

Original Article

A Comparative Study of Dexmedetomidine vs Esmolol for Attenuation of Stress Responses to Laryngoscopy and Endotracheal Intubation

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ABSTRACT

Introduction: Direct laryngoscopy and endotracheal intubation induce a transient circulatory reflex response characterized by tachycardia, hypertension and arrhythmias. This pressor response is not significant in healthy individuals but can be lethal in patients with cardiovascular or intracranial diseases.

Aims: To compare the efficacy of intravenous Dexmedetomidine and Esmolol in attenuating hemodynamic response to laryngoscopy and intubation in patients undergoing elective surgeries under general anesthesia.

Methods: This was a prospective, randomized study conducted on 52 patients aged between 18-60 years, with Mallampatti grade I or II. The subjects were divided into two equal groups, E & D which received Inj. Esmolol (1.0 mg/kg) in 10 ml normal saline two minutes before intubation and Inj. Dexmedetomidine (1 µg/kg) in 10 ml normal saline over ten minutes before intubation respectively. Hemodynamic parameters were recorded before and during intubation and at 0, 1, 3 and 5 minutes after intubation. The values of both the groups were compared and expressed as Mean $\pm$ SD. Statistical analysis was done using student's t-test.

Results: There was a fall in the mean arterial pressure and heart rate in both the groups but the fall in hemodynamic parameters exacerbated due to pressor response was better noted with study drug Dexmedetomidine than Esmolol.

Conclusion: The pressor response to tracheal manipulation was significantly attenuated ($p < 0.05$) in both the groups but dexmedetomidine was more efficacious in blunting the pressor response.

Keywords: Dexmedetomidine, Esmolol, Stress response, Laryngoscopy

INTRODUCTION

Laryngoscopy is endoscopy of the larynx. It is a method to visualise the vocal folds and the glottis. Tracheal intubation is mandatory in most surgical patients requiring general anaesthesia and critically ill patients requiring mechanical ventilation.¹

Direct laryngoscopy and endotracheal intubation induce a transient circulatory reflex response characterized by tachycardia, hypertension and arrhythmias. This fluctuation of hemodynamic parameters is noted due to an increase in plasma catecholamine levels in response to this stimulus. This reflex lasts for 5-10 minutes after intubation.²

This momentary response is well tolerated in healthy individuals but is considered potentially dangerous in patients with cardiovascular or intracranial diseases.³

Alleviating stress response of laryngoscopy and endotracheal intubation is critical in management of general anaesthesia patient undergoing surgical intervention. Several drugs and manoeuvres have been tried and there is a constant search for ideal drug to mitigate this stress response.⁴

Esmolol is an ultra-short acting beta-adrenergic receptor antagonist. It minimizes the increase in heart rate and myocardial contractility which is the primary determinant of myocardial oxygen consumption, by attenuating the positive chronotropic and inotropic effects of increased adrenergic activity.²

Dexmedetomidine is an imidazole derivative and a highly selective alpha-2 adrenergic receptor agonist, and it produces sympatholysis.²

This study was undertaken to compare the efficacy of esmolol and dexmedetomidine for attenuation of stress response to laryngoscopy and endotracheal intubation in patients posted for elective surgeries under general anaesthesia.

AIMS AND OBJECTIVES

The main aim is to compare the efficacy and safety of intravenous Dexmedetomidine and Esmolol in attenuating hemodynamic response to laryngoscopy and intubation in normotensive patients undergoing elective surgeries under general anaesthesia.

MATERIAL AND METHOD

After obtaining written and informed consent, we conducted a randomised study in 52 patients and compared the efficacy of Esmolol and Dexmedetomidine for attenuation of stress response to laryngoscopy and endotracheal intubation. Patients were divided randomly in two groups with 26 patients in each group. Inclusion criteria consisted of age between 18-60 years, either sex, ASA grading I/II and surgeries conducted under general anaesthesia. Exclusion criteria consisted of patient's refusal, age below 18

years, patients with Mallampatti grade III and IV, patients having chronic hypertension, sinus bradycardia, hypotension, co-existing cardio-respiratory diseases, hepatorenal diseases and on long term opioids, patients who could not be intubated within 2 minutes of administration of study drugs, known hypersensitivity to drugs and patients having ECG changes like conduction block, cardiac failure.

