

AN EVALUATION OF INJ. DEXMEDETOMIDINE AND INJ. ESMOLOL ON ATTENUATION OF HEMODYNAMIC STRESS RESPONSE DURING LARYNGOSCOPY AND TRACHEAL INTUBATION - A COMPARATIVE STUDY

Rituraj Saini¹, Urmila Keshari¹, Veenashree Managavi¹

¹Department of Anaesthesiology and Critical Care, Gandhi Medical College, Bhopal, Madhya Pradesh, India

Received : 14/10/2022
Received in revised form : 19/11/2022
Accepted : 30/11/2022

Keywords:
Dexmedetomidine, Esmolol,
Laryngoscopy, Tracheal intubation.

Corresponding Author:
Dr. Rituraj Saini,
Email: drsharanyakkaushik@gmail.com
ORCID: 0000-0003-2817-649X

DOI: 10.47009/jamp.2023.5.1.66

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (1); 319-323



Abstract

Background: Laryngoscopy and tracheal intubation are most frequently used procedure to maintain patency of airway in patient undergoing general anaesthesia or having critical illness or patient having critical injury. Laryngoscopy, is Endoscopy of Larynx which is a part of throat. It is a procedure done with Laryngoscope to visualise the vocal cords and the glottis and performed to facilitate tracheal intubation during general anaesthesia or cardiopulmonary resuscitation or for surgical procedure of head and neck surgeries. Esmolol is ultrashort acting beta blocker causes decrease in heart rate, atrio-ventricular conduction and myocardial oxygen demand. Various studies have been conducted to compare the effect of dexmedetomidine and esmolol in attenuation of hemodynamic response of laryngoscopy and tracheal intubation. The objectives are to 1) To assess the hemodynamic changes during and after laryngoscopy and endotracheal intubation. 2) To compare and evaluate the efficacy of dexmedetomidine and esmolol in attenuating hemodynamic response during and after laryngoscopy and endotracheal intubation. **Materials and Methods:** This prospective observational study was conducted on 60 patients in the age group of 18 to 60 years, ASA Grade I & II of either sex, undergoing elective surgeries under general anaesthesia. The study includes drugs dexmedetomidine hydrochloride 100mcg/ml ampoule of 2ml and inj. Esmolol 10mg/ml vial of 10ml, 18 Gauge intravenous cannula, Anaesthesia workstation, Laryngoscope with blade, polyvinyl chloride cuffed Endotracheal tube and other drugs accessories for general anaesthesia and all relevant monitoring devices. The incidence of Hypotension / Hypertension, Tachycardia / Bradycardia and Dysarrhythmias and any other side effect were recorded throughout the study period and compared among groups. **Result:** In Dexmedetomidine group none of the patients had hypotension and one patient had bradycardia, while in Esmolol group no patients had hypotension and had bradycardia. At time of laryngoscopy and intubation, heart rate was increase in both Dexmedetomidine & Esmolol group but more in Esmolol group ($p < 0.01$). There was continuous decrease in heart rate at 2,4,6,8,10 minutes after intubation in both groups, but the mean heart rate at any time was lower in the Dexmedetomidine group than in the Esmolol group which was statistically significant ($p < 0.01$). SBP was increase in both Dexmedetomidine & Esmolol group but more in Esmolol group ($p < 0.01$). MAP was increase in both Dexmedetomidine & Esmolol group but more in Esmolol group ($p < 0.01$). **Conclusion:** Dexmedetomidine is more effective than Esmolol in attenuation of haemodynamic changes during laryngoscopy and intubation. Thus we conclude that Dexmedetomidine is a better drug to attenuate the haemodynamic response during laryngoscopy and intubation.

