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Case report

MANAGING PNEUMOPERICARDIUM IN ADVANCED LUNG CANCER: A CASE REPORT AND LITERATURE REVIEW

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Abstract: **Introduction:** Pneumopericardium, tho- ugh rare, can lead to severe complications such as cardiac tamponade, particularly in patients with malignancies. This case-based review examines the incidence, management, and outcomes of pneumopericardium in a patient with advanced lung cancer.

Case Report: We present a comprehensive literature review and a detailed analysis of a 57-year-old male with metastatic squamous cell carcinoma of the lung, who developed pneumopericardium. The patient's clinical presentation, diagnostic challenges, and management strategies were documented and compared with similar cases. He presented with cough and dyspnea, and imaging revealed pneumopericardium, likely due to tumor invasion into the pericardial space. Management involved conservative measures, including antibiotics and close monitoring. A literature review revealed that management strategies for pneumopericardium vary based on hemodynamic stability, ranging from conservative treatments to invasive procedures. Recurrence is common, and survival times post-diagnosis are highly variable.

Conclusion: Pneumopericardium in cancer patients requires a tailored management approach, with a multidisciplinary team essential for optimizing patient outcomes. This case underscores the need for heightened awareness and prompt, individualized treatment plans for managing such complex conditions.

Keywords: pneumopericardium, lung cancer, pericardiocentesis.

INTRODUCTION

Pneumopericardium, the accumulation of air or gas within the pericardial sac, represents a rare yet clinically significant finding. The etiology of pneumopericardium is multifaceted, encompassing direct or indirect trauma, fistula formation between the pericardium and thoracic air-containing structures, barotrauma, infectious processes, and iatrogenic complications following medical interventions (1). Studies have documented its occurrence across various clinical scenarios, emphasizing the importance of understanding its complex origins and potential implications for patient management (2, 3). Although pneumopericardium itself is rare, its association with malignancies is even less common and is seldom discussed in the literature (2). This association is crucial as malignancy-related pneumopericardium may arise due to tumor invasion directly into the pericardial space, leading to air accumulation, or indirectly through infection and necrosis within tumor tissues (4). For instance, lung cancer, particularly squamous cell carcinoma, has been noted in case reports to precipitate pneumopericardium through these mechanisms (3, 4). This underscores the need for heightened awareness and prompt management to mitigate potential complications such as cardiac tamponade, which can be life-threatening (5).

This case report elucidates a rare instance of pneumopericardium in a patient with metastatic squamous cell carcinoma of the lung, underscoring the diagnostic challenges and complex management required. The review of similar cases in the literature not only broadens the understanding of pneumopericardium's clinical trajectory in the context of cancer but also reinforces the need for an integrated, multidisciplinary approach to care in such intricate cases (3, 4, 6). By detailing this case and comparing it with existing reports, we aim to contribute valuable insights into the nuanced interplay between cancer and pericardial air accumula-

tion, enhancing strategies for diagnosis, management, and overall patient outcomes.

CASE REPORT

A 57-year-old male with a history of hypertension and left mandibular squamous cell carcinoma, treated with mandibulectomy and metallic brace replacement two years prior, presented with a relapse. Over the last 18 months, positron emission tomography (PET) scans detected metastases in his lungs, liver, kidneys, and bones. He reported a two-day history of cough and dyspnea, without fever, palpitations, or chest pain, and had a blood pressure of 122/70 mmHg. Laboratory investigations revealed leukocytosis, neutrophilia, anemia, and hypercalcemia due to bone metastasis. Physical examination noted reduced air entry and wheezing in the right lower lobe, consistent with aspiration pneumonia, along with difficulty in oral intake but without nausea or vomiting.

Prior computed tomography (CT) scans of the neck (Figure 1A-1B) and chest (Figure 1C-1D) revealed a heterogeneously enhancing lesion with central necrosis in the left submental space, involving the floor of the mouth and left digastric muscle. There was thickening in the left submandibular gland extending to the pre-epiglottic space, and a peripherally enhancing subcutaneous lesion in the right submental region. The lungs displayed four stellate lesions, the largest located near the bronchus of the right middle lobe. The heart size was normal, with no effusions or lymphadenopathy, and multiple hypodense lesions were observed in the liver.

