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ORIGINAL ARTICLE

Incidence of Post-Operative Pulmonary Complications in Patients Undergoing Cardiac Surgery with Low Tidal Volume Ventilation

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ABSTRACT

Objective: This study sought to determine if low-tidal ventilation during CPB was superior to a resting-lung strategy with no ventilation in terms of pulmonary complications following surgery.
Study Design: This was a retrospective study.
Place and Duration: This study was done at the Punjab Institute of cardiology, Lahore from 1st May 2021 to 1st Nov, 2022.
Methodology: A total of 1348 patients were enrolled in this study following inclusion criteria. They were divided into two groups equally. SPSS version 24 was used to enter and analyzed collected data. For qualitative variables was presented in frequency(%). For quantitative variables i.e., age, height, weight, preoperative FEV1/FCV, tidal volume, PEEP, PaO_2 and $PaCO_2$ mean ±SD was calculated. Chi-square was applied to compare post-operative outcomes between the groups. P-value of <0.05 was taken as significant.
Results: The mean age of the cases in Group A was 55 ± 9.08 while in Group B was 56 ± 9.19. There were 75% male and 25% females in Group A while 84% male and 16% females in Group B. In our data there were 67% diabetic and 59% smokers in Group A however 62% diabetic and 58% smokers were enrolled in Group B. Mean tidal volume given to Group A was 8.5 ± 1.8 while in Group B was 7.5 ± 1.3. Peak respiratory pressure in Group A was 18 and in Group B was 16. Mean perfusion time, cross clamp time and anesthesia duration was significant between the groups p-value 0.01. Mean tidal volume given to Group A was 8.5 ± 1.8 while in Group B was 7.5 ± 1.3. Peak respiratory pressure in Group A was 18 and in Group B was 16. Mean perfusion time, cross clamp time and anesthesia duration was significant between the groups p-value 0.01.
Conclusion: This study found that continuing low tidal volume ventilation was not superior to no ventilation during CPB in terms of the rate of reintubation, pleural effusion, and pulmonary congestion, although there was a significant difference between pneumonia, atelectasis, and prolong ventilation.
Keywords: PEEP, CPB, FEV1/FCV ,Pulmonary Complications, Ventilation, Tidal Volume

INTRODUCTION

Postoperative pulmonary complications (PPC) make up a significant component of the results of heart surgery. They cover a range of incidents, some of which are infectious (hospital- or ventilator-acquired pneumonias), while others are mechanical (atelectasis requiring respiratory support). At best, they might be linked to longer hospital stays, and at worst, they might be linked to increased mortality. Numerous processes are thought to be involved, including systemic inflammatory response syndrome brought on by cardiopulmonary bypass (CPB), decreased bronchial arterial blood flow, and pulmonary collapsus during CPB. [1-2] It is yet unclear how mechanical ventilation would affect CPB. On the one hand, CPB permits continuous blood oxygenation throughout cardiac surgery, regardless of heartbeat or oscillations, enabling cardiothoracic surgeons to continue their treatment uninterrupted. [3] As a result, resting-lung techniques with no ventilation during CPB are routinely used, despite earlier research showing no benefit in terms of procedure length or clinical outcomes. [4] Previous research, on the other hand, found that PPC was reduced when the lung remained ventilated during CPB. When compared to no ventilation (noV) techniques, meta-analyses indicated that biological oxygenation improved following weaning from CPB when ventilation was maintained or after lung recruitment techniques. [5] Maintaining mechanical ventilation was also linked to a lower inflammatory response and tissue damage. [6] Furthermore, earlier studies were not generally randomized or focused on objective clinical outcomes, therefore recommendations for breathing during CPB remain moderate. [7] Furthermore, most trials use an open labeled design to examine mechanical ventilation during CPB. [8] As a result, additional trials are required to get more solid proof of efficacy. [9]

MATERIAL AND METHODS

Total 1348 patients were enrolled using 5% level of significance and 80% power of study, taking population proportion of pulmonary complications 28.8% in low tidal volume ventilation group and 33.8% in no ventilation group. [10] Non-probability sampling technique was used and patients were separated into two equal groups, 674 in Group A and 674 in Group B. Data was collected on well designed preforma.

Research design: Retrospective study

Place & Duration: This study was performed at PIC, Lahore from 1st May 2021 to 1st Nov, 2022

Sample: Total 1348 patients were enrolled

Operational Definition: In the no Ventilation group, patients did not get any breathing support CPB. Five breaths per minute were taken by those in the VENT group, with a tidal volume of 3 mL/kg with a positive end expiratory pressure of 5 cm H_2O) .[11]

Inclusion Criteria: Eligible patients were those over the age of 25 who were scheduled to undergo elective cardiac surgery using CPB. Procedures involving thoracic surgery were not included. We also didn't include patients that needed emergency surgery.

Statistical Analysis: SPSS version 24 was used to enter and analyzed collected data. For qualitative variables like gender, diabetes, smoking status, and outcomes i.e., pneumonia, reintubation, atelectasis, pleural effusion, and pulmonary congestion frequency percentages were calculated. For quantitative variables i.e., age, height, weight, preoperative FEV1/FCV,tidal volume, PEEP, PaO_2 and $PaCO_2$ mean and standard deviation was calculated.Student t test was used to compare means and chi-sqaure was applied to compare post-operative outcomes between the groups. P-value of <0.05 was considered significant.

