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## Case Report

# The great invasion, a case of lung mass invading the heart through the pulmonary veins <sup>☆</sup>

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## ARTICLE INFO

## Article history:

Received 2 June 2022

Revised 7 June 2022

Accepted 8 June 2022

## Keywords:

Cardiac

Lung cancer

Metastasis

Hematogenous spread

Lymphatic spread

## ABSTRACT

The heart is a rare site of metastatic lesions of malignancies. Cardiac metastasis may go unrecognized till autopsy, and about half of all newly diagnosed lung cancer patients have metastasis to another organ. Due to the absence of early symptoms, the clinical diagnosis of cardiac metastasis is challenging. Even when they are symptomatic, these symptoms may be masked by the clinical features of primary cancer. Noncardiac neoplasms may spread to the heart through lymphatic or hematogenous dissemination, local extension, or a transvenous route. Here, we report a case of a 56-year-old male with lung mass extending from the right upper lobe to the left atrium was associated with mass effect on superior vena cava and left brachiocephalic vein.

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## Introduction

Metastases to the heart are more frequent than primary cardiac neoplasms and are associated with a poor prognosis [1]. Tumors most likely to involve the heart include lung and breast cancers, melanoma, and lymphoma [2,3]. Tumor may spread to the heart by retrograde lymphatic exten-

sion, hematogenous spread, direct contiguous extension, or transvenous extension.

Lung cancers present with the invasion of the heart in only 8%-10% of cases [4]. About 15%-35% of patients with lung cancers were found to have cardiac metastases in autopsies [5].

Cardiac metastases are usually asymptomatic, and their clinical presentations are highly variable depending mainly on the involved site. We describe a case of lung mass extending

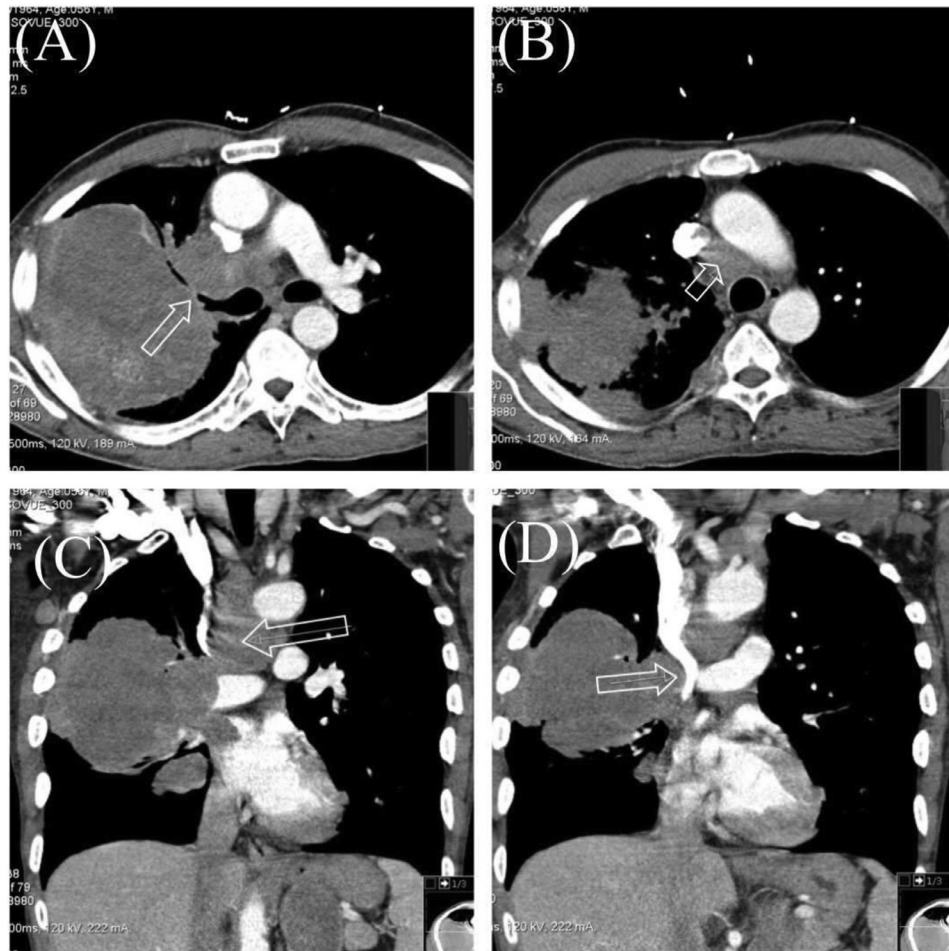
<sup>☆</sup> Competing Interests: All authors declare no conflict of interest.

