ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 02 | February - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARISON OF THE EFFECTS OF FENTANYL VERSUS DEXMEDETOMIDINE ON AIRWAY REFLEXES AND HEMODYNAMIC RESPONSE TO TRACHEAL EXTUBATION FOLLOWING GENERAL ANESTHESIA

Anesthesiology

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ABSTRACT

Laryngospasm, bronchospasm, cough and tachycardia are physiological responses during anesthesia emergence and endotracheal extubation. Tracheal extubation should be performed while patient is deeply anesthetized to reduce airway reflexes. Dexmedetomidine and fentanyl both have sedative and analgesic effect. The purpose of this study is to compare the effectiveness of dexmedetomidine or fentanyl on airway reflexes and hemodynamic response to tracheal extubation following general anesthesia. **Method:** 30 patients of ASA I and II, aged between 18 to 55 year undergoing general anesthesia on elective basis were randomly divided in two groups.15 patients received 0.5 µg/kg dexmedetomidine while other patient received 1µg/kg fentanyl. Fifteen minutes before expected last surgical suture inhalational agent cut off and equal amount of solution of drug was given. All patients were extubated and all were monitored after extubation. The airway reflexes to extubation, level of sedation and hemodynamic response were noticed. **Statistical Analysis:** For nonparametric data Chi-square test and for parametric data t test was used. **Result:** Total 30 patients were involved in the study. Dexmedetomidine was associated with increase quality of extubation compared with fentanyl. After extubation in fentanyl group heart rate was higher compared with dexmedetomidine group. In the dexmedetomidine group heart rate was not significantly increase after extubation. When compared to fentanyl, participants in the dexmedetomidine group demonstrated more drowsiness during airway suctioning and extubation. Fentanyl group post-extubation patients were awake, whereas dexmedetomidine group patients were arousable. **Conclusion:** The finding of current study show that Single-dosage dexmedetomidine 0.5 µg/kg given 15 min before extubation created better response against airway reaction to laryngoscopy and effective in maintaining hemodynamic stability. This resulted in better tracheal extubation without prolonging recovery in comparison to fentanyl 1 µg/kg iv.

KEYWORDS

dexmedetomidine, Fentanyl, Tracheal Extubation, Bronchospasm, General anesthesia

INTRODUCTION

During endotracheal intubation and extubation, the sympathetic reflex is generally invariably associated to hemodynamic changes. Many times, the release of catecholamines during intubation and extubation causes an abruptly inflated hemodynamic response[1]. Hemodynamic and negative airway reactions after extubation are possible. Patient's movement, coughing, laryngospasm, airway irritation, acute agony after operation, and emergence are all necessary for an easy extubation[2]. Even though these modifications are temporary, an anesthesiologist can find them to be very concerning. Other medications, such intravenous lignocaine[3], opioids like fentanyl and remifentanil[4,5], esmolol[6], labetalol[7], intratracheal local anaesthetic instillation[8], dexmedetomidine, which can also be administered during extubation, are utilized to lessen the intubation response. Intubation hemodynamic reactions have been extensively studied, but extubation care and safeguards are rarely taken with the same rigour. An effective method for quick and smooth extubation is still fully not evolved.

It is this Dexmedetomidine is a highly selective agonist of the 2-adrenoreceptor that causes sedation and analgesia without changing respiratory status[9,10]. Dexmedetomidine has been reported to lessen the frequency of emerging agitation when administered following induction[10]. Additionally, it has been noted to have dose-dependently decreased arterial blood pressure (BP), heart rate (HR)[11], and plasma catecholamine responses to intubation and extubation in ophthalmic and vascular procedures[12,13].

Synthetic opioid fentanyl has been shown to control the sneezing reflex following abdominal hysterectomy and periocular injections, as well as to decrease the frequency of coughing during and after extubation[14,15]. In elective gynecologic surgery, fentanyl has also been shown to lessen the cardiovascular reactions after tracheal extubation[15].

The aim of study to compare the effect of fentanyl and dexmedetomidine in attenuating airway reflexes and hemodynamic response during emergence and extubation of the endotracheal tube.

