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Original research article

A Comparison Between Dexmedtomidine and Esmolol for attenuation of stress response to direct laryngoscopy and endotracheal intubation

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Abstract

Laryngoscopy and endotracheal intubation is commonly associated with hemodynamic changes due to reflex sympathetic stimulation. The hemodynamic changes are usually transitory, variable and unpredictable and are probably of no consequence in healthy individuals, but may be hazardous to those with history of pre-eclampsia, hypertension, cardiovascular or cerebrovascular diseases. A prospective randomized clinical study was undertaken in patients belonging to ASA-I physical status scheduled for elective surgeries under general anaesthesia with endotracheal intubation. Patients in Group D (n=36) received 0.5mcg/kg dexmedetomidine in 50mL NS over 10minutes before induction. Patients in Group E (n=36) received 0.5mg/kg esmolol diluted to 10mL over 60seconds after induction. The mean HR in dexmedetomidine group (maximum increase of 88.09±10.31 at intubation) was significantly lower than esmolol group (maximum increase of 93.72±8.27 at intubation), which was statistically significant but not clinically. SBP, DBP and MAP changes between the two groups were statistically insignificant at all points. We concluded that dexmedetomidine 0.5mcg/kg and esmolol 0.5mg/kg are comparable in attenuating the hemodynamic stress response to laryngoscopy and tracheal intubation without any adverse effects.

Keywords: dexmedetomidine, esmolol, laryngoscopy, intubation response

Introduction

Laryngoscopy and endotracheal intubation following induction of general anaesthesia is commonly associated with increase in arterial blood pressure and tachycardia due to reflex sympathetic discharge caused by epipharyngeal and laryngopharyngeal stimulation [1]. These responses are mediated by cardioaccelerator nerves and sympathetic chain ganglion [2]. The principle mechanism behind this is the sympathetic response resulting from increased catecholamine activity which is usually transitory, variable, unpredictable and hazardous to patients with hypertension, myocardial insufficiency or cerebrovascular diseases and predisposes to development of pulmonary edema, myocardial insufficiency and cerebrovascular accident [3, 4, 5, 6].

Intravenous anesthetic induction agents do not adequately or predictably suppress these responses. So measures like deepening the plane of anaesthesia, airway manipulation, duration of laryngoscopy and intubation and the researchers have used different pharmacological measures like use of volatile anesthetics, topical and intravenous lidocaine, opioids, clonidine, nitroglycerine, calcium channel blockers and-blockers prior to initiating laryngoscopy to blunt this response.

Dexmedetomidine is an imidazole derivative and highly selective alpha (α)-2-adrenergic receptor agonist [7]. Its advantages include sedation, analgesia, anxiolysis and improved hemodynamic stability. It produces hyperpolarization of noradrenergic neurons and suppression of neuronal firing in the locus coeruleus leads to decreased systemic noradrenalin release results in attenuation of sympathoadrenal responses and hemodynamic stability during laryngoscopy and tracheal intubation [8].

Esmolol, an ultra-short acting selective beta-1 blocker with rapid onset of action, short elimination half-life and decreased incidence of adverse effects is advantageous compared with longer acting betablockers [9]. Esmolol decreases the force of contraction and heart rate by blocking action of catecholamines on beta-adrenergic-1 receptors of the sympathetic nervous system, mainly found in the heart thus attenuates the tachycardia and hypertensive responses to laryngoscopy and endotracheal intubation [10].

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Methodology

Source of data

Data was collected from patients scheduled for elective surgeries under general anaesthesia with endotracheal intubation, in the Department of Anaesthesiology.

Study Design: A prospective randomized study

Inclusion Criteria:

1) Patient willing to give informed consent.
2) American Society of Anesthesiologists (ASA) class I patients.
3) Aged between 18-60 years posted for elective surgeries under general anaesthesia with endotracheal intubation.

Exclusion Criteria

1) Unwilling to participate in study.
2) Allergy to the study drugs.
3) Anticipated difficult airway.
4) Emergency surgical procedures.
5) Patients requiring rapid sequence induction and intubation.
6) Baseline heart rate less than 60bpm, baseline systolic blood pressure less than100mmHg.
7) PR interval > 0.24sec, 2nd or 3rd degree heart block on ECG.
8) Sick Sinus Syndrome.

