Comparative effects of propofol and nitroglycerine on efficacy of rewarming in patients undergoing on-pump coronary artery bypass grafting

Bhupesh Kumar, Prerana Chauhan, K. S. Shyam Thinganam
Departments of Anaesthesia and Intensive Care and 'Cardiothoracic and Vascular Surgery, Post Graduate Institute of Medical Education and Research, Chandigarh, India

ABSTRACT

Objectives: To compare the effects of propofol and nitroglycerine (NTG) on the efficacy of rewarming, extra volume added during cardiopulmonary bypass and extravascular lung water (EVLW) in patients undergoing on-pump coronary artery bypass grafting. Materials and Methods: A prospective, randomized, blinded trial, twenty adult patients were randomly assigned to receive either NTG infusion (NTG group) or propofol infusion (propofol group) during rewarming. Results: After drop in temperature at the end of surgery and till 24 h were significantly less in propofol group compare to NTG group (P < 0.025). Extra volume added during cardiopulmonary bypass and net crystalloid balance till 24 h was less in the propofol group (P < 0.003). There was no difference in EVLW and postoperative outcome. Conclusions: Propofol use during moderate hypothermic cardiopulmonary bypass is associated with less after drop in temperature and less requirement of extra fluid during the perioperative period.

Key words: After drop; Extravascular lung water; Fluid balance

INTRODUCTION

Decrease in body temperature following termination of cardiopulmonary bypass (CPB) that is, postoperative hypothermia is common. Nitroglycerine (NTG) is a predominant venodilator commonly used during rewarming on CPB for the prevention of postoperative hypothermia.[1] However, its use is associated with a decrease in reservoir volume leading to the addition of extra fluids and blood during CPB besides causing hemodynamic compromise.[2] High positive fluid balance on CPB is associated with more pronounced increase in extravascular lung water (EVLW) after termination of CPB. EVLW is the volume within the lung interstitium and the alveoli and is a very good clinical surrogate marker of pulmonary edema. It correlates with extravascular thermal volume in the lungs and may be evaluated by the pulse-induced contour cardiac output (PiCCO), a transpulmonary cardiac output (CO) monitoring tool through the mean transit time method.[3] Use of propofol during CPB has been shown to decrease systemic vascular resistance (SVR).[4] We hypothesized that by predominantly decreasing SVR propofol would provide better homogenous rewarming during CPB and less afterdrop in temperature after surgery (primary outcome). In addition, it may produce less decrease in reservoir volume leading to less addition of extra fluids and blood on CPB, better hemodynamic stability and less accumulation of EVLW in comparison to NTG (secondary outcome).
MATERIALS AND METHODS

After approval from institute’s ethics committee and informed consent, 20 subjects of either sex, between 20 and 70 years, undergoing elective coronary artery bypass grafting were included in this prospective, randomized, double-blinded study. The exclusion criteria included patients with poor left ventricular function (ejection fraction [EF] <50%), peripheral vascular disease, uncontrolled hypertension and diabetes mellitus, preoperative renal dysfunction and history of cerebrovascular accident. All subjects received alprazolam 0.25 mg as premedication on night before and morning of the surgery. Other preoperative cardiac drugs except for angiotensin converting enzyme inhibitors and digoxin were continued till morning of the surgery. Intravenous (IV) morphine 0.1 mg/kg and midazolam 1 mg were administered in the operating room (OR) before instituting invasive arterial and central venous cannulation. Anesthesia was induced with IV fentanyl 5 µg/kg, propofol titrated to achieve loss of consciousness and vecuronium 0.1 mg/kg to facilitate endotracheal intubation. Ventilation was adjusted to achieve the end tidal carbon dioxide (EtCO$_2$) between 35 and 40 mmHg. Boluses of IV fentanyl 2–4 µg/kg were given before skin incision, sternotomy, and after persistent increase in mean arterial blood pressure (MAP) >20% from baseline. Maintenance of anesthesia was achieved using boluses of morphine (maximum cumulative dose <0.5 mg/kg) and oxygen isoflurane mixture (prior to and after termination of CPB) titrated to maintain entropy between 40 and 60 using type E-entropy-00 module (GE Health Care Finland OY Helsinki, Finland, USA).

