Original Article

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Comparative Evaluation of Dexmedetomidine and Fentanyl Infusion on Haemodynamic Response in Patients Undergoing Elective Surgery Under General Anaesthesia

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Abstract

Context: The procedures like laryngoscopy and intubation evoke stress response in patients undergoing elective surgeries under general anaesthesia.

Aims: To compare and evaluate dexmedetomidine and fentanyl on hemodynamic response like Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) in patients during intubation and extubation.

Settingsand Design: Doubleblinded Randomised Control prospective Study

Materials and Methods: AAfterobtainingethical clearance, 90 patients belonging to American Society of Anaesthesiologists class I/II, Scheduled for surgeries with duration of approx. 90mins were randomly divided into two groups. Group A received dexmedetomidine 1µg/kg as loading dose over 10mns prior to induction followed by infusion at 0.5µg/kg/hr until 10mins prior to extubation. Group B received IV Fentanyl 1µg/kg as loading dose over 10mins prior to induction followed by infusion at 0.5 µg/kg/hr until 10mins prior to extubation.

Exclusion criteria included cardiovascular disease, Obesity >30kg/m2, patients with anticipated difficult airway, on sedatives, hypnotics and who have allergy to the study drug. *Statistical analysis used:* Data analyzed- SPSS22.0 software. *Test of significance:* Chi-squaretest. Continuousdata: Mean standard deviation. Testof significance:Independentttest p value:<0.05-statistically significant.

Results: With respect to hemodynamic response during intubation and extubation, Group A has shown significantly lower HR, SBP, DBP and MAP in comparison to Group B. Post-operative Visual Analogue Score for first 24hrs was significantly less in Group A compared to Group B.

Conclusion: Dexmedetomidine is better and safe alternative to fentanyl in attenuating hemodynamic response during both intubation and extubation.

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Keywords: Dexmedetomidine; Extubation; Fentanyl; General anaesthesia; Hemodynamic response; Intubation; Post-operative pain.

Key Message: The haemodynamic changes that occur during intubation and extubation may sometimes lead to extreme cardiovascular disturbances. Intraoperative dexmedetomidine infusion has used successfully to maintain haemodynamic stability throughout the procedure.

Introduction

General anaesthesia is the plan of anaesthesia for major head & neck surgeries, neurosurgeries, laparoscopic and dental surgeries. Laryngoscopy and intubation are associated with sympathetic stimulation and major hemodynamic changes.[1] There was always a need to attenuate the sympathetic response to prevent perioperative stress induced ischemic changes.[2]

Maintenance of anaesthesia is done with inhalational agents. The requirement of volatile anaesthetics depends upon the intraoperative hemodynamic stability.[3] Patients requiring high MAC may take longer time for recovery from anaesthesia and thereby causing delay in extubation.[4]

One of the factors contributing for intraoperative hemodynamic instability include inadequate analgesia. Poor control of intraoperative pain may cause hypertension leading to increased bleeding at the surgical site.[5]

Extubation also is associated with stress response.6 Violent extubation may lead to development of pulmonary edema or bleeding from the pack sites especially in case of ENT surgeries.[7] Abrupt increase in blood pressure during extubation may lead to post-operative haematoma in neurosurgery cases.[8]

Post-operative analgesia is also of utmost concern for anaesthesiologist especially in first 24 hours. Inappropriate pain management may lead to immobility, deep vein thrombosis, poor rehabilitation and progression to chronic pain.[9]

The present study is being conducted to evaluate the efficacy of intraoperative dexmedetomidine and fentanyl infusion on hemodynamic changes during intubation, extubation and postoperative analgesia.

Objectives

Primary Objective

- To compare and evaluate dexmedetomidine and fentanyl on hemodynamic response like Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) in patients during intubation and extubation.

Secondary Objective

- To assess the inhalational agent requirement throughout the procedure
- To assess the pain in the recovery period by Visual Analogue scale (VAS)

Material and Methods

The ethical clearance was obtained before starting the study.