INTRODUCTION

Laryngoscopy and tracheal intubation are most frequently used procedure to maintain patency of airway in patient undergoing general anaesthesia or having critical illness or patient having critical injury. Tracheal intubation is a procedure in which translaryngeal placement of endotracheal tube into trachea via the nose or mouth to maintain an open airway or to serve as a conduit through which drugs can be administered. It is frequently performed in anesthetized patients to facilitate ventilation and to prevent possibility of asphyxiation or airway obstruction. Most widely used route is oral route. Intubation is an invasive procedure so usually performed after administration of general anaesthesia and a neuromuscular blocking drugs. It can be performed in awake patient with local or topical anaesthesia or in emergency without any anaesthesia at all.^[1] A conventional laryngoscope or video laryngoscope or flexible fiberoptic bronchoscope is used to identify the vocal cords & to pass the tube between them into the trachea instead of into the esophagus.^[2] Direct Laryngoscopy and tracheal Intubation is a noxious stimulus, which can provoke untoward response in the cardiovascular system, respiratory system, and other physiological system. In laryngoscopy and intubation there is stimulation of afferent nerve fibres of Epiglottis and infra-epiglottic region causes vasomotor centre stimulation and release of sympathomimetic amines, epinephrine and norepinephrine. Heart rate increased by 20% of baseline, blood pressure increased by 50% of baseline, dysrhythmias, bradycardia, increase in intracranial pressure and increase in intraocular pressure can occur because of these stress responses.^[3,4] In healthy patients these stress responses are well tolerated but in elderly patients, patient with low cardiac reserve and with other comorbidity these stress response may become life threatening.

Dexmedetomidine is highly specific and selective alpha-2adrenoceptor agonist causes decreases in HR,^[2] blood pressure and also having sedative and analgesic effect. Esmolol is ultrashort acting beta blocker causes decrease in heart rate, atrio-ventricular conduction and myocardial oxygen demand.

Various studies have been conducted to compare the effect of dexmedetomidine and esmolol in attenuation of hemodynamic response of laryngoscopy and tracheal intubation. The study was done to Evaluate the effect of Inj. Dexmedetomidine and Inj. Esmolol on attenuation of hemodynamic stress response during laryngoscopy and tracheal intubation- "A comparative study"

Objectives

1. To assess the hemodynamic changes during and after laryngoscopy and endotracheal intubation.

2. To compare and evaluate the efficacy of dexmedetomidine and esmolol in attenuating hemodynamic response during and after laryngoscopy and endotracheal intubation.

MATERIALS AND METHODS

This prospective observational study was conducted on 60 patients in the age group of 18 to 60 years, ASA Grade I & II of either sex, undergoing elective surgeries under general anesthesia after approval of the institutional ethical committee.

Allocation of Groups: 60 patients were divided in to two groups comprising 30 patients each:-

Group (D): Dexmedetomidine Group [N=30]

Group (E): Esmolol Group [N=30]

Material: The study includes drugs dexmedetomidine hydrochloride 100mcg/ml ampoule of 2ml and inj. esmolol 10mg/ml vial of 10ml, 18G intravenous cannula, anaesthesia workstation, laryngoscope with blade, polyvinyl chloride cuffed endotracheal tube and other drugs accessories for general anaesthesia and all relevant monitoring devices.

Patients of both sexes aged 18-60 years of ASA Grade I & II and scheduled for elective procedure under GA were included in this study.

Exclusion Criteria

1. Patient with Mitral or Aortic or Tricuspid or pulmonary Stenosis, Left Ventricular Failure, AV conduction block.
2. Patient with Asthma, Chronic obstructive pulmonary disease, Any severe liver or renal disease.
3. Patients with neurological disease, spinal deformities or any muscular dystrophy.
4. Patient with history of drug allergy to dexmedetomidine or Esmolol or neostigmine or any other drug used in general anaesthesia.
5. Patients taking antihypertensive, sedatives, beta-blockers, MAO-inhibitors, Oral hypoglycemic or Anticonvulsants treatment.
6. Pregnant or breast-feeding females.

Technique and Method

On the day of surgery, Anaesthesia machine and circuits were checked, resuscitation equipments were kept ready. After confirmation of NPO status, patients were shifted to the operating room and connected to monitor. Preoperative base line parameters, such as HR, SBP, DBP, MBP, SPO₂, ECG were recorded after 5 min of settling in the operative room. Following this, Group (D) were given inj. Dexmedetomidine 1mcg/kg diluted to 50ml with normal saline over 10 minutes with infusion pump. Group (E) were given inj. Esmolol 0.5 mg/kg diluted to 20ml with normal saline over 10 minutes with infusion pump.

