**
Dr. Manjula Sudhakar Rao, Senior Resident, Department of Anesthesiology, Father Mullers Medical College Hospital, Kankanady, Mangalore, Karnataka, INDIA.
Email: manjularao1010@gmail.com

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INTRODUCTION

Laryngoscopy and endotracheal intubation have become the integral part of general anaesthesia and critical care of patients. It has been practiced since its description by Rowbothom and Magill in 1921.[1] Laryngoscopy and tracheal intubation are noxious stimuli which provoke a transient but marked sympathetic response manifesting as hypertension and tachycardia.[2] Hypertensive patients are more prone to have significant increase in blood pressure (BP), whether they have been treated beforehand or not.[3]

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In susceptible patients, particularly those with systemic hypertension, coronary artery disease, cerebrovascular disease and intracranial aneurysm, even these transient changes can result in potentially deleterious effects like left ventricular failure, arrhythmias, myocardial ischaemia, cerebral haemorrhage and rupture of cerebral aneurysm.[3,4] Many pharmacological methods have been devised to reduce the extent of these haemodynamic events. These include opioids, local anaesthestics, beta adrenergic blockers and vasodilator drugs. Beta adrenergic blockers have been used to successfully attenuate this undesirable response to intubation. They act by blocking the effect of the hyperactive sympathetic system on the cardiovascular system. A short acting and cardio selective blocker may be more useful with minimal adverse effects.[5] Esmolol is an ultra-short acting, β1 cardio selective, β blocking agent with a short half-life (9min). This agent has been used to reduce the increase in heart rate and blood pressure in response to tracheal intubation, thereby reducing the myocardial oxygen demand.[6] Fentanyl is a synthetic opioid agonist used as an adjuvant to provide analgesia during general anaesthesia. Studies have shown its efficacy in reducing the hemodynamic response to laryngoscopy and endotracheal intubation. It acts by blunting the tracheal sensitivity to the stimulus of laryngoscopy and intubation.[7] In this study we have compared the efficacy of Esmolol and Fentanyl in attenuating the pressor response to laryngoscopy and intubation during general anaesthesia.

AIMS AND OBJECTIVES

1. To study the effect of esmolol and fentanyl on haemodynamic response to laryngoscopy and endotracheal intubation.
2. To compare the effects of esmolol and fentanyl on attenuation of the haemodynamic response to laryngoscopy and endotracheal intubation.
3. To evaluate any adverse effects of these drugs during anaesthesia and recovery.

MATERIALS AND METHODS

This prospective randomised single blind comparative study was conducted in the department of anaesthesiology, Pushpanjali Crosslay Hospital Ghaziabad during the period of 12 months from December 2014 to December 2015. A total of 100 patients who underwent elective surgical procedures under general anaesthesia were randomly enrolled for this study using table of random numbers.

Inclusion criteria

1. All normotensive patients undergoing surgical procedures under general anaesthesia.
2. Patients aged between 18 to 60 years with ASA grade 1 and 2 risk.

Exclusion criteria

1. Patients not willing to be part of the study.
2. Emergency surgical procedures.
3. General anaesthesia with non-invasive airway devices.
4. Haemodynamically unstable patients.
5. Patients on beta blockers and calcium channel blockers.
6. Difficult airway.

METHODOLOGY

Sample size- Sample size was calculated using the following formula

$$n = \frac{2(Z\alpha + Z\beta)^2 X\, \sigma^2}{d^2}$$

Zα = 1.96 at 95% confidence level

Zβ = 1.28 at 90% power.

σ and d are combined SD and mean difference from reference no 35

Hence the sample size was calculated as 98.