Method of Study and Collection of Data

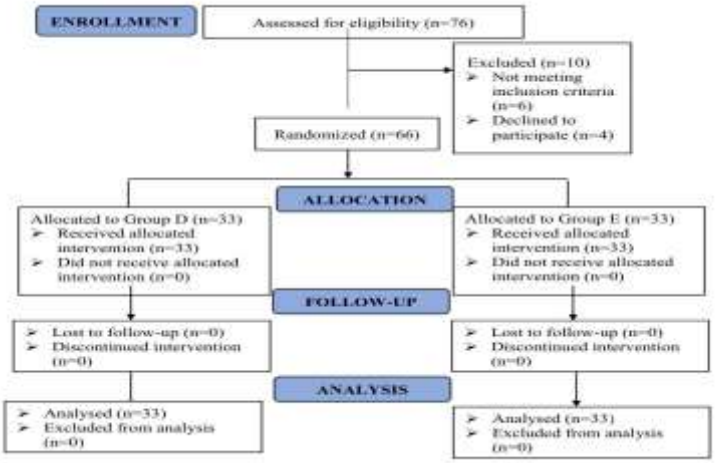
Following ethical committee approval, patients fulfilling the essential criteria were selected. Detailed pre-anesthetic evaluation was done. An informed and written consent was taken from all patients. Demographic (age, gender), morphologic (weight, height) and vital parameters were recorded. The patients were randomly divided into 2groupsof 36 each using a computer-generated randomization table.

Group E

Esmolol group (n=36) received 0.5mg/kg esmolol diluted to 10mL given IV over 60 seconds after induction.

Group D

Dexmedetomidine group (n=36) received 0.5mcg/kg dexmedetomidine in 50mLNS given IV over 10minutes before induction.



Results

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Table 1: Comparison of HR between study groups

HR (bpm)		Group D		Group E		Inter group p value from basal
		Mean	SD	Mean	SD	
	Preop	87.18	9.45	83.60	7.86	0.123
Intubation	0 Min	88.09	10.31	93.72	8.27	0.025
	1 Min	84.09	8.69	85.66	7.56	0.465
	2 Min	81.27	8.73	83.66	7.48	0.257
	3 Min	79.87	9.94	82.42	8.81	0.266
	4 Min	80.09	8.86	80.69	7.85	0.771
	5 Min	80.54	9.15	77.63	8.76	0.208
	6 Min	80.63	9.69	76.06	7.24	0.055
	7 Min	80.06	8.76	75.69	8.53	0.081
	8 Min	79.67	8.65	74.93	9.12	0.075
	9 Min	79.54	8.41	75.81	9.12	0.136
	10 Min	81.03	8.15	76.72	9.0	0.071

Note: p value* significant at 5% level of significance (p<0.05).
Note: 0 Min-at intubation.

Fig 1: Comparison of Mean HR

The mean HR in dexmedetomidine group was lower than esmolol group from intubation, till 10 minutes after intubation (p<0.05). This was significant statistically but not clinically (5bpm) only.

Table 2: Comparison of HR within study groups

		Group D		Intra group p value from basal	Group E		Intra group p value from basal
		Mean	SD		Mean	SD	
	Preop	87.18	9.45	-	83.60	7.86	-
Intubation	0 Min	88.09	10.31	0.55	93.72	8.27	<0.001
	1 Min	84.09	8.69	0.11	85.66	7.56	0.21
	2 Min	81.27	8.73	0.001	83.66	7.48	0.97
	3 Min	79.87	9.94	0.001	82.42	8.81	0.51
	4 Min	80.09	8.86	0.001	80.69	7.85	0.16
	5 Min	80.54	9.15	0.001	77.63	8.76	0.003
	6 Min	80.63	9.69	0.001	76.06	7.24	<0.001
	7 Min	80.06	8.76	0.001	75.69	8.53	<0.001
	8 Min	79.67	8.65	0.001	74.93	9.12	<0.001
	9 Min	79.54	8.41	0.001	75.81	9.12	<0.001
	10 Min	81.03	8.15	0.001	76.72	9.0	<0.001

Note: p value* significant at 5% level of significance (p<0.05)

