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Attenuation of Hemodynamic Response to Laryngoscopy And Intubation With Esmolol - A Study

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Abstract
INTRODUCTION
Laryngoscopy and tracheal intubation must be considered to be the most potent noxious stimuli in respect of their effects on autonomic nervous activity. Increase in BP, HR occurs most commonly from reflex sympathetic discharge in response to laryngotracheal stimulation.
Tracheal intubation is associated with increase in arterial pressure, heart rate, plasma catecholamine concentration.
Different drugs have been used to attenuate stress response to laryngoscopy and tracheal intubation.
The present study was conducted to study the effect of Esmolol 2mg/kg intravenously to attenuate the hemodynamic response to laryngoscopy and tracheal intubation.
Key words: *anesthesia, attenuation of stress, laryngoscopy, Esmolol*
AIM: *To study the effect of Esmolol in attenuating the hemodynamic response to Laryngoscopy and Tracheal intubation.*
Materials and Methods: *We conducted a prospective randomized, double blind study in 60 patients in the age group of 25 -55 yrs belonging to ASA physical status I or II in Guntur Medical College and General Hospital, Guntur in August 2017 to December 2017 were included in the study. The patients were randomly allocated into two groups and each group included 30 patients.*
Group I (n = 30): *Patients received Esmolol 2mg/kg intravenously 1 min prior to induction with thiopentone sodium*
Group II (n = 30): *Patients were intubated after giving 10ml of normal saline 1min prior to induction with thiopentonesodium.*
The general anesthesia technique was standardized for all two groups. Hemodynamic variables were recorded at base line, after giving induction agent thiopentone, and 1, 2,3,4,5 mins after intubation.
Results: *The results showed that in group I, where patients received Esmolol 2mg/kg, pressure response was attenuated significantly during laryngoscopy and tracheal intubation in the form of less rise or no rise of blood pressure and pulse rate, when compared to group II patients, where they received 10ml normal saline 1min prior to induction.*
There was a statistical difference (P<0.05) between group I and group II in HR, SBP, DBP, MAP at all-time points.
Conclusion: *The pressure response to laryngoscopy and tracheal intubation was effectively attenuated with Esmolol 2mg/kg when given prior to induction.*

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I. Introduction

During laryngoscopy and tracheal intubation there is reflex sympathetic discharge caused by epipharyngeal and laryngopharyngeal stimulation which causes rise in BP, HR. The hemodynamic response to laryngoscopy and tracheal intubation in most of the patients are transient, highly variable but may have adverse effects like arrhythmias, myocardial ischemia, left ventricular failure, increased intracranial pressure, and rupture of cerebral aneurysm in patients with Pre-existing cerebrovascular and cardiovascular diseases. (2)

Various agents like beta blockers, calcium channel blockers, nitroglycerine, sodium nitroprusside, lidocaine etc have been used to attenuate the hemodynamic response. (1)

Among which, beta blocking agents, Esmolol Hydrochloride, an ultra-short acting beta blocker, with cardio selective property having an elimination half-life of 9min is the choice in prevention of hemodynamic alteration following endotracheal intubation and laryngoscopy (3, 4, and 5)

AIM: To study the effects of Esmolol in attenuating the hemodynamic response to laryngoscopy and tracheal intubation in ASA Grade I and II patients.

II. Materials And Methods

After obtaining an approval from the institutional ethical committee and written informed consent from the patients, the study was carried out in Guntur Medical College and General Hospital, Guntur, during the period of Aug 2017 to Dec 2017. 60 patients of ASA grade I and II aged between 25-55 years undergoing elective surgical procedures under general anesthesia were included in the studyPatients with anticipated difficult intubation, Bronchial Asthma, significant cardiac, neurological, respiratory, hepatic, renal disorder, history of drug allergy and unwilling patients were excluded from the study.The study was a randomized controlled double blind study.

The sample size of 30 patients each was taken for two groups. Group I (Esmolol Group) and Group II (Normal saline).

Group I (esmolol group) (n = 30): Patients received Esmolol 2mg/kg intravenously one min prior to induction with Thiopentone sodium 5mg/kg.

Group II (control) (n = 30): Patients received identical volume of normal saline intravenously one min prior to induction.

A routine pre-operative checkup was done in all patients and patient's demographic data such as sex, age, weight were recorded.