A thorough preanaesthetic check-up was carried out, history was taken and systemic examination done. Vitals were noted including weight of the patient.

Investigations asked prior to surgery include

- Complete haemogram
- Serum electrolytes
- Blood urea and serum creatinine
- Random blood sugar
- Bleeding time and clotting time
- ECG and Chest x-ray
- Urine analysis for sugar, albumin and microscopy
- No other specific investigations were asked

All patients were examined 1 day prior to the surgery, investigation reports were checked, anaesthetic procedure explained and informed consent was taken.

Fasting was ensured for 8hours and patients were premedicated with Tab.Alprazolam 0.5mg and Tab.Rantac 150mg, which were repeated again on the morning of surgery.

Preparation of drug for infusion

Dexmedetomidine 1ml ampule containing 100mcg

was diluted with normal saline till 20cc so that the solution contains drug of 5µg per ml

Fentanyl 2ml containing 100µg was diluted with normal saline till 20cc so that the solution contains 5µg per ml.

The drugs were administered using a syringe pump.

Patients were randomly divided into two groups by computer generated table-

GROUP A: IV Dexmedetomidine 1µg/kg as loading dose over 10mins prior to induction followed by infusion at 0.5µg/kg/hr until 10mins prior to extubation.

GROUP B: IV Fentanyl 1µg/kg as loading dose over 10mins prior to induction followed by infusion at 0.5µg/kg/hr until 10mins prior to extubation.

Venous access was secured with 18G IVC and fluids were started at the rate of 5ml/kg/hr.

Once the patient was shifted to OT their basal HR, NIBP, SPO2 were noted and monitoring started.

Before the induction of anaesthesia patients were premedicated with Inj.Glycopyrrolate 0.005mg/kg.

Loading dose of the study drug was started at the rate of 1µg/kg and given over 10mins. HR, SBP, DBP, MAP, RR and SPO2 were noted before the start of infusion.

Preoxygenation was done with 100% oxygen for 3mins and anaesthesia induced with Inj.Propofol at 2mg/kg till loss of verbal commands

After the loading dose was given, the required monitoring parameters were once again recorded and the study drug infusion rate was changed to maintenance dose of 0.5µg/kg/hr till 10mins prior to extubation.

Tracheal intubation with appropriate size oral endotracheal tube is facilitated by Inj.Succinyl choline 2mg/kg. Maintenance of anaesthesia is done by 60% nitrous oxide in oxygen, isoflurane and Inj.Vecuronium 0.1mg/kg as muscle relaxant. Isoflurane concentration was titrated to maintain stable hemodynamic.

Patient was mechanically ventilated to maintain ETCO2 between 30-35mm of Hg.

HR, SBP, DBP, MAP, RR, SPO2 were recorded 1min after intubation and then at 3min, 5min followed by at every 15 min interval till extubation.

Bradycardia will be treated by IV Atropine at 0.02mg/kg and hypotension will be treated by titrating isoflurane concentration or by rate of infusion of intravenous fluids.

Infusion of the study drug was stopped and isoflurane was discontinued 10mins prior to reversal.

The residual neuromuscular blockade was reversed with Inj.Neostigmine 0.05mg/kg and Inj. Glycopyrrolate 0.01mg/kg.

After observing the motor recovery and spontaneous breathing efforts, patient was extubated after thorough oral suctioning. Vitals were noted 1, 3 ,5, and 15min after extubation to check for extubation response.

Patient was transferred to post anaesthesia care unit for observation of any nausea or drug induced side effects.

For first 24 hrs patient was monitored for pain using VAS score and the number of analgesics used were noted.

Results

Present study compares the efficacy of both fentanyl and dexmedetomidine infusion on attenuating the pressor response during intubation and extubation. Study has been conducted on 90 subjects and all the patients were included in the study.The demographic data of age, sex, weight, ASA physical status were comparable between the groups. (Table no 1)

Table 1: PatientDemographicCharacteristics.