HR within dexmedetomidine group did not show statistically significant increase at intubation and showed statistically significant decrease from 2nd minute to 10th minute after intubation.
HR within esmolol group showed statistically significant increase at intubation (max 10bpm) and showed

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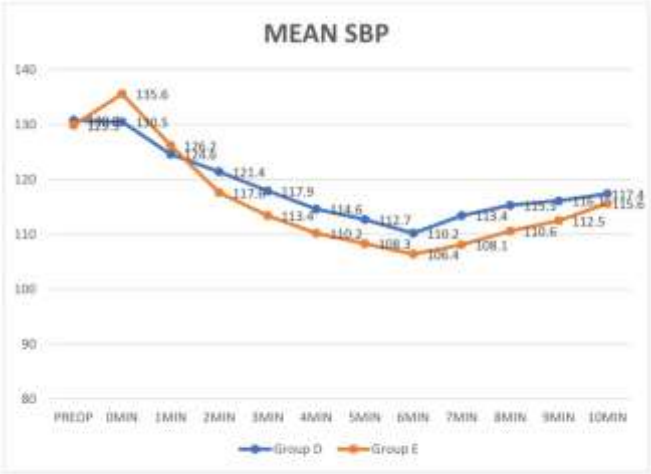
statistically significant decrease from 5th min till 10th min after intubation.

Table 3: Comparison of SBP between study groups

SBP (mmHg)		Group D		Group E		Inter-group p value from basal
		Mean	SD	Mean	SD	
	PREOP	130.8	8.58	129.9	12.07	0.699
Intubation	0 Min	130.5	8.47	135.6	12.29	0.099
	1 Min	124.6	9.72	126.2	13.80	0.628
	2 Min	121.4	9.04	117.6	14.42	0.214
	3 Min	117.9	10.50	113.4	12.24	0.141
	4 Min	114.6	11.46	110.2	14.92	0.312
	5 Min	112.7	13.17	108.3	14.12	0.052
	6 Min	110.2	13.57	106.4	12.20	0.150
	7 Min	113.4	14.51	108.1	12.62	0.098
	8 Min	115.3	13.51	110.6	12.56	0.057
	9 Min	116.1	13.42	112.5	14.46	0.485
	10 Min	117.4	12.16	115.6	13.98	0.655

SBP changes between the two groups were statistically insignificant at all points. Thus, mean SBP was attenuated in both groups comparably.



Note: 0 MIN– at intubation

Fig 2: Comparison of Mean SBP

Table 4: Comparison of SBP within study groups

		Group D		Intra group p value from basal	Group E		Intra group p value from basal
		Mean	SD		Mean	SD	
	PREOP	130.8	8.58	-	129.9	12.07	-
Intubation	0 Min	130.5	8.47	0.87	135.6	12.29	0.017*
	1 Min	124.6	9.72	0.005*	126.2	13.80	0.168
	2 Min	121.4	9.04	<0.001*	117.6	14.42	<0.001*
	3 Min	117.9	10.50	<0.001*	113.4	12.24	<0.001*
	4 Min	114.6	11.46	<0.001*	110.2	14.92	<0.001*
	5 Min	112.7	13.17	<0.001*	108.3	14.12	<0.001*
	6 Min	110.2	13.57	<0.001*	106.4	12.20	<0.001*
	7 Min	113.4	14.51	<0.001*	108.1	12.62	<0.001*
	8 Min	115.3	13.51	<0.001*	110.6	12.56	<0.001*
	9 Min	116.1	13.42	<0.001*	112.5	14.46	<0.001*
	10 Min	117.4	12.16	<0.001*	115.6	13.98	<0.001*

Note: p value* significant at 5%levelof significance (p<0.05)

SBP in dexmedetomidine group showed statistically significant decrease from 1st to 10th minute after intubation from baseline. SBP in esmolol group showed statistically significant increase from baseline at intubation which is clinically not significant (only 6% rise) and statistically significant decrease from 2nd to 10th minute after intubation from baseline. However, changes in SBP in both the groups were

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clinically insignificant.

