Am J Cardiovasc Dis 2020;10(4):392-397
www.AJCD.us /ISSN:2160-200X/AJCD0113622

Case Report

Optimization of multi-organ failure for successful coronary angioplasty in acute myocardial infarction after pneumonectomy

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Received May 1, 2020; Accepted August 18, 2020; Epub October 15, 2020; Published October 30, 2020

Abstract: Pneumonectomy is a procedure that possesses several chronic complications most commonly associated with cardiovascular and respiratory systems. Acute myocardial infarction in patients after pneumonectomy and with other comorbidities represents high risk of interventional complications and mortality. We present a case of effective percutaneous coronary angioplasty in a 75-year-old patient with acute non-STEMI infarction, previous pneumonectomy and multi-organ pathology. Choice of treatment strategy and clinical decision making were further complicated by the presence of multiple risk factors, including impaired respiratory function and advanced age of the patient. However, after the short term stabilization of cardiac and respiratory failure symptoms, the patient underwent successful angioplasty with implantation of a drug eluting stent on the right coronary artery. The patient demonstrated a significant improvement of the symptoms and multiorgan failure parameters after angioplasty. This report shows the effective management strategy of patient with acute myocardial infarction and concomitant multi organ failure with indication for percutaneous coronary intervention.

Keywords: Percutaneous coronary angioplasty, acute myocardial infarction, pneumonectomy, comorbidities

Introduction

The management of acute myocardial infarction in patients with multiple comorbidities, such as acute and chronic heart failure (HF), respiratory failure, kidney injury and anemia, may be challenging and precipitate a high risk of complications and mortality [1]. Patients after pneumonectomy have high morbidity and mortality rates with complications arising from cardiovascular system [2]. Decrease of pulmonary function after pneumonectomy in older population may have an impact on short and long term survival due to worsening of coronary circulation and myocardial systolic function, progression of pulmonary hypertension [2]. In elderly individuals, who require percutaneous coronary intervention (PCI) procedure, advanced age, presence of multiple comorbidities and multiorgan failure may further contribute to high rates of complications and mortality. Management of such patients with PCI requires detailed clinical assessment and careful consideration of benefits and risks of intervention. We report an effective strategy of determining the optimal timing of PCI in high risk patients, which includes symptom management and prior stabilization of clinical state for the reduction of overall risks associated with PCI.

Case report

A 75-year-old male was admitted with symptoms of chest pain, expiratory dyspnea, and peripheral edema to the Cardiology Department of University Hospital #1. He presented with arterial pressure 130/70 mmHg, heart rate of 68 beats/min and oxygen saturation of 88% (with high nasal inhalation of oxygen). Lung auscultation revealed wheezes and crepitation in basal segments of the right lung. No pathological murmurs were identified on heart auscultation. The patient had a history of coronary artery disease, arterial hypertension, chronic obstructive pulmonary disease (COPD) and left-sided pneumonectomy for lung cancer in 2005. The patient reported that his first symptoms of chest pain occurred two year ago and became

