Original Article

Attenuation of pressor response to laryngoscopy and intubation: A comparative study of efficacy of topical nitroglycerine, sublingual nifedipine and intravenous lignocaine

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Abstract

Background: Laryngoscopy and tracheal intubation frequently induce a cardiovascular stress response and may cause profound alteration of the hemodynamic state as consequences of anesthetic drug effects. A lot of methods have been tried to attenuate the cardiovascular response to laryngoscopy and intubation. **Material and Methods:** Study was carried on 100 patients aged between 20 to 60 years and randomly divided into 4 groups of 25 each as Group I (Control group), Group II (nitroglycerine 2% topically), Group III (nifedipine sublingually), Group IV (2% xylocaine intravenously) prior to intubation. Pulse rate, systolic and diastolic blood pressure were recorded at different time intervals. **Results:** The highest increase in pulse rate was in control Group I and less increase in lignocaine Group IV. Comparison of control Group I with Nitroglycerine Group II, Nifedipine Group III, Lignocaine Group IV there was statistically highly significant difference in the changes in mean systolic blood pressure at all the time intervals. **Discussion:** Intravenous lignocaine was more effective in attenuating the pulse rate and rate pressure product response to laryngoscopy and intubation, while topical nitroglycerine was best in attenuating the blood pressure.
Key Words: Pressor response, laryngoscopy, tracheal intubation, nitroglycerine.

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INTRODUCTION

Laryngoscopy and tracheal intubation frequently induce a cardiovascular stress response and may cause profound alteration of the hemodynamic state as consequences of anesthetic drug effects administered perioperatively and the adrenergic state of the patient[1]. The frequent occurrence of cardiovascular responses to laryngoscopy and tracheal intubation has attracted the attention of anaesthesiologists for more than 5 decades. The reason for this is an occasional report of sudden death immediately after intubation and increasing awareness about the common occurrence of potentially dangerous responses such as tachycardia, hypertension and arrhythmias after this routine procedure. Following laryngoscopy with or without intubation, plasma concentration of catecholamines is increased and there may be associated myocardial ischemia and cerebral hemorrhage[2-4]. Exaggerated cardiovascular response to laryngoscopy and endotracheal intubation has attracted the attention of many workers in this field over the last few years. A lot of methods like deep general anaesthesia with ether and fentanyl have been tried to attenuate the cardiovascular response to laryngoscopy and endotracheal intubation[5]. Intravenous and topical lignocaine[6,7], intranasal and topical nitroglycerine [8]or sublingual nifedipine[9] were also used by some workers. In this study

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intravenous lignocaine with its well established role of central depression and antiarrhythmic action, topical nitroglycerine [2%] and sublingual nifedipine [10mg] were used to attenuate the cardiovascular response to laryngoscopy and endotracheal intubation and their effects were evaluated.

MATERIAL AND METHODS

This study was conducted on 100 patients of both sexes in the age group between 20-60 years belongs to ASA Grade I and II posted for general surgical, orthopaedic and gynaecological procedures. A routine pre-anaesthetic examination was done on the day prior to surgery, anaesthetic plan was explained to patients and written consent was taken. Patients with hypertension, diabetis mellitus, ischaemic heart disease, pulse rate<60 beats/minute, systolic BP <100 mm Hg, conduction abnormality in ECG and history of myocardial infarction were excluded from the study. All the selected patients for study were pre-medicated with tab Diazepam on the previous night and 0.2 mg/kg diazepam in recovery room. No anticholinergic drug was given either for premedication or at induction of anaesthesia. Study was carried on 100 patients aged between 20 to 60 years and randomly divided into 4 groups of 25 each.

Group I: Control group

Group II: Received nitroglycerine 2% topically [30 mg], 15 minutes prior to intubation.

Group III: Received 10 mg nifedipine sublingually 15-20 minutes prior to intubation.

Group IV: Received 2% lignocaine intravenously [1.5 mg/kg], 3 minutes prior to intubation.

