Scientific Research Publishing

Yangtze Medicine, 2025, 9(2), 125-130
https://www.scirp.org/journal/ym
ISSN Online: 2475-7349
ISSN Print: 2475-7330

Ultrasound Revealed Right Atrial Tumor Thrombus in a Patient with Superior Vena Cava Syndrome: A Case Report

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How to cite this paper: Chen, H.L. and Xu, W. (2025) Ultrasound Revealed Right Atrial Tumor Thrombus in a Patient with Superior Vena Cava Syndrome: A Case Report. *Yangtze Medicine*, **9**, 125-130.
https://doi.org/10.4236/ym.2025.92010

Received: May 31, 2025
Accepted: June 22, 2025
Published: June 25, 2025

Abstract

Objective: To evaluate the clinical utility of ultrasonography in diagnosing right atrial tumor thrombus among a patient with superior vena cava syndrome (SVCS). Case presentation: A 73-year-old male with small cell lung cancer presented with facial edema 10 days after chemotherapy. Contrast-enhanced Computed Tomography (CT) revealed lung cancer with lymph node metastases, invasion of the superior vena cava, and right pulmonary artery. Ultrasound revealed stenosis of the superior vena cava with sluggish blood flow, showing a tumor thrombus extending into the right atrium. Conclusion: This case highlights ultrasound's critical role as a tool for SVCS evaluation, particularly in detecting intracardiac involvement and quantifying hemodynamic severity, enabling timely intervention to mitigate life-threatening complications.

Keywords

Ultrasound, Superior Vena Cava Syndrome, Right Atrial Tumor Thrombus

1. Introduction

Superior vena cava syndrome (SVCS) is commonly caused by lung cancer in about 80% of cases and is a common clinical emergency in malignant tumors. Its main manifestations include facial swelling, dyspnea and the opening of collateral circulation [1]-[3]. Due to the strong invasiveness of the tumor, it may directly invade the blood vessels or form tumor thrombus. If a tumor thrombus detaches and enters the right atrium, it can cause pulmonary embolism, posing a life-

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threatening risk. Currently, contrast-enhanced Computed Tomography (CT) is the preferred imaging modality for the assessment of SVCS, but its detection of intracardiac masses is limited by motion artifacts [4]. Ultrasound, however, enables dynamic observation of vascular lesions, hemodynamics and intracardiac structures, offering distinct advantages for rapid bedside screening. This article reports a case of small cell lung cancer complicated with SVCS and right atrial tumor thrombus, focusing on the value of ultrasound in diagnosis and providing reference for clinical practice.

2. Case Presentation

A 73-year-old male presented with hemoptysis in May 2024.Bronchoscopic biopsy at a local hospital confirmed small cell carcinoma of the right upper lobe (immunohistochemistry: CD56+, TTF-1+, Syn+, Ki-67 approximately 80%). He received IP chemotherapy and achieved partial remission. Ten days ago, he was transferred to our hospital due to facial edema, and superior vena cava syndrome was clinically suspected. A re-examination of contrast-enhanced CT at our hospital revealed: lung cancer with multiple lymph node metastases; superior vena cava and right pulmonary artery invasion (**Figure 1** and **Figure 2**). Superior vena cava ultrasound showed: the superior vena cava wall was smooth, with a diameter of approximately 19 mm in the distal segment and 5 mm in the proximal segment, a hypoechoic mass of about 42*24 mm was seen beside it, with an unclear boundary from the superior vena cava (**Figure 3**); The blood flow in the lumen was slow (with a velocity of 13 cm/s); a hypoechoic mass of about 44*20 mm was seen extending from the superior vena cava to the right atrium (**Figure 4**), showing slight swinging. Ultrasound Suggestion: proximal stenosis of the superior vena cava (compression); hypoechoic masses in the superior vena cava and right atrium - metastasis of lung cancer? Given the patient's concomitant superior vena cava syndrome, his treating doctor initiated hormone therapy and supportive care. Eight days later, the facial edema showed significant improvement, but the patient declined further treatment and requested discharge.

