

# Attenuation of Cardiovascular Response to Laryngoscopy and Intubation a Comparative study between i.v. Esmolol Hydrochloride and Fentanyl

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## ABSTRACT:

**Background and Aim:** Laryngoscopy and endotracheal intubation is a integral part of anaesthetic management and critical care. It is associated with mechanical stimulation of the upper respiratory tract leading to sympathetic adrenal stimulation. The aim of study was to determine efficacy in order to blunt intubation and laryngoscope stimulation response. Durgs like Esmolol, beta blocker and opiod like Fentanyl studied scientifically to establish best drug to prevent the complications of upper respiratory tract stimulation and smooth conduction of anaesthesia and to determine efficacy of esmolol 2 mg/kg IV bolus and fentanyl 2 mcg/kg bolous attenuated sympathetic response to laryngoscope and Tracheal intubation and ascertain the effectiveness of Esmolol and Fentanyl in supressing sympathetic response.

**Material and Methods:** This study was conducted in 60 patients aged 20-50 years and patient were devided in two groups.Group I Fentanyl Group-II Esmolo group with laryngoscope intubation response in each group undergoing general anaesthesia.

**Results:** This study was undertaken to compare the attenuation of laryngoscope and intubation response during general anaesthesia. 2 mg/kg IV bolus Esmolol and 2 mcg/kg fentanyl IV before laryngoscope at Department of Anaesthesia Chlmeda Anand Rao Institute of Medical Sciences, Bommakal, Karimnagar. During period Esmolol found to better drug to blunt laryngoscope and intubation.

**Conclusion:** Esmolol 2 mg/kg I.V bolus significantly attenuate the laryngoscopy and intubation sympathetic response.

**Keywords:** Esmolol, fentanyl, laryngoscopy, intubation, heart rate, blood pressure.

## INTRODUCTION

Endotracheal intubation has become an integral part of the anaesthetic management and critical care of the patient and has been practiced following its description by Rowbotham and Magill. Laryngoscopy and endotracheal intubation are associated with mechanical stimulation of the respiratory tract leading to sympatho adrenal stimulation. It manifests as an increase in heart rate, blood pressure and cardiac complications.<sup>[1]</sup>

Hemodynamic response to laryngoscopy is immediately after intubation and lasts for 5-10 minutes. The response may be tolerated by healthy individuals but may precipitate arrhythmias, myocardial ischaemia and

cerebrovascular accidents in patients with preexisting cardiovascular disease.<sup>[2]</sup> These hemodynamic responses reflect sympathoadrenal reflex stimulation (epipharyngeal and laryngopharyngeal stimulation) with a concomitant increase in plasma level of catecholamines and activation of alpha and beta adrenergic receptors.<sup>[3]</sup>

Esmolol is an ultra short acting beta blocker with cardio selective properties having an elimination half-life of 9 min and distribution half-life of 2 min. It can be used for prevention of hemodynamic alteration following endotracheal intubation and laryngoscopy.<sup>[4]</sup> Fentanyl citrate, an opioid is a phenylpiperidine of the 4-aminopiperidine series structurally related to but not derived from pethidine in the appropriate dose, controls

both heart rate and blood pressure responses.

The purpose of study was to determine the efficacy of esmolol 2 mg/kg IV bolus and IV fentanyl 2µg/kg in attenuating the sympathetic responses to laryngoscopy and tracheal intubation and ascertain the effectiveness of esmolol hydrochloride and fentanyl in suppressing sympathetic response.

## MATERIALS AND METHODS

A Clinical comparative study of attenuation of sympathetic response to laryngoscopy and intubation was done in 60 patients posted for elective surgeries selected randomly.

### Study Center

The Study was conducted at Department of Anaesthesiology, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar. The duration of study was for the period of 18 months. The patients were selected from various ENT, Orthopaedic, Gynaecological, General surgical, Neurological and Laparoscopic procedures.

### Inclusion Criteria

- Patients scheduled for elective surgeries
- Age between 20-50 years of both the sexes.
- Patients with ASA grade I or II.
- Mallampati airway assessment of grade I and II

### Exclusion Criteria

- Unwilling patients
- Emergency surgeries
- Anticipated difficult intubation
- Patients with ASA grade III or higher
- Patients with cardiovascular diseases
- Patients on beta blockers or calcium channel blockers
- Patients in whom laryngoscopy and intubation proved to be prolonged or difficult.