HR, SBP, DBP, MBP & SpO₂ were recorded when patient shifted in operation theater baseline values (T₀), after administration of study drug (T₁), after giving induction agent (T₂) and just after intubation (T₃), at 2min (T₄), 4min (T₅), 6min (T₆), 8 min (T₇), 10min(T₈) after laryngoscopy & intubation. At the end of surgery the neuromuscular blockade was antagonized with inj. Glycopyrolate (.01mg/kg) IV and inj. Neostigmine (.05mg/kg) IV and patient were extubated after complete reversal of neuromuscular blockade.

The incidence of Hypotension/ Hypertension, Tachycardia / Bradycardia and Dysarrhythmias and any other side effect were recorded throughout the study period and compared among groups.

RESULTS

This study was conducted on 60 patients of ASA Grade I & II, undergoing elective surgeries under general anesthesia. Patients were divided in to two groups comprising 30 patients each. On the day

prior to surgery, pre-anesthetic evaluation was done and detailed history of cardiovascular system, respiratory system, central nervous system, drug therapy and drug allergy was taken. A thorough clinical examination of the patient was performed including General Physical Examination & systemic examination. Mallampatti grading was used for assessment of airway to anticipate difficult intubation.

Pre-operatively patients were explained about the procedure and technique and written informed consent was taken. All the patients were kept nil per orally for at least 6 hour prior to the surgery. All routine investigations like Complete blood count, Urine (R & microscopic), Blood (urea, creatinine), Blood sugar, Electrocardiogram & X-ray (above 40 years) were done prior to surgery. Relevant specific investigation was also done. All patients were given Inj glycopyrolate 0.2 mg IV, and inj. Ondansetran 4 mg IV, Inj Ranitidine Hydrochloride 50 mg IV before infusion.

Table 1: Comparative evaluation of Mean Heart Rate between Dexmedetomidine & Esmolol at different time interval among study subjects.

Groups	Mean Heart Rate (MHR)								
	T0	T1	T2	T3	T4	T5	T6	T7	T8
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD
Group D	101.73± 2.08	92.70± 1.17	86.30± 1.23	101.84± 1.45	89.66± 1.21	82.06± 1.46	78.46± 1.81	75.46± 1.85	72.5± 1.81
Group E	101.86± 2.16	98.06± 2.08	94.13± 1.67	104.37± 2.02	99.13± 1.54	95.70± 1.55	93.50± 1.50	90.66± 1.44	88.46± 1.43
Student 't' Test Value	0.243	5.36	7.38	9.21	9.47	13.64	15.04	15.2	15.96
P-Value	0.809 (NS)	0.001 (HS)	0.001 (HS)	0.001 (HS)	0.001 (HS)	0.001 (HS)	0.001 (HS)	0.001 (HS)	0.001 (HS)

Table 2: Comparative evaluation of Systolic blood pressure between Dexmedetomidine & Esmolol at different time interval among study subjects.

Groups	Systolic blood pressure (SBP)								
	T0	T1	T2	T3	T4	T5	T6	T7	T8
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD
Group D	131.46± 2.81	121.96± 2.73	119.93± 2.25	133.03± 1.90	123.06± 3.05	115.33± 3.57	108.8± 2.26	105.80± 1.76	102.26± 1.87
Group E	131.46± 2.50	128.60± 2.52	122.80± 5.10	135.03± 2.29	127.93± 3.30	125.80± 2.74	124.46± 2.24	123.00± 2.14	121.60± 1.92
Student 't' Test Value	0.000	9.756	2.811	1.837	5.931	12.716	27.783	33.837	39.439
P-Value	1.000	0.001 (HS)	0.007 (S)	0.0071(S)	0.001 (HS)	0.001 (HS)	0.001 (HS)	0.001 (HS)	0.001(HS)

Table 3: Comparative evaluation of Mean Arterial pressurebetween Dexmedetomidine & Esmolol at different time interval among study subjects.