Parameters	Group A	Group B
Number (N)	45	45
Age (Years)	36.29±9.93	37.44±8.98
Weight(kg)	59.51±10.49	61.11±9.84
Gender (male/female)	20/25	24/21
ASA status (I/II)	33/12	31/14

ASA: American Society of Anaesthesioloigists

Baseline HR (bpm) was comparable in both the groups.

After start of dexmedetomidine infusion, HR decreased to 78.53±9.10 bpm in Group A. After intubation in 1st minute, there was slight increase in HR of about 80.73±8.57, which settled down to below the baseline 10mins after intubation. In the 1st minute after extubation, HR increased, which was 69.56±6.46 but still was lower than the baseline level.

In Group B, after start of fentanyl infusion, HR maintained at 82.73±7.32 which was same as baseline level (82.71±9.72). In the 1st minute after intubation, there was significant increase in HR

which was 95±7.63. The increase in HR settled down to baseline level 15mins after intubation. In the 1st minute after extubation, there was again significant increase in HR of 87.38±8.47, which settled down to 77.36±13.86 after 5mins of extubation.(Fig. 1)

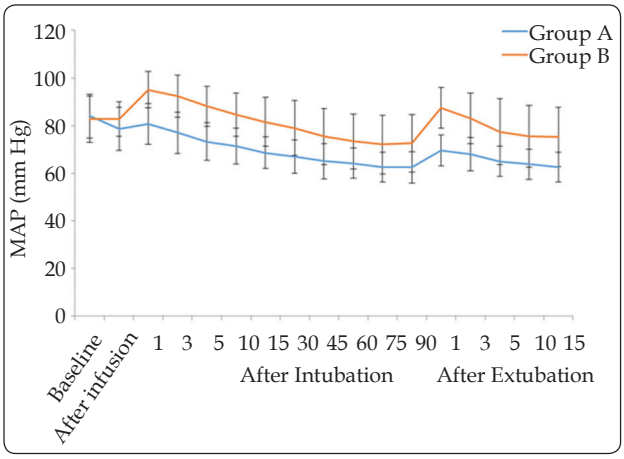

Fig. 1: Line Diagram Showing Heart Rate Comparison Between two Groups.

There was no significant difference in Mean arterial pressure (MAP) between two groups at baseline and also after the infusion of the study drugs. (Fig. 2)

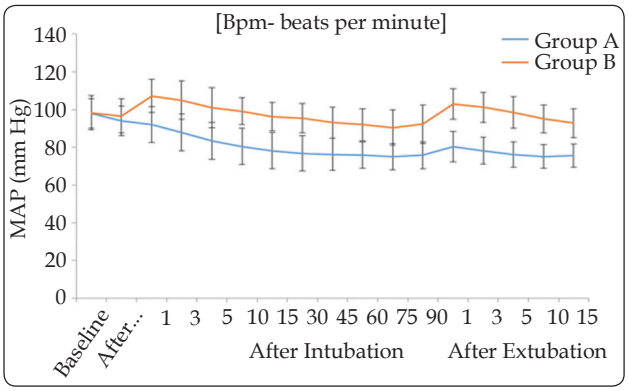

Fig. 2: Line Diagram Showing Mean Arterial Blood Pressure Comparison Between Two Groups.

Patients who received fentanyl had shown significant increase in MAP in the 1st minute after intubation from 96.71±8.99 to 107.31±8.69 and also in the 1st minute after extubation from 92.29±10.21 to 103.04±8.03.

Patients who received dexmedetomidine had shown no increase in MAP after intubation and also only mild increase in MAP in the 1st minute after extubation from 75.89±7.08 to 80.42±8.01.

