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Research Article

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To Compare Efficacy and Safety of Intravenous Nitroglycerine with Topical Nitroglycerine [ORAL NTG SPRAY] During Laryngoscopy and Intubation

Dr. Jigneshkumar L Parmar[1], Dr. Zakiyabegum Saiyed[2], Dr. Jyotsna Baria[3], Dr. Saumil Shah[4], Dr. Sejal Kalara[5] and Dr. Vismit Gami[6*]

[1]Department of Anaesthesiology GMERS Medical college, Godhra

[2]Department of Anaesthesia Parul Sevashram Hospital, Waghodiya, Vadodara

[3]Department of Anaesthesia Zydus medical College and hospital, Dahod

[4]Department of Anaesthesia Shardaben General Hospital, NHLMMC, Ahmedabad, Gujarat

[5]Department of Community Medicine GMERS Medical College, Godhra

[6]Smt. NHL Municipal Medical College, Ahmedabad, India

[*]Corresponding Author
Vismit Gami, Smt. NHL Municipal Medical College, Ahmedabad, India.

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Abstract

Hypertension and tachycardia following tracheal intubation can lead to serious complications such as myocardial ischemia and increased intracranial pressure. Various agents, including nitroglycerin (NTG), have been used to attenuate these hemodynamic responses. This study evaluates the efficacy of intravenous (IV) and oral transmucosal NTG spray in mitigating pressor responses during laryngoscopy and intubation. Results indicate that both forms of NTG effectively prevent significant increases in blood pressure while causing transient tachycardia. Findings align with previous research, suggesting NTG as a viable option for hemodynamic stabilization during intubation.

Keywords: Nitroglycerin (NTG), Hemodynamic Response, Tracheal Intubation, Hypertension Attenuation, Tachycardia Management

Abbreviations

No- Number
P- Pulse
BP- Blood Pressure
Temp- Temperature
RR- Respiratory Rate
RS- Respiratory System
CNS- Central Nervous System
CVS- Cardio Vascular System
P/A- Per Abdomen
HB- Haemoglobin
PT- Prothrombin Time
LFT- Liver Function Test
Tc- Total count
APTT- Activated Partial Thromboplastin Time
RFT- Renal Function Test
PC- Platelet Count
HIV- Human Immune Deficiency virus
HBsAg- Hepatitis B Surface Antigen
SE- Serum Electrolytes
RBS- Random Blood Sugar
ECG- Electrocardiogram
CXR- Chest x ray
MCG- Microgram
KG- Kilogram
M- Male
F- Female
ASA- American Society of Anaesthesiologists
IV- Intravenous
SD- Standard Deviation
Inj.- Injection

1. Introduction

Laryngoscopy and intubation in the anaesthetized patient are associated with significant increase in blood pressure and the heart rate. These increases in the pulse rate and blood pressure are usually of short duration and well tolerated by healthy patients. However, in patients with hypertension, infraction and cardiovascular diseases, these changes may lead to complications like MI, dysrhythmia, cardiac failure and cerebrovascular catastrophes [1,2].

These changes occur from reflex sympathetic discharge resulting from pharyngeal and laryngotracheal stimulation with increase in plasma concentration of epinephrine and nor- epinephrine. This reaction is not prevented by regular pre-medication [3,4].

Many methods have been identified to attenuate pressure response including inhalation agents, narcotics, vasodilators, adrenergic and calcium channel blockers. Nitroglycerine has been identified as an effective agent in this regard. Nitroglycerine is effective in blunting the pressure response to laryngoscopy and intubation with different route with different dose. Off course it would have some side effects like hypotension and tachycardia. But with doses used in clinical setting to attenuate this pressure response, side effects are minimal [5].

This study therefore designed to compare the safety and efficacy of intravenous nitroglycerine 2mcg/kg and oral nitroglycerine spray one puff (400mcg/puff) in attenuation of hemodynamic effects during laryngoscopy and intubation.

2. Aims and Objectives

The aim of the study is to compare efficacy and safety of Intravenous Nitroglycerine with Topical Nitroglycerine (oral NTG spray) during laryngoscopy and intubation.

The Objectives

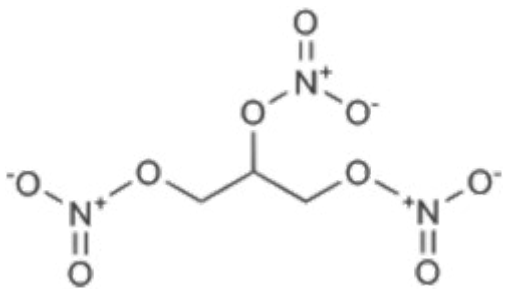
To compare

1. Change in the heart rate in both the groups.
2. Change in the systolic arterial pressure, diastolic arterial pressure and mean arterial pressure in both the groups.
3. Occurrence of arrhythmias and any other side effects in both the groups.

3. Pharmacology

Nitroglycerine

Chemical Structure



Nitroglycerin (NG), known also as nitroglycerine, trinitroglycerin, trinitroglycerine, or nitro,more correctly as glyceryl trinitrate. Molecular formula- $C_3H_5N_3O_9$, clear liquid in appereance. Dilation of peripheral arteries and veins due to relaxation of vascular smooth muscle.

Pharmacokinetics

Absorption: Rapid.

Distribution Protein binding is approximately 60% (parent); 1,2 dinitroglycerin is 60%; 1,3 dinitroglycerin is 30%.

Metabolism Primarily metabolized in the liver by nitrate reductase to inorganic nitrate and the active 1,2 and 1,3 dinitroglycerols.

Elimination Serum half-life is 3 min (Minitran) and 1 to 8 min (sublingual). Clearance is 1 L/kg/min (Minitran).

Onset of Action

1 to 2 min (IV), 1 to 3 min (sublingual), and 1 h (ER).

Peak Effect

1 to 4 h (immediate-release tablet), 6 to 7 min (sublingual), and 2 h (transdermal).

Duration

3 to 5 min (IV), 30 to 60 min (sublingual), 5 h (ER), and up to 12 h (transdermal ointment).

Indications and Usage

Aerosol Spray, Sublingual Tablets

Acute relief of an attack or prophylaxis of angina pectoris caused by coronary artery disease.

ER Capsules, Transdermal Ointment, Transdermal Patch

Prevention of angina pectoris caused by coronary artery disease.

Intra Venous

- Treatment of perioperative hypertension;
- Control of CHF in the setting of acute MI;
- Treatment of angina pectoris in patients not responding to sublingual nitroglycerin and beta-blockers;
- Induction of intraoperative hypotension.

Rectal Ointment

Treatment of moderate to severe pain associated with chronic anal fissures.

Unlabeled Uses Intra Venous

- Management of acute MI;
- Treatment of hypertensive emergencies;
- In combination with vasopressin to treat variceal bleeding,
- Cocaine-induced acute coronary syndrome;
- Management of Prinzmetal angina occurring in patients without coronary heart disease;

• Management of sympathomimetic-induced cardiopulmonary toxicities.

Sublingual
• Management of acute MI;
• Management of Prinzmetal angina occurring in patients without coronary heart disease.

Transdermal
• Management of acute MI;
• Treatment of Prinzmetal angina occurring in patients without coronary heart disease;
• Treatment of chronic anal fissure pain (ointment); erectile dysfunction; Raynaud disease.

Contraindications
Allergy to organic nitrates; patient using phosphodiesterase type 5 inhibitors (PDE5) (eg, sildenafil, tadalafil, vardenafil).

Pericardial tamponade; restrictive cardiomyopathy; constrictive pericarditis; solutions containing dextrose in patients with known allergy to corn or corn products.

Early MI; severe anemia; increased intracranial pressure.

Dosage and Administration Adults Aerosol Spray
1 or 2 sprays onto or under tongue at first sign of acute angina attack; repeat every 5 min (do not exceed 3 sprays in 15 min). Also, may be used 5 to 10 min before activity that might precipitate an anginal attack.

ER Capsules
2.5 to 6.5 mg 3 to 4 times daily initially, titrate to response.

Sublingual Tablets
0.3 to 0.6 mg dissolved under the tongue or in buccal pouch at first sign of acute angina attack; repeat every 5 min (do not exceed 3 tablets in 15 min). Also, may be used as a single dose 5 to 10 min before activity that might precipitate an anginal attack.

Transdermal Ointment
Initially, ½-inch dose applied twice daily (upon arising in the morning and 6 h later). May double dose in patients tolerating this dose but failing to respond to it.

Transdermal Patch
Initially, 0.2 to 0.4 mg/h patch applied once daily; titrate dose to response. Remove patch after 12 to 14 h to provide nitroglycein-free interval.

