Original Research Article

Comparison of the efficacy of dexmedetomidine with esmolol in attenuating laryngoscopic and intubation response

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Abstract

Background: Laryngoscopy and endotracheal intubation have become an integral part of anaesthetic management and critical care. Being noxious stimuli they ellicit stress response manifested as increased blood pressure, heart rate and arrhythmias. Various pharmacological and non-pharmacological methods have been used. **Aims:** To compare the efficacy of dexmedetomidine with that of esmolol in attenuating laryngoscopic and intubation response after rapid sequence induction. **Materials and Methods:** It is Prospective randomized double blind study in 120 Patients in the age group of 20 to 40 years scheduled for general anesthesia from January 2012 to December 2012 divided into 3 groups Group D: (N=40) Receive dexmedetomidine 0.5mcg/kg body weight in 20ml NS, Group E: (N=40) Receive esmolol 0.5mg/kg body weight in 20ml NS. Group C: (N=40) Receive 20ml NS over 5minutes before induction. Invasive systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) are recorded before giving the study drug, before induction of anaesthesia, before endotracheal intubation, immediately after endotracheal intubation, every 5 seconds in first minute and at 5mins, 10mins and 15mins after endotracheal intubation. The data is tabulated and analyzed statistically. **Results:** When compared between dexmedetomidine and esmolol statistically significant difference was observed in percentage change of invasive systolic blood pressure at 6 time points in less than one minute, but no statistically significant difference was found in percentage change in non-invasive systolic blood pressure which was measured at 1, 3, 5, 10, 15 minutes after intubation. Similar trend is also observed in DBP where a statistically significant difference was observed at 7 time points when measured invasively but the difference was only at one time point i.e. at 3rd minute when measured non-invasively. Statistically significant difference was observed in percentage change in heart rate at 11 time points in less than 1 minute and at 1, 3, 5, 10th minute after tracheal intubation. **Conclusion:** We conclude that Dexmedetomidine and Esmolol are effective in blunting the hemodynamic response to intubation, but Dexmedetomidine is superior to Esmolol in attenuating the hemodynamic response to laryngoscopy and endotracheal intubation without any significant side effects

Key Word: Dexmedetomidine, Esmolol, Endotracheal intubation

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Received Date: 28/03/2019 Revised Date: 04/05/2019 Accepted Date: 20/06/2019
DOI: https://doi.org/10.26611/10151115

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 08 July 2019

INTRODUCTION

Laryngoscopy and endotracheal intubation have become an integral part of anesthetic management and critical care. The techniques of laryngoscopy and tracheal intubation are also essential in critical care medicine for airway protection and mechanical ventilation. Being noxious stimuli they elicit stress response manifested as increased blood pressure, heart rate and arrhythmias. The magnitude of hemodynamic changes may depend on depth of anesthesia and duration of stimulus. Cardiovascular response is a reflex phenomenon mediated by vagus (x) and glossopharyngeal (ix) nerves.

How to site this article: Karri Tej Pavan, Amudala Sivaram. Comparison of the efficacy of dexmedetomidine with esmolol in attenuating laryngoscopic and intubation response. *MedPulse International Journal of Anesthesiology.* July 2019; 11(1): 23-29.
http://medpulse.in/Anesthsiology/index.php