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<https://doi.org/10.1016/j.radcr.2022.06.025>

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**Fig. 1 – Chest C.T. with contrast showing large mid-right lung mass extending from the right upper lobe of the lung to the left atrium (A) constriction of right bronchus with invasion of the left atrium, (B) Paratracheal lymph nodes, (C, D) SVC compression.**

from the right upper lobe to the left atrium in a 56-year-old smoker male.

### Case presentation

A 56-year-old male with a history of Hypertension, HIV and 25 pack-year of smoking presented to the Emergency Department following an episode of new-onset generalized weakness described as “loss of control over his body like diffuse paralysis” along with imbalance and inability to move his extremities. Sudden alteration of his mentation prompted his co-workers to bring him to the ED.

He denied any loss of consciousness, shaking movements, bowel or urinary incontinence. His symptoms self-resolved in the ED without any interventions. He also reported 25-pound weight loss over the last 14 months and right leg numbness for the past 6 months.

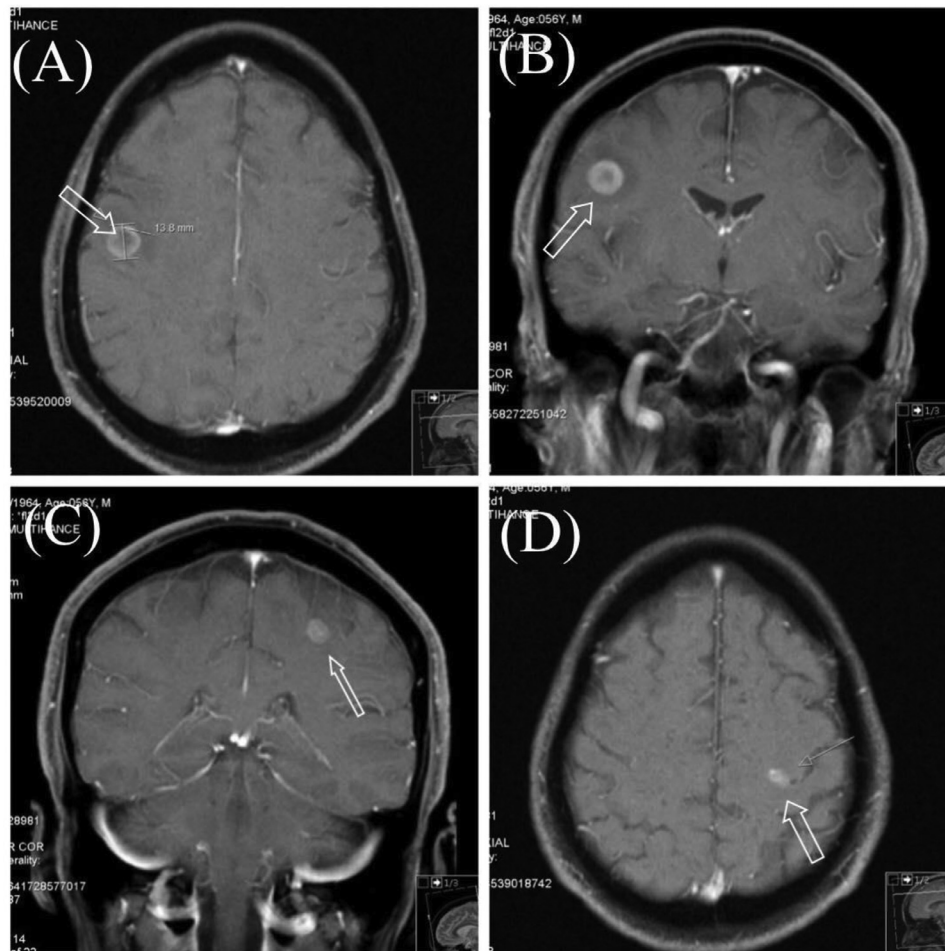
On physical examination, there was significant temporal and extremity wasting. The right lower extremity showed 4/5 power on dorsiflexion, with the rest of the neurological ex-

