e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(5); 1902-1911

Original Research Article

A Comparison of Intravenous Infused Esmolol and Dexmedetomidine on Hemodynamic Response to Laryngoscopy and Endotracheal Intubation in Elective Laparoscopic Gynecological Surgery

Dharmpal Atal[1], Chandrashekhar Chatterjee[2], Rama Chatterjee[3], Shailaja[4], Kiran Bala[5], Pawan Kumar Bairwa[6], Renu Garg[7]

[1]3rd year PG Student, Department of Anaesthesia, SMS Medical College & Hospital, Jaipur

[2]Senior Professor, Department of Anaesthesia, SMS Medical College & Hospital, Jaipur

[3]Senior Professor, Department of Anaesthesia, SMS Medical College & Hospital, Jaipur

[4]3rd year PG Student, Department of Anaesthesia, SMS Medical College & Hospital, Jaipur

[5]3rd year PG Student, Department of Anaesthesia, SMS Medical College & Hospital, Jaipur

[6]3rd year PG Student, Department of Anaesthesia, SMS Medical College & Hospital, Jaipur

[7]3rd year PG Student, Department of Anaesthesia, SMS Medical College & Hospital, Jaipur

Received: 14-03-2023 / Revised: 30-03-2023 / Accepted: 30-04-2023

Corresponding author: Dr. Dharmpal Atal

Conflict of interest: Nil

Abstract

Background: Rigid laryngoscopy and tracheal intubation remain the gold standard in airway management despite the emergence of new airway devices. These procedures ensure airway patency, ventilation control, and effective delivery of inhalation agents. However, they can stimulate sympathetic and sympatho-adrenal activities, causing temporary effects such as increased heart rate, blood pressure, intra-cranial pressure, and intra-ocular pressure. Complications like cardiac arrhythmia, myocardial ischemia, myocardial infarction, and cerebral hemorrhage may arise due to elevated catecholamine levels. Arterial hypertension during laryngoscopy and intubation primarily stems from increased cardiac output rather than systemic vascular resistance.

Methods: Several drugs and techniques have been used to manage the hemodynamic response to laryngoscopy and intubation. These include deepening anesthesia, omitting cholinergic medications, pre-treatment with Nitro-glycerine and Isosorbide dinitrate, Propranolol, Droperidol, Lidocaine administration, Beta-blocker Esmolol, Clonidine, Dexmedetomidine, Calcium channel blockers, Gabapentin, and opioids like Fentanyl and Remifentanyl. The choice of technique or drug depends on surgery necessity, duration, anesthetic technique, route of administration, and patient's medical condition.

Results: Opiates reduce sympathetic response via vasodilation, vasomotor depression, and vagal center stimulation. Beta blockers effectively prevent heart rate elevation compared to blood pressure response. Esmolol, a short-acting β-1 adrenergic antagonist, ensures hemodynamic

stability during laryngoscopy and intubation. Dexmedetomidine, a selective α2-adrenergic receptor agonist, provides analgesic and sedative effects when administered intrathecally, epidurally, or intravenously. It reduces cardiovascular response to tracheal intubation and lessens the need for thiopentone induction and perioperative fentanyl.

Conclusion: This study aimed to compare the efficacy of Esmolol and Dexmedetomidine, belonging to different drug classes, in attenuating pressure response during laryngoscopy and endotracheal intubation for elective laparoscopic gynecological surgeries under general anesthesia.

Keywords: Airway management, laryngoscopy, tracheal intubation, sympathetic response, hemodynamic response, anesthesia, Esmolol, Dexmedetomidine, laparoscopic gynecological surgeries, pressure response.

CTRI Number: CTRI/2022/10/046140.

Introduction

Despite the emergence of new airway devices in recent year, rigid laryngoscopy and tracheal intubation still remain gold standard in airway management. It maintains the patency of airway, it controls the ventilation, and helps in delivering inhalation agent to the patient.

