Original Research Article

A comparative study of Dexmedetomidine versus Fentanyl for attenuation of hemodynamic response to laryngoscopy and endotracheal intubation

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Abstract

Background: Laryngoscopy and tracheal intubation lead to tachycardia and hypertension due to increase in the plasma concentration of catecholamines subsequent to sympathetic stimulation. Present study was aimed to compare dexmedetomidine versus fentanyl for attenuation of hemodynamic response to laryngoscopy and endotracheal intubation. **Material and Methods:** Present study was a single-centre, prospective, randomized, double blind controlled comparative study conducted in patients of age group 18-60 years, either sex, belonging to ASA status I/II, MPG I/II, posted for elective surgery under GA, willing to participate in study. In operation theatre, 60 patients were randomly divided into two groups as Group D (intravenous dexmedetomidine - 1 µg/kg) and group F (intravenous fentanyl 2 µg/kg). **Results:** In present study, general characteristics such as age (years), Sex (M/F), Weight(kg), ASA (I/II) and Surgeries were comparable in both groups, difference was not statistically significant ($p>0.05$). In group D significant reduction in pulse rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure as compared to fentanyl group and difference was statistically significant. **Conclusion:** Dexmedetomidine is more effective in attenuation of hemodynamics without compromising patient safety and recovery from anaesthesia.

Keywords: laryngoscopy, endotracheal intubation, dexmedetomidine, fentanyl, hemodynamic response

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INTRODUCTION

Laryngoscopy and tracheal intubation lead to tachycardia and hypertension due to increase in the plasma concentration of catecholamines subsequent to sympathetic stimulation. The elevation in arterial pressure generally peaks in 1-2 minutes and returns to normal levels within five minutes.[1] The laryngoscopic response in these patients can increase myocardial oxygen demand and may lead to complications in susceptible individuals.[2] Various prophylactic interventions have been tried to blunt this stress response; administration of local anesthetics, opioids, beta blockers, alpha 2 adrenergic agonists, vasodilators, magnesium, or increased concentrations of volatile anesthetic.[3,4] Dexmedetomidine is highly selective, short-acting central alpha 2 agonist. It reduces sympathetic responses to airway instrumentation thereby minimizing changes in blood pressure and heart rate during laryngoscopy and intubation. After a bolus of 1µg/kg, a biphasic response is seen. Activation of alpha 2 receptors by dexmedetomidine leads to dose dependent sedation,

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anxiolysis, analgesia and decrease in plasma catecholamine concentration.[4] Fentanyl is a synthetic pure μ-receptor agonist with shorter time to peak analgesic effect, larger safety margin, minimal respiratory depression at analgesic doses and rapid termination of effect after small bolus doses, and relative cardiovascular stability.[5] Present study was aimed to compare dexmedetomidine versus fentanyl for attenuation of hemodynamic response to laryngoscopy and endotracheal intubation.

MATERIAL AND METHODS

Present study was prospective, comparative, clinical study conducted in department of anaesthesiology, at Bharati Vidyapeeth Medical College and Hospital, Sangli, Maharashtra, India. Study duration was of 2years (November 2014 to October 2016) Study was approved by institutional ethical committee.

Inclusion criteria:

Patients of age group 18-60 years, either sex, belonging to ASA status I/II, MPG I/II, posted for elective surgery under GA, willing to participate in study.

Exclusion criteria

ASA grade III, IV and V. Age More than 60 years. Pregnancy, morbid obesity, full stomach and emergency surgery. Patients with a history of Diabetes Mellitus, Hypertension, Cerebrovascular disease, Ischemic heart disease, Arrhythmias, Shock, and Chronic obstructive pulmonary disease (COPD). Patients with difficult airway, patients requiring laryngoscopy for a duration > 30 seconds or requiring multiple attempts.

Written informed consent of the patient has been taken after explaining the anaesthesia technique. Patients under the study have undergone through pre-anaesthetic evaluation including detailed history, clinical examination and necessary investigations depending on age, sex, and disease of the patient. Pre-operative and patients were kept nil per oral for 6 hours before surgery. All patients received oral T.Alprazolam 0.5 mg the night before surgery.

In operation theater, 60 patients were randomly divided into two groups.

Group D – received intravenous dexmedetomidine (1 μg/kg) diluted in 10 ml NS.

Group F – received intravenous fentanyl (2 μg/kg) diluted in 10 ml normal saline.