RESULTS

The mean age of the cases in Group A was 55 ± 9.08 while in Group B was 56 ± 9.19. There were 75% male and 25% females in Group A while 84% male and 16% females in Group B. In our data there were 67% diabetic and 59% smokers in Group A however 62% diabetic and 58% smokers were enrolled in Group B. (Table 1)

Mean tidal volume given to Group A was 8.5 ± 1.8 while in Group B was 7.5 ± 1.3. Peak respiratory pressure in Group A was 18 and in Group B was 16. Mean perfusion time, cross clamp time and anesthesia duration was significant between the groups p-value 0.01. (Table 2)

Table 1: Demographics and clinical characteristics.

		Low Tidal Volume Ventilation Group (674)	No Ventilation Group (674)
Age		55 ± 9.08	56 ± 9.19
Gender	Male	507 (75%)	567 (84%)
	Female	167 (25%)	107 (16%)
Height		161.21 ± 7.11	159.50 ± 6.35
Weight		70.13 ± 13.24	68.10 ± 14.11
Diabetic		454 (67%)	417 (62%)
Smokers		398 (59%)	389 (58%)
Preoperative FEV1/FCV		0.79 ±0.28	0.82 ± 0.39

Table 2: Intra-operative Variables.

Intra-operative Variables			
	Low Tidal Volume Ventilation Group (674)	No Ventilation Group (674)	P-Value
Tidal Volume (ml/kg)	8.5 ± 1.8	7.5 ± 1.3	0.001
Peak respiratory pressure cm H_2O	18 (15, 21)	16 (14, 19)	0.001
Perfusion Time (h)	2.8 ± 1.4	2.0 ± 1.1	0.01
Aortic cross clamp time (h)	2.8 ± 1.4	1.6 ± 0.6	0.01
Anesthesia duration (h)	7.8 ± 1.9	6.6 ± 1.7	0.01

Table 3: 1 year Outcomes after CABG

Primary Outcomes			
Variables	Low Tidal Volume Ventilation Group (674)	No Ventilation Group (674)	P-Value
Pneumonia	47 (7%)	74 (11%)	0.045
Reintubation	27 (4%)	34 (5%)	0.75
Atelectasis	121 (18%)	155 (23%)	0.04
Pleural effusion	20 (3%)	13 (2%)	0.78
Pulmonary congestion	7(1%)	20 (3%)	0.09
Prolong Ventilation	40 (6%)	61 (9%)	0.01

1 year outcome showed that in our data post-operative pneumonia, prolong ventilation and atelectasis was significant while reintubation, pleural effusion and pulmonary congestion was insignificant, showing p-value 0.75, 0.78 and 0.09 respectively. (Table 3)

DISCUSSION

Despite advances in CPB procedures and postoperative intensive care, pulmonary complications following cardiac surgery remain common. By definition, they are any of a number of disorders affecting the respiratory system that have the potential to have a major impact on patient outcomes and healthcare costs[13] Lungs are hypoxemic and managed by either low continuous ventilation or resting lung, depending on local procedures in cardiac surgery anaesthesia during CBP[14] Continual lung protective breathing was shown to improve postoperative outcomes in clinical trials[13] The purpose of this study was to evaluate the outcomes of cardiac surgery patients who underwent either no ventilation or low tidal volume ventilation while on CPB.

The mean age of the cases in Group A was 55 ± 9.08 while in Group B was 56 ± 9.19. There were 75% male and 25% females in Group A while 84% male and 16% females in Group B. In our data there were 67% diabetic and 59% smokers in Group A however 62% diabetic and 58% smokers were enrolled in Group B.

Mean tidal volume given to Group A was 8.5 ± 1.8 while in Group B was 7.5 ± 1.3. Peak respiratory pressure in Group A was 18 and in Group B was 16. Mean perfusion time, cross clamp time and anesthesia duration was significant between the groups p-value 0.01.

Although the results failed to show a statistically significant difference between the treatment groups, there was a trend toward fewer incidents in the VENT group compared to the noV group. Likewise, reintubation, pleural effusion and pulmonary congestion was insignificant, showing p-value 0.75, 0.78 and 0.09 respectively. Moderate and severe pulmonary problems were 21% less common in the LOV group than in the NoV group in a prior trial (23% vs. 44%, P = 0.001). [15]

In order to demonstrate the protective link between ventilation and better postoperative respiratory outcomes in cardiac surgery, the current study included a larger sample size of patients than earlier investigations. While the risk reduction was nearly as good as anticipated, the incidence of events was lower than projected. Similarly, prior experiments lacked sufficient power or were biased, resulting in considerable variation and contradictory findings.

CONCLUSION

This study found that continuing low tidal volume ventilation was not superior to no ventilation during CPB in terms of the rate of reintubation, pleural effusion, and pulmonary congestion, although there was a significant difference between pneumonia, atelectasis, and prolong ventilation.

Conflict of interest: The authors have no conflicts of interest to declare.

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