Perioperative Hypertension, Induction of Intraoperative Hypotension, Refractory Angina, CHF Secondary to Acute MI Adults
IV 5 mcg/min initially using nonabsorbing infusion set or 25 mcg/min using a polyvinyl chloride (PVC) administration set; titrate to response. Initial dose (non-PVC set) titration should be in 5 mcg/min increments every 3 to 5 min until some response is observed. If no response occurs at 20 mcg/min, increments of 10 to 20 mcg/min can be used. Once a partial BP response is observed, reduce dose and lengthen interval between dose increases.

Drug Interactions
Alcohol Severe hypotension and CV collapse may occur.

Beta-Blockers (eg, Propranolol) Beta-blockers blunt the reflex tachycardia produced by nitroglycerin without preventing its hypotensive effects. Additional hypotensive effects may occur.

Calcium Channel Blockers Symptomatic orthostatic hypotension may occur.

Ergot Alkaloids (eg, Dihydroergotamine) May increase systolic BP and decrease antianginal effects.

Heparin May decrease anticoagulation effect when used in conjunction with IV nitroglycerin. Monitor the patient's anticoagulation status.

Salicylates (eg, Aspirin) Vasodilatory and hemodynamic effects of nitroglycerin may be enhanced.

Adverse Reactions
Cardiovascular Crescendo angina, hypotension, palpitations, rebound hypertension, syncope, vasodilatation.

CNS Asthenia, dizziness, headache, light-headedness, paresthesia, restlessness, vertigo, weakness.

Dermatologic Allergic reactions including contact dermatitis or fixed drug eruptions (ointment or patches), drug rash, exfoliative dermatitis, flushing, perspiration.

GI Abdominal pain, burning or tingling in the oral cavity (sublingual), nausea, vomiting.

Hematologic-Lymphatic Methemoglobinemia.

Miscellaneous Application-site irritation (trans dermal), Collapse, pallor, peripheral edema.

Storage/Stability
Store ER capsules, aerosol spray, trans dermal ointment, trans dermal patch, solution for injection, and rectal ointment at controlled room temperature (59° to 86°F).

Protect from freezing and light. Discard any unused solution. The rectal ointment should be discarded after 8 weeks of first opening.

Store premixed nitroglycerin with dextrose at room temperature of 77°F. (brief exposure up to 104°F does not affect product).

Store sublingual tablets at controlled room temperature (68° to 77°F). Protect sublingual tablets from moisture.

4. Review of Literature

Cardiovascular response to laryngoscopy and intubation of the trachea are recognized since long and various attempts have been made to attenuate these responses by use of different drugs, techniques or combination of both.

Shribman AJ (1987) had compared the catecholamine and cardiovascular responses to laryngoscopy alone and also had been compared with those following laryngoscopy and intubation in 24 patients allocated randomly to each group.

Following induction and following laryngoscopy, the vocal cords were visualized for 10 s. In one group of patients, ventilation was then re-instituted via a face mask, while in the second group the trachea was intubated during the 10-s period and ventilation of the lungs maintained. Arterial pressure, heart rate and plasma noradrenaline and adrenaline concentrations were measured before and after induction and at 1, 3 and 5 min after laryngoscopy.

There were significant and similar increases in arterial pressure and circulating catecholamine concentrations following laryngoscopy with or without intubation. Intubation, however, was associated with significant increases in heart rate which did not occur in the laryngoscopy-only group.

Iwasaka H (1993) had compared the efficacy of intranasal administration of Trinitroglycerine spray and that of TNG solution during general anesthesia in nineteen patients were randomly assigned to receive either 0.3 mg TNG solution (Solution group) or 0.3 mg TNG spray (Spray group) intranasally.

Two min after drug administration, systolic blood pressure decreased significantly in both groups, and this level persisted for 10 min. Diastolic blood pressure also decreased in the spray group, but not in the solution group. Heart rate increased significantly in both groups 2 min after drug administration. Oxygen index (PaO_2/FIO_2) decreased significantly in both groups, and the level persisted 10 min after administration.

Although no significant differences were found between two nitroglycerin forms in any of these hemodynamic and respiratory parameters, nitroglycerin spray may have clinical advantages because of reliability in its effect, ready availability, ease of application and high stability.

Mikawa K (1992) had evaluated the efficacy and safety of intravenous (IV) nitroglycerin in attenuating the hypertensive response to laryngoscopy and incubation as a new application of the drug.

Thirty normotensive patients (ASA physical status I) undergoing elective surgery were divided into three groups of ten patients each. After induction of anesthesia either 1.5 µglkg of nitroglycerin, 2.5 µg/kg of nitroglycerin, or saline (control) was administered IV simultaneously with the start of laryngoscopy (lasting 30 seconds). Patients who received saline showed a significant increase in mean arterial pressure and rate-pressure product associated with tracheal intubation. These increases following tracheal intubation were significantly reduced in nitroglycerin-treated patients compared with those in the control group ($p < 0.05$).

A single, rapid IV dose of nitroglycerin is a simple, practical, effective, and safe method to attenuate the hypertensive response to laryngoscopy and tracheal intubation.

Harbhej singh (1995) had compared the safety and efficacy of lidocaine, esmolol, and nitroglycerin in modifying the hemodynamic response to laryngoscopy and intubation in 40 ASA physical status I and II patients undergoing elective surgery with general endotracheal anesthesia.

After induction of anaesthesia, patients received one of the following four study drugs intravenously (IV) prior to laryngoscopy: Group 1 (control) = saline 5 ml; Group 2 = lidocaine
1.5 mg/kg; Group 3 = esmolol 1.4 mg/kg; Group 4 = nitroglycerin 2 µg/kg. Mean arterial pressure (MAP) and heart rate (HR) were recorded every minute for 20 minutes following induction of anesthesia, following laryngoscopy and intubation. MAP increased significantly in all four treatment groups (control 49% ± 19%, lidocaine 55% ± 26%, esmolol 25% ± 11%, nitroglycerin 45% ± 21%) compared with preinduction baseline values. In the esmolol-pretreated patients, the increase in HR was significantly lower (20% ± 3%) compared with the nitroglycerin (37% ± 8%), lidocaine (52% ± 8%), and control (29% ± 4%) groups.

Lidocaine 1.5 mg/kg IV and nitroglycerin 2 µg/kg IV were ineffective in controlling the acute hemodynamic response following laryngoscopy and intubation. Esmolol 1.4 mg/kg IV was significantly more effective than either lidocaine or nitroglycerin in controlling the HR response to laryngoscopy and intubation ($p < 0.05$). Esmolol also was significantly more effective than lidocaine in minimizing the increase in MAP (25% vs. 55%).

k. Bijoria (1992) had evaluated the efficacy of isosorbide dinitrate buccal spray (Isomack) in attenuating the cardiovascular response to laryngoscopy and tracheal intubation in 60 patients undergoing elective surgery under general anaesthesia.

Patients were allocated to one of three groups of 20 patients each. Group 1 patients were administered placebo buccal spray 90 s before induction of anaesthesia. Groups 2 and 3 had

isosorbide dinitrate spray 30 and 90 s before induction of anaesthesia. Systolic, diastolic and mean arterial pressures and heart rate were monitored. After the spray, group 3 patients had a significant decrease in systolic arterial pressure ($p < 0.01$). At 1 min after intubation, systolic, diastolic and mean arterial pressures showed a significant increase in group 1 patients (24.9 mmHg, 14.2 mmHg and 18.7 mmHg respectively). In contrast, groups 2

and 3 showed a significant decrease in these parameters ($p < 0.01$). Although significant tachycardia was present following intubation in all the three groups, the degree of tachycardia was greater in groups 2 and 3 ($p < 0.01$).

Firoozbakhsh F (2008) had studied the effect of intravenous nitroglycerine on blood pressure during intubation.

150 patients of 20-50 years of age were enrolled in this randomized double blind clinical trial. They were randomly divided into two group, one received 2 µg/kg nitroglycerine while the other group did not received any drug. Blood pressure was checked in 3 different stages and compared.
In both group, pre and post intubation systolic pressure had a significant difference; whereas this relation could not be found for the diastolic pressure. Injection of 2 µg/kg nitroglycerine immediately after anesthetic induction is effective in preventing the unwanted increase in the blood pressure.

P Gupta (2009) had compared the efficacy of intravenous infusions of nitroglycerin and esmolol in attenuating hemodynamic responses to laryngoscopy and endotracheal intubation in sixty ASA 1 and 2 patients scheduled for elective surgical procedures were randomly divided into three groups of 20 patients each.

