ORIGINAL ARTICLE

A Comparative Study of Dexmedetomidine Versus Esmolol for Attenuation of Cardiovascular Response to Laryngoscopy and Endotracheal intubation

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Abstract

The present study compares the effects of dexmedetomidine and esmolol on cardiovascular response occurring due to laryngoscopy and endotracheal intubation. A randomised controlled study was carried out on 90 healthy adult patients (ASA I and ASA II) under general anaesthesia. Patients were randomly allocated into two groups i.e group E and group D. Group D received dexmedetomidine 0.6µg/kg and group E received esmolol 1mg/kg. Heart rate, systolic blood pressure and diastolic blood pressure were recorded at baseline, at induction and at 1,3,5 and 10minutes after intubation. This study showed that dexmedetomidine (0.6µg/kg) was more effective than esmolol (1mg/kg) for attenuating the cardiovascular response to laryngoscopy and intubation.

Keywords

Dexmedetomidine, Esmolol, Cardiovascular Response, Endotracheal Intubation

Introduction

Laryngoscopy and tracheal intubation are noxious stimuli that evoke transient but marked sympathetic response manifesting as increase in the heart rate , blood pressure, intraocular and intracranial pressure.This sympathoadrenal response is deleterious in patients with coronary artery disease, myocardial insufficiency and cerebrovascular disease.These changes are seen maximum immediately after intubation and last for 5 to 10 minutes (1).Topical or intravenous lidocaine ,opoids, ,inhaled anaesthetics, vasodilators, calcium channel blockers or adrenergic blockers have been used successfully for decreasing the haemodynamic response to laryngoscopy (2-7). Esmolol is a water soluble rapid onset, ultra short acting, selective alpha adrenergic recptor antagonist with proven efficacy to provide haemodynamic stability during laryngoscopy and tracheal intubation. Dexmedetomidine is an imidazole derivative and selective alpha 2 adrenergic receptor agonist (8). Alpha 2 agonists produce hyperpolarisation of nonadrenergic neurons and suppression of neuronal firing in the locus ceruleus which leads to decreased systemic nonadrenaline release resulting in attenuation of sympathoadrenal responses and hemodynamic stability during laryngoscopy and tracheal intubation (9).We conducted this study tocompare the efficacy of esmolol and dexmedetomidine for attenuation of the sympathomimetic responseduring laryngoscopy and intubation in patients undergoing elective procedure under general anaesthesia.

Material and Method

After permission from institutional ethics committee, the prospective comparative randomized study was carried out in 90 patients aged between 18years and 60 years, of either gender, belonging to ASA class1 or class 11, posted for elective surgeries which was planned under general anaesthesia. Patients with anticipated difficult airway, laryngoscopy time more than 15 seconds, on preoperative beta blockers and alpha

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2 agonists , with history of asthma, hypertension ,diabetes, hepatic and renal failure, pregnant and lactating women were excluded from the study.On the day prior to surgery preanaesthetic checkup of the patients was performed . All patients were explained about anaesthesia technique and written informed consent was taken.Patients were fasted for 8 hours prior to surgery and were premedicated with injection Ondansterone 0.1mg/kg I.V and Inj.Tramadol 2mg/kg IM about half an hour before induction. Patients were randomly divided into two groups i.e Group D (Dexmedetomidine group) and Group E (Esmolol group).

An I.V line was secured with an appropriate sized canula in all patients inside operation theatre and fluid was started @ 10-15 ml/kg/hr. Patients were connected to multi-channel monitor and basal SBP, DBP, HR , ECG and SPO2 (oxygen saturation) were recorded.

