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# Dislodged Endovascular Heat-Induced Thrombus Resulting in Pulmonary Embolus Following Post-Operative Ultrasound Compression

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# Dislodged Endovascular Heat-Induced Thrombus Resulting in Pulmonary Embolus Following Post-Operative Ultrasound Compression

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## Introduction

Venous insufficiency and consequent varicose veins are common problems faced by many patients. Incessant pain, discomfort, and swelling of the lower extremities are a few of the symptoms that motivate patients to seek treatment<sup>1</sup>. Management modalities for symptomatic venous insufficiency range from conservative therapies including leg elevation and compression to open surgical approaches such as saphenous vein stripping and ligation<sup>2</sup>. Minimally invasive procedure options have been introduced and have been widely used as an alternative to the open surgical approach. Radiofrequency ablation (RFA) is among the minimally invasive and now widely used interventions<sup>3,4,15,19</sup>. RFA utilizes electromagnetic energy delivered to the venous wall causing vessel spasm and collagen contraction followed by fibrotic sealing of the vessel lumen<sup>4,10,11,21</sup>. RFA, since its development in the late 90s, has quickly become one of the most popular surgical treatments for venous insufficiency due to its excellent postoperative outcomes and minimal varicose vein recurrence<sup>11,12</sup>. The favorable outcomes of RFA have allowed it to overshadow the traditional forms of surgical chronic venous insufficiency modalities as discussed in a large-scale prospective randomized clinical trial EVOLVeS (endovenous radiofrequency obliteration (closure procedure) versus ligation and stripping) carried out by Lurie et al in 2003<sup>12,14</sup>. In comparison to the operative stripping and high ligation group, the RFA group had fewer overall postoperative complications including less echymosis and hematoma<sup>4,15,19</sup>, and quicker return to normal activity with preserved efficacy<sup>6</sup>. In the 2-year follow-up, there was a non-statistically significant difference in the recurrence rate of 14% in the RFA group as opposed to 21% of the stripping and ligation group<sup>12,14</sup>. Quality of life scores also seemed to favor the RFA group at the 2-year follow-up<sup>12,14</sup>. Several other studies, most notably a meta-analysis by Leubke et al, 2008, support RFA over the traditional stripping and high ligation<sup>23</sup>. Endovascular Heat Induced Thrombosis (EHIT) is a rarely encountered complication of RFA<sup>1</sup>. EHIT occurs secondary to induced vascular injury with the formation of deep vein thrombus (DVT) originating from the ablated superficial vein. A meta-analysis by Healy et al. reviewed fifty-two studies and 16,398 patients who underwent an endovascular thermal ablation. They noted that EHIT type 2-4 occurred in 1.4% of the participants<sup>5</sup>. Further complications arising from EHIT have rarely been reported in the literature. One such case report was published by Sufian et al. In 2011 discussing the theoretical possibility of DVT dislodgement causing pulmonary embolism (PE)<sup>18</sup>.