amination being within normal limits. Cardiac examination recorded normal S1 and S2; no murmur, rubs, or gallops were heard. Chest X-ray revealed a large mass-occupying majority of the right lung, which appeared to be contiguous with the mediastinum and right hilum.

CT chest was remarkable for large mid-right lung mass with satellite lesions to the pleura and lung parenchyma. The tumor was seen extending from the right upper lobe of the lung to the left atrium via the right superior pulmonary vein then into the right inferior pulmonary vein opening in the left atrium. There was an associated mass effect on the superior vena cava and left brachiocephalic vein either due to the tumor or lymphadenopathy (Fig. 1).

MRI of the brain was significant for 2 ring-enhancing lesions in the cortex with surrounding edema; located in the right frontal subcortical region and the left frontal cortex, respectively. These findings were highly suspicious for metastatic disease to the brain, and hence further imaging was undertaken (Fig. 2).

CT abdomen with contrast revealed large bilateral adrenal metastasis with extension into the left inferior adrenal vein continuing into the inferior renal vein. Some



**Fig. 2 – MRI of the brain showing 2 ring-enhancing lesions with surrounding edema; located in the right frontal subcortical region (A) and the left frontal cortex (B).**

shotty retroperitoneal lymphadenopathy was also noted (Fig. 3).

TEE showed a massive tumor involving the right superior pulmonary vein that extended into the left atrium inferiorly and partially obstructed the right inferior pulmonary vein. As a result, flow in the right inferior pulmonary vein was markedly diminished, but no tumor was seen in the right inferior pulmonary vein per se. The tumor had expanded the entire right superior pulmonary vein significantly (Fig. 4).

The entire mass showed characteristics of a tumor based on its features and echo density. It had areas of neovascularization with areas of necrosis and calcification. No obvious echogenicity suggestive of thrombus was noted.

While the malignancy placed the patient at a high risk of thrombotic events, obstruction of the pulmonary veins and invasion of major vessels, the brain metastasis increased the risk of bleeding as well. Prophylactic anticoagulation was initiated as no thrombus was seen per se on the TEE. A close watch for bleeding events like intracranial bleeds and hemoptysis was kept. Also, the patient was placed on neuro-vascular checks to detect any embolic events. Then, A CT-guided needle biopsy of the right lung was performed.

