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Original Article

Evaluating hemodynamic outcomes of different dosages of intravenous nitroglycerin after coronary artery bypass graft surgery

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Abstract

BACKGROUND: Hemodynamic deterioration is a common postoperative problem. Intravenous nitroglycerin (NTG) is used for prevention of this complication. Nitroglycerin has different doses and is primarily a vasodilator. Applying different doses of intravenous NTG can induce different effects on post-operative cardiac instability, so we aimed to investigate whether there was a difference need for administration of inotrope drugs in patients undergoing CABG as indicators of cardiac instability.

METHODS: Sixty seven consecutive patients enrolled in this double-blind clinical trial performed in Shahid Rajaee hospital, Shahid Beheshti University of Medical Science, Tehran, Iran.

RESULTS: The decrease in blood pressure and the need for administration of epinephrine was more prevalent in warming up period in all three groups. No need for administration of epinephrine was detected before and during anesthesia in groups receiving 100 and 150 µg/min intravenous nitroglycerin, but 6.6 percent (1 patient) of patients receiving 50 µg/min epinephrine, demonstrated a decrease in blood pressure which necessitated the use of epinephrine.

CONCLUSIONS: It seemed that application of different doses of intravenous nitroglycerin did not exert a significant influence on cardiac instability and the need for use of inotrope drugs.

KEYWORDS: Nitroglycerin, CABG, epinephrine.

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Systemic hypertension -a common encountered problem in patients undergoing aortocoronary bypass grafting (CABG)- is considered an important issue in postoperative care unit as it is associated with increase in myocardial oxygen consumption and higher mortality rate.[1-7]

Preserved ventricular function, previous history of hypertension, aortic valve replacement, pain, nausea and vomiting, hypoventilation and associated hypercapnia, emergence excitement, advanced age, urinary retention, and preexisting renal disease are considered risk factors for development of postoperative hypertension.[8,9]

Vasoconstriction is considered to be a common mechanism for post-operative hypertension and appliance of vasodilators is recommended for management of postoperative increase in blood pressure and managing hemo-

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dynamic instability.[8] The aim is to maintain the blood pressure below 130 mm Hg or the mean arterial pressure below 70 mm Hg in order to minimize the potential adverse effects of hypertension.[9,10]

Nitroglycerin (NTG) -an antihypertensive medication- is primarily a vasodilator that lowers blood pressure by reducing preload, filling pressures, stroke volume, and cardiac output and is used during the early phase of postoperative recovery as a good choice for preventing postoperative hypertension and decrease of need for transfusion.

Following administration of NTG, the above parameters maintained more frequently in normal range. Also, due to vasodilatory effects of NTG, it is expected that the need to blood transfusion become less. Decreasing the need to blood transfusion means less coagulopathy and electrolyte disturbance and more hemodynamic stability.

To the best of our knowledge, there was no study to evaluate the efficacy of different dosages of NTG in this regard. So, we designed the present study to investigate whether applying different doses of intravenous NTG can induce different effects on postoperative stability of cardiovascular system and the need for blood transfusion.

Methods

After obtaining institutional approval from Ethics Committee of our university and taking written informed consents from patients, sixty seven consecutive patients, aged 50-75 years, enrolled in this double-blind clinical trial which was performed in Shahid Rajaee hospital throughout September 2009 to September 2010. All patients had ejection fraction more than forty percent and all were candidate for on pump elective CABG surgery. Coronary artery stenosis was documented by angiography and all patients had negative history for diabetes, renal, hepatic and hematologic disorders. If there was any change in technique of anesthesia, the need for massive transfusion, any cardiac arrest during induction or emergence of anesthesia, the patients were excluded from the study. Patients were assigned randomly into three groups; each group received different dosage of intravenous nitroglycerin (50 µg/min, 100 µg/min and 150 µg/min, respectively). Selecting the dosage of NTG was based on the two previous studies.[9,11]

Anaesthesia was induced by midazolam (0.1 mg/kg), etomidate (0.2 mg/Kg), sufentanil (1 mic/kg) and pancuronium (0.1 mg/kg) for all patients. Drug preparation was performed by a primary anesthesiologist through the syringes with similar volumes. Data collection was done by second anesthesiologist who was blind to drug preparation.

All surgeries were done by a single surgeon. All patients had three implanted grafts.

Mean arterial pressure and heart rate were evaluated at baseline before induction of anesthesia, just before inducing hypothermia, at the end of warming up period and finally six hours after admission to the ICU. Epinephrine (0.05 mic/kg) administered as inotrope when systolic blood pressure was lower than 80 mmHg. Also, homologous blood was transfused in case of low blood pressure and low hemoglobin (Hb less than 8 mg/dl) level as a volume expander.

