A comparative Study of Efficacy of Esmolol and Fentanyl For Blood Pressure and Heart Rate Attenuation During Laryngoscopy and Endotracheal Intubation

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Abstract

Background: Blood pressure and heart rate elevation during laryngoscopy and tracheal intubation may cause serious medical problems ex.: patients with cardiovascular disease as well as patients with increased intracranial pressure. **Aim of study:** Comparism between Fentanyl and Esmolol in attenuating blood pressure and heart rate during laryngoscope and tracheal intubation. **Patients and Method:**60 adult patients of both sex, ages between (20-33) , labeled as ASA I and ASA II will undergo elective surgery, divided into two groups, each group contain 30 patients: Esmolol Group (E) takes 0.5 mg/kg esmolol IV. And Fentanyl Group (F) takes 1 mic/kg fentanyl IV.Blood pressure and heart rate was recorded before drugs administration as baseline reading and another reading was taken after drug administration as well as after tracheal intubation. **Result:** blood pressure and heart rate readings of both groups, when compared to baseline reading shows that **Regarding heart rate**, there are significance differences between the two groups, in that, esmolol reduce heart rate in all stages when compared to fentanyl. **Regarding systolic blood pressure,** both drugs reduce systolic blood pressure and there are significances in all stages, favored esmolol except in T3 due to rise in sbp when using fentanyl. **Regarding diastolic blood pressure,** both drugs also reduce diastolic blood pressure but there are no significances in these reading except in T3 due to esmolol reduce dpb much more than fentanyl does. ***Conclusions:*** esmolol in a dose of 0.5mg/kg is more effective than fentanyl in a dose of 1mic/kg in attenuation of hemodynamic response after endotracheal intubation.

Key words*: Esmolol, fentanyl, hemodynamic changes, endotracheal intubation*

Introduction

Due to sympathoadrenal discharge resulting from direct stimulation of epipharyngeal, laryngopharyngeal and par- pharyngeal area, together with increase plasma level of nor epinephrine [2]. The afferent sensory pathway is comprised of the glosopharyngeal nerve, which innervates the pharyngeal, structures superior to the anterior surface of the epiglottis, and the vagus, which innervates the posterior epiglottis distally into the trachea . The efferent responses to laryngoscopy and endotracheal intubation are mediated by both the parasympathetic and sympathetic nervous systems. The parasympathetic response, which is mediated by the vagus, can produce sinus bradycardia or arrest (occur mainly in children),But the main responce in adult is sympathetic stimulation[3] .

These responce start with the first 5 second from laryngoscopic manipulation and intubation , and reach a platuea level after 45-60 seconds from intubation and return to normal level in 5 minutes[4] .

Esmolol is cardioselective $beta_1$ recepter blocker with rapid onset ,a very short duration of action ,and no significant intrinsic sympathomimetic or membrane stabilizing activity at therapeutic dosage . Esmolol reduce heart rate and, to a lesser extent, blood pressure .It has been successfully used to prevent tachycardia and hypertension in response to perioperative stimuli ,such as intubation ,surgical stimulation and emergence [13]

Although fentanyl has no significant effect on the cardiovascular system, it depends on the central Vigus stimulation [14]. Opioids neutralize the hemodynamic responses to intubation and surgical stresses, but are associated with nausea, vomiting, and hypoventilation, there are many studies into the reduction of hemodynamic responses to laryngoscopy and intubation, and many medications have been used, but there is still no specific medication for it [14&15].

Patients and method:

After approval obtaining from Arabic board council comities, and attaining a written consents from patients a double blind study was done to 60 patients.

Inclusion criteria :

* classified as ASA I , ASA II .

* scheduled for elective surgery (lower abdominal surgery) under general anesthesia and muscle relaxation with endotracheal intubation

the study was done in Al-yarmouk teaching hospital , in November the 1st 2014 to December 1st 2015 . Exclusion criteria include:

* Pregnant patients .

* Patients refusing .

* Patients with ENT surgery .

* baseline pulse rate <60 bpm .

* Patient with suspected difficult intubation.

