# Mycotic (Infected) Pseudoaneurysm, a Diagnostic Challenge – Case Series

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## ABSTRACT

Mycotic pseudoaneurysm (or infected pseudoaneurysm) is an infectious arteritis, leading to the destruction of the arterial wall with the formation of a blind, saccular outpouching contiguous with the arterial lumen. Delayed management or non-management of mycotic pseudoaneurysms is associated with high morbidity and mortality due to complications such as arterial rupture, hemorrhage, and fulminant sepsis. Earlier diagnosis of mycotic pseudoaneurysm is essential for time management. Multidetector computed tomography (MDCT) is a widely used imaging modality for detecting the mycotic pseudoaneurysm, its characterization, and vascular mapping. MDCT findings of mycotic pseudoaneurysm are blind, saccular outpouching of an artery with irregular arterial wall, perivascular soft-tissue mass, or edema. Uncommon results of MDCT include arterial lumen thrombosis, arterial wall calcification, and perivascular gas. Management of mycotic pseudoaneurysm includes endovascular stenting with graft repair, endovascular embolization, open surgery, medical therapy (intravenous antibiotics), or a combination of these. We report three cases of mycotic pseudoaneurysm affecting aortic isthmus, a segmental branch of the pulmonary artery, and the internal mammary artery. All cases posed a diagnostic challenge, which only on subsequent imaging revealed to be a mycotic pseudoaneurysm.

**Keywords:** Mycotic pseudoaneurysm, Aortic isthmus, Pulmonary artery, Internal mammary artery, Infection, *Staphylococcus aureus*, Salmonella, Streptococci, *Escherichia coli*, Multidetector computed tomography, Thoracic aortography, Pulmonary arteriography, and Volume rendered

## INTRODUCTION

Aneurysms are true aneurysms and false aneurysms (pseudoaneurysms). True aneurysms contain all three layers of the aortic wall (intima, media, and adventitia). In contrast, pseudoaneurysms have less than three layers by the adventitia or peri-adventitial tissues. Pseudoaneurysms are vascular abnormalities that lack a complete arterial wall.[1]

Pseudoaneurysms arise from a disruption in the arterial wall, allowing blood to dissect into the tissues, creating a perfused sac around the damaged artery contiguous with the arterial lumen. The perfused sac around the damaged artery is either contained by the media, adventitia, or by the soft-tissue structures surrounding the injured vessel.[2] The frequency of involvement of arteries include aorta, peripheral arteries, cerebral arteries, and visceral arteries.

## CASE REPORT

### Case 1

A 46-year-old male came to the medical department with complaints of chest pain for 1 month. There was no evidence of fever, weight loss, and hemoptysis, not a known case of diabetes and hypertension. Routine blood investigations were done, which showed high white blood cell (WBC) counts – 19,300/ml and high erythrocyte sedimentation rate (ESR) level – 84 mm/h.

On admission, an initial chest radiograph showed a homogenous radio-opacity in the left upper zone. The radio-opacity is broad based toward the superior mediastinum with a widening of the same [Figure 1].

Multidetector computed tomography (MDCT) thoracic aortography was done, which showed focally intense enhancing saccular outpouching in the inferolateral wall of aortic isthmus, mushroom shaped [Figure 2a-c] and presented just distal to the origin of the left subclavian artery [Figure 2a-c]. This measures ~46 × 27 × 42 mm (AP × TR × CC) and 14 mm (neck) with prominent periaortic hypoattenuating inflammatory soft tissue causing a subsegmental passive collapse of the left upper lobe [Figure 2a-c].

MDCT thoracic aortography – three-dimensional (3D) volume rendered (VR) images (axial, sagittal and coronal) shows focal saccular outpouching (pseudoaneurysm) in the inferolateral wall of aortic isthmus, just distal to origin of the left subclavian artery [Figure 3a-c].

