# Pulmonary Complications after Cardiopulmonary Bypass and its relation with Aortic Cross Clamp Time

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## Abstract

**Background:** Pulmonary complications after cardiopulmonary bypass was have devastating effects on the outcome of the surgery.

**Objective:** To find out the frequency of pulmonary complications after cardiopulmonary bypass related to aortic cross clamp time.

**Methodology**: In this cross-sectional study of 120 patients, aged 16 to 78 years. The study was carried out at Punjab Institute Cardiology Hospital Lahore and Gulab Devi Chest Hospital Lahore. Quantitative statistics were displayed as frequency distribution, mean, range and standard deviation. Chi-square test was used to see relationship among pulmonary complications after cardiopulmonary bypass and prolonged aortic cross clamp time. P-value less than 0.05 was taken as significant.

**Results:** Overall 120 patients were included in this study, among 51 (42%) patients had pulmonary complications post-operative. Most recurrent post-operative pulmonary complication was pleural effusion 37 (30%) patients, prolonged mechanical ventilation 22 (18%), pneumonia in 3 (2.5%) and pulmonary edema in 1 (0.83%) patients. The major element of danger of postoperative pulmonary complication was prolonged aortic cross clamp time above 90 minutes and p-value was 0.002.

**Conclusion:** It is summarized that pleural effusion is the common complication after cardiopulmonary bypass and prolonged aortic cross clamp time >90mints had a high risk of pulmonary complications after cardiopulmonary bypass.

**Keywords**: Pulmonary complications, Cardiopulmonary Bypass, Pulmonary embolism, Pleural effusion.

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## Introduction

Pulmonary complications after cardiopulmonary bypass remain a leading cause of mortality and morbidity. Pulmonary complication after cardiopulmonary bypass was 58% according to international journal of surgery.[1] Cardiopulmonary bypass (CPB) is a technique that temporarily bypass the function of the heart and lungs during cardiac surgery, maintaining the circulation of blood and oxygen content of the body. The pathogenesis of pulmonary complication after CPB is linked with irregularity of exchange of gas, disturbance in lung technicalities, or mutual. Random exchange of gas is proved by the expanding of the alveolar-arterial oxygen pitch, improvement in the permeability of microvascular in the lungs.[2] Many risk factors involved which cause pulmonary complication after CPB like hypertension, Obesity, diabetes, Age>65, Preoperative pulmonary complication, Prolonged aortic cross clamp time, Prolonged CPB time, Respiratory distress due to non-reversal anesthesia and Ventilation perfusion mismatch.[3]

Common pulmonary complication after cardiopulmonary bypass included pleural effusion, atelectasis, prolonged mechanical ventilation, pneumonia, pneumothorax and pulmonary embolism.[4] Pleural effusion is one of the commonest pulmonary complications after CPB. The incidence of pleural effusion after CPB has been estimated at 27-95%. those patients with pleural changes in after operative period would have a greater decrease in pulmonary function test (PFTs).[5] Prolonged mechanical ventilation is also a major complication after cardiopulmonary bypass. PMV also increased hospital stay and cost.[6,7] In this study, we examined the frequency of pulmonary complications after cardiopulmonary and their relationship with prolonged aortic cross clamp time.

