



## PREVALENCE & CLINICAL OUTCOME / COURSE OF PLEURAL EFFUSION IN POST CABG PATIENTS

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### ABSTRACT

**BACKGROUND:** Pleural effusion occurs commonly after CABG. Usually this effusion is small and asymptomatic. Large symptomatic effusion also occur but in a small proportion of patients. Pleural effusion after CABG can be associated with significant morbidity and prolonged hospital stay. Early diagnosis and management can reduce the morbidity and hospital stay of the patient.

**OBJECTIVE:** Objectives of the study are to identify the risk factors and Severity of pleural effusion in post CABG patients.

**Material and Methods:** The study was conducted in ICU cardiac surgery department of Punjab Institute of Cardiology Lahore between July 2011 to December 2011.

100 patients in cardiac surgery ICU of Punjab Institute of Cardiology Lahore were enrolled in study after fulfilling the inclusion criteria, Procedure of research was explained to the patient and informed consent was taken. Demographic data, name, age, gender, surgical procedure details, co-morbidities like COPD, EF, and smoking were recorded on the attached proforma. Patients were kept in cardiac surgery ICU for at least 7 days. They were assessed for presence and severity of pleural effusion on CXR. Daily CXR was done and examined by consultant chest physician on morning round. The size of effusion on the CXR was categorized as follow: small effusion occupied less than mid chest, large effusion occupied more than mid chest. Possible risk factors for developing the pleural effusion in post CABG patients were recorded.

**RESULTS:** Out of total 100 post CABG patients with pleural effusion, majority (87%) of the patients were male. Mean age of the patient was  $54.42 \pm 9.39$ . Left side pleurotomy was reported in majority (72%) patients. LIMA harvesting was reported in (88%) patients. Most of the patients (83%) suffered from left sided pleural effusion, (4%) from right sided, and (13%) had bilateral pleural effusion. Out of total 100 patients (79%) had small size (less than mid chest) of pleural effusion and (21%) had large size (more than mid chest) of symptomatic effusion. Out of 100 patients (27%) needed pleural aspiration. The level of serum albumin reduced in more than (90%) of patients.

**CONCLUSION:** Majority of the patients after CABG developed left sided effusion of small size. Large size of pleural effusion also occurred but in a small proportion. The effusion mainly causes some respiratory symptoms that require pleural aspiration. LIMA harvesting, pleurotomy, and hypoalbuminemia were the major risk factors of pleural effusion in post CABG patients.

**KEY WORDS:** LIMA = Left internal mammary artery, CABG = Coronary artery bypass grafting, ICU = Intensive care unit, CXR = Chest X-ray, EF = Ejection fraction, COPD = Chronic obstructive pulmonary disease.

### INTRODUCTION

Coronary artery bypass grafting (CABG) is performed on more than 600,000 patients per year in the United States<sup>1</sup>. Patients commonly develop pleural effusions directly related to this operation, making this procedure one of the most common causes of a pleural effusion. Within

(J Cardiovasc Dis 2013;11(4):88 -92)

a week after CABG, the reported prevalence of pleural effusions has ranged from 41% to 87%<sup>2-5</sup>. Most effusions are small, unilateral, left-sided, and asymptomatic. In general, these effusions gradually resolve over several weeks. However, some patients who undergo CABG develop moderate to large effusions that sometimes produce symptoms. Large pleural effusions in the immediate postoperative period occur with an incidence of 0.5% to 8.5%<sup>6</sup>. Hurlbut and associates reported that 4 of 100 patients (4%) who had received internal mammary artery grafts developed moderate or large effusions after surgery. Aarnio and associates followed the postoperative course of 200 patients receiving

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internal mammary artery grafts and reported that 8.5% required a thoracentesis while in the hospital<sup>7</sup>. Despite the projected large numbers of effusions developing after CABG, no large series have described patients with this entity.