Direct laryngoscopy and tracheal intubation causes increase in sympathetic and sympathoadrenal activities to the mechanical stimulation of larynx and trachea. Increase in heart rate and blood pressure are the most common effects seen following laryngoscopy and intubation it also increase intra cranial pressure and intra ocular pressure because of significant increase in circulating catecholamine's. These effects are temporary but it may lead to cardiac arrhythmia, myocardial ischemia, myocardial infarction, and cerebral haemorrhage.[1-3] The arterial hypertension is due to increase in cardiac output rather than increase in SVR and associate with the transient rise in CVP (central venous pressure)[4]

Various drugs and techniques have been described to control the hemodynamic response to the laryngoscopy and intubation, such as deepening of anaesthesia, omitting cholinergic medications, pre-treatment with Nitro-glycerine and Isosorbide dinitrate (Elkayam et al)[5] Propranolol (McCammon et al)[6], Droperidol (Curren J et al)[7], administration of Lidocaine (Stoelting et al)[8], Beta blocker-Esmolol[9], Clonidine, Dexmedetomidine (Scheinin B et al)[10], Calcium channel blockers, Gabapentin, Opioids (Dahlgaren et al)[11] like Fentanyl and Remifentanyl can be used for its prevention. The technique or drug of choice depends upon the necessity and duration of surgery, choice of anaesthetic technique, route of administration, and medical condition of patient.

Opiates decrease sympathetic response to noxious stimulation by vasodilation, depression of vasomotor and stimulation of vagal centre.[12-14]

Beta blockers with negative chronotropic, antihypertensive, antiarrhythmic and anti-ischemic properties make these agents more effective in preventing rise in heart rate than pressure response and blunts the hemodynamic responses to tracheal intubation in treated hypertensive patients.

Esmolol is a potent ultra-short acting (half-life 9 min) cardio selective adrenoreceptor selective β-1 competitive antagonist. It also obtunds the cardiac response to exercise and other stimuli. Esmolol is short acting because of its esterase induced rapid metabolic inactivation. It can be an efficient agent to

provide hemodynamic stability during laryngoscopy and intubation.[15]

Dexmedetomidine is a selective Alpha$_2$-adrenoreceptor agonist with a α_2/α_1selectivity(alpha-2:alpha-1=1600:1). It has analgesic and sedative properties, when administered intrathecally, epidural or intravenously as an adjuvant.

It activates central alpha-2 adrenergic receptor and inhibits the release of norepinephrine from the adrenergic neurons, CNS and from postganglionic fibres of cardiac nerves and an increase of parasympathetic tone. This results in decrease in blood pressure, heart rate, cardiac output and peripheral venous resistance.[16]

dexmedetomidine can reduce the cardiovascular response to tracheal intubation and need of thiopentone for induction and perioperative fentanyl requirement.[17]

With above background the present study was designed to compare the efficacy of two different class of drugs Esmolol versus Dexmedetomidine for attenuation of pressure response (mean heart rate, mean systolic blood pressure, mean diastolic blood pressure, mean arterial pressure, mean rate pressure product) to laryngoscopy and endotracheal intubation in patient undergoing elective laparoscopic gynaecological surgeries under general anaesthesia.

Material and Method

This Hospital based, Randomized, double-blind, Superiority type of interventional study was conducted at the tertiary care center which is one of the largest tertiary care center of Northern India.

This study included all the Patients Undergoing laparoscopic gynecological surgery, aged 20-50 year of either gender with weighing of 40-70kg. Patients with anticipated difficult airway, chronic disease (like hypertension, diabetes, hepatic disease), patients on beta blockers, pregnant and lactating women also patients taking laryngoscopy time more than 20 seconds excluded from this study.

Sample size : A Sample of 30 cases in each group calculated at 95% confidence interval & 80% power to verify the expected difference of 14.6±1.92 in mean heart rate in two groups after 10 minutes of receiving Esmolol and Dexmedetomidine in patients undergoing elective gynaecological laparoscopic surgery.

