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Effect of a Single Pre-Operative Dose of Dexmedotomidine Versus Fentanyl on Anesthetic Requirement and Peri-Operative Hemodynamic Stress Response

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ABSTRACT

Background: Dexmedetomidine has sympatholytic, ant nociceptive, sedative, and anti-sialagogue properties without causing respiratory depression. Dexmedetomidine is the active d-isomer of medetomidine, that is a selective and specific α2-adrenoceptor agonist. It acts by the central sympatholytic action. So it provides haemodynamic stability. It has both analgesic as well as anaesthetic sparing property. Dexmedetomidine is also an effective sedative. **Methods:** Study Population:- Two groups were included in this study.49 cases were included in group II & 50 cases were included in group II.The duration of study was over a period of 6 month.This study was conducted in the Department of Anesthesia in Carrier Institute of Medical Sciences, Lucknow. **Results:** This result revealed that adverse effect of bradycardia was seen only in one patient. None of the patients was sedated after discontinuation of anesthesia. **Conclusion:** This study concludes that, during laryngoscopy and in the perioperative period, a single pre-operative dose of Dexmedetomidine provides better hemodynamic stability in comparison to Fentanyl by attenuation of sympathoadrenal response.

Keywords: Dexmedetomidine, Pre-Operative Dose, Bradycardia.

INTRODUCTION

Dexmedetomidine is the active d-isomer of medetomidine, that is a selective and specific α2-adrenoceptor agonist.[1] It acts by the central sympatholytic action. So it provides haemodynamic stability. It has both analgesic as well as anaesthetic sparing property.[2] Dexmedetomidine is also an effective sedative.[3,4]

During laparoscopy, endotracheal intubation and time of extubation are the most critical events which aggravate transient, but marked sympatho-adrenal response such as tachycardia and hypertension. Similarly, at the time of surgery carbon dioxide (CO2) used for creating pneumoperitoneum, causes spikes in plasma levels of catecholamine and vasopressin. Due to this intra-abdominal pressure rises and leads to side effects on the CVS like low cardiac output, rise in arterial pressure and increase systemic and pulmonary vascular resistance.[4]

It is always a challenge for anesthesiologists to manage hypertensive patients. The progressive ventricular hypertrophy, which is occurring in hypertensive patients, leads to diastolic dysfunction. This diastolic dysfunction gets worse whenever there is tachycardia in the perioperative period. It may lead to myocardial infarction that causes morbidity and even mortality. A severe hemodynamic response to laryngoscopy and intubation can be observed in poorly controlled hypertensive patients in comparison to well-controlled hypertensive patients.[5]

Several pharmacological agents such as opioids, beta blockers, calcium channel blockers, combined alpha and beta blockers, lignocaine, and alpha-2 receptor agonists have been used to maintain stable hemodynamics in the perioperative period. Fentanyl is a common choice for control of hemodynamics in the perioperative period. Though, it has some side effects like respiratory depression and increased incidence of postoperative nausea and vomiting (PONV).[6,7] Dexmedetomidine has sympatholytic, ant nociceptive, sedative, and anti-sialagogue properties without causing respiratory depression.[8-11]

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MATERIALS AND METHODS

Study Population

Two groups were included in this study.49 cases were included in group II & 50 cases were included in group II.

Study duration
The duration of study was over a period of 6 month.

Study Area
This study was conducted in the Department of Anesthesia in Carrier Institute of Medical Sciences, Lucknow.

Data collection
After approval by institutional ethical committee and taking written informed consent, 99 patients of either sex, between age Group of 18 – 60 years, ASA Grade I and Grade II, scheduled for surgery under general anesthesia were randomly selected and included in this study. Thourough preoperative examination, basic laboratory investigations like complete haemogram, blood sugar, renal function test, ECG and CHEST X-RAY were carried out. All patients were confirmed for nil by mouth status and were premedicated with injection Glycopyrrolate 5-10 µg/kg i.m. 30 minutes before induction of anesthesia. Pre-operative vitals and BISvalues were noted in the operation room before giving the study drug and considered as baseline. Patients were randomly divided into 2 Groups.Group1- Received Inj. Dexmedetomidine 1 µg/Kg 10 and Group 2- Received Inj. Fentanyl 2 µg/kg 10 minutes before induction.