The patients of groups C, E and N received intravenous infusions of normal saline, esmolol hydrochloride (100 mgm/kg/min) and nitroglycerin (0.5 mgm/kg/min) respectively. Infusions were started 5 minutes before induction and continued till 5 minutes after intubation. It was observed that nitroglycerin prevented a rise in diastolic blood pressure and attenuated the rise in systolic blood pressure, but failed to attenuate increase in the heart rate, while esmolol effectively controlled the increase in systolic BP, diastolic BP and heart rate following intubation. And it was concluded that esmolol infusion is more effective in attenuating hemodynamic responses to intubation as compared to nitroglycerin infusion.

Vanden Berg AA (1997) Attenuation of the haemodynamic responses to noxious stimuli in patients undergoing cataract surgery. A comparison of magnesium sulphate, esmolol, lignocaine, nitroglycerine and placebo given i.v. with induction of anaesthesia.

A study was conducted on 100 middle-aged to elderly patients (n = 52, healthy; n = 48, suffering from either diabetes, hypertension, ischaemic heart disease or a combination of these diseases) undergoing cataract extraction to assess the effects of laryngoscopy and tracheal intubation, anaesthesia and surgery, eye bandaging and tracheal extubation, saline (control), magnesium sulphate 40 mg kg-1, esmolol 4.0 mg kg-1, lignocaine 1.5 mg kg-1 and glyceryl trinitrate 7.5 micrograms kg-1 given i.v. at induction of anaesthesia on heart rate (HR), blood pressure (BP), rate-pressure product (RPP) and pressure-rate quotient (PRQ).
Anaesthesia was standardized.

Haemodynamic responses and requirements for atropine, ephedrine and labetalol to maintain HR and BP during surgery were similar in healthy and diseased patients, and in the test drug groups. Differences produced by the test drugs were evident until 5 min following intubation. Esmolol prevented rises in HR and RPP.

Glyceryl trinitrate prevented a rise in BP, but was associated with tachycardia and a fall in PRQ to < 1.0. Magnesium sulphate and lignocaine did not prevent responses to laryngoscopy and tracheal intubation, and were associated with rises in RPP. Application of the eye dressing and tracheal extubation at the end of surgery each caused significant increases in HR, BP and RPP in all groups.

Mohammadreza Safavi (2011) The aim of the present study was to compare the efficacies of continuous intravenous (IV) infusion of nitroglycerine, IV hydralazine, or sublingual nifedipine in modifying cardiovascular responses to endotracheal intubation, in women with severe preeclampsia undergoing cesarean delivery under general anesthesia.

A total of 120 patients undergoing cesarean delivery were randomly divided into 3 groups, each receiving one of the following drugs before intubation: 5 µg/min nitroglycerine administered by continuous IV infusion (Group NTG, n = 40); a 10-mg capsule of nifedipine deposited sublingually (Group NIF, n = 40); or 5–10 mg hydralazine intravenously (Group H, n= 40). Heart rate (HR), systolic arterial pressure (SAP), diastolic arterial pressure (DAP), and mean arterial pressure (MAP) were simultaneously recorded in the mother at pre-induction, pre- intubation, and at 1, 3, 5, and 10 min after intubation.

In contrast to those in group NIF and group H, the patients in group NTG showed no significant increases in HR, SAP, DAP, or MAP after intubation, compared to baseline. The incidence of hypotension was significantly greater in group NIF than in group H or group NTG [15 (37. 5%) vs. 8 (20%) vs. 5 (12. 5%) respectively, P = 0. 025].

In patients with severe preeclampsia undergoing cesarean delivery, a continuous IV infusion of nitroglycerine was able to attenuate the cardiovascular response to intubation to a greater
extent than the use of sublingual nifedipine or IV hydralazine, without significant adverse effects on the newborn.

Atul B Vyas (2014) had observed the various pressor responses to laryngoscopy and intubation in normotensive patient undergoing elective surgery under general anesthesia in 60 patients of ASA grade 1 and II patients posted for elective surgeries. He used three different attenuating doses (400, 800, 1200 mcg) of intranasal nitroglycerine five minutes before induction as given below Group 1- 400 micrograms-20 patients, Group 2- 800 micrograms-20 patients and Group 3- 1200 micrograms-20 patients.

All three groups effectively attenuated the pressor response to laryngoscopy and intubation. Maximum rise in heart rate was seen in group III (23.86%). Maximum fall in systolic (19.6%), diastolic

(30.76%), and mean arterial blood pressure (25.53%) was observed in group III at 10th minute of laryngoscopy and intubation.

Best results of attenuation of pressor response were seen with 400 and 800 micrograms of intranasal nitroglycerine. One thousand and two hundred micrograms dose caused maximum increase in heart rate and caused maximum fall in blood pressure.

Vijayalakshmi (2014) had studied the efficacy of a single pre-induction 2 µg/kg bolus injection of fentanyl followed by two puffs of nitroglycerin sub lingual spray (400 µg /spray) for attenuation of the hemodynamic response to endotracheal intubation in normotensive patients in 80 patients.

Group I received a single 2 µg/kg IV bolus of fentanyl diluted to 5 ml with normal saline 5 min prior to laryngoscopy followedby two puffs of nitroglycerin sub lingual spray (400
µg/spray) 2 minutes prior to intubation (n=40). Group II received a single 2 µg/kg IVbolus of fentanyl diluted to 5 ml with normal saline 5 min prior to laryngoscopy (n=40).

Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and rate pressure product were compared to basal values at pre-induction, induction, intubation andpost-intubation as well as at time increments of 1, 3, 5, 7 and 10 min.

Fentanyl combined with nitroglycerin did not attenuate hemodynamic pressor responses more than fentanyl alone. Increases of HR (7.9%), DBP (4.0%), MAP (3.6%) and RPP (6.0%) along with attenuation of SBP (2.7%) were observed in the fentanyl-nitroglycerin group as compared to the equivalent control measured values.

A single pre-induction bolus injection of fentanyl followed by two puffs of nitroglycerin sub lingual spray in a thiopen-tone/suxamethonium anesthetic sequence neither successfully attenuates nor successfully suppresses the hemodynamic pressor responsemore effectively than fentanyl alone in normotensive patients resulting from endotracheal intubation.

Said A. Latief (1995) had administered intranasal nitroglycerine in group I of 35 adult patients and, 1.5 ng/kg body weight of lidocaine intravenously in group II of 35 patients one minute before the induction of anesthesia.

Arterial blood pressure and heart rate were recorded before, during, and after the induction ofanesthesia and at ninute 0, I, 2, 3, 5 , 7 and 10 after tracheal intubation.

Intranasally adninistered nitroglycerine was found to be an effective, safe, and sinple nethod in attenuating the hypertensive response to direct laryngoscopy and tracheal intubation.

Fassoulaki A (1983) had studied the intranasal administration of NTG was under taken in 35 adult females pt 1 min before the induction of anaesthesia. A control group consisting of 32 patients did not receive NTG. Systolic arterial pressure (SAP) and heart rate (HR) were recorded before the induction of anaesthesia and at 0,3, and 5 min after tracheal intubation. SAP did not increase significantly in the NTG group immediately after intubation, while significant decreases in SAP were observed at 3 and 5 min ($P>0.005$ and $P<0.001$ respectively). SAP did increase significantly in the control group. HR was increased in both groups immediately after intubation ($P<0.001$ and $P<0.001$ respectively).

NTG administered intranasally is a safe, simple and effective method to attenuate the hypertensive response to laryngoscopy and tracheal intubation.

Khan FA (2004) study measured the changes in pulse pressure secondary to laryngoscopy and tracheal intubation in eighty adult surgical patients.

Two groups of forty patients each were included, young (group A) 18-25 years and middle-aged (group B) 45-55 years. The patients were ASA Class 1 or 2, of either gender and non-hypertensive. Systolic, diastolic, and mean blood pressure, and heart rate were measured preinduction and 1, 2 and 3 minutes after induction. Thereafter they were measured every minute for five minutes after intubation. Pulse pressure was obtained by subtracting the diastolic from the systolic blood pressure.

No pulse pressure change occurred in the young group despite of a significant increase in both systolic and diastolic blood pressures. The middle aged group showed an average rise of
+18 mm of Hg in pulse pressure (taken at 1 minute post-intubation) compared to the baseline measurement ($P<0.0001$).

These changes in pulse pressure during anaesthesia may indicate an additional pulsatile stress due to laryngoscopy and intubation.

Xue FS (2006) Blood pressure and heart rate changes during intubation: a comparison of direct laryngoscopy and a fibreoptic method.

Noninvasive blood pressure and heart rate were recorded before and immediately after anaesthesia induction, at anaesthesia intubation and every minute thereafter for 5 min.

Nasotracheal intubation was accompanied by significant increases in blood pressure and heart rate compared to baseline values in both groups.