MATERIALS AND METHODS

A Prospective study was carried out after taking written informed consent from the patients, who posted for elective abdominal and lower limb surgeries under general anesthesia.

Total 30 patients of American society of anesthesiologist grade 1 and grade 2, male or female aged between 18 to 55 year who posted for elective abdominal and lower limb surgeries under general anesthesia were included in study. Patients with history of upper respiratory tract infection, patient with liver dysfunction, patients with renal dysfunction and patients who had known allergy to study drug were excluded from the study. Perioperative evaluation of patient was done including history taking, general and systemic examination of patients and airway assessment. Patients undergoing study were divided into two groups randomly. Group D(dexmedetomidine) receive dexmedetomidine 0.5 mcg/kg and Group F(fentanyl) receive fentanyl 1mcg/kg.

All patients were pre-medicated with oral alprazolam 25 mcg in the night before the surgery. On the operating room, after securing an intravenous access, injection ondansetron 4 mg were given. Multipara monitor used to record Base line hemodynamic parameters such as HR, BP, and oxygen saturation. All patients were induced with propofol 2 mg/kg, fentanyl 2 mcg/kg i.v. Tracheal intubation was done using vecuronium (loading dose of 0.1 mg/kg, intermittent bolus of 0.02 mg/kg) and anaesthesia was maintained on O2:N2O (0.3 L: 0.3 L) and isoflurane 1% dial concentration adjusted to maintain minimum alveolar concentration to 1. Isoflurane stopped 10 minutes before expected last surgical suture, and equal amount of test solution (10 ml) was given over a period of 5 min by infusion pump.

The test solution was prepared by uninvolved anaesthesiologist. Five minutes after the infusion, the patient was reversed from muscle relaxant effect with injection neostigmine 0 .05 mg/kg and glycopyrrolate0 .01 mg/kg. Vitals taken at 5 minutes from the time of study drug administration until 30 min post extubation. Level of sedation during suction and extubation were assessed using observer assessment sedation score (Table 1).

The airway response under direct laryngoscopy to suction was noted by five-point scale(Table 2). After 5 min interval, the level of sedation was assessed, and smoothness of extubation was noted by four-point scale (Table 3). When mean arterial BP fall more than 10% of baseline value, intravenous injection mephenteremine 1 ml (6 mg/ml) was supplemented.

Drop in HR more than 20% from baseline was treated with intravenous injection atropine 0.2 mg.

Table 1: Observer Assessment Sedation Score

Observation	Score
Responds readily to name spoken in normal tone	5
Lethargic response to name spoken in normal tone	4
Responds only after name is called loudly and/or repeatedly	3
Responds only after mild prodding or shaking	2
Does not respond to mild prodding or shaking	1

Table 2: Grading Of Airway Reflexes

Grades	Description
1	Excellent (breathing well, no response to laryngoscopy and suctioning)
2	Good (breathing well, minimal grimacing response to laryngoscopy and suction)
3	Satisfactory (breathing well, coughing attempt to laryngoscopy, and suction)
4	Poor (breathing well, coughing on tube during laryngoscopy)
5	Very poor (coughing on tube with breath holding)

Table 3: Smoothness Of Extubation

Grades	Description
1	No coughing on endotracheal tube
2	Coughing on the tube
3	Vomiting
4	Laryngospasm

OBSERVATION AND RESULT

Total 30 patients were included in study. The demographic data of both groups are presented in Table 4.There were no significant differences between groups for age, weight, sex and American society of anesthesia grade.

Table: 5 Demoghraphic Data

Parameter	Dexmedetomidine N=15	Fentanyl N=15	P value
Age-mean(95% CI)	38.6667	37.0667	0.6148
Sex(male: female)	11:4	10:5	0.6903
Weight-mean(95%CI)	64.4667	59.4	0.0628
ASA grade(1:2)	9/6	8/7	0.7125

There was no significant difference between the two groups with respect to smoothness of extubation. The number of patients with no coughing on endotracheal tube in situ was almost same in patient with dexmedetomidine group compared with those in fentanyl group. Laryngospasm did not occur in any patient of both group.