* patient on drug effecting autonomic nervous system .

* patients on antihypertensive drugs.

* Patient's allergy to the corresponding drugs of the study.

Demographic data including:

1. Age (20-33) years.

2. Sex , male (36) , female (24).

3. Body weight (70 -90 kg).

All patients were fasting for at least 6-8 hours. Basic monitoring which includes (Bp - HR - PR - SpO2) was attained by using non-invasive devices.

Patients divided into two groups as Group F take 1 mic / Kg fentanyl IV and Group E take 0.5 mg / Kg esmolol IV

DATA collection:

* At 0 time To (time just before the drug of the study was injected), blood pressure and pulse rate were taken as baseline measure , and the drug of the study were injected slowly over one minute .

* T1 after 3 minutes from drug administration the reading of blood pressure and heart rate were taken.

* T2 after general anesthesia was given; a reading was taken just before performing endotracheal intubation. (two minutes after T1)

* T3 another reading was was taken just after performing endotracheal intubation.

* T4 final reading was recorded after 5 minutes from performing endotracheal intubation. Intubation was fascillating with a sleeping dose of propofol (1.5 - 2.5) was injected slowly and 0.1 mg / kg of vecuronium bromide.

At the end of the operation, Halothane was stopped and muscles reversal was done with neostigmine (0.01 mg / kg) together with Atropine (0.01 mg / kg) were given.

All patients were awake extubated in left lateral position and safely discharged from operating room.

NOTE: patients in group B they were injected with 0.5 Mic / kg fentanyl (after 5 minutes from intubation).

Statistical Analysis

Analysis of data was carried out using the available statistical package of SPSS-20 (Statistical Packages for Social Sciences- version 20).

Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum-maximum values).

The significance of difference of different means (quantitative data) was tested using analysis of variance (ANOVA) for more than two groups, using independent student-t-test for difference between two independent means, and paired t-test for difference between two dependent means (paired observations). Statistical significance was considered whenever the P value was equal or less than 0.05

Results

First of all there are no difference between the two groups according to body weight, gender and age.

Table (1): Distribution of study group according to age, weight and Male / female ratio

Demographic data	Group 1	Group 2
Age	27.8	25.8
Weight Weight	73.2	79.1
Male / female ratio	17/13	19/11
P value for age =0.491		
P value for Weight = 0.104		

There were no significance differences between baseline readings of systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate

Table (2): corelated between baseline readings of systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate in patients groups.

Parameter	Group	N	Mean	Std. Deviation	P-value
Systolic Baseline	E	30	132.50	8.854	.314
	F	30	135.33	12.433	
diastolic Baseline	E	30	83.03	6.965	.462
	F	30	81.47	9.273	
MAP Baseline	E	30	99.6	6.911	.949
	F	30	99.47	8.966	
Heart rate Baseline	E	30	90.73	8.65	.581
	F	30	88.90	15.86	

T1: Systolic blood pressure was decrease in both groups, from the baseline reading, the reduction in sbp was so obvious with esmolol and it was a significant change when compared with fentanyl. P value <0.05

Diastolic blood pressure was decrease in both groups, from baseline reading, although dbp was reduced, when using esmolol, more than when using fentayl but it was not significant. P value > 0.05

Mean blood pressure was decrease in both groups and although esmolol reduce mbp more than fentanyl, but the changes were not significant. p value > 0.05

Heart rates were decreased in esmolol group only and fentanyl group show slight increase in heart rate, but the overall changes was a significant value which favored esmolol. P < 0.05.

Table (3): comparison between values of systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate in esmolol group and fentanyl group after 3 minutes.