There are two distinct pleural effusions directly related to CABG in the perioperative period: effusions resulting from atelectasis due to diaphragm dysfunction and hemorrhagic effusions resulting from internal mammary artery (IMA) harvesting. In addition, pleural effusions from congestive heart failure may occur after CABG. These pleural effusions are associated with different clinical characteristics, pathophysiology, pleural fluid (PF) analyses, management, and sequelae. The pleural effusions that result from diaphragm dysfunction are often diagnosed by their radiographic appearance. The effusions are small, with associated ipsilateral atelectasis on the left; thoracentesis is rarely performed on these effusions. Management of these effusions is conservative. These pleural effusions usually resolve spontaneously within 2 weeks without clinical sequelae. However compared to CABG/CPB, OPCAB yielded better gas exchange and earlier extubation but no difference in chest radiographs, spirometry, pneumonia or pleural effusion<sup>8</sup>. In addition, prolonged intra-operative time is also associated with a higher prevalence of pleural effusion, because the trauma caused to pleura during the procedure has been linked to the development of pleural effusion. Furthermore, other phenomena associated with longer surgery period such as blood transfusion, endothelial injury and inflammatory response may contribute to the development of this complication.<sup>9</sup>

The surgical technique used can affect the development of pleural effusions after CABG in the immediate postoperative period. The use of an IMA graft tends to result in an ipsilateral pleural effusion more often than a saphenous vein graft (87% versus 47% at postoperative day 6)<sup>4</sup>. These effusions usually present similar to the effusion from diaphragm dysfunction; the fluid appears in the immediate perioperative period, is usually small, is ipsilateral to the IMA harvesting, and may be associated with atelectasis. Most patients with large effusions had IMA harvesting (10.9% of 282 of patients with IMA ± saphenous venous graft (SVG) versus 4.5% of 67 patients with SVG alone<sup>10</sup>. The presumed cause of pleural effusions attributable to IMA harvesting is parietal pleural injury when the IMA is harvested with the pleura and thoracic fascia intact, the reported incident of post-operative pleu-

ral effusion is 5 to 11%<sup>10,11</sup> but increases to 20<sup>10</sup> to 50%<sup>11</sup>. These larger pleural effusions are typically hemorrhagic and inflammatory with elevated protein and lactate dehydrogenase (LDH) levels<sup>12</sup>. In a study of therapeutic thoracentesis for symptomatic patients after CABG, the early large effusions had a mean red blood cell (RBC) count of 706,000 cells/mL, mean white blood cell (WBC) count of 7000 cells/mL with an eosinophil predominance, and mean LDH level of 1368 U/dL<sup>7</sup>. Usually, only one or two thoracentesis were required for resolution<sup>12</sup>. Other perioperative pleural effusions not directly related to the coronary artery bypass grafting may be related to congestive heart failure, pulmonary embolism, and pneumonia.

Pleural effusion in post-CABG patients occur in significant number of patients. In Pakistani population it has not been studied extensively. This study has been designed to evaluate patients who are at risk of developing pleural effusion and further more to identify the severity of effusion requiring pleural aspiration. The results of this study will highlight the patients at risk of pleural effusion and enable ICU doctors/consultant physiotherapist to intervene early thus to reduce morbidity and hospital stay of post CABG patient.

## MATERIAL AND METHODS

The study was conducted in ICU cardiac surgery department of Punjab Institute of Cardiology Lahore from July 2011 to December 2011. Study design was descriptive cross sectional and sampling technique used was non-probability, purposive sampling. Patients of both genders who underwent CABG and developed pleural effusion were included in this study. While patients without pleural effusion or who were documented to have pre-op pleural effusion of any cause like renal failure, cardiac or respiratory failure were excluded.

100 patients in cardiac surgery ICU of PIC Lahore were enrolled in study after fulfilling the inclusion criteria, Procedure of research was explained to the patient and informed consent was taken. Demographic data, name, age, gender, surgical procedure details, co-morbidities like COPD, EF and smoking were recorded on the attached proforma. Patients were kept in cardiac surgery ICU for at least 7 days. They were assessed for presence and severity of pleural effusion on CXR. Daily CXR was done and examined by consultant chest physician on morning round. The size of effusion on the CXR was categorized as follow: small effusion occupied less than mid chest while large effusion occupied more than mid chest. Possible risk fac-

tors for developing the pleural effusion in post CABG patients were recorded like LIMA harvesting, intact/open pleura, off pump/on pump, duration of procedure, number of blood transfusions and number of SVG.