Blood pressure and heart rate at intubation, and the maximum values of blood pressure during the observation were significantly higher in the fibreoptic bronchoscope group. However, the maximum values of heart rate were not significantly different between the two groups.

Fibreoptic nasotracheal intubation may result in more severe pressor and tachycardiac responses than direct laryngoscopic nasotracheal intubation.

Hwang JJ (1995) The use of intranasal nitroglycrin to prevent pressor responses during intubation in general anesthesia: a comparison of various doses.

This study was designed to compare the efficacy of four different dosages of intranasal NTG (0.3, 0.5, 0.75, and 1.0 mg) in preventing pressor responses to laryngoscopy and tracheal intubation during the induction of general anesthesia.

One hundred patients (ASA I or II) scheduled for elective surgery were included. These study subjects were divided into five groups and randomly assigned to four different dosages of intranasal NTG and a placebo. Each group consisted of 20 patients. The NTG solution was administered 1 min before the injection of thiopental. Systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure (MAP) and heart rate (HR) were recorded before the induction of anesthesia (T1), before laryngoscopy (T2), and at 0, 3, and 5 min after tracheal intubation (T3, T4, and T5 respectively).

In patients who received a placebo (control group), there were significant increases in SAP, MAP, HR and rate-pressure-product (RPP) associated with tracheal intubation. Tachycardia was noted in all experimental groups. The increases in MAP associated with tracheal intubation were significantly less in patients who received NTG of 0.5 mg or more but not 0.3 mg. Although 0.5 mg of NTG did attenuate the increases in SAP after tracheal intubation, the increases in SAP of the other three experimental groups were no less than that of the control group. Rate-pressure- product (RPP) values of the experimental groups were noted to be equal to or higher than those of the control group during the period of study. Contrary to the results of the study conducted by Grover et al., 0.75 mg of NTG did not attenuate the pressor responses.

Intranasal NTG does not attenuate the pressor responses to laryngoscopy and tracheal intubation.

Perez pena jm (1991) Effect of an intravenous nitroglycerine bolus on the hemodynamic impact of laryngoscopy and intubation.

The aim of this study was to evaluate the effectiveness of intravenous administration of a single dose of nitroglycerin in lessening the hemodynamic effects induced during laryngoscopy and tracheal intubation.

In an initial subset of 8 patients we verified that the hemodynamic changes after an intravenous dose of 2, 5, or 10 micrograms/kg of nitroglycerin were comparable. The study included 30 patients with a good clinical condition who were anesthetized with fentanyl, thiopental sodium and succinylcholine. They were allocated into two groups of 15 patients according to the intravenous administration or not of 2 micrograms/kg of nitroglycerin after induction of anesthesia.

Increase in systolic blood pressure (SBP) and double product (SBP x heart rate) during laryngoscopy and 15, 30, and 45 seconds thereafter was significantly lower in nitroglycerin treated patients than in controls. Increase in diastolic blood pressure was also lower in nitroglycerin treated patients but this difference was only present during laryngoscopy. There were no significant heart rate differences among the two groups of patients.

It is concluded that a single intravenous dose of 2 micrograms/kg of nitroglycerin was able to lessen the increase in blood pressure induced by laryngoscopy and tracheal intubation without deleterious effects.

5. Material and Methodology

After thorough pre-operative history and clinical examination 60 adult patients were enrolled in this study.

Inclusion Criteria

- ❖ Adult patients between ages 18-60 years of both sexes.
- ❖ ASA grade I and grade II patients.
- ❖ Patients who required general anesthesia.
- ❖ Patients who required oral intubation.

Exclusion Criteria

We exclude the patients having following features,

- ❖ ASA grade III and IV patients.
- ❖ Patients requiring nasal intubation
- ❖ Previous h/o difficult intubation
- ❖ Repeated attempt of intubation
- ❖ emergency surgery
- ❖ Pregnant patient
- ❖ known sensitivity or intolerance to nitroglycerine
- ❖ Patients who are prone for hypotension
- ❖ Patient with dehydration.

Method of Study

After obtaining institutional board approval, written informed consent was obtained from 60 adult patients undergoing elective surgeries in which oral intubation required and were placed in two different groups (30 in each group).

- ❖ Group I: Patients received nitroglycerine spray orally 1 puff(400mcg)
- ❖ Group II: Patients received intravenous nitroglycerine 2 µg/kg

All patients were instructed to remain nill by mouth for at least 8 hours before surgery. Patients were pre-medicated with, Tab. Lorazepam hydrochloride 1mg night before surgery Tab. Diazepam hydrochloride 5mg in early morning on the day of surgery.

On arrival in the operation theatre patients were monitored with routine non invasive blood pressure measurement, pulse oximetry and ecg, heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure were recorded as a baseline value.

After securing intravenous line all the pts were given inj. Glycopyrrolate 0.2mg and fentanyl 2mcg/kg prior to injection of study drug HR, SBP, DBP, MAP were recorded and designated as

pre induction value. Anesthesia technique was identical in both groups.

After securing intravenous line all patients were given Inj. Glycopyrrolate 0.2mg and Inj. Fentanyl hydrochloride 2mcg/kg. After 5 minutes pulse, SBP, DBP, MAP recorded and considered as pre induction readings.

In all patients induction of anesthesia was done with Inj. Thiopental sodium 5mg/kg and muscle relaxation was provided with Inj. Vecuronium bromide 0.15mg/kg. Intermittent positive pressure ventilation was given for 3 minutes with mask and 100% O_2 at the rate of 12 breaths/min.

Then Group I: patients received 1 puff (400mcg) of oral NTG spray Group
II: patients received 2mcg/kg IV NTG

All patients were further ventilated for 30seconds; laryngoscopy and intubation with proper size of tube were carried out within 30seconds by senior anesthesiologist.

Anesthesia was maintained with 0_2(50%) +N_20 (50%) + sevoflurane(0.5 to 1%MAC)

All the parameters including HR, SBP, DBP, MAP and side effects were recorded at following intervals;
✓ Baseline: on arrival in OT.
✓ Pre-induction: After inj. Glycopyrrolate with fentanyl
✓ 0 minute: at the time application of study drug
✓ After intubation 1, 2, 3, 4, 5, 7 and 10th min.

There after anesthesia was maintained with inj. Vecuronium+O_2+N_2O+sevoflurane inhalation. Monitoring was done in the form of NIBP, ECG, TEMP., SPO_2, $ETCO_2$, I/O and blood loss. After completion of surgery patients were reversed with inj glycopyrrolate and inj neostigmine. All patients were extubated when fully awake and following verbal command than sifted to post-operative ward.

We had defined following parameters for study:
❖ Hypotension was defined as SBP<25% of baseline value or <90mm of Hg which ever was lower
❖ Hypertension was defined as SBP>25% of baseline value or >150mm of Hg which ever was greater
❖ Tachycardia was defined as HR> 25% of baseline value
❖ Bradycardia was defined as HR<60beats/min
❖ An arrhythmia was defined as any ventricular or supraventricular premature beat or any rhythm other than sinus.
❖ Incidence of all this parameter was recorded in both the groups. Hypotension was treated with head low position and with fluid.
❖ Rescue drugs: inj phenylephrine hydrochloride for hypotension and inj. Esmolol hydrochloride for tachycardia.

Pre-intubation and post intubation data were compared by paired "t" test in both groups.

6. Proforma

To compare efficacy and safety of intravenous nitrogycerine with topical nitrogycerine (NTG spray) during laryngoscopy and intubation.

Name: Registration no: Age/sex/weight:
Final diagnosis: Date of surgery: Operative procedure:

Past History
- H/o previous drug allergy/drug sensitivity
- H/o major medical illness
- H/o previous operation or anesthesia
- Family history

General Examination
Vital

Pulse	Tongue/conjunctiva/nail
Blood pressure	Back and spine
Temperature	Airway
RR	

Systemic Examination
- Cardiovascular system
- Respiratory system
- Elementary system
- Central nervous system

Investigation

CBC	PT & APTT
RFT	ECG
Serum electrolyte	CHEST X-RAY
LFT	HIV/HBsAG
Urine analysis	Blood group

Group Allocation
60 normotensive patients (ASA physical status I & II) undergoing elective surgery. Group I: Nitroglycerine spray orally (400mcg)
Group II: Intravenous nitroglycerine 2mcg/kg

Inclusion Criteria
- Adult patients between ages 18-60 years of both sexes.
- ASA grade I and grade II patients.
- Patients who required general anesthesia.
- Patients who required oral intubation.

Exclusion Criteria
- ASA grade III and IV patients.
- Patients requiring nasal intubation
- Previous h/o difficult intubation
- Repeated attempt of intubation
- Emergency surgery
- Pregnant patient
- Known sensitivity or intolerance to nitroglycerine,
- Patients who are prone for hypotension,
- Patient with dehydration.