Upon admission, a chest x-ray indicated a right lower lobe effusion suggestive of pneumonia, leading to treatment with ceftriaxone and levofloxacin, which was later switched to clindamycin due to the possibility of anaerobic infection. Subsequent CT scans showed an increased mass in the right middle lobe with multiple cavitations and bronchial com-

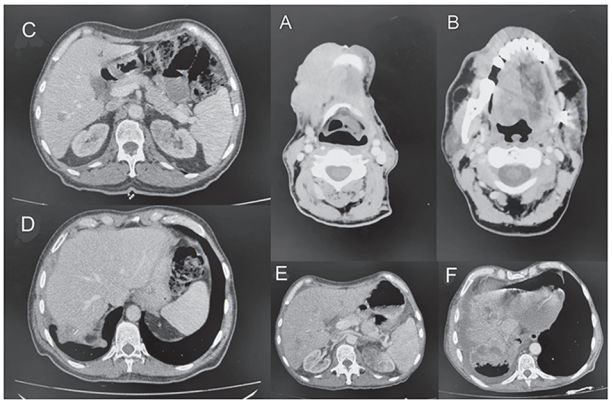

Figure 1. *Computed tomography (CT) scans of the neck and chest*

A-B: A computed tomography scan of the neck taken one year before admission. Status post (S/P) left mandibulectomy with surgical clips is seen in the subcutaneous region along with a metallic mandibular brace. There is a 4.8 × 3.3 cm heterogeneously enhancing deep soft tissue lesion showing central necrosis in the left submental space, involving the floor of the mouth and left digastric muscle, and extending to the left submandibular gland, with thickening/edema or invasion into the left pre-epiglottic space. (B) A 1.7 × 1.4 cm peripherally enhancing subcutaneous cystic soft tissue lesion/lymph node is observed in the right submental region. The thyroid gland is unremarkable, the vocal cords are symmetrical, and the infraglottic airways are normal in caliber. No abnormalities were noted in the nasopharynx.

C-D: A computed tomography scan of the chest taken five months before admission. Four irregular lesions appear in the lung, displaying a stellate appearance, the largest measuring 4.1 × 2.9 cm in the right middle lobe, abutting the anterior aspect of its bronchus. The heart is normal in size, with no pericardial or pleural effusions evident. No mediastinal or hilar lymphadenopathy is observed, and the chest wall is intact. The visualized portions of the upper abdomen show multiple hypodense liver lesions.

E-F: A computed tomography scan of the chest performed on admission. The lungs show an increase in the size of the previous heterogeneous mass in the right middle lobe, now occupying the entire right lower lobe with multiple cavitations. This mass compresses the adjacent bronchus, with surrounding post-obstructive ground-glass consolidations and atelectatic changes. The observed lesion invades the adjacent mediastinal surface, showing pneumopericardium. Multiple scattered pleural nodules are evident, the largest of which measures 4.7 × 2.6 cm in the right costodiaphragmatic recess, revealing a hypodense appearance indenting the liver, with adjacent bone erosions/lesions involving the 6th and 7th ribs. Bilateral minimal pleural effusion with nodular wall thickening is noted, along with bi-apical atelectatic/fibrotic bands. Scattered ground-glass opacities are observed in the right upper lobe. These features are suggestive of pleural, lung, and bone metastasis. The upper abdomen shows multiple small hypodense liver lesions suggestive of metastasis and a 1 × 1.2 cm benign-looking calcified lesion abutting the left side of the intrahepatic portion of the inferior vena cava. A 4.6 × 4.6 × 3.8 cm mass involving the left upper renal pole is also observed, suggesting secondary metastasis.

Table 1. *A summary of reported cases of cancer-related pneumopericardium in the literature*