Vagus and glossopharyngeal nerves carry afferent stimulus from epiglottis and infraglottic region and activate the vasomotor center to cause peripheral sympathetic adrenal response to release catecholamine's. Norepinephrine, epinephrine and dopamine levels rise, but the raise in norepinephrine levels is consistently associated with elevation of blood pressure and heartrate.[1]Till date, the exact mechanism of hemodynamic response to laryngoscopy and intubation is not clear. The principle mechanism behind hypertension and tachycardia is an exaggerated sympatheticaction[2]due to increased catecholaminerelease.[3] The rise in the pulse rate and blood pressure is usually transient, variable and unpredictable. This may not be of much significance in healthy individuals but can be hazardous in those with hypertension, cardiac dysfunction, coronary artery disease or cerebrovascular disease. Laryngoscopic response in such individuals can precipitate myocardial insufficiency, pulmonary edema, arrhythmias, left ventricular failure, and cerebrovascular hemorrhage. Various pharmacological and non-pharmacological methods have been used to attenuate the hemodynamic response to laryngoscopy and endotracheal intubation. The non-pharmacological methods include Smooth and gentle intubation with a shorter duration of laryngoscopy, Insertion of LMA in place of endotracheal intubation and Blocking Glossopharyngeal and superior laryngeal nerves. Pharmacological methods like Inhalational anesthetics, intravenous lidocaine narcotics, topical anesthesia, ß- blockers, calcium channel blockers, ACE inhibitors, vasodilators like nitroglycerine and sodium nitroprusside etc. were tried by various authors. Intravenous anesthetic induction agents do always adequately not suppress the circulatory responses evoked by endotracheal intubation. Inappropriate doses, opioids like fentanyl may be effective, but complex respiratory depression and truncal rigidity are frequent accompaniments. Vasodilators and lidocaine provide an incomplete solution to hypertension, having no effect on heartrate. Inhalation anesthetic agents also do not have encouraging effects in attenuating the hemodynamic response to laryngo-tracheal intubation. Nicardipine reduces systemic vascular resistance. It has no effect on cardiac contractility or preload[5] but can cause a dose dependent reflex increase in heart rate. Alpha-2agonistshaverecently gained significance in attenuating the laryngo-sympathetic response. Initially Clonidine, was introduced in to clinical practice for its sympatholytic, sedative, anesthetic sparing effects and hemodynamic stabilizing properties.[6]Dexmedetomidine decrease the induction dose of intravenous anesthetics and the intraoperative requirement of opioid and volatile anesthetics. It was also found to decrease the plasma concentration of catecholamine's during induction, intubation and maintenance of anesthesia thus prompting a good perioperative hemodynamic stability. It was also observed that the rise of intra ocular pressure with suxamethonium and intubation was blunted with dexmedetomidine premedication. Dexmedetomidine is increasingly being used as a sedative for monitored anesthesia care (MAC) because of its analgesic properties, "cooperative sedation", and lack of respiratory depression. Dexmedetomidine has been approved as a short-term sedative for critically ill patients needing mechanical ventilation in the ICU. However, bradycardia and hypotension are frequent with the use of dexmedetomidine. Increased plasma concentrations of dexmedetomidine were shown to be associated with increased preload and afterload and decreased cardiac output. Till recently dexmedetomidine was not available in India though it is being used in other countries since many years. Since it has been recently introduced in India and not many studies have been done in India regarding its usefulness in suppressing intubation response, there is a need to study its effectiveness. Since tachycardia appears to be associated more frequently with myocardial ischemia than does hypertension, interesting approach towards attenuating cardiac responses to laryngeal stimulation is the use of β-adrenergic antagonists. However, whilst attenuation of pressor response to laryngotracheal intubation is desirable, excessive negative chronotropic and inotropic action of the β – receptor blockers may reduce coronary perfusion and precipitate heart failure in susceptible patients. Esmolol is an effective option because it is ultra-short acting and can be administered intravenously. It has predominant action on β receptors and possesses no significant membrane stabilizing activity. It has rapid onset and ultra-short duration of action (10-15 min),as it is metabolized by plasma esterases. Peak effects with bolus injection of esmolol are seen in one to two minutes. Esmolol also decreases bispectral index(BIS), a numerical index that directly reflects the activity of cerebral cortex and the level of consciousness. Moreover, it aids in decreasing the dose of anesthetics for maintaining adequate depth of anesthesia. With Esmolol treatment, the difficulties of therapy with long lasting β-blockers are avoided. Sympathetic nervous system responses can be suppressed with a single dose IV before tracheal intubation. Several studies showed esmolol to be effective in blunting the heart rate response to laryngoscopy and intubation but blood pressure response was blunted only at higher doses. Dexmedetomidine is a recently introduced centrally acting α-2 agonist. Esmolol is a time tested effective β blocker. Both of them have a good potential in reducing blood pressure and heart rate, thus we seek to compare the

efficacy of both these drugs in countering the increased sympathetic response secondary to laryngoscopy and tracheal intubation.