Parameter	Group	N	Mean	Std. Deviation	P-value
Systolic after 3 minutes	E	30	125.53	8.982	0.013
	F	30	133.23	13.836	
diastolic after 3 minutes	E	30	76.70	6.824	0.543
	F	30	78.27	12.259	
MAP after 3 minutes	E	30	92.93	6.94	0.145
	F	30	96.70	12.112	
Heart rate after 3 minutes	E	30	83.43	7.99	0.017
	F	30	92.07	17.475	

Systolic blood pressure decrease was a minimal with esmolol when compared to fentanyl because fentanyl augments the hypotensive effect of the induction agent and the reduction of dbp was significant, which favored fentanyl. P < 0.05

Diastolic blood pressure decrease in both groups in equal manner and the changes were not significant. p value > 0.05

Mean blood pressure decrease was in both groups, but fentanyl reduce mbp more than esmolol but not to a significant value. P value > 0.05

Heart rates were decreased in esmolol group only to a significant value because the rate was not change in fentanyl group. P value < 0.05.

Table (3): comparison between values of systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate in esmolol group and fentanyl group before intubation.

Parameter	Group	N	Mean	Std. Deviation	P-value
Systolic before intubation	E	30	124.7333	8.250	0.040
	F	30	113.3333	19.106	
diastolic before intubation	E	30	68.63	5.986	0.974
	F	30	68.73	15.682	
MP before intubation	E	30	87.33	6.076	0.259
	F	30	83.73	16.188	
Heart rate before intubation	E	30	78.00	7.456	0.000
	F	30	92.97	16.923	

Systolic blood pressures were decreased in esmolol group also in period of intubation and sbp were going up in case of fentanyl and the changes were not significant. p value > 0.05

Diastolic blood pressure was slightly decrease in esmolol group, but increased to a significant value in case of fentanyl. P value < 0.05

Mean blood pressure were decreased slightly in esmolol group but mbp were jumped in fentanyl group but not to a significant value. P value > 0.05

Heart rate were increased slightly in esmolol group compared to fentanyl where heart rate was increased to significant change which favored esmolol. P value < 0.05.

Table (4): comparison between values of systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate in esmolol group and fentanyl group after intubation.

Parameter	Group	N	Mean	Std. Deviation	P-value
Systolic after intubation	E	30	119.66	9.140	0.689
	F	30	121.533	23.739	
diastolic after intubation	E	30	67.93	5.994	0.011
	F	30	77.90	19.787	
MP after intubation	E	30	85.20	6.509	0.065
	F	30	92.43	20.051	
Heart rate after intubation	E	30	80.43	7.682	0.000
	F	30	99.90	16.283	

Systolic blood pressure was increased slightly in esmolol group and sbp remain constant in fentanyl group and the changes were not significant. p value < 0.05

Diastolic blood pressure was slightly increased in esmolol group and slightly decreased in fentanyl group but the changes were not significant. p value > 0.05

and Mean blood pressure were slightly increased in esmolol group and slightly decreased in fentanyl group and the changes were not significant. p value > 0.05 so, Heart rate were slightly increased in esmolol group and slightly decreased in fentanyl group and the changes were significant. p value < 0.05.

Table (4): Comparison between values of systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate in esmolol group and fentanyl group after 5 minutes intubation.

Parameter	Group	N	Mean	Std. Deviation	P-value
Systolic after 5 minutes intubation	E	30	125.33	8.727	0.350
	F	30	121.63	19.658	
diastolic after5 minutes intubation	E	30	70.40	6.420	0.256
	F	30	74.30	17.477	
MP after5 minutes intubation	E	30	88.67	6.535	0.671
	F	30	90.10	17.161	
Heart rate after 5 minutes intubation	E	30	82.83	7.808	0.000
	F	30	97.27	18.486	

Discussion

In the present study we compare between esmolol in a dose of 0.5/kg and fentanyl in a dose of 1mic/kg in order to attenuate the hemodynamic response that occur during endotracheal intubation. and we found that esmolol is more effective than fentanyl in that respect [16]. Esmolol provide a smothe and gradual control of the blood pressure .and prevent the rise of blood pressure during intubation.

Esmolol also prevent the rise of the heart rate during intubation [17], Increasing the dose of the study drugs may cause unplanned hypotension and bradycardia [18], especially fentanyl which may augment the hypotensive effect of the propofol.

We need to increase the dose of fentanyl in order to control the heart rate [19], as it shows in our study fentanyl failed in attenuating the rise of heart rate during intubation.