The blood pressure and pulse rate were recorded prior to induction and were monitored with non-invasive blood pressure monitor and cardiac monitor and pulse oximetry. After securing a peripheral intravenous line, all the patients were pre-oxygenated with 100% oxygen for 3 minutes. Induced with 2.5% thiopentone sodium in a dose of 5 mg/kg, paralyzed with succinylcholine 2 mg/kg. Laryngoscopy and intubation performed after 90 seconds with MacIntosh laryngoscope. Intubation done with an appropriate size, cuffed endotracheal tube. The cuff inflated and air entry confirmed bilaterally. Tube fixed and connected to Bain's circuit.Anaesthesia was maintained with nitrous oxide [50%] and oxygen [50%]. IPPV and with muscle relaxant pancuronium 0.8 mg/kg. At the end of operation, patients were reversed using inj. Neostigmine 0.05 mg/kg and inj. Atropine 0.02 mg/kg diluted and given. No surgical stimulus was allowed upto 5 minutes of intubation.

Pulse rate, systolic and diastolic blood pressurewere recorded at different time intervals.

1. pre induction.
2. at laryngoscopy.
3. 1st minute after laryngoscopy.
4. 2nd minute after laryngoscopy.
5. 5th minute after laryngoscopy.

RESULTS

The highest age in this study was 60 years and lowest was 20 years.The study comprised male 55 patients and female 45 patients. Commonest type of surgery done was surgical (Table 1).

Table 1: Distribution of parameters among different groups

Parameters	Group I Control	Group II Nitroglycerine	Group III Nifedipine	Group IV Xylocaine
Age Group (year)				
20-29	10	05	12	10
30-39	06	05	05	06
40-49	02	09	05	05
50-60	07	06	03	04
Sex				
Male	14	12	11	08
Female	11	13	14	17
Type of surgery				
Surgical	22	23	21	22
Orthopedic	01	01	01	02
Gynaecological	02	01	03	01

Increase in pulse rate was significant in all four groups. Maximum increase in pulse rate was first minute after laryngoscopy and endotracheal intubation. The highest increase in pulse rate was in control Group I and less increase in lignocaine Group IV (Table 2).

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Table 2: Mean pulse rate in the various groups at different time intervals

Time interval	Group I [control]	Group II [Nitroglycerine	Group III [Nifedipine]	Group IV [Xylocaine]
Pre-operative	81.44±5.0	79.68±4.68	81.48±7.98	81.56±8.68
Pre induction	85.92±8.52	84.28±4.52	87.20±7.82	84.64±7.12
During laryngoscopy	108.48±8.52	100.48±4.47	106.2±9.33	94.84±9.86
1 min after laryngoscopy and ETI	113.48±6.24	106.48±4.51	109.88±7.75	100.56±8.73
3 mins after laryngoscopy and ETI	111.24±6.72	101.92±4.76	105.56±9.2	93.44±11.16
5 mins after laryngoscopy and ETI	102.52±7.00	97.52±4.16	101.28±9.59	88.00±11.16

Between control Group I and Group II nitroglycerine there was statistically significant changes in mean pulse rate during laryngoscopy and at 5th minutes and highly significant difference at 3 minutes after laryngoscopy and intubation. Between control Group I and nifedipine Group III there was no statistically significant difference at the time of 3 minutes of laryngoscopy and intubation. Between control group I and xylocaine Group IV highly significant difference at the all the intervals. Between nitroglycerine Group II and Nifedipine Group III there was highly significant difference during laryngoscopy and significant difference 1 minute after laryngoscopy, but no significant difference at 3rd and 5th minute. Between nitroglycerine and xylocaine and nifedipine and xylocaine there was statically highly significant difference in changes of mean pulse rate at all time intervals. Table 3 shows mean systolic blood pressure in various groups at different intervals.

