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A Comparison of Effect of Dexmedetomidine and Esmolol For Attenuation of Haemodynamic Stress Response During Direct Laryngoscopy and Tracheal Intubation

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Abstract

Objective: To study and compare the effectiveness of intravenous dexmedetomidine and esmolol in attenuating sympathomimetic response to direct laryngoscopy and endotracheal intubation.

Methods: 100 patients aged between 18 years to 50 years of either sex belonging to ASA class I and II with Mallampatti grading I and II posted for various elective surgeries under general anaesthesia were divided into two groups. Group D received dexmedetomidine 1 μg/kg and group E received esmolol 2 mg/kg. Heart rate, blood pressure and ECG were recorded at baseline, after premedication, after induction, after intubation, 1,2,3,5 and 10min after intubation.

Results: Heart rate and blood pressure at various intervals were noted and compared between the two groups. The attenuation of heart rate was more in dexmedetomidine group than the patients who received esmolol.

Conclusion: Dexmedetomidine is safe and more effective than Esmolol in attenuating the haemodynamic response to direct laryngoscopy and endotracheal intubation in patients undergoing surgical procedures under general anaesthesia.

Keywords: Dexmedetomidine; Esmolol; Intubation; laryngoscopy.

Introduction

Direct Laryngoscopy and endotracheal intubation are associated with certain cardiovascular changes such as hypertension, tachycardia and wide variety of cardiac arrhythmias. These hemodynamic changes occur due to epipharyngeal and laryngopharyngeal stimulation which causes reflex increase in sympatho-adrenal activity and sympathetic discharge.[1,2] Increase in blood pressure and heart rate are usually transient, variable and unpredictable. These effects are usually of no consequences in healthy individuals but it may be hazardous in patients with hypertension, myocardial insufficiency, pre-eclampsia, eclampsia, cerebral hemorrhage etc. To attenuate this stress response, various drugs and methods have been used[3] such as premedicating patient with antihypertensive drugs - vasodilator (eg. hydralazine), beta blocker (eg. Esmolol, labetalol), calcium channel blocker (eg. nifedipine), α-2 agonist (clonidine, dexmedetomidine), nitroglycerine (intravenous, intranasal spray or sublingual), ACE inhibitor (eg. captopril,enalapril), Opioids (fentanyl, alfentanyl, sufentanyl), Lignocaine (intravenous, spray or gargles), deepen plane of

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anaesthesia by intravenous induction agent or increasing concentration of volatile anaesthetic during mask ventilation, decreasing laryngoscopy time to less than 15 seconds.

Dexmedetomidine is a highly selective α-2 adrenergic agonist that has sympatholytic, sedative, anxiolytic and analgesic effect.[4] Studies have shown that dexmedetomidine decreases the induction doses of intravenous anaesthetic agent and also decreases the intra operative opioid and volatile anaesthetic requirements for maintenance of anaesthesia.[5,6]

Esmolol is a cardioselective β adrenergic blocker that has an effect with rapid onset and short duration. While it inhibits β1 receptors of myocardium, it also inhibits β2 receptors of smooth muscles of bronchial and vascular walls at higher doses.[7,8]

This study was designed to study and compare the effectiveness of intravenous dexmedetomidine and esmolol in attenuating sympathomimetic response to direct laryngoscopy and endotracheal intubation in patients undergoing surgical procedures under general anaesthesia.

Aims and Objectives

1. To study and compare the effectiveness of I.V. Dexmedetomidine and I.V. Esmolol in attenuating the haemodynamic response to direct laryngoscopy and endotracheal intubation in patients undergoing surgical procedures under general anaesthesia.
2. To study any side-effects of the drugs in intraoperative and postoperative period.

Materials and Methods

After obtaining institutional ethical committee approval, this prospective clinical study was conducted in the Department of Anaesthesiology, at McGann Hospital, Shimoga Institute of Medical Sciences, Shimoga. Written informed consent was obtained from 100 patients aged between 18 years to 50 years of either sex belonging to ASA class I and II with Mallampatti grading I and II posted for various elective surgeries under general anaesthesia at our institute. Exclusion criteria were patient refusal, patient less than 18 and more than 50 years, ASA grade III/IV/V, allergy to any of the anaesthetic drug used in the study, patients with hypertension, cardiac, renal, hepatic and respiratory diseases, patients on medications like hypnotics, narcotics or antihypertensive drugs, patients with difficult airway and obese patients, history of alcohol or drug abuse, pregnant or nursing mother. Study population were randomly divided by computer generated numbers into 2 groups with 50 patients in each group.