The following two studies below were performed by using same dose [or even less] of esmolol that has been used in our study and proved that esmolol in a dose of 0.5 mg/kg and 0.4 mg/kg was effective in attenuating the rise of blood pressure and heart rate during endotracheal intubation as Jazaer state that esmolol in a dose of 0.5mg/kg is enough for attenuating hemodynamic response during intubation.[20] , whilst Kasey found that esmolol in a dose of 0.4mg/kg is enough for attenuating hemodynamic response that occur during intubation.[21]

Many previous studies favored esmolol in attenuation the rise of blood pressure and heart rate during endotracheal intubation ,when compared to fentanyl , although the doses of the study drugs were higher from the doses in current study : shobhana and Purvi found that both fentanyl in a dose of 2mic/kg and esmolol in a dose of 2 mg/kg , can attenuate the hemodynamic response , But only esmolol provided consistent and reliable protection against increases in both heart rate and systolic blood pressure accompanying laryngoscopy and endotracheal intubation [22] , so Feng *etal.,* found that esmolol in a dose of 2mg/kg could reliably offer protection against increase heart rate and blood pressure, while fentanyl in a dose of 3mic/kg only protect against hypertension not tachycardia [23] as well as Gogus *etal.,* found esmolol in a dose of 2mg/kg is better than fentanyl in a dose of 2mic/kg in attenuation of hemodynamic response.[24] , whilst Sampangiramaiah and Jodumut found that esmolol in a dose of 1.5mg/kg is better than fentanyl in a dose of 2mic/kg , in attenuating hemodynamic response , and fentanyl in such dose my cause severe hypotension [25]. So *Habib Bostan, Ahmet Eroglu* found that both esmolol in a dose of 1mg/kg and fentanyl in a dose of 1 mic/kg , can attenuate the hemodynamic response , but esmolo is more effective[26].

Ethical Clearance: Hospital and patient approvals were taken

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Conflict of Interest: None

References

1) Samuelson P, Reves J, Kouchoukos,N. Hemodynamic responses to anesthetic induction with midazolam or diazepam in patients with ischemic heart disease. Anesth Analg 60:802, 1981,MD Consult – Emergent management of the airway ,http://eresources.library.mssm.edu:2082/das/article/body/455...11.

2) kovac AL.controlling the hemodynamic response to laryngoscopy and endotracheal intubation .Journal of Clinical Anesthesia 1996; 8: 63-79

3) Giles RW, Berger HJ, Barash PG, et al: Continuous monitoring of left ventricular performance with the computerized nuclear probe during laryngoscopy and intubation before coronary artery bypass surgery. Am J Cardiol 50:735, 1982

4) Stoelting RK: Circulatory changes during direct laryngoscopy and tracheal intubation: Influence of duration of laryngoscopy with or without priorlidocaine. Anesthesiology,1977. 47:381.

5) Lee JA,Rushman GB, Davies NJH, Gashman JN. Cardiovascular response.Lee´s Synopsis of anesthesia.2006;218

6) Stoelting RK,Roberta LH,Katherine EM. Systemic & Pulmonary Arterial Hypertension. Anasthesia & Co- Existing Disease2008;96.

7) Hassan HG, el-Sharkawy TY, Renck H, et al: Hemodynamic and catecholamine responses to laryngoscopy with vs. without endotracheal intubation. ActaAnaesthesiol Scand ,1991,35:442.

8) O'Hare R, McAtamney D, Mirakhur RK, et al: Bolus dose remifentanil for control of haemodynamic response to tracheal intubation during rapid sequence induction of anesthesia. Br J Anaesth ,1999,82:283.

9) indler CH, Schumacher PG, Scheider MC, et al: Effects of intravenous lidocaine and/or esmolol on hemodynamic responses to laryngoscopy and intubation: A double-blind, controlled clinical trial. J Clin Anesth ,1991,8:491.

10) Tomichek R, Rosow C, Schneider R, et al: Cardiovascular effects of diazepam-fentanyl anesthesia in patients with coronary artery disease. Anesth Analg, 1982.61:217.