Groups	Mean Arterial pressure (MAP)								
	T0	T1	T2	T3	T4	T5	T6	T7	T8
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD
Group D	99.24± 3.24	89.90± 2.12	88.06± 2.00	101.84± 1.45	92.54± 1.97	85.59± 1.77	82.23± 0.88	79.55± 1.28	75.69± 1.51
Group E	99.71± 3.06	97.81± 2.24	94.60± 3.64	103.65± 1.70	99.26± 2.29	97.22± 1.68	95.92± 1.51	94.95± 1.35	93.86± 1.22
Student 't' Test Value	0.568	14.025	8.612	4.224	12.149	26.030	42.678	45.283	51.184
P-Value	0.572	0.001(HS)	0.001(HS)	0.001(HS)	0.001(HS)	0.001(HS)	0.001(HS)	0.001(HS)	0.001(HS)

Table 4: Comparative evaluation of Mean SPO2 between Dexmedetomidine & Esmolol at different time interval among study subjects.

Groups	Mean SPO2								
	T0	T1	T2	T3	T4	T5	T6	T7	T8
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Group D	99.33±0.47	99.43±0.50	99.40±0.56	99.23±0.62	99.33±0.47	99.30±0.46	99.23±0.62	99.33±0.47	99.43±0.50
Group E	99.33±0.47	99.43±0.50	99.40±0.56	99.26±0.58	99.33±0.47	99.30±0.46	99.23±0.62	99.33±0.47	99.43±0.50
Student 't' Test Value	0.000	0.000	0.000	0.213	0.000	0.000	0.000	0.000	0.000
P-Value	1.000	1.000	1.000	0.832 (NS)	1.000	1.000	1.000	1.000	1.000

DISCUSSION

There are sufficient evidences that suggest reflex sympathetic hemodynamic stress response of laryngoscopy and endotracheal intubation. King BD et al,^[6] were found in their study that during general anaesthesia, direct laryngoscopy and intubation is associated with average rise of Heart rate was 23 beats/min and average rise of SBP by 53 mm Hg. These changes usually persisted for 5 minutes and were returned to normal basal value spontaneously. In another study Bruder N et al,^[7] also found that laryngoscopy and intubation leads to an increase in blood pressure of 40-50% and heart rate of 20%, these increase was greatest 1 min after intubation and lasted for 5-10 min.

For effective attenuation of these sympathetic responses there were so many pharmacological methods used. We selected dexmedetomidine and esmolol as study drug due to its efficacy in attenuating hemodynamic response. Many other studies also done previously with these study drugs. In support of our study Yavascaoglu B et al,^[8] concluded in their study that dexmedetomidine 0.5µg/kg is more effective than Esmolol 0.5 mg/kg in stress response attenuation of laryngoscopy. B Sebastian et al,^[9] also compare the effect of two doses of IV dexmedetomidine 0.5 µg/kg and 0.75 µg/kg with placebo in attenuating stress response of laryngoscopy and intubation. They all concluded that dexmedetomidine 1 µg/kg & 0.75µg/kg is more potent in attenuating cardiovascular response.

In view of above facts we select our dose of dexmedetomidine is 1 µg/kg body weight and esmolol is 0.5mg/kg body weight for attenuation of stress responses of laryngoscopy and intubation.

In our study during laryngoscopy and intubation significant difference between mean heart rate of Group D and Group E with less rise in Mean HR in Group D compared with Group E which is consistent throughout study period. At time after 2, 4, 6,8,10 min after intubation mean heart rate is less in Group D than Group E at any time. In Group D & E there is statistically significant difference between mean HR (p-value < 0.01 highly SIGNIFICANT) after administration of study drug & after intubation. The result of our study supported by Siddareddigari VR et al as they also compare the effect of esmolol

2.0mg/kg & dexmedetomidine 1.0 mcg/kg intravenously to placebo. The rise in HR and rate pressure product at the time of intubation were minimal upto 15 min in dexmedetomidine.

