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Research Article

Comparison of Different Ventilation Strategies during Cardiopulmonary Bypass in Smoker Patients Under Cardiac Surgery

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ABSTRACT

Background: Control of pulmonary ventilation during surgery, especially heart surgery, is very important. Therefore, in this study, we will compare different ventilation strategies during cardiopulmonary bypass in smokers undergoing cardiac surgery.

Methods: A total of 42 patients who had a clinical indication for CABG were included in this study. Patients were randomly divided into two groups. All patients were operated on by the same surgeon and cardiac anesthesia team in the same condition. The patient data includes age, sex, height, weight, and spirometry indices (FEV1, FVC, FEV1 / FVC, MMEF, PEF, PaO2, PaCO2, PaO2 / fio2, PaO2 / fio2, and Pent. T) were recorded prospectively for each patient.

Results: Examines the spirometry indices of patients in the two groups in both pre-procedure and off-pump time, do not show significant changes (P<0.005).

Conclusion: The use of different ventilation strategies in smokers undergoing CABG surgery could not cause significant changes in patients' respiratory parameters.

Introduction

Smoking is considered a major risk to human health, as it causes cardiovascular complications and mortality in these people [1]. Smoking stimulates all aspects of atherosclerosis (endothelial dysfunction to acute clinical events, often thrombotic) [2-3]. On the other hand, it also increases inflammation, thrombosis and oxidation of low-density lipoprotein cholesterol [4-7]. Recent results support the hypothesis that exposure to secondhand smoke increases oxidative stress as a primary mechanism for the onset of cardiovascular dysfunction [2,5,7]. Today, it has been proven that performing cardiopulmonary bypass (CPB) procedure induces pulmonary and systemic inflammatory reactions in patients [8]. Such responses may contribute to multiple postoperative complications (including acute lung injury, bleeding disorders, and organ failure) [9]. A double-blind clinical trial study found that smokers who quit less than 2 months before CABG surgery were more likely to have postoperative pulmonary complications than smokers who quit more than 2 months before CABG surgery [10]. With advances in surgical techniques and postoperative care, major complications following CABG were also decreasing [11].

Despite a widespread use of fast-track protocols, patients might still require several hours of ventilatory support to recover from cardiac surgery. Since the past, large tidal volume (VT) has been used to support to minimize atelectasis and to minimize positive end-expiratory pressure (PEEP) levels. This method improves arterial

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oxygenation by using low tail oxygen fractions without hemodynamic consequences [12]. Recent experimental data indicate that these ventilator settings might worsen pulmonary damage with granulocyte activation, hyaline membrane formation, increased vascular permeability, and pulmonary and systemic release of inflammatory mediators [13-14]. Three recent randomized controlled clinical trials confirmed these experimental findings, showing that in patients with acute lung injury, the use of a low VT decreased the pulmonary and systemic inflammatory response and improved survival [15-17].
Due to the significant number of smokers undergoing cardiopulmonary bypass surgery and the existence of different ventilation methods, the aim of this study was to compare different ventilation strategies during cardiopulmonary pump in smokers during cardiac surgery.

Methods

This cross-sectional study was approved by the Institutional Review Board of Shaheed Beheshti University of Medical Sciences. A total of 42 patients who had a clinical indication for CABG were included in this study. Exclusion criteria were patients younger than 15 and older than 65 years old, renal and hepatic failure, IABP or ECMO support just before surgery, intubated patients, previous heart surgery, and uncontrolled diabetes mellitus. All patients were operated on by the same surgeon and cardiac anesthesia team in the same condition. The patient data includes age, sex, height, weight, and spirometry indices (FEV1, FVC, FEV1/ FVC, MMEF, PEF, PaO2, PaCO2, PaO2 / fio2, PaO2/ fio2, and Pent. T) were recorded prospectively for each patient. Patients were randomly divided into two groups.

Data were analyzed using SPSS statistical software version 22.0 (SPSS Inc., Chicago, IL, USA) and results are presented as mean± standard deviation (SD). Independent t-test analysis was performed to compare the indices. $P< 0.05$ was considered statistically significant.

Results

42 patients with an average age of 58.62 years, 19 male and 17 females were included in the study. The patient's demographics and variables are listed in (Table 1), which Based on this, there is no significant difference between the two groups of patients ($P>0.05$).

The results in (Table 2), which examines the spirometry indices of patients in the two groups in both pre-procedure and off-pump time, do not show significant changes.

The results of measuring the two indices PaO2 and PaCO2 in four time periods (Figures 1A and 1B) in patients of the two groups do not show a significant difference.