In operation theater, heart rate, ECG, oxygen saturation and non-invasive blood pressure monitors were instituted. Baseline hemodynamic parameters were recorded. An intravenous access was established and ringer's lactate 10ml/kg/hr infusion was started before infusing any medication. Inj. Glycopyrrolate 0.004 mg/kg was given intravenously 15 minutes before IV premedication. Group D received Dexmedetomidine 1 μg/kg diluted in 10 ml normal saline and given slowly IV over 10 min. Group F received Fentanyl 2 μg/kg diluted in 10 ml normal saline and given slowly IV over 10 min. Vitals (HR, SBP, DBP, MAP and SpO_2) were monitored during the infusion of the study drugs. Premedication with Inj. Ondansetron 0.1mg/kg IV, Inj. Midazolam 0.02 mg/kg IV given 3 min before induction. All patients were pre-oxygenated with 100% oxygen for 5 minutes prior to induction. Patients were induced with Inj. Propofol 2 mg/kg IV over 30 seconds and loss of eyelash reflex checked. Inj. Succinylcholine 2mg/kg IV was given for relaxation. Patients were intubated with appropriate size cuffed endotracheal tube. Anaesthesia was maintained on 0_2(50%), N_2O(50%) and Isoflurane (0.5-1%) surgical stimulation was not allowed for 10 minutes after intubation.

Any intraoperative complications such as hypotension, bradycardia, Airway obstruction, Regurgitation and Laryngospasm or postoperative complications such as delayed recovery, Hoarseness of voice and sore throat, hypotension, bradycardia if occurred were noted. After surgery, neuromuscular block was antagonized with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg). and extubated after deflating the cuff when the patient regained consciousness and protective airway reflexes. Intraoperatively, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), MAP, SpO2, and ECG were recorded at the following intervals: at baseline, after drug administration, before induction, after induction, during and after laryngoscopy (1, 3, 5 and 10 min). Patients were observed postoperatively for 24 h for any complications.

All the above recorded observations were compared statistically and the results were analysed and concluded. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) were calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.05 was considered as statistically significant.

RESULTS

In the present study, general characteristics such as age (years), Sex (M/F), Weight(kg), ASA (I/II) and Surgeries were comparable in both groups, difference was not statistically significant (p>0.05).

Table 1: General Characteristics

Characteristics	Group D	Group F	P-value
Age (years)	36.16 ± 9.86	33.83 ± 10.22	0.78
Sex (M/F)	14/16	13/17	0.37
Weight(kg)	53.2 ± 6.82	54.5 ± 6.63	0.33
ASA (I/II)	24/6	26/4	0.63

Table 2: Pulse rate comparison

Time	Group D (Mean ±SD)	Group F (Mean ±SD)	P value
Baseline	87.3 ± 8.9	81.8 ± 9.9	0.409
After study drug	87.1 ± 7.9	81.6 ± 8.0	0.023
Before induction	79.1 ± 7.9	83.6 ± 8.0	0.009
At induction	73.2 ± 6.5	87.1 ± 8.1	0.013
At intubation	74.3 ± 6.6	90.2 ± 8.9	0.021
1 min after intubation	72.3 ± 6.1	86.6 ± 8.5	0.022
3 min. after intubation	71.6 ± 6.9	87.6 ± 8.8	0.031
5min after intubation	70.9 ± 6.8	87.3 ± 8.1	0.013
10 min after intubation	73.4 ± 4.9	87.1 ± 9.1	0.019

We measured mean pulse rates in both groups at baseline, after study drug, before induction, at induction, at intubation, 1 min, 3 min, 5 min, 10 min after intubation. In group D significant reduction in pulse rate compare to fentanyl group. Also pulse rate compared to base line is significantly reduced in dexmedetomidine group.

Table 3: Comparison of changes in systolic blood pressure (SBP)

Time	Group D (Mean ±SD)	Group F (Mean ±SD)	P value
Baseline	122.3 ± 11.11	121.6 ± 8.6	0.59
After study drug	114.1 ± 10.30	129.4 ± 8.4	0.031
Before induction	112.6 ± 9.7	130.2 ± 8.2	0.024
At induction	133.5 ± 6.9	140.3 ± 1.8	0.004
At intubation	111.6 ± 9.9	130.2 ± 8.2	0.005
1 min after intubation	109.2 ± 8.5	130.53 ± 6.4	0.001
3 min. after intubation	108.6 ± 8.6	130.5 ± 7.8	0.023
5min after intubation	109.2 ± 5.1	128.6 ± 8.0	0.009
10 min after intubation	111.6 ± 9.9	130.2 ± 8.2	0.013

In the present study, systolic blood pressure values at baseline, after study drug, before induction, at induction, at intubation, 1 min, 3 min, 5 min, 10 min after intubation were stable in dexmedetomidine group as compared to fentanyl group. Also at intubation dexmedetomidine group had significant reduction in systolic blood pressure compared to fentanyl group. Also changes in systolic blood pressure compared to base line was significantly reduced in dexmedetomidine group.

