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CASE REPORT **Open Access**

The Role of Chest Radiography to Diagnose Large Pericardial Effusion in Woman 66 Years Old With Malignancy : *Hiding Pericardial Effusion*

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ABSTRACT

Introduction: Pericardial effusion refers to an increase in fluid accumulation in the pericardial cavity. This pericardial fluid acts as a lubricant between the layers of the pericardium. We report a case of pericardial effusion, which was significant but not detectable on conventional chest radiographs.
Case: A 66-year-old woman with lung adenocarcinoma accompanied by large pericardial effusion without sign of impending tamponade. The diagnosis of pericardial effusion was mainly based on echocardiography, where there is a large pericardial effusion but without signs of cardiac tamponade, and the patient then underwent pericardiocentesis. Previously, the patient had undergone two examinations with two different imaging modalities, namely CXR and chest CT scan, where on the CXR results, the patient only showed cardiomegaly.
Discussion: There are four parameters suggestive for assessing a pericardial effusion, namely enlargement of the heart silhouette, pericardial fat stripe, left dominant pleural effusion, and an increase in the transverse diameter of the heart compared to the previous chest X-ray. This parameter is obtained not only based on the position of the photo taken but requires another position, whereas, in this patient, only CXR was performed with the posteroanterior position.
Conclusion: When there are complaints of progressive shortness of breath in individuals with an underlying disease that may cause pericardial effusion, then the CXR examination cannot be used as a reference when there are no radiographic signs that point to pericardial effusion because CXR has a low diagnostic value in assessing the presence of pericardial effusion.

Keywords : Chest Radiography, Malignancy, Pericardial Effusion

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Introduction

Pericardial effusion refers to an increased accumulation of fluid in the pericardial cavity where the amount is only between 15 and 50 ml of serous fluid under normal conditions.[1] This pericardial fluid is a lubricant between the layers of the pericardium.[2] Fluid accumulation that occurs can be in the form of exudate, transudate, or sanguine. In general, the cause of pericardial effusion can be from infection, rheumatology, neoplasm, trauma, cardiac, vascular, idiopathic, and other causes1, which then broadly etiology can be grouped into inflammatory causes and causes non-inflammatory.[3]

One study conducted from 2006 to 2016 in Mexico to assess the prevalence of pericardial effusion in systemic diseases found that the enormous volume of pericardial fluid accumulation was in patients with neoplastic etiology. However, neoplasms themselves were not the most common etiology of pericardial effusion.[2] The 2015 European Society of Cardiology (ESC) guideline on managing pericardial disease states that in developing countries, neoplasms account for 10-25% of cases as the etiology of pericardial effusion.[3]

Pericardial effusion is a common clinical condition in daily practice in symptomatic and asymptomatic patients. A clinician needs the ability to make a diagnosis before it develops into a life-threatening condition such as cardiac tamponade, particularly in areas with limited imaging modalities. This case report aims to describe the types of radiological modalities that can be used in diagnosing pericardial effusion, especially conventional radiography so that it can be seen whether a simple modality is sufficient to establish a pericardial effusion.

Case

The pulmonology division consulted a 66-year-old woman diagnosed with lung adenocarcinoma stage T4N2M1c and pericardial effusion. The current patient complains of shortness of breath that had been felt for two months which has worsened in the last week. There was dyspnea on effort and paroxysmal nocturnal dyspnea. There was a history of previous intermittent shortness of breath for the last two years. There had been a weight loss of approximately 15 kg in the last nine months. The patient had a history of breast cancer three years ago and had a mastectomy. The patient had been diagnosed with lung adenocarcinoma and had undergone oral chemotherapy with IRESSA (gefitinib) since 2021 and stopped in March 2022. The patient had also previously undergone nine cycles of

chemotherapy, but the patient stopped at the patient's wish. The patient had a history of confirmed COVID-19 in March 2022 and passive smoking for the last 30 years.

On physical examination, he was conscious with a weight of 48 kg, a height of 163 cm (Body Mass Index of 18.07 kg/m2), blood pressure 110/80 mmHg, pulse 105 times per minute regular, breathing 24 times per minute, body temperature 36.5 Celsius, and oxygen saturation 98% with nasal cannula 4 liters per minute. On physical examination, the thorax was symmetrical, the vocal fremitus decreased in the right mediobasal region, dull percussion on the right hemithorax as high as ICS IV to the base, vesicular breath sounds, and decreased impression in the right mediobasal region of the right hemithorax, no rhonchi and wheezing were found. Electrocardiographic examination found rhythmic sinus rhythm, heart rate of 107 beats per minute, regular, low voltage limb and precordial leads, and electrical alternans (Figure 1).