Patients were randomized either into NTG or propofol group using a computer generated a random number and sealed envelope method by a person not involved in the study. NTG group received morphine 0.2 mg/kg, midazolam 0.05 mg/kg boluses titrated to maintain target entropy on CPB and NTG infusion during rewarming. NTG infusion (1 µg/kg/min) was started at the start of rewarming and titrated in 0.5 µg/kg/min increment to obtain maximum pump flow 2.4–2.6 L/m$^2$ while maintaining target MAP between 50 and 80 mmHg. Propofol group received morphine 0.2 mg/kg and propofol infusion during CPB. Propofol infusion (50 µg/kg/min) was initiated at the start of CPB to maintain target entropy and titrated in 25 µg/kg/min increment to obtain maximum pump flow 2.4–2.6 L/m$^2$ while maintaining target MAP between 50 and 80 mmHg during rewarming. Hypotension unresponsive to maximum pump flow was treated by using phenylephrine 50 µg boluses. The lowest and highest MAP and number of episodes of hypotension or hypertension (MAP <45 mmHg and >90 mmHg for >20 s respectively) were noted. Anesthesia was conducted by anesthesiologist not involved in the study. Person involved in the collection of data were blinded about study drug, by covering syringe pump and extension tubing. Perfusionist not involved in the study managed NTG or propofol infusion and phenylephrine boluses during CPB. CPB circuit included roller pump and membrane oxygenator, prime consisted of 1000 mL lactated ringer solution, 3 mL/kg of mannitol and 5000 IU of unfractionated heparin. Moderate hypothermia (cooling up to 28°C nasopharyngeal) was used in all cases. During CPB, hematocrit was maintained at 24–27. Rewarming was started at the time of last distal coronary anastomosis. During rewarming the maximum difference between perfuse and blood temperature was kept at ≤7°C, with maximum perfusate temperature ≤38°C and blood temperature ≤than 37°C. Patients were rewarmed up to rectal temperature of 36.5°C before termination of CPB. The operation theater and Intensive Care Unit (ICU) environment was maintained at 20°C–22°C. After the termination of CPB a heating mattress warmed to 39°C was used inside OR while no heating device were used in ICU. NTG (1 µg/kg/min) and propofol (50 µg/kg/min) in NTG and propofol group respectively were continued till 30 min prior to extubation. Morphine (30 µg/kg/min) - midazolam (50 µg/kg/min) combination in NTG group and morphine (30 µg/kg/min) together with propofol (50 µg/kg/min) in propofol group were used for ICU sedation. Perioperative fluid management was left at the discretion of attending a physician who was unaware of the study. Total NTG, propofol and phenylephrine used during rewarming, amount of extra volume (crystalloid or blood) added during CPB, intraoperative and postoperative fluid balance at the end of 24 h were recorded. Rectal (T$_{rectal}$), nasopharyngeal (T$_{nasopharyngeal}$) and foot (T$_{foot}$) temperature were monitored using a calibrated thermister (GE Healthcare Oy Kuortaneenkatu 2, Finland, USA). The temperature drop during cooling, rewarming time (start of rewarming to achieve rectal temperature 36.5°C), time spent at peak T$_{rectal}$ during CPB, open sternotomy period (time interval between completion of rewarming to sternal closure), interval between end of CPB to end of surgery, afterdrop in temperature at the end of surgery (difference in T$_{rectal}$, T$_{nasopharyngeal}$ and T$_{foot}$ from end of CPB to the end of surgery), maximum afterdrop
in temperature during 24 h ICU stay (difference in temperature from end of CPB to the minimum temperature in ICU) were recorded. Heart rate, central venous pressure (CVP), arterial blood pressure, CO, SVR, EVLW, intrathoracic blood volume (ITBV), global end-diastolic volume index (GEDVI) measured using PiCCO catheter (PULSION Medical System, Munchen, USA) and arterial blood gas were recorded at following time points: at baseline before induction of anesthesia (T0), after induction of anesthesia (T1), 30 min after coming off CPB (T2), at ICU admission (T3), 4 h after ICU (T4), 8 h after ICU (T5), 30 min postextubation (T6), and at 24 h after ICU admission (T7). The duration of mechanical ventilation, ICU stay and postoperative mortality and morbidity (neurological deficit, renal dysfunction defined as serum creatinine >2 mg/dL and liver dysfunction defined as serum bilirubin >2 mg/dL) were noted.