100 patients who met the defined inclusion and exclusion criteria were enrolled for this study. A written informed consent was taken from the patients who were enrolled. Block randomisation method was used to assign patients into two groups- Group A (Fentanyl group) and Group B (Esmolol group). A number was assigned to each patient of the day using random number chart. Patient with even number was taken into esmolol group and the one with odd number was taken into fentanyl group, thus avoiding selection bias. Patients were evaluated by taking detailed history, physical examination, airway assessment and relevant investigations preoperatively. They were asked to fast overnight. Group A patients received Inj. Fentanyl 1.5 microgram per kg intravenously 5 minutes prior to laryngoscopy. Group B patients received Inj. Esmolol 2 milligram per kg intravenously 3 minutes prior to laryngoscopy. All patients received standard premedications like H2 blockers, prokinetics, antisialogogues and anxiolytics prior to induction. They were pre-oxygenated and induced with Inj.Propofol 2mg per kg intravenously and intubated after paralysing with intermediate acting non depolarising muscle relaxant. General anaesthesia was maintained with volatile agents and oxygen nitrous oxide mixture during the surgery. Patient's heart rate (HR), systolic blood pressure(SBP), diastolic blood pressure (DBP) were recorded prior to induction, at the time of intubation and at intervals of 1, 3 and 5 minutes after intubation. Mean arterial pressure (MAP) and rate pressure product (RPP) were calculated. At the conclusion of the surgery, patients were reversed using Inj. Neostigmine 0.05mg per kg and Inj.Glycopyrolate 0.01mg per kg and extubated. Any

adverse effects of the medications were noted. The data was recorded and tabulated in a standard format. After completion of 100 cases, the data was analysed to compare the efficacy of Fentanyl and Esmolol to attenuate the haemodynamic response to laryngoscopy and intubation. Statistical analysis was done to assess the significance of differences between the two groups. Mean and standard deviations were calculated for all the readings. Two tailed paired student t tes was used to determine whether the observed differences were significant. P value of 0.05 or less was taken as significant at 95% confidence.

OBSERVATIONS AND RESULTS

A total of 100 patients were enrolled for this study. All patients underwent elective surgical procedures under general anaesthesia.

Table 1: Distribution of cases by gender

			Drug used		Total
gender	Male	Count	23	26	49
		%	46.0%	52.0%	49.0%
	Female	Count	27	24	51
		%	54.0%	48.0%	51.0%
Total		Count	50	50	50
		%	100.0%	100.0%	100.0%

x2=0.36 p=0.548 ns

Chi square test showed a p value of 0.543 for difference between the two groups with reference to gender composition. This p value was statistically not significant. Hence the two groups were comparable.

Table 2: Age and weight comparison

	Drug used	N	Mean	Std. Deviation	t
Age	Esmolol	50	45.600	8.997	1.654
	Fentanyl	50	42.640	8.903	p=0.101 ns
Weight	Esmolol	50	65.480	10.839	.418
	Fentanyl	50	66.400	11.178	p=0.677 ns

Heart Rate

Table 3: Comparison of HR between fentanyl and esmolol groups

	drugused	N	Mean	Std. Deviation	t
Hr pre	Esmolol	50	83.040	11.146	1.149
	Fentanyl	50	86.340	16.971	p=0.253 ns
Hr intub	Esmolol	50	86.100	6.119	1.006
	Fentanyl	50	87.960	11.549	p=0.317 ns
Hr 1min	Esmolol	50	84.180	6.880	1.069
	Fentanyl	50	85.940	9.406	p=0.288 ns
Hr 3min	Esmolol	50	87.420	8.199	1.384
	Fentanyl	50	84.940	9.662	p=0.17 ns
Hr 5min	Esmolol	50	87.560	7.675	3.525
	Fentanyl	50	80.700	11.420	p=0.001 vhs

Systolic Blood Pressure

Table 4: Comparison of systolic BP between fentanyl and esmolol groups

	Drug used	N	Mean	Std. Deviation	t
Sbp preinduction	Esmolol	50	124.560	11.634	3.938
	Fentanyl	50	135.040	14.792	p=0.001 vhs
Sbp intubation	Esmolol	50	115.540	14.204	.789
	Fentanyl	50	113.100	16.642	p=0.432 ns
sbp1min	Esmolol	50	114.460	12.786	1.312
	Fentanyl	50	118.300	16.271	p=0.193 ns
Sbp 3min	Esmolol	50	105.780	14.406	2.070
	Fentanyl	50	110.620	8.109	p=0.041 sig
Sbp 5min	Esmolol	50	108.800	10.108	.056
	Fentanyl	50	108.680	11.293	p=0.955 ns

Diastolic Blood Pressure

Table 15: Comparison of diastolic BP between the fentanyl and esmolol groups.