As shown in [Table 1], mean heart rate (±SD) bpm at basal value was found to be 101.73±2.08 which is increases after laryngoscopy to 101.84 ± 1.45 and after 6 min and 10 min of intubation heart rate were decreases to 78.46±1.81 and 72.5±1.81 respectively. There is decrease in heart rate after dexmedetomidine (14.51%) from baseline but increase in heart after laryngoscopy and intubation (9.32%) from previous value & increase in heart rate (0.1 %) from baseline. Same results are found with study drug as in our study by Alka chandra et al,^[10] as they compare Dexmedetomidine 0.4 µg/kg diluted in 20 ml NS and normal saline 0.4 ml/kg over 10 min before intubation. Heart rate is significantly increased in control group from (85.04 bpm) to (102.18 bpm) after intubation but less changes in Dexmedetomidine group from (90.48 bpm) to (86.34 bpm).

As shown in [Table 2] (Graph 3), mean (±SD) systolic blood pressure (mmHg) at baseline value was 131.46±2.81 which is increase after laryngoscopy to 133.03±1.90 and decreases after 6 & 10 min of intubation systolic blood pressure were 108.8±2.26 & 102.26±1.87 respectively. There is decrease in SBP after dexmedetomidine administration (2%) from baseline but increase in SBP after laryngoscopy and intubation (1.2%) from baseline and (10.9%) from previous value. Alka chandra et al & Jaakola ML et al,^[11] also found that dexmedetomidine 0.4 µg/kg & 0.6µ/kg is more potent in controlling rise in SBP after intubation than placebo. During laryngoscopy and intubation significant difference between mean SBP of Group D and Group E with less elevation in Mean SBP in Group D compared with Group E which is consistent throughout study period. At time after 2, 4, 6,8,10 min after intubation mean SBP is less in Group D than Group E at any time. In Group D & E there is statistically significant difference between mean SBP (p-value < 0.01 highly SIGNIFICANT).

As shown in [Table 3], mean (±SD) Diastolic blood pressure (mmHg) at baseline value was 83.66±4.55 which is increase after laryngoscopy to 86.66±1.84, and after 6 &10 min of intubation Diastolic blood

pressure were 68.73 ± 1.43 & 62.53 ± 1.96 respectively. There is decrease in DBP after dexmedetomidine administration (3.47%) from baseline but increase in DBP after laryngoscopy and intubation (3.71%) from baseline and (15.93%) from previous value. As in our study Jaakola ML et al studied potency of single IV dexmedetomidine $0.6 \mu\text{g}/\text{kg}$ over placebo. There was maximum DBP was significantly less in dexmedetomidine group compared with placebo group. Keniya VM et al,^[12] studied Dexmedetomidine $1 \mu\text{g}/\text{kg}$ was given over 10 minutes and was continued in a dose of $0.2\text{--}0.7 \mu\text{g}/\text{kg}/\text{hour}$ intraoperatively. They also observed increase in DBP 21% in Dexmedetomidine group as compared to 25% in control group. During laryngoscopy and intubation significant difference between mean DBP of Group D and Group E with less increase in Mean DBP in Group D compared with Group E which is consistent throughout study period. At time after 2, 4, 6, 8, 10 min after intubation mean DBP is less in Group D than Group E at any time. In Group D & E there is statistically significant difference between mean DBP (p-value < 0.01 highly significant).

As shown in [Table 4], mean(\pm SD) MAP (mmHg) at baseline value was 99.24 ± 3.24 , after Dexmedetomidine administration 89.90 ± 2.12 , after induction agent 88.06 ± 2.00 , after laryngoscopy 101.84 ± 1.45 , and after 2 min, 4 min, 6 min, 8 min, 10 min of intubation Mean blood pressure were 92.54 ± 1.97 , 85.59 ± 1.77 , 82.23 ± 0.88 , 79.55 ± 1.28 , 75.69 ± 1.51 respectively. There is decrease in MAP after dexmedetomidine administration (11.2%) from baseline but increase in MAP after laryngoscopy and intubation (2.64%) from baseline and (13.5%) from previous value. Same result as above study found by Yildiz M et al.^[13] They observe increase in MAP in all groups after tracheal intubation but it is significantly reduced in Dexmedetomidine group.