Table 3: Mean systolic blood pressure in various groups at different intervals

Time interval	Group I [control]	Group II [nitroglycerine]	Group III [nifedipine]	Group IV [xylocaine]
Pre-operative	122.48±6.46	119.12±6.24	119.76±5.63	121.04±5.03
Pre induction	127.12±5.74	121.52±5.72	122.16±5.28	123.04±5.41
During laryngoscopy	150.16±8.10	127.84±5.85	131.76±7.00	139.68±7.34
1 min. after laryngoscopy and ETI	155.2±10.06	132.08±5.55	134.64±5.76	146.8±5.59
3 mins after laryngoscopy and ETI	149.84±10.01	123.84±5.82	128.48±5.17	137.68±5.37
5 mins after laryngoscopy and ETI	137.76±8.37	117.76±5.92	123.04±3.16	129.92±4.52

Comparison of control Group I with Nitroglycerine Group II, Nifedipine Group III, xylocaine Group IV there was statistically highly significant difference in the changes in mean systolic blood pressure at all the time intervals. Between nitroglycerine group II and Nifedipine Group III there was statistically significant difference at laryngoscopy and endotracheal intubation 1st minutes, 3rd minute and 5 minutes in mean systolic blood pressure. Between nifedipine Group III and xylocaine Group IV there was statistically significant difference in mean systolic blood pressure at all time intervals. Table 4 shows mean diastolic blood pressure in various groups at different intervals.

Table 4: Mean diastolic blood pressure in various groups at different time intervals

Time interval	Group I [Control]	Group II [Nitroglycerine]	Group III [Nifedipine]	Group IV [Xylocaine]
Pre-operative	80.88±4.28	78.80±3	79.44±4.60	79.12±4.73
Pre induction	84.56±4.06	80.64±2.87	80.96±3.79	80.56±4.02
During laryngoscopy	103.60±7.63	86±3	90.72±5.99	92.88±5.03
1 min. after laryngoscopy and ETI	108.88±9.14	89.92±3.80	92.08±4.94	98.24±4.29
3 mins after laryngoscopy and ETI	101.04±6.53	83.36±3.25	85.84±5.41	91.20±3.10
5 mins after laryngoscopy and ETI	95.20±5.29	78.32±2.80	81.68±4.49	85.12±3.78

Between control Group I and Nitroglycerine Group II, Nifedipine Group III, xylocaine Group IV there was a statistically highly significant difference in the changes of mean diastolic blood pressure at all time intervals. Between nitroglycerine group II and Nifedipine Group III there was statistically significant difference in the changes of mean diastolic blood pressure at all time intervals except at 1 minute after laryngoscopy and intubation. Between nitroglycerine Group II and xylocaine Group IV there was highly significant difference in the changes of mean diastolic blood pressure at laryngoscopy and intubation and 1st, 3rd and at the end of 5th between nifedipine Group III and xylocaine Group IV there was statistically highly significant difference at 1st minutes, 3rd minutes and at the end of 5th minute after laryngoscopy and intubations. Between control Group I and Nitroglycerine Group II, control Group I and Nifedipine Group III, control Group I and xylocaine Group IV, nitroglycerine Group and xylocaine Group there was statistically highly significant difference in the changes of mean arterial pressure at all the time intervals. Between nitroglycerine Group II and Nifedipine Group III there was no statistically significant change in mean arterial pressure. Between nifedipine Group III and xylocaine Group IV there was statistically significant difference in mean arterial pressure at laryngoscopy and highly significant difference in changes in mean arterial pressure at 1.3 and 5 minutes after laryngoscopy and intubation.