In both the Groups general anesthesia was administered after preoxygenation for 3 minutes with Inj. Sodium Thiopentone (2.5%) 4- 6 mg/kg to produce loss of eyelash reflex followed by Inj. Succinylcholine 1.5-2 mg/kg. Patients were ventilated with 100% O 2 and on achieving complete relaxation intubation was done with appropriate sized cuff portex endotracheal tube. Anesthesia was maintained in both the Groups with O (66%), N O (33%), Isoflurane, 2 2 Inj. Vecuronium 0.1 mg/kg as initial dose and 0.02 mg/kg as maintenance dose, and ventilation was continued with IPPV (intermittent positive pressure ventilation). Pulse, blood pressure Spo and BIS value were recorded before 2 induction, during laryngoscopy, every 1 minute upto 5 minutes after intubation and then every 10 minutes till extubation.Volatile anesthetics were titrated to maintain BIS value between 40-60, ideal for surgical plane of anesthesia.Patients were reversed with injection Glycopyrrolate (0.008mg/kg) and injection Neostigmine (0.05mg/kg) intravenously at the end of the surgery. Duration of surgery, duration of anesthesia, total dosage of Vecuronium (mg) was recorded. Total dosage of Isoflurane (ml/hr) was measured by using EHRENWORTH AND EISENKRAFT formula. (3 x FGF x Volume %) Post-operative vitals, Ramsay sedation score and Visual Aaxnalouge Score for pain were recorded. Patients were observed for adverse effects like nausea, vomiting, bradycardia, and hypotension.

Data analysis
Data were analysed by using Microsoft excel & Statistics.

RESULTS

In this study we were included 99 total number of population. All the cases were divided in two groups. Group I contains 50.5% population & 49.5% cases were included in group II. In this study 18-60 years age group were included, which showed in [Table 2]. Among all cases we found that, 34% male in group I & 66% were female. While In group II 67.3% were female & 32% male. The duration of surgery & Volume (ml/hr) of Isoflurane usage were showing in [Table 5 & 6]. This result revealed that adverse effect of bradycardia was seen only in one patient. None of the patients was sedated after discontinuation of anesthesia.

Table 1: Distribution of cases according to groups

Groups	Total no. of cases	Percentage
Group I	50	50.5%
Group II	49	49.5%
Total	99	100%

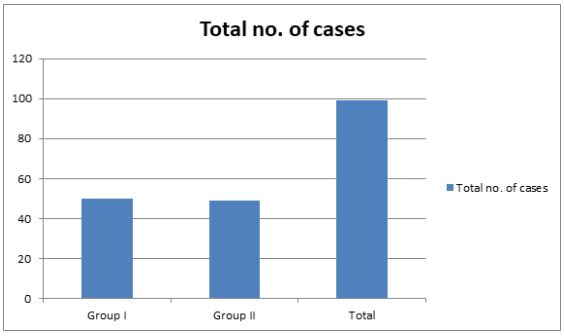

Figure 1: This chart showing Distribution of cases according to groups

Table 2: Distribution of cases according to Age & weight

	Group I	Group II	P value
Age	33.18±9.8	36.84±11.38	
Weight	58.4±7.63	54.69±8.8	>0.05

Table 3: Distribution of cases according to gender

Groups	Male	Female	Total
Group I	17(34%)	33(66%)	50
Group II	16(32%)	33(67.3%)	49

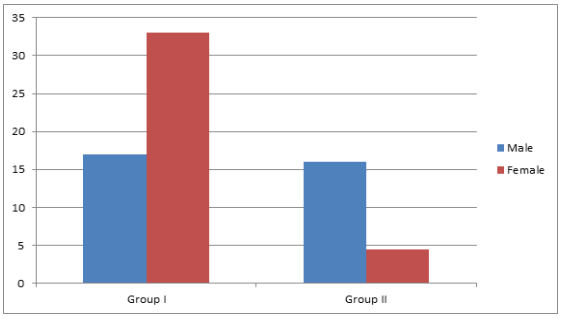

Figure 2: This chart showing Distribution of cases according to gender

Table 4: Distribution of cases according to duration of surgery

Duration of surgery	Group I	Group II	P value
Mean	109	101.63	>0.05
SD	20.4	21.3	

Table 5: Distribution of cases according to Volume (ml/hr) of Isoflurane usage

Groups	MEAN±SD	P value
Group I	7.41±1.34	>0.05
Group II	14.25±2.43	

Table 6: Distribution of cases according to adverse effect

Adverse effect	No. of patient	
	Group I	Group II
Nausea/Vomiting	0	0
Shivering	0	0
Hypotension	0	0
Bradycardia	1	0