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## Methodology

This was a cross-sectional and descriptive, study of those victims who have pulmonary complications after Cardiopulmonary bypass (CPB) presented at ICU of Punjab Institute Cardiology Hospital and Gulab Devi Chest Hospital Lahore. The inquiry was completed during May to November 2017. Data was gathered by using purposive sampling method. A total of 120 patients aged 16 to 78 years of either sex, who undergone CABG, valve replacement and repair, congenital repair and aortic root replacement and repair were included. In all patients' typical methods of surgeries were used. All process was finished through central skin opening. Standard CPB equipment was used in all patients including oxygenator of membrane and the filters of arterial line. Venus cannulation process was ended via right atrium by means of bi-caval or atrio-caval techniques with single stage double venous cannulas or a double stage single venous cannula respectively. The cannulation of artery was finished through rising aorta by using angle tip or straight tip aortic cannula. Lactate ringer was used to major CPB route. Temperature was dropped to 30-28˚C after starting CPB to maintain modest hypothermia throughout surgery. Chilly blood cardioplegia was used for cardiac seize and protection after applying aortic cross-clamp. All victims were alienate off from CPB after warming again to 36.5-37˚C. After completion of surgery, patients were moved to Intensive Care Unit (ICU). Patients who expired during surgery, patients with incomplete medical record and pediatric patients were excluded. Duration of mechanical ventilation greater than 24 hours or who require re-intubation in patients was noted as prolong mechanical ventilation. Pneumonia was identified by the existence of high temperature, cough with sputum, findings of pneumonia on chest X-ray and on lab reports. Pleural effusion was labeled by the presence of pleural finding on chest X-ray. The SPSS version 21.0 was used for analyzed data. Qualitative variables were displayed in the form of charts and tables alongside its percentage and quantitative data were showed in the form of frequency distribution, mean, range and standard deviation by descriptive analysis. Chi-square analysis was used to see relationship among pulmonary complications after cardiopulmonary bypass and prolonged aortic cross clamp time. P-value less than 0.05 was taken as significant. Ethical approval was sought from the ethics committee of the hospital for conduction of the study.

## Results

Overall 120 patients were included in this study, among 51 (42%) patients had pulmonary complications post-operative. Figure-I shows sex distribution among 120 patients who undergone on Cardiopulmonary Bypass (CPB). The obtained results showed that male gender was predominant. Mean of age was 47.4±15 years.

**Figure-I: Sex distribution of the patients who Cardiopulmonary Bypass.**

**Table-I: Risk factors of postoperative Pulmonary complications among patients who undergone Cardiopulmonary Bypass.**

| Risk factors of Postoperative Pulmonary Complications | Yes | No | Total |
|---|---|---|---|
| Hypertension | 59 (49%) | 61 (51%) | 120 (100%) |
| Diabetes | 47 (39%) | 73 (61%) | 120 (100%) |
| Pre-Op Pulmonary Complication | 34 (28%) | 86 (72%) | 120 (100%) |
| Prolonged aortic cross clamp time above 60 mints | 65 (54%) | 55 (46%) | 120 (100%) |

In this study, the main risk factors were hypertension, diabetes, pre-operative pulmonary complication and prolonged aortic cross clamp time above 90 mints. (Table-I)

**Table-II: Frequency of Pulmonary Complications after Cardiopulmonary bypass (n=120)**

| Pulmonary complications | Frequency | Percentage |
|---|---|---|
| Pleural effusion | 37 | 31% |
| Prolonged mechanical ventilation | 22 | 18% |
| Pneumonia | 3 | 2.50% |
| Pulmonary edema | 1 | 0.83% |

Most common pulmonary complication after CPB was pleural effusion, which occurred in 37 (31%) patients, prolonged mechanical ventilation occurred in 22 (18%) patients, pneumonia occurred in 3 (2.5%) patients and pulmonary edema 1 (0.83%) patients. (Table-II)

**Table-III: Frequency of Pulmonary Complications after CPB related to prolonged Aortic cross clamp time**

| Prolonged aortic cross clamp time above 90 mints | Pulmonary complication (Yes) | Pulmonary complication (No) | Total | p-value |
|---|---|---|---|---|
| Yes | 8 (72.7%) | 3 (27.7%) | 11 (100%) | 0.002 |
| No | 43 (39.4%) | 66 (60.6%) | 109 (100%) | |

Table-III shows incidence of pulmonary complications after CPB were significant in those patients who have prolonged aortic cross clamp time above 90 minutes, 11 patients have prolonged aortic cross clamp time in which 8 (72.7%) patients have pulmonary complications and 3 (27.2%) patients have no pulmonary complication. (p=0.002)