All patients were premedicated withTab diazepam 10mg night before surgery. All the patients were kept overnight fasting. On arrival to operation theatre I.V line was secured, IV Fluids Ringer Lactate 5ml/kg started. Premedicated with injection glycopyrrolate.20mcg/kg IV. Base line values (Preanesthetic) heart rate, noninvasive blood pressure (NIBP), peripheral O2 saturation, continuous electrocardiogram (ECG) and were recorded. The study drug was prepared in a 10ml syringe separately by another anesthesiologist who was not involved in the study and identical volume of control drug was given. All the patients were Pre-Oxygenated with 100%O2 for 3 min. Abolus dose dose of Esmolol 2mg/kg was given slowly intravenously in study group Iand identical volume of normal saline was given in group II. One min later anesthesia was induced with thiopentone sodium 5mg/kg and ing Suxamethonium 2mg/kg was given after adequate ventilation.

Then a direct laryngoscopy was performed by a professional anesthetist. With a standard Macinost Laryngoscopy blade and trachea was intubated with an appropriate size cuffed endotracheal tube and patient was ventilated. In all patients intubation was done with in a period 30 seconds.

Anaesthesia was maintained with balanced technique of N_2O 60% O_2 40% systemic analgesia, Isoflurane 1% and inj Atracurium besylate 0.5mg/kg. At the end of the surgery patients were reversed with inj glycopyrrolate 20mic/kg and neostigmine 0.05 mg/kg patients were extubated after return of airway protective reflex, the heart rate, and blood pressure were recorded at the following time intervals during the procedure.

1. Before intubation – Baseline and
2. 1 min after Thiopentone sodium
3. 1 minute, 2 minute, 3minute, 4 minute, 5minute after intubation

The results were tabulated and statistically analyzed.

III. Results

There was no significant difference in the demographic profile among the groups regarding age, sex body weight. (TABLE 1, 2, 3)

Sex distribution (Table 1)

Sex	Group I	Group II
Male	20	20
Female	10	10
Total	30	30

We evaluated 60 patients including 40 males and 20 females

Age (Table 2)

Age group in year	Group I	Group II
25 - 35	10	1o
35 - 45	10	10
45 - 55	10	5

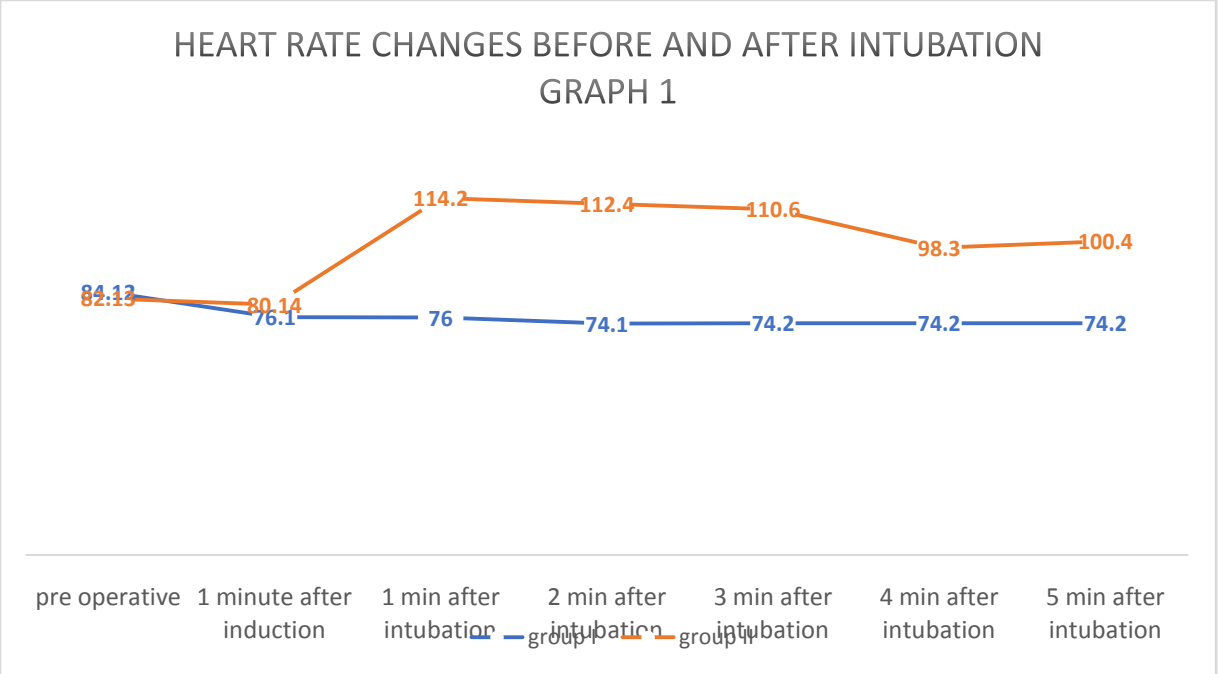
Weight of the patients (Table 3)