## Case Report

RC is a 48-year-old male that presented to the outpatient office with concerns for painful varicose veins with previous episodes of superficial thrombophlebitis in his right lower extremity classified as Clinical Etiologic Anatomic Pathophysiologic classification (CEAP) 4a. He was evaluated with bilateral venous insufficiency ultrasounds (US) which showed mid great saphenous vein (GSV) above knee with 13mm in depth, 10mm in diameter, 3.6 second of reflux time, peripheral GSV 12.5mm/12mm/2s, central GSV below knee 9mm/8mm/4.8s, mid GSV below knee 9mm/5mm/4.3s with a stable nonocclusive chronic thrombus in the R GSV above the knee. Given these US findings and failed conservative management, the patient wished to pursue further surgical intervention. The patient underwent a right GSV RFA of 48.5cm total length over 10 cycles. The procedure was divided into distal and proximal approach placing two different sheaths to avoid the chronic GSV thrombus just proximal to the right knee as previously noted in preoperative US. On post operative day three, the patient presented to an outpatient medical imaging center for a follow up venous duplex US evaluation. Upon US imaging of the right GSV, a thrombus was identified in the proximal GSV protruding into the sapheno-femoral junction (SFJ). The thrombus was measured at 1.83cm in length and color doppler was used to confirm its presence in the proximal GSV (Figure 1). To further confirm the presence of thrombus in the vein, the US technician compressed the area of thrombus and noticed the incomplete collapsibility of the vein, thus corroborating the first assessment. Unfortunately, upon releasing the compressive force, the US technician visualized the thrombus release and embolize upstream towards the common femoral vein (CFV) (Figure 2). The findings were relayed to the vascular surgery team immediately and the patient was advised to be admitted for observation. The patient at the time of admission was stable hemodynamically. He endorsed mild pain in the right lower extremity as expected from recent intervention, however, he denied any chest pain, shortness of breath, or other symptoms relating to PE. Subsequent chest computed tomography angiography (CTA) was performed which showed an acute thromboembolism in the right lower subsegmental branch (Figure 3) with no evidence of acute right heart strain. Computed Tomography (CT) venogram was negative for any iliac or caval thrombus. Heparin drip was initiated upon admission. The patient remained asymptomatic and stable throughout the observation and was promptly discharged on apixaban therapy. During the subsequent follow up appointments at 1-month and 2-month interval, the patient remained stable and asymptomatic from the pulmonary embolism. At the 2-month mark, the patient completed a repeat CTA of chest which demonstrated interval resolution of the pulmonary embolism.

## Abstract

**Introduction:** Venous insufficiency and consequent varicose veins are common problems faced by many patients. Fortunately, there are many treatment options available including a minimally invasive method known as Radiofrequency ablation (RFA). RFA is not without complications; amongst those are endovascular heat induced thrombosis (EHIT). This rare complication is typically managed conservatively, however, in rare occasions, the thrombus can detach and embolize causing further issues for patients. **Case Description:** A 48-year-old male underwent an uneventful RFA procedure for a CEAP 4a venous insufficiency. On the post-operative ultrasound venous duplex evaluation, the patient was found to have EHIT type 2 in the right greater saphenous vein extending to the sapheno-femoral junction. During compression and release of the ultrasound probe by the ultrasound technician, the thrombus detached from the venous wall and embolized to a right lung subsegmental branch. **Discussion:** This case report focuses on the possibility of secondary sequela that may arise from EHIT affecting other organ systems from the RFA procedure, the classification system of EHIT, and management options.

## Discussion

EHIT is a known and rare complication of the commonly performed procedure, RFA. EHIT is a thrombus extension from the superficial vein into the deep venous system, which may require treatment with chemical anticoagulation or mechanical thrombectomy<sup>14,17,21</sup>. First introduced by Lurie et al in 2005, the occurrence of EHIT following RFA of chronic venous insufficiency remains a low frequency complication<sup>12</sup>. EHIT was initially classified into four distinct categories by Kabnick et al depending on the degree of thrombus extension into the deep venous system<sup>8</sup>. Another classification system was proposed by Lawrence et al, and the most recent classification system, proposed by the American Venous Forum, incorporates elements of the Kabnick and Lawrence classification systems<sup>2,8</sup>.

### Class Definition

- I Thrombus without propagation into the deep vein
  - a. Peripheral to superficial epigastric vein
  - b. Central to superficial epigastric vein, up to and including the deep vein junction
- II Thrombus propagation into the adjacent deep vein but comprising <50% of the deep vein lumen
- III Thrombus propagation into the adjacent deep vein but comprising; >50% of the deep vein lumen
- IV Occlusive deep vein thrombus contiguous with the treated superficial vein