A total of 60 eligible subjects were recruited consecutively till sample size was achieved. Subjects were randomly allocated into one of the following two groups using block randomization method to ensure the equal number of subjects in both group.

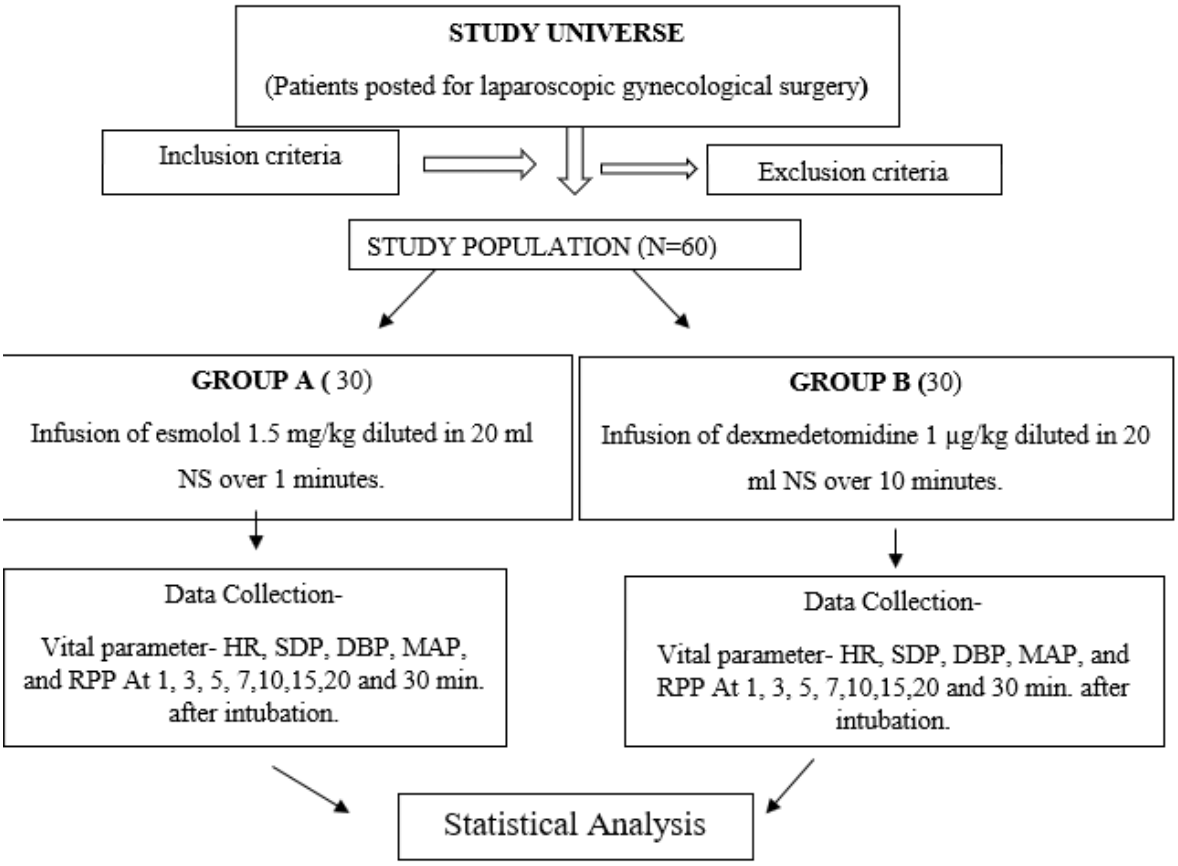
Group A- Patients received intravenous infusion of esmolol 1.5 mg/kg diluted in 20 ml NS over 1 minutes. Group B-Patients received intravenous infusion of dexmedetomidine 1 μg/kg diluted in 20 ml NS over 10 minutes.