The sample size was based on a power calculation which showed that 67 patients per group were necessary to achieve 80% power to detect a 24% difference in the mean arterial pressure among three groups, with Alfa=0.05. Data are presented as mean (SD) or numbers. Categorical variables were analyzed by Pearson and chi-square tests and by Fisher's exact test when the anticipated number was less than 5. $P < 0.05$ was considered statistically significant. All statistical analyses were performed using SPSS 16.0 for Windows statistical package.

Results

In this double-blind clinical trial, sixty seven patients were evaluated (mean age: 60.2 ± 10.29). Twenty-six (38.8%) patients were female and forty-one (61.2%) were male. There was no significant difference among three groups regarding duration of surgery. Mean

total bypass time was 67 ± 0.3 minutes and mean cross-clamp time was 35±0.5. No significant difference was noted in the preoperative ejection fraction among three groups (Table 1). The decrease in blood pressure and the need for administration of epinephrine and blood transfusion was more prevalent in warming up period in all three groups. No need for administration of epinephrine was detected before and during anesthesia in groups receiving 100 and 150 µg/min intravenous nitroglycerin, but 6.6 percent (1patient) of patients receiving 50 µg/min intravenous nitroglycerins, demonstrated a decrease in blood pressure which necessitated the use of epinephrine (P = 0.701). Results are demonstrated in Figures 2, 3, and 4. Inotropic drug was administered to all three groups during warming up period and ICU admission but no significant difference was detected (P-value=0.251 and 0.119, respectively). On the other hand, the need for blood transfusion was present in all phases, more prevalent in group receiving 50 µg/min intravenous nitroglycerin group (Figures 5, 6, and 7) because in other groups (100 and 150 µg) the effect of venodilator was better than that in group of 50 µg which affected the return of heavy blood from cardiac pump to patient circulation. We had no myocardial ischemic episodes during and after operation.

Table 1. The preoperative ejection fraction in three groups

Group	Ejection fraction
Group 1 (NTG: 50µg/min)	46 ± 4.7
Group 2 (NTG: 100µg/min)	46.8 ± 6.28
Goup 3 (NTG: 150µg/min)	47.33 ± 5.07

Data are presented as mean ± SD. There was no significant difference among three groups.
NTG: Nitroglycerin

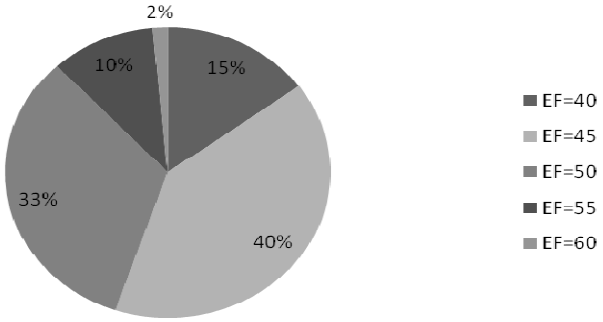

Figure 1. Prevalence of ejection fraction in evaluated patients

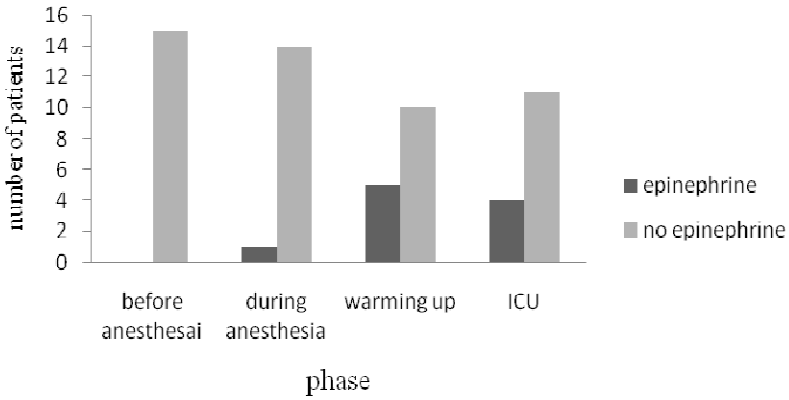

Figure 2. Administration of epinephrine in patients receiving 50 µg/min intravenous nitroglycerin