NBM- 8 hours

Premedication
Tab. Lorazepam hydrochloride 1mg night before surgery
Tab. Diazepam hydrochloride 5mg in early morning on the day of surgery

Induction
Inj. Glycopyrrolate bromide 0.2mg iv
Inj. Fentanyl hydrochloride 2mcg/kg iv
Inj. Pentothal sodium 5mg/kg iv
Inj. Vecuronium bromide 0.15mg/kg iv
IPPV- for 3 minutes with 100% O_2.

After 3min either iv NTG or NTG oral spray given than after 30sec laryngoscopy and intubation done by senior anesthesiologist within 30secs.

Maintenance
O_2+N_2O (50%) +0.5 to 1% sevoflurane No additional drug till 10 min.

Observation

TIME	PULSE	SBP	DBP	MBP	COMPLICATIONS
Baseline					
Pre induction					
0 min- Drug inj					
Intubation 1st min					
2nd min					
3rd min					
4th min					
5th min					
7th min					
10th min					

Monitoring HR, NIBP (SBP, DBP, MAP), SPO2, EtCO2, TEMP., Input/Output and blood loss.Rescue drug: Inj phenylephrine hydrochloride for hypotension and Inj esmolol hydrochloride for tachycardia.

7. Results and Observation

Total sixty adult patients of both sex and ASA grade I and II were enrolled in this study.

Table I show demographic data of both group like age, sex and weight. Both group were comparable in respect to age, weight and gender.

Table II shows heart rate changes before and after intubation in both group. Heart rate increased significantly in both group immediately after intubation upto 4 min. Rise in heart rate was significant but it had started decrease after that and come to normal level at 10 min.

Table IV, V, VI show changes in systolic, diastolic and mean blood pressure before induction and after intubation. Systolic blood pressure, diastolic blood pressure and mean arterial pressure decreased significantly in both group immediately after intubation($p<0.05$). Fall in blood pressure was comparable in both group.

Table VI shows occurrence of complication in both group. Hypotension was observed in two patient in group I which was treated by head low position and fast fluid. Tachycardia observed in two patients in group II which was subsided within five minutes. None of the patient required rescue medicines.

VARIABLES	GROUP I NTG SPRAY	GROUP II IV NTG
AGE IN YEARS	48.96	48.43
SEX(M:F)	6:24	6:24
WEIGHT IN KG	53.06	52.93

Table 1: Demographic Data

AT THE TIME	GROUP I (NTG SPRAY)	GROUP II (IV NTG)	P VALUE
Baseline	87.33±11.67	90.4±12.55	
Pre induction	87.46±12.61	91.2±12.28	
0 min-Drug inj	91.83±11.93	94.4±13.60	
Intubation 1st min	111.7±12.21	105.2±12.54	P< 0.05

2nd min	108.9±13.03	102.2±12.53	P< 0.05
3rd min	104.5±12.45	97.5±12.56	P< 0.05
4th min	99.4±12.09	96.2±12.56	P< 0.05
5th min	94.8±12.45	96.3±12.60	P< 0.05
7th min	88.26±13.06	91.1±11.66	P> 0.05
10th min	86.33±14.55	87.5±12.66	P> 0.05

Table 2: Mean Heart Rate at Different Intervals of Time

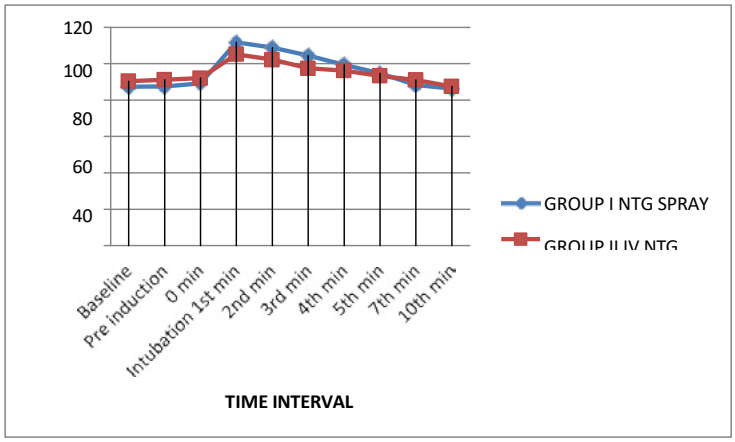


Figure 1: Mean Heart Rate at Different Intervals of Time (Graph)

AT THE TIME	GROUP I NTG SPRAY	GROUP II IV NTG	P value
Baseline	139.1±17.35	142.1±12.08	
Pre induction	135.3±20.47	133.2±16.40	
0 min- Drug inj	132.2±19.92	131.1±16.66	
Intubation 1st min	113.7±21.68	122.7±15.37	P< 0.05
2nd min	127.3±13.38	121.3±8.93	P< 0.05
3rd min	122.3±13.38	116.3±8.86	P< 0.05
4th min	117.3±13.38	111.3±8.86	P< 0.05
5th min	112.2±13.51	106.3±8.86	P< 0.05
7th min	107.5±14.21	103.4±13.80	P< 0.05
10th min	106.8±17.22	102.6±12.38	P< 0.05

Table 3: Mean Systolic Blood Pressure

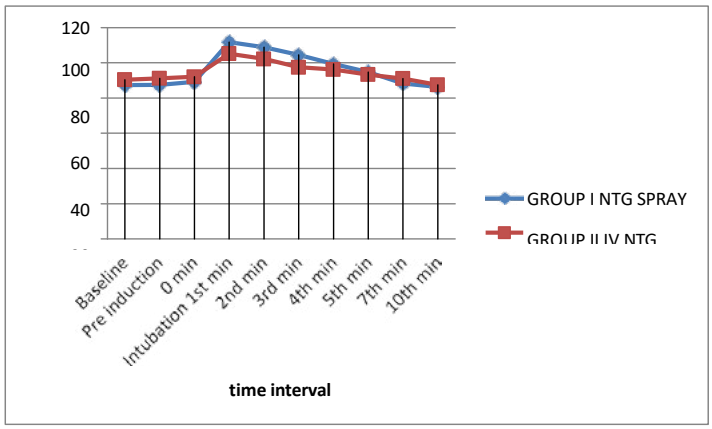


Figure 2: Mean Systolic Blood Pressure (Graph)

AT THE TIME	GROUP I NTG SPRAY	GROUP II IV NTG	P value
Baseline	84.63±4.08	96±6.73	
Pre induction	79.5±11.02	83.06±9.78	
0 min- Drug inj	81.3±10.15	85.1±10.20	
Intubation 1st min	79.5±4.19	88.4±5.3	P< 0.05
2nd min	76.5±4.19	83.4±5.3	P< 0.05
3rd min	73.5±4.27	78.4±5.3	P< 0.05
4th min	70.5±4.27	73.4±5.3	P< 0.05
5th min	67.5±4.27	70.4±5.30	P< 0.05
7th min	69.1±13.89	69.3±10.97	P< 0.05
10th min	69.3±13.52	67.4±10.37	P< 0.05

Table 4: Mean Diastolic Blood Pressure

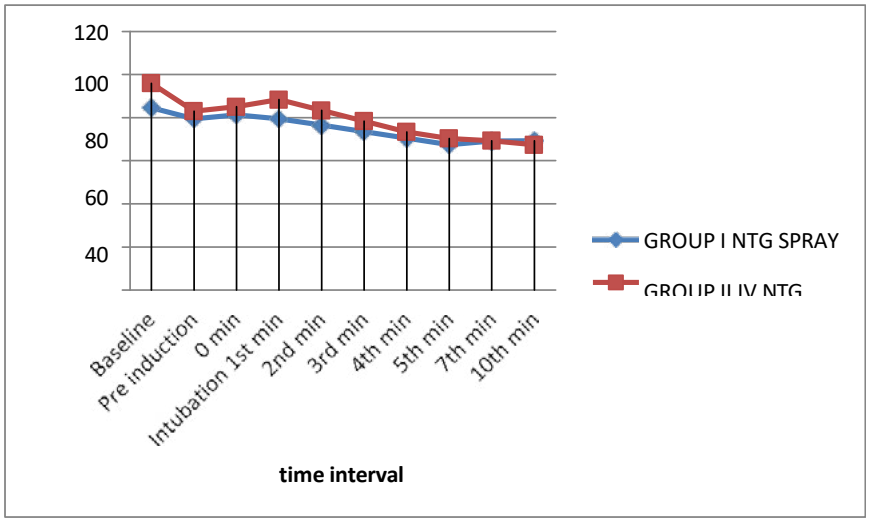


Figure 3: Mean Diastolic Blood Pressure (Graph)