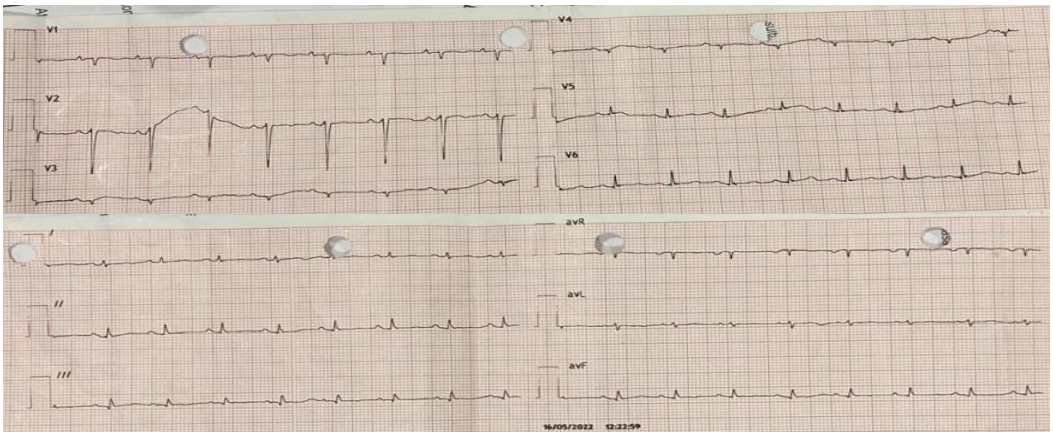

Figure 1. Electrocardiography finding of the patient

From the chest x-ray examination, the impression of a soft tissue mass of the right lung, bilateral pulmonary fibrosis, thickening of the right lung minor fissure, right pleural effusion, and cardiomegaly with dilatation et atherosclerosis of the aorta was obtained (Figure 2). Then, the patient underwent a multislice computed tomography (MSCT) scan with the results of a right lung mass with tumor metastases to bone and liver, bilateral pulmonary fibrosis, right bilateral pleural effusion, pericardial effusion, and atherosclerosis of the aorta (Figure 2). When consulted to the Cardiology division, bedside echocardiography was performed with the results of large pericardial effusion with swinging heart and without signs of impending cardiac tamponade, normal left and right ventricular systolic function (eyeballing), no right atrial and right ventricular collapse, and negative of IVC plethora (Figure 3).

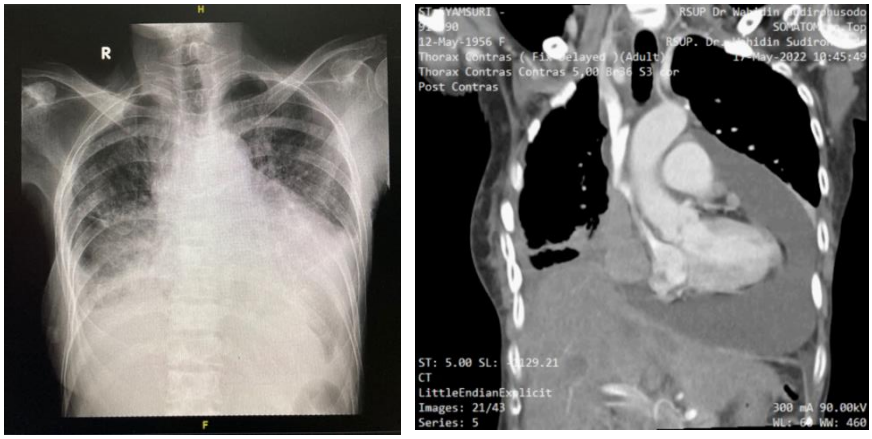

Figure 2. The results of the chest X-ray (left) and chest MSCT (right) from the patient.

Based on the history, physical examination, and supporting examinations, our patient was diagnosed with Large Pericardial Effusion without signs of Impending Cardiac Tamponade and planned for Pericardiocentesis with an aspiration of 300 ccs of pericardial fluid in which fluid The pericardial discharge is hemorrhagic and recommended for aspiration of pericardial fluid every 8 hours from the patient.