Data was entered and analyzed using SPSS version 11.5 for window software. All quantitative variables were expressed as mean and standard deviation (SD), While qualitative variables (gender, DM, smoking, off-pump, on-pump, size of effusion, dyspnea, cough, ABG's) were presented as frequencies, percentages and pie charts.

**RESULTS:**

The total sampling units that were included in this study were 100 (100.0%). The mean age of the patients was  $54.42 \pm 9.39$ , of which 87 (87.0%) were males. DM was reported in 42 (42.0%) patients. 37 (37.0%) were smokers. 27(27.0%) had COPD. LIMA harvesting was reported in 88 (88.0%). The patients who passed through off-pump surgery were 4 (4.0%) while 96 (96.0%) were operated with on-pump. Number of blood transfusion varied from 1-5. In majority of patients 47 (47.0%) no. of SVG was 2 while only 1 (1.0%) had 1 SVG). Open pleura was reported in the left in majority of 72 (72.0%) patients, 13 (13.0%) had on both sides while 8 did not have open pleura.

On the basis of CXR 33 (33.0%) had left sided

**Table 1: Combined Pleural Effusion**

	Right	Left	Both	No	Total
<b>Day 3</b>	1%	33%	8%	58%	100%
<b>Day 5</b>	2%	33%	4%	61%	100%
<b>Day 7</b>	1%	17%	1%	81%	100%
<b>Total</b>	4%	83%	13%		

**Table 2: Size of Pleural Effusion**

Size of Pleural Effusion	Frequency	Percent
<b>Less than mid chest</b>	79	79.0
<b>More than mid chest</b>	21	21.0
<b>Total</b>	100	100.0

pleural effusions, only 1 had right sided , while 8 had bilateral effusion on the 3rdday (Table 1). 33 (33.0%) had left sided pleural effusion 4 had bilateral pleural effusion while 2 had right sided pleural effusion on the 5th day. 17 (17.0%) had left sided pleural effusion while 1 had right sided and bilateral effusion on the 7thday. Overall the figures revealed that 4% patients suffered from right sided pleural effusion, 83% from left sided and 13% had bilateral pleural effusion. So majority

**Left Mild Pleural Effusion**



**Right Moderate Effusion**



of the patients developed left side pleural effusion after CABG.

The size of pleural effusion was less than mid chest in 79 (79.0%) patients while in 21 (21.0%) the size of pleural effusion was more than mid chest (Table 2). Aspiration was needed only in 27 (27.0%) patients while in majority of the patients 73(73.0%) it was not needed. The patients who needed aspiration of effusion had the following

### Massive Rt pleural effusion



### Left Moderate Effusion



problems, dyspnea in 27 (27.0%), cough 9 (9.0%), ABG's abnormality 18 (18.0%) while atelectasis was noted in 10 (10.0%). Post-operative aspiration was reported in 6 (6.0%) on the 7th day of the operation, 3 (3.0%) reported post-operative aspiration on 5th, 8th, 10th, 13th day. Majority of patients 72 (72.0%) did not have pleural aspiration on any side. 5 (5.0%) had right side aspiration and only 1 had bilateral aspiration. 2400 ml was aspirated in 1 (1.0%) patient but majority of patient did not have any amount of aspiration 74 (74.0%). Pre-operative EF was normal in 70 (70.0%) patients but on the 7th post-operative day, 29 (29.0%) had poor EF.