VAS scores are significantly higher in fentanyl group when compared to dexmedetomidine at 0hr, 6hr, 12hr and 24hrs post-surgery.(Fig. 3)

There was significant difference in the requirement of rescue analgesics in the first 24hrs between the two groups. (Fig. 4)

62.2% of patients from Group A required only 2 rescue analgesics while 62.2% of patients from Group B required 3 rescue analgesics in the first 24hrs following surgery. [p value <0.001, significant]

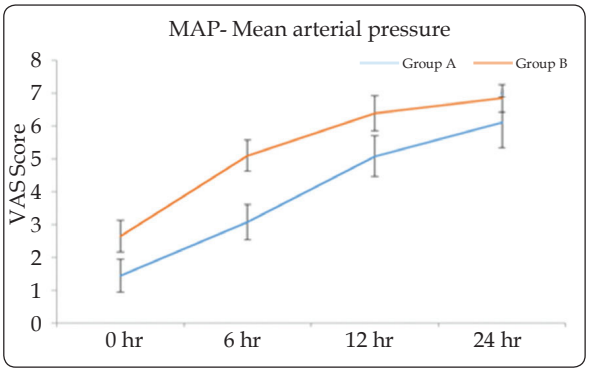

Fig. 3: Line Diagram Showing Vas Scores Comparison Between Two Groups.

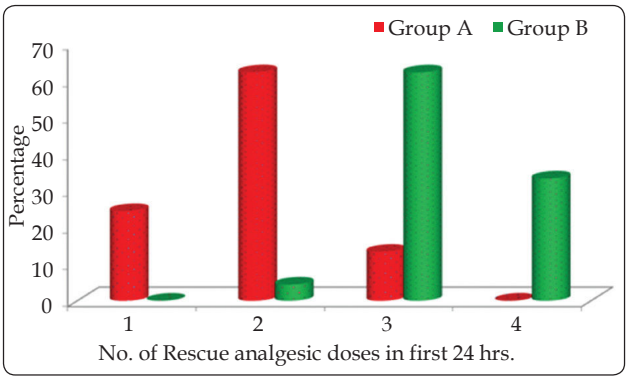

Fig. 4: Bar Diagram Showing Rescue Analgesics Comparison Between Two Groups.

Abbreviations

HR	Heart Rate
Bpm	Beats Per Minute
PR	Pulse Rate
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
NIBP	Non-Invasive Blood Pressure
MAP	Mean Arterial Pressure
ECG	Electrocardiogram
SPO2	Peripheral capillary oxygen saturation
CVS	Cardiovascular system
PA	Per Abdominal
RS	Respiratory System
CNS	Central Nervous System
VAS	Visual Analogue Scale
Iv	Intravenous
ASA-PS	American Society of Anaesthesiologists – Physical Status
D5W	Dextrose 5% in water
NS	Normal Saline

CBC	Complete Blood Count
HB	Haemoglobin
WBC	White Blood Count
HS	Hora somni- at bedtime
RFT	Renal function tests
i.e.,	That is
µg/mcg	Microgram
Kg	Kilogram
Mm Hg	Millimetre of Mercury
cm	Centimetre
mg	Milligram
ml	Millilitre
mins	Minutes
Secs	Seconds
SD	Standard Deviation
Tab	Tablet
hr	Hour
ETCO2	Endtidal carbondioxide
No. of	Number of
Approx.	Approximately
Intraop	Intraoperative
Postop	Postoperative

Discussion

During general anaesthesia, the critical events include laryngoscopy, tracheal intubation and extubation. These events are associated with significant sympathetic stimulation. To mitigate the hemodynamic changes associated with sympathetic response, various techniques have been tried. These techniques range from application of local anaesthtetics, nerve blocks infiltration to various drugs. Short acting beta blockers like esmolol was tried initially to treat hypertensive episodes. But beta blockers are associated with side effects like bradycardia and conduction delays. Other drugs include calcium channel blockers, vasodilators, opioids and adrenergic blocking agents.