Pre anaesthetic evaluation of all patients consisted of detailed history, physical examination and routine investigations. A written informed consent was taken after proper counselling.

All patients were fasted overnight and no sedatives or anxiolytics were given on the previous night. Vital parameters (Heart rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean Arterial Pressure, SpO₂) noted in preoperative room considered as baseline.

Patients were pre-medicated with Inj. Glycopyrrolate 0.005-0.01 mg/kg iv, Inj. Ondansetron 0.1mg/kg iv and Inj. Fentanyl 2µg/kg iv. Patients were randomly divided into two groups and each group consisted of 26 patients. Group E comprised of patients receiving Inj. Esmolol (1.0 mg/kg) in 10 ml normal saline two minutes before induction. Group D comprised of patients receiving Inj. Dexmedetomidine (1µg/kg) in 10 ml normal saline over 10 minutes prior to induction.

Patient pre-oxygenated with 100% oxygen for 3 minutes. Induction done with Inj. Thiopentone sodium (5-7 mg/kg) iv + Inj. Succinylcholine (1.5 mg/kg) iv + IPPV. Intubation done with appropriate sized cuffed endotracheal tube and received oxygen-nitrous mixture (50:50). Intubations done smoothly and gently within 30 seconds. Anaesthesia maintained with O₂ + N₂O + Isoflurane. Muscle relaxation done with Inj. Vecuronium bromide with a loading dose of 0.08mg/kg iv and maintenance of 0.02 mg/kg iv. After completion of surgery, patients were extubated following reversal of residual muscle paralysis with Inj. Neostigmine 0.05mg/kg iv and Inj. Glycopyrrolate 8µg/kg iv.

Hemodynamic parameters monitored at various intervals were Baseline (T₀), Vitals after premedication (T₁), Immediately after giving the study drug (T₂), During Intubation (T₃), Immediately after intubation (T₄), 3 minutes after intubation (T₅) and 5 minutes after intubation but prior to surgical incision (T₆).

Complications and side effects were recorded as bradycardia (heart rate < 60/ min) treated with Inj. Atropine 0.6mg IV, hypotension (typically less than 20% of baseline) managed with 200ml crystalloid bolus and Inj. Mephentermine 6mg iv, respiratory depression (SpO₂ < 90% on room air and/or respiratory rate of <8/min).

Statistical analysis was done using suitable statistical software. Interpretations of observations and results was done using unpaired Student t- test. A P-value of <0.001 was highly significant, <0.05 was significant and >0.05 considered not significant

OBSERVATIONS AND RESULTS

After studying 52 cases, observations and results were summarised in tabulated form and described below. Both groups comprised of 26 patients.

No significant difference was found in Age, Sex, Height, Body weight and ASA grade. No statistical difference for heart rate was found between both the groups at T₀ and T₁. Significant difference was found in Heart rate between the two groups at T₂.

Table 1: Demographical profile of the patients of both the groups

Parameters	Group E (n=26)	Group D (n=26)	P-Value
Age (mean ± SD)yr	34.7 ± 2.83	35 ± 2.40	0.40
Sex (male/female)	13/13	13/13	
Height (cm)	165.1 ± 6.60	164.6 ± 7.12	0.45
Body weight (kg)	71.4 ± 5.75	70.3 ± 6.25	0.35
ASA grade i/ii	13/13	13/13	

Table 2: Heart rate at different time intervals in the two groups

	Group E (n=26)	Group D (n=26)	P-value
Baseline (T ₀)	82.9 ± 3.60	82.6 ± 4.11	0.42 (>0.05)
After Premedication (T ₁)	86 ± 2.98	86.2 ± 3.70	0.43 (>0.05)
Immediately After Study Drug (T ₂)	80.2 ± 3.58	76.8 ± 4.44	0.01 (<0.05)
During Intubation (T ₃)	103.8 ± 6.49	91.8 ± 4.26	<0.001
Immediately After Intubation (T ₄)	102.2 ± 5.20	89.6 ± 4.50	<0.001
3 Minutes After Intubation (T ₅)	98.6 ± 4.78	84 ± 5.49	<0.001
5 Minutes After Intubation But Prior To Surgical Incision (T ₆)	92.4 ± 4.42	79.1 ± 5.85	<0.001