CONCLUSION

Following conclusion are drawn from the present study:-

1. Dexmedetomidine significantly attenuates the haemodynamic changes during laryngoscopy and intubation.
2. Esmolol also significantly attenuates the haemodynamic changes during laryngoscopy and intubation.
3. Dexmedetomidine is more effective than Esmolol in attenuation of haemodynamic changes during laryngoscopy and intubation.

Thus we conclude that Dexmedetomidine is a better drug to attenuate the haemodynamic response during laryngoscopy and intubation.

Acknowledgment

The authors gratefully acknowledge patients of the enrolled for surgery, nursing staff, and Anaesthesia department of Gandhi Medical College and Hamidia Hospital for their wholehearted participation in the study.

REFERENCES

1. Scheinin B, Lindgren L, Randell T, Scheinin H, Scheinin M. Dexmedetomidine attenuates sympathoadrenal responses to tracheal intubation and reduces the need for thiopentone and per operative fentanyl. *British journal of anaesthesia*. 1992;68(2):126-31
2. Shane Sheppard, Chris J. Eagle, Leo Strunin. A bolus dose of esmolol attenuates tachycardia and hypertension after tracheal intubation. *Canadian Journal of Anaesthesia* March 1990, Volume 37, Issue 2, pp 202–205
3. Gueredo E, Gaecia-Fuentes EM. Assessment of the efficacy of esmolol on the haemodynamic changes induced by laryngoscopy and tracheal intubation: a meta-analysis. *Acta Anaesthesiol Scand*. 2001 Sep;45(8):1011-22.
4. Rathore A, Gupta HK, Tanwar GL, Rehman H. Attenuation of stress response of tracheal intubation with different doses of esmolol. *IJA* 2002;46(6):449-452
5. Basar H, Akpınar S, Dogancı N, Buyukkocak U, Kaymak C et al. The effects of preanaesthetic, single-dose dexmedetomidine on induction, hemodynamic, and cardiovascular parameters. *Journal of clinical anaesthesia*. 2008 Sep;20(6):431-436
6. King B D, Harris L C, Greifenstein, Elder J D, Dripps R D. Reflex circulatory responses to direct laryngoscopy and tracheal intubation performed during general anesthesia. *Anesthesiology*. 1951 Sep;12(5):556–566
7. Bruder N, Granthil C, Ortega D. Consequences and prevention methods of hemodynamic changes during laryngoscopy and intubation. *Ann Fr Anaesthesia Reanim* 1992; 11 (1):57-71.
8. B Yavascaoglu, FN Kaya, M Baykara, M Bozkurt. A comparison of esmolol and dexmedetomidine for attenuation of intraocular pressure and haemodynamic responses to laryngoscopy and tracheal intubation. *Eur J Anaesthesiol*. 2008 Jun;25(6):517-9.
9. B Sebastian, A T Talikoti, D Krishnamurthy. Attenuation of haemodynamic responses to laryngoscopy and endotracheal intubation with intravenous dexmedetomidine: Vol; 61 Issue 1P 48-54
10. Alka c, Reena r, Jay K, A Vohra. The effects of intravenous dexmedetomidine premedication on intraocular pressure and pressor response to laryngoscopy and intubation. *JOACP*; 2016 Volume : 32 Issue : 2 P 198-202.
11. Jakola ML, Ali-Melkkila T, Kanto J, Kallio A, Scheinin H, Scheinin M. Dexmedetomidine reduces intraocular pressure, intubation response and anaesthetic requirements in patients undergoing ophthalmic surgery. *Br J Anaesth* 1992;68:570-5
12. Keniya VM, Ladi S, Naphade R. Dexmedetomidine attenuates hemodynamic response to tracheal intubation and reduce perioperative anaesthetic requirement. *IJA* vol;55. Issue 4 July-Aug 2011: 352-57
13. Yildiz M, Tavlan A, Tuncer S, Reisli R, Yosunkaya A, Otelcioglu S. Effect of dexmedetomidine on haemodynamic responses to laryngoscopy and intubation, perioperative haemodynamics and anaesthetic requirements. *Drugs R D* 2006;7: 43-52