Table 5: Mean arterial pressure in the various groups at different time intervals

Time interval	Group I [control]	Group II [Nitroglycerine]	Group III [Nifedipine]	Group IV [xylocaine]
Pre-operative	94.75±4.56	92.33±3.71	92.87±4.50	93.36±3.99
Pre induction	98.74±4.12	94.26±3.38	94.69±3.59	94.72±4.18
During laryngoscopy	119.12±7.17	99.94±3.44	104.4±5.54	108.14±4.99
1 min. after laryngoscopy and ETI	124.32±8.88	103.97±3.90	106.26±4.36	114.42±3.22
3 mins after laryngoscopy and ETI	117.31±6.78	96.85±3.61	100.05±4.32	106.69±3.41
5 mins after laryngoscopy and ETI	109.38±5.71	91.46±3.40	95.47±3.39	100.05±3.52

In control Group I the pre-operative mean rate pressure product value of 9967.04±708.38 has increased to 16298.16±1654.98 during laryngoscopy and to 17569.20±1345.49 at the 1st minutes after laryngoscopy. The value at the end of 5th minute after laryngoscopy and endotracheal intubation was 14129.76±1388.37. In Nitroglycerine Group II, the pre-operative mean rate pressure product was 9337.52±1198.14. It increased to 12848.64±874.22 during laryngoscopy and to 14068.80±920.87 after the 1st minute after endotracheal intubation. It decreased to 11488.64±827.11 at the end of 5th minute after laryngoscopy and intubation. In Nifedipine Group III, the pre-operative value of 9737.68±820.49 has increased to 14003.04±1555.46 during laryngoscopy and to 14796±1261.64 after the 1st minute after endotracheal intubation. It decreased to 12387.2±1158.66 at the end of 5th minute after laryngoscopy and intubation. In xylocaine Group IV, the pre-operative value was 9871.04±1140.48 has increased to 13269.44±1860.56 during laryngoscopy and to 14775.84±1576.45 after the first minute after endotracheal intubation. It decreased to 11419.28±1389.02 at the end of 5th minute after laryngoscopy and intubation.

DISCUSSION

Laryngoscopy and endotracheal intubation elicit adrenergic responses that precipitate transient but intense increase in heart rate. Blood pressure and arrhythmias. The rise of blood pressure and pulse rate depends upon various factors namely light planes of anaesthesia, repeated attempts at laryngoscopy and intubation, prolonged laryngoscopy, coughing straining at induction, respiratory obstruction giving rise to hypoxia and hypercarbia. These changes are insignificant in healthy normotensive patients this sympathoadrenal response result in increased cardiac work load which in turn may culminate in perioperative myocardial ischemia, infarction, rhythm disturbances, acute heart failure, pulmonary edema and ventricular arrhythmias in susceptible individual owing to sudden increase in myocardial oxygen demand. This response is undesirable in patients with hypertension, cardiovascular diseases, cerebrovascular diseases, PET, hyperthyroidism etc., it is therefore advisable to attenuate the pressor response to laryngoscopy and intubation. Present study was done to observe the cardiovascular response to laryngoscopy and endotracheal intubation in normotensive patients to find out the efficacy of nitroglycerine, sublingual nifedipine and IV lignocaine in attenuating the haemodynamic response. In our study, hypoxia was avoided by pre-oxygenating with 100% for 3 minutes in all cases. Adequate elimination of CO2 was ensured by controlled ventilation technique. No anticholinergic drug was given either for premedication or at the time of induction of anaesthesia. The pre-operative pulse rate was similar in all four groups. There was small increase in pulse rate before induction probably due to anxiety. There was a significant rise in pulse rate during laryngoscopy and endotracheal intubation in all four groups. This increase in pulse rate from pre-operative period to laryngoscopy was significant between I and II ($p<0.05$) and II and III ($p<0.05$) highly significant between groups I and IV ($p<0.001$) groups II and IV ($p<0.001$). patients receiving IV lignocaine had the lowest variation in pulse rate. The pulse rate variation in group III was similar to that of control group. The pulse rate was found to be highest one minute after laryngoscopy and intubation, the rise in pulse rate was maximum in group I and least in group IV. This difference between group I and IV was statistically highly significant. IV lignocaine appeared to be the best in attenuating the pulse rate response to laryngoscopy and endotracheal intubation, nifedipine and nitroglycerine are not effective in controlling pulse rate response. The systolic blood pressure preoperatively was compared in all four group averaging 120 mm Hg. The systolic blood pressure rose in all group with laryngoscopy. The increase being maximum in the control group I[27.68±8] and least in the nitroglycerine group II (8.72±1.6). the increase in systolic blood pressure in group III and IV was less than the control group (12.00±8.3) (18.64±6.8). The systolic blood pressure was highest 1 minute after intubation in all the groups, patients receiving nitroglycerine had least rise (12.96±2.2) at the end of 5 minute it was below baseline (-1.2±2.4). Nifedipine [III] was not as effective as nitroglycerine in attenuating the systolic blood pressure, but was better than xylocaine. The difference in increase in systolic blood pressure was highly significant between group I and II, I and III, I and IV. The systolic blood pressure was significantly highly