Patients were selected after thorough preanaesthetic assessment and investigations. An informed consent was taken in all the patients. 60 cases were divided into two groups with 30 cases in each group. Group-I was Fentanyl group. Here patients received 2µg/kg Fentanyl IV, 3 minutes before laryngoscopy and intubation. Group-II was esmolol group. All the patients in this group received 2mg/kg of Esmolol IV, 3 minutes before laryngoscopy and intubation.

**Investigations:** Hb%, TC, DC, ESR & RBS Blood urea and serum creatinine, ECG Chest X-ray.

### Premedication

All the patients were visited the day before surgery and

preanaesthetic counselling was done. All patients received alprazolam 0.5 mg at night on the day before surgery. On the day of surgery intravenous line was secured with 18G cannula and following premedications were given 45 minutes before induction. Inj. Midazolam 0.05mg/kg IM Patients were monitored by pulse oximeter. On entering the OT pulse oximeter, non invasive blood pressure and ECG monitors were connected. A preinduction heart rate, systolic and diastolic blood pressures were recorded. IV infusion of NS solution was started.

### Anaesthesia technique

All the patients were preoxygenated with 100% oxygen for 3 minutes before induction. Induction was achieved with Inj. Thiopentone sodium 5mg/kg IV given in 2.5% solution. Inj. Glycopyrrolate 0.2mg IV was given along with Thiopentone. After induction of anaesthesia (loss of eyelash reflex), heart rate, systolic and diastolic blood pressures were recorded. Succinylcholine was administered at a dose of 2mg/kg IV.

Laryngoscopy was done using rigid laryngoscope with standard Macintosh blade. Intubation was done with appropriate sized, disposable, high volume low pressure cuffed endotracheal tube. Oral intubation was done for all surgical procedures. Laryngoscopy and intubation was done within 15 to 20 seconds. Heart rate, systolic and diastolic blood pressure were recorded at 1,3,5,7 and 10 minute intervals from the onset of laryngoscopy. In group-I, IV fentanyl was administered 3 minutes before laryngoscopy and intubation. In group-II, IV esmolol was administered 3 minutes before laryngoscopy and intubation.

## STATISTICAL ANALYSIS

Descriptive data presented as Mean  $\pm$ SD and in percentage. Multiple group comparisons were made by one way ANOVA followed by unpaired 't' test for pair wise comparison. For all the tests a 'P' value of  $\leq 0.05$  was considered for statistical significance.

## RESULTS

**Table1: Mean age distribution between the groups Group**

Group	Age		t-test	P-value
	Mean SD			
Fentanyl	30.83	10.719	-1.09	0.28
Esmolol	33.8	10.364		

The age range was 20-50 years for study groups The Mean value of age with standard deviations are 30.83 10.719 and 33.8 10.3 for Fentanyl and Esmolol Groups. There was no significant difference between two groups ( $p=0.28$ ).

**Table 2: Mean Systolic Blood Pressure distribution at different times between the groups**

Time Assessment	Systolic Blood Pressure				t-test	p-value
	Fentanyl	% Difference	Esmolol	% Difference		
Pre Induction	137.63±11.669		129±11.694		0.873	0.386
Post Induction	129.83±11.35	-5.7	128.27±11.662	-0.6	0.527	0.6
1 Min	148.23±11.392	7.7	137.23±10.42	6.4	3.902	<0.001**
3 Min	145.73±12.165	5.9	134.93±10.144	4.6	3.735	<0.001**
5 Min	137.97±10.826	0.2	129.6±10.743	0.5	3.005	0.004**
7 Min	131.43±11.054	-4.5	126.43±9.912	-2.0	1.845	0.07
10 Min	128.63±11.47	-6.5	125.8±9.932	-2.5	1.023	0.311

**Fentanyl Group**

A fall in systolic blood pressure of 5.7% from pre induction level of 137.63, 11.669 was observed following induction. The rising systolic blood pressure was 7.7% at 1 minute with the onset of laryngoscopy and intubation (148.23 11.392). Then it decreased to 5.9% and 0.2% at 3 and 5 minutes. A 4.5% lower than basal value (128.63 ±11.47) was recorded at the end of 10 minutes.