11) Randell T.Haemodynamic response to intubation : What more do we have to know ?Acta Anaesthesiol scand 2004:48:393-395.

12) Longmire S, Leduc L, Jones MM, Hawkins JL, Joyce TH, 3rd, Cotton DB. The hemodynamic effects of intubation during nitroglycerin infusion in severe preeclampsia. *Am J Obstet Gynecol.* 2007;164(2):551-6

13) Strauss RG, Keefer JR, Burke T, Civetta JM. Hemodynamic monitoring of cardiogenic

pulmonary edema complicating toxemia of pregnancy. *Obstet Gynecol.* 1999;55(2):170-4.

14) Deganwa, M. M. ; Seth, A. ; Prakash, S.; Deganwa, M. and Gogia, A. R. "Attenuation of the hemodynamic response to laryngoscopy and tracheal intubation with Fentanyl, Lignocaine nebulization, and a combination of both: a randomized controlled trial," *Anesthesia: Essays and Researches*, 2016,vol. 10, no. 3, pp. 661–666.

15) Totonchi,Z; Salajegheh, S.; Mohaghegh, M. R. ; Kiaei, M. M. ; Shirvani, M. and Ghorbanlo, M. "Hemodynamic effect of intravenous lidocaine during aortic cannulation in cardiac surgery," *Interventional Medicine and Applied Science*, 2017, vol. 9, no. 2, pp. 56–60.

16) Habib B. and Ahmet E. Comparison of the Clinical Efficacies of Fentanyl, Esmolol and Lidocaine in Preventing the Hemodynamic Responses to Endotracheal Intubation and Extubation.

17) Shobhana G. and Purvi T.A comparative study of efficacy of esmolol and fentanyl for pressure attenuation during laryngoscopy and endotracheal intubation.2011-5-2;2014-12-2.

18) Sampangiramaiah S.; Jodumut S. Comparison of effect of esmolol vs. esmolol and fentanyl on hemodynamic response to laryngoscopy and tracheal intubation in controlled hypertensive patients: a randomized controlled double blind study}. Anaesth Pain & Intensive Care 2013;17(3):267-273.

19) Feng CK., Chan KH, Liu KN, Or CH, Lee TY. A comparison of lidocaine, fentanyl, and esmolol for attenuation of cardiovascular response to laryngoscopy and tracheal intubation. Acta Anaesthesiol Sin 1996 Sep;34(3):172.

20) Mohammed J N ; Attenuation of hemodynamic response to laryngoscopy and endotracheal intubation by two doses of esmolol .2013

21) Kasey P. Bensky , Linda Donhue-spencer. The dose related effect of two boluse doses of esmolol on heart rate and blood pressure following laryngoscop and intubation,AANA journal,2000,vol.68,no5 .

22) Shobhana Gupta , Purvi Tank . {A comparative study of efficacy of esmolol and fentanyl for pressure attenuation during laryngoscopy and endotrachealintubation.2011-5-2;2014-12-2.

23) Feng CK[1], Chan KH, Liu KN, Or CH, Lee TY.{ A comparison of lidocaine, fentanyl, and esmolol for attenuation of cardiovascular response to laryngoscopy and tracheal intubation.}. Acta Anaesthesiol Sin 1996 Sep;34(3):172.

24) Nermin G., Belgin A., Nurten S., Mustafa B.The comparison of the effects of dexmedetomidine, fentanyl andesmolol on prevention of hemodynamic response to intubationNermin} Rev Bras Anestesiol. 2014;64(5):314-319

25) Sampangiramaiah S.; Jodumut S.Comparison of effect of esmolol vs. esmolol and fentanyl on hemodynamic response to laryngoscopy and tracheal intubation in controlled hypertensive patients: a randomized controlled double blind study. Anaesth Pain & Intensive Care 2013;17(3):267-273.

26) Habib B., Ahmet E.Comparison of the Clinical Efficacies of Fentanyl, Esmolol and Lidocaine in Preventing the Hemodynamic Responses to Endotracheal Intubation and Extubation.