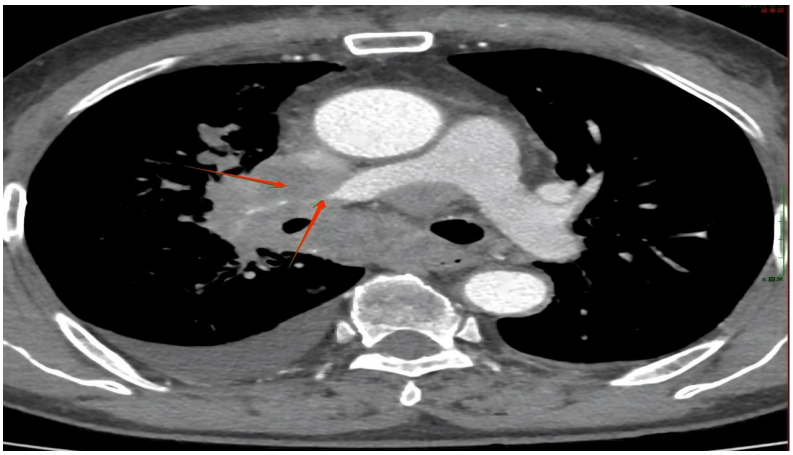

Figure 1. Tumor invasion of the right pulmonary artery.

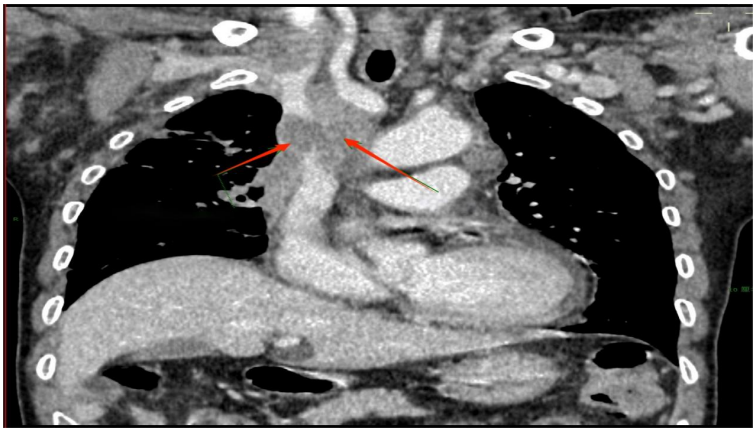

Figure 2. Tumor invasion of the superior vena cava.

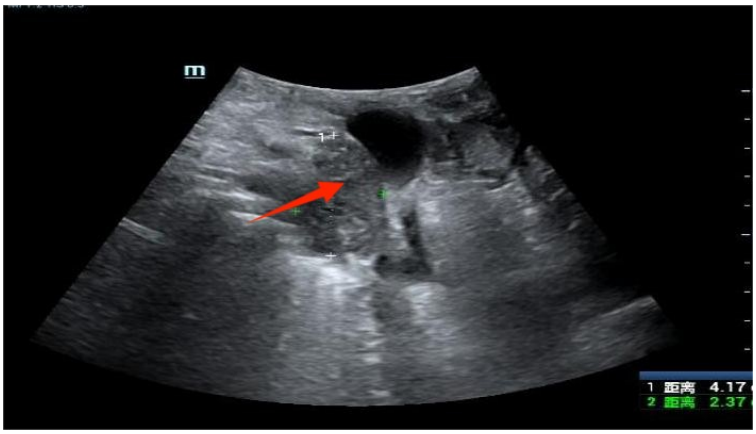

Figure 3. Hypoechoic mass abutting the superior vena cava.

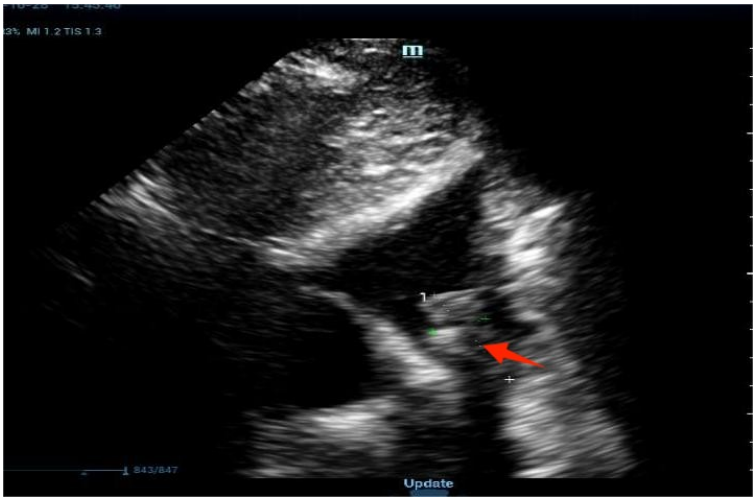

Figure 4. Tumor invasion of the right atrium.