The statistical analysis was performed using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 15.0 for Windows). Normally distributed data means were compared by using independent sample t-test. For skewed data Mann–Whitney test was applied. P value obtained was adjusted for multiple comparisons using false detection rate. For multiple comparisons repeated measure, ANOVA was applied. Qualitative or categorical variables were described as frequencies and proportions. Proportions were compared by using Chi-square or Fisher’s exact test whichever was applicable. Multivariate analysis was done see the effect of CPB time on primary outcome variables. All statistical tests were one-sided and performed at a significance level of $\alpha = 0.05$. Based on previous literature suggesting mean difference in after drop of temperature 0.7°C with standard deviation of 0.6 our sample size came out to be 10 per group at a power of 80% and confidence interval of 95%. A total of 20 patients were recruited in the study with 10 in each group.

RESULTS

All 20 patients completed the study. The demographic profile, number of patients receiving preoperative vasodilator medication and preoperative EF were comparable between both the groups [Table 1]. Duration of CPB and aortic cross-clamp time was higher while duration between end of CPB to end of surgery was lower in the propofol group than NTG group. However other intraoperative characteristics, including rewarming time, time spent on peak rectal temperature during rewarming and open sternotomy time were comparable between both the groups [Table 1].

Baseline temperatures and lowest temperature during CPB were comparable in both the groups. Afterdrop in temperature at the end of surgery and maximum afterdrop till 24 h of ICU stay were significantly less in the propofol group in comparison to NTG group [Table 2].

| Table 1: Demographic and intra-operative characteristics |
|---------------------------------------------------------|
| Demography                                             | NTG group (n=10) | Propofol group (n=10) | P   |
| Age (years)                                            | 63.50±4.79       | 58.40±8.35            | 0.111 |
| Sex (male:female)                                      | 9:1              | 9:1                   | 1.00  |
| Weight (kg)                                            | 65.80±13.19      | 73.30±13.30           | 0.222 |
| Height (cm)                                            | 168.10±11.38     | 167.60±7.13           | 0.908 |
| BSA (kg/m²)                                            | 1.74±0.22        | 1.82±0.18             | 0.400 |
| LVEF (%)                                                | 57.20±5.51       | 58.10±2.64            | 0.647 |
| β-blocker (n)                                          | 9                | 8                     | 0.531 |
| ACE inhibitor/ARB blocker (n)                          | 4                | 4                     | 1.0   |
| Hemoglobin (g/dL)                                      | 12.48±1.56       | 13.02±2.11            | 0.525 |
| Duration of surgery (min)                              | 383.50±42.10     | 462.00±126.80         | 0.080 |
| Duration of CPB (min)                                  | 155.20±34.14     | 214.60±70.65          | 0.028*|
| Aortic cross clamp time (min)                          | 100.00±20.59     | 147.20±45.87          | 0.006*|
| Rewarming time (min)                                   | 64.00±14.13      | 69.50±19.33           | 0.477 |
| Duration end of CPB to end of surgery (min)            | 100.20±25.52     | 74.80±17.54           | 0.018*|
| Time spent on peak rectal temperature (min)            | 8.30±3.43        | 10.70±1.82            | 0.067 |
| Open sternotomy time (min)                             | 62.00±17.84      | 53.30±15.56           | 0.260 |

All values except gender distribution in mean±SD. P<0.05 was considered significant. BSA: Body surface area, LVEF: Left ventricular ejection fraction, CPB: Cardiopulmonary bypass, SD: Standard deviation, NTG: Nitroglycerine, ACE: Angiotensin-converting enzyme, ARB: Angiotensin receptor blocker
Multivariate analysis done after keeping duration of CPB as covariate also showed significantly less afterdrop in temperature at the end of surgery ($P < 0.001$) and until 24 h of ICU stay ($P < 0.001$) in propofol group compared to NTG group.

Pump prime and the cardioplegia volume and total blood loss were comparable between two groups [Table 3]. Amount of extra volume of crystalloid added during CPB was significantly less in the propofol group than NTG group ($P < 0.003$). In addition, intraoperative ($P - 0.0001$), total crystalloid intake till 24 h in ICU ($P - 0.000$) and net balance of crystalloid ($P - 0.000$) were also significantly less in propofol group [Table 3]. However, there was no statistically significant difference in requirement of blood between two groups.