In group E, 10 ml of 0.9% saline was infused for 10 minutes (infusion being started at Ist minute). After 7 minutes of infusion , 1mg/kg of esmolol (at 7th minute ;diluted with 0.9% saline to 10ml) was given in 30 seconds. In group D, 0.6µg/kg body weight dexmedetomidine (diluted with 0.9% saline to 10 ml) was administered for 10 minutes (infusion being started at Ist minute). After 7 minutes of infusion , 10ml of 0.9% saline was administered in 30 seconds. Patients were preoxygenated with 100% O2 by a face mask for 3minutes. Anaesthesia was induced with I.V thiopentone 3-5mg/kg in graded dose till loss of eye lash reflex at 8th minute and muscle relaxation was achieved by succinylcholine at a dose of 1-2 mg/kg at 9thminute. 60 seconds later patient was intubated with proper sized cuffed endotracheal tube using a Macintosh laryngoscope (at 10thminute). All intubations were done by same experienced anaesthesiologist. Anaesthesia was maintained with 40% O2, 60% N2O vecuronium , intermittent positive pressure ventilation and Isoflurane as per requirement of the surgery. All patients were put on controlled ventilation using closed circuit with circle absorber system. Heart rate (H.R), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured at 1,3,5 and 10 minutes after intubation. Electrocardiography , pulseoximetry and capnography were used to monitor ECG changes, Oxygen saturation (Spo2) and end tidal CO2 concentration respectively. Surgical interventions like catheterization , nasogastric tube insertion , incision was done 10 minutes after intubation to avoid disturbances in data recording. Patient was observed for any episode of bradycardia, hypotension and any other adverse events during surgery. Bradycardia (HR< 50beat/min) was treated with inj.Atropine 0.6mgI.V. Any hypotension (SBP<20% baseline) was managed initially with a fluid bolus.If unresponsive inj.Ephedrine 0.5mg/kg I.V in graded doses was given.At the end of surgery, when patients regained respiratory attempts, residual neuromuscular block was reversed with inj.Neostigmine and inj.Glycopyrolate . Recovery was assessed and extubation was carried out. After complete clinical recovery patients were shifted to post anaesthesia care unit.

Statistical Analysis

Mean and Standard deviation for all values were calculated and compared within group, with baseline values as well as intergroup comparison were done. Paired and unpaired t-test and chi-square test were used for statistical analysis. P-value < 0.005 was considered stastically significant.P-value < 0.001 was considered stastically highly significant. The data was analysed with the help of computer software MS Excel and SPSS 19.

Results

Ninety (45 in each group) patients were randomized during the study.

There was no significant difference in demographic characteristics such as age,weight and sex. Both groups were comparable (*Table 1*)

Mean heart rate at baseline was 84.11 beats/min. in group E which was comparable to 86.5 beats/min. in group D and difference was not statistically significant. Same trend observed at end of induction in both groups. After that the HR at 1minute, 3 minute, 5minute and 10 minutes after intubation was significantally lesser in group D as compared to Esmolol group and difference was statistically significant (*Table 2*). The mean SBP at baseline was 123 mmHg in group E which was comparable with 125.2 mmHg in group D and difference was not statistically significant. Same trend was observed at the end of induction /just before intubation. After that SBP at 1minute,3minute, 5minute and 10 minutes after intubation was significantaly lesser in group d as compared to the esmolol group (group E) and difference was statistically significant (*Table 3*). The mean DBP At baseline was 82.66 mmHg in group E which was comparable with 84.2mmHg in group D and the difference was not statistically significant. Same trend was observed at the end of induction/ just before intubation. At 1minute and 3 minute after intubation DBP was significantly lesser in group D as compare to group E and difference was statistically significant. However mean DBP at 5 minute and 10 minute after intubation was comparable between group E and group D and the difference was statistically insignificant (*Table 4*). No patients in either group required treatment for bradycardia

and hypotension. No other adverse effects were noted in any patient.

Discussion

During laryngoscopy and intubation it is necessary to control cardiovascular response especially in patients with cerebrovascular disease. Many drugs were studied and found effective. There are conflicting results in various studies which compare dexmedetomidine and esmolol for attenuation of this response. In our study we found that dexmedetomidine was more effective than esmolol for controlling heart rate and blood pressure after laryngoscopy and intubation. Alagol et al. found that esmolol was better than dexmedetomidine for controlling this response.(10)

Jaakola *et al*., in their study concluded that dexmedetomidine attenuates the increase in heart rate and blood pressure during intubation. The dose used for this study was similar to the dose used by us.(11) Lawrence *et al*., found that a single dose of 2µg/kg of dexmedetomidine before induction of anesthesia attenuated the hemodynamic response to intubation as well as that to extubation.(12) Bradycardia was observed at the first and 5th minute after administration. This might have been due to bolus administration. Sulaiman *et al*., studied the effects of dexmedetomidine on attenuation of stress response to endotracheal intubation in patients undergoing elective off pump coronary artery bypass grafting ,they concluded that pretreatment with dexmedetomidine at a dose of 0.5µg/kg as 10 minute infusion prior to induction of anesthesia attenuate the hemodynamic response to laryngoscopy and intubation.(13) A biphasic cardiovascular response has been described after the administration of dexmedetomidine. A bolus of 1µg/kg results in a transient increase in arterial blood pressure and reflex decrease in heart rate in young healthy patients. Initial response is due to alpha 2 receptor stimulation of vascular smooth muscle. This response can be markedly decreased by slow infusion over 10 minutes (14). In our study, this effect was not noticed due to the slow infusion of the drug over 10 minutes. Saraf *et al* ., also found that the dexmedetomidine (0.6µg/kg) given 10 minute before induction effectively attenuate the pressor response to laryngoscopy and intubation without any side effect.(15) Tanskanen *et al* ., studied that continuous infusion of 0.2-0.4µg/kg of dexmedetomidine in patients of craniotomies started 15 minutes before induction of anesthesia and continued till the end of surgeries had increased peri-operative hemodynamic stability and fast recovery without respiratory depression.16 We have used low dose of dexmedetomidine i.e 0.6µg/kg because higher dose i.e 1µg/kg was associated with increased incidence of hypotension and bradycardia.(17,18) Dexmedetomidine in a dose of 1µg/kg has been shown to cause increased sedation levels and need for oxygen supplementation.(19)