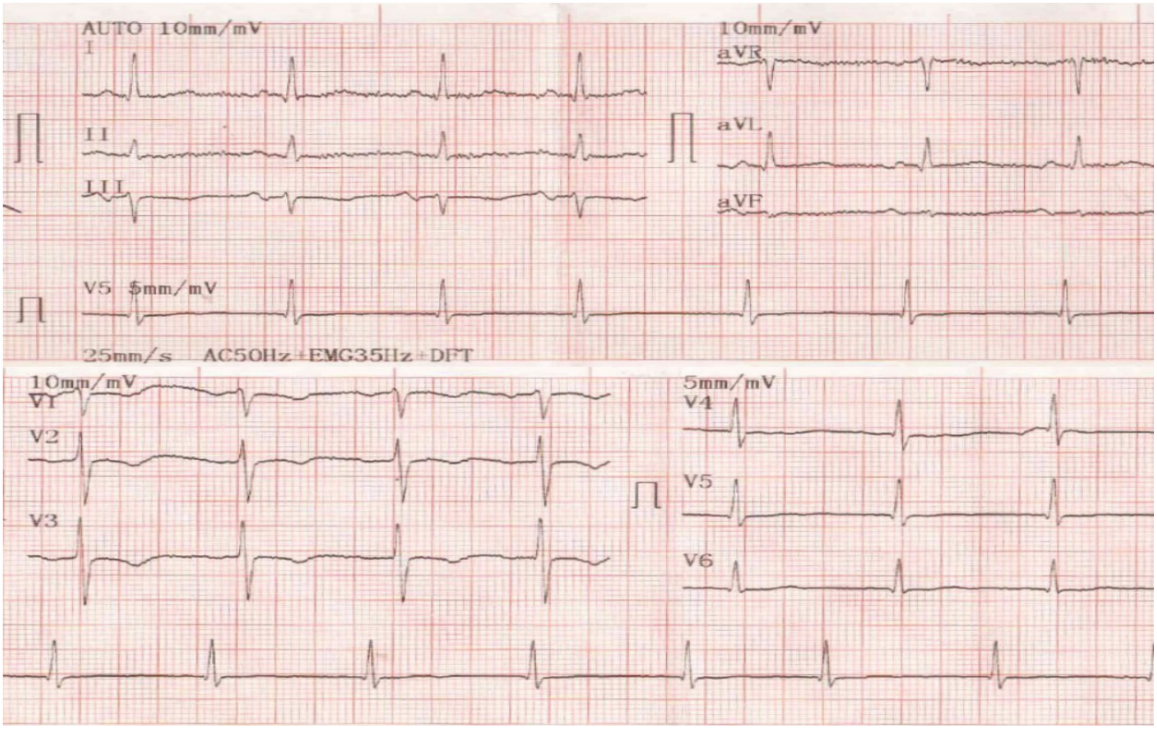

Figure 1. ECG of the patient showing sinus rhythm, negative T waves in III, V1 to V3 leads.

progressively severe in the last few months. He underwent an angiography in an another hospital two months prior to the admission, which revealed chronic total occlusion of obtuse marginal (OM1) branch, significant stenosis of right coronary artery (RCA) and 30% stenosis of the left main (LM) artery. The intervention was not performed because of high risk of complications and mortality conditioned by severity of comorbid states.

On presentation his electrocardiogram (ECG) revealed sinus rhythm with negative T waves in III, V1 to V3 leads (**Figure 1**). The blood chemistry tests were as follows: creatinine 156 mcmol/l (glomerular filtration rate [eGFR] - 40 mL/min/1.73 m^2), potassium 4.28 mmol/L, sodium 139.8 mmol/L, albumin 41.6 gr/L, total cholesterol 4.57 mmol/L, LDL 2.24 mmol/L, HDL 2.02 mmol/L, total bilirubin 3.1 mcmol/L, AST - 8.8 U/L, ALT - 9.1 U/L, C-reactive protein 3.656 mg/M. The blood tests showed red blood cell count (RBC) on the low reference edge 4.2, decreased hemoglobin (Hg) 92 g/L and mean corpuscular volume (MCV) 69 f/L. Iron concentration in blood was low (Fe 3.4 mcmol/l, normal value - 11-28 mcmol/l). Vitamin B_{12} concentration was 485 pcg/ml (Normal range 214 - 864 pcg/ml). High sensitive troponin level on admission was 11 pg/mL and increased on next day up to 16 pg/mL.

The transthoracic echocardiography revealed eccentric left ventricular (LV) hypertrophy with left ventricular end-diastolic diameter (LVEDD) 5.9 cm. Ejection fraction (EF) was estimated 40%. Regional wall motion abnormalities of LV, particularly hypokinesis of mid-lateral, posterior-lateral and inferior-lateral walls were observed. Doppler examination revealed type I diastolic dysfunction, 3rd degree of pulmonary hypertension with P_{max} 65 mmHg and a mild mitral regurgitation.

On the 2nd day of hospitalization the patient developed a reduced level of consciousness, acute kidney injury (estimated eGFR dropped to 40 mL/min/1.73 m^2) and ventricular ectopic beats (Lown 2 grade).

Patient was diagnosed with non-ST-elevation myocardial infarction based on the clinical picture, biomarkers and electrocardiographic findings. Taking into account his age, comorbidities and kidney dysfunction the initial therapeutic strategy was adopted including treatment with