Values indicated in mean ± SD

Table 3. Systolic Blood Pressure of Two Groups at Different Time Intervals

	Group E (n=26)	Group D (n=26)	P-value
Baseline (T ₀)	132.8 ± 4.63	134.6 ± 4.71	0.23
After Premedication (T ₁)	134.4 ± 7.98	136.7 ± 5.96	0.20
Immediately After Study Drug (T ₂)	131 ± 6.48	128 ± 5.57	0.066
During Intubation (T ₃)	144.1 ± 4.59	136.9 ± 2.02	<0.001
Immediately After Intubation (T ₄)	141.4 ± 4.11	133.2 ± 3.58	<0.001
3 Minutes After Intubation (T ₅)	140.2 ± 4.26	129.6 ± 4.40	<0.001
5 Minutes After Intubation But Prior To Surgical Incision (T ₆)	137.6 ± 4.94	127 ± 4.73	<0.001

Values indicated in mean ± SD

Table 4. Diastolic Blood Pressure of Two Groups at Different Time Intervals

	Group E (n=26)	Group D (n=26)	P-value
Baseline (T ₀)	82.2±6.28	83±5.43	0.39
After Premedication (T ₁)	83.6±5.94	83.2±5.82	0.44
Immediately After Study Drug (T ₂)	80.8±6.05	76.2±5.47	0.06
During Intubation (T ₃)	92.3±6.49	86.7±4.83	<0.05
Immediately After Intubation (T ₄)	91.1±4.33	85.3±5.14	<0.05
3 Minutes After Intubation (T ₅)	88.6±3.74	82.6±5.58	<0.05
5 Minutes After Intubation But Prior To Surgical Incision (T ₆)	86.4±4.00	78.4±5.37	<0.05

Values indicated in mean ± SD

Table 5. Mean Arterial Pressure Of Two Groups At Different Time Intervals

	Group E (n=26)	Group D (n=26)	P-Value
Baseline (T ₀)	97.9±6.69	99±7.42	0.14
After Premedication (T ₁)	98.8±8.54	99.5±5.08	0.41
Immediately After Study Drug (T ₂)	97.5±8.31	91.5±2.87	<0.05
During Intubation (T ₃)	110.9±6.78	103.4±2.75	<0.05
Immediately After Intubation (T ₄)	108.1±6.52	99.9±4.62	<0.05
3 Minutes After Intubation (T ₅)	105.1±5.80	97.1±3.41	<0.05
5 Minutes After Intubation But Prior To Surgical Incision (T ₆)	101.8±4.51	91.8±2.34	<0.001

Values indicated in mean ± SD

Table 6. Complications in Both Groups

Complications	Group E (N=26) (%)	Group D (N=26) (%)
Nausea	1 (3.8)	0 (0)
Vomiting	0 (0)	0 (0)
Bradycardia	2 (7.6)	1 (3.8)
Hypotension	5 (19)	3 (11)
Respiratory Depression	0 (0)	0 (0)

The heart rate of patients in Group D was found to be lower than that of Group E and this difference was found to be statistically highly significant ($P<0.001$) at T₃, T₄, T₅, T₆. Hence, dexmedetomidine decreased heart rate more than Esmolol.

The Mean Systolic blood pressure were statistically comparable at T₀ and T₁. The systolic pressure was found to be lower in Group D as compared to Group E at T₂, T₃, T₄, T₅ and T₆. Statistical difference was found to be highly significant at T₃, T₄, T₅, and T₆.

Comparison of Diastolic blood pressure between both the groups was found to be statistically insignificant at T₀, T₁, T₂. Statistical difference was found at T₃, T₄, T₅ and T₆ ($P<0.05$). The diastolic pressure was lower in Group D as compared to Group E.