Allocation concealment was ensured using opaque sealed envelope method for group allocation. Allocation was done by a person not involved directly in the research to avoid selection bias. Neither the anesthetist nor the patient was aware of the groups and the drugs used (Double blind).

Patients heart rate, systolic blood pressure (SBP) and diastolic blood pressure(DBP), mean arterial pressure(MAP), respiratory rate(RR), arterial oxygen saturation(SPO2), RPP, temperature were measured at 5 minute after starting infusion, after completion of infusion, after induction, , at 1 minute after intubation, at 3 minute after intubation, at 5 minute after intubation, at 10 minute after intubation, at 15 minute after intubation and at 30 minute after intubation.

All patients were subjected to standard Pre anesthetic checkup before the surgery including detailed history, examination, vitals, routine investigations and markers.

Consort flow chart of the study



Statistical analysis: Quantitative data were summarized as mean and standard deviation and analyzed using Student "t-test". Frequencies and percentage were analyzed using chi square test. A "p-value" <0.05 was taken as statistically significant. SPSS trial version 22 was used for statistical test.

Result

Both the groups were comparable in relation to their baseline characteristics like age, gender, ASA grade and type of surgery (Table 1)

Table 1: Age, gender, ASA grade, type of surgery wise distribution of patients.

		Group D	Group T	p-value
Age (M±S.D.)	In Years	31.226± 5.b	30.66 ± 4.77	0.450
Weight (M ±S.D.)	In kg	56.83 ± 5.34	58.88 ± 4.42	0.111
ASA	Grade I	30 (100%)	30 (100%)	<0.05
	>Grade I	0	0	
Type of surgery	Infertility	73.33%	70%	
	Aub	3.33%	0	
	Cervical Biopsy	3.33%	3.33%	

	Cervical Incompitance	6.67%	3.33%	
	Endometrial Cyst	3.33%	3.33%	
	Laparotomy	3.33%	0	
	Pid	3.33%	6.66%	
	Polyp	3.33%	3.33%	
	molar pregnancy	0	3.33%	
	LT Ovarian Cyst	0	3.33%	
	LT hydrosalpinx	0	3.33%	

Table 2: Comparison of heart rate in Group A and Group B

Heart Rate	Group A		Group B		Test of Significance		
	Mean	SD	Mean	SD	T Test Value	P Value	Significance
Base Line	90.87	6.998	91.03	6.935	-0.163	0.871	NS
5 Min After Infusion Start	90.37	6.82	89.27	6.41	1.229	0.236	NS
After Induction	86.43	4.202	82.20	4.55	3.75	<0.001	S
Just Before Intubation	84.47	4.51	79.50	5.01	4.038	<0.001	S
1 Min	83.20	5.9	78.93	4.89	3.56	<0.001	S
3 Min	83.77	4.493	78.27	5.14	4.14	<0.001	S
5 Min	80.10	4.444	74.67	5.1	4.39	<0.001	S
10 Min	75.70	4.450	72.47	5.46	2.512	0.015	S
15 Min	75.17	4.264	72.77	6.1	1.98	0.59	S
30 Min	76.13	5.1	73.13	4.15	2.49	0.015	S

Table 3: Comparison of SBP in Group A and Group B

SBP	Group A		Group B		Test of Significance		
	Mean	SD	Mean	SD	T Test Value	P Value	Significance
Base Line	132.10	11.621	128.20	3.727	1.750	0.085	NS
5 Min After Infusion	131.10	5.892	126.67	5.616	2.961	0.001	S
After Induction	127.73	7.277	110.27	6.2	10.05	<0.01	S
Just Before Intubation	123.93	7.995	105.5	5.9	10.54	<0.01	S
1 MIN	115.50	6.580	102.90	4.496	8.700	<0.01	S
3 MIN	112.07	6.674	102.83	5.1	7.456	0.000	S
5 MIN	118.03	6.950	101.07	4.112	12.45	0.000	S
10 MIN	113.53	7.305	100.27	6.944	7.253	0.000	S
15 MIN	111.60	8.548	99.67	5.061	6.652	0.000	S
30 MIN	107.07	7.714	101.77	6.924	2.808	0.007	S