Few para-aortic necrotic lymph nodes were seen; the largest of these measures 17 × 11 mm in station 6 [Figure 4a]. Few



**Figure 2:** (a-c) A 46-year-old male presented with chest pain for 1 month. Multidetector computed tomography thoracic aortography (axial, sagittal, and coronal sections in mediastinal window) shows focal intense enhancing saccular outpouching (pseudoaneurysm) in the inferolateral wall of aortic isthmus, mushroom shaped (*) just distal to origin of the left subclavian artery (small white arrow) with periaortic hypoattenuating prominent inflammatory soft tissue (large white arrow) causing subsegmental passive collapse of the left upper lobe (white arrowhead).
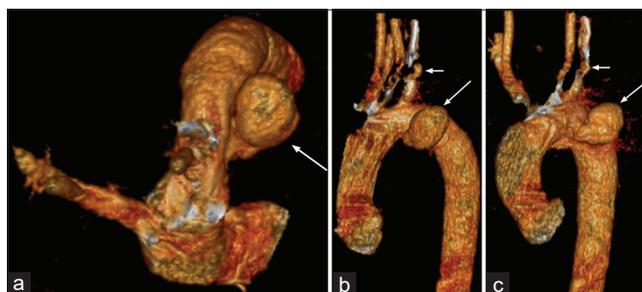


**Figure 3:** (a) A 46-year-old male presented with chest pain for 1 month. Multidetector computed tomography (MDCT) thoracic aortography – three-dimensional (3D) volume rendered (VR) image (axial) shows focal saccular outpouching (pseudoaneurysm) in the inferolateral wall of aortic isthmus, mushroom shaped (white arrow) just distal to origin of the left subclavian artery. (b) A 46-year-old male presented with chest pain for 1 month. MDCT thoracic aortography – 3D VR image (sagittal) shows focal saccular outpouching (pseudoaneurysm) in the inferolateral wall of aortic isthmus, mushroom shaped (large white arrow) just distal to origin of the left subclavian artery (small white arrow). (c) A 46-year-old male presented with chest pain for 1 month. MDCT thoracic aortography – 3D multidetector computed tomography image (coronal) shows focal saccular outpouching (pseudoaneurysm) in the inferolateral wall of aortic isthmus, mushroom shaped (large white arrow) just distal to origin of the left subclavian artery (small white arrow).



**Figure 1:** A 46-year-old male presented with chest pain for 1 month. Frontal chest radiograph shows a homogenous radio-opacity in the left upper zone, broad based toward aortic knuckle (large white arrow) causing superior mediastinal widening.

left lower paratracheal partially necrotic lymph nodes were seen; the largest of these measures 14 × 10 mm in station 4L [Figure 4b]. Few aortopulmonary or subaortic partially necrotic lymph nodes were seen, the largest of these measures 15 × 11 mm in station 5 [Figure 4b], signifying reactive lymphadenopathy.

Sputum smear showed 15–20 pus cells, more than 25 epithelial cells, and few Gram-positive cocci in pairs and short chains groups.

These findings represent saccular pseudoaneurysm and prominent periaortic inflammatory soft tissue with suspicious mycotic etiology, and managed with a trial of intravenous antibiotics.

**Case 2**

A 75-year-old male came to the medicine outpatient department (OPD) with complaints of dyspnea, right-sided chest pain, massive hemoptysis, and fever. On examination, the patient was mildly anemic, moderately built. Pulse rate was 110 beats/min, blood pressure was 90/60 mmHg, and breath sounds were absent in the right upper zone. Routine blood investigations showed high WBC counts – 17,500/ml and high ESR level – 69 mm/h.

On admission, the initial chest radiograph showed an inhomogeneous radio-opacity involving the right lung field upper and mid zones [Figure 5].

MDCT pulmonary arteriography was done, which showed a well-defined intensely enhancing saccular outpouching measuring 1.8 × 1.5 × 1.5 cm (CC × AP × TR), arising from the feeding posterior segmental branch of the right pulmonary artery, supplying the upper lobe [Figure 6a-d]. Multiple internal vasculatures, predominantly from the upper lobe segmental branches of the pulmonary artery, are seen coursing through the lesion. Large inhomogeneous mass with extensive air bronchograms, internal reticulations,

cavitations, perifocal ground-glass opacities, and septal thickenings was seen [Figure 6b and d]. These features represent infective etiology with mycotic pseudoaneurysm of the right pulmonary artery posterior segmental branch supplying the upper lobe.