When compared to fentanyl, participants in the dexmedetomidine group demonstrated more drowsiness during airway suctioning and extubation. Fentanyl group post-extubation patients were awake, whereas dexmedetomidine group patients were arousable.

There was no significant increase in heart rate after extubation compared with preextubation value in dexmedetomidine group.

Heart rate in fentanyl group was increased at 5 and 10 minute after extubation compared to preextubation value. Heart rate was significantly higher in fentanyl group at 1, 5 and 10 minutes after extubation compared with dexmedetomidine group.

From the time of test drug administration to extubation, however dexmedetomidine produced significant drop in heart rate when compared to fentanyl.

At 5 minutes after medication administration, both groups experienced a decrease in blood pressure. This decrease improved with a fluid bolus and was sustained at 10% of baseline value throughout.

Hemodynamic Variation Over Time

Vital sign	Dexmedetomidine group(n=15)	Fentanyl group (n=15)	P value
Vital sign before study drug administration			
Mean heart rate in bpm(mean± SD)	78.53333± 4.3730	79.4666±4.7730	0.5811
MAP(mean± SD)	79.6±3.4805	82.1933±4.3092	0.0809
Vital sign at 5 min from administration of study drug			
Mean heart rate in bpm(mean± SD)	73.4± 3.7738	76.6666±4.7157	0.0457
MAP(mean± SD)	63.8667±2.8751	68.7133±4.8263	0.024
Vital sign at 10 min from administration of study drug(post extubation)			
Mean heart rate in bpm(mean± SD)	69.4± 3.06594	76.9333±5.4963	0.0001
MAP(mean± SD)	67.0667±1.9808	74.5733±6.1254	0.0001
Vital sign at 15 min from administration of study drug(post extubation)			
Mean heart rate in bpm(mean± SD)	68 ±2.2677	77.3333±4.5145	0.0001
MAP(mean± SD)	65.62±1.8845	70.7133±4.4657	0.0004
Vital sign at 20 min from administration of study drug(post extubation)			
Mean heart rate in bpm(mean± SD)	67.466±2.0655	78.26666±4.26726	0.0001
MAP(mean± SD)	66.2±1.1193	69.34±3.8544	0.0052
Vital sign at 25 min from administration of study drug(post extubation)			
Mean heart rate in bpm(mean± SD)	68.133±2.3258	79.4666±4.7035	0.0001
MAP(mean± SD)	65.7933±1.2986	69.2533±3.7642	0.0022
Vital sign at 30 min from administration of study drug(post extubation)			
Mean heart rate in bpm (mean± SD)	68.5333±1.7674	81.333±4.9952	0.0001
MAP(mean± SD)	66.18667±1.28166	69.30667±2.6293	0.0003

