ORIGINAL ARTICLE

ATTENUATION OF HAEMODYNAMIC RESPONSE DURING LARYNGOSCOPIC INTUBATION WITH FENTANYL

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ABSTRACT

Introduction: Identified as a depth-of-anesthesia-dependent influencing factor, endotracheal intubation has been suggested to be one of the most invasive stimuli in anesthesia, particularly during induction[3] and after tracheal intubation. The objective of the study was to find a safe and effective means of attenuating the cardiovascular response to laryngoscopy and tracheal intubation.

Methodology: S.A.L Hospital and Medical institute and KESAR SAL Medical College and Research Institute, Ahmedabad during 2008-2010 in 100 patients, divided in two groups having 50 patients in each group. One group received intravenous fentanyl while other group termed as control group received intravenous normal saline. The following hemodynamic variables were considered for study: changes in heart rate and comparison of the controlled group with the group who received fentanyl; & changes in systolic arterial pressure and diastolic arterial pressure in the fentanyl treated group in comparison to the control group.

Results: At induction both the groups were observed to have a 5% decrease in heart rate in comparison to basal levels. At intubation, however, the fentanyl group had a highly significant mean heart rate at 12% below the control group ($P \leq 0.0001$). Highly significant attenuation of systolic blood pressure was observed in the fentanyl group with a 10% average lower value than the control over all measured points. As with SBP, high attenuation of the DBP pressor response to intubation in the fentanyl group was observed at all measured times – on average 10% greater attenuation than the control group.

Conclusion: In conclusion, fentanyl attenuated the cardiovascular response to laryngoscopy & intubation, and was more effective in attenuating these responses. DBP was maintained in the fentanyl group. No patient manifested any ischemic ECG changes so fentanyl is safe in patients of ASA physical status I/II.

Keywords: Laryngoscope, Tracheal Intubation, Fentanyl, Systolic Blood Pressure, Diastolic Blood Pressure

INTRODUCTION

Identified as a depth-of-anesthesia-dependent influencing factor[1], endotracheal intubation has been suggested to be one of the most invasive stimuli in anesthesia[2], particularly during induction[3] and after tracheal intubation.[3,4]

Significant changes in blood pressure and heart rate are known to occur during laryngoscopy and tracheal intubation[5] following induction of anaesthesia. The exact mechanisms of the pressor response are not known, but have been associated with both sympathetic[2,4] and parasympathetic responses[4], which may include symptoms such as increased plasma catecholamine concentrations[6,7], increased blood pressure and increased heart rate.

The methods to attenuate the response to the reflex stimulus of laryngoscopy and intubation have included Deep anaesthesia with intravenous / inhalational agents; Topical / I.V. lignocaine[8]; Narcotics, intravenous / topical vasodilators; and Adrenergic blockers and calcium channel blockers.[4]

The objective of the study was to find a safe and effective means of attenuating the cardiovascular response to laryngoscopy and tracheal intubation.

METHODOLOGY

Following institutional approval by the ethical committee at S.A.L. Hospital and Medical Institute, Ahmedabad (Gujarat, India) informed consent to participate in this study was obtained from 100 patients. The study population consisted of randomly selected ASA physical status I/II, male/female adults between the ages of 20 and 60 years, scheduled for elective surgical procedures.

Patients having pre-existing systemic disorders, ischemic heart disease, hypertensive heart disease, diabetes mellitus, bronchial asthma, previous myocardial infarction, renal disease, cerebrovascular insufficiency or association with any co-morbid disease were excluded from the study.

Each patient was randomly assigned to one of two double-blind study groups by closed enveloped method: the Fentanyl group received a single 2 μg/kg IV bolus in the round dose of 20μg/10kg of fentanyl diluted to 10 ml (20μg/ml) with normal saline 5 min prior17 to laryngoscopy and intubation (n=50) and the control group received the same volume of IV bolus of normal saline according to weight (n=50). Observer was not aware of the drug given. Heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded via a GE multichannel monitor for each patient. Then baseline/before induction HR, SBP and DBP levels were taken.