**Figure 5:** A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. Frontal chest radiograph shows a fairly defined inhomogeneous radio-opacity in the right upper and mid zones lung fields (large white arrow).
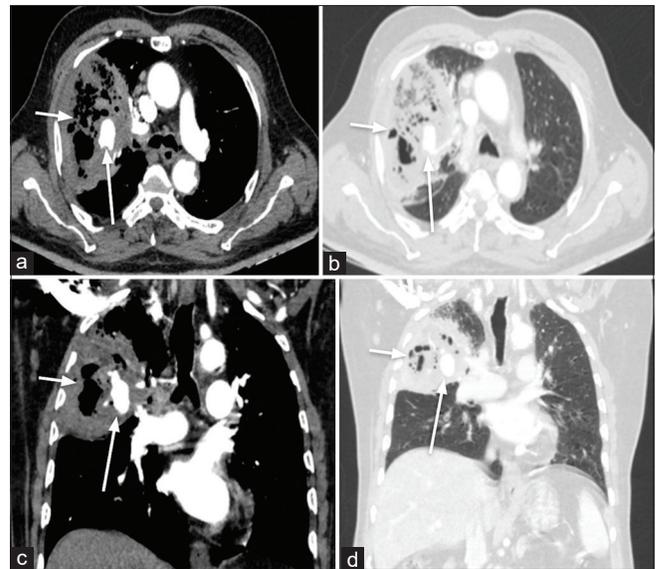


**Figure 6:** (a-d) A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. Multidetector computed tomography pulmonary arteriography (axial sections in mediastinal and lung windows) and (coronal sections in mediastinal and lung windows) shows focal intensely enhancing saccular outpouching (pseudoaneurysm) arising from the feeding posterior segmental branch of the right pulmonary artery (large white arrow) supplying the upper lobe with large inhomogeneous mass with extensive internal air bronchograms, internal reticulations, and cavitations (small white arrow).



**Figure 4:** (a and b) A 46-year-old male presented with chest pain for 1 month. Multidetector computed tomography thoracic aortography, (axial sections in mediastinal window) shows few para-aortic necrotic lymph nodes (white arrowhead), few left lower paratracheal partially necrotic lymph nodes (small white arrow), and few aortopulmonary or subaortic partially necrotic lymph nodes (large white arrow).

MDCT pulmonary arteriography – 3D volume rendered images (axial, coronal, sagittal) shows focal saccular outpouching (pseudoaneurysm) arising from the feeding posterior segmental branch of the right pulmonary artery [Figure 7a-c].

From the blood culture, *Escherichia coli* was isolated and managed with antibiotics accordingly.

Coil embolization of the pseudoaneurysm was successfully performed. Post-operative follow-up chest radiographs (immediate, 3 days later, and 4 weeks later) were taken, which showed coiling with minimal, partial, and near-complete resolution of the inhomogeneous radio-opacity, respectively [Figure 8a-c].

**Case 3**

A 43-year-old male came to the medicine OPD presented with fever, pain, and localized swelling in the right upper anterior chest wall for 1 month. Routine blood investigations showed WBC counts – 10,900/ml, and high ESR level – 54 mm/h.

The initial chest radiograph showed no significant abnormality [Figure 9].
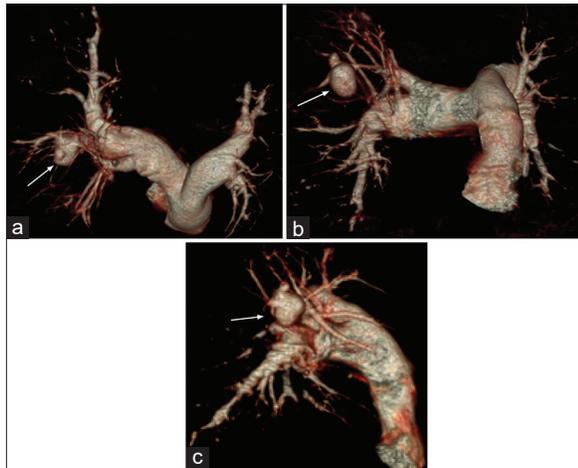


**Figure 7:** (a) A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. Multidetector computed tomography (MDCT) pulmonary arteriography – three-dimensional (3D) volume rendered (VR) image (axial) shows focal saccular outpouching (pseudoaneurysm) arising from the feeding posterior segmental branch of the right pulmonary artery (white arrow). (b) A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. MDCT pulmonary arteriography – 3D VR image (coronal) shows focal saccular outpouching (pseudoaneurysm) arising from the feeding posterior segmental branch of the right pulmonary artery (white arrow). (c) A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. MDCT pulmonary arteriography – 3D VR image (sagittal) shows focal saccular outpouching (pseudoaneurysm) arising from the feeding posterior segmental branch of the right pulmonary artery (white arrow).