AIMS

To compare the efficacy of dexmedetomidine with that of esmolol in attenuating laryngoscopic and intubation response after rapid sequence induction

MATERIALS AND METHODS

Prospective randomized double-blind study done in a period of One Year. Total 120patients with age group of 20 to 40 years scheduled for general anesthesia from January 2012 to December 2012.

Approval from hospital ethics committee was sought and written informed consent from patients was obtained.

Inclusion Criteria: Patients in the age group of 20 to 40 years scheduled for general anesthesia

Exclusion Criteria

1. Patients with anticipated difficult airway.
2. Patients in whom endotracheal intubation take more than 30 seconds.
3. Patients with ischemic heart disease. (valvular heart disease and conduction abnormalities)
4. Patients with hypertension and diabetes mellitus.
5. Patients with thyroid disease.
6. Patients on treatment with beta blockers

Patients are randomly allocated into three groups using computer generated randomization programme.

Group D :(N=40) Receive dexmedetomidine 0.5mcg/kg body weight in 20ml NS over 5minutes before induction.

Group E :(N=40) Receive esmolol 0.5mg/kg body weight in 20ml NS over 5minutes before induction.

Group C : (N=40) Receive 20ml NS over 5minutes before induction.

After shifting the patient into the operating room, the monitors NIBP, SPO_2, and ECG are connected and IV line is secured with 18G cannula. Inj. Midazolam 1mg IV is given as premedication. Arterial line is secured in radial artery after giving local anesthesia. All the patients are preoxgenated for 5minutes and administered the study drugs during the period of preoxygenation. The drugs are loaded by one anesthetist who is blinded to the study in 20ml syringe, coded and handed over to another anesthetist who is blinded to the drug present in the syringe for administration. After completion of 5minutes, anesthesia will be induced with injection thiopentone 5mg/kg body weight and injection succinylcholine 2mg/kg body weight in rapid sequence and trachea is intubated with appropriate size endotracheal tube by a reasonably experienced anesthetist. Inj. Fentanyl 2mcg /kg IV, inj. Vecuronium 0.1mg/kg iv are administered and anesthesia is maintained on sevoflurane 1.5-2.0%, N2O:O2 =2:1 liter/minute through circle system. Invasive systolic blood pressure (SBP), diastolic blood pressure (DBP), Mean arterial pressure (MAP) and heart rate (HR) are recorded before giving the study drug, before induction of anesthesia, before endotracheal intubation, immediately after endotracheal intubation, every 5 seconds in first minute and at 5mins, 10mins and 15mins after endotracheal intubation. The data is tabulated and analyzed statistically.

Statistical Analysis: At the end of study all data is compiled and statistically analyzed using

Diagrammatic representation, Quantitative data is analysed by student t-test, Qualitative data is analysed by chi square test, Power of the study is calculated by Altman's nomogram and P<0.001 is taken as highly significant.

RESULTS

Table1: Demographic details

Patient Characteristics [mean ±SD)]			
Patients characteristics	**Group D** (N=40)	**Group E** (N=40)	**Group C** (N=40)
Age (years)	35.9±5.25	33.6±6.14	33.3±6.91
Sex(M/F)	14/16	19/11	19/11
Weight(Kg)	56±13.3	54±9.7	57±7.7

There was no statistically significant difference in the age, gender and weight between the three groups.