Preoperative assessement (PAC)

All the patients underwent a detailed pre anaesthetic check-up on the day before surgery and all the routine and specific investigations like Hemoglobin, Total leucocyte count, Differential leucocyte count, Liver function test, Renal function test, ECG, X-Ray chest (PA view), Fasting/ Random Blood Sugar, Platelet count were done. Whenever necessary special tests were carried out. The patients were electively kept nil by mouth for 6 hours before surgery and prior to operation patients were explained about the procedure and informed consent was taken from patients' relatives.

After the patient was shifted to the operation theatre, standard monitors like ECG, NIBP, and pulse oximetry were applied and baseline parameters [Spo_2, Heart rate (HR), Systolic blood pressure (SBP), Diastolic blood pressure (DBP), Mean arterial pressure(MAP) were recorded. Intravenous line with 18 gauge cannula was secured and intravenous fluid was started. Patients were pre-medicated with: Inj. Ondansetron 0.15 mg/kg i.v and Inj. Midazolam 1mg i.v. 1hour prior to surgery.

Group D: received Inj. Dexmedetomidine 1 μg/ kg diluted in 20 ml NS injected slowly over 10 min before induction.

Group E: received Inj. Esmolol 2mg/kg before induction.

All patients were preoxygenated with 100% oxygen at 8 lit/min for 3 minutes using Bain's circuit. Patients were induced after giving the study drug with Inj. Propofol 1% 2 mg/kg i.v. followed by Inj. Suxamethonium 2 mg/kg i.v to facilitate endotracheal intubation. Intubation was done with an appropriate Portex cuffed endotracheal tube after direct laryngoscopy using Macintosh blade. After confirming equal bilateral air entry, endotracheal tube was fixed and positive pressure ventilation was started. Maintenance with 50% 0_2+ 50% N_2O + sevoflurane + Inj. Vecuronium Bromide (0.08 mg/kg loading and 0.01 mg/kg maintenance)

Monitoring

- Heart rate(HR)
- Systolic blood pressure(SBP)
- Diastolic blood pressure(DBP)
- Mean arterial blood pressure(MAP)
- Pulse oximetry(Spo2)

All parameters were recorded at following stages:

- Baseline
- After pre-medication
- After induction.
- After intubation.
- At 1,2,3,5 and 10 mins after intubation.

All patients were reversed after onset of spontaneous respiration using Inj. Glycopyrrolate 8µg/kg i.v. and Inj. Neostigmine 0.05 mg/kg i.v. After satisfied criteria for extubation, thorough oral and endotracheal suction was done and patients were extubated. Any prevalence of laryngospasm, bronchospasm or desaturation were recorded and managed according to standard protocols. Any intraoperative complication were recorded and managed accordingly.

Patients were shifted to recovery room and any immediate postoperative complication e.g. nausea, vomiting, shivering, respiratory depression, sedation, restlessness, hypotension, bradycardia etc were recorded and managed accordingly.

Statistical Analysis

All patients data were recorded in proforma of study. Data was expressed as mean values ± standard deviation (SD). Quantitative data was analysed using t-test and qualitative by chi square test. Statistical calculations were carried out using Microsoft Office Excel 2010 and Graph Pad Prism 6.05 (quickcalc) Software (Graph pad software inc. La Jalla CA USA). Changes in hemodynamic variables from baseline and a comparison of means were analysed by paired t-test for each time interval. A P-value <0.05 was considered statistically significant. P value >0.05 was considered non-significant.

Observations and Results

100 patients aged between 18 years to 50 years of either sex belonging to ASA class I and II posted for various elective surgeries under general anaesthesia at our institute were randomly selected and divided by computer generated numbers into 2 groups with 50 patients in each group.