3. Discussion

SVCS is a clinical emergency caused by compression and obstruction of the superior vena cava, resulting in impaired venous return from the upper body. It is

common in patients with malignancies, among which lung cancer -particular small cell lung cancer-is the predominant malignant cause [5]. Small cell lung cancer has strong invasiveness and a high early metastasis rate, and it is prone to involve the mediastinal structures through direct invasion or lymphatic metastasis. In this case, the patient's KI-67 index reached 80%, indicating intense tumor proliferative activity strongly associated with rapid SVCS progression.

The function of the superior vena cava is to return the blood from the head, neck, upper limbs, and trunk to the heart. When the return flow is blocked, it will lead to an increase in the venous pressure of the upper body, thus presenting a series of clinical symptoms. The most common features and symptoms include facial or neck swelling, upper limb swelling, dyspnea, cough and the dilation of collateral veins on the chest wall [6]. If combined with a thrombus or tumor embolus in the right atrium, it may further trigger a pulmonary embolism, endangering life.

For cancer patients with suspected SVCS, commonly used imaging examination methods in clinical practice include contrast-enhanced CT, Magnetic Resonance Imaging (MRI), and ultrasonography. The high spatial resolution of contrast-enhanced CT can clearly show the compression range of the tumor and the surrounding invasion situation. MRI is radiation-free and has high soft tissue contrast, enabling multi-planar evaluation of the tumor infiltration degree. However, neither contrast-enhanced CT nor MRI can dynamically observe the lesion. When the lesion invades blood vessels, it is also impossible to obtain hemodynamic parameters. In contrast, ultrasonography provides distinct advantages: it is not only convenient, fast, and inexpensive, but also can dynamically observe the lesion in blood vessels, non-invasively evaluate its relationship with the vessel wall, the patency of blood vessels, and hemodynamic parameters. Moreover, ultrasound can be used as a rapid bedside screening tool, which can shorten the diagnosis time and has significant advantages for the emergency evaluation of SCVC. In addition, the diagnostic rate of ultrasound for right atrial masses is higher than that of contrast-enhanced CT [7]. It can dynamically track the superior vena cava to the right atrium. When the tumor invades the right atrium, it can be detected in a timely manner.

It is not common for lung cancer patients to present with SVCS and concurrent right atrial tumor thrombus [8]. However, when a lesion is detected in the superior vena cava, the possibility of a right atrial tumor thrombus should be alerted. In this case, based on the patient's clinical manifestations, contrast-enhanced CT, and ultrasound examination results, the diagnosis of SVCS was confirmed. However, the contrast-enhanced CT of this patient did not detect the tumor thrombus in the right atrium. The possible reason is that the rapid movement of the heart produced motion artifacts, which blurred or masked the low-density tumor thrombus in the right atrium. At this time, ultrasound examination is particularly important. It not only supplements the undetected right atrial tumor thrombus by contrast-enhanced CT but also can clarify its size, shape, relationship with the

heart wall, and movement pattern, providing decision-making support for clinical practice. In addition, it can quantify the severity of the condition through kinetic parameters such as the flow velocity and spectral shape of the stenotic segment, providing key data for selecting the diameter of the intravascular stent, and is superior to other invasive examinations.

4. Conclusions

This case illustrates the clinical presentation of small cell lung cancer complicated by SVCS and right atrial tumor thrombus. While contrast-enhanced CT clearly delineated the tumor invasion of blood vessels, it failed to detect the right atrial tumor thrombus due to cardiac motion artifacts interference. In contrast, dynamic ultrasound imaging distinctly visualized the tumor thrombus extending from the superior vena cava into the right atrium and quantitatively assessed blood flow velocity at the stenotic segment. These findings underscore the complementary diagnostic value of ultrasonography to CT, offering significant guidance for clinical management.

Consequently, for patients with SVCS, particularly those at risk of cardiac involvement, ultrasonography is recommended as an essential complementary modality to CT. Such an approach facilitates early and precise intervention, thereby improving patient prognosis.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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