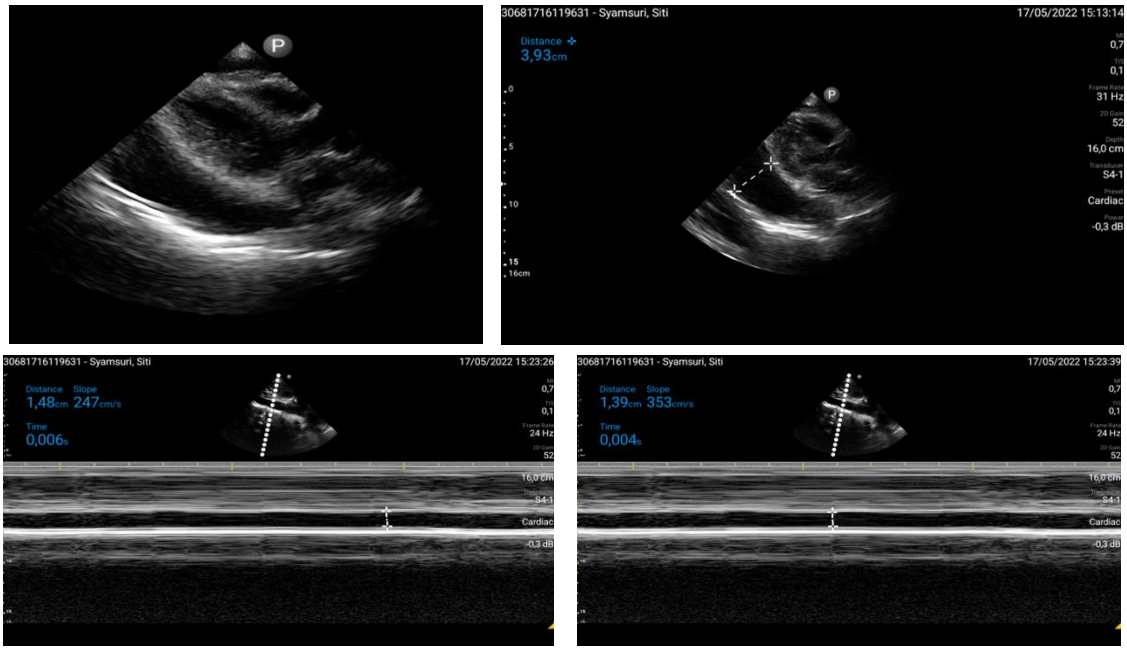

Figure 3. Pre-pericardiocentesis echocardiography in the patients.

Discussion

Lung cancer is the leading cause of death in cancer cases.[4] It was stated that the most cardiovascular complications in patients with lung cancer undergoing radiation therapy (RT) to the thorax were pericardial effusion and cardiac tamponade. In an autopsy study of patients with a history of radiation therapy, 70% had pericardial damage on the thorax.[5]

The pericardium is an avascular fibrous sac that encloses the heart and major blood vessels such as the proximal pulmonary trunk, ascending aorta, and distal to the superior and inferior vena cava. [6.7] The pericardium consists of two layers, namely the fibrous and serous layers. Then the serous layer consists of the visceral and parietal layers.[6] The visceral layer contains a single layer of mesothelial cells attached to the epicardium with a thickness of <1 mm in producing pericardial fluid. The parietal layer is a fibrous layer with a thickness of <2 mm with the main content is a small amount of collagen and elastin tissue which gives little elasticity to the pericardium so that the pressure-volume curve of the pericardium does not run linearly.[7,8]

This patient has had a primary disease, namely lung cancer, since two years ago. The patient had also received oral and parenterally chemotherapy but did not undergo the treatment routinely. One of the most common cardiovascular complications in patients with lung cancer is pericardial effusion, where malignancy is the cause of pericardial effusion in 10-25% of cases.[3]

In chronic conditions, the accumulation of pericardial fluid will occur gradually over a certain period before hemodynamic instability occurs. At this time, the patient will not show acute circulatory failure, but the symptoms that arise are shortness of breath that is getting worse, as in this patient, pericardial effusion due to an ongoing chronic condition, namely lung malignancy.[9] In this chronic condition, there will be an increase in the accumulation of pericardial fluid slowly. The pericardial membrane stretches to accommodate this increase in pericardial fluid volume without significant changes in pericardial pressure, and the patient is asymptomatic until the stretch of the pericardial membrane reaches its limit, causing symptoms..[8,10]

In this patient, it can be said that she is not in a state of cardiac tamponade because he did not meet the cardinal symptoms and signs of cardiac tamponade, i.e., hypotension, pulsus paradoxus, increased central venous pressure (in which this patient obtained DVS R + 2 mm Hg), and distant heart sounds on chest auscultation.[3] However, in this patient, the physical examination revealed the presence of tachycardia.