Group	Drug	Dose
D	Dexmedetomidine	1µg/kg in 20 ml NS Over 10 minutes i.v.
E	Esmolol	2mg/kg i.v.

Table 1: Demographic Data.

Group	D	E
Age (Years) Mean ± Sd	38.8±11.78	34.03±12.39
Sex	Male- 28	Male- 26
	Female- 22	Female- 24
Weight (Kgs)		
Mean ± Sd	65.96±9.03	62.26±6.15

No statistically significant difference was found between the groups (p>0.05).

Table 2: Comparison of changes in Mean HEART RATE between the two groups.

Heart rate	D		E		P Value
	Mean	± SD	Mean	± SD	DE
Baseline	84.56	11.2	86.53	13.35	0.5382
After premed	80.26	11.46	81.96	9.81	0.5395
After induction	81.46	10.96	83.96	11.81	0.3989
After intubation	87.36	8.91	94.06	12.35	0.0192
1 min after intubation	88.23	8.42	95.5	14.5	0.0209
2 min after intubation	85.73	9.42	93.6	12.98	0.0094
3 min after intubation	82.23	8.99	89.66	13.08	0.013
5 min after intubation	81.56	8.51	87.96	13.57	0.0327
10 min after intubation	78.06	8.17	82.3	12.22	0.1196

Graph 1: Changes in mean heart rate.

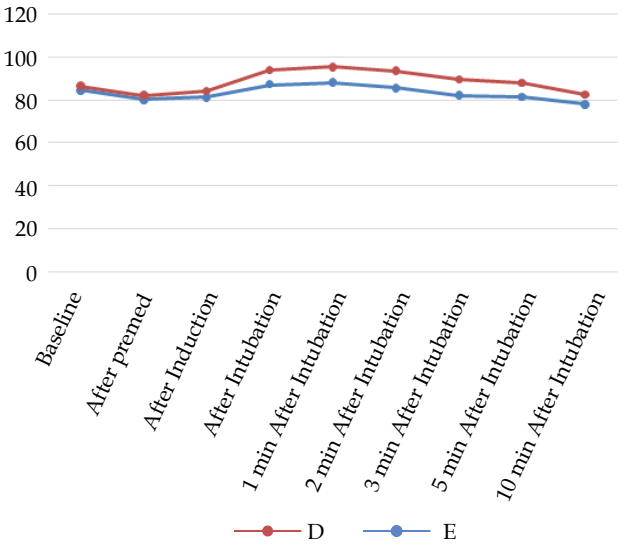

Table 3: Comparison of changes in Mean Sbp (Systolic Blood Pressure) ± S.D. between the two groups.

Systolic blood pressure	D		E		P Value
	Mean	± SD	Mean	± SD	DE
Baseline	125.73	9.77	126.7	10.18	0.7079
After premed	125.1	9.32	124.86	7.89	0.9146
After induction	124.9	11.44	122.46	7.8	0.3384
After intubation	128.93	11.52	135.46	10.98	0.0284
1 min after intubation	129.76	12.29	135.86	10.07	0.0398
2 min after intubation	125.9	12.28	133.4	8.68	0.0083
3 min after intubation	122.26	12.33	130.66	8.35	0.0031
5 min after intubation	118.36	11.42	124.2	8.31	0.0273
10 min after intubation	117	8.97	120.7	8.67	0.1097

Graph 2: Changes in mean SBP.

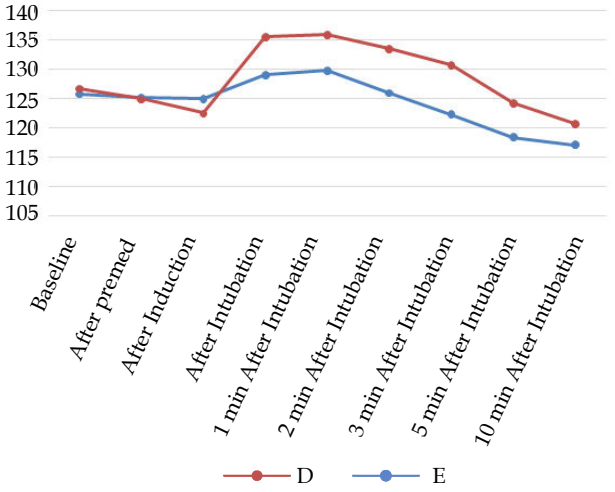

Table 4: Comparison of Changes in Mean DBP (Diastolic Blood Pressure) ± S.D. between the two groups.