Table 4: Comparison of DBP in Group A and Group B

DBP	Group A		Group B		Test of Significance		
	Mean	SD	Mean	SD	t-Value	p-value	Significance
Base Line	90.77	9.457	86.03	4.047	2.520	0.014	Ns
5 Min After Infusion	92.20	6.789	77.73	3.523	10.359	<0.001	S
After Infusion	84.40	5.893	74.00	3.063	8.577	<0.001	S
After Induction	80.43	4.651	72.00	3.040	-8.313	<0.001	S
Just Before Intubation	78.13	4.710	70.27	3.095	7.644	<0.001	S
1 Min	76.50	4.493	68.53	3.115	7.981	<0.001	S
3 Min	74.67	4.971	66.50	3.138	7.609	<0.001	S
5 Min	71.83	4.186	64.70	2.879	7.691	<0.001	S
7 Min	69.37	4.089	63.43	2.763	6.585	<0.001	S
10 Min	68.90	7.554	61.70	2.680	4.920	<0.001	S
15 Min	59.90	2.618	57.90	2.618	5.534	<0.001	S
20 Min	66.53	6.021	58.53	2.675	6.111	<0.001	S
30 Min	58.53	2.675	57.10	2.670	4.948	<0.001	S

Table 5: Comparison of MAP in GROUP A and GROUP B

MAP	Group A		Group B		Test of Significance		
	Mean	SD	Mean	SD	t test value	P value	Significance
Base line	105.54	5.4	104.09	5.46	1.123	0.266	NS
5 min after infusion	104.83	5.9	99.10	5.48	3.89	<0.001	S
After infusion	98.84	4.9	82.76	5.23	12.289	<0.001	S
After induction	96.20	4.5	81.42	4.89	12.182	<0.001	S
before intubation	93.40	6.1	79.77	5.01	9.458	<0.001	S
1 Min	91.83	6.2	78.66	6.944	7.776	<0.001	S
3 Min	89.47	5.46	76.94	5.06	9.219	<0.001	S
5 Min	87.23	5.48	76.82	4.64	7.941	<0.001	S
7 Min	84.66	5.23	75.63	6.92	5.702	<0.001	S
10 Min	83.78	4.89	74.22	6.94	6.168	<0.001	S
15 Min	81.56	5.01	73.16	5.01	6.494	<0.001	S
20 Min	79.00	6.10	72.79	4.66	4.431	<0.001	S
30 Min	77.36	5.65	71.99	6.94	3.287	0.007	S