Author [YOP]	Age (year)	Gender	Cancer	Interval from cancer diagnosis to presentation	Presentation	Fistula	Chest CT	Management	Outcome	Recurrence	Survival (in days)
Hirani et al., 2020 (3)	65	Male	Locally-advanced EGJ adenocarcinoma	NA	NA	Gastropericardial	Pneumopericardium in the posterior aspect with foci of gas above the esophageal stent communicating with the pericardium	Conservative approach (not described)	Improved	No	NA
Baydur et al., 1976 (2)	64	Male	SCC lung	3 months	Right-sided chest pain, progressive dyspnea, and productive cough	Bronchopericardial	Mass in the right lower lobe with a small pneumothorax plus pneumopericardium	Not clearly described	Temporary improvement, but pneumopericardium persisted until pleural effusion accumulated	No	51
Kim et al., 2000 (4)	53	Male	Double 1ry SCC lung	10 months	Progressive dyspnea on exertion and severe chest pain	Bronchopericardial	Pneumopericardium and left hydropneumothorax	Diagnostic pericardiocentesis and fluid analysis revealed exudative fluid	Fully improved	No	NA
Nakamura et al., 2021 (6)	70	Female	Stage IIIB SCC lung	6 months	Chest pain, exacerbation of cough, and severe palpitations	Bronchopericardial	Lung cancer on the left hilum abutting the pericardium (causing pneumopericardium) and invading the mediastinum (causing pneumomediastinum)	Fluoroscopy-guided urgent pericardiocentesis through the superior margin of the left 5th rib	JVD, dyspnea, and chest pain improved	No	180
Lages et al., 2018 (7)	66	Male	SCC lung	9 months	Dyspnea and chest pain	Bronchopericardial	Pneumopericardium of 28mm in maximum thickness	None	Minimal improvement in presenting symptoms	No	21
Al-Taweel et al., 2016 (8)	56	Male	SCC lung	NA	Hemoptysis and cough	Direct invasion into the left atrium	A small amount of air measuring 3-4 mm within the pericardium	Video-assisted thoracic surgery with pericardial window	Fully improved	Yes	>180
Sener et al., 2013 (9)	51	Male	NKTL	NA	Fever and cough	Gastropericardial	NA	Drainage with tube placement	Failure	No	1 (due to septic shock)
Kubisa et al., 2016 (10)	42	Male	NSCLC	6 months	Progressive weakness, fever, dry cough, and weight loss	Bronchopericardial	Severe inflammatory infiltrations in the right pulmonary hilum, with the presence of fluid and gas in the pericardium. Also, a subcarinal tumor of 80mm in the left cavity was observed with an extensive air cavity communicating with the left main bronchus and the pericardial cavity.	Mini-thoracotomy was performed above the 6th left rib and the pericardium was decompressed of air and fluid	Failed drainage and the patient underwent US-guided drainage	Yes	21
Mandal et al., 2019 (11)	81	Male	SCC esophagus	NA	Dyspnea and cough	Esophagopericardial	Pneumopericardium	Conservative approach (not described)	No improvement	NA	10

Fournel et al., 2018 (12)	84	Male	Esophagus	NA	Cardiogenic shock	Esophagopericardial	Massive pneumopericardium	Pericardiocentesis with closed drainage. A stent was applied to close the fistula.	No improvement	NA	4
Liao et al., 2017 (13)	53	Male	SCC lung	NA	Dyspnea, fever, thoracic pain	Esophagopericardial	Pneumopericardium with an anterior extent associated with a small amount of pericardial fluid	Pericardiocentesis with endoscopy-guided stent	NA	No	NA
Wang et al., 2016 (14)	53	Male	Lung	7 months	Dyspnea and chest pain	Esophagopericardial	Large pneumopericardium	Pericardiocentesis with endoscopy-guided stent	NA	No	NA
Rao et al., 2013 (15)	6	Female	Acute lymphoblastic leukemia	NA	Dyspnea and fever	Not reported	NA	Pericardiocentesis	NA	No	NA
Kasama et al., 2011 (16)	64	Male	SCC esophagus	NA	Dysphagia	Esophagopericardial	Pneumopericardium	Pericardiectomy	NA	NA	NA
Imai et al., 2008 (17)	77	Male	SCC lung	11 months	Dyspnea	Pleural space and pericardium	Pneumopericardium without mediastinal emphysema	Pericardiocentesis with drainage	NA	No	NA
Durães Campos et al., 2020 (18)	67	Male	Lung	1 month	Dyspnea, productive cough, and hemoptysis	Pleuro-pericardial	A left pulmonary mass containing areas of necrosis and gas, associated with the anterior pneumopericardium	Close monitoring and conservative management	Deterioration	No	30

pression, accompanied by post-obstructive changes and mediastinal invasion causing pneumopericardium. Additional metastatic lesions were identified as pleural nodules in the liver, kidneys, sternum, and ribs (Figure 1E-1F). Despite a negative purified protein derivative (PPD) test excluding tuberculosis, and the non-feasibility of bronchoscopy due to his oral condition, transthoracic echocardiography confirmed pneumopericardium.

The patient was discharged three days later, hemodynamically stable, but with continued elevated white blood cell counts (WBC = 17.09×10^9/L), lower hemoglobin levels (7.9 gm/dL), and elevated neutrophils (90.6%). At discharge, he exhibited no edema, jugular vein distension, dyspnea, chest pain, or wheezing, and maintained good bilateral air entry.

