Effect of Intensive vs Moderate Alveolar Recruitment Strategies Added to Lung Protective Ventilation on Postoperative Pulmonary Complications

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ABSTRACT
Aim: to establish the effects of intensive alveolar recruitment therapy in decreasing the post-operative pulmonary complications.
Methodology: A randomized multi centered study was performed with patients in ICU having hypoxemia after a cardiac surgery. Patients were allocated to two groups (intensive vs moderate recruitment strategy) with ventilation having small tidal volume. Severity of post-operative pulmonary complications was primary outcome. Secondary outcome was duration of stay in hospital and ICU, hospital mortality and the rate of barotrauma.

Results: The pulmonary complication severity score of the intensive and moderate group patients was 1.58±0.91 and 2.10±1.01 respectively. The mean ICU stay, hospital stay and mechanical ventilation in ICU mean of the intensive group patients was 4.06±2.12 days, 10.10±3.21 days and 11.28±2.80 respectively. While, the mean ICU stay, hospital stay and mechanical ventilation in ICU mean of the moderate group patients was 4.70±2.04 days, 14.09±2.99 days and 12.15±2.08 respectively.

Conclusion: Patients having hypoxemia after a cardiac surgery, intensive alveolar recruitment therapy proves to be more helpful in decreasing the severity and occurrence of post-operative pulmonary complications as compared to moderate alveolar recruitment therapy.

Keywords: Alveolar recruitment, tidal volume, pulmonary complications.

INTRODUCTION
Postoperative morbidity and mortality are greatly increased by postoperative pulmonary complications following a surgical intervention. After open chest surgery, Lung inflammation is often activated by extracorporeal circulation resulting in atelectasis. This condition proves to be harmful for the mechanical ventilation. It may be associated with pneumonia, hypoxemia, ARDS, and lung injury. The results of these complications are the increased utilization of all available resources, prolonged need for mechanical ventilation or oxygen therapy.

For the protection of lung parenchyma, various studies have been performed claiming that there may be reduction in postoperative complications with the help of lung protective ventilation. Various methods have been adopted for this so far that includes reducing tidal volume or low tidal volume with alveolar retaining procedures.

These studies reflect that control groups were given non-protective mechanical ventilation having no PEEP and increased levels of VT. Hence it was unable to determine the specified role of alveolar recruitment procedures. The past studies were not able to establish the advantage of more intense alveolar recruitment strategy during abdominal surgery. Rather it caused more trouble. There are a few numbers of studies in favor of intensive alveolar recruitment strategies in patients already having low VT ventilation. It also proved that inflammation was reduced and lung function was improved without causing any complications.

This study determines the specified role of intense alveolar recruitment therapy for the reduction of intensity of clinical complications regarding the lungs in patients having hypoxemia and low VT ventilation after cardiac surgery.

METHODOLOGY
A randomized multi centered study was performed in intensive care units of Peoples University of Medical & Health Sciences, Nawabshah, Chaudhry Pervaiz Ellahi Institute of Cardiology (CPEIC), Multan and CMH Lahore. The duration of study was from April 2019 to April 2021. Ethical clearance and informed consent were taken.

The eligibility criteria were patient having elective cardiac surgery, having hypoxemia at the time of admission in ICU. Exclusion criteria comprised of patients <18-80 years old, having previous lungs or cardiac surgery, suffering from neuromuscular disorder, BMI lower than 20 or greater than 40, left ventricular ejection fraction lower than 35%, MAP of pulmonary vessels greater than 35mmHg, requiring any emergency surgery or mechanical ventilation, more than 2ug/kg/min norepinephrine, having arrhythmia or non-responsive hypotension at the time of admission, having pneumothorax or being a participant in another study.

Patients were randomly allocated to two groups i.e. lung-protective ventilation with moderate alveolar recruitment strategy or lung-protective ventilation with intense alveolar recruitment strategy. Regarding the blinding, due to the difference in ventilator setting, the research team was not blinded in the initial hours. The extent of post-operative pulmonary complications was the primary endpoint in the duration of hospital stay scored from 1-5. Where 0 represented no symptoms, 4 depicted reintubation within 48 hours and 5 showed death before discharge. The independent analysis of bed side radiographs was done by two pulmonary specialists who were blinded. The assessment of complication and severity of complication was done on daily basis until the discharge from hospital. The secondary outcome included duration of hospital stay, duration of stay in ICU, rate of barotrauma and hospital mortality.