Wt KG	Group **I**	Group **II**
60 – 69	9	12
50 – 59	12	11
40 - 49	9	7

Heart rate (beats/min) changes before and after intubation (Table 4)

	GROUP I (E) MEAN ± SD	GROUP II (NS) MEAN ± SD	P- VALUE
PRE OPERATIVE	84.12±1.2	82.13± 7.83	0.17
1 MIN AFTER INDUCTION	76.1±1.2	80.14 ± 5	0.0001
1 MIN AFTER INTUBATION	76 ±1.2	114.2 ± 5.6	0.0001
2 MIN AFTER INTUBATION	74.1±1.6	112.4 ± 4	0.0001
3 MIN AFTER INTUBATION	74.2 ± 1.2	110.6 ± 3	0.0001
4 MIN AFTER INTUBATION	74.2 ± 1.2	98.3 ± 1.3	0.0001
5 MIN AFTER INTUBATION	74.2 ± 1.2	100.4 ± 1.2	0.0001

The changes in heart rate was assessed at preoperative and 1 min after induction and 1min, 2min, 3min, 4min, 5min, after laryngoscopy and tracheal intubation in group I and group II and their comparative statistics were presented in Table 4. The difference in heart rate between group II and group I was notsignificant pre operatively (p >0.17). 1 min after intubation in group I there was decrease in HR from base line value of 84.12± 1.2 to 76 ± 12 (11%). But in group II HR was increased from baseline value of 82.13 ± 7.8 to 114.2 ± 5.6 (28.5%). P < 0.001, which was highly significant.