Table 4: Comparison of changes in diastolic blood pressure (DBP)

Time	Group D (Mean ±SD)	Group F (Mean ±SD)	P value
Baseline	78.6 ± 6.5	75.6 ± 5.6	0.54
After study drug	73.8 ± 6.5	80.6 ± 6.5	0.014
Before induction	71.2 ± 6.6	82.8 ± 6.7	0.021
At induction	73.3 ± 4.1	86.3 ± 5.8	0.022
At intubation	71.2 ± 5.7	83.4 ± 1.6	0.031
1 min after intubation	70.6 ± 6. 7	83.6 ± 5.1	0.013
3 min. after intubation	69.6 ± 5.7	84.7 ± 4.3	0.019
5min after intubation	70.22 ± 4.52	84.37 ± 3.36	0.011
10 min after intubation	73.33 ± 4.61	83.33 ± 1.306	0.003

We noted a statistically significant reduction in diastolic blood pressure in dexmedetomidine group as compared to fentanyl group. Also, Diastolic blood pressure compared to base line was significantly reduced in dexmedetomidine group.

Table 5: Comparison of changes in mean arterial pressure (MAP)

Time	Group D (Mean ±SD)	Group F (Mean ±SD)	P value
Baseline	92.9 ± 7.7	90.5 ± 5.6	0.549
After study drug	88.3 ± 7.8	95.3 ± 6.4	0.013
Before induction	88.6 ± 7.4	96 ± 6.3	0.001
At induction	89.4 ± 5.5	101.6 ± 6.2	0.021
At intubation	85.3 ± 7.7	98.3 ± 7	0.003
1 min after intubation	85.3 ± 7.8	98.5 ± 5.8	0.001
3 min. after intubation	83.6 ± 7.1	98.5 ± 5.2	0.004
5min after intubation	82.5 ± 6.6	99.6 ± 4.5	0.001
10 min after intubation	85.3 ± 7.4	90.3 ± 5.6	0.003

In present study, no intraoperative complications such as hypotension, bradycardia, airway obstruction, regurgitation and laryngospasm or postoperative complications such as delayed recovery, hoarseness of voice and sore throat, hypotension, bradycardia were noted.

DISCUSSION

Several techniques have been tried in an effort to attenuate adverse hemodynamic responses to intubation. Commonly used techniques include increasing the depth of anesthesia by heavy premedication, potent narcotics such as fentanyl, and inhalation anesthetic agents. Others include intravenous (IV) and topical lignocaine, clonidine, calcium channel blockers, sodium nitroprusside, beta-adrenergic blockers, and magnesium sulfate.[6,7] Laryngoscopy and tracheal intubation are known to increase sympathetic activity that may be detrimental to patients with pre-existing ischemic or hypertensive heart diseases. In patients with cardiovascular or cerebral disease, there is increased risk of morbidity and mortality from the tachycardia and hypertension resulting from this stress. The modalities tried to attenuate this pressure response has targeted both the afferent (smooth and swift laryngoscopy, deeper plane of anaesthesia, increased MAC for volatile inhalational agents, topical lignocaine spray and intravenous opioids) as well as efferent limb (anti-hypertensives, β-blockers, calcium channel blockers, vasodilators and adrenergic blockers).[8] In study by Aditya P. M *et al.*,[9] difference in heart rate and mean arterial pressure of patients in two groups after laryngoscopy and intubation was not statistically significant at any point of time. The hemodynamic changes did not require any intervention in the form of administration of rescue medication. Dexmedetomidine 0.5 µg/kg is as effective as fentanyl 2 µg/kg in attenuating the hemodynamic response accompanying laryngoscopy and tracheal intubation. In study by Das B *et al.*,[10] increase in heart rate after laryngoscopy and intubation was significantly lower in Group D compared to Group F (P=0.039). Mean heart rate remained lower at one minute after intubation in Group D but it was not statistically significant (94.64 s vs 86.28 sec). Mean sedation score is higher in Group D compared to Group F. At 1 µg/kg dose, both dexmedetomidine and fentanyl cause partial attenuation of sympathetic response to laryngoscopy and intubation but dexmedetomidine blunts this response more effectively than fentanyl. Gunalan *et al.*, [11] in their study of comparative evaluation of bolus administration of dexmedetomidine and fentanyl for stress attenuation during laryngoscopy and endotracheal intubation have concluded that dexmedetomidine (1 mcg/kg) given prior to intubation provided protection against the pressor response during laryngoscopy and intubation when compared to fentanyl. Ozair *et al.*,[12] and Jain *et al.*,[13] in their studies of comparison of dexmedetomidine and fentanyl found the use of dexmedetomidine in the dose of 1 mcg/kg to be effective in controlling the pressor response to intubation without significant side effects. Similar findings were noted in present study. Dexmedetomidine resulted in progressive increases in sedation, blunted the hemodynamic responses during laryngoscopy, and reduced opioid and anaesthetic requirements. Furthermore, Dexmedetomidine decreased blood pressure and heart rate as well as the recovery time after the operation.[14,15]

Limitations of present study were, small sample size, observational bias and low risk (ASA I/II) population was studied. The levels of catecholamines were not measured which would have shown more accurate attenuation.

CONCLUSION

Heart rate and blood pressure following laryngoscopy and endotracheal intubation were more stable with dexmedetomidine as compared to fentanyl. Thus dexmedetomidine is more effective in attenuation of hemodynamics without compromising patient safety and recovery from anaesthesia.

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