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Research Paper

A Comparative Study To Find The Optimal Time To Inject Small Dose Fentanyl To Obtund The Haemodynamic Responses To Laryngoscopy And Intubation In Ent Patients

Medical Science

KEYWORDS :

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ABSTRACT

Hypertension and tachycardia usually accompany laryngoscopy and endotracheal intubation, which might be detrimental to patients with heart disease. The aim of the study was to determine the optimal time for injecting a low dose of Fentanyl (2µg / kg body wt) before intubation, for effectively attenuating the circulatory responses that accompanies laryngoscopy and intubation. This study was done in patients of both sexes in age group 20-50, posted for elective ENT surgeries planned under General Anaesthesia in a Tertiary care hospital . The patients were randomly assigned into four groups . Patients were given Inj Fentanyl 2µg / kg body wt either 1 minute, 5 minutes or 10 minutes before laryngoscopy and endotracheal intubation according to the group to which they were assigned. Patients in the control group received Inj.Pentazocine 500µg / kg body weight 5 minutes before intubation. The study showed that of all the four groups, Group III or the group where Inj Fentanyl 2 µg / kg body wt was given 5 minutes before intubation showed the maximum attenuation of the hemodynamic responses that accompany laryngoscopy and endotracheal intubation during anaesthetic induction. Also, the complications were found to be minimal in Group III compared to the other groups.

INTRODUCTION

Hypertension and tachycardia occurring during laryngoscopy and endotracheal intubation in a light plane of anaesthesia has been reported since 1950 [1]. This increase in blood pressure and heart rate occurs most commonly from reflex sympathetic discharge in response to laryngotracheal stimulation, which in turn causes increased plasma norepinephrine concentration [2]. The response following laryngoscopy and intubation peaks at 1.2 minutes and returns to baseline within 5 to 10 minutes. Though these sympathoadrenal responses are probably of little consequence in healthy individuals, it is hazardous to those with hypertension, coronary artery heart disease, intracranial pathology and hyperactive airways. In such cases, these responses need to be suppressed. A frequent recommendation is to maintain the heart rate and blood pressure within 20% of the normal awake value for that patient.

Fentanyl is increasingly being used to effectively attenuate the stress response during anaesthetic induction. However there has been no evaluation of the optimal time of injection of small dose Fentanyl to effectively obtund the secondary circulatory responses to laryngoscopy and endotracheal intubation. Hence this study was designed to evaluate the optimal time for injecting small dose Fentanyl to effectively attenuate the circulatory responses accompanying laryngoscopy and intubation during anaesthetic induction.

MATERIALS AND METHODS

A study was done to examine the optimal time for injecting small dose Fentanyl during anaesthetic induction to attenuate circulatory responses to laryngoscopy and endotracheal intubation in patients posted for elective ENT surgeries. The study comprised of 80 patients in the age group 20 to 50 years. Both male and female patients posted for ENT surgeries were included for the study.

Inclusion criteria:

1. Patients in ASA physical status I & II
2. Patients with modified Mallampatti scores I & II
3. Age 20 to 50 years

Exclusion criteria:

- Patients in ASA physical status III & IV
- Patients with modified Mallampatti scores III & IV
- Patients with Systemic Hypertension, Coronary Artery Heart Disease,
- H/O Cerebrovascular Accidents, Chronic Renal Failure, Valvular Heart Diseases Patients on antihypertensives or cardiac drugs

In this study, patients were randomly assigned into 4 groups:

Group I: 20 patients were given Inj Pentazocine (500 µg / kg body weight) 5 minutes before intubation: which served as the control group.

Group II: 20 patients were given Inj Fentanyl (2 µg / kg body weight) 1 minute before intubation.

Group III: 20 patients were given Inj Fentanyl (2 µg / kg body weight) 5 minutes before intubation.

Group IV: 20 patients were given Inj Fentanyl (2 µg / kg body weight) 10 minutes

before intubation.