**Esmolol Group**

A decrease in systolic blood pressure 0.6% (128.27±11.662) from the basal level of 129±11.694 occurred with induction of anaesthesia. With the onset of laryngoscopy

and intubation rise in systolic blood pressure was only 6.4% (137.23±10.42) at 1 minute. Subsequent observation showed fall to 4.6% (134.93±10.14) at 3 minutes and reached to the pre induction level at the end of 5 minutes. A 2.5% lower than the basal value (125.8±9.93) was recorded at 10 minutes.

No significant variation is found in both groups with pre and post induction values. A statistically significant difference is observed both the groups at subsequent assessments (P<0.001 and P<0.05). Attenuation of systolic blood pressure is highly significant with Esmolol when compared with fentanyl. A maximum rise of only 6.4% was seen (P<0.001).

**Table 3: Mean Diastolic Blood Pressure distribution at different times between the groups**

Time Assessment	Diastolic Blood Pressure				t-test	p-value
	Fentanyl	% Difference	Esmolol	% Difference		
Pre Induction	77.63±5.828		76.07±5.439		1.076	0.286
Post Induction	75.87±5.692	-2.3	75.2±4.951	-1.1	0.48	0.63
1 Min	86.5±4.637	11.4	80.07±5.132	5.3	5.094	<0.001**
3 Min	85.1±3.575	9.6	79.33±4.678	4.4	5.364	<0.001**
5 Min	81.1±3.397	4.5	76.43±4.116	-38.9	4.789	<0.001**
7 Min	77.63±4.597	0.0	75.4±4.731	-0.8	1.854	0.069
10 Min	75.77±4.688	-2.4	74.97±4.993	-1.4	0.64	0.525

\*\*p-value <0.01, highly significant at 5% level of Significance.

**Fentanyl group**

This group showed mean pre induction value of 77.63 5.828. There was a small fall to 75.87±5.692 (2.3%) after induction. The Maximum rise found at 1 minute was 11.4% more than preinduction value 86.5±4.637. It decreased to 85.1±3.575 i.e., 9.6% at 3 minutes and 81.1±

3.397 i.e., 4.5% at 5 minutes. The Mean values at 7 and 10 minutes showed a small decrease.

**Esmolol Group**

Preinduction value is 76.7±5.439. Maximum increase in diastolic pressure was 5.3% (80.07±5.132) from the basal

level following a small decrease by 4.4% ( $79.33 \pm 4.678$ ) after induction of anesthesia. Maximum increase was at 1 minute interval. It decreased to  $79.33 \pm 4.678$  i.e., 4.4% at 3 minutes and  $76.43 \pm 4.116$  at 5 minutes. The mean values at 7 & 10 minutes were slightly less than basal level.

One Way ANOVA shows no significant difference both the groups at pre and post induction levels. When compared with Fentanyl, Esmolol shows highly significant suppression of diastolic Blood Pressure. The Maximum rise was 11.4% and 5.3% in Fentanyl and Esmolol groups respectively ( $P < 0.001$ ).

**Table 7: Mean Arterial pressure distribution at different times between the groups**

Time Assessment	Mean Arterial Pressure				t-test	p-value
	Fentanyl	% Difference	Esmolol	% Difference		
Pre Induction	$95.65 \pm 6.43$		$93.68 \pm 5.89$		1.235	0.222
Post Induction	$93.167 \pm 7.88$	-2.6	$93.107 \pm 5.48$	-0.6	0.034	0.973
1 Min	$106.967 \pm 5.89$	11.8	$98.807 \pm 4.876$	5.5	5.839	$<0.001^{**}$
3 Min	$105.223 \pm 4.86$	10.0	$97.73 \pm 5.19$	4.4	5.766	$<0.001^{**}$
5 Min	$100.07 \pm 4.23$	4.6	$94.117 \pm 5.13$	0.5	4.909	$<0.001^{**}$
7 Min	$95.39 \pm 39$	-0.3	$92.41 \pm 5.23$	-1.3	2.27	0.027*
10 Min	$93.42 \pm 5.72$	-2.3	$91.95 \pm 5.18$	-1.8	1.043	0.301

\*\*p-value $<0.01$ , highly significant, \*significant, at 5% level of significance.

### Fentanyl Group

The Pre induction mean value is  $95.65 \pm 6.43$ . A decrease of 2.6% was seen with induction. The Maximum rise in mean arterial pressure was by 11.8% ( $106.967 \pm 5.89$ ) at 1 Minute interval. It further reduced at 3 and 5 minutes interval. A small fall was found at 7 and 10 Minutes.

