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# Rasmussen aneurysm: A rare but fatal sequela of pulmonary tuberculosis – clinical insights and management perspectives

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## Abstract

The pseudoaneurysmal dilatation of a pulmonary artery branch next to or inside a tuberculous cavity is the hallmark of Rasmussen aneurysm, a rare but potentially lethal consequence of pulmonary tuberculosis. It results from long-term inflammatory artery wall erosion, which causes severe hemoptysis in those who are afflicted. Because of its non-specific appearance and overlap with other pulmonary illnesses, it is still clinically underdiagnosed, despite autopsy studies estimating its presence in 4–8% of individuals with cavitary tuberculosis. The epidemiology, pathogenesis, clinical signs, radiographic findings, differential diagnosis, and current therapy approaches of Rasmussen aneurysm are all covered in detail in this study. While minimally invasive procedures like endovascular embolization have greatly improved clinical outcomes, imaging advancements, especially CT pulmonary angiography, have improved early detection. Raising awareness of this illness is essential for prompt diagnosis and effective treatment, particularly in areas where tuberculosis is endemic. To avoid severe hemorrhagic consequences, any patient with a history of tuberculosis who presents with hemoptysis should be evaluated for a Rasmussen aneurysm.

**Keywords:** Rasmussen Aneurysm; Pulmonary Tuberculosis; Hemoptysis; Pulmonary Artery Pseudoaneurysm; CT Angiography; Endovascular Embolization; Cavitary Lung Lesions

## 1. Introduction

A localized dilatation of a pulmonary artery branch caused by inflammatory erosion of the arterial wall inside a tubercular cavity is known as Rasmussen's aneurysm. Only 4% of autopsy series of individuals with persistent cavitary tuberculosis have this uncommon cause of hemoptysis. We describe a case of an older woman who had Rasmussen's aneurysm-related massive hemoptysis.[1]

Rasmussen aneurysm is a unique type of pseudoaneurysm of a pulmonary artery branch that is typically located inside or next to a lung cavity. Both conditions are frequently caused by pulmonary tuberculosis.[2][3] Fritz Valdemar Rasmussen was the first to describe the disease in 1868. Approximately 5–8% of individuals have this extremely rare complication, which is linked to cavitary tuberculosis of the lung, according to postmortem results.[4]

Originally used only to describe cavitary TB, the term "Rasmussen aneurysm" is now used to describe any anatomical aneurysm that coexists with any type of destructive lung lesion.[5]

The TB infection can weaken the pulmonary artery wall and cause an aneurysm, especially in cavitary lesions (where the tissue has degraded).[6]

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## 2. Epidemiology and Prevalence

One of the less prevalent side effects of pulmonary TB is Rasmussen aneurysm.[7] According to autopsy reports, the incidence of cavitary tuberculosis in patients is 4-8%.[8] Relatively few clinical cases are documented in the literature, despite the predominance in autopsy investigations.[9] The illness is more common in regions where tuberculosis is prevalent.[10] In the differential diagnosis of hemoptysis, Rasmussen aneurysm should be taken into account, particularly in patients with a history of tuberculosis. More cases may be observed in areas with lower prevalence of tuberculosis as a result of increased migration and population movement from high-prevalence areas.[11]

Although autopsy studies estimate that it occurs in 5-8% of cases of cavitary tuberculosis, it is rarely identified clinically. The TB cavity's chronic inflammation weakens the artery wall, which leads to the production of aneurysms. The potential for Rasmussen aneurysms to burst and cause potentially fatal hemoptysis (coughing up blood) is a serious clinical issue.[8]

### 2.1. Clinical presentation

- Hemoptysis: The severity of this most prevalent symptom might vary from minor to severe.[12]
- Fever: There may be a low-grade fever, particularly if the aneurysm is linked to active TB.[12]
- Cough: The underlying pulmonary disease may cause a cough, frequently accompanied by expectoration.[12]
- Breathlessness: The patient may develop dyspnea, especially while exerting themselves.[12]
- Others: Chest discomfort, sweating during night, and weight loss are also possible.[12]

### 2.2. Pathology

A pseudoaneurysmal dilatation of a pulmonary arterial branch next to or inside a tuberculous cavity is its defining feature. This happens because