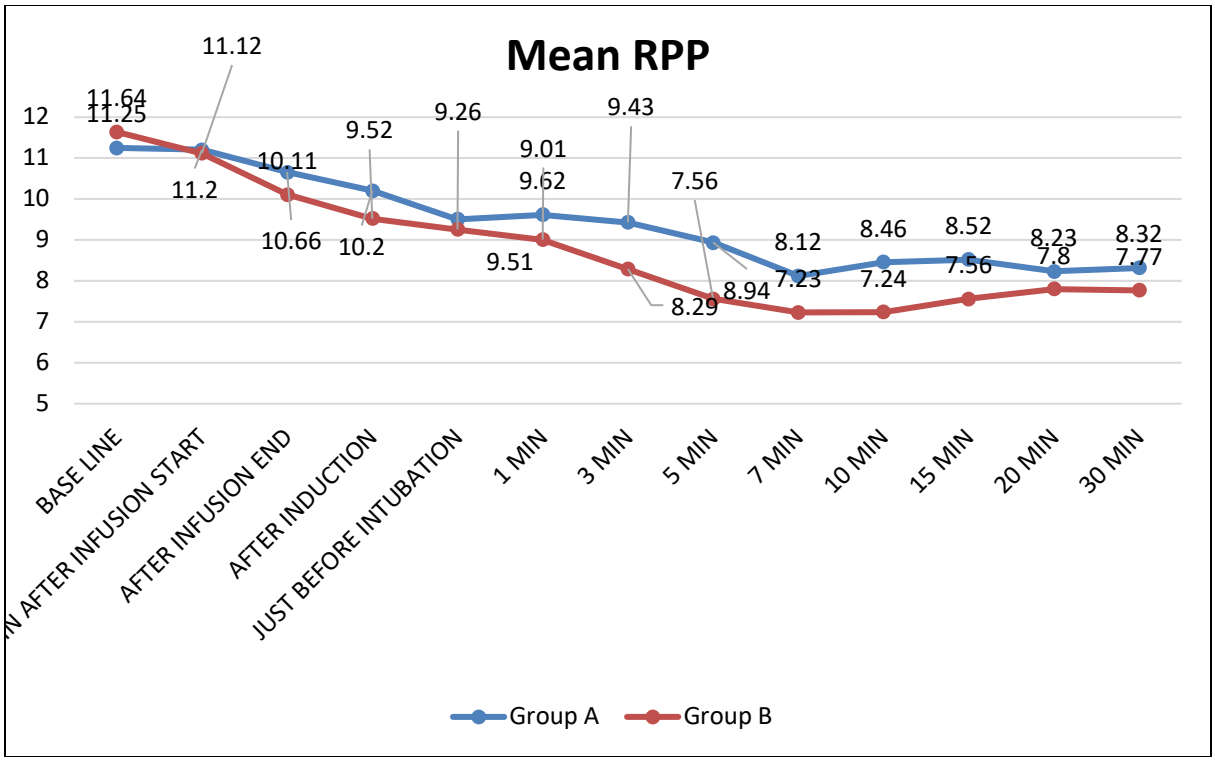


Figure 1: Comparison of RPP in Group A and Group B

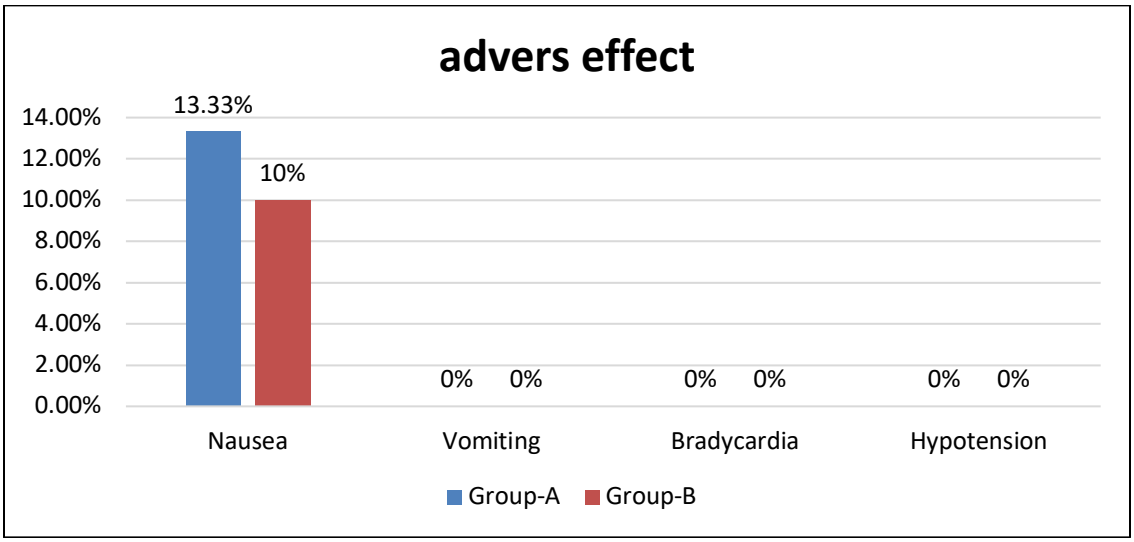


Figure 2: Adverse effects.