Statistical difference was noted between both the groups in MAP immediately after administering the study drug, during intubation immediately after intubation and 3 minutes after intubation. ($p<0.05$). A highly significant difference was noted between both groups at 5 minutes after intubation ($p<0.001$). Dexmedetomidine proved to be a better drug in comparison to esmolol for Mean Arterial Pressure. Incidence of complications were not significant in any group.

DISCUSSION

Direct laryngoscopy and endotracheal intubation are inevitable traumatic procedures for initiation of general anaesthesia for prolonged elective surgeries as well as cardiopulmonary resuscitation. It leads to a temporary, yet prompt sympathoadrenal reflex resulting in hypertension and tachycardia.

In healthy individuals, this momentary reflex is not significant whereas it can be detrimental in patients with hypertension, coronary vascular disease and cerebrovascular diseases. Such patients need prophylaxis in the form of antihypertensive agents, beta-blockers, narcotics and other drugs.

In this study, we have used two agents (Esmolol and Dexmedetomidine) to study its efficacy in attenuating hemodynamic stress responses to laryngoscopy and endotracheal intubation.

Dexmedetomidine is an imidazole derivative, which acts on α -2 adrenergic receptors in the brain and spinal cord inhibiting neuronal firing, thereby resulting in hypotension, bradycardia, sedation and analgesia. Its effects are mediated by inhibition of central sympathetic outflow.

Esmolol is an ultra-short acting cardioselective beta blocker with a transient effect and short half-life. It prevents the action of epinephrine and nor-epinephrine. It decreases the force and rate of heart contractions by blocking the beta-adrenergic receptors of the sympathetic nervous system.

Chung F and McCammon R. L. ^{9, 10} observed that laryngoscopy and tracheal manipulation were responsible for rise in hemodynamic parameters. This is consistent with our study as the peak rise in blood pressure was noted during intubation.

Most of the previous studies have compared blood pressure and Heart rate before and after laryngoscopy. In our study, we also compared the parameters during intubation.

Various studies have used dexmedetomidine in the dose ranging from 0.5 to 10µg/kg and observed that notable hypotension and bradycardia occurred at higher doses. (Keniya VM et al, 2011) ⁵

Studies with use of Dexmedetomidine in the range of 0.5-2µg/kg have resulted in effective control of hemodynamic responses during tracheal manipulation (Sulaiman et al, 2015).⁶ We, therefore, used dexmedetomidine in the dose of 1µg/kg over 10 minutes prior to intubation and observed a consistent protection on Heart rate.

Studies have used Esmolol as bolus and infusion in the dose ranging from 0.4-2mg/kg. the results observed have been variable and no agreement has been reached regarding the optimum dose and timing of delivery. A study used Dexmedetomidine (0.5µg/kg) and Esmolol (0.5mg/kg) in lower doses than our study and found similar results. (Saurabh Varshney et al, 2019) ⁴

A study used Esmolol in the dose of 2mg/kg as compared to Dexmedetomidine 1µg/kg to assess their efficacy in attenuation of hemodynamic responses to tracheal manipulation (Gogus et al, 2014) ⁷. They observed that esmolol was more effective than dexmedetomidine in the prevention of rise in blood pressure following tracheal intubation. But, dexmedetomidine was found to be more effective in preventing rise in Heart rate than esmolol. Their results were comparable to our study regarding Heart rate but showed contrasting results regarding blood pressure. This difference could be attributed to double dose of Esmolol as compared to our study.

Another study compared Dexmedetomidine (1µg/kg), Esmolol (2mg/kg) and Fentanyl (2µg/kg) and observed their effects on heart rate, Blood pressure due to tracheal manipulation. They concluded that Dexmedetomidine blunted tachycardia better than esmolol and the converse was true for blood pressure. (M. Mavri et al, 2015) ⁸

In the present study, no side effects of either two drugs were significant. Both drugs provided a good attenuating response. However, dexmedetomidine provided superior control over pressor response.

CONCLUSION

On the basis of the findings of this study, we conclude that Dexmedetomidine (1.0 µg/kg) is a better agent than Esmolol (1mg/kg) in attenuating the sympathomimetic response to laryngoscopy and intubation.

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