AT THE TIME	GROUP I NTG SPRAY	GROUP II IV NTG	P value
Baseline	99.6±7.70	103.5±10.56	
Pre induction	100.4±13.44	102.3±11.54	
0 min- Drug inj	98.9±13.78	101.3±11.83	
Intubation 1st min	94.4±7.19	89.4±9.20	P< 0.05
2nd min	91.4±7.19	87.23±9.20	P< 0.05
3rd min	88.4±7.19	83.40±9.20	P< 0.05
4th min	85.4±7.19	80.23±9.20	P< 0.05
5th min	82.4±7.19	75.3±9.08	P< 0.05
7th min	84.4±11.9	81.4±9.72	P< 0.05
10th min	81.9±15.15	80.6±10.66	P< 0.05

Table 5: Mean of Mean Arterial Blood Pressure

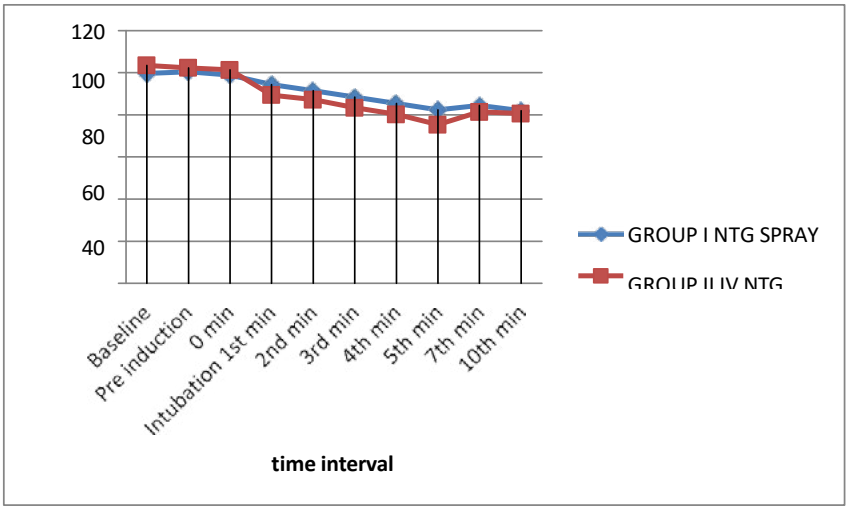


Figure 4: Mean of Mean Arterial Blood Pressure (Graph)

Complication	No of patients	
	Group I	Group II
Hypotension	2	None
Tachycardia	None	2
Arrhythmias	None	None

Table 6: Complications in Both Groups

8. Discussion

Hypertension and tachycardia subsequent to tracheal intubation have been well documented. In susceptible patients even this short period (2-7 minutes) of hypertension and tachycardia can result in myocardial ischemia or increased intracranial pressure [3-8].

Complications resulting from these hemodynamic events after intubation include left ventricular dysfunction, hypertensive crises, pulmonary edema, cardiac dysrhythmia, myocardial ischemia, and myocardial necrosis [5].

Many agents have been used to attenuate undesirable hemodynamic responses to laryngoscopy and intubation with varying success. These include intravenous opioids, vasodilators, calcium channel blockers, intravenous and topical lignocaine and adrenoceptor blocking drugs alone or in combination with other drugs [5].

Nitroglycerine available in many forms like Tablets, Transdermal patch, Oral sublingual tablet and Oral transmucosal spray as well as injectable. Uptill now many research have been done with oral and sublingual tab, injection, trans nasal spray and transdermal patch of nitroglycerine for attenuation of pressure response during laryngoscopy and intubation. No study was done with oral spray of NTG for attenuation of pressure response during laryngoscopy and intubation.

Katsuya mikawa evaluated the efficacy and safety of intravenous (IV) nitroglycerin in attenuating the hypertensive response to laryngoscopy and intubation as a new application of the drug in his study [7].

K bijoria, A. bajaj had used isosorbide dinitrate spray for attenuation of cardiovascular response to laryngoscopy and intubation [9].

In the present study nitroglycerine spray and iv nitroglycerin were selected because of their similar pharmacokinetic profile i.e. rapid onset of action, short duration of action,
rapid elimination, termination of action.

Katsuya mikawa in his study used 1.5mcg/kg and 2.5mcg/kg iv NTG and found that a single, rapid IV dose of nitroglycerin is a simple, practical, effective, and safe method to attenuate the hypertensive response to laryngoscopy and tracheal intubation [7].

K bijoria evaluated the efficacy of isosorbide dinitrate (one spray delivers 1.25mg isosorbide dinitrate in 0.9ml) buccal spray in attenuating the cardiovascular response to laryngoscopy and tracheal intubation in his study [9].

Farhad firoozbakhsh F in his study injection nitroglycerine 2 µg/kg IV immediately after anesthetic induction is effective in preventing the unwanted increase in the blood pressure [10].

Fsssoulaki also used NTG intranasally for attenuation of the hypertensive response to laryngoscopy and tracheal intubation. In the present study we used IV and Oral transmucosal spray of NTG for same purpose [11].

Atul B Vyas studied three different doses 400mcg, 800mcg and 1200mcg of intranasal NTG for attenuation of pressure response during laryngoscopy and intubation [12]. He found best results of attenuation of pressor response were seen with 400 and 800 micrograms of intranasal nitroglycerine.

In the present study oral NTG spray used which was in dose of 400mcg/puff and intra venous NTG in dose of 2mcg/kg used which was comparable with studies of katsuya mikawa, farhad firoozbakhsh and atul B Vyas [7,10,12].

Heart rate

P gupta used nitrogycerine infusion which was failed to attenuate increase in heart rate following laryngoscopy and intubation in his study [5].

K Bijoria also observed that isosrbide dinitrate spray causes significant tachycardia following intubation [9].

A fassoulaki obseved with intranasal NTG, HR was increased immediately after intubation. Iwasaka H found
administration of TNG spray and that of TNG solution during general anesthesia, Heart rate was increased significantly in both groups 2 min after drug administration [11,13].

In the present study heart rate changes were observed after intubation in both group. Heart rate increased significantly in both group immediately after intubation upto 5 min, but it had started decrease thereafter and come to normal level at 10 min. ($P<0.05$).

Systolic, Diastolic and Mean Arterial Pressure

P gupta[5] observed that nitroglycerin prevented a rise in diastolic blood pressure and attenuated the rise in systolic blood pressure following intubation [5].

K Bijoria found after the spray significant decrease in systolic arterial pressure at 1 min after intubation, diastolic and mean arterial pressures also showed a significant decrease in his study [9].

A fassoulaki observed SAP did not increase significantly in the NTG group immediately after intubation, while significant decreases in SAP were observed at 3 and 5 min [11].

Iwasaka H found two min after drug administration, systolic blood pressure and Diastolic blood pressure decreased significantly in both groups, and this level persisted for 10 min [13].

M Safavi observed the patients in group NTG showed no significant increases in SAP, DAP, or MAP after intubation, compared to baseline [14].

Vanden berg AA observed Glyceryl trinitrate prevented a rise in BP following intubation [15].

In the present study SAP, DBP and MAP did not increase signifiacantly in the both the groups compare to baseline value after laryngoscopy and intubation. These parameters were significantly decreased at 1 to 5 min ($p<0.05$) after intubation. Our data were comparable with other study. None of our patient had significant serious complications.

9. Conclusion

Nitroglycerine spray orally 1 puff (400mcg) and intravenous nitroglycerine 2 µg/kg were equally effective in attenuation of pressure response following laryngoscopy and intubation during general anesthesia.

Both were significantly effective in controlling systolic, diastolic and mean blood pressure.

There were temporary rise in heart rate with both root of administration without any serious complication. Both root of administration were simple, easy and safe for attenuation of pressure response [16-19].