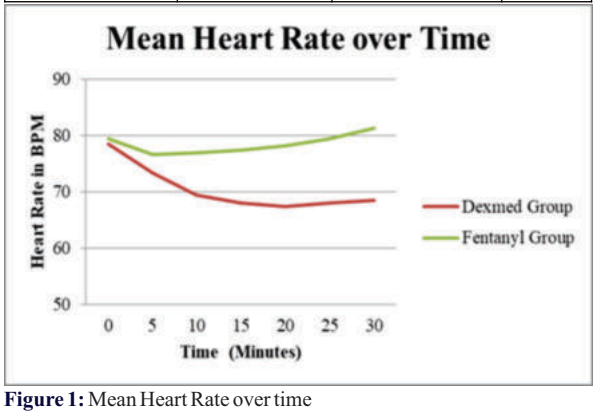

Figure 1: Mean Heart Rate over time

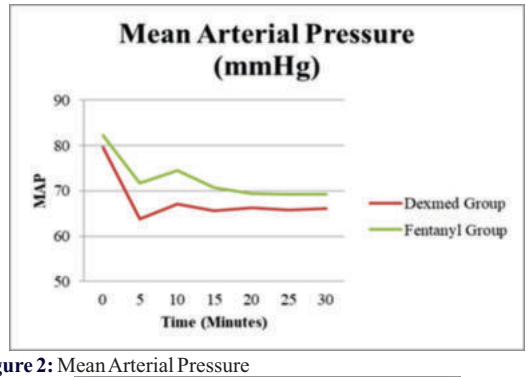

Figure 2: Mean Arterial Pressure

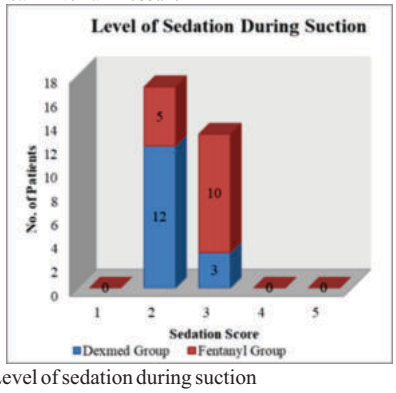

Figure 3: Level of sedation during suction

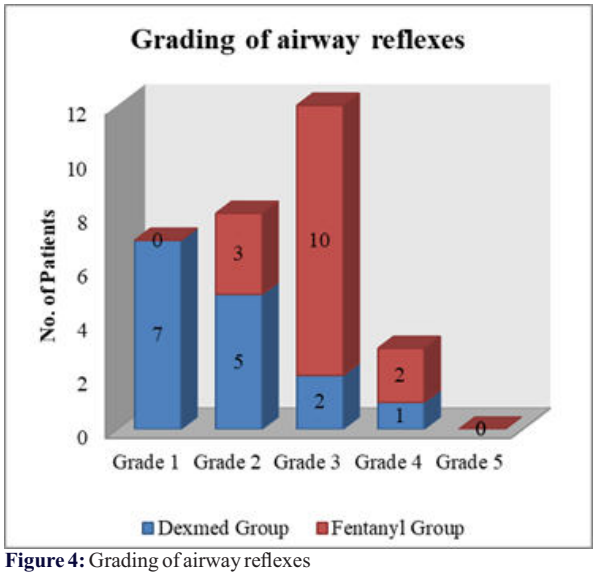

Figure 4: Grading of airway reflexes

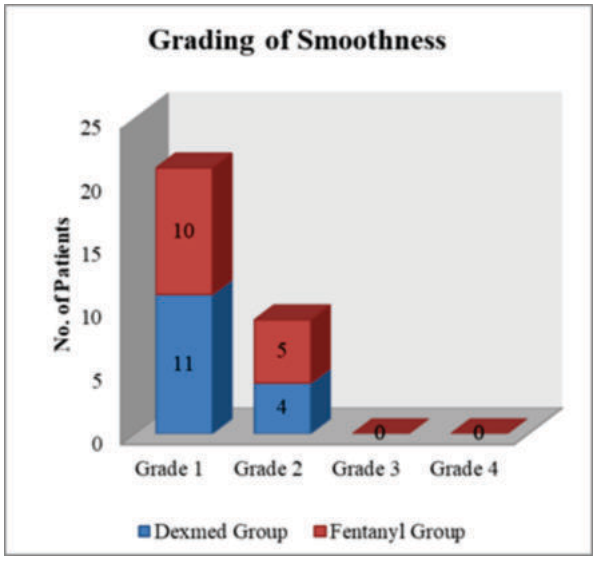

Figure 5: Showing grading of smoothness while extubation

Dexmedetomidine group patients in larger number tolerated laryngoscopy and suction. In fact in both the groups no breathing difficulty or related event reported.

DISCUSSION

Extubation should be devoid of major changes in hemodynamic parameters and adverse events, such as coughing, or laryngospasm. In the same way as intubation during laryngoscopy causes reflex responses in the heart and lungs, extubation also stimulates receptors, particularly in the larynx, trachea, and bronchi. The plasma concentration of noradrenaline and adrenaline increases during laryngoscopy, intubation, and extubation. This causes tachycardia and hypertension, which can lead to complications such cardiac failure, pulmonary edema, and cerebrovascular hemorrhage[16].Recovering from anesthesia often results in elevated catecholamine concentration following anesthetic withdrawal which is further aggravated by laryngeal manipulation occurring during extubation.