Extravascular lung water index (EVLWI) and GEDVI were comparable between both the groups at all-time points. Furthermore, there was no significant change in EVLWI or GEDVI from the baseline value at any time points in either group. Intrathoracic blood volume index was comparable at baseline, but it became significantly

Table 2: Afterdrop in temperatures

| Temperatures (°C) | NTG group (n=10) | Propofol group (n=10) | $P$ | 95% CI of the difference |
|------------------|------------------|-----------------------|-----|--------------------------|
| Baseline $T_{naso}$ | 35.38±0.54       | 35.72±0.57            | 0.68 | −0.86-0.18               |
| Baseline $T_{rectal}$ | 36.11±0.50      | 36.35±0.42            | 0.88 | −0.87-0.19               |
| Baseline $T_{foot}$ | 30.48±1.32       | 30.54±1.54            | 2.96 | −1.4-1.28                |
| Lowest $T_{naso}$ on CPB | 28.91±0.96      | 29.26±0.39            | 3.40 | −0.34-1.04               |
| Lowest $T_{rectal}$ on CPB | 29.67±0.46      | 29.84±0.16            | 2.96 | −0.49-0.15               |
| Lowest $T_{foot}$ on CPB | 28.91±0.96       | 29.26±0.39            | 3.40 | −0.62-1.44               |
| Afterdrop ES $T_{naso}$ | 1.10±0.31     | 0.50±0.26              | 0.0004* | 0.32-0.87             |
| Afterdrop ES $T_{rectal}$ | 1.05±0.21   | 0.48±0.18              | 0.0000* | 0.38-0.75             |
| Afterdrop ES $T_{foot}$ | 1.35±0.43     | 0.72±0.13              | 0.0006* | 0.33-0.92             |
| Afterdrop ICU $T_{naso}$ | 1.14±0.42     | 0.70±0.28              | 0.025* | 0.09-0.78             |
| Afterdrop ICU $T_{rectal}$ | 1.09±0.33   | 0.73±0.36              | 0.017* | 0.03-0.68             |
| Afterdrop ICU $T_{foot}$ | 1.55±0.46   | 0.82±0.13              | 0.0002* | 0.41-1.04             |

All values in mean±SD. *Significant difference between two group ($P<0.05$ was considered significant). $T_{naso}$: Nasopharyngeal temperature, $T_{rectal}$: Rectal temperature, $T_{foot}$: Foot temperature, Afterdrop ES: Afterdrop at the end of surgery, Afterdrop ICU: Afterdrop till 24 h of Intensive Care Unit admission, NTG: Nitroglycerine, CI: Confidence interval, CPB: Cardiopulmonary bypass, SD: Standard deviation

Table 3: Effect on fluid balance

| Fluid (mL/kg) | NTG group (n=10) | Propofol group (n=10) | $P$ | 95% CI of the difference |
|--------------|------------------|-----------------------|-----|--------------------------|
| Prime volume | 19.10±6.04       | 16.57±3.39            | 0.18 | 0.91-9.43               |
| Cardioplegia volume | 20.94±0.95     | 20.32±1.23            | 2.52 | −0.41-1.65               |
| Extracrystalloid added on CPB | 30.53±12.28  | 8.98±4.48             | 0.003* | 23.30-34.70           |
| Extra blood added on CPB | 6.77±8.80   | 2.99±4.05             | 7.02 | −2.66-10.22             |
| Intraoperative crystalloid intake | 81.35±13.42  | 46.55±7.44            | 0.0001* | 24.60-44.99           |
| Intraoperative blood intake | 8.54±14.15  | 2.99±4.05             | 7.02 | −4.07-15.33             |
| Intraoperative urine output | 16.78±8.43   | 18.26±4.73            | 7.02 | −7.90-9.44              |
| Intraoperative blood loss | 11.92±4.35    | 11.85±3.43            | 7.92 | −3.61-3.74              |
| Postoperative crystalloid intake | 46.89±13.13  | 32.99±6.80            | 0.18 | 4.07-23.73             |
| Postoperative blood intake | 0.91±1.91    | 0.78±1.69             | 17.46 | 0.00-1.81             |
| Postoperative urine output | 37.35±18.98  | 36.47±15.83           | 17.46 | −15.54-17.31            |
| Postoperative drain output | 4.69±2.88    | 4.52±2.47             | 17.46 | −2.35-2.69             |
| Total crystalloid intake | 128.24±22.47  | 79.25±12.99           | 0.000* | 31.45-65.95           |
| Total blood intake | 9.44±13.84    | 3.78±4.50             | 5.76 | −4.00-15.34            |
| Total urine output | 54.13±24.84   | 54.72±17.78           | 12.24 | −20.90-19.71            |
| Total blood loss | 16.60±5.29    | 16.37±4.17            | 13.32 | −4.25-4.71             |
| Net crystalloid balance | 74.11±7.18   | 24.81±10.78           | 0.000* | 40.68-57.90            |
| Net blood balance | −7.16±11.46   | −10.63±12.06           | 1.98 | −3.50-14.38            |