## Discussion

Post-operative pulmonary complications are the most common and notable contributor of morbidity and mortality.[8] Pulmonary complication after cardiopulmonary bypass was 58% according to international journal of surgery.[1] In other study the reported incidence of post-operative pulmonary complications ranges from 3% to 16% after CABG and 5% to7% later than valvular heart operation.[9] In our study pulmonary complication after CPB occur approximately 42% of the total 120 patients. Pulmonary complications generally occur within the first week of cardiac surgery. Many factors involved which can cause pulmonary complication after CPB are Age>60, hypertension, Diabetes, Obesity, Smoking, prolonged CPB time, pre-operative-pulmonary complication, redo-surgery, emergency surgery and prolong aortic cross clamp time.[6] Aortic XCL time >60 min is called prolonged aortic cross clamp time and it is an independent risk factor for low cardiac output, prolonged ventilation, pulmonary complication, mortality and prolong hospital stay .aortic cross clamp time divided into 3 categories aortic cross clamp time<60mint,aortic cross clamp time 60 to 90 minutes.[7] In previous study out of 1108 patients 618 patients had aortic cross clamp time <60mints in which 93 (15%) patients had pulmonary complication, 362 patients had aortic cross clamp time 60 to 90 mints in which 61 (17%) patients had pulmonary complication and 128 patients had aortic cross clamp time >90 mints in which 28 (22%) patients had pulmonary complication and their p-value=0.160.[1]

According to present study out of 120 patients 55 patients had cross clamp time <60 mints in which 16 (29%) patients had pulmonary complication, 54 patients had cross clamp time 60 to 90 mints in which 27 (50%) patients had pulmonary complication and 11 patients had cross clamp time >90 mints in which 8 (72%) patients had pulmonary complication, and their p- value <0.05.

Common pulmonary complications after cardiac surgery were pleural effusion, atelectasis, pneumonia, ARDS, pneumothorax, pulmonary embolism and prolonged mechanical ventilation. Frequencies of pulmonary complication were following according to previous researches;[4,5,6] pleural effusion 27-95%, atelectasis 16.6-88%, prolonged mechanical ventilation 6-58%, pneumonia 4.2-20%, and pneumothorax 1.4%.

There is also a high incidence of pleural changes (pleural effusion or pleural thickening) after CABG. According to previous researches Pleural effusion occur 27-95%. Factors which can cause pleural effusion after CPB was age >60, pre-operative pulmonary complication, prime volume, CPB time and aortic cross clamp time.[5] In present study out of 120 patients, 37 (30%) patients had pleural effusion. Main predictor of pleural effusion according to my study is prolonged aortic cross clamp time. In previous studies prolonged mechanical ventilation occur 6-58% patients.[10] According to definition of prolonged mechanical ventilation, ventilation time >24 hours out of 1108 patients 618 patients had cross clamp time <60 mints in which 27 (4%) patients had prolonged mechanical ventilation, 362 patients had cross clamp time 60 to 90 minutes in which 23 (6%) patients had prolonged mechanical ventilation and 128 patients had >90 mints aortic cross clamp time in which 19 (15%) patients had prolonged mechanical ventilation with p-value<0.001, its mean according

to this study there is relation between prolonged cross clamp time and prolonged mechanical ventilation.[7]

In present study out of 120 patients 22 (18%) patients had prolonged mechanical ventilation,8 Patients who had prolonged aortic cross clamp time >90 minutes in which 3 (37%) patients had prolonged mechanical ventilation and its p-value=0.06. Its mean there is no association between prolonged mechanical ventilation and aortic cross clamp time. Some other factors like age >65, role of anesthesia and prolonged CPB time can cause prolonged mechanical ventilation. In previous studies pneumonia occur 4-20% of patients.[11] In present study there was only 3 patients who had diagnosed pneumonia after CPB. In present study there was no other pulmonary complication occur.

## Conclusion

It is concluded that pleural effusion was the common complication after cardiopulmonary bypass and prolonged aortic cross clamp time >90 minutes had a high risk of pulmonary complications after Cardiopulmonary Bypass.

**Authors Contribution: AS:** Conception of work, Acquisition and Analysis of data and Drafting. **HMA:** Acquisition and Analysis of data, Interpretation of data and revising. **NA:** Design of work, Acquisition and Analysis of data and revising. **AWG:** Interpretation of data and revising. **RR:** Acquisition and Analysis of data and drafting. **:** Design of work and drafting.
All authors critically revised and approve its final version.

**Conflict of Interest**: No conflict of interest among authors.

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