Patients are admitted with complaints of shortness of breath in the emergency department, where shortness of breath is a common symptom of cardiovascular and respiratory diseases.[9] Routine examinations such as electrocardiography (ECG) and chest X-ray (CXR) can be performed to help establish a diagnosis.[1]

On ECG examination, this patient found the presence of low voltage limb and precordial leads, and electrical alternans. The ECG can vary from normal to non-specific ST-T segment changes in small pericardial effusions.[1] The ECG images found in this patient are appropriate for cases of pericardial effusion because it is said that the characteristic ECG in large pericardial effusions may be low QRS voltage, PR segment depression, and electrical alternans. These ECG findings are said to be specific but less sensitive for pericardial effusion, so the 12-lead ECG is a less supportive modality in diagnosing pericardial effusion.[9]

Various imaging modalities can be performed to establish a pericardial effusion, including Chest X-Ray, CT scan, Magnetic Resonance Imaging (MRI), or Echocardiography. The diagnosis of pericardial effusion is made based on echocardiography which can semiquantitatively assess the size and hemodynamic effects of the pericardial effusion.[3] Based on the European Society of Cardiology (ESC) guidelines on the management of pericardial disease, transthoracic echocardiography examination is the recommended examination in diagnosing pericardial effusion (Class I Recommendation, level C).

On CXR examination, the pericardial layer commonly will not be seen.[11] When a pericardial effusion occurs, the accumulation of pericardial fluid will be seen on the CXR image but will still not be seen if the accumulation of fluid that occurs is <200 ml.[12] In one study, the signs of pericardial effusion based on CXR were enlarged heart silhouette, pericardial fat stripe, left dominant pleural effusion, and increased transverse diameter of the heart compared to the previous chest radiograph.[13]

Left pleural effusion is the sign most associated with pericardial effusion, while right pleural effusion is more associated with the presence of heart failure. This left pleural effusion is a specific sign of pericardial effusion. However, it is not sensitive because this pericardial effusion will still be associated with pericardial effusion even though it is found in individuals with lung disease and pleural disease. Pericardial fat stripe is a sign found only in large pericardial effusions, so it is said to have a sensitivity of up to 50% in this group, and the sensitivity will decrease as the amount of fluid accumulation in the pericardial cavity decreases.[13]

It is argued that an enlarged cardiac silhouette and an increase in the transverse diameter of the heart compared to the previous CXR are signs of pericardial effusion. This sign can be said to suggest a pericardial effusion if it excludes the presence of cardiac disease in the individual. The presence of underlying heart disease that causes an enlarged heart chamber can also be seen as an enlarged heart image on radiography.[13]

In the frontal view, an enlarged heart image will be obtained, calculated based on the Cardiothorax Ratio (CTR), which is >50%.[12] This image gives a globular shape with a symmetrical enlargement of the heart contour called the "water bottle sign" due to a considerable accumulation of fluid in the heart. Pericardial cavity so that it gives a water bottle or "flask-shaped," namely a pumpkin-like heart appearance.[8,10,12,14] The "water bottle sign" will appear in 68% of patients with large pericardial effusions (>500 ml) where the results of echocardiography show a pericardial effusion >2 mm.[13]

In pericardial effusion with posterior expansion, there can be an increase in the cranial angle formed by the right and left main bronchial > 90 degrees. On the lateral view, there is a "bulge sign" on the posteroinferior and a loss of retrosternal space on the anterosuperior. In addition, it can also be found the presence of pericardial fat, which visualizes the fluid that is between epicardial fat and pericardial fat, which is called the "Oreo cookie sign" or "sandwich sign" or "Retrosternal fat pad sign," where epicardial fat and pericardial fat will give an image of a high density. In contrast, the pericardial fluid will give an image of intermediate density. [12,15] This image will be seen anteriorly due to adipose tissue being more attached to the right ventricle. [12] On the lateral view, a "double-lucency sign" can also be found.[9] Further, by using density differences, pericardial fluid and myocardium had distinct features, but this method is limited to transudate or chylous fluids with low density so that they can be distinguished from myocardial density.[12]