*Significant difference between two groups $P<0.05$ was considered significant. All values in mean±SD. CPB: Cardiopulmonary bypass, NTG: Nitroglycerine, CI: Confidence interval, SD: Standard deviation
less in the propofol group at 30 min after coming off CPB compared to NTG group ($P - 0.02$). It remained comparable between both groups at all other time points [Figure 1a-c].

Heart rate, CVP, MAP, cardiac index and systemic vascular resistance index (SVRI) were comparable between two groups [Figure 2a-c]. There was significant fall in MAP from baseline value at 30 min after coming off CPB, 4 h after ICU admission, 30 min post-extubation and at 24 h after ICU admission in NTG group in contrast to no intra-group variation in propofol group [Figure 2b].

PaO$_2$/FiO$_2$ ratios were comparable between both the groups at all points. Higher value from baseline were seen after induction of anesthesia, 30 min after CPB and at ICU admission in the propofol group, but only after induction of anesthesia in NTG group [Figure 2d].

Total morphine used during surgery, and total phenylephrine required to maintain target MAP during rewarming was comparable in both the groups [Table 4]. Number of hypertensive episodes (NTG group $2.20 \pm 2.15$ vs. $0.80 \pm 1.39$ in propofol group) and hypotensive episodes (NTG group $0.90 \pm 1.44$ vs. $0.30 \pm 0.94$ in propofol group) during rewarming were comparable in both the groups. Duration of mechanical ventilation (NTG group $25.2 \pm 3.8$ h vs. $17.3 \pm 2.7$ h in propofol group), ICU stay (NTG group $3.5 \pm 0.8$ days vs. $2.9 \pm 0.9$ days in propofol group), postoperative morbidity and mortality (none in either group) were comparable between the groups.

**DISCUSSION**

The present study showed that as compared to NTG, propofol use during rewarming was associated with significantly less afterdrop in temperature at the end of surgery and until 24 h of ICU stay. Amount of extra crystalloid volume added during CPB, total intraoperative and net crystalloid balance at 24 h in ICU were also significantly less in propofol group compare to NTG group, but it did not affect EVLW and postoperative outcome parameters.

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**Figure 1:** (a) Extravascular lung water index; (b) Intrathoracic blood volume index; (c) Global end diastolic volume index at different time intervals (T0 - baseline before induction of anaesthesia, T1 - after induction of anaesthesia, T2 - 30 min after coming off cardio pulmonary bypass, T3 - at Intensive Care Unit (ICU) admission, T4 - 4 h after ICU, T5 - 8 h after ICU, T6 - 30 min postextubation, and T7 - at 24 h after ICU admission) ($P < 0.05$ was considered significant, *indicate significant difference between two groups)
Postoperative hypothermia after termination of CPB is a result of nonhomogenous warming due to failure of heat transfer to vasoconstricted peripheral tissues during rewarming. Pharmacologically induced vasodilatation has been proposed as a method to improve rewarming by dilating these constricted vessels.\(^1\) Tugrul et al.\(^6\) showed significantly higher afterdrop in esophageal temperature in the control group compared to SNP and isoflurane used for rewarming during CPB. NTG is one other commonly used a vasodilator; however it has shown to cause a decrease in reservoir volume leading to the addition of extra fluid during CPB.\(^5\) Our study result of less afterdrop in temperature at the end of surgery and until 24 h of ICU stay in propofol group may be because of homogenous rewarming with use of propofol due to preferential decrease in SVR as compared to whole-body venodilator effect of NTG.\(^5\) Although duration of CPB and aortic cross-clamp time were higher while duration between end of CPB to end of surgery were shorter in propofol group compared to NTG group, these value