### DISCUSSION:

Coronary artery bypass grafting (CABG) is performed on more than 600,000 patients per year in the United States<sup>1</sup>. Patients commonly develop pleural effusions directly related to this operation, making this procedure one of the most common causes of pleural effusion. The present study demonstrates the incidence of small size and large size symptomatic pleural effusion in the immediate 1st week of post CABG patients. In the week after CABG, the reported prevalence of pleural effusions has ranged from 41% to 87%<sup>2-5</sup>. Most effusions are small, unilateral, left-sided, and asymptomatic. In general, these effusions gradually resolve over several weeks. However, some patients who undergo CABG develop moderate to large effusions that sometimes produce symptoms. Large pleural effusions in the immediate postoperative period occur with an incidence of 0.5% to 8.5%<sup>6</sup>. The prevalence depends somewhat on the method used to detect the pleural effusion. The present study demonstrates that 83% patients develop left side pleural effusion within 1st week of CABG, only 4% patients suffer from right side pleural effusion and 13% patients develop bilateral pleural effusion. Out of 100 patients 79% have small size (less than mid chest) effusion and that are asymptomatic and 21% have large size (more than mid chest) symptomatic effusion which is comparable to previous studies. Aarino<sup>6</sup> and his co-workers assessed that prevalence of pleural effusion occurring in up to 50% to 75% of patients in the 1st week after CABG operation. They also followed the post operative course of 200 patients receiving IMA grafts and reported that 8.5% required a thoracentesis immediately after surgery. At 3 months, 20% of patients had a pleural effusion but only 1% required thoracentesis. Landymore and Howell<sup>13</sup> reported that none of their 67 patients required a thoracentesis during 3 months of follow up. None of 3 studies described the pleural fluid characteristics. In our study, 27% patients had symptoms of pleural effusion like cough, dyspnea, atelectasis, and abnormal ABG'S and they were treated with therapeutic thoracentesis. While majority of the patients (73%) were managed conservatively either by using anti inflammatory agents, diuretics, non invasive ventilation through CPAP mask, or by emphasizing deep breathing (incentive spirometry) exercises.

Several factors have been associated with the development of post-CABG pleural effusion. Some authors have reported that pleural effusion is more





common following LIMA harvest<sup>1</sup>. This may be due to pleurotomy, which allows the blood to enter the pleural cavity, or to the LIMA harvest itself, which leaves the raw surface that can be the source of serous fluid<sup>2,3</sup>. The present study also demonstrated so, LIMA harvesting was reported in 88% and open pleura was reported in 72% patients.

Regarding demographics, this study showed that 87% were male and 13% were female patients, the mean age incidence of pleural effusion in post CABG patients was  $54.42 \pm 9.39$ .

Looking at co-morbid conditions like EF%, the present study highlighted that out of 100 patients 71% had normal EF, only 29% had poor EF% after 1st week of CABG. On the other hand, renal function tests (urea, creatinine) also remained normal in majority of patients after CABG surgery, while serum albumin level was greatly reduced in majority of population of CABG patients. So it became clear that hypoalbuminemia may cause pleural effusion in post CABG patients.

#### **STUDY LIMITATIONS:**

The sample size of the study was small as compared to the other international studies; moreover the results in our study cannot be applied to

general population as this was a single hospital based study. However it provides significant data regarding the pleural effusion among the patients of post CABG presented in the cardiac surgery ICU of Punjab Institute of Cardiology, Lahore.

#### **CONCLUSION:**

In conclusion, the findings of the present study indicated that there is high frequency of pleural effusion within 1st week of CABG surgery. Majority of patients after CABG develop small size (less than mid chest) of pleural effusion and on left side. However large size (more than mid chest) of pleural effusion also occur but in a small proportion of population. Small size pleural effusion can be managed with anti-inflammatory agents, diuretics, noninvasive ventilation through CPAP mask or by encouraging patients to do deep breathing exercises like incentive spirometry. While the large symptomatic effusion need therapeutic thoracentesis.

Most common risk factors that lead to cause pleural effusion are LIMA harvesting, pleura opening and hypoalbuminemia. Early diagnosis and effective management can reduce the morbidity and hospital stay of post CABG patient.

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