After recording baseline HR, SBP and DBP levels, the study drug (2 μg/kg of fentanyl diluted to 10 ml with normal saline) or the control placebo (10 ml normal saline) was administered by using double blind study and patients were pre-oxygenated for 5 min via a facemask with Bain circuit. Patients were induced with Inj. Propofol 2mg/kg intravenously followed by succinylcholine 1 mg/kg intravenously. Intermittent positive pressure ventilation with 100% 02 was given and at induction readings of HR, SBP and DBP were taken.

After the onset of complete relaxation, Laryngoscopy and Intubation were performed and at laryngoscopy readings of HR, SBP and DBP were taken. Upon bilateral, equal air entry confirmation, the endotracheal tube was fixed and the patients mechanically ventilated using a Bain system. Following recovery from suxamethonium, atracuriumbesylate 0.5mg/kg was given intravenously for maintaining muscle relaxation and traces of inhalation anesthetic agent was continued. Immediately after intubation at 1,2,3,4,5,10 and 15 minutes interval heart rate, systolic pressures and diastolic pressures were recorded. Any adverse clinical event occurring during the study period was recorded e.g. arrhythmia, cardiac arrest.

Statistical analysis: Statistical analysis of patient's gender, age and weight for both the fentanyl and control groups are reported. Intra- and inter-group analysis for HR, SBP and DBP were statistically evaluated using unpaired t-tests where $P<0.05$ was considered significant, and $P<0.001$ highly significant.

RESULTS

The mean age of the patients in Group 1 is 36.9 and in Group 2 is 36.1.The calculated P value is 0.68, which suggest that the observed difference is not significant at 95% confidence limit. It indicates the study is age matched, and samples are drawn from the same population.

Table 1: Characteristics of study participants

Variable	Group 1	Group 2
Age(yrs)		
20-30	19	16
31-40	10	16
41-50	18	15
51-60	3	3
Age (Mean ± SD)	36.9 ± 10.4	36.1 ± 9.5
Gender		
Male	33	31
Female	17	19
Weight(kg)		
40-50	3	5
51-60	26	25
61-70	21	20
Weight (Mean ± SD)	58.7 ± 4.6	58.3 ± 5.2
ASA Grade		
I	42	43
II	8	7

The mean age of the patients in Group 1 is 36.9 and in Group 2 is 36.1.The calculated P value is 0.68, which suggest that the observed difference is not significant at 95% confidence limit. It indicates the study is age matched, and samples are drawn from the same population.

There are 33 males and 17 females in Group 1 and 31 males and 19 females in Group 2. The calculated Chi square value is 0.043, which is not significant at 5% level of significance. It indicates that the study is sex matched and samples are drawn from the same population.

The mean weight of the patients is 58.7±4.6 kgs in Group 1 and 58.3±5.2 kgs in Group 2 as shown in Table 1. The calculated P values 0.684, which suggest that the observed difference is not significant at 95% confidence limit. It indicates the study is age matched, and samples are drawn from the same population.

ASA physical status I in Group 1 and Group 2 was 42 and 43 respectively, while ASA status II in Group 1 and Group 2 was 8 and 7 respectively. There was no statistical difference among both the groups, p value=0.78(>0.05) by Chi square test.

Table 2: Comparison of Basal vitals (mean)

Group	HR	SBP	DBP	SPO_2
1	76.9±6.1	122.1±4.9	78.9±4.6	99.7±0.5
2	76.3±4.8	123.3±2.5	79.5±2.6	99.6±0.5
p-Value	0.58	0.12	0.42	0.32

Table 3: Comparison of Heart rate, Systolic BP (SBP) and Diastolic BP (DBP) at different interval