### Esmolol Group

The Pre induction mean value is  $93.68 \pm 5.89$ . A decrease of 0.6% was seen with induction. The Maximum rise in mean arterial pressure was by 5.5.8% ( $98.807 \pm 4.876$ ) at 1 Minute interval. It further reduced at 3 and 5 minutes interval. A small fall was found at 7 and 10 Minutes.

One way ANOVA shows no significant difference both the groups before and after induction. A significant difference seen in both the groups at 1,3,5 and 7 minutes interval ( $P < 0.001$ ). The Maximum rise is 11.8% in Fentanyl group where as it is 5.5 % in Esmolol group. Between the two study groups Esmolol is highly significantly in attenuating pressure response.

## DISCUSSION

Endotracheal intubation and laryngoscopy is associated with rise in blood pressure, heart rate and cardiac dysarrhythmias. [5,6] These above mentioned effects may be short lived they may have adverse effects in high risk patients like, those with cardiovascular diseases, increased intracranial pressure or anomalies of cerebral vessels. Rise in heart rate of 29.9 beats/min was

documented in a study. An average rise in mean arterial pressure of 25 mmHg and 47.7 mmHg have been documented. [7]

An increase in mean arterial pressure of 26.5 mmHg and 20 to 40 torr when compared with awake control levels and 35 to 60 torr when compared with preintubation values, [8,9,10] have been reported after placement of an endotracheal tube.

Previous studies have shown that unique pharmacokinetic behaviour of esmolol makes it well suited for controlling the cardiovascular response to tracheal intubation and laryngoscopy when used as a continuous infusion technique. [10] A simple alternative is using bolus doses of esmolol and many study have investigated this and concluded it to be efficacious in attenuating the cardiovascular response to laryngoscopy and tracheal intubation. [11,12] In studies conducted before, 2mg/kg IV bolus esmolol injected prior to induction has been effective in attenuating cardiovascular response to laryngoscopy and intubation. [13,14,15] Optimal time of administration is 3 minutes before laryngoscopy and intubation. [16] Esmolol also prevented the bispectral index during induction of anaesthesia and orotracheal intubation. [17]

In our study heart rate increased with esmolol was 12.29% and fentanyl was 20.7%. Both esmolol and fentanyl attenuated the heart rate highly significantly ( $P < 0.001$ ). It reaches to a level which is clinically less significant by the end of 5 minutes in esmolol and



fentanyl groups. Suppression of maximum rise in heart rate by esmolol is statistically highly significant when compared with fentanyl ( $P < 0.001$ ). It remains significant till 7 minutes.

With administration of fentanyl maximum increase of systolic blood pressure compared to preinduction value was 7.7% and with esmolol it was only 6.4%. Between the two drugs esmolol showed better result ( $P < .001$ ).

Similarly mean arterial pressure increased by Fentanyl limited the maximum rise to 11.8% ( $P < .01$ ) while esmolol to only 5.5% ( $P < .001$ ). It reached preinduction level over 7 minutes in fentanyl group and 5 minutes in esmolol group. The attenuation of mean arterial pressure by esmolol is highly significant when compared with fentanyl ( $P < .001$ ).

### Limitations of Study

- Adequate depth of anaesthesia and neuromuscular relaxation was monitored only by clinical observations.
- Various drugs used in the present study are known to influence the haemodynamic changes which was not evaluated.
- The heart rate at preinduction level shows statistically significant variations between two groups clinically it is not significant.
- Variations in parameters can occur as the patient starts to come out of the effect of succinylcholine and before the action of supplemented vecuronium sets in.
- Haemodynamic changes associated with two stages i.e., direct laryngoscopy and passage of tracheal tube into trachea were not studied separately.

### CONCLUSION

In patients with Esmolol significantly attenuates the sympathetic response to laryngoscopy and intubation. Fentanyl also significantly attenuates the sympathetic response. Esmolol is more effective than fentanyl in attenuation of sympathetic response to laryngoscopy and intubation. IV. Bolus dose of esmolol 2mg/kg administered 3 minutes before laryngoscopy and intubation can be recommended to attenuate the sympathetic response to laryngoscopy and intubation without any side effects of the drug.

### CONFLICT OF INTEREST:

The authors declared no conflict of interest.

**FUNDING:** None

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