In reference to hemodynamic parameter Heart rate, SBP,DBP, MBP and RPP were seen significantly more downgrade (“p value<0.05) by Group B or in dexmedetomidine group as compare to Group A or Esmolol group at 5 minute after starting infusion, after completion of infusion, just before intubation, at 1 minute after intubation, at 3 minute after intubation, at 5 minute after intubation, at 10 minute after intubation, at 15 minute after intubation, at 30 minute after intubation.(table 2-5 and figure 1)

Only 13.3% patients in group A and 10% in group B reported nausea while none of the case shows side effect like vomiting, bradycardia, and hypotension. (Figure 2)

Discussion

Direct laryngoscopy and tracheal intubation causes increase in sympatho-adrenal activities due to the mechanical stimulation of larynx and trachea.

Various techniques and drugs have been described to control the hemodynamic response to the laryngoscopy and intubation in order to prevent any rise in myocardial work load and oxygen demand as well as to preserve the perfusion of vital organs.

The present study was undertaken to compare the efficacy and safety profile of these two different classes of drug.

In our study the demographic data and type of surgery were comparable in both the groups thus alleviating confounding factor.

In this study Heart rate, SBP, DBP, MBP and RPP were seen significantly lower ("p value<0.05) in the Group B or in dexmedetomidine group as compare to Group A or Esmolol group at different time interval.

Reddy *et al* (2014)[18] studied consented 90 adult. Group E received 2.0 mg/kg of esmolol and Group D received 1.0 µg/kg of dexmedetomidine, intravenously over 10 min and 3 min before induction of general anesthesia.

Both the drugs attenuated the pressure response. Of the two drugs administered, dexmedetomidine provided a consistent, reliable and effective attenuation of haemodynamic pressure when compared to esmolol (P value .001).

Shrivastav *et al* (2015) also compared dexmedetomidine (group D) 1 µg/kg and esmolol (group E) 1.5 mg/kg and found that dexmedetomidine is more effective than esmolol for attenuating heart rate, SBP, DBP and MBP response to laryngoscopy and intubation in elective neurosurgical patients. (P value 0.001). Selvaraj V *et al* (2016)[19] also observed the similar result with esmolol and dexmedetomidine on patients.

Similarily Gupta HB *et al* (2016)[20] and Sharma *et al* (2018) concluded that the SBP, DBP and MBP at 1 min, 3 min, 5min and 10 min after intubation was significantly lower in the dexmedetomidine group as compared to the esmolol group.

We observed, only 13.3% patients in group A and 10% in group B reported nausea while none of the case shows side effect like vomiting, bradycardia, and hypotension.

our study supported by Gupta HB *et al*[20] and T shering *et al* conclude that effect of dexmedetomidine on attenuation of pressor response to laryngoscopy and intubation is more pronounced than esmolol. The effectiveness of dexmedetomidine over esmolol makes it a useful drug for attenuation of hemodynamic response to laryngoscopy and intubation as a routine.

Conclusion

The dexmedetomidine infusion(1mcg/kg) was better than esmolol infusion (1.5mg/kg) in blunting the intubation response with better hemodynamic stability. There was no statistical significant difference of nausea in both the groups. None of the participants had experienced vomiting, hypotension& bradycardia. So the dexmedetomidine infusion was better than esmolol infusion.

References

1. Reid LC, Brace DE. Irritation of the respiratory tract and its reflex effect upon heart. Surg Gynaec & Obst. 1940;70;157-62.