Group	Before induction	Induction	Laryngoscopy and intubation	Intubation	1 min	2 min	3 min	4 min	5 min	10 min	15 min
Heart Rate (mean)											
1	76.9	74.9	76.9	76.3	78.1	77.0	78.9	77.9	80.1	79.1	81.1
2	76.3	73.9	85.8	87.6	87.4	90.1	89.7	88.8	89.6	87.2	89.2
p –Value	0.57	0.36	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Percent difference between measured HR levels and basal values											
1	0.00	-2.60	0.00	-0.78	1.56	0.13	2.60	1.30	4.16	2.86	5.46
2	0.00	-3.1	12.5	14.8	14.5	18.2	17.6	16.5	17.5	14.3	16.9
SBP (mean)											
1	122.1	122.7	127.5	122.5	126.1	123.5	126.1	124.7	125.9	127.9	127.7
2	123.3	121.3	135.8	134.7	138.3	139.4	138.2	136.3	138.9	136.0	137.0
p-Value	0.11	0.21	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Percent difference between measured SBP levels and basal values											
1	0.00	0.49	4.42	0.33	3.28	1.15	3.28	2.13	3.11	4.75	4.59
2	0.00	-1.62	10.1	9.21	12.1	13.0	12.1	10.5	12.6	10.2	11.1
DBP (mean)											
1	78.9	80.1	81.3	79.5	81.7	79.9	82.1	83.3	81.5	79.9	80.5
2	79.5	77.5	84.7	84.1	87.7	90.0	88.8	87.3	87.7	90.4	85.9
p –Value	0.41	0.009	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Percent difference between measured DBP levels and basal values											
1	0.00	1.52	3.04	0.76	3.55	1.27	4.06	5.58	3.30	1.27	2.03
2	0.00	-2.54	6.59	5.79	10.3	13.2	11.6	9.79	10.4	13.7	8.0

Attenuation of heart rate related hemodynamic response to tracheal intubation by a single 2 μg/kg bolus of fentanyl was observed at all measured time points. At induction both the groups were observed to have a 5% decrease in heart rate in comparison to basal levels. At intubation, however, the fentanyl group had a highly significant mean heart rate at 12% below the control group (P≤0.0001).

Further, significant attenuation was also observed at post intubation (P≤0.001), which was lower than the control value by 15%, 1 min after intubation by 12% (P≤0.001), 2 min after intubation by 18% (P≤0.0001), 3 min after intubation by 15% (P≤0.001),4 min after intubation by 15% (P≤0.0001), 5 min after intubation by 13% (P≤0.001), at 10 min post-intubation the fentanyl group was 12% lower than that of the control (P≤0.001) and at 15 min post-intubation the fentanyl group was 11% lower than that of the control (P<0.001).

Highly significant attenuation of systolic blood pressure was observed in the fentanyl group with a 10% average lower value than the control over all measured points. The difference between measured points at intubation was 8% decrease observed in the fentanyl group (P≤0.01), followed by a 10% difference at 1 min post-intubation (P≤0.001), 12% at 2 min (P≤0.001), 10% at 3 min (P≤0.001), 8% at 4 min (P≤0.01), 11% at 5 min (P≤0.001), 6% at 10 min (P≤0.01) and 7% at 15 min post-intubation (P≤0.001).

As with SBP, high attenuation of the DBP pressor response to intubation in the fentanyl group was observed at all measured times – on average 10% greater attenuation than the control group.

The attenuation was observed at 1 min post-intubation with a 3% difference (P<0.04).This was preceded by a 7% difference at 1 min (P=0.012), 12% at 2 min (P≤0.001), 7% at 3 min (P<0.01),4% at 4 min (P<0.04),7% at 5 min (P<0.01),12% at 10 min (P<0.001)and a 6% reduction at 15 min post-intubation.