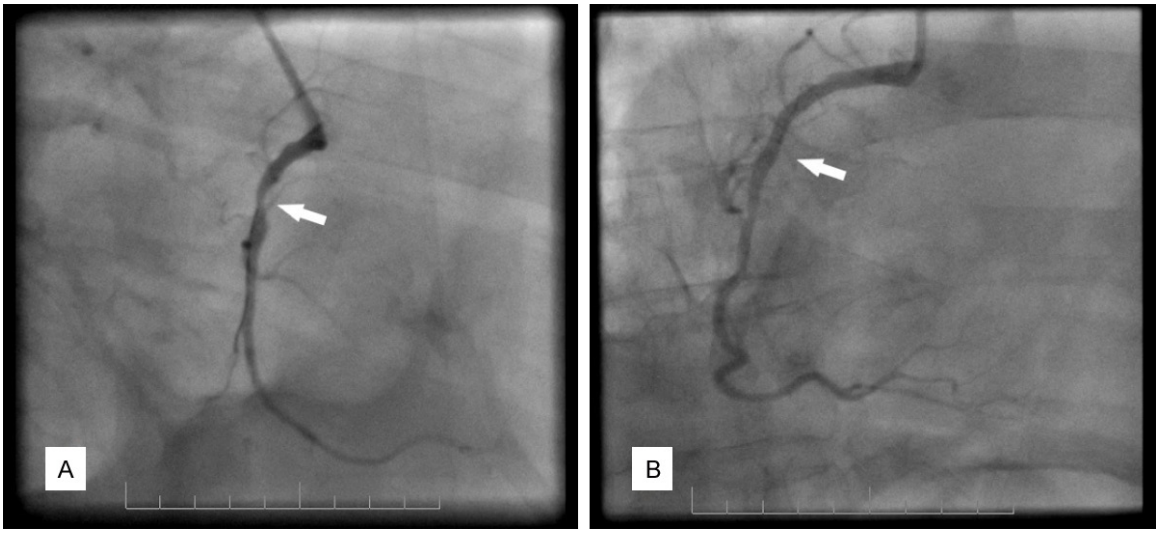

Figure 2. A. Angiography performed before implantation of stent, arrow showing the stenosis of proximal RCA. B. The result of PCI procedure, arrow showing the successful implantation of drug eluting stent of the stenotic RCA. RCA - right coronary artery; PCI - percutaneous coronary intervention.

following medications: asprin 100 mg/daily, clopidogrel 75 mg/daily, rosuvastatin 40 mg/daily, ramipril 5 mg/daily, heparin 1000 E/hour initially under control of APTT, and aclidinium bromid with formoterol aerosol. Intravenous administration of furosemide 60 mg daily dose initially and nitroglycerin were the treatment at acute phase for cardiopulmonary failure signs relief. The patient also received amiodarone 400 mg daily for the management of frequent ventricular ectopic beats. No relapses and recurrent angina pectoris were observed after treatment initiation.

We were faced with a decision of performing coronary angiography in a high risk patient with many risk factors, including heart failure, respiratory failure, anemia and low eGFR. After clinical stabilization of heart failure symptoms on the 3rd day, development of euvolemic state and stable blood saturation without need for oxygen inhalation, the patient underwent coronary angiography followed by PCI. Angiography revealed 70% stenosis of proximal RCA with occlusion of OM1 and moderate stenosis (30%) of LM artery. Successful implantation of a drug eluting stent (Ultimaster 2.5 × 24 mm, Terumo) was performed with a satisfactory final angiographic result (**Figure 2A**, **2B**).

Successful PCI resulted in clinical improvement with resolving of signs of multi-organ decompensation. Creatinine level dropped to 144 mcmol/l with a further decrease to 131 mcmol/l. eGFR was estimated 50 mL/min/1.73 m^2. Patient continued to receive a full dose antiplatelet treatment and the continuation of hospital stay went uneventful without any coronary symptoms, respiratory failure or worsening of kidney function and anemia.

At follow up visits after one and three months patient had marked improvement of symptoms, without chest pain and had mild exertional dyspnoe. Physical examination at follow up visits did not find any pulmonary rales and his blood pressure was 130/80 mmHg. Blood chemistry tests after three months showed mildly decreased kidney function with creatinine 142 mcmol/l (eGFR was estimated 46 ml/min/1,73 m^2) without changes of other biochemical parameters. The echocardiography at 3 months follow-up showed improved systolic function (EF 44%) with mild mitral regurgitation and moderate pulmonary hypertension with P_{max} estimated 50 mmHg. The patient was in sinus rhythm without ventricular ectopic beats. Dual antiplatelet combination, statin, ramipril, low dose amiodarone, combined bronchodilator aerosol on demand and furosemide were long term treatment strategy of patient with frequent outpatient monitoring.

The patient provided written informed consent for the use of his data in this case-report. The case-report was approved by the local ethics

committee; all the procedures were in accordance with the Helsinki declaration.

Discussion

Despite the significant advances in surgical and anesthetic techniques, pneumonectomy continues to have chronic complications most commonly associated with cardiovascular and respiratory systems. After pneumonectomy the long term incidence of acute myocardial infarction and pulmonary edema are high, ranging from 2.5-5% [2] and 4%-7% [3] respectively. Furthermore, confirmation of the diagnosis is challenging due to the frequency of silent episodes and manifestation with acute cardiorespiratory failure.