Table 2: Percentage change in invasive SBP from baseline Invasive and non-invasive SBP

Time points of measurement	Dex %change from Baseline	Esmolol %change from baseline	Control %change from baseline	Dex Vs Esmolol P-value	Dex Vs Control P-value	Esmolol Vs Control P-value
BEFOREINDUCTION	-0.7	-1.5	-3.5	NS	NS	NS
BEFOREINTUBATION	-5.2	5.3	3.4	0.025	0.025	NS
0SEC	7.3	23.8	27.4	0.005	<0.001	NS
5SEC	17.7	31.2	29.9	0.005	0.01	NS

10SEC	19.9	30.7	29.4	0.025	0.05	NS
15SEC	17.5	32.4	27.2	0.01	NS	NS
20SEC	17.4	30	22.3	0.025	NS	NS
25SEC	21.3	29	21.1	NS	NS	NS
30SEC	20.3	27.4	18.8	NS	NS	NS
35SEC	19.3	28	14.8	0.05	NS	0.01
40SEC	19.7	24.4	15.6	NS	NS	NS
45SEC	19.9	26.1	14.2	NS	NS	0.025
50SEC	19	21.5	11.2	NS	NS	0.05
55SEC	20	24.1	9.1	NS	0.05	0.01
1MIN	18	21.6	7	NS	0.05	0.01
3MIN	4.6	7.9	8.6	NS	NS	
5MIN	-7.3	-6.9	-15	NS	0.05NS	0.025
10MIN	-17.7	-13.3	-20.5	NS	NS	0.01
15MIN	-7.5	-10.9	-20	NS	0.01	0.025
Percentage change in non-invasive SBP from base line noninvasive SBP						
BEFORE INDUCTION	-2.2	8.4	-3	NS	NS	NS
1MIN	22.6	24.9	10.7	NS	0.005	<0.001
3MIN	5	11.4	2.8	NS	NS	NS
5MIN	-11.8	1.9	-9.2	NS	0.05	0.005
10MIN	-11.8	-8.4	-13.8	NS	NS	NS
15MIN	-7.5	-8.3	-12.4	NS	NS	NS

The percentage change in Invasive SBP from baseline was observed to be low in dexmedetomidine group than esmolol group which is lesser than control group at all time points of measurement numerically, but after statistical analysis significant difference was found only at some time points which were highlighted in the table The percentage change in Noninvasive SBP from baseline was observed to be low in dexmedetomidine group than esmolol group which is lesser than control group at all time points of measurement numerically, but after statistical analysis significant difference was found only at some time points which were highlighted in the table

Table 3: Percentage change in invasive DBP from baseline Invasive and noninvasive DBP

Time points of measurement	Dex	Esmolol	Control	Dex Vs Esmolol	Dex Vs Control	Esmolol Vs Control
	%CHANGE FROM BASELINE	%CHANGE FROM BASELINE	%CHANGE FROM BASELINE	P-VALUE	P-VALUE	P-VALUE
BEFOREINDUCTION	-1.5	0.6	-0.1	NS	NS	NS
BEFOREINTUBATION	8.9	22.4	21	0.025	0.05	NS
0SEC	26.4	47.4	49.5	0.005	0.005	NS
5SEC	40.5	54.2	52.4	0.05	NS	NS
10SEC	40.9	54.2	50	0.025	NS	NS
15SEC	40.4	52.1	46.8	0.05	NS	NS
20SEC	37.6	48.8	42	0.05	NS	NS
25SEC	35	46.4	39.4	0.05	NS	NS
30SEC	35	44.8	37.8	0.05	NS	NS
35SEC	35.2	43.5	37.1	NS	NS	NS
40SEC	34	40.2	35.9	NS	NS	NS
45SEC	34.4	39.4	34.2	NS	NS	NS
50SEC	35.7	36.3	28.7	NS	NS	NS
55SEC	32.5	35	28.2	NS	<0.001	<0.001
1MIN	31.2	30.9	27.3	NS	NS	NS
3MIN	13.6	21	7.2	NS	NS	0.005
5MIN	1.1	3	-0.6	NS	NS	NS
10MIN	-8.1	-2.5	-7.3	NS	NS	NS
15MIN	1.3	-1.6	-1.7	NS	NS	NS
Percentage change in non-invasive DBP from baseline noninvasive DBP						
BEFORE INDUCTION	-1.6	4.5	1.7	0.05	NS	NS
1MIN	33.7	42.2	26.5	NS	NS	NS