Risk factors that contribute to the development of EHIT have not been well elucidated. Several studies suggest that a large diameter of the GSV near the SFJ may contribute to increased frequency of thrombus formation and extension<sup>9</sup>. However there have been additional studies which dispute this proposal<sup>14</sup>. Many other factors have been identified in small scale studies that may increase the risk of developing EHIT including demographics and CEAP score which did not seem to play a role in patients who underwent RFA treatment<sup>6,17,21</sup>. However, these studies have not been fully validated, and the consensus remains unclear. Additionally, there is a question of whether routine post-operative ultrasound surveillance is warranted, as the risk of complications due to EHIT are rare and EHIT tends to resolve without intervention over time<sup>3,16,22</sup>. There is agreement that earlier identification of EHIT is recommended to minimize the risk of further sequela<sup>9</sup>. To date, our study is the second case report in the literature describing EHIT leading to pulmonary thromboembolism event. Treatments and management for different classes of EHIT have yet to be standardized<sup>2,10</sup>. Currently, the management guidelines recommend a graded treatment approach based on the AVF EHIT classification by the American Venous Forum and Society for Vascular Surgery<sup>8</sup>. Observation is recommended for EHIT type 1. In the event of AVF EHIT II, which is described in this case report, weekly surveillance +/- chemical treatment in patients with increased risk is suggested albeit controversial. For EHIT type 3 and 4, anticoagulation therapy is generally recommended<sup>8</sup>. Moreso, the management of pulmonary thromboembolism related to EHIT formation has not been well studied, and whether long-term anticoagulation is indicated for these patients remains unclear. Given the finding at the time of the post-operative duplex US of this case report, the US technician attempted to validate by compression<sup>3</sup> of the vein containing the thrombus which resulted in the dislodgement of the thrombus and consequent pulmonary emboli. Though a comprehensive assessment and management protocol for the identification and treatment of EHIT has yet to be fully elucidated, further attempt at studying to create a more comprehensive standardized EHIT protocol may be beneficial.

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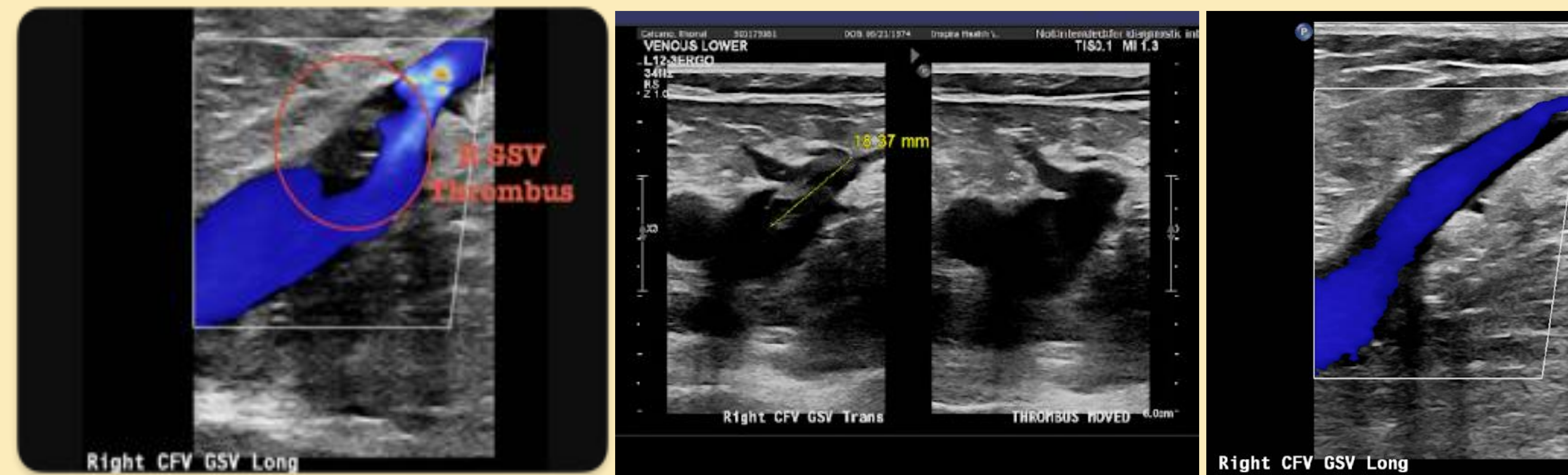


Figure 1. US venous duplex showing the presence of thrombus in R proximal GSV with color doppler (Left) and measurement (Right).