Diastolic blood pressure	D		E		P Value
	Mean	± SD	Mean	± SD	DE
Baseline	78.9	8.01	80	7.99	0.5964
After premed	79.06	6.78	78.93	6.93	0.9417
After induction	78.23	9.1	77.63	5.97	0.7638
After intubation	84	8.11	88.83	6.1	0.0116
1 min after intubation	82.16	9.23	87.03	5.44	0.0157
2 min after intubation	79.73	8.57	85.2	3.88	0.0023
3 min after intubation	74.56	11.64	82.1	5.1	0.0012
5 min after intubation	72.2	9.75	78.16	5.65	0.0053
10 min after intubation	71.8	9.89	76.3	6.25	0.0395

Graph 3: Changes in mean DBP.

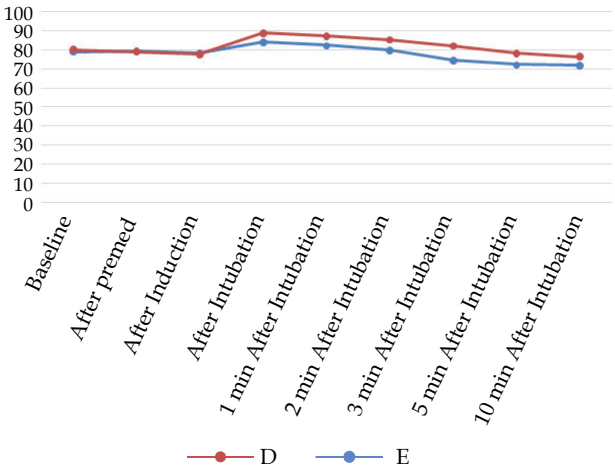

Table 5: Comparison of changes in Mean of MAP (Mean Arterial Pressure) ± S.D. between the two groups.

Mean arterial blood pressure	D		E		P Value
	Mean	± SD	Mean	± SD	DE
Baseline	94.5	7.93	95.26	8.13	0.7153
After premed	94.33	7.27	94.03	6.55	0.8672
After induction	93.76	9.41	92.5	5.61	0.5312
After intubation	98.96	8.14	104.46	6.53	0.0055
1 min after intubation	98.03	9.15	103.4	5.62	0.0082
2 min after intubation	95.1	9.22	101.3	4.44	0.0016
3 min after intubation	90.43	11.5	98.3	4.89	0.0011
5 min after intubation	87.63	9.56	93.5	5.69	0.0054
10 min after intubation	86.9	8.86	91	5.98	0.04

Graph 4: Changes in mean MAP.

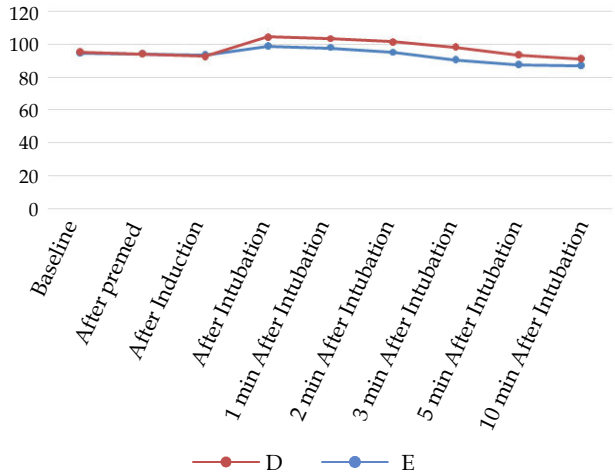

Table 6:

Side Effects and Compications	D	E
Intraoperative		
Bradycardia	--	--
Hypotension	--	--
Arrhythmia	--	--
Bronchospasm	--	--
POSTOPERATIVE		
Bradycardia/tachycardia	--	--
Hypotension/Hypertension	--	--
Arrhythmia	--	--
Respiratory depression	--	--
Bronchospasm	--	--
Vomiting	--	--