Table 4: Drug requirement during intraoperative period

| Drugs                              | NTG group (n=10) | Propofol group (n=10) | P    |
|------------------------------------|------------------|-----------------------|------|
| NTG used during rewarming (mg/kg)  | 0.31±0.12        | -                     | -    |
| Propofol used during rewarming (mg/kg) | -               | 1.12±0.27             | -    |
| Midazolam used during surgery (mg/kg) | 0.07±0.04        | -                     | -    |
| Morphine used during surgery (mg/kg) | 0.45±0.09        | 0.39±0.12             | 0.321|
| Phenylephrine used during rewarming (µg/kg) | 2.82±3.21        | 0.63±1.43             | 0.064|

NTG: Nitroglycerine

Figure 2: (a) Central venous pressure; (b) Mean arterial pressure; (c) Systemic vascular resistance index; (d) p/f ratios; at different time intervals (T0 - baseline before induction of anaesthesia, T1 - after induction of anaesthesia, T2 - 30 min after coming off cardio pulmonary bypass, T3 - at Intensive Care Unit (ICU) admission, T4 - 4 h after ICU, T5 - 8 h after ICU, T6 - 30 min postextubation, and T7 - at 24 h after ICU admission). \(P < 0.05\) was considered significant, *indicate significant difference between two groups, +indicates significant difference from baseline value within nitroglycerine group, and ‡indicates significant difference from baseline value within propofol group.
may not have affected the afterdrop in temperature since rewarming time, time spent at peak rectal temperature during rewarming and the open sternotomy period were comparable between the two groups. Further this was confirmed on multivariate analysis where keeping duration of CPB as covariate did not altered the significance level of afterdrop in temperature.

Decrease in reservoir blood volume of the CPB circuit indicates venodilation. Hynynen et al.\(^\text{[2]}\) showed that use of NTG and SNP during CPB decreased the reservoir blood volume while atrial natriuretic factor and phentolamine had no effect. Our study results of less extra crystalloid volume addition during CPB, total intraoperative and postoperative crystalloid requirement in the propofol group is similar with Baraka et al.\(^\text{[4]}\) who showed that the administration of propofol during CPB results in a significant decrease of MAP without a significant change in reservoir volume, suggesting propofol preferential decrease in SVR without significant change in venous capacitance. Although the requirement of blood was similar in both the groups there was tendency for less addition of extra blood in venous reservoir and total intraoperative blood requirement in the propofol group. This may be due to less addition of extra crystalloid in the propofol group.

Extravascular lung water is calculated by subtracting the ITBV from the intrathoracic thermal volume (ITTV). ITTV is the volume of distribution of the thermal indicator in the 4 chambers of heart and lungs. ITBV is the volume within the thoracic vasculature (4 chambers of the heart and pulmonary vasculature). EVLW has shown to increase significantly after termination of CPB and during post-operative period particularly when crystalloid prime is used or after prolonged CPB.\(^\text{[7,8]}\) High positive fluid balance during CPB is associated with more pronounced increase in EVLW and deterioration of pulmonary gas exchange after termination of CPB. Negative water balance, increase in urine output and increase in colloid osmotic pressure contribute in lowering of EVLW in the postoperative period after termination of CPB.\(^\text{[9]}\) NTG infusion with optimal positive end-expiratory pressure has shown to decrease EVLW in adult respiratory distress syndrome patients.\(^\text{[10]}\)

To the best of our knowledge, there is no previous study that examine the effect of vasodilators on EVLW after CPB. Our result suggests that both propofol and NTG had a similar effect on EVLW despite significantly high net fluid balance in the NTG group. This may be because the extra volume administered remained in capacitance venous system due to preferential venodilator action of NTG. ITBV index at 30 min after CPB was significantly higher in NTG group than propofol group.