3MIN	15.5	24.8	5.4	0.05	0.05	<0.001
5MIN	5.2	11.2	0.055	NS	NS	0.025
10MIN	-5.6	3.4	-9.7	NS	NS	NS
15MIN	1.3	-0.3	-5.9	NS	NS	0.001

The percentage change in invasive DBP from baseline was observed to be low in dexmedetomidine group than esmolol group which is lesser than control group at all time points of measurement numerically, but after statistical analysis significant difference was found only at some time points which were highlighted in the table The percentage change in Non invasive DBP from baseline was observed to be low in dexmedetomidine group than esmolol group which is lesser than control group at all time points of measurement numerically, but after statistical analysis significant difference was found only at some time points which were highlighted in the table.

Table 4: Percentage change in Heart Rate from baseline Heart Rate

Time points of measurement	Dex %change from baseline	Esmolol %change from baseline	Control % change from baseline	Dex Vs Esmolol P-value	Dex Vs Control P-value	Esmolol Vs Control P-value
BEFOREINDUCTION	-23.7	-12.1	-0.1	<0.001	<0.001	<0.001
BEFOREINTUBATION	5.5	17.2	14.4	0.05	NS	NS
0SEC	7.2	26.4	18.4	0.01	NS	NS
5SEC	12.9	29.3	19	0.025	NS	NS
10SEC	16.2	28.2	16.3	0.05	NS	NS
15SEC	13	29.1	18.9	0.01	NS	NS
20SEC	7.4	26.8	17.9	<0.001	NS	NS
25SEC	9.5	23.9	16.1	0.01	NS	NS
30SEC	7.2	22.5	15.3	0.005	NS	NS
35SEC	4	18.7	15.6	0.005	0.025	NS
40SEC	2.2	18.6	15	<0.001	0.025	NS
45SEC	1.6	19.1	12.9	<0.001	0.05	NS
50SEC	2.5	18.6	13.1	<0.001	0.05	NS
55SEC	2.3	19	12.6	<0.001	0.05	NS
1MIN	0.9	18.7	13.5	<0.001	0.01	NS
3MIN	-10.9	11.3	7.2	<0.001	<0.001	NS
5MIN	-12.14	1.7	-1.2	<0.001	0.01	NS
10MIN	-14.6	-2.1	-9.1	<0.001	NS	NS
15MIN	-13.1	-7.9	-9.8	NS	NS	NS

The percentage change in Heart Rate from baseline was observed to be low in dexmedetomidine group than esmolol group which is lesser than control group at all time points of measurement numerically, but after statistical analysis significant difference was found only at some time points which were highlighted in the table

DISCUSSION

The sequence of induction of anesthesia, laryngoscopy and tracheal intubation is associated with marked hemodynamic changes and autonomic reflex activity which may because of concern in many high-risk patients[7] Laryngoscopy and intubation are associated with rise in heart rate, blood pressure and incidence of cardiac arrhythmias. Less commonly bradycardia may occur as a result of vagal stimulation Ghaus *et al* (2002)[8]. These potentially dangerous changes disappear within 5 minutes of onset of laryngoscopy. Although these responses of blood pressure and heart rate are transient and short lived, they may prove to be detrimental in high risk patients especially in those with cardio vascular disease, increased intracranial pressure or anomalies of the cerebral blood vessels. Many factors in fluence the cardiovascular changes associated with laryngoscopy and intubation. Age, drugs, type and duration of procedures, depth of anesthesia, hypoxia, hypercarbia etc., influence the pressor response. Variations of heart rate changes decrease with increasing age. Young patients show more extreme changes. Marked fluctuations in hemodynamic responses are often seen in geriatric patients.[9] In our study we selected the optimal age range of 20 to 40 years. Patients on anti-hypertensive drugs may exhibit a decrease in pressor response. We excluded the patients on anti-hypertensive medications from our study. A variable combination of drugs used for premedication, induction, relaxation and maintenance of anaesthesia can influence the sympathetic response to laryngoscopy and intubation. Midazolam decreases the blood pressure and increases the heartrate. Glycopyrrolate premedication can moderately increase the heart rate. Fentanyl is also a known modifier