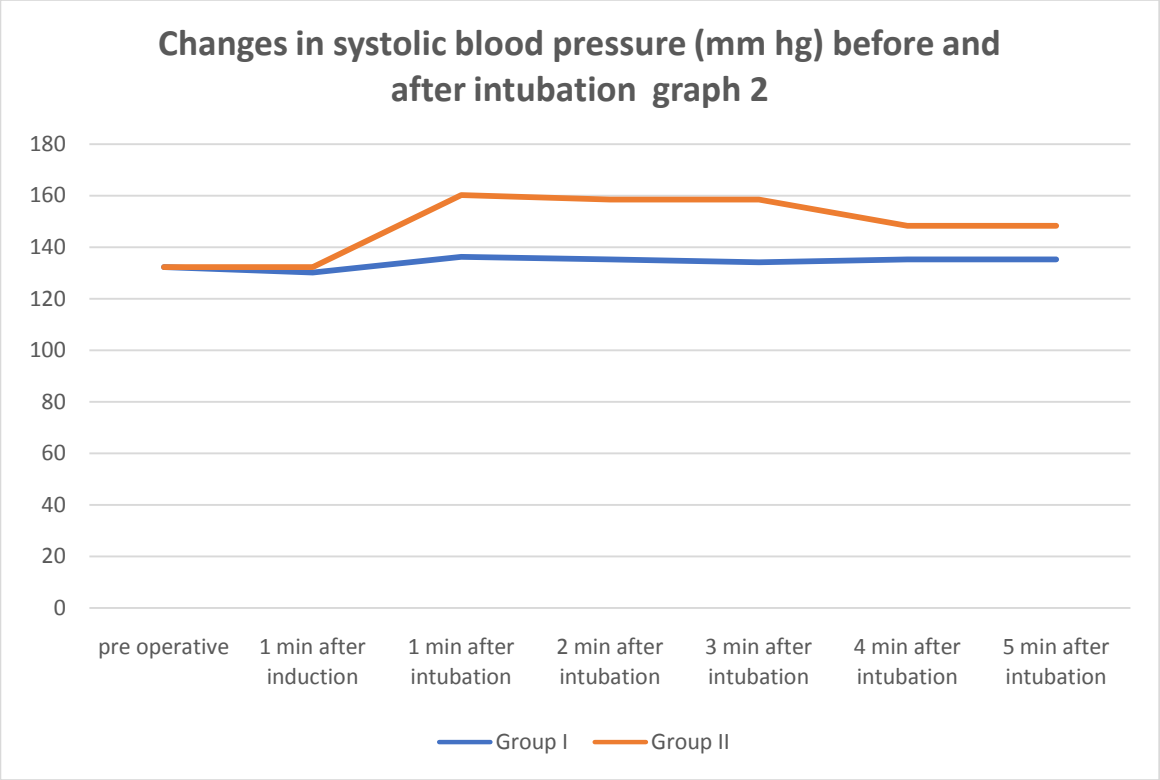


Changes in systolic blood pressure (mm Hg) before and after intubation Table 5

	GROUP I N =30	GROUP II N =30	P-VALUE
	MEAN ±SD		
PRE OP	132.2 ± 1.6	132.2 ± 4	1.0
1 MIN AFTER INDUCTION	130.12 ± 1.6	132.2 ± 4	1.0
1 MIN AFTER INTUBATION	136.2 ± 1.4	160.2 ± 5.2	0.001
2 MIN AFTER INTUBATION	135.16 ± 1.8	158.4 ± 3.6	0.0001
3 MIN AFTER INTUBATION	134.13 ± 1.5	158.4 ± 3.6	0.0001
4 MIN AFTER INTUBATION	135.16 ± 2.0	148.2 ± 1.6	0.0001
5 MIN AFTER INTUBATION	135.16 ± 2.0	148.2 ± 2.0	0.0001

The changes in SBP were assessed at pre-operatively and 1 min after induction and 1, 2,3,4,5 min after laryngoscopy and intubation. There was no significant variation found in both the groups in their preoperative and 1 min after induction (p 1.0)

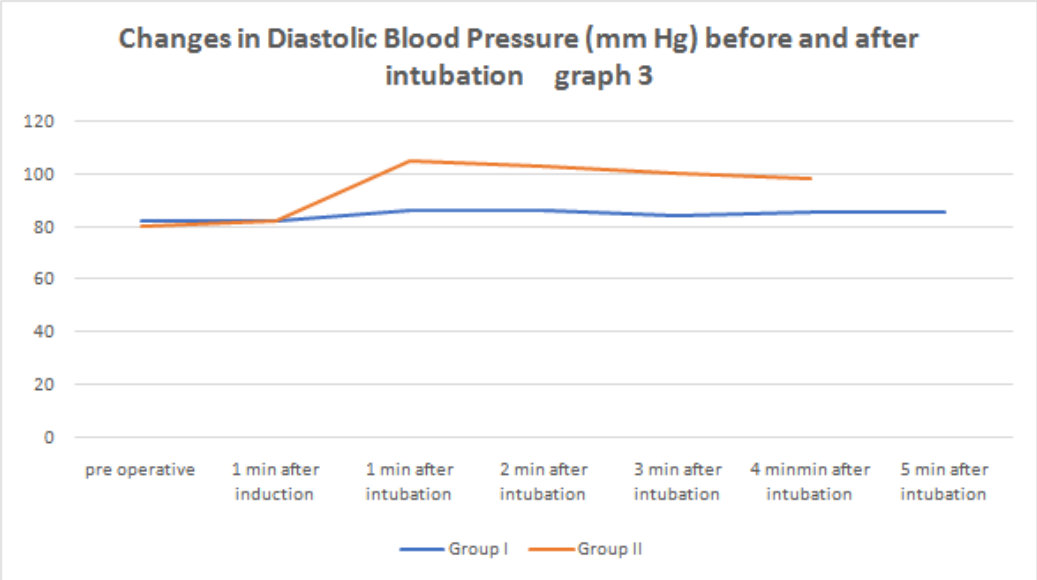
In group II, 1 min after intubation, the SBP was 160.2 ± 5.2mm hg but in group I it was 136.2 ± 1.4 mm hg which was significant p 0.001. There is less rise in SBP in group I (3%). but there was increase in SBP at all-time points in group II when compared with group I p <0.001 which was highly significant