event at the end of 5 minutes after laryngoscopy in group I, whereas, the hypertensive response lasted for only 1 minutes after laryngoscopy in the other groups.These observations suggest that though nitroglycerine and nifedipine effectively attenuates the pressor response. The increase in systolic blood pressure was not totally prevented.Safavi M *et al*[7] also found that the nifedipine-treated group showed both greater MAP variability and a greater maternal HR response than the nitroglycerine-treated group after laryngoscopy and tracheal intubation, sublingual nifedipine induces a greater variability in the arterial baroreflex system. Van den Berg *et al*[10] compared the effects of lidocaine and nitroglycerine on the prevention of stress in laryngoscopy, and showed that nitroglycerine successfully prevented an increase in BP. In a study by Mikawak *et al*[11], it was shown that administration of a single dose of intravenous nitroglycerine was a safe and effective method for attenuation of the hypertensive response following intubation. In a study performed in Greece[8,11] on women who received nitroglycerine before induction of anesthesia, it was found that nitroglycerine effectively attenuated the increase in BP after laryngoscopy. The mean diastolic blood pressure was comparable in all groups pre-operatively. The rise in diastolic blood pressure was during laryngoscopy and I minute laryngoscopy and intubation. The rise I diastolic blood pressure was highest in the control group [28.0±9.1]at 1 minute after laryngoscopy and intubation followed by group [IV] lignocaine [19.12±5.5]. least in group II [11.12±2.3] and IV [12.64±4.2].The increase in diastolic blood pressure persisted even at the end of 5 minute in group I. in group II, III and IV lasted for one minute after laryngoscopy and intubation. The changes in diastolic blood pressure were highly significant between group I and II, I and iii and I and IV.

The rate pressure product correlates with myocardial oxygen consumption. It is desirable to keep the rate pressure product at<15,000 so as to reduce the myocardial oxygen consumption. In this study, the peak value of rate pressure product was seen at 1 minute after laryngoscopy and endotracheal intubation. It was highest in control group I [17569.20±1345.49]. the rate pressure product was least in xylocaine group [1548.24±512.6] at 5 minutes after laryngoscopy and endotracheal intubation. The difference between group I and II, I and III, I and IV were highly significant. At five minutes it was highly significant between II and IV, III and IV. Between nitroglycerine [II] and nifedipine [III], nitroglycerine [II] was better in attenuating the rise in rate pressure product at all stages. IV lignocaine [Group IV] proved best at controlling rate pressure product, even though its attenuation of pressor response was inferior to nitroglycerine [Group II] and nifedipine [Group III]. It was observed from the study that laryngoscopy and endotracheal intubation were associated with a definite increase in pulse rate and systolic, diastolic and mean sublingual nifedipine effectively attenuated the pressor response, but were of not much use in preventing rise in pulse rate. Nitroglycerine appears to be more effective. Kumari *et al*[13] also observed similar findings. Intravenous lignocaine was most effective in preventing a rise in pulse rate with laryngoscopy and endotracheal intubation. Though it was not effective in attenuating the pressor response when compared to the other two drugs. The rate pressure product was best controlled with lignocaine. Out study concludes that IV lignocaine was more effective in attenuating the pulse rate and rate pressure product response to laryngoscopy and intubation, while topical nitroglycerine was best in attenuating the blood pressure.

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