of laryngoscopic response. So, we avoided these drugs before induction and intubation to see the exact effect of study drugs on larynogoscopic and intubation response. Thiopentone was selected for inductions till continues to be the most popular agent for induction. In normovolemic patients thiopentone 5mg/kg i.v can transiently decrease10-20 mm Hg of blood pressure and increase the heartrate by15-20 beats/min. There is increase in catecholamine levels, both noradrenaline andadrenaline.[10] Succinylcholine has negative inotropic and chronotrpic effect. It acts on the muscarinic receptors of SA node. A marked noradrenergic response was noted when intubation was performed under succinylcholine. The most significant factor during laryngoscopy influencing cardiovascular responses is found to be the duration of laryngoscopy. A linear increase in heartrate and mean arterial pressure during the first 45 seconds was observed. Further prolongation had little effect. As the duration of laryngoscopy is normally less than 30 seconds, the results of studies in which it takes longer than this have less clinical relevance. The force applied during laryngoscopy has only minor effect. In our study, the duration of laryngoscopy and intubation was limited to 20 seconds. There were many studies in the past evaluating the efficacy of Dexmedetomidine in attenuating hemodynamic response to laryngoscopy and tracheal intubation. In them different Authors have tried different dosages given as infusions over different duration of time. There were also many studies evaluating the efficacy of Esmolol in attenuating the pressor response. There were lot of arguments in literature regarding the administration of Esmolol whether as an infusion or as a bolus. Based on the result of large meta-analysis performed by Figuer do *et al* (2001)[11] Esmolol given as an infusion with a loading dose of 500 micrograms/kg over 4 minutes rendered optimum results. In our study, we employed 0.5 mg/kg of Esmolol in 20 ml NS over 5 minutes before induction. We could trace only one study in the literature comparing Dexmedetomidine with Esmolol regarding attenuation of hemodynamic response to laryngoscopy and tracheal intubation; which proved Dexmedetomidine is to be more effective. In all the above clinical trials the parameters of comparison were BP and HR at different points of time before and after laryngoscopy and tracheal intubation. The mean SBP, DBP, MAP, HR were compared at similar points of time between the groups. But technically the most appropriate factor of clinical relevance in a laryngoscopic response is the fluctuation of hemodynamic parameters from base line than the absolute value. Thus, in our study we principally compared the percentage change in all the four hemodynamic parameters from the baseline at similar points of time before and after laryngoscopy and tracheal intubation. Another difference in the methodology of our study is employing invasive arterial blood pressure monitoring along with conventional non-invasive blood pressure monitoring. It usually takes an average of 40 seconds to measure blood pressure in oscillometry through noninvasive blood pressure monitoring. But hemodynamic fluctuations occur continuously during and after laryngoscopy and tracheal intubation. Thus, with NIBP recording the hemodynamic variations before 40 seconds is not possible. The differences in the results are very evident in our study. When compared between dexmedetomidine and esmolol statistically significant difference was observed in percentage change of invasive systolic blood pressure at 6 time points in less than one minute, but no statistically significant difference was found in percentage change in non-invasive systolic blood pressure which was measured at 1, 3, 5, 10, 15 minutes after intubation. Similar trend is also observed in DBP where a statistically significant difference was observed at 7 time points when measured invasively but the difference was only at one time point i.e. at 3rd minute when measured non-invasively. Mean arterial pressure also has same trend showing a difference at 10 time points when measured invasively and at only one point when measured non-invasively. The common point observed here is that the fluctuations in blood pressure is more within 1 minute after intubation which could be traced only with the help of invasive arterial pressure monitoring. Statistically significant difference was observed in percentage change in heart rate at 11 time points in less than 1 minute and at 1, 3, 5, 10th minute after tracheal intubation. When dexmedetomidine was evaluated alone against control statistically significant difference was observed in percentage change of invasive systolic blood pressure at 4 time points before 1minute and difference was observed only at 2 time points in non-invasive monitoring. Similarly, DBP and MAP also differed at 2 time points when measured invasively and only at one time point when measured non-invasively. Statistically significant difference was observed in percentage change of heart rate at 5 time points before 1minute and at first third and fifth minute after tracheal intubation. When esmolol was evaluated against control statistically significant difference was observed in SBP at 4 time points before 1 minute and at 4 time points after 1 minute when measured invasively and only at 2 time points after 1 minute when measured non-invasively. No statistically significant difference was observed in percentage change in heart rate at any time point after tracheal intubation.