Table 5: Comparison of DBP between study groups

		Group D		Group E		p value
		Mean	SD	Mean	SD	
	PREOP	86.78	8.13	82.60	10.83	0.051
Intubation	0 Min	86.67	9.69	91.39	11.24	0.07
	1 Min	84.06	9.78	82.78	11.93	0.633
	2 Min	79.12	8.73	75.75	11.29	0.15
	3 Min	75.87	10.22	71.54	10.43	0.089
	4 Min	74.87	11.82	69.27	11.72	0.053
	5 Min	74.09	12.43	67.66	11.61	0.055
	6 Min	72.72	14.92	66.60	11.03	0.08
	7 Min	73.78	13.93	68.18	10.47	0.09
	8 Min	75.48	13.26	70.63	10.43	0.07
	9 Min	75.69	12.97	71.75	11.41	0.14
	10 Min	76.24	11.26	72.97	12.62	0.25

DBP changes between the two groups were statistically insignificant at all points. Thus, attenuation of mean DBP was comparable between the groups.

0 MIN– at intubation

Fig 3: Comparison of Mean DBP

Table 6: Comparison of DBP within study groups

		Group D		Intra group p	Group E		Intra group p
		Mean	SD	value from basal	Mean	SD	value from basal
	PREOP	86.78	8.13	-	82.60	10.83	-
Intubation	0 Min	86.67	9.69	0.938	91.39	11.24	0.001*
	1 Min	84.06	9.78	0.122	82.78	11.93	0.931
	2 Min	79.12	8.73	<0.001*	75.75	11.29	0.005
	3 Min	75.87	10.22	<0.001*	71.54	10.43	0.001*
	4 Min	74.87	11.82	<0.001*	69.27	11.72	0.001*
	5 Min	74.09	12.43	<0.001*	67.66	11.61	0.001*
	6 Min	72.72	14.92	<0.001*	66.60	11.03	0.001*
	7 Min	73.78	13.93	<0.001*	68.18	10.47	0.001*
	8 Min	75.48	13.26	<0.001*	70.63	10.43	0.001*
	9 Min	75.69	12.97	<0.001*	71.75	11.41	0.001*
	10 Min	76.24	11.26	<0.001*	72.97	12.62	0.001*

Note: p value* significant.

DBP in dexmedetomidine group showed statistically significant decrease from 2nd to 10th minute after intubation from baseline. DBP in esmolol group showed statistically significant increase from baseline at intubation which is clinically non-significant (only 11% rise) and statistically significant decrease from 2nd to 10th minute post intubation. Thus, both the drugs were comparable in attenuating DBP response to intubation.

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Table 7: Comparison of MAP between study groups

		Group D		Group E		P value
		Mean	SD	Mean	SD	
	PREOP	98.81	8.10	97.66	12.48	0.595
Intubation	0 Min	99.90	8.14	105.87	11.30	0.103
	1 Min	97.36	9.13	96.30	10.05	0.694
	2 Min	92.84	7.90	87.72	11.43	0.409
	3 Min	89.42	11.09	85.00	11.64	0.376
	4 Min	87.15	13.68	82.09	10.58	0.218
	5 Min	86.78	12.75	80.75	12.40	0.057
	6 Min	85.39	13.32	80.09	12.08	0.108
	7 Min	85.81	14.47	81.36	11.70	0.174
	8 Min	88.31	13.45	83.90	10.67	0.312
	9 Min	88.75	13.61	85.66	10.36	0.686
	10 Min	89.57	12.44	87.03	12.67	0.880

Note: 0 Min-at intubation.

MAP changes between the dexmedetomidine and esmolol groups were statistically insignificant at all points. Thus, attenuation of mean MAP was comparable between the groups.

Fig 4: Comparison of Mean MAP

Table 8: Comparison of MAP within study groups

		Group D		Intragro up p	Group E		Intragroup p
		Mean	SD	value from basal	Mean	SD	value from basal
	PREOP	99.81	8.10	-	97.66	12.48	-
Intubation	0 Min	97.90	8.14	0.615	105.87	11.30	<0.019*
	1 Min	94.36	9.13	0.09	95.30	10.05	0.320
	2 Min	89.84	7.90	0.001*	87.72	11.43	0.001
	3 Min	87.42	11.09	<0.001*	85.00	11.64	0.001*
	4 Min	86.15	13.68	<0.001*	82.09	10.58	<0.001*
	5 Min	86.78	12.75	<0.001*	80.75	12.40	<0.001*
	6 Min	85.39	13.32	<0.001*	80.09	12.08	<0.001*
	7 Min	85.81	14.47	<0.001*	81.36	11.70	<0.001*
	8 Min	88.51	13.45	<0.001*	82..90	10.67	<0.001*
	9 Min	88.75	13.61	<0.001*	85.66	10.36	<0.001*
	10 Min	87.57	12.44	<0.001*	88..03	12.67	<0.001*