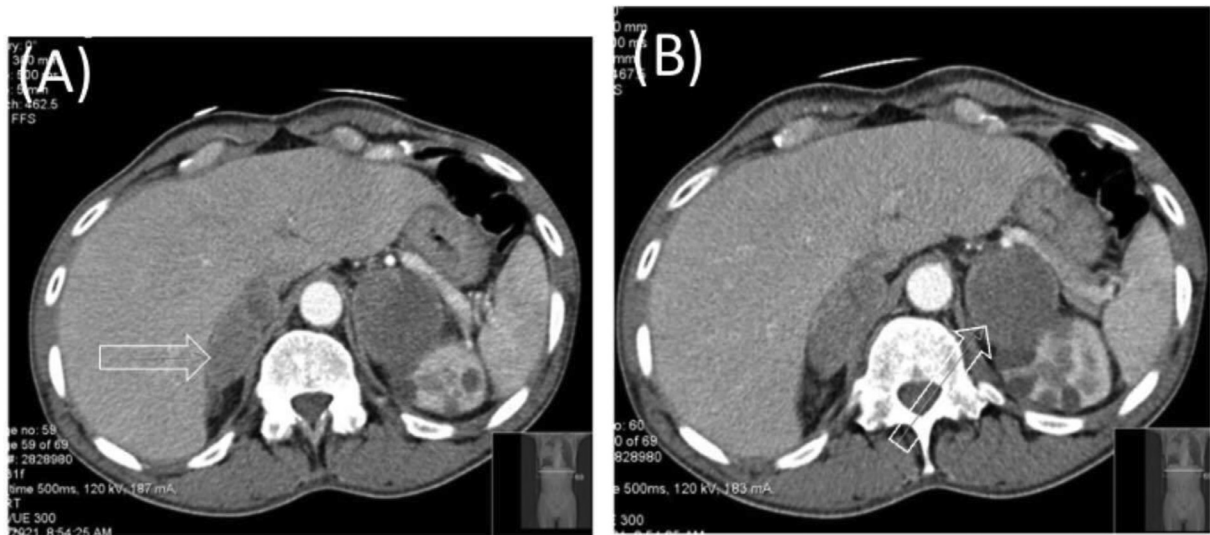
The patient was started on dexamethasone, and radiation oncology was consulted. He was scheduled for whole-brain radiation therapy in 10 days, with additional radiation therapy to the chest for the large lung mass effect. The patient did not have any new symptoms or seizure episodes and reported feeling better. He was discharged and followed up with an oncologist for chemotherapy.

## Discussion

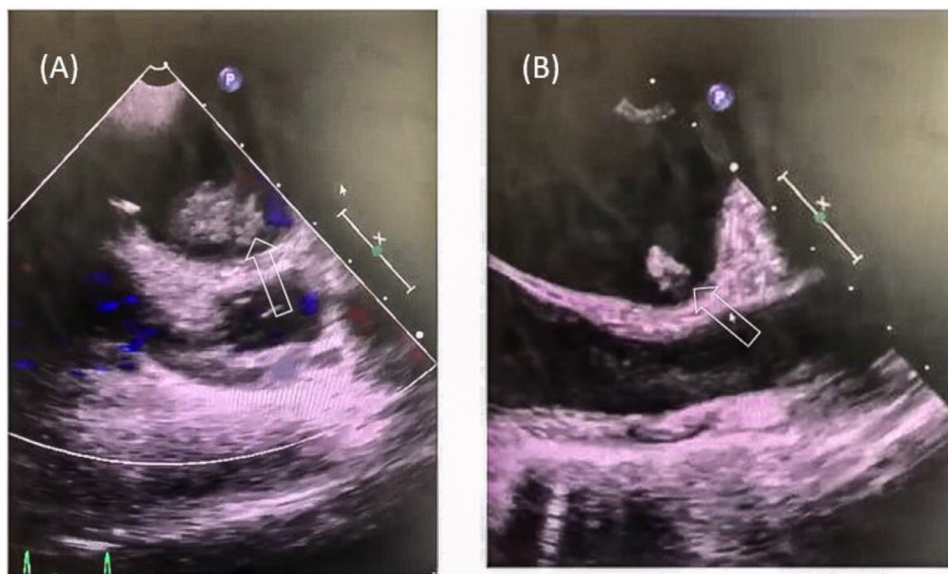
Although primary cardiac are extremely uncommon secondary tumors are not. Cardiac metastases happen in about 1.5%-21% of all malignant neoplasms, and lung cancers are the most common primary tumors associated with these metastases [6]. Metastases to the heart occur mainly in elderly adults between the ages of 60 and 80 years, and there is no gender difference in their susceptibility [7].