Discussion

Cardiovascular response to laryngoscopy and endotracheal intubation has always become a challenge for anaesthesiologists. Cardiovascular response may occur in form of hypertension, tachycardia and different types of arrhythmias. These effects may prove disastrous in patients of hypertension, myocardial insufficiency, pre-eclampsia, eclampsia, cerebral hemorrhage etc.[9,10] High incidences of myocardial ischemia- infarction, cardiac arrhythmia, acute LVF and cerebrovascular accidents following intubation in patients with hypertension were reported in study by C. Prys-Roberts et al (1971).[11] As discussed earlier, various drugs and techniques have been tried to attenuate this hemodynamic response to laryngoscopy and tracheal intubation. In our study we compared the effects of Dexmedetomidine and Esmolol in attenuating the hemodynamic response to laryngoscopy and tracheal intubation. For this study 100 patients aged between 18 years to 60 years of either sex belonging to ASA class I and II posted for various elective surgeries under general anaesthesia were selected randomly after applying inclusion and exclusion criteria. These patients were divided into 2 groups of 50 patients each.

Group D: Dexmedetomidine 1µg/kg in 20 ml NS over 10 minutes i.v.

Group E: Esmolol 2mg/kg i.v.

Both groups were comparable in age, sex and body weight as shown in Table 1, 2 and 3 and there was no statistically significant difference between these three groups.

Hemodynamic Parameters

(A) Heart Rate (Hr): As shown in Table 4, baseline values of mean Heart rate were comparable between two groups with no statistically significant difference (P>0.05). Changes in heart rate after giving study drug and after induction were also not statistically significant between any of the group. (P>0.05). Heart rate increased after intubation and increase was more in group E (94.06±12.35) and in group D (87.36±8.91). Maximum rise in heart rate was seen after 1 minute of intubation (Group D – 88.23±8.42, Group E – 95.5±14.50). Heart rate started to return to baseline values after 2 minute in group D and after 5 minutes in group E. Between group D and group E changes in heart rate was statistically significant after intubation and till 5 minutes after intubation. Thus our study suggests that Dexmedetomidine provides more significant attenuation of heart rate than Esmolol after laryngoscopy and tracheal intubation. Srivastava V. et al,[12] concluded that Dexmedetomidine provide better control of heart rate after laryngoscopy and intubation than Esmolol. Thus result of our study correlates with studies conducted by Srivastava V. et al.[12] Kharwar et al.[9] observed that there was a more decrease in pulse rate from baseline in the dexmedetomidine group as compared with the esmolol group from baseline after induction. At 1 min after intubation, they observed an increase in heart rate from baseline in the esmolol group and decrease from baseline in the dexmedetomidine group. While in our study heart rate increased from baseline after intubation in both dexmedetomidine and esmolol receiving patients.

(B) Systolic Blood Pressure(Sbp): As shown in table 5, baseline values of mean SBP were comparable between two groups with no statistically significant difference (P>0.05). Changes in SBP after giving study drug and after induction were also not statistically significant between any of the group(P>0.05). SBP increased in all groups after intubation and increase was more in group E (135.46±10.98mmHg) and less in group D (128.93±11.52mmHg). In both groups maximum rise in SBP was seen after 1 minute of intubation (Group D-129.76±12.29mmHg, Group E-135.86±10.07mmHg). SBP started to return to baseline values after 2 minute in group D and after 3 minutes in group C. Between group D and group E changes in SBP was statistically significant after intubation and till 5 minutes after intubation. (P<0.05). Thus this data indicates that Dexmedetomidine controls rise in SBP after laryngoscopy and tracheal intubation more effectively than Esmolol.

Reddy S. et al[13] showed that mean SBP levels were significantly controlled by Dexmedetomidine

as compared to Esmolol after intubation. Thus results of our study is comparable with studies conducted by Reddy S. et al.