Changes in Diastolic Blood Pressure (mm Hg) before and after intubation Table 6

	GROUP I N =30	GROUP II N =30	P-VALUE
	Mean ± SD		
PRE OP	82.13 ± 1.6	80.2 ± 1.6	>0.05
1 MIN AFTER INDUCTION	82.18 ± 1.8	80.3 ± 1.6	
1 MIN AFTER INTUBATION	86.18 ± 1.4	104.6 ± 2.4	0.0001
2 MIN AFTER INTUBATION	86.23 ± 1.3	102.4 ± 2.3	0.0001
3 MIN AFTER INTUBATION	84.24 ± 1.6	100.12 ± 1.6	0.0001
4 MIN AFTER INTUBATION	85.26 ± 1.8	98.26 ± 2.0	0.0001
5 MIN AFTER INTUBATION	85.28 ± 1.2	98.13 ± 1.2	0.0001

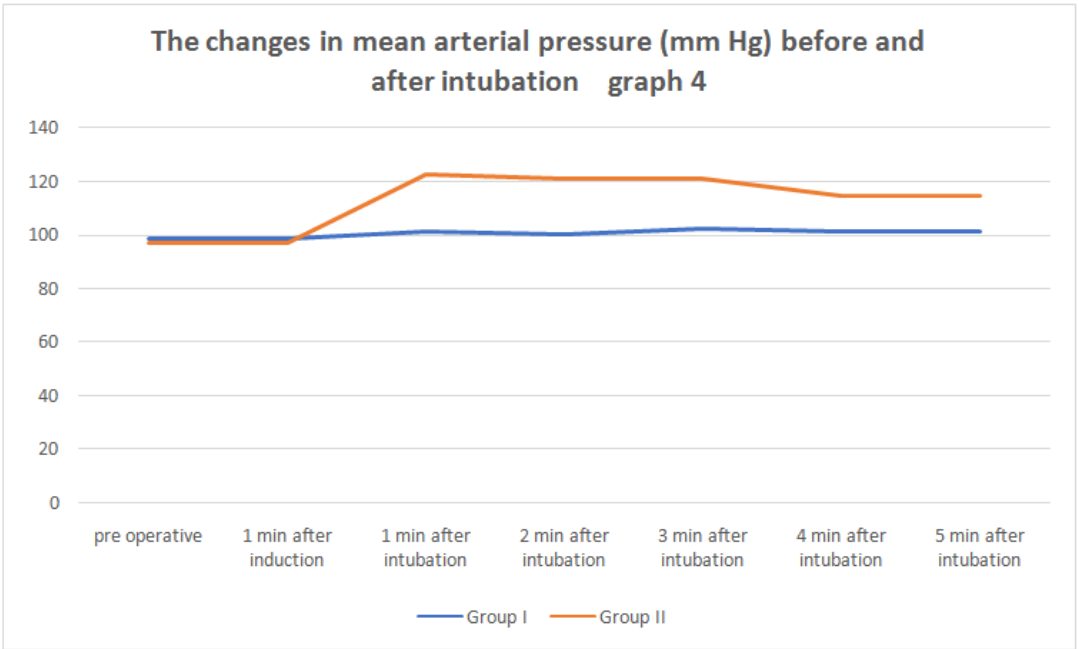
The changes in DBP were assessed preoperatively and 1 min after induction and 1, 2,3,4,5 min after intubation there was no significant difference in their DBP in pre-operative and 1 min after induction. But was highly significant P<0.0001 at all-time points. Esmolol is efficient in attenuating DBP 1 min after Intubation in group I. The basal DBP in group I was 82.13±1.6 mm Hg and 1 min after intubation it was 86.18 ± 1.4 mm Hg.There was only 2% increase from its basal value. In group II the basal DBP value was 80.2±1.6 mm Hg. 1 min after intubation it was 104.6 ± 2.4 mm Hg. There was 24% increase from its basal value p <0.0001which was highly significant.