Table 1. Demographic Data

Parameter	Group E (n=30)	Group D (n=30)	P value
Age (yrs)	33.44±2.69	41.75±4.42	0.12
Gender	M= 17	M =18	0.79
	F= 13	F=12	
Weight (kg)	52.77±1.64	48.5 ± 2.87	0.19

Table 2. Comparison of Heart Rate (beats/min) Between Groups

Heart Rate	Group E	Group D	P value
Baseline HR	84.11±2.93	86.5±4.78	0.66 (NS)
HR at induction	79.66±2.97	79.13± 2.66	0.53(NS)
HR at 1minute after intubation	96.93±4.44	81.33±3.33	< 0.0001(HS)
HR at 3minutes after intubation	95.86±3.99	79.33±3.37	<0.0001(HS)
HR at 5minutes after intubation	90.66±4.003	76.13±3.14	<0.0001(HS)
HR at 10 minutes after intubation	90.53±3.53	74.73±2.94	<0.0001(HS)

NS= Non significant *HS= Highly significant*

Table 3. Comparison of SBP between group E and Group D

Parameter	Group E	Group D	P value
SBP at Baseline	123 ± 1.2	125.2 ± 0.96	0.26 (NS)
SBP at induction	133.11 ± 6.4	133.8 ± 0.76	0.85(NS)
SBP at 1minute after intubation	165.80 ± 9.53	128 ±7.33	< 0.0001(HS)
SBP at 3minutes after intubation	156.80 ± 9.09	124 ± 6.33	<0.0001(HS)
SBP at 5minutes after intubation	143.80 ± 7.88	118 ± 4.48	<0.0001(HS)
SBP at 10 minutes after intubation	136.27 ± 5.29	110 ± 3.61	<0.0001(HS)

NS= Non significant *HS= Highly significant*

Table 4. Comparison of DBP (mmHg) between Group E and Group D

Parameter	Group E	Group D	P value
DBP at Baseline	82.66 ± 0.91	84.2 ± 0.66	0.27 (NS)
DBP at induction	78.66 ± 5.39	79.33 ± 5.66	0.64 (NS)
DBP at 1minute after intubation	99.33 ± 6.65	80.06 ± 8.08	< 0.0001(HS)
DBP at 3minutes after intubation	90.26 ± 7..67	74 ± 8.26	<0.0001(HS)
DBP at 5minutes after intubation	74.66 ± 5.68	71.86 ± 7.12	0.59 (NS)
DBP at 10 minutes after intubation	71.60 ± 5.7	69.26 ± 6.203	0.12 (NS)

NS= Non significant *HS= Highly significant*

Results of our study correlates with the study conducted by Reddy SV and coworkers, who found that dexmedetomidine (1µg/kg) was more effective than esmolol (2µg/kg) for suppressing the pressure response to laryngoscopy and intubation.(20) Similar results about dexmedetomidine and esmolol were observed by Gupta H B *et al.* (21) Recently in a study, the effect of dexmedetomidine versus esmolol on attenuation of stress response to endotrachial intubation in patients undergoing elective off pump CABG , it was observed that dexmedetomidine (0.5µg/kg) provides more sustained hemodynamic stability than esmolol (2mg/kg). (22)
The limitation of the study was that we did not measure the plasma norephinephrine levels and study did not include placebo group.

Conclusion

Based on the results of our study we concluded that dexmedetomidine in dose of 0.6µg/kg i.v is more effective to attenuate the cardiovascular pressure response to laryngoscopy and intubation than esmolol 1mg/kg i.v when prescribed before laryngoscopy and endotracheal intubation. Both drugs had no side effects in our study.

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