Figure 2. US venous duplex of R CFV GSV demonstrating a vacant site of previously seen thrombus (Left) and with color doppler (Right).

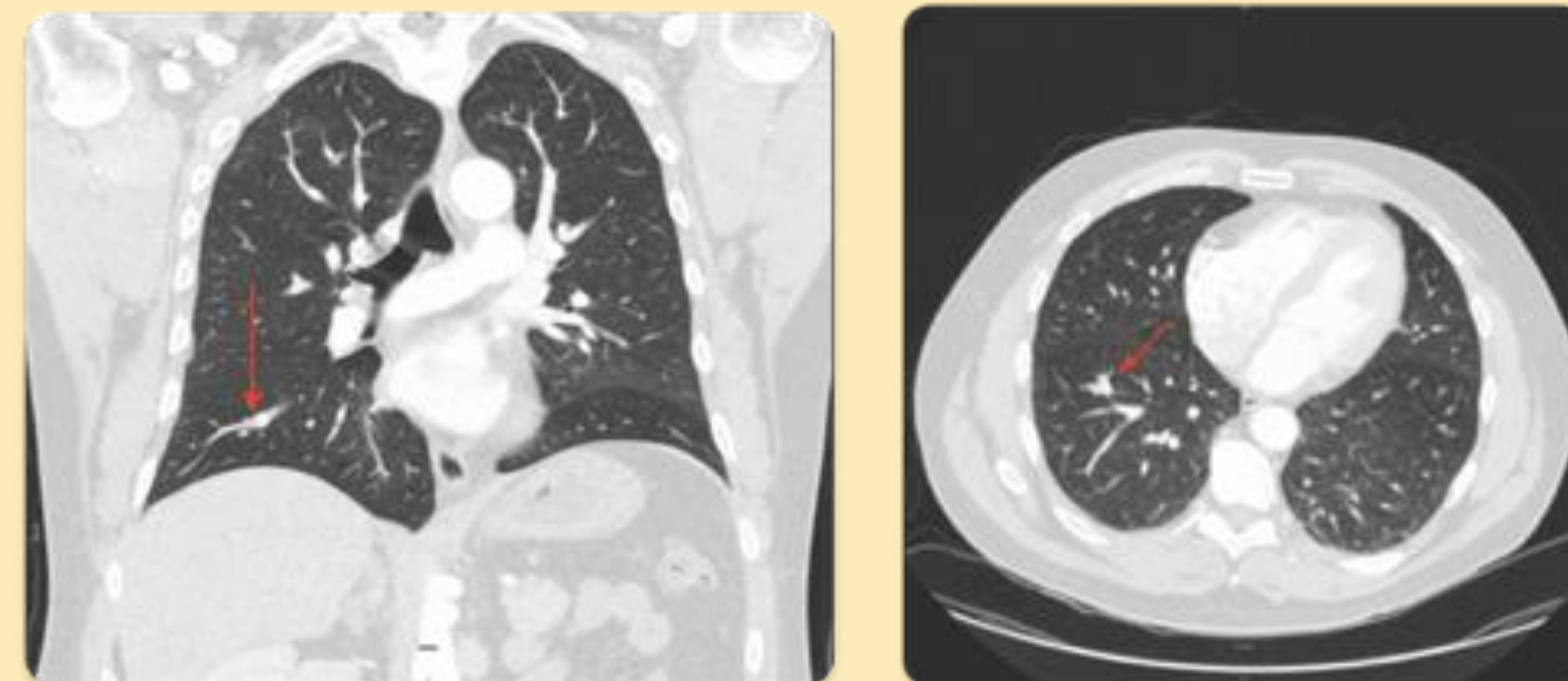


Figure 3. Computed tomography angiography of the chest with acute thromboembolism in right sub-segmental branch (left - coronal, right - axial).