Ultrasound evaluation of the right upper anterior chest wall swelling was done, which showed an ill-defined fluid collection measuring 4 × 3.5 cm in the 1st costochondral junction. Contrast-enhanced CT of the chest was advised.

Non-enhanced CT chest showed a soft-tissue density lesion/fluid collection measuring ~5.4 × 4 × 3.9 cm in the right upper anterior chest wall, epicenter in the first costochondral junction, and sternocostal joint causing bony destruction and lysis of the right costochondral junction. Contrast-enhanced CT chest showed the central non-enhancing necrotic area with faintly enhancing thin septations and peripheral faintly enhancing margin [Figure 10a-c].

Posteriorly, the fluid collection encasing the right internal mammary artery with a focal well-defined intensely enhancing saccular outpouching measuring 10 × 9 mm arising from the anterolateral wall of the right internal mammary artery. These features represent the infective collection with pseudoaneurysm of the right internal mammary artery [Figure 10a-c].

Contrast-enhanced CT chest – 3D volume rendered images (axial, coronal, sagittal) show focal saccular outpouching (pseudoaneurysm) of the right internal mammary artery [Figure 11a-c].
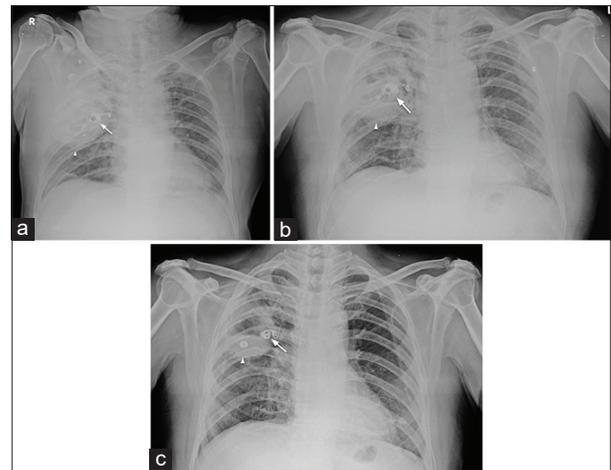


**Figure 8:** (a) A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. Immediate post-operative follow-up frontal chest radiograph shows coils filling the pseudoaneurysm sac (small white arrow) with minimal resolution of inhomogeneous radio-opacity (white arrowhead). (b) A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. Post-operative day 3 follow-up frontal chest radiograph shows coils filling the pseudoaneurysm sac (small white arrow) with partial resolution of inhomogeneous radio-opacity (white arrowhead). (c) A 75-year-old male presented with dyspnea, right-sided chest pain, massive hemoptysis, and fever. Four weeks post-operative follow-up frontal chest radiograph shows coils filling the pseudoaneurysm sac (small white arrow) with near-complete resolution of inhomogeneous radio-opacity (white arrowhead).
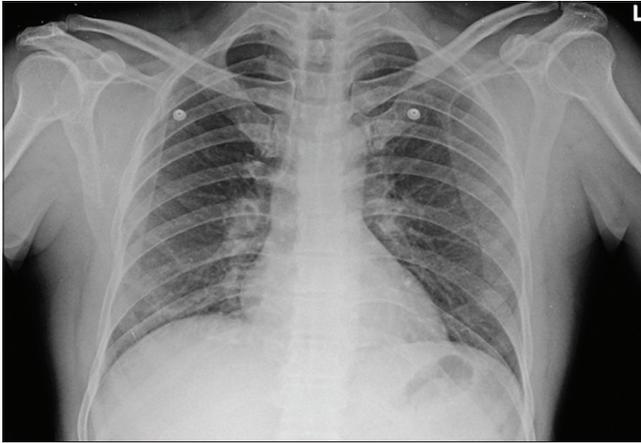
**Figure 9:** A 43-year-old male presented fever, pain, and localized swelling in the right upper anterior chest wall for 1 month. Frontal chest radiograph shows no significant abnormality.