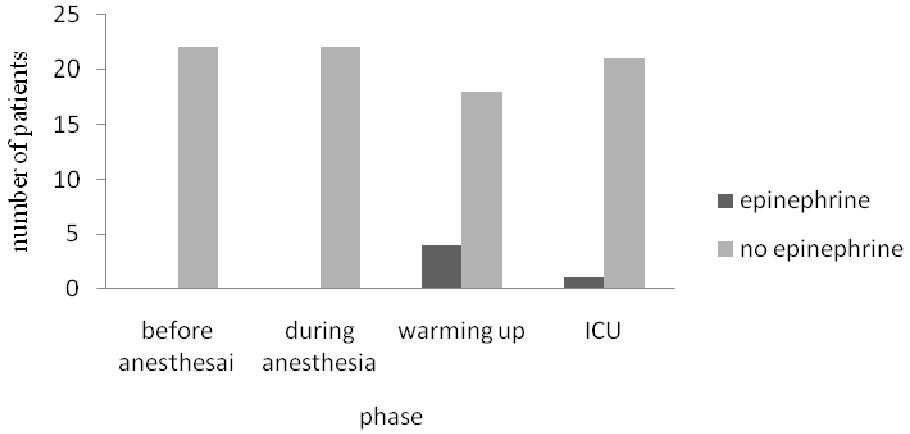

Figure 3. Administration of epinephrine in patients receiving 100 µg/min intravenous nitroglycerin

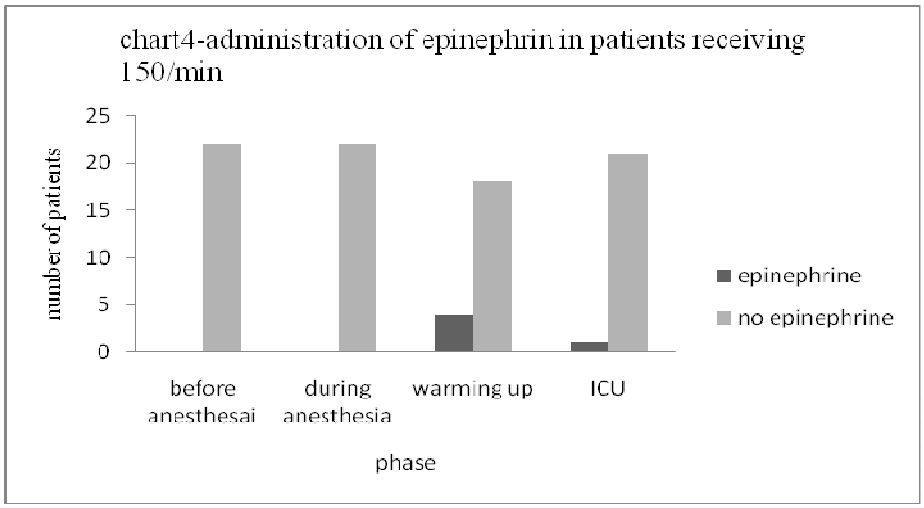

Figure 4. Administration of epinephrine in patients receiving 150 µg/min intravenous nitroglycerin

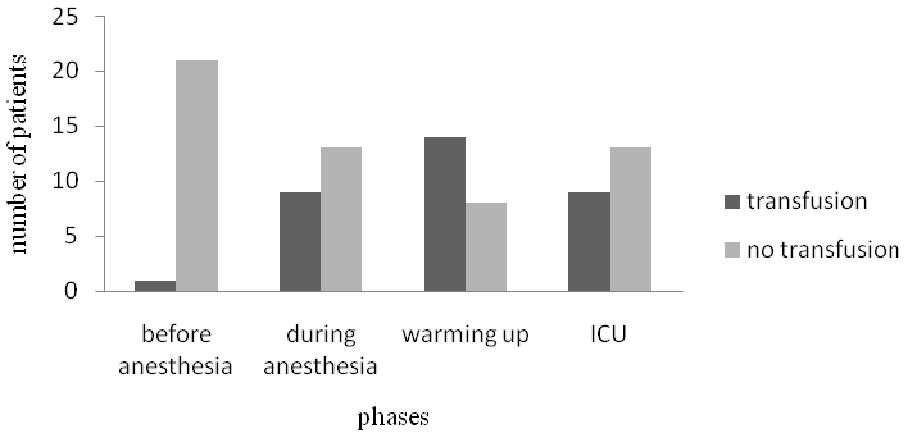

Figure 5. Blood transfusion in patients receiving 50 µg/min intravenous nitroglycerin