	Drug used	N	Mean	Std. Deviation	t
Dbp pre-intubation	Esmolol	50	81.000	10.535	.161
	Fentanyl	50	80.600	14.010	p=0.872 ns
Dbp intubation	Esmolol	50	77.240	14.244	1.907
	Fentanyl	50	70.840	18.987	p=0.06 ns
dbp1min	Esmolol	50	71.420	8.069	.887
	Fentanyl	50	73.500	14.479	p=0.377 ns
Dbp 3min	Esmolol	50	65.900	11.014	.044
	Fentanyl	50	65.980	6.723	p=0.965 ns
Dbp 5min	Esmolol	50	66.820	9.077	.773
	Fentanyl	50	68.200	8.781	p=0.442 ns

Mean arterial pressure

Table 6: comparison of MAP between fentanyl and esmolol groups

	drugused	N	Mean	Std. Deviation	t
mappreinduction	Esmolol	50	92.200	10.392	2.077
	Fentanyl	50	97.140	13.220	p=0.04 sig
mapintubation	Esmolol	50	87.360	13.127	.999
	Fentanyl	50	84.260	17.574	p=0.32 ns
map1min	Esmolol	50	83.160	8.747	1.756
	Fentanyl	50	87.540	15.321	p=0.082 ns
map3min	Esmolol	50	77.280	11.375	1.168
	Fentanyl	50	79.420	6.201	p=0.246 ns
map5min	Esmolol	50	78.760	8.463	.856
	Fentanyl	50	80.160	7.888	p=0.394 ns

Rate pressure product:

Table 7: Comparison of RPP in fentanyl and esmolol group

	drugused	N	Mean	Std. Deviation	t
Rate pressure product	Esmolol	50	10313.820	1905.039	2.961
	Fentanyl	50	11624.660	2484.333	p=0.004 hs
Rpp intubation	Esmolol	50	9946.920	1535.634	.155
	Fentanyl	50	10007.840	2317.119	p=0.877 ns
rpp1min	Esmolol	50	9648.480	1441.017	1.608
	Fentanyl	50	10129.300	1547.799	p=0.111 ns
rpp3min	Esmolol	50	9229.920	1429.468	.603
	Fentanyl	50	9391.180	1238.238	p=0.548 ns
rpp5min	Esmolol	50	9570.620	1269.701	2.793
	Fentanyl	50	8779.940	1547.592	p=0.006 hs

Table 8: Difference From Preinduction To 5 Min

	drugused	N	Mean	Std. Deviation	t
HR	Esmolol	50	-4.5200	13.09345	3.93800
	Fentanyl	50	5.6400	12.70346	P<0.001 VHS
SBP	Esmolol	50	15.7600	11.83485	3.46700
	Fentanyl	50	26.3600	18.08908	P<0.001 VHS
DBP	Esmolol	50	14.1800	7.98389	.83400
	Fentanyl	50	12.4000	12.81421	P=0.407 NS
MAP	Esmolol	50	13.4400	8.51208	1.56500
	Fentanyl	50	16.9800	13.53829	P=0.121 NS
RPP	Esmolol	50	743.2000	2327.43367	4.30400
	Fentanyl	50	2844.7200	2550.03203	P<0.001 VHS