**Figure 10:** (a-c) A 43-year-old male presented fever, pain, and localized swelling in the right upper anterior chest wall for 1 month. Contrast-enhanced computed tomography chest (axial, coronal, and sagittal sections in mediastinal window) shows a fairly defined peripherally enhancing collection in the right upper anterior chest wall epicentered in 1st costochondral junction and sternocostal joint (small white arrow). Adjacent encasement of the right internal mammary artery with pseudoaneurysm of the artery is seen (large white arrow).

Fine-needle aspiration cytology of the chest wall abscess was done, which showed plenty of inflammatory cells, Gram-positive cocci in pairs and short chains. From the blood culture, *Staphylococcus aureus* isolated and managed with antibiotics accordingly.
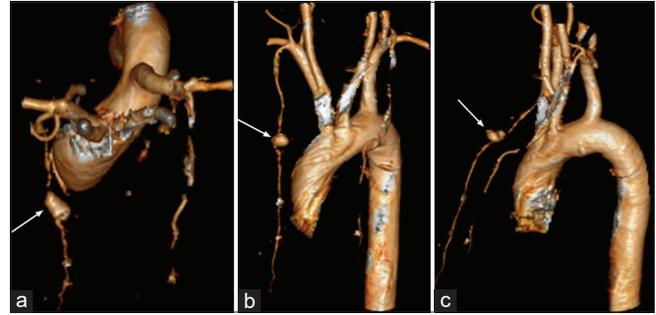


**Figure 11:** (a) A 43-year-old male presented fever, pain, and localized swelling in the right upper anterior chest wall for 1 month. Contrast-enhanced computed tomography (CT) chest – three-dimensional (3D) volume rendered (VR) image (axial) shows focal saccular outpouching (pseudoaneurysm) of the right internal mammary artery (large white arrow). (b) A 43-year-old male presented fever, pain, and localized swelling in the right upper anterior chest wall for 1 month. Contrast-enhanced CT chest – 3D VR image (coronal) shows focal saccular outpouching (pseudoaneurysm) of the right internal mammary artery (large white arrow). (c) A 43-year-old male presented fever, pain, and localized swelling in the right upper anterior chest wall for 1 month. Contrast-enhanced CT chest – 3D VR image (sagittal) shows focal saccular outpouching (pseudoaneurysm) of the right internal mammary artery (large white arrow).

## DISCUSSION

The frequency of involvement of arteries include aorta, peripheral arteries, cerebral arteries, and visceral arteries.

Mycotic (or infective) pseudoaneurysms are localized, irreversible vascular dilatations caused by the destruction of the vessel wall by an invasive organism. The term "mycotic" derives from the mushroom-like appearance of the aneurysms and not their underlying microbiological etiology.

Pseudoaneurysms are caused by trauma, inflammation, and iatrogenic (such as drainage, surgery, and percutaneous biopsy).[3] The most common cause of the pseudoaneurysms is trauma, that is, road traffic accidents or falls.[4]

Mycotic pseudoaneurysms may develop due to infection of a pre-existing aneurysm that accounts for approximately 13.3% bacterial origin.[5-7] Mycotic pseudoaneurysms develop from bacterial organisms, 55% of which belong to the Gram-positive cocci, with *S. aureus* accounting for 45% and streptococci were accounting for 10%.[8] Salmonella accounts for ~30–40%.[9]

Salmonella infections prevalent in Asian populations carry a high incidence of mycotic pseudoaneurysm formation. Fungal infections account for 1% of mycotic pseudoaneurysms and in immunocompromised individuals.[10] Common fungal species include *Candida*, *Aspergillus*, *Penicillium*, and *Histoplasma*.

The current risk factors of mycotic pseudoaneurysms are atherosclerosis,[11] increasing age.[12] Vascular anomalies, including pre-existing aneurysms, patent ductus arteriosus, or coarctation of the aorta, are also risk factors. Other risk factors include immunocompromised conditions, including fungal infections, HIV infection, malignancy, diabetes mellitus, and immunosuppressive medication.