Premedication:

All the patients were given Tab Diazepam 10 mg orally the night before surgery. Tab Ranitidine 150 mg was given at 7 am on the morning of surgery. All the patients were given Inj Glycopyrrolate 5 µg / kg body wt intramuscularly 45 minutes before surgery.

Monitoring:

Patients were shifted to operation table and connected to standard multimonitor – ECG, NIBP and pulseoximeter. NIBP was recorded every minute for the initial time period up to 10 minutes after endotracheal intubation. The average of the first two preoperative values recorded 3 minutes apart were noted down which represented the operating room baseline values.

Induction and Intubation:

Patients were given Inj Fentanyl 2µg / kg body wt either 1 minute, 5 minutes or 10 minutes before laryngoscopy and endotracheal intubation according to the group to which they were assigned. Patients in the control group received Inj. Pentazocine 500µg / kg body weight 5 minutes before intubation. Patients were preoxygenated for 3 minutes. A priming dose of Vecuroni-

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um Bromide (0.01mg / kg body wt) was given; followed 4 minutes later by Inj Thiopentone Sodium (5mg / kg body wt). Inj Vecuronium (0.1 mg / kg body wt) was then given one minute after Thiopentone. Thereafter all the patients were manually ventilated with bag and mask with100% oxygen for 3 minutes. Laryngoscopy and intubation was then done and the time taken for the same was noted. Those that took more than 15 seconds were excluded from the study. After confirmation of the endotracheal tube position, anaesthesia was then maintained for the next 3 minutes with 67% Nitrogen and 33% Oxygen. No surgical stimulation was permitted for 5 minutes after intubation. The baseline, preintubation, during intubation, 1 minute after intubation and 3 minutes after intubation values of the circulatory variable such as heart rate and systolic blood pressure were recorded.

Changes in each circulatory variable after tracheal intubation were based on the differences between baseline values and values obtained 1 minute after intubation. The baseline and 1 minute postintubation values of HR and SBP were compared. These circulatory variables were compared among the groups. I compared the effectiveness of Fentanyl given 1 minute, 5 minutes and 10 minutes before intubation in obtunding the stress response to intubation, as shown by the increase in SBP and HR that follows laryngoscopy and intubation. We compared the effectiveness between the three groups and also with a control group which did not receive Fentanyl. Since the maximum stress is at one minute after intubation, we took it as the cutoff point to compare the effectiveness in attenuating the increase in SBP and HR from the baseline. The incidence of hypertension, hypotension, tachycardia, bradycardia and any dysrhythmias were recorded throughout the study period and compared among the groups.

DATA ANALYSIS:

All results were expressed as mean ± SD. The data were analysed using a repeated measures- analysis of variance (ANOVA) for within group comparisons. Differences among groups were analysed using a one-way ANOVA. A Tukeys test was used when a significant difference was indicated with the ANOVA procedure. Complication rates among patients were analysed using $\chi 2$ test. A P value of < 0.05 was considered statistically significant.

RESULTS

The heart rate and systolic blood pressure were the circulatory variables that were measured in this study. The operation room baseline value of these two variables was noted first. The preintubation, during intubation, 1 minute after intubation and 3 minutes after intubation values of these two variables were noted. There were no significant differences among the groups in the baseline values of systolic blood pressure and heart rate. There were significant differences among the

groups with respect to the preintubation, during intubation, 1 minute and 3 minutes after intubation values of SBP and HR. Changes in SBP and HR was greatest 1 minute after intubation. Hence these values were therefore used for comparison with the baseline values to determine whether there were intergroup as well as within group differences.