DISCUSSION

Pneumopericardium is an uncommon yet significant clinical entity frequently associated with various complications (1). While often linked to trauma, infections, and iatrogenic causes, cases in cancer patients, as highlighted in our literature review (Table 1), typically arise due to tumor invasion or the development of pathological fistulas between the pericardium and air-containing structures. Our patient, a 57-year-old male with metastatic squamous cell carcinoma, developed pneumopericardium likely due to tumor invasion into the pericardial space—a finding supported by radiological evidence of a large mass invading the mediastinal surface (3).

The literature reveals a range of presentations from chest pain and dyspnea to more subtle symptoms like cough and fever, often precipitated by the cancer's progression to involve pericardial structures.

The interval from cancer diagnosis to the presentation of pneumopericardium varies widely, reflecting the aggressive nature of the underlying malignancy or the delayed manifestation of its complications. For instance, patients reported by Baydur (2) and Kim (4) developed symptoms within 3 to 10 months post-cancer diagnosis, presenting with chest pain and dyspnea. This rapid onset suggests a direct and aggressive tumor interaction with the pericardial space.

The diversity in presentation patterns, from acute chest pain and dyspnea to more insidious symptoms like cough and fever, underscores the need for clinicians to maintain a high index of suspicion in patients with known malignancies. Management approaches in reported cases range from conservative measures, such as oxygen therapy and antibiotics, to more inva-

sive procedures like pericardiocentesis and surgical intervention. The choice of management is heavily influenced by the patient's hemodynamic stability and the presence of life-threatening complications such as cardiac tamponade (5). Invasive interventions are reserved for more severe cases or those demonstrating rapid clinical deterioration, as seen in the cases reported by Nakamura (6) and Lages (7), where urgent pericardiocentesis was required to manage symptoms and prevent cardiac arrest.

Recurrence of pneumopericardium was noted in some cases, such as that reported by Al-Taweel et al. (8), indicating the persistent and recurrent nature of the underlying pathological process, often necessitating repeated interventions. Survival times post-pneumopericardium diagnosis vary significantly, ranging from as little as 1 day in severe cases like that of Sener et al. (9) to over 180 days in others (8). This highlights the variable prognosis in these patients, reflective of both the aggressive nature of the underlying cancer and the effectiveness of the intervention strategies employed (Table 1).

In **conclusion**, the review of literature alongside our patient case illustrates the complexity of pneumopericardium in cancer patients. The condition not only presents variably but also requires a tailored, often aggressive management strategy. The involvement of a multidisciplinary team is crucial to optimizing outcomes, emphasizing the role of personalized medicine in managing complex oncological complications. This synthesis of data aids in better understanding the clinical trajectory of pneumopericardium in cancer patients and reinforces the necessity for vigilant monitoring and proactive intervention to improve patient survival and quality of life.

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Sažetak

LEČENJE PNEUMOPERIKARDIJUMA KOD UZNAPREDOVALOG KARCINOMA PLUĆA: PRIKAZ SLUČAJA I PREGLED LITERATURE

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Uvod: Pneumoperikardijum, iako redak, može dovesti do ozbiljnih komplikacija kao što je srčana tamponada, posebno kod pacijenata sa malignitetima. Ova prikaz slučaja, zasnovan na pregledu literature, istražuje incidencu, lečenje i ishode pneumoperikardijuma kod pacijenata sa uznapredovalim karcinomom pluća.

Prikaz slučaja: Prikazujemo sveobuhvatan pregled literature i detaljnu analizu slučaja pacijenta starog 57 godina sa metastatskim skvamocelularnim karcinomom pluća koji je razvio pneumoperikardijum. Klinička prezentacija pacijenta, dijagnostički izazovi i strategije lečenja su dokumentovani i upoređeni sa sličnim slučajevima iz literature. Kod našeg pacijenta su prisutni kašalj i dispneja, a kasniji snimci su otkrili pneumoperikardijum, verovatno usled invazije tumora u perikardijalni prostor. Lečenje je uključivalo konzervativne mere sa antibioticima i praćenjem. Pregled literature je pokazao da se strategije lečenja pneumoperikardijuma razlikuju u zavisnosti od hemodinamske stabilnosti pacijenta, varirajući od konzervativnog lečenja do invazivnih procedura. Recidiv je čest, a preživljavanje nakon dijagnoze je veoma varijabilno.

Zaključak: Pneumoperikardijum kod pacijenata sa rakom zahteva prilagođen pristup lečenju, a multidisciplinarni tim je ključan za optimizaciju ishoda pacijenata. Ovaj slučaj naglašava potrebu za povećanom svesti i brzim, personalizovanim planovima lečenja za efikasno upravljanje ovakvim složenim stanjima.

Ključne reči: pneumoperikardijum, karcinom pluća, perikardiocenteza.

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