Data was analyzed by SPSS version 25.0.Chi square test was applied for comparison of categorical variables and P value of <0.05 was determined as statistically significant.

RESULTS
Total 390 patients were included in this study (195 in each group).

The mean weight, gender distribution, BMI, PBW, creatinine, euro score and parsonnett score in both groups is shown in Table I.

The pulmonary complication severity score of the intensive and moderate group patients was 1.58±0.91 and 2.10±1.01 respectively. The difference was statistically significant at (p=0.000) (Table. II). The mean ICU stay, hospital stay and mechanical ventilation in both the groups is presented in Table 2. (Table. II). Hospital death, barotrauma, need of supplemental O2>24 hours within first 5 days, extended use of NIV, pneumonia, hospital wound infection, blood loss >300 mL in first 6 hours after surgery, cardiovascular complications whole hospital stay, septic shock, atrial fibrillation and reoperaton in both groups is shown in Table II.

Table 1: Baseline characteristics of the patients

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intensive</th>
<th>Moderate</th>
<th>Test of Sig.</th>
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<tbody>
<tr>
<td>Gender</td>
<td></td>
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<tr>
<td>Male</td>
<td>(66.2%) n=129</td>
<td>(73.3%) n=143</td>
<td>χ²=2.36 p=0.123</td>
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<tr>
<td>Female</td>
<td>(33.8%) n=66</td>
<td>(26.7%) n=52</td>
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The effects of Intensive alveolar recruitment therapy were studied by Bitker L et al. It was observed in many clinical settings, nonetheless, it can’t be generalized. It is advised by Neto AS et al. never to think of positive pressure ventilation as an uncomplicated and unthreatened procedure for the patients having a surgery under GA in whom the intervention is used for only a few minutes to hours or in severely ill patients who need ventilation for a period of days to weeks.

A study was done by Futter E et al. showed 10.5% of the patients belonging to lung protection group suffered from complications while 27.5% of the patients from non-protective group suffered from the pulmonary and extrapulmonary complications. After a period of seven days, only 5% of the patients receiving lung protective ventilation required intubation while 17% from non-protective group needed intubation due to respiratory failure.

It is still unclear how PEEP plays a role during general anesthesia in a surgery. It observed that levels greater than 0cmH2O are protective against the pulmonary complications but at the same time they may cause circulatory insufficiency and cause injury to lungs as a result of overdistension. It was determined by a study conducted by Hemmes SN et al. if higher PEEP levels with recruitment strategies help in avoiding the post-op complications in patients at mechanical ventilation and low VT during general anesthesia. As shown by the results, the patients of higher PEEP value group experienced intra-op hypotension and required greater number of vasoactive drugs and 40% of these patients had post-op pulmonary complications. Patients in low PEEP group, 39% of post-op complications were seen.

In conventional clinical settings the average tidal volume used for mechanical ventilation ranges between 10-15ml/kg body weight. And it is believed to cause "stretch-induced" injury among patients having acute lung injury or ARDS. Brower RG et al. showed 10-15ml/kg body weight is not a useful technique used in a variety of clinical settings, nonetheless, it can’t be generalized. It is advised by Neto AS et al. never to think of positive pressure ventilation as an uncomplicated and unthreatened procedure for the patients having a surgery under GA in whom the intervention is used for only a few minutes to hours or in severely ill patients who need ventilation for a period of days to weeks.

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that low tidal volume during the surgery for ventilation are protective against post-operative pulmonary complications whereas the role of high PEEP values remains unclear.

CONCLUSION
In patients having hypoxemia after a cardiac surgery, intensive alveolar recruitment therapy proves to be more helpful in decreasing the severity and occurrence of post-operative pulmonary complications as compared to moderate alveolar recruitment therapy.

REFERENCES