SBP (mm Hg)	CONTROL		GROUP II		GROUP III		GROUP IV	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
BASELINE	120.85	6.18	124.50	7.13	118.40	4.33	120.60	8.34
PRE	121.50	6.32	123.10	6.57	117.30	4.17	116.60	8.21
DURING	124.40	6.85	133.05	4.94	121.05	4.35	119.60	8.07
1 MIN AFTER	150.70	8.18	150.55	4.72	131.00	3.70	141.00	10.26
3 MINS AFTER	140.00	7.02	143.30	4.60	126.50	4.35	132.70	10.16

TABLE-1: SYSTOLIC BLOOD PRESSURE CHANGES IN THE FOUR GROUPS

TABLE-2 HEART RATE CHANGES IN THE FOUR GROUPS

HR (PER MINUTE)	CONTROL		GROUP II		GROUP III		GROUP IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
BASELINE	78.60	5.28	77.30	6.30	77.00	6.82	77.60	6.67
PRE INTUBATION	83.30	3.76	69.90	4.13	74.20	5.62	67.45	4.29
DURING INTUBATION	102.05	8.36	98.60	11.41	81.80	4.05	84.00	6.99
1 MIN AFTER INTUBATION	121.20	7.88	118.60	6.65	97.55	9.73	112.30	10.94
3 MINS AFTER INTUBATION	111.85	9.26	108.60	6.87	94.10	4.88	91.65	10.50

TABLE-3 COMPLICATIONS IN THE FOUR GROUPS

COMPLICATIONS	GROUP I	GROUP II	GROUP III	GROUP IV	Sig
Tachycardia	10	8	1	6	χ^2= 0.41 P = 0.02
Bradycardia	0	5	9	12	
Hypertension	12	5	2	5	χ^2= 2.86 P= 0.004
Hypotension	0	0	0	0	NIL
Chest rigidity	0	0	1	1	χ^2 = 2.05 P = 0.56

Dysrhythmias	**2**	**1**	**2**	**0**	**χ^2 = 2.35 P = 0.50**
Depression of Spontaneous ventilation	**0**	**0**	**1**	**5**	
Delayed recovery	**0**	**1**	**0**	**0**	
Post operative Respiratory depression	**0**	**0**	**1**	**0**	

DISCUSSION

Laryngoscopy and tracheal intubation are usually accompanied by increases in arterial blood pressure and heart rate [3]. This response is undesirable, especially in patients with cardiovascular and intracranial disease. Induction of anaesthesia is a critical phase in the anaesthetic procedure. Sympathetic response, coughing and straining during laryngoscopy and endotracheal intubation should be avoided. The transient nature of hypertension and tachycardia, that usually lasts about 10 minutes during laryngoscopy and intubation, might be the reason for the fewer incidences of complications in the normotensive patient. However in patients with compromised heart or with neurological disease, such transient nature of hypertension may itself precipitate heart failure and intraventricular haemorrhage. Since Fentanyl in large doses that were initially used to attenuate circulatory responses to intubation produce many side effects, small dose Fentanyl is increasingly being used to effectively attenuate the stress response during anaesthetic induction. However there has been no evaluation of the optimal time of injection of small dose Fentanyl to effectively obtund the secondary circulatory responses to laryngoscopy and endotracheal intubation. Hence this study was designed to evaluate the optimal time for injecting small dose Fentanyl to effectively attenuate the circulatory responses accompanying laryngoscopy and intubation during anaesthetic induction. For this study we used Inj. Fentanyl 2 μg / kg body weight before induction based on the study made by Nishina.K et al [4] & Bharat Chaudhary et al [5] who showed that this dose effectively blunted the increase in SBP, DBP, MAP and HR that accompanies laryngoscopy and intubation. Young et al (1998) [6] has done a similar study using Fentanyl 2μg/kg to obtund the intubation response.

SYSTOLIC BLOOD PRESSURE CHANGES:

In the study Pentazocine was used in the control group I. The stress response to laryngoscopy and intubation was not attenuated in the control group as shown by the statistically significant increase in the mean SBP value recorded at 1 minute after intubation from the baseline. This finding was in concordance with the study done by Young et al as well as with the study done by Adachi et al. In group II where Fentanyl was given 1 minute before intubation, the increase in mean SBP from baseline to 1 minute after intubation was also statistically significant, meaning that the stress response to laryngoscopy and intubation was not adequately obtunded. This finding was also in concordance to the study by Young et al. When Fentanyl was given 5 minutes before intubation as in Group III, the increase in mean SBP from baseline to 1 minute after intubation was the least among the four groups. This increase was not statistically significant proving that the pressor response to laryngoscopy and intubation was adequately obtunded in this group. This finding was also in accordance with Young et al study. In Group IV, the increase in mean SBP recorded at 1 minute after intubation from the baseline value was statistically not significant. This showed that the pressor response to intubation was adequately attenuated in this group. This finding however was not in concordance with the study of Young et al. From the above findings, both Group III and Group IV showed adequate attenuation of stress response to laryngoscopy and intubation. Multiple comparisons among the four groups by the Tukeys test showed that there was no statistical difference between groups I and II, as well as between Groups III and IV. Since the increase in mean SBP at 1 min after intubation was the least in Group III, it can be concluded that the pressor response to laryngoscopy and intubation is best attenuated when Fentanyl is given 5 minutes before intubation, which is consistent with the peak analgesic effect of Fentanyl. (Table-1)

HEART RATE CHANGES:

In the control group, the increase in mean heart rate recorded 1 minute after intubation from the baseline was statistically significant. This increase was the highest recorded among the four groups showing that there was no attenuation of stress response to laryngoscopy and intubation. This finding was in concordance with the study done by Young et al and by Adachi et al. In Group II, there was a statistically significant increase in the mean heart rate from the baseline to that recorded at 1 minute after intubation. This increase was the second highest recorded among the groups. This showed that there was no attenuation of stress response in Group II as well. This finding was in concordance to the finding by Young et al. Patient in Group III who received Fentanyl 5 minutes before intubation showed adequate attenuation of stress response as shown by the increase in heart rate from baseline which was not statistically significant. Also, it can be recalled from the graph that the value recorded is the least among the groups. This finding was also in concordance with the study made by Young et al. In group IV, the increase in heart rate from the baseline to 1 minute after intubation was not statistically significant. This shows that there was adequate attenuation of stress response to laryngoscopy and intubation in patients receiving Fentanyl 10 minutes before intubation. This finding was not in concordance with Young et al who showed that there was no adequate attenuation in this group. The multiple comparisons among groups showed that there was no statistically significant difference between groups III and IV. In this study, both Group III and Group IV showed adequate attenuation of stress response to laryngoscopy and intubation. Since the increase in mean heart rate was the least in Group III, it can be concluded that the attenuation of stress response to laryngoscopy and intubation is best achieved by giving low dose Fentanyl 5 minutes before intubation, which is consistent with its peak analgesic effect.(Table-2) This finding was in concordance to the study of Young et al.

COMPLICATIONS:

Hypertension was defined as an increase in SBP more than 120% of the patient's baseline value. Hypotension was defined as SBP less than 70 % of the patient's baseline value. Tachycardia and bradycardia were defined as a heart rate greater than 120 bpm and less than 60 bpm respectively. A dysrhythmia was defined as any ventricular or supraventricular premature beat or any sustained rhythm that is other than sinus rhythm. Depression of spontaneous respiration before Thiopentone was defined as a fall in SPO2 value to less than 92% with an oxygen mask. Chest rigidity was defined as an increase in the resistance to bag and mask ventilation. Delayed recovery was defined as the failure of the patient to wakeup even 20 to 30 minutes after the termination of anaesthesia, thus preventing or delaying the extubation of the trachea. Postoperative respiratory depression was defined as a fall in respiratory rate to less than 12 and a fall in SPO2 value to less than 92% in the post anaesthesia care unit. These complications were recorded throughout the study period and compared among the groups. Hypertension occurred mostly in Groups I and II. This difference was statistically significant. This showed that the attenuation to pressor response to laryngoscopy and intubation was not adequate in these two groups. This was in concordance to the study done by Young et al. Only 7 out of the 40 patients in groups III and IV had hypertension, prov-

ing that the stress response was better obtunded in these two groups.