The primary tumor is usually lung cancer due to its prevalence and proximity to the heart [1]. Autopsy of patients with cardiac metastases reveals that the primary tumor is bronchogenic carcinoma in 36% of patients, nonsolid primary ma-





**Fig. 3 – CT abdomen with contrast showing bilateral adrenal metastasis with extension into the left inferior adrenal vein (A) Right adrenal metastasis, (B) Left adrenal metastasis, and (C) Right lung mass with bilateral adrenal metastasis.**



**Fig. 4 – TEE Bicaval view with mass invading the left atrium through one of the pulmonary veins (A, B).**

lignancies such as leukemia in 20% of patients, and breast cancers in 7% of patients [3].

In lung cancers, the histopathological subtypes affect the rate of metastases to the heart with an incidence of 26% of cases in adenocarcinoma followed by squamous cell carcinoma, undifferentiated carcinoma, and bronchoalveolar carcinoma [8]. The pericardium is the most frequent site of cardiac metastases, while myocardium involvement is less common, and the endocardium is rarely affected [9].

Malignancies can spread to the heart through multiple pathways such as lymphatic spread, direct invasion from the nearby structures, transvenous extension, and hematogenous spread [8]. Lymphatic spread often leads to pericardial involvement, while hematogenous spread usually affects the my-

ocardium [6]. Tumors can spread to the left atrium through the pulmonary veins and the right atrium through the superior and the inferior vena cava [8]. In our patient, the lung mass extended from the right upper lobe to the left atrium. It was also associated with a mass effect on the superior vena cava and left brachiocephalic vein.

In most cases, cardiac metastases are asymptomatic and diagnosed only after death [10]. In some cases, they may be the early or the only presentation of an underlying undiagnosed neoplasm. The clinical presentation is highly variable and depends on the site, the tumor's size, and the extent of the invasion of adjacent structures. Clinical manifestations can be due to external compression, direct invasion, or intramural obstruction, leading to pericardial effusion, arrhythmias, com-

pression of the cardiac chambers, obstruction of the outflow tracts, and interference with the valvular function or coronary flow through obstruction or embolization. Intracardiac metastasis may cause clinical presentations of right-sided failure such as peripheral edema or left-sided heart failure such as orthopnea [8].

There has been an increase in the incidental detection of cardiac metastasis because of the widespread use of advanced imaging modalities. Echocardiography is a valuable tool for detecting cardiac metastasis, and transesophageal echo is better in the visualization of the atria than transthoracic echo [10]. CT and MRI are also helpful in the evaluation of metastasis. They give a better idea about the location, extent, morphological characteristics, and local extension. They can also help in the differentiation between tumor and thrombus by using contrast [1].

Metastases to the heart often occur in advanced cancers, particularly lung cancers. Treatment of cardiac invasion is usually palliative with chemo- or radiotherapy. These metastases are usually masked by the symptoms of primary cancer, which usually gets the main focus [6]. Cardiac metastasis generally carries a poor prognosis and reflects the extensive spread of the primary neoplasm.

## Conclusion

Cardiac metastases often develop late in the course of advanced malignancies, and the patients usually have metastases at other sites at the time of the diagnosis. Cardiac metastases can be the first presentation of undiagnosed primary cancer and can also be overlooked by the clinical features of diagnosed one. Given the proximity of the lung cancers to the heart and their prevalence, cardiac metastases originating from these neoplasms are more often. These metastases will be detected more frequently with the availability and widespread utilization of advanced imaging modalities.

## Competing interests

In terms of our authors, we certify to take all public responsibility for the contents, and all the authors have contributed substantially to the drafting and have approved the final version. None of the authors has any conflicts of interest with the contents. All of the authors attest that all applicable subject protection guidelines and regulations were followed in the conduct of this research. The work has not been published and is not under consideration elsewhere and does not duplicate

or overlap other published work. No portion of the text has been copied from other material in the literature.

## Author contributions

S.R and H.F are responsible for creation, editing and writing of manuscript including submission. A.R, S.A, M.B are responsible for image acquisition, editing and writing of manuscript. M.N and J.M are responsible for final editing, proof reading and revision of manuscript.

## Patient consent

As this is a case report, informed consent for publication has been obtained from the patient.

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