Table 1- Comparison of demographic indicators of patients included in the study

Indexes	N group (N=21)	V group (N=21)	P value
Age (m±sd)	58.00±8.32	59.25±8.32	0.663
Gender: Male (n(%))	19 (90.47%)	17 (85.00%)	0.236
Hight (m±sd)	171.42±7.91	170.6±7.81	0.737
Weight (m±sd)	83.00±17.28	76.05±11.16	0.136
BMI (m±sd)	28.16±5.32	26.15±.74	0.171
Smoke Rate (m±sd)	29.05±4.02	26.40±12.64	0.703

Table 2- comparison of spirometry indices of patients admitted to the study in the two groups

Indexes	N group (N=21)	V group (N=21)	P value
EF(m±sd)	87.85±39.48	44.25±8.62	0.219
Pump time (m±sd)	112.76±39.48	129.35±24.88	0.117
Clamp time (m±sd)	64.80±23.37	74.05±20.65	0.188
FEV1 (m±sd)	275.57±74.64	255.35±68.82	0.373
FEV1% (m±sd)	89.52±21.03	86.50±20.34	0.642
FVC (m±sd)	316.09±88.16	304.9±80.28	0.673
FVC% (m±sd)	72.57±15.52	73.75±17.62	0.82
FEV1/FVC (m±sd)	88.19±8.05	84.7±8.65	0.188
FEV1%/FVC% (m±sd)	123.04±11.79	118.4±11.28	0.205
MMEF (m±sd)	309.23±83.72	298.15±90.309	0.685
MMEF% (m±sd)	119.04±33.68	103.6±27.31	0.115
PEF (m±sd)	684.52±156.96	645.35±166.48	0.442
PEF% (m±sd)	88.33±22.88	81.65±20.82	0.334
Vent T	12.38±4.65	11.75±2.45	0.588

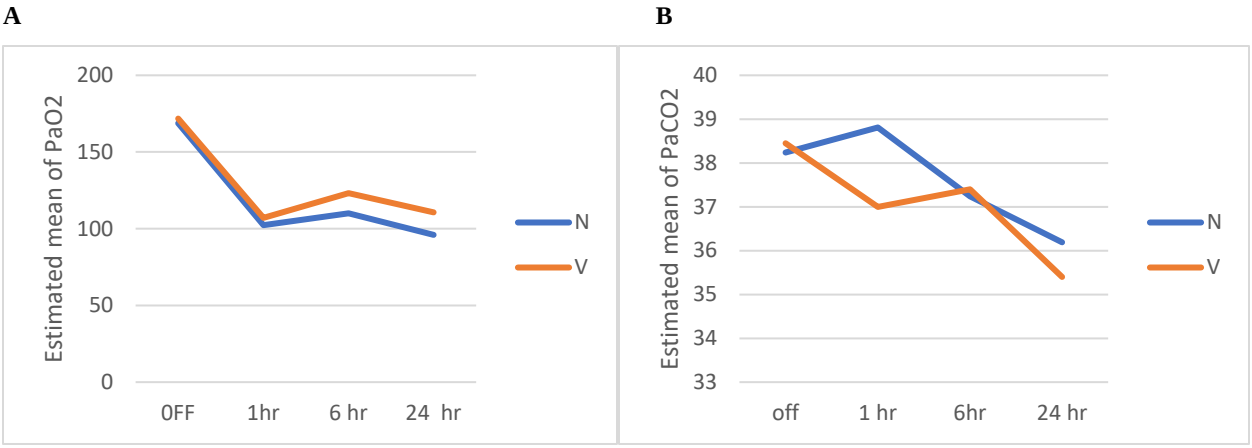

Figure 1- Comparison of the course of changes in PaO2 and PaCO2 in patients of the two groups

Discussion

Today, the general public is increasingly aware of the dangers of smoking and governments are attaching great importance to tobacco control, however, the prevalence of smoking is very high [4]. This rate of consumption in patients with coronary artery disease undergoing CABG surgery is 55 to 60%, which is higher than 30% in Western countries [14-16]. Respiratory management of this group of patients is considered as one of the challenges of treatment teams. Therefore, adopting different ways of ventilation of these patients in order to achieve the best method can be helpful. In general, this trial would answer the question that whether maintaining mechanical ventilation during CPB is more preferable than no ventilation?

The main findings of this study showed that the use of ventilation in smokers during CABG surgery did not cause significant changes in the level of respiratory parameters of these patients compared to similar patients without ventilation. Although many previous studies have emphasized the impact of smoking in patients undergoing CABG surgery [17], however, the use of ventilation cannot be considered an effective measure to improve the respiratory status of these patients. However, a study by Zhang et al. On patients undergoing CABG surgery showed that the use of ventilation could improve patients' respiratory conditions during surgery.

Smoking impairs obstructive ventilation and exacerbates respiratory disease, which in turn causes postoperative pulmonary complications. Smoking cessation within a month improves laryngeal and phagocytic macrophage function, thus reducing pulmonary complications after surgery in a few weeks [17-18].

So far, few studies have assessed the Comparison of Different ventilation strategies during cardiopulmonary bypass in smoker patients under cardiac surgery. There are limitations of the trial due to the inherent properties such as its single-center design.