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GROUP - I ORAL NT

Serial No.	Pts. Name	Registration No.	Age/Sex	weight(kg)	Diagnosis	Surgery	PULSE										SBP					
							baseline	fentanyl	0 min-Drug inj	intubation 1min	2min	3min	4min	5min	7min	10min	baseline	fentanyl	0 min-Drug inj	intubation 1min	2min	3min
1	savitaben	F96819	40/F	40	parotid tumour	WE+DP FLAP	100	102	113	124	128	119	115	116	105	91	120	111	113	110	105	100
2	lalitaben	F97644	42/F	45	ca rt breast	rt MRM	95	98	111	120	115	110	100	95	88	94	125	110	110	115	110	105
3	hamidaben	F99516	48/F	60	ca rt breast	rt MRM	105	99	102	125	120	115	110	105	82	73	140	166	139	130	125	120
4	shashikalaben	F96453	57/F	50	ca endometrium	TAH+BSO	90	92	98	115	110	105	100	95	90	80	130	136	134	120	115	110
5	jagrutiben	F93735	27/F	60	ca lt Breast	lt MRM	88	66	100	111	142	137	131	129	104	91	140	136	105	130	125	120
6	chandrikaben	F93369	32/F	55	ca rt breast	rt MRM	100	101	107	124	119	114	109	100	84	87	126	132	87	116	111	106
7	indraben	F95469	50/F	74	# lt femur	internal fixation	96	93	90	119	114	109	104	99	85	89	135	111	115	125	120	115
8	vandanaben	F91247	30/F	40	ewing sarcoma	WE+PROSTHESIS	80	82	81	111	105	100	95	90	103	99	130	134	99	120	115	110
9	Sitadevi	F99204	60/F	85	ca endometrium	staging laprotomy	95	98	103	120	115	110	105	100	89	80	141	110	126	131	126	121
10	sharifabibi	F98549	55/F	57	rt parotid tumour	wle+flap	84	84	80	109	104	99	94	89	75	86	186	188	157	150	145	140
11	kanchanben	F92636	60/F	55	ca rt breast	rt MRM	73	73	76	100	95	90	85	80	63	63	157	157	157	147	142	137
12	mahiraben	F8865	53/F	50	ca ovary	interval laparotomy	82	97	100	107	102	98	93	88	94	90	144	142	126	134	129	124
13	motlibai	F91962	60/F	30	ca bladder	radical cystectomy	96	96	94	120	115	110	105	100	104	103	179	165	143	140	135	130
14	gyansing	G226	50/M	60	ca bladder	radical cystectomy	97	80	98	122	118	113	108	103	107	99	130	136	143	120	115	110
15	metiben	F94420	55/F	50	ca rectosigmoid	anterior resection	92	100	105	117	112	107	102	97	95	94	150	140	125	140	135	130
16	niruben	F99792	42/F	48	ca ovary	interval laparotomy	58	61	84	85	98	109	101	103	97	83	118	113	110	113	108	103
17	minaben	F95846	43/F	55	ca rt breast	rt MRM	100	97	101	125	120	115	110	105	88	98	120	134	121	110	105	100
18	gunvantiben	F11322	39/F	48	ca ovary	interval laparotomy	83	86	92	108	103	98	93	88	94	91	130	140	121	119	114	109
19	madhuben	F14351	38/F	50	ca endometrium	exp. Laprotomy	93	100	99	118	113	108	103	98	76	80	151	159	126	141	136	131
20	jubedabibi	G17517	50/F	50	ca cervix	staging laprotomy	101	104	99	126	121	116	111	105	95	100	162	158	137	151	146	141
21	kantaben	G13923	60/F	56	ca lt Breast	lt MRM	95	98	100	123	118	114	109	103	105	104	164	149	130	154	149	144
22	ushaben	G14901	45/F	50	ca ovary	exp. Laprotomy	89	96	88	114	109	104	99	94	70	60	135	138	120	125	120	115
23	jyotsanaben	G9402	52/F	60	ca ovary	exp. Laprotomy	75	72	77	100	95	90	85	80	74	71	126	130	106	116	111	106
24	navalsingh	G16501	60/M	50	ca gallblader	diagnostic lap.	94	90	80	119	114	109	104	99	68	72	118	98	116	108	103	98
25	dayaben	G16901	50/F	60	ca ovary	exp. Laprotomy	76	77	82	101	96	91	86	81	81	120	144	142	138	134	129	124
26	kishorbhai	G15132	60/M	50	THYMOMA	diagnostic lap.	81	79	84	106	101	96	91	86	97	103	133	138	140	123	118	113
27	Nandlal	G15420	35/M	50	CA stomach	lap GJ	67	69	67	92	87	82	77	72	103	86	143	138	125	133	128	123
28	Sangabhai	G12700	60/M	50	Ca rectum	lap APR	90	91	90	115	110	105	100	95	80	68	145	109	110	135	130	125
29	satish	G7565	30/M	54	Ca rectum	lap APR	79	75	82	94	91	88	85	81	90	79	116	112	108	106	101	96
30	danubhai	G15427	60/M	50	RCC	radical nephrectomy	66	68	72	81	78	75	72	69	62	56	135	129	109	125	120	115

G SPRAY

				DBP										MAP									complication		
4min	5min	7min	10min	baseline	fentanyl	0 min-Drug inj	intubation 1min	2min	3min	4min	5min	7min	10min	baseline	fentanyl	0 min-Drug inj	intubation 1min	2min	3min	4min	5min	7min	10min	hypotention	tachycardia	bradycardia
95	100	125	111	87	85	77	82	79	76	73	70	86	72	89	99	110	84	81	78	75	72	101	95			
100	95	99	109	85	73	108	80	77	74	71	68	64	79	82	96	126	78	75	72	69	66	84	83			
115	110	100	134	90	114	85	85	82	79	76	73	84	84	100	132	103	95	92	89	86	83	98	107			
100	95	96	93	80	84	76	75	72	69	66	63	54	73	90	94	88	85	82	79	76	73	78	62			
115	110	100	102	86	66	69	81	78	75	72	69	42	56	100	90	83	95	92	89	86	83	66	72			
101	96	80	98	81	87	55	76	73	70	67	64	50	66	98	104	68	93	90	87	84	81	61	80			
110	105	95	91	85	80	76	80	77	74	71	68	59	40	106	94	90	101	98	95	92	89	81	56			
105	100	101	105	90	87	83	85	82	79	76	73	74	68	106	105	89	100	97	94	91	88	84	86			
116	111	101	88	82	73	86	77	74	71	68	65	66	50	100	90	103	95	92	89	86	83	83	70			
135	130	120	126	92	84	80	87	84	81	78	75	59	75	116	130	110	108	105	102	99	96	84	93			
132	127	117	86	89	88	88	84	81	78	75	72	49	66	103	122	102	98	95	92	89	86	69	76			
119	114	104	110	85	77	73	80	77	74	71	68	70	70	97	97	93	92	89	86	83	80	80	82			
125	120	110	75	96	84	96	91	88	85	82	79	63	46	116	120	114	108	105	102	99	96	76	56			
105	100	118	114	85	83	82	80	77	74	71	68	74	76	104	102	116	99	96	93	90	87	94	84			
125	120	110	100	81	70	78	76	73	70	67	64	69	67	101	102	91	96	93	90	87	84	80	78			
98	93	86	72	82	72	70	77	74	71	68	65	48	44	97	90	88	92	89	86	83	80	66	56	hypotention		
95	90	92	90	85	83	91	80	77	74	71	68	69	63	98	99	102	93	90	87	84	81	78	76			
104	99	125	121	80	90	80	75	72	68	65	62	80	72	100	110	90	95	92	89	86	83	95	82			
126	121	111	110	79	73	70	72	69	66	63	60	64	80	100	100	88	95	92	89	86	83	78	84			
136	131	135	126	85	94	89	80	77	74	71	68	72	90	105	111	99	100	97	94	91	88	91	102			
139	134	119	114	84	80	80	79	76	73	70	67	82	80	110	110	120	105	102	99	96	93	96	96			
110	105	95	106	89	84	87	84	81	79	76	73	71	69	101	96	98	96	93	90	87	84	77	73			
101	96	90	84	82	83	81	77	74	71	68	65	64	59	102	104	90	97	94	91	88	85	76	68	hypotention		
93	91	123	101	80	56	83	75	72	69	66	63	76	74	85	71	96	80	77	74	71	68	97	79			
119	114	104	132	86	78	89	81	78	75	72	69	93	84	97	97	123	92	89	86	83	80	99	95			
108	103	140	140	83	85	100	78	75	72	69	66	86	56	100	102	120	93	90	87	84	81	113	78			
118	113	103	120	82	68	75	77	74	71	68	65	101	92	97	93	94	92	89	86	83	80	94	119			
120	115	100	109	87	74	76	82	79	76	73	70	64	61	106	87	68	101	98	95	92	89	79	78			
91	95	111	111	80	70	70	75	72	69	66	63	82	80	90	87	80	85	82	79	76	73	95	90			
110	105	117	127	81	60	53	76	73	70	67	64	58	88	94	80	72	89	86	83	80	77	81	103			