Tachycardia also followed the same pattern showing higher incidence in groups I and II. This was also statistically significant. Group III had the least incidence followed by Group IV, again proving that there was better attenuation of stress response in these groups. This was also in accordance to Young et al. Bradycardia occurred commonly in groups III and IV, maximum number being in Group IV. There was no case of bradycardia in the control group. This also was in concordance to the study by Young et al. Bradycardia is a well recognized side effect of Fentanyl. In this study, though 26 patients had bradycardia, none of them resulted in any haemodynamic instability. Only 4 required Inj Atropine sulphate 0.6 mg IV stat to treat it. Truncal rigidity or chest rigidity was seen in 2 patients. This is also another recognized troublesome side effect of Fentanyl. But in both these cases, there was no interference with ventilation, and it was effectively managed with bag mask assisted ventilation. This was statistically not significant. Young et al in his study had no case of chest rigidity in his patients. Dysrhythmias were noted in only 5 patients. All of these were ventricular premature beats. None of these cases had hemodynamic instability. All of these disappeared spontaneously. There was no statistically significant difference. Young et al in his study noted dysrhythmias mainly in the control group. Lindgren and Saarnivaara (1987) [7] in their study proved that Fentanyl in doses of 1, 2 or 3μg/kg body wt provided adequate protection against cardiac arrhythmias during induction of anaesthesia. But in my study, I noted dysrhythmias in 3 of the Fentanyl treated patients. Depression of spontaneous ventilation occurred mostly in Group IV (5 patients). This is also a well recognized side effect of Fentanyl. Since the time interval between administering Fentanyl and the actual anaesthetic induction was high (around 7-8 minutes) in Group IV, this might be the reason for the higher incidence of this complication in this group. In my study, none of the patients in all the groups were left unattended after giving Fentanyl remembering this potential complication. Once the SPO2 fell to 92% in room air, 100% O2 was administered through bag and mask. There was one case of delayed recovery in Group II. But this was due to the surgery ending quicker than expected. The patient eventually recovered after 15 minutes and was extubated uneventfully. This was not statistically significant. Post operative respiratory depression occurred in only 1 patient in Group III. This is also a recognized side effect of Fentanyl. He was efficiently managed at Post anaesthesia care unit. This was also not statistically significant.(Table-3)

Many studies have reported a beneficial effect of Fentanyl as an adjunct to barbiturate induction. Dahlgren and Messeter [8] have shown that 5 μg / kg of Fentanyl given before intubation effectively blunts the cardiovascular stress responses to intubation in neurosurgical patients. Using 8 μg / kg Fentanyl preloading, Martin et al. [9] demonstrated that Fentanyl abolishes both the heartrate and blood pressure increases related to tracheal intubation and prevents an increase of pulmonary capillary wedge pressure during the induction of anaesthesia with Thiopentone. Nishina.K & Mikawa.K et al (1995) [37] in their study has shown that Fentanyl 2 μg/kg attenuated the increases in HR, SBP and DBP more effectively than Fentanyl 1 μg/kg and concluded that a bolus dose of Fentanyl 2 μg/kg given at the time of peritoneal closure was of value in attenuating the cardiovascular changes associated with tracheal extubation and emergence from anaesthesia, and that this treatment did not prolong the recovery. Adachi.Y, Takamatsu.I & Harada.M et al (1998) [10] in their study compared the effects of Fentanyl 4 μg/kg, Pentazocine 0.5 mg / kg and buprenorphine 5 μg/kg administered 5 minutes before Thiopentone induction and concluded that only Fentanyl 4 μg/kg diminished the circulatory responses of systolic blood pressure to the stimulation of endotracheal intubation. Unlike sympathetic blockers, vasodilators and local anaesthetics, Fentanyl can produce potentially disturbing side effects, such as skeletal muscle rigidity and postanaesthetic respiratory depression.

CONCLUSION:

A small dose Fentanyl in the dose of 2μg/kg body weight when given 5 minutes before intubation adequately attenuates the circulatory response to laryngoscopy and endotracheal intubation without producing major complications.

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