Note: p value* significant at 5% level of sgnificance (p<0.05)

MAP in dexmedetomidine group showed statistically significant decrease from 1st to 10th minute after intubation from baseline. MAP in esmolol group showed statistically significant increase from baseline at intubation which was clinically insignificant (only 8%) and statistically significant decrease from 2nd to 10th minute after intubation from baseline. However, changes in MAP in both the groups were clinically insignificant.

No significant side effects were observed during the study.

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Discussion

In our study, the mean HR in dexmedetomidine group was significantly lower (88.09±10.31 at intubation) than esmolol group (93.72±8.27 at intubation) from intubation, till 10 minutes after intubation (p<0.05). This was statistically significant but not clinically (just 5bpm only)

Changes in SBP, DBP and MAP between the two groups were statistically insignificant and comparable at all points. Thus, attenuation of mean SBP, DBP and MAP were comparable between the groups.

Vigneshwaran Chandramohan *et al*. [11] in 2022 did a comparative study between dexmedetomidine 0.75mcg/kg and esmolol 0.75mg/kg for attenuation of hemodynamic responses during laryngoscopy and endotracheal intubation. The study concluded that both drugs have statistically significant attenuation of HR, SBP, DBP and MAP to laryngoscopy and intubation without any adverse effects. Although the study drugs have favourable reduction in hemodynamic response, dexmedetomidine has better maintainance of hemodynamics following intubation.

In a study done by Anjali *et al*. [12] for a comparative evaluation of dexmedetomidine group (0.5mcg/kg) and esmolol group (1 mg/kg), the HR, SBP and DBP was significantly reduced in dexmedetomidine group compared to esmolol group. Both drugs had no side effects in the study.

In a study done by Srivastava *et al*. compared (Group C) 20 ml 0.9% normal saline, dexmedetomidine (Group D) 1mcg kg^{-1}, and group esmolol (Group E) 1.5 mg kg^{-1}. Their study concluded that dexmedetomidine 1mcg kg−1 was more efficacious than esmolol 1.5mg kg^{-1} for blunting hemodynamic stress response . [13]

Sandeep Sharma *et al*. [14] in their study concluded that SBP, DBP and MAP values were significantly lower in the dexmedetomidine group (1mcg/kg) at all-time intervals upto 10 minutes after intubation HR within dexmedetomodine group did not show statistically significant increase at intubation and showed stastistically significant decrease from 2nd minute to 10 minute after intubation.

HR within the esmolol group showed statistically significant increase at intubation (max 10bpm) and showed statistically significant decrease from 5th minute till 10th minute after intubation. Maximum increase in HR was at intubation (93.72±8.27), which returned to baseline, 2 minutes after intubation but however, it did not require any intervention.

SBP and DBP in dexmedetomidine group showed statistically significant decrease from 1st to 10th minute and 2nd to 10th after intubation from baseline respectively. MAP in dexmedetomidine group showed statistically significant decrease from 1st to 10th minute after intubation from baseline. However, changes in BP were clinically insignificant and dexmedetomidine effectively attenuated BP response in our study.

In our study, SBP, DBP and MAP in esmolol group showed statistically significant increase at intubation (0 min) and statistically significant decrease from 2ndto 10th minute after intubation from baseline. BP changes observed were not clinically significant and did not require any intervention and no patients had any adverse effects.

Thus, in our study, we found there was sustained suppression of hemodynamic response to laryngoscopy & intubation within dexmedetomidine group while there was an initial increase followed by decrease within the esmolol group.

Conclusion

We concluded that dexmedetomidine 0.5mcg/kg and esmolol 0.5mg/kg are comparable in attenuating the hemodynamic stress response to laryngoscopy and tracheal intubation without any adverse effects.

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