(C) Diastolic Blood Pressure (DBP): As shown in Table 6, baseline values of mean DBP were comparable between two groups with no statistically significant difference (P>0.05). Changes in DBP after giving study drug and after induction were also not statistically significant between any of the group (P>0.05). DBP increased in all groups after intubation and increase was more in group E (88.83±6.10mmHg) and lesser in group D (84±8.11mmHg). Maximum rise in DBP was seen after intubation in all the groups. DBP started to return to baseline values after 2 minutes in group D and after 3 minutes in group E. Between group D and group E changes in DBP was statistically significant after intubation and till 10 minutes after intubation.(P<0.05). Thus our study shows that Dexmedetomidine attenuates rise in DBP after laryngoscopy and tracheal intubation more effectively than esmolol. Srivastava V. et al,[12] showed that the use of both esmolol and dexmedetomidine were effective in decreasing the hypertensive response to laryngoscopy and intubation though the use of dexmedetomidine was more effective for same. Jain V. et al[14] observed that the preinduction mean DBP values were statistically significantly different between the two groups of Dexmedetomidine and Fentanyl. (P < 0.05). Postinduction mean DBP showed a comparable increase, which was statistically not significant. Post laryngoscopic comparison of the mean DBP values showed a statistically significant variation in mean DBP values at 1,2,5,10, and 15 min, demonstrating better suppression of the pressor response to intubation in patients receiving Dexmedetomidine. In our study we observed that DBP were not significant pre-induction but was significant after intubation and after 1,2,3,5,10 minutes after intubation.

(D) Mean Arterial Pressure (Map): Baseline values of mean MAP were comparable between two groups with no statistically significant difference (P>0.05). Changes in MAP after giving study drug and after induction were also not statistically significant between any of the group (P>0.05). MAP increased in all groups after intubation and increase was more in group E (109.1±7.99 mmHg) and lesser in group D (98.96±8.14 mmHg). Maximum rise in MAP was seen after intubation in all the groups. MAP started to return to baseline values after 2 minutes in group D, after 5 minutes in group E. Between group D and group E changes in MAP was statistically significant after intubation and till 10 minutes after intubation. (P<0.05) Hence this study demonstrates that Dexmedetomidine is better than Esmolol in attenuating rise in MAP after laryngoscopy and tracheal intubation. Jain V.et al[14] did a comparison between the two groups of Dexmedetomidine and esmolol which showed that there was no statistically significant difference between the mean baseline MAP values of the two groups. The post laryngoscopic mean MAP values showed a statistically significant difference between the two groups, with intravenous dexmedetomidine group at 1,2,5,10, and 15 min demonstrating better suppression of the pressor response to intubation. Thus results of our study are comparable with studies conducted by Gupta S,Tank P[15] and Jain V.et al.[14] Gogus N. et al,[16] showed that esmolol was more effective than dexmedetomidine in prevention of the increases in systolic, diastolic and mean arterial pressures following endotracheal intubation. On the other hand, dexmedetomidine was more effective than esmolol in preventing the increase in heart rate which differs from our study which shows that Dexmedetomidine is better than Esmolol in controlling both heart rate and SBP,DBP and MAP.

Mean Oxygen saturation remained above 98% in all the groups. Changes in oxygen saturation was not statistically significant (P>0.05) between any of the groups at any point of time interval.

Side Effects and Complication

In our study, No intraoperative bradycardia, hypotension, arrhythmias, bronchospasm or postoperative vomiting, respiratory depression, bronchospasm, bradycardia/tachycardia, hypotension/hypertension, arrhythmias or any other side effects or complication were observed in any of the groups.

Summary and Conclusion

This study was designed to study and compare the effectiveness of intravenous dexmedetomidine and esmolol in attenuating sympathomimetic response to direct laryngoscopy and endotracheal intubation in patients undergoing surgical procedures under general anaesthesia. It is concluded that there was an increase in the heart rate , systolic blood pressure, diastolic blood pressure and mean blood pressure during laryngoscopy and post endotracheal intubation in both the groups but Dexmedetomidine

produces more significant attenuation of rise in heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure as compared to Esmolol. No serious side effects or complications were found in any of the study groups.

Dexmedetomidine is safe and more effective than Esmolol in attenuating the haemodynamic response to direct laryngoscopy and endotracheal intubation in patients undergoing surgical procedures under general anaesthesia.

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