In general, there is transient profound decrease in SVR at the commencement of CPB, followed by its steady increase as CPB progresses, it finally decreases with an increase in temperature during rewarming.\(^\text{[11]}\) We did not calculate SVR during CPB however at all other time points heart rate, CVP, MAP, CI and SVRI were comparable in both the groups. Significant decrease in MAP from baseline value at 30 min after CPB, 4 h of ICU admission, 30 min postextubation and 24 h after ICU admission in NTG group could be related to potent venodilator action of NTG.

Similar duration of mechanical ventilation, ICU stay, postoperative morbidity and mortality in both groups suggested no clinically significant difference in the outcome variable.

**Limitation**

Two groups were not comparable in terms of duration of CPB, aortic cross clamp and surgery times. However, a multivariate analysis done to analyze the effect of duration of CPB did not altered the significance level of primary outcome variable. Small difference in afterdrope temperature although statistically significant may not be of great clinical significance. EVLW may be affected by multiple factors like age, duration of CPB, etc. All these except duration of CPB were comparable between both groups. SVR and CI values during CPB were not noted that would have given actual values of changes in SVR during the CPB. Our study had small sample size to show the effect on EVLW and a further larger randomized controlled trial may be needed.

**CONCLUSION**

In comparisons to NTG infusion use of propofol infusion during rewarming in moderate hypothermic CPB is associated with less need for fluid administration and less postoperative temperature drop however this did not offer any advantage in decreasing EVLW, duration of mechanical ventilation or, ICU stay.

**REFERENCES**

1. Deakin CD, Petley GW, Smith D. Pharmacological vasodilatation improves efficiency of rewarming from hypothermic cardiopulmonary bypass. Br J Anaesth 1998;81:147-51.
2. Hynynen M, Palojoki R, Salmenperä M, Tikkanen I, Harjula A, Fyhrquist F, et al. Vasodilator properties of atrial natriuretic factor: A comparison with nitroglycerin, nitroprusside, and phentolamine during cardiopulmonary bypass. J Cardiothorac Anesth 1989;3:720-5.

3. Katzenelson R, Perel A, Berkenstadt H, Preisman S, Kogan S, Sternik L, et al. Accuracy of transpulmonary thermodilution versus gravimetric measurement of extravascular lung water. Crit Care Med 2004;32:1550-4.

4. Baraka A, Dabbous A, Siddik S, Bijjani A. Action of propofol on resistance and capacitance vessels during cardiopulmonary bypass. Acta Anaesthesiol Scand 1991;35:545-7.

5. Gerson JL, Allen FB, Seltzer JL, Parker FB Jr, Markowitz AH. Arterial and venous dilation by nitroprusside and nitroglycerin – Is there a difference? Anesth Analg 1982;61:256-60.

6. Tugrul M, Pembechi K, Camci E, Ozkan T, Telci L. Comparison of the effects of sodium nitroprusside and isoflurane during rewarming on cardiopulmonary bypass. J Cardiothorac Vasc Anesth 1997;11:712-7.

7. Duma S, Aksakal D, Benzer W, Haider W, Krieger G, Polzer K, et al. Intraoperative changes in extravascular lung water. Study on heart surgery patients. Anaesthesist 1985;34:593-9.

8. Hoeft A, Korb H, Mehlihorn U, Stephan H, Sonntag H. Priming of cardiopulmonary bypass with human albumin or Ringer lactate: Effect on colloid osmotic pressure and extravascular lung water. Br J Anaesth 1991;66:73-80.

9. Kuniyoshi Y. A study of changes in extravascular lung water after extracorporeal circulation – Clinical and experimental studies of decremental factors. Nihon Kyobu Geka Gakkai Zasshi 1992;40:209-18.

10. Gologorskii VA, Bagdat’ev VE, Gel’fand BR, Lapshina Ilu, Nistratov SL. The effect of a nitroglycerin infusion on the hemodynamics, extravascular lung water and gas exchange in patients with adult respiratory distress syndrome. Anesteziol Reanimatol 1992;5-6:31-3.

11. Kam PC, Hines L, O’Connor E. Effects of cardiopulmonary bypass on systemic vascular resistance. Perfusion 1996;11:346-50.

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