2. Chraemmer-Jørgensen B, Hertel S, Strøm J, Høilund-Carlsen PF, Bjerre-Jepsen K. Catecholamine response to laryngoscopy and intubation. The influence of three different drug combinations commonly used for induction of anaesthesia. Anaesthesia. 1992; 47:750-6.
3. King BD, Harris LC, Greifenstein FE, Elder JD et al: Reflex circulatory response to direct laryngoscopy and tracheal intubation performed during anaesthesia. Anaesthesiology. 1951; 12: 556-66.
4. Wycoff, C.C. Endotracheal intubation: effects on blood pressure and pulse rate. Anaesthesiology. 1960,2,153-158.
5. Elkayam, Uri and Wilbert S Aronow: Glyceryl trinitrate ointment and isosorbide dinitrate: review of their pharmacological properties and therapeutic use. Drugs. 1982; 23:165.
6. Mc Cammon RL, Hilgenberg JC and Stoelting RK: Effect of propranolol on circulatory responses to induction of diazepam- nitrous oxide anaesthesia and to endotracheal intubation. Anaesth. analg. 1981 aug;60(8):579-83
7. Curren J, Crowley M and Sullivan GO: Droperidol and endotracheal intubation: attenuation of pressure response to laryngoscopy and intubation. Anaesthesia,1980;35:290-294.
8. Stoelting, R.K. Peterson C.: Circulatory changes during direct laryngoscopy and tracheal intubation: Influence of duration of laryngoscopy with or without prior lidocaine. Anaesthesiology. 1977; 47:381.
9. Miller DR, Martinaeu RJ. Esmolol for control of haemodynamic responses during anaesthetic induction. Can J Anaesth. 1989;36: S164 5
10. Scheinin B, Lindgren L, Randell T, Scheinin H, Scheinin M. Dexmedetomidine attenuates sympathoadrenal responses to tracheal intubation and reduces the need for thiopentone and perioperative fentanyl. Br J Anaesth. 1992; 68:126 31.
11. Dahlgren N and Messeter K: Treatment of stress response to laryngoscopy and intubation and intubation with fentanyl. Anaesthesia. 1981: nov;36(11):1022-6.
12. Laubie M, Schmitt H et al: Centrally mediated bradycardia and hypotension induced by narcotic analgesics: Dextromoramide and fentanyl. Europian J of pharma. 1974;28(1):66-75.
13. Kautto. U.M.; Attenuation of circulatory response to laryngoscopy and intubation by fentanyl. Acta anaesthesia Scandinavica. 1982;217-21.
14. Black, T.E. Kay B, Healy et al: Reducing the haemodynamic responses to laryngoscopy and intubation. A comparison of alfentanyl with fentanyl. Anaesthesia. 184; 39:883.
15. Sheppards S et al. A bolus dose of Esmolol attenuates tachycardia and hypertension after tracheal intubation: Br. J. Anaesth. 1992 May; 68(5) 529-30.
16. Yavascaoglu B, Kaya FN, Baykara M, Bozkurt M, Korkmaz S. A comparison of esmolol and dexmedetomidine for attenuation of intraocular pressure and haemodynamic responses to laryngoscopy and tracheal intubation. Eur J Anaesthesiol. 2008; 25:517-9.
17. Bajwa SJ, Kaur J, Singh A, Parmar S, Singh G, Kulshrestha A, et al: Attenuation of pressor response and dose sparing of opioids and anaesthetics with pre-operative dexmedetomidine; Indian J Anaesth. 2012; 56:123-8.
18. Reddy SV, Balaji D, Ahmed SN. Dexmedetomidine versus esmolol to attenuate the hemodynamic response to laryngoscopy and tracheal intubation: A randomized double-blind clinical study. Int J Appl Basic Med Res. 2014; 4:95-100

19. Selvaraj V, Manoharan KR. Prospective randomized study to compare between intravenous dexmedetomidine and esmolol for attenuation of hemodynamic response to endotracheal intubation. Anesth Essays Res. 2016; 10:343 8.

20. Gupta HB, Vyas S. A comparative study of efficacy of intravenous dexmedetomidine and intravenous esmolol for attenuation of stress response during laryngoscopy and endotracheal intubation. Int J Basic Clin Pharmacol. 2016; 5:1803 8.