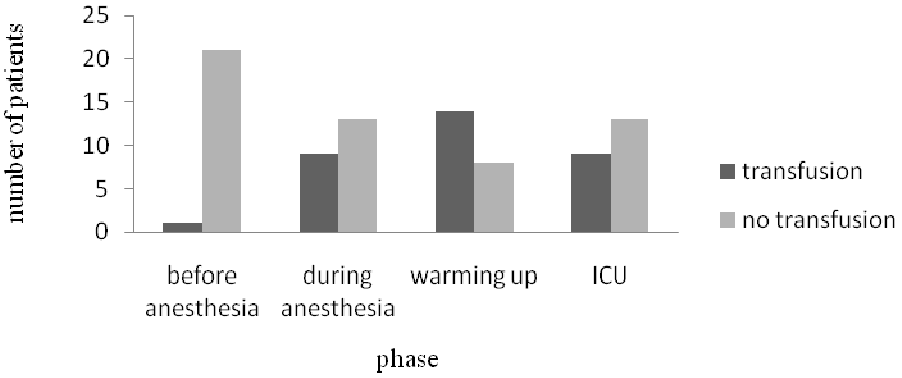

Figure 6. Blood transfusion in patients receiving 100 µg/min intravenous nitroglycerin

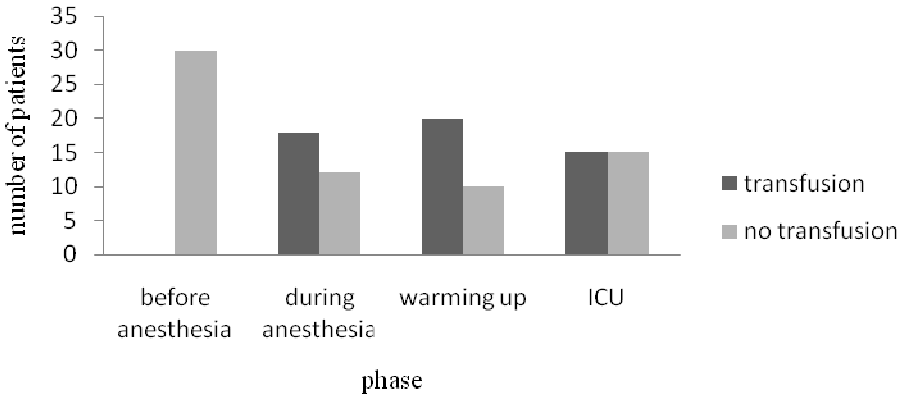

Figure 7. Blood transfusion in patients receiving 150 µg/min intravenous nitroglycerin

Discussion

Patients undergoing elective on-pump CABG were enrolled in this study. Different doses of intravenous nitroglycerin and administration of epinephrine as an inotrope were evaluated in this study. We found that none of the groups needed administration of epinephrine prior to anesthesia. Regarding our data during induction of anesthesia, only group one (NTG = 50 µg/min) needed inotrope use which was not statistically significant comparing with other two groups (P-value = 0.701). Inotrope was administered to all three groups during warming up period and ICU admission but no significant difference was detected (P-value = 0.251 and 0.119, respectively). Also, blood was transfused in all three groups in all phases but no significant difference was detected. Considering our data, it seems that application of different doses of intravenous nitroglycerin has no significant effect on the need for use of inotrope drugs and blood transfusion.

Apostolidou et al. [11] assessed the efficacy of a continuous infusion of nicardipine and nitroglycerin in reducing the incidence and severity of perioperative myocardial ischemia during elective coronary artery bypass grafting procedures. They used nitroglycerine 0.5-1 microgram/kg. They showed that only nicardipine lessened the severity of myocardial ischemia shortly after coronary revascularization. They didn't investigate the effect of different dosages of NTG on hemodynamic parameters.

Also, Petry et al. [10] studied the effects of infusing 3 microgram/kg/min nitroglycerin on hemodynamic, renal blood flow, kidney function, and the requirement for homologous blood transfusions. They also didn't evaluate

the effects of different dosages of NTG on postoperative hemodynamic stability.

There were some limitations in our study. Measurement of blood pressure post-surgery was used as an only indicator for applying inotrope drugs, while in other studies performed in similar way, more indices were measured. In a study performed by van Wezel et al. heart rate, cardiac index and vascular resistance were evaluated before and after operation.[12] In order to resolve it, more accurate measurements are required. Also, it seems that our study population was small and more studies are recommended with larger sample size in order to find out more accurate and inclusive results.

Conclusion

Our study showed that applying different dosages of NTG (50 µg/min, 100 µg/min and 150 µg/min) had no different effect on maintenance of hemodynamic stability and the need for blood transfusion. Further study must be performed before final conclusion can be elucidated.

Acknowledgment

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Conflict of Interests

Authors have no conflict of interests.

Authors' Contributions

All authors carried out the study, participated in the design of the study and acquisition of data, performed the statistical analysis and wrote the manuscript. All authors read and approved the final manuscript.

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