Dexmedetomidine is a highly selective α2 agonist.[11] It maintains hemodynamic stability through its central sympatholytic action. Dexmedetomidine has been extensively used as an adjuvant to general anaesthesia owing to its anaesthetic sparing and sedative properties. Fentanyl is synthetic potent µ receptor agonist. It controls both heart rate and blood pressure responses during intubation and extubation.[13]

This was a prospective double blinded randomized controlled study carried out at R L Jalappa Hospital and Research, Tamaka, Kolar, during the Academic year from January 2019-June 2020. Ninety patients of age group 20-50years with ASA grade I, II of either sex undergoing elective surgeries with duration of approx. 90mins like laminectomy, Oro-maxillary, ENT, Thyroid, laparotomies and laparoscopic surgeries under general anaesthesia were included. Patients were randomly divided into two groups each of 45 after obtaining the informed consent. Baseline vitals like HR, SBP, DBP and MAP were recorded. Loading dose of the study drug was started at the rate of 1µg/kg and given over 10mins. After the loading dose is given, the required monitoring parameters were once again recorded and the study drug infusion rate was changed to maintenance dose of 0.5µg/kg/hrPreoxygenation was done with 100% oxygen for 3minutes and premedicated with glycopyrrolate and induced with propofol. till 10mins prior to extubation. Group A received dexmedetomidine and Group B received fentanyl. The infusion of study drug was stopped 10mins prior to extubation. HR, SBP, DBP and MAP were again recorded until 15mins post extubation. VAS scores were recorded for first 24hrs post-operative period. The requirement of rescue analgesics was also compared between two groups.

Both the groups were comparable in terms of age, weight, gender and ASA grading in our study. In our study, we observed that there was significant difference in the heart rate after the intubation with less increase in dexmedetomidine group when compared to fentanyl group as in accordance with the study conducted by Tanuja et al.

From our study, we observed a significant increase in SBP, DBP and MAP after intubation with fentanyl group than dexmedetomidine group with p value less than 0.05. Our results were consistent with the study conducted by Patel CR et al, which has shown similar fluctuations in blood pressure after intubation implying the attenuating effect of dexmedetomidine on laryngoscopic response.[5]

From Our study, we found out that intraoperative hemodynamic were better maintained with dexmedetomidine infusion with MAP 20% less than baseline than fentanyl infusion. Bekker et alfrom his study concluded that dexmedetomidine infusion was able to blunt the perioperative blood pressure changes.[8]

By observing the significant increase in HR and MAP in our study after extubation in fentanyl group than dexmedetomidine group, we conclude that dexmedetomidine is better in attenuating the stress

response during extubation. Kotak N et alfrom his study concluded that 0.5µg/kg of dexmedetomidine over 10mins prior to extubation is effective in attenuating stress response to extubation.[6] Aksu et alfrom his study concluded that 0.5µg/kg of dexmedetomidine is effective in mitigating airway reflexes during extubation better than fentanyl 1µg/kg.[7] Study done by Garg A et aldemonstrated that intraop infusion of dexmedetomidine at 1 µg/kg over 10 min followed by 0.4 µg/kg/h reduces the emergence agitation after nasal surgery.

Post-operative analgesia is important for anaesthesiologist as it impairs the recovery of the patient. Our study demonstrated that patients who received intraop dexmedetomidine had less VAS scores when compared to fentanyl group with p value less than 0.05.

Our results were consistent with the study done by Vaswani JP et al, where they concluded that postoperative analgesia was higher in dexmedetomidine group.[10] Study done by Turgat N et al., demonstrated that fentanyl group required earlier rescue analgesic than dexmedetomidine group.

In our study there is insignificant difference in RR and SPO2 between two groups.

Dexmedetomidine has side effects such as bradycardia and hypotension. We did not encounter any such episodes in our study.

Conclusion

We hereby conclude from our study that, dexmedetomidine at 1µg/kg over 10mins followed by 0.5µg/kg/hr of infusion is better in attenuating the stress response to intubation, in maintaining the intraoperative hemodynamic and in attenuating extubation response. Dexmedetomidine also provides better post-operative analgesia when compared to fentanyl.

Conflict of Interest: Nil

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