DISCUSSION

In modern anesthesia practice, it is very essential to know the series of physiological changes (stress response), that occur during and after laryngoscopy. Under anesthesia stress response has been universally recognized phenomenon (J. Zargar et al, 2002). Stress response is accompanied by an increased stimulation of sympathetic efferent tracks, resulting in adrenergic response. It leads to release of catecholamines in the circulation, that can cause severe hypertension, tachycardia, cardiac arrhythmias, myocardial ischemia, left ventricular dysfunction and rupture of cerebral aneurysm in susceptible individuals.[1] Direct laryngoscopy and intubation are toxic stimuli. It can provoke stress response in the cardiovascular, respiratory and other physiological system. The magnitude of the response is greater with increasing force and duration of laryngoscopy. After intubation, the response reaches its maximum level within 1 min and ends in 5-10 min.[13] To prevent rise in blood pressure, it is important to limit the time for laryngoscopy.

The present study was undertaken to assess and compare the effects of Dexmedetomidine and Fentanyl on laryngoscopic stress response and hemodynamic stability during general anesthesia. In 1997, C.J. Lawrence et al did a double-blind placebo controlled study to investigate the effect of a single pre-induction intravenous dose of Dexmedetomidine 2 μg/kg on anesthetic requirement and peri-operative hemodynamic stability. They found that laryngoscopy and tracheal intubation caused 0 and 31 mm of Hg increase in the mean systolic blood pressure, 1 and 26 mm of Hg increase in the mean diastolic blood pressure and 13 and 29 beats/minutes increase in the mean heart rate in Dexmedetomidine and Placebo Groups, respectively. These two Groups were compared during first 51 minutes after tracheal intubation. During this period, mean systolic blood pressure, diastolic blood pressure and heart rate were significantly lower in the Dexmedetomidine Group in comparison to placebo Group (P<0.001). One minute after postextubation the mean systolic blood pressure and heart rate were significantly lower in the Dexmedetomidine Group as compared to its counterpart.(P<0.001). In the post anesthesia care unit, over a three hour period, the mean systolic blood pressure, diastolic blood pressure and heart rate were significantly low in Dexmedetomidine Group.(P<0.001) Dexmedetomidine has sedative and analgesic property via central actions in the locus coeruleus and in the dorsal horn of the spinal cord.[5]

Dexmedetomidine has also been used in normal adult as well as in patients having coronary heart disease. It provides hemodynamic stability perioperatively.

Fentanyl produces analgesia, sedation and in large doses unconsciousness and anesthesia by virtue of its agonist effect on opioid receptor. These receptors are located in thalamus, hypothalamus, reticular system and gamma neurons. It prevents release of substance-P along with pain pathway and release dopamine and acetylcholine in central nervous system. High dose of opioids dull the neuroendocrine stress response to surgery.[21,22]

It was inferred that, Dexmedetomidine an α agonist agent, when used 2 as a pre-induction drug, reduces stress response to laryngoscopy and tracheal intubation, therefore reduces heart rate and blood pressure perioperatively. Fentanyl, an opioid agonist agent, however increases the heart rate & blood pressure during laryngoscopy and tracheal intubation nonetheless it was significant when compared with the baseline value of that Group. When compare to the baseline value, the rise in mean heart rate was maximum upto 23% in Group 2(Fentanyl) and mean systolic blood pressure was 8% and mean diastolic pressure was 1.51% but the rise was not significant when compare with the control group of the other studies where the rise in mean heart rate was approximately 29%, mean systolic blood pressure was 21% and mean diastolic blood pressure was 46%.

Therefore, it was inferred that Fentanyl can also help to reduce laryngoscopic stress response, as the rise in hemodynamics after laryngoscopy and intubation was within the normal limits of heart rate and blood pressure. Thus it may be recommended in patients' with cardiovascular instability, ischemic heart disease and hypertension.

CONCLUSION

The finding of the present study can be concluded as follows:-

1) During laryngoscopy and in the perioperative period, a single pre-operative dose of Dexmedetomidine provides better hemodynamic stability in comparison

to Fentanyl by attenuation of sympathoadrenal response.

2) During surgery, dexmedetomidine and Fentanyl when used with BIS monitoring, deliver adequate depth of anesthesia.
   i. Dexmedetomidine reduces the usage of anesthetic agents required during surgery as compared to Fentanyl, Hence it is more cost-effective.
   ii. Dexmede tomidine helps to reduce theatre pollution as compare to Fentanyl, when there is poor scavenging system.
3) In postoperative period, Dexmedetomidine provides smooth recovery without undue sedation with better analgesia in comparison to Fentanyl. Thus it reduces the requirement of analgesics.

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