Mycotic (or infected) pseudoaneurysms can develop from (i) hematogenous spread of infectious microemboli into the vasa vasorum of a normal caliber artery or a pre-existing aneurysm, (ii) infection of a pre-existing intimal defect by circulating infectious agent, (iii) contiguous involvement of the vessel from an adjacent source of sepsis, or (iv) direct infectious inoculation of the vessel wall at the time of vascular trauma.[13] Infectious arteritis destroys the arterial wall with subsequent contained rupture and formation of a pseudoaneurysm. Mycotic pseudoaneurysm wall consists of compressed perivascular tissue, hematoma, and fibro-inflammatory tissue.

The early clinical presentations of mycotic (or infected) pseudoaneurysms are febrile illness with insidious onset, general malaise, and weight loss. Mycotic (or infected) pseudoaneurysms late clinical manifestations are profound septicemia or with consequences of rapid aneurysm expansion, rupture,[8] and life-threatening bleeding. Blood investigations show elevated peripheral blood leukocyte count (neutrophilia in 65–83%), elevated ESR, and elevated C-reactive protein.[8]

Thoracic aortic mycotic pseudoaneurysms manifest as chest and interscapular pain. Abdominal aortic mycotic pseudoaneurysms usually manifest as abdominal pain with or without a pulsatile mass.[14] Peripheral mycotic pseudoaneurysms may manifest as pain, pulsatile mass, palpable thrill, local inflammatory changes (cellulitis or abscess), vascular compromise (distal embolization, thrombophlebitis, or arteriovenous fistula), or compressive neuropathy.[15]

Intracranial mycotic pseudoaneurysms can cause headaches, seizures, or focal neurologic symptoms, but many are asymptomatic until aneurysm rupture and bleeding occur.[16] Most visceral mycotic aneurysms involve the hepatic artery, splenic artery, superior mesenteric artery,[17] and renal artery.[18]

Aortic mycotic pseudoaneurysms have 63–100% mortality.[19] Intracranial mycotic pseudoaneurysms have 60–90% mortality.[20] Peripheral mycotic pseudoaneurysms have 0–15% mortality.[15] An optimal outcome in the management of infected pseudoaneurysms depends on the prompt diagnosis.

MDCT angiography is the current imaging modality of choice to evaluate suspected mycotic pseudoaneurysms.[21] MDCT is necessary to establish the diagnosis, localize, characterize, assess the number, and detect complications, vascular mapping, and treatment planning. Its advantages include rapid examination time of a large volume, high-resolution angiograms with three-dimensional reconstruction of vascular anatomy for surgical or endovascular treatment planning.

Magnetic resonance imaging is useful in a few isolated cases of mycotic pseudoaneurysms. Its disadvantages relative to MDCT include longer examination time, increased susceptibility to motion artifact, lower spatial resolution, and smaller volume coverage.[22]

The risk of spontaneous rupture of an "extra-organic visceral" pseudoaneurysm is very high, with 100% mortality rate.[23] The specific management of a mycotic pseudoaneurysm must be individualized and is dependent on the characteristics such as location, morphology, presence, and extent of bleeding, and available expertise. Therapeutic options include open surgery, endovascular stent placement, endovascular embolization, medical therapy (intravenous antibiotics), or a combination of these.

Open thoracic surgical intervention is associated with a higher risk of morbidity. In recent times, endovascular stent-graft repair has provided a feasible and less invasive technique in managing aortic diseases with reduced perioperative mortality and morbidity.[24,25]

Endovascular advantages of stent repair include a smaller incision, avoidance of cardiopulmonary bypass, and aortic cross-clamping in infected aortic pseudoaneurysms. Early complications include post-implantation syndrome, stent misplacement, arterial embolism, visceral infarcts, and renal failure. Late complications include stent infection, migration, endoleak, and fracture.

Digital subtraction angiography was not performed for these patients to confirm the diagnosis of mycotic pseudoaneurysm.

## CONCLUSION

Mycotic pseudoaneurysm is a rare vascular pathology creating a diagnostic challenge with differentials such as conglomerate nodal disease, pulmonary mass or mediastinal mass, and an infected collection.

Mycotic (or infected) pseudoaneurysm is a rare vascular pathology that can rupture spontaneously resulting in devastating outcomes and needs early management.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent.

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**Conflicts of interest**

There are no conflicts of interest.

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