Conclusion

The use of ventilation in smokers undergoing CABG surgery could not cause significant changes in patients' respiratory parameters.

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References

[1] Ford ES, Ajani UA, Croft JB, Critchley JA, Labarthe DR, Kottke TE, et al. Explaining the decrease in US deaths from coronary disease, 1980–2000. N Engl J Med. 2007; 356(23):2388-98.

[2] Davoudi M, Farhanchi A, Moradi A, Bakhshaei MH, Safarpour G. The effect of low tidal volume ventilation during cardiopulmonary bypass on postoperative pulmonary function. J Tehran Heart Cent. 2010; 5(3):128.

[3] John LC, Ervine IM. A study assessing the potential benefit of continued ventilation during cardiopulmonary bypass. Interact Cardiovasc Thorac Surg. 2008; 7(1):14-7.

[4] Sepehripour AH, Lo TT, McCormack DJ, Shipolini AR. Is there benefit in smoking cessation prior to cardiac surgery?. Interact Cardiovasc Thorac Surg. 2012;15(4):726-32.

[5] Scherer M, Dettmer S, Meininger D, Deschka H, Geyer G, Regulla C, et al. Alveolar recruitment strategy during cardiopulmonary bypass does not improve postoperative gas exchange and lung function. Cardiovasc Eng. 2009; 9(1):1-5.

[6] Arozullah AM, Henderson WG, Khuri SF, Daley J. Postoperative mortality and pulmonary

complication rankings: how well do they correlate at the hospital level?. Med Care. 2003; 41(8):979-91.
[7] Figueiredo LC, Araújo S, Abdala RC, Abdala A, Guedes CA. CPAP at 10 cm H2O during cardiopulmonary bypass does not improve postoperative gas exchange. Rev Bras Cir Cardiovasc. 2008;23(2):209-15.
[8] Mahjoubifard M, Heidari M, Dahmardeh M, Mirtajani SB, Jahangirifard A. Comparison of dexmedetomidine, lidocaine, and fentanyl in attenuation hemodynamic response of laryngoscopy and intubation in patients undergoing cardiac surgery. Anesthesiol Res Pract. 2020; 2020.
[9] Aneeshkumar S, Sundararajan L. Use of risk calculator in predicting postoperative respiratory failure in patients undergoing elective/emergency surgery at a tertiary care hospital in South India. Indian Journal of Respiratory Care. 2020; 9(1):47.
[10] Chi D, Chen C, Shi Y, Wang W, Ma Y, Zhou R, et al. Ventilation during cardiopulmonary bypass for prevention of respiratory insufficiency: A meta-analysis of randomized controlled trials. Medicine. 2017; 96(12):e6454.
[11] Wang YC, Huang CH, Tu YK. Effects of positive airway pressure and mechanical ventilation of the lungs during cardiopulmonary bypass on pulmonary adverse events after cardiac surgery: A systematic review and meta-analysis. J Cardiothorac Vasc Anesth. 2018; 32(2):748-759.
[12] Heinrichs J, Lodewyks C, Neilson C, Abou-Setta A, Grocott HP. The impact of hyperoxia on outcomes after cardiac surgery: a systematic review and narrative synthesis. Can J Anaesth. 2018;65(8):923-35.
[13] McGuinness SP, Parke RL, Drummond K, Willcox T, Bailey M, SO-COOL investigators. A multicenter, randomized, controlled phase IIb trial of avoidance of hyperoxemia during cardiopulmonary bypass. Anesthesiology. 2016;125(3):465-73.
[14] Swenne CL, Lindholm C, Borowiec J, Carlsson M. Surgical-site infections within 60 days of coronary artery by-pass graft surgery. J Hosp Infect. 2004; 57(1):14-24.
[15] Benedetto U, Albanese A, Kattach H, Ruggiero D, De Robertis F, Amrani M, et al. Smoking cessation before coronary artery bypass grafting improves operative outcomes. J Thorac Cardiovasc Surg. 2014; 148(2):468-74.
[16] Papathanasiou A, Milionis H, Toumpoulis L, Kalantzi K, Katsouras C, Pappas K, et al. Smoking cessation is associated with reduced long-term mortality and the need for repeat interventions after coronary artery bypass grafting. Eur J Cardiovasc Prev Rehabil. 2007; 14(3):448-50.
[17] Ladha K, Melo MF, McLean DJ, Wanderer JP, Grabitz SD, Kurth T, et al. Intraoperative protective mechanical ventilation and risk of postoperative respiratory complications: hospital-based registry study. Bmj. 2015;351.
[18] Nguyen LS, Merzoug M, Estagnasie P, Brusset A, Koune JD, Aubert S, et al. Low tidal volume mechanical ventilation against no ventilation during cardiopulmonary bypass heart surgery (MECANO): study protocol for a randomized controlled trial. Trials. 2017;18(1):1-6.