DISCUSSION

There is a substantial evidence that laryngoscopy and intubation is accompanied by a considerable increase in HR and BP[4] and this hypertensive response has been shown to be due to a sympathomimetic discharge caused by stimulation of upper respiratory tract. These changes are usually of short duration and well tolerated by healthy patients but can cause many dangerous complications like left ventricular failure, acute myocardial infarction and cerebral haemorrhage especially in patients with cerebral and cardiovascular diseases.[3] In principle, the response can be diminished or modified locally, centrally or peripherally and attempts have been made to accomplish this by using different approaches. [10]

The use of beta adrenergic blocking drugs for the treatment of angina pectoris, HT and arrhythmias is now well established. It is a common practice in anaesthesia to give increments of beta blockers[9] to control tachycardia intraoperatively in patients at risk for developing myocardial ischemia but there is a concern about the long duration of action of these drugs and other side effects like bronchospasm, hypotension etc.

The circulatory effect of laryngoscopy, both tachycardia and systemic hypertension are proportion to the duration of conventional endoscopy beginning at 15 and peaking at 45 seconds. The 30 second laryngos-

copy followed by intubation was chosen so that protective measures could be adequately tested while not unduly endangering the patients in the control group.

At pre-induction, when fentanyl or the saline placebo[10] was administered, a significant difference between fentanyl and the control group HR was not observed, but at intubation a 12% lower HR value[11] was recorded for the fentanyl group. Over all measured points, the fentanyl group HR was 11% lower than the control.

Results of our study show that laryngoscopy and intubation resulted in significant increase in HR, SBP and DBP in control group which could be associated with critical increase in myocardial oxygen consumption. Despite these any ischemic ECG changes or any cardiac adverse events did not occur in any of our patient of control group because patients were healthy of physical status ASA I/II and myocardial perfusion was maintained. Fentanyl also has added advantage of analgesia during intra operative course. Fentanyl's low economic cost and unique pharmacodynamic properties make it still one of the best opioids at present to attenuate hemodynamic responses to endotracheal intubation with minimal side effects.

CONCLUSION

In conclusion, fentanyl attenuated the cardiovascular response to laryngoscopy & intubation, and was more effective in attenuating these responses. DBP was maintained in the fentanyl group. No patient manifested any ischemic ECG changes so fentanyl is safe in patients of ASA physical status I/II.

REFERENCE

1. Randell T. Hemodynamic responses to intubation: what more do we have to know? ActaAnaesthesiolScand 2004; 48: 393-5.
2. Kayhan Z, Aldemir D, Mutlu H. Which is responsible for the hemodynamic response due to laryngoscopy and endotracheal intubation? Catecholamines, vasopressin or angiotensin? Eur J Anaesthesiol 2005; 22: 780-5.
3. Prys-Roberts C, Greene LT, Meloche R, Foëx P. Studies of anaesthesia in relation to hypertension. II. Hemodynamic consequences of induction and endotracheal intubation. Br J Anaesth 1971; 43: 531-47.
4. Kovac AL. Controlling the hemodynamic response to laryngoscopy and endotracheal intubation. J ClinAnesth 1996; 8: 63-79.
5. Hung O. Understanding hemodynamic responses to tracheal intubation. Can J Anaesth 2001; 48: 723-6.
6. Ebert JP, Pearson JD, Gelman S, Harris C, Bradley EL. Circulatory responses to laryngoscopy: the comparative effects of placebo, fentanyl and esmolol. Can J Anaesth1989; 36: 301-6.
7. Reid LC, Brace DE. Irritation of the respiratory tract and its reflex effect upon the heart. SurgGynecolObstet 1940; 70: 157-62.
8. Malde AD, Sarode V. Attenuation of the hemodynamic response to endotracheal intubation: fentanyl versus lignocaine. The Internet Journal of Anesthesiology 2007; 12.
9. Helfman SM, Gold MI, DeLisser EA, Herrington CA. Which drug prevents tachycardia and hypertension associated with tracheal intubation: lidocaine, fentanyl, or esmolol? AnesthAnalg 1991; 72: 482-6.
10. Ebert JP, Pearson JD, Gelman S, Harris C, Bradley EL. Circulatory responses to laryngoscopy: the comparative effects of placebo, fentanyl.
11. Dahlgren N, Messeter K. Treatment of stress response to laryngoscopy and intubation with fentanyl. Anaesthesia 1981;36: 1022-6.