Dexmedetomidine, a potent alpha-adrenoceptor agonist, decrease the sympathetic outflow and noradrenergic activity thereby counteracting the hemodynamic fluctuation occurring at the time of extubation and fentanyl is a proven drug to attenuate the intubation and extubation response. We compared the effects of dexmedetomidine and fentanyl in attenuation of hemodynamic and airway reflexes during emergence and extubation.

Dexmedetomidine activates receptors in the medullary vasomotor center, reducing norepinephrine turnover and decreasing central sympathetic outflow, resulting in alterations in sympathetic function and decreased HR, and BP.

In our study, patients of both groups showed drop in HR and BP throughout the study period. On comparison between the groups, dexmedetomidine group showed a significant drop in BP at 5 min interval after drug administration and improved with fluid boluses. Kothari et al[17] compared lignocaine and dexmedetomidine and observed that single dose of dexmedetomidine 0.5 µg/kg given 5 min before extubation produced better attenuation of hemodynamic response in craniotomy patients.

However, Sharma et al[18] found an increase in mean arterial pressure for first 3 min in dexmedetomidine group which may be due to bolus drug administration effect and decreased from baseline value after 5 min.

Dexmedetomidine induces drowsiness and anxiolysis primarily through central stimulation of parasympathetic outflow and suppression of sympathetic outflow from the locus ceruleus in the brainstem. Dexmedetomidine produced a better sedative score than fentanyl, which may explain why there was a rise in HR and BP in the fentanyl group following extubation compared to the dexmedetomidine group.

Ninety patients participated in the trial by Choi et al[19] and they were divided into 3 groups at random: fentanyl, oxycodone, and control. Coughing reactions, acute postoperative pain and hemodynamic responses during the recovery period were evaluated. They found that oxycodone use prior to tracheal extubation decreased cough response and were equally as beneficial as fentanyl use for enhancing the quality of the extubation. Additionally, laparoscopic cholecystectomy patients who received single boluses of oxycodone or fentanyl shown equivalent effectiveness in reducing initial postoperative pain.

Aksu et al[20] also found similar hemodynamic response of increase in HR and BP after the extubation of rhinoplasty patients in fentanyl group when compared with 0.5 µg/kg dexmedetomidine.

Kim and Bishop[21] found 76% incidence of coughing during emergence. Coughing can result in hypertension, tachycardia, increased intraocular and intracranial pressure, myocardial ischemia, bronchospasm, and surgical bleeding.

In our study, dexmedetomidine group showed better airway response during laryngoscopy and oral suctioning when compared to fentanyl which correlated well with better sedation score in dexmedetomidine group.

CONCLUSION

The finding of current study show that Single-dosage dexmedetomidine 0.5 µg/kg given 15 min before extubation created better response against airway reaction to laryngoscopy and effective in maintaining hemodynamic stability. This resulted in better tracheal extubation without prolonging recovery in comparison to fentanyl 1 µg/kg iv.