From all radiological images obtained on CXR, it is said that no sign can distinguish individuals with pericardial and without pericardial effusion. Of the four radiological signs of CXR mentioned above, enlargement of the heart silhouette gives a reasonably good sensitivity value of 71% but has a low specificity value of 41%. While the other three signs, namely left pleural effusion, pericardial fat stripe, and increased transverse diameter of the heart, gave the opposite value, namely 78% for specificity and a low sensitivity value of <70%. When viewed from the size of the pericardial effusion, although there were no radiographic signs on CXR indicating their size, left pleural effusion and pericardial fat stripe were said to be able to show moderate to large pericardial effusion even though these two signs had low sensitivity but have a specificity value of > 91% and an accuracy of > 70%. On this basis, CXR is said to have a low diagnostic level in establishing pericardial effusion.[13]

This patient only found cardiomegaly characterized by CTR exceeding 50%, which can occur in pericardial effusion but can also occur in various conditions other than pericardial effusion, such as enlargement of the heart chambers due to cardiac structural disorders. No

water bottle sign was found, which is a sign of pericardial effusion, possibly due to pleural effusion in the right hemithorax, according to what was found on physical examination, namely dimness on percussion of the right hemithorax as high as ICS IV so that the right border of the heart to assess the presence of a water bottle sign became obscured. However, this sign is said to be present in 68% of patients with large pericardial effusions and echocardiography >2 mm. In addition, there was a right pleural effusion in this patient. Right pleural effusion was more associated with the presence of heart failure. However, in this patient, it was suspected that it was due to a malignant process that occurred in the right lung, while what was said to be associated with pericardial effusion was left pleural effusion even though it was said to be Left pleural effusion and pericardial fat are not diagnostic for pericardial effusion.[13] Therefore, based on the CXR finding, it is not said to be a true pericardial effusion on other imaging modalities in this patient, revealing a large pericardial effusion (> 500 ml). This finding can happen because the CXR image has a low diagnostic level in establishing a pericardial effusion,[13] so in this patient, an imaging examination with other modalities such as echocardiography was performed.

An echocardiography examination will visualize the pericardial effusion as an echo-free space surrounding the heart.[7] The presence of cardiac chamber collapse is a sign that can be found before hemodynamic failure.[8]

Based on the size, the pericardial effusion can be classified into small (50-100 ml), moderate (100-500 ml), and large (> 500 ml), in addition to other classifications based on the onset, distribution, and composition of the accumulated pericardial fluid.[3,11] In trivial pericardial effusion, this accumulation of pericardial fluid will only be seen in the posterior region of the heart, namely behind the left ventricle in the oblique sinus, as well as in small pericardial effusions. However, trivial pericardial effusion can only be seen during the systolic phase, while small pericardial effusion can be seen in both the systolic and diastolic phases.[7,11] If there is an increase in the accumulation of pericardial fluid to > 100 ml (moderate epicardial effusion), the spread of pericardial fluid will occur circumferentially so that it can be seen both anteriorly and posteriorly to the heart. i.e., the free movement of the heart in the pericardial cavity.[10]

Based on the results of echocardiography from this patient, it was found that there was an accumulation of pericardial fluid with a size of 3.93 cm (39 mm) which was classified as a large pericardial effusion which was estimated to be >500 ml of accumulated pericardial fluid. In this patient, the accumulation of pericardial fluid occurs slowly, as evidenced by the

complaint of shortness of breath that has been felt for two months gradually.[11] In addition, the presence of lung cancer experienced two years ago is the etiology of a pericardial effusion, where it is said that neoplasm is one of the causes of chronic pericardial fluid accumulation. (hypotension, increased central venous pressure, and distant heart sounds) were not found.[8]

Based on echocardiography findings in this patient, there was no sign of cardiac tamponade as mentioned above, so this patient was diagnosed with Large Pericardial Effusion without sign of impending tamponade. It is said that pericardial effusion will not always show an echolucent image on echocardiography due to the presence of fibrin/clot, protein, chyle, tumor cells, and bacteria.[11] Therapy for pericardial effusion with known etiology is required to treat the underlying disease as the cause of the pericardial effusion.[3,10] In the European Society of Cardiology guidelines for the management of pericardial effusion, it is stated that pericardiocentesis is an invasive therapy performed on large pericardial effusions that have not been successfully treated pharmacologically and are also the treatment of choice for pericardial effusions with a malignant etiology (Class I Recommendation, Level C).[3]

Conclusion

No single radiological sign on CXR examination can be used as a diagnostic standard for pericardial effusion. However, this patient found cardiomegaly, which has a sensitivity of 71% but low specificity of 41%, so the signs obtained have no diagnostic value but only have predictive value for pericardial effusion. Therefore, CXR examination cannot be used as a reference when there are no radiographic signs suggesting pericardial effusion regarding its low diagnostic value in assessing the presence of pericardial effusion.

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