DISCUSSION

A hemodynamic response of increased HR and BP to manipulation in the area of the larynx, by means of laryngoscopy and intubation, has been well recognized for 60 years. Stimulation of mechanoreceptors in the pharyngeal wall, epiglottis, and vocal cords is thought to be the cause for the haemodynamic response. The receptors are abundant over arytenoid cartilage, vocal cords, epiglottis and hypopharynx. Transitory hypertension and tachycardia are probably of no consequence in healthy individuals, but either one or both may be hazardous to those with hypertension, myocardial insufficiency or cerebrovascular diseases. The transient changes can result in potentially deleterious effect like left ventricular failure, pulmonary edema, myocardial ischemia and cerebral haemorrhage.[4] Numerous studies have been published with different drugs to attenuate this response to laryngoscopy and intubation. In this study we have compared the efficacy of fentanyl and esmolol in attenuation the pressor response to laryngoscopy and intubation. We found that in the fentanyl group, the average heart rate increased by1.85% during laryngoscopy and intubation. In the esmolol group, the rise in heart rate was 3.1% which is higher than that of fentanyl group. The increase in heart rate in the esmolol group as a response to intubation was not statistically significant. However, at 5 min after intubation, the HR in fentanyl group was 8 bpm lower compared to esmolol group. P value for this difference was 0.001 making this very highly significant. Hence our study showed that Fentanyl is a better drug to control the tachycardia as a response to laryngoscopy and intubation. Gupta A *et al*[37] found Esmolol beneficial in controlling tachycardia as response to laryngoscopy and intubation. Lars *et al* also found that esmolol controlled tachycardia.[5] However Ranganathan *et al*[38] found Fentanyl effectively supressed the tachycardia during intubation. Ebert *et al* (39)in their study found Fentanyl more effective than esmolol in controlling heart rate as response to laryngoscopy and intubation. Their finding was similar to the present study. On the contrary, Bostan *et al* found esmolol controlled HR better than Fentanyl.[35] We found both fentanyl and esmolol effectively prevented rise of SBP as a response to intubation. In fact there was a fall of SBP noted in both the groups as compared to pre induction levels. When compared to fentanyl group, the average SBP was significantly lower in esmolol group during pre-induction and 3 min post intubation periods. Hence esmolol is more effective in controlling SBP as compared to fentanyl. DBP fell significantly in the fentanyl group as compared to esmolol group. Esmolol was also effective in supressing the rise of DBP, however there was no significant fall in DBP in esmolol group. However when the two groups were compared, there was no statistically significant differences in DBP. Both fentanyl and esmolol were effective in blocking the rise MAP as response to laryngoscopy and intubation. There was a statistically significant reduction in MAP in both the groups. MAP was significantly lower in the esmolol group in the pre induction period only. Both fentanyl and esmolol were able to prevent the rise of RPP as a response to laryngoscopy and intubation. In the fentanyl group, it reduced by a statistically significant amount. The RPP was significantly lower in the esmolol group during the pre induction period and 5 min after intubation. Ebert *et al*[39] found that Fentanyl decreased the SBP, MAP and DBP significantly below the baseline, while these were either maintained at or elevated slightly in the esmolol group. Helfman *et al*.[40] did not find any attenuation of the pressor response with 200 mcg fentanyl, however they intubated 2 minutes after study drug injection. Lars *et al*[5] did not find any statistically significant difference in MAP between esmolol and placebo groups while our study showed esmolol effectively prevented rise of MAP during laryngoscopy and intubation. Gupta *et al*[37] found esmolol effectively attenuated the rise of SBP and DBP as response to laryngoscopy and intubation. Yushi *et al*[7] found fentanyl was more effective in controlling the stress response to intubation when compared to the stress response to laryngoscopy. Dahlgren and Masseter also found fentanyl effectively controlled the stress response to laryngoscopy and intubation. [29]

CONCLUSION

Based on findings of this study, we conclude that,

1. Fentanyl is better than esmolol in controlling tachycardia in response to laryngoscopy and endotracheal intubation.
2. Both fentanyl and esmolol are effective in controlling the rise in systolic blood pressue as a response to laryngoscopy and endotracheal intubation.
3. Esmolol is more effective than fentanyl in controlling rise in systolic blood pressure and rate pressure product.

In conclusion, both fentanyl and esmolol are effective in attenuation of hemodynamic response to laryngoscopy and intubation. Fentanyl is more effective in preventing tachycardia while esmolol is more effective in controlling rise in systolic BP and rate pressure product.

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