REFERENCES

1. Lowrie A, Johnston PL, Fell D, Robinson SL. Cardiovascular and plasma catecholamine reactions at tracheal extubation. BrJ Anaesth 1992;68:261–3.
2. Cranfield KA, Bromley LM. Least alveolar convergence of desflurane for tracheal extubation in profoundly anesthetized, unpremedicated youngsters. Br J Anaesth 1997;78:370–1.
3. Gefke K, Andersen LW, Friesel E. Lidocaine given intravenously as a suppressant of cough and laryngospasm regarding extubation after tonsillectomy. Acta Anaesthesiol Scand 1983;27:111–2.
4. Nishina K, Mikawa K, Maekawa N, Obara H. Fentanyl constricts cardiovascular reactions to tracheal extubation. Acta Anaesthesiol Scand 1995;39:85–9.
5. Aouad MT, Al-Alami AA, Nasr VG, Souki FG, Zbeidy RA, Siddik Sayyid SM. The impact of low-measurement remifentanil on reactions to the endotracheal tube during rising up out of general anesthesia. Anesth Analg 2009;108:1157–60.
6. Lim SH, Chin NM, Tai HY, Wong M, Lin TK. Prophylactic esmolol mixture for the control of cardiovascular reactions to extubation after intracranial surgery. Ann Acad Med Singapore 2000;29:447–51
7. Muzzi DA, Black S, Losasso TJ, Cucchiara RF. Labetalol and esmolol in the control of hypertension after intracranial surgery. Anesth Analg 1990;70:68–71.
8. Jee D, Park SY. Lidocaine splashed down the endotracheal tube weakens the airway-circulatory reflexes by nearby anesthesia during development and extubation. Anesth Analg 2003;96:293–7.
9. Zub D, Berkenbosch JW, Tobias JD. Preliminary experience with oral dexmedetomidine for procedural and anesthetic premedication. Paediatr Anaesth. 2005;15:932–938.
10. Ibacache M, Muñoz HR, Brandes V, Morales AL. Single-dose dexmedetomidine reduces agitation after sevoflurane anesthesia in children. Anesth Analg. 2004;98:60–63, table of contents
11. Bhana N, Goa KL, McClellan KJ. Dexmedetomidine. Drugs. 2000;59:263–268; discussion 269–270.

12. Jaakola ML, Ali-Melkkilä T, Kanto J, et al. Dexmedetomidine reduces intraocular pressure, intubation responses and anaesthetic requirements in patients undergoing ophthalmic surgery.Br J Anaesth. 1992;68:570–575.
13. Talke P, Chen R, Thomas B, et al. The hemodynamic and adrenergic effects of perioperative dexmedetomidine infusion after vascular surgery. Anesth Analg. 2000;90:834–839.
14. Inagaki Y, Shindo H, Mashimo T, Yoshiya I. The effects of epidural fentanyl on hemodynamic responses during emergence from isoflurane anesthesia and tracheal extubation: A comparison with intravenous fentanyl. Anesth Analg. 1997;85:328–335.
15. Tao J, Nunery W, Kresovsky S, et al. Efficacy of fentanyl or alfentanil in suppressing reflex sneezing after propofol sedation and periocular injection. Ophthal Plast Reconstr Surg. 2008;24:465–467.
16. Murat Alp Alkaya, Kemal Tolga Saraçoğlu, Gökhan Pehlivan, Zeynep Eti FYG. Effects of Esmolol on the Prevention of Haemodynamic Responses to Tracheal Extubation after Craniotomy Operations. Turk J Anaesth Reanim. 2014;42:86–90.
17. Kothari D, Tandon N, Singh M, Kumar A. Attenuation of circulatory and airway responses to endotracheal extubation in craniotomies for intracerebral space occupying lesions: Dexmedetomidine versus lignocaine. Anesth Essays Res 2014;8:78-82.
18. SharmaVB, Prabhakar H, Rath GP, Bithal PK. Comparison of dexmedetomidine and lignocaine on attenuation of airway and pressor responses during tracheal extubation. J Neuroanaesth Crit Care 2014;1:50-5.
19. Choi, Eun Kyung, Kwon, Nyeongkeon Park, Sang-Jin,Comparison of the effects of oxycodone versus fentanyl on airway reflex to tracheal extubation and postoperative pain during anesthesia recovery after laparoscopic cholecystectomy. Medicine: March 2018 – 97:13-0156.
20. Aksu R, Akin A, Biçer C, Esmaoglu A, Tosun Z, Boyaci A. Comparison of the effects of dexmedetomidine versus fentanyl on airway reflexes and hemodynamic responses to tracheal extubation during rhinoplasty: A double-blind, randomized, controlled study. Curr Ther Res Clin Exp 2009;70:209-20.
21. Kim ES, Bishop MJ. Cough during emergence from isoflurane anesthesia. Anesth Analg 1998;87:1170-4.