CONCLUSION

We conclude that Dexmedetomidine and Esmolol are effective in blunting the hemodynamic response to intubation, but Dexmedetomidine is superior to Esmolol in

attenuating the hemodynamic response to laryngoscopy and endotracheal intubation without any significant side effects.

REFERENCES

1. Menda F, Koner O, Sayin M, Ture H, Imer P, Aykac B. Dexmedetomidine as an adjunct to anesthetic induction to attenuate hemodynamic response to endotracheal intubation in patients undergoing fast-track CABG. Ann Card Anaesth 2010; 13:16-21.
2. Gunes Y, Gunduz M, Ozcengiz D, Ozbek H, Isik G. Dexmedetomidine-remifentanil or propofol-remifentanil anesthesia in patients undergoing intracranial surgery. Neurosurg Q 2005;15:122-6.
3. MorinAM, GelbnerG, SchwarzU, KahlM, Adams HA, Hulf H, *et al*. Factors influencing pre-operative stress responses in coronary artery bypass graft patients. BMC Anaesthesiology 2004; 4(7).
4. Donegan MF, Bedford RF. Intravenously administered lignocaine prevents intracranial hypertension during endotracheal suctioning. Anesthesiology 1980; 2; 5 16-8.
5. Saitoh C, Momose K, Tanaka H, *et al*. Pharmacologic profile of nicardipine hydrochloride in anesthetized dogs with acute heart failure. Part 1. Hemodynamic effects in normal dogsand dogs with acute heart failure. Arzneimittelforschung 1998; 48:125–32.
6. Vickery RG, Sheridan BC, Segal IS, Maze M. Anesthetic and hemodynamic effects of stereoisomers of medetomidine, at á$_2$ -adrenergic agonist, in halothane anesthetized dogs. Anesth Analg 1988; 67:611-5
7. Black TE, Kay Band Healy TEJ. Reducing the hemodynamic responses to laryngoscopy and intubation.Anaesthesia1984;39:883-887
8. Saif Ghaus M, Vinita Singh, Kumar A, Wahal R. A study of cardiovascular response during laryngoscopy and intubation and their attenuation by ultrashort acting: beta-blockers-Esmolol. Indian J Anaesth2002;104.
9. Ismail S, Azam S I , Khan F A. Effect of age on hemodynamic response to tracheal intubation. A comparison of young middle aged and elderly patients.Anaesth Intensive Care 2002; 30(5): 608-14.
10. Lindgren L, Yli – Hankala A , Randell T , Kirvela M , Scheinin M , and Neuvoven P J. Hemodynamic and catecholamine responses to induction of anaesthesia and tracheal intubation comparison between propofol and thiopentone. BrJ Anaesth 1993; 70: 306-310.
11. E. Figueredo, E. M. Garcia-Fuentes. Assessment of the efficacy of esmolol on the haemodynamic changes induced by laryngoscopy and tracheal intubation: A meta-analysis Acta Anaesthesiologica Scandinavica: 2001:Volume 45, Issue 8, pages 1011–1022.