The changes in mean arterial pressure (mm Hg) before and after intubation table 7

	GROUP I	GROUP II	P-VALUE
	Mean± SD		
PRE OP	98.6 ± 1.2	96.6 ± 1.6	>0.005
1 MIN AFTER INDUCTION	98.42 ± 1.6	96.6 ± 1.6	>0.005
1 MIN AFTER INTUBATION	101.3 ± 1.8	122.6 ± 2.8	<0.001
2 MIN AFTER INTUBATION	100.32 ± 1.2	120.8 ± 3.2	<0.001
3 MIN AFTER INTUBATION	102.36 ± 1.4	120.8 ± 3.2	<0.001
4 MIN AFTER INTUBATION	101. 48 ± 3.2	114.6 ± 2.6	<0.001
5 MIN AFTER INTUBATION	101.48 ± 3.2	114.6 ± 2.6	<0.001

The changes in mean arterial pressure were assessed at pre-operative and 1 min after induction and 1, 2,3,4,5 min after laryngoscopy and intubation. No significant variation was found in mean arterial pressure in both groups pre-operatively as well as 1 min after post induction. The mean arterial pressure was raised in both the groups after laryngoscopy and tracheal intubation but, less rise (98.6 ± 1.2 mm Hg to 101.3 ± 1.8 mm Hg) 2.7% in group I when compared to group II which was 21.5% (from 96.6 ± 1.6 to 122.6 ± 2.8 mm Hg). There was a significant difference seen in both groups at 1, 2,3,4,5 minutes after laryngoscopy and tracheal intubation p<0.001 which was statistically significant.



IV. Discussion

Hypertension and tachycardia have been reported since 1950 during intubation under light anesthesia (7).

Bachofen M, (8) stated the criteria for selection of appropriate drug to prevent sympathetic response are as follows the drug must be applicable, regardless of patient collaboration, prevent impairment of cerebral blood flow and avoid arousal of the patient. It should neither be time consuming nor effect the modality of the ensuing anesthesia. Intravenous esmolol appear to fulfill the above criteria.

Various methods and techniques have been used to attenuate hemodynamic stress response to laryngoscopy and tracheal intubation. It ranges from topical application of local anesthetics, infiltration nerve blocks, and various pharmacological agents. (6)

Various pharmacological agents have been used, e.g. beta blockers, calcium channel blockers, nitroglycerine, opioids, pregabalin, and lignocaine to suppress the hemodynamic stress response. (1)

Among which esmolol an ultra-short acting beta blocker, owing to its unique pharmacokinetic behavior (8) is well suited for controlling hemodynamic stress response during laryngoscopy and tracheal intubation by continuous infusion as studied by Liuet al (9).

Hussain AM et al who compared the efficacy of control, esmolol 2mg/kg and fentanyl 2 mic/kg and showed increase in blood pressure in all groups but least in esmolol group (10).

In our study heart rate was decreased by 11% (from 84.12 ±1.2 to 76 ± 1.2) immediately 1min after intubation in group I. But there was an increase in heart rate from base value of 82.13 ± 7.8 to 114.2 ± 5.6(28.5%) ($p < 0.001$) in group II(graph 1, table 4). This was similar to the study of Uguret et al (12) who compared the efficacy of esmolol 1.5mg/kg, fentanyl 1mic/kg, lignocaine 1.5mg/kg and control which showed decrease in heart rate in esmolol group when compared to control group after induction and 1 min after intubation ($p<0.0083$). Singh H et al also showed similar attenuation in esmolol group, they compared the efficacy of esmolol, lignocaine, nitroglycerine and control for attenuation of hemodynamic stress response (11)

In our studies the mean arterial pressure was raised in both the groups after laryngoscopy and tracheal intubation but, less rise (98.6 ± 1.2 mm hg to 101.3 ± 1.8 mm Hg) 2.7% in group I when compared to group II which was 21.5% (from 96.6 ± 1.6 to 122.6 ± 2.8 mm hg) the results were significant ($p<0.001$).These findings were similar to the results of Gupta, Tank et al who found that esmolol shows significant attenuation of stress response after intubation. (13)

In our study maximum rise in SBP, DBP in group I at first min after intubation were 3% and 2% respectively. Mean arterial pressure was only 2.7% as compared to group II, in which SBP, DBP, and MAP were 23.5%, 24% and 21.5% respectively $P<0.001$ (table 5,6,7 and graph 2,3,4), which was highly significant. Similar results were observed in Begum et al (14) studies, who also reported that maximal response was at first min immediately after intubation. Our studies were well correlated with Begum et al studies.

V. Conclusion

Esmolol an ultra-short acting beta blocking agent in a dose of 2mg /kg body weight administered intravenously 3 minutes prior to laryngoscopy and tracheal intubation, effectively attenuate the hemodynamic stress response without any side effects.

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