Acute myocardial infarction with multiple organ pathology and decompensation is a frequent clinical presentation, which makes the decision difficult in everyday clinical practice in the absence of strict guideline recommendations. Careful and rigorous treatment strategy can help identify the "golden time" and prevent the delays in coronary artery intervention in high risk elderly patients with multiple comorbidities.

Current ESC guidelines recommend performing percutaneous angiography and, when appropriate, angioplasty in elderly individuals with a high benefit/risk ratio [4]. The data suggest a reduction of mortality in patients above 75 years of age, who were diagnosed with non-STEMI and treated with PCI [5]. The improvement of outcomes was observed regardless of chronic kidney disease or diabetes, and was particularly pronounced among men [5]. Additionally, successful treatment of an elderly patient who underwent CABG for a severe coronary artery disease and a past pneumonectomy of a lung cancer were also reported in the literature, showing benefits and feasibility of surgical approach [6]. However, studies showed that increasing number of comorbid conditions was associated with a lower probability of favorable angiographic performance in both emergency and planned PCI in elderly population [7]. It can be concluded that some patients do not receive invasive treatment, which may have an impact on the outcomes.

In the retrospective study conducted by Groenedijk R et al. (1999), involving 62 patients who underwent pneumonectomy for bronchial cancer between 1984 and 1995, respiratory function and age over 70 years are the main prognostic factors for post-pneumonectomy hospital morbidity and mortality. **Table 1** summarizes the studies which addressed the issue of patients with multiple comorbidities and previous pneumonectomy undergoing coronary intervention.

In clinical practice, the decision to perform PCI in individuals with multiple comorbidities and multi-organ failure is difficult, as the clinical deterioration may be life-threatening. In addition, elderly patients presenting with acute myocardial infarction with additional risk factors have higher mortality [8].

This case demonstrates a strategy to manage high risk patients with PCI indications and history of multi-organ failure. In present case the patient received heart failure therapy, including intravenous diuretic for the management of HF decompensation, as well as oxygen therapy, bronchodilators and treatment for acute kidney injury. Only after stabilization of heart failure sings, insuring absence of repeated angina pectoris, achievement of euvolemic state and increase of GFR the decision to perform coronary angiography with following PCI was taken.

Conclusion

In patients with an indication of PCI for non-STEMI or unstable angina and comorbidities, particularly a history of cardiorespiratory failure after pneumonectomy, angioplasty may be performed after optimal medical therapy directed to achieve euvolemic state, stabilization of respiratory parameters. The determination of optimal timing of coronary angioplasty and PCI depends on assessment of ischemic status severity, acute cardiac and respiratory failure progression and risk assessment of other comorbidities. Careful evaluation of the patient and experience are required to determine the optimal timing for PCI and appropriate management.

This case provides a strategy for handling these difficult cases with appropriate treatment arrangement for safe coronary intervention, taking into consideration benefits and risks of PCI.

Table 1. Characteristics of studies involving patients with multiple comorbidities and pneumonectomy, who underwent coronary intervention

Author (year)	Type	Country	Number of patients	Age group	Outcome
Ofori-Asenso R. et al. (2019)	Retrospective, Cohort study	Australia	1,488	>70	Presence of multiple comorbidities was associated with poor outcomes
Vallabhajosyula S. et al. (2019)	Retrospective, Cohort study	United States of America	444253	55-82	Multiorgan failure was associated with an increase of in-hospital mortality
Dégano IR. et al. (2017)	Cohort study	Europe (data collected from the EUROTRACS database)	79,791	50-90	Patients with MI who received a PCI during hospital admission had a lower risk of in-hospital mortality regardless of sex, age, presence of ST elevation, and DM or CKD
Shapiro M. et al. (2010)	Retrospective study	United States of America	1267	Mean age 61.3	Presence of many comorbidities in older individuals after pneumonectomy was predictor of morbidity and mortality
Groenendijk RP. et al. (1999)	Retrospective study	The Netherlands	62	40-80	Older age and respiratory function were the main prognostic factors for hospital morbidity and mortality after pneumonectomy
Kumar P. et al. (2003)	Case report	United Kingdom	1	70	Case of successful CABG in an old patient with past pneumonectomy

MI - myocardial infarction; PCI - percutaneous coronary intervention; DM - diabetes mellitus; CKD - chronic kidney disease.

Disclosure of conflict of interest

None.

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