GROUP - II

Serial No.	Pts. Name	Registration No.	Age/Sex	weight(kg)	Diagnosis	Surgery	PULSE										SBP			
							baseline	fentanyl	0 min-Drug inj	intubation 1min	2min	3min	4min	5min	7min	10min	baseline	fentanyl	0 min-Drug inj	intubation 1min
31	sayarabanu	G12396	40/F	50	ca lt Breast	lt MRM	96	96	96	111	108	105	102	99	89	81	138	130	126	125
32	aminaben	G16906	40/F	71	ca ovary	exp. Laprotomy	90	92	106	105	102	98	93	90	86	80	140	146	140	127
33	fensibai	G17072	50/F	60	ca cervix	radical hysterectomy	86	90	94	102	99	96	93	90	90	91	130	136	120	117
34	madhuribenG17495		30/F	50	ca ovary	diagnostic lap.	80	84	80	95	92	89	86	83	94	92	140	144	140	127
35	santaben	F98543	40/F	47	ca breast	MRM	103	102	100	118	115	112	109	106	96	90	133	135	123	120
36	arunaben	F90731	45/F	29	OGS lt femur	WLE+reconstruction	100	96	102	115	112	109	106	103	100	89	138	108	109	125
37	vestiben	G90915	48/F	35	ca ovary	subtotal hysterecotomy	98	96	76	113	110	107	104	101	79	72	139	103	92	126
38	fatehkhatun	F99319	50/F	60	ca rt breast	rt MRM	72	72	77	87	84	81	78	75	74	71	136	130	106	123
39	manguben	G298	46/F	68	ca ovary	staging laprotomy	105	103	97	120	117	114	111	109	100	81	139	140	123	126
40	kunwarlal	F99872	50/M	40	lt renal mass	lt radical nephrectomy	99	98	96	114	111	109	106	103	92	90	146	99	115	133
41	jivtiben	G2344	48/F	70	ca rt breast	rt MRM	98	96	106	113	110	107	104	101	88	80	146	140	140	132
42	laxmibai	G4402	60/F	51	ca lt Breast	lt MRM	64	61	82	79	76	73	70	67	59	62	140	148	122	127
43	obayabhai	F92564	60/M	62	s.c.c of nose	WLE+reconstruction	80	69	79	95	92	89	86	83	79	72	141	147	121	128
44	jivrajbhai	F98451	60/M	40	STS lt thigh	wle+stg	84	86	128	99	96	93	90	87	110	90	132	132	123	119
45	shardaben	F86420	60/F	39	ca ovary	exp. Laprotomy	100	103	105	115	112	109	106	103	105	100	131	153	120	118
46	kesarben	F98440	60/F	80	ca lt Breast	lt MRM	110	108	109	125	122	119	116	113	112	104	172	153	130	150
47	shardaben	F94306	35/F	45	ca rt breast	rt MRM	92	90	90	107	104	101	98	95	89	85	134	120	134	121
48	dineshbhai	F96685	47/M	50	lt renal mass	radical nephrectomy	120	105	125	135	132	129	126	123	117	119	137	135	136	124
49	sushilaben	F98585	60/F	60	ca rt breast	rt MRM	75	81	82	90	87	84	81	78	80	100	169	169	129	150
50	khetbai	F98532	44/M	55	ca lt Breast	lt MRM	81	82	80	96	93	90	87	84	90	114	154	146	125	141
51	vimalben	F96257	60/F	41	ca rt colon	exp. Laprotomy	88	104	98	103	100	97	94	91	92	105	140	130	107	127
52	hargovanbhai	G156	35/M	40	o/c/o ca rectum	port insertion	99	98	100	114	111	108	105	102	96	86	139	130	114	126
53	shitalben	F99013	25/F	35	swelling in lt knee	curretage+cementing	81	87	90	96	93	90	87	84	79	75	128	112	116	115
54	lakhiben	G17903	55/F	60	ca rt breast	rt MRM	84	86	90	99	96	93	90	87	86	83	136	99	115	123
55	teji	G13735	52/F	50	ca ovary	interval laparotomy	69	68	71	84	81	78	75	72	86	88	130	126	129	117
56	gangaben	G18653	35/F	60	ca cervix	exp. Laprotomy	94	90	96	102	100	96	95	94	92	84	135	134	146	122
57	kiranben	G18641	25/F	70	astroid wall tumor	WLE+mess plasty	82	97	100	97	94	91	88	85	88	90	144	142	126	131
58	sanjiv	G15431	50/M	60	ca lower CBD	exp. Laprotomy	92	100	105	107	104	101	98	95	95	94	150	140	125	137
59	Hasinaben	G17790	60/F	60	ca endometrium	exp. Laprotomy	102	111	94	117	114	111	108	105	99	77	177	131	122	140
60	madhuben	G16373	45/F	50	ca ovary	exp. Laprotomy	88	86	80	103	100	97	94	91	91	80	150	140	138	136

IV NTG

DBP																MAP										complication		
2min	3min	4min	5min	7min	10min	baseline	fentanyl	0 min-Drug inj	intubation 1min	2min	3min	4min	5min	7min	10min	baseline	fentanyl	0 min-Drug inj	intubation 1min	2min	3min	4min	5min	7min	10min	hypotention	tachycardia	bradycardia
118	111	104	97	109	118	91	80	80	84	79	74	69	64	77	70	108	104	100	101	96	91	86	81	93	94			
120	113	106	99	116	110	90	96	80	83	78	73	68	63	80	74	102	106	102	95	90	85	80	75	94	88			
110	103	96	90	110	120	90	84	80	83	78	73	68	63	70	80	100	102	94	93	88	83	78	73	72	98			
120	113	106	99	130	120	90	92	86	82	77	72	67	62	80	74	110	108	108	103	98	93	88	83	90	89			
113	106	99	92	109	97	101	80	55	94	89	84	79	74	81	72	116	96	62	109	104	99	94	89	90	84			
118	111	104	97	86	84	91	83	87	84	79	74	69	64	50	54	97	93	96	90	85	80	75	70	63	71			
119	112	105	98	82	108	93	68	55	86	81	76	71	66	52	72	95	81	75	88	83	78	73	68	71	85			
116	109	102	95	90	84	92	83	81	85	80	75	70	65	64	59	102	104	90	95	90	85	80	75	76	68			
119	112	105	98	108	111	96	80	70	89	84	79	74	69	71	65	103	102	89	95	90	85	80	75	91	86			
126	119	112	105	90	89	96	67	80	89	84	79	74	69	64	61	86	82	90	79	74	69	64	60	77	70			
125	118	111	104	120	104	96	90	80	88	83	78	73	68	80	70	106	102	102	99	94	89	84	79	90	80			
120	113	106	99	112	110	90	74	88	83	78	73	68	63	70	82	100	97	104	93	88	83	78	73	90	90			
121	114	107	100	131	100	95	81	74	88	83	78	73	68	92	70	112	116	93	105	100	95	90	85	88	85			
112	105	98	91	100	88	94	75	72	87	82	77	72	67	68	54	96	98	94	89	84	79	74	69	85	71			
111	104	97	90	89	93	96	88	80	89	84	79	74	69	59	65	99	115	88	92	87	82	77	72	70	74			
143	136	129	122	94	90	104	89	80	97	92	87	82	77	60	56	124	113	94	105	100	95	90	85	74	68		tachycardia	
114	107	100	93	101	110	98	80	80	91	86	81	76	71	70	63	105	100	103	95	90	85	80	75	86	82			
117	110	103	96	79	86	94	97	99	87	82	77	72	67	50	51	93	114	114	85	80	75	70	65	65	62		tachycardia	
143	136	129	122	120	130	98	99	91	91	86	81	76	71	90	94	131	138	104	115	110	105	100	95	105	107			
134	127	120	113	91	86	101	98	64	94	89	84	79	74	63	58	112	106	73	105	100	95	90	85	70	67			
120	113	106	99	89	110	90	80	91	83	78	73	68	63	66	76	91	104	100	84	79	74	69	64	75	90			
119	112	105	98	110	117	92	87	76	85	80	75	70	65	72	71	105	107	97	95	90	85	80	75	89	96			
108	101	94	100	99	92	94	67	69	87	82	77	72	67	54	46	95	87	85	85	80	75	70	65	73	72			
118	111	104	97	90	89	96	67	80	89	84	79	74	69	64	61	86	82	90	79	74	69	64	60	77	70			
110	103	96	90	108	106	111	80	99	104	99	94	89	84	72	76	96	95	94	89	84	79	74	69	76	70			
117	110	103	96	116	107	101	93	97	94	89	84	79	74	80	72	105	100	103	95	90	85	80	75	86	82			
124	117	110	103	113	110	95	77	73	88	83	78	73	68	70	70	97	97	93	90	85	80	75	70	80	82			
130	123	116	109	102	100	91	70	78	84	79	74	69	64	69	67	101	102	91	94	89	84	79	74	80	78			
133	126	119	112	93	104	121	93	86	100	95	90	85	80	59	60	123	113	101	115	110	105	100	95	85	80			
129	122	115	108	115	105	93	94	96	86	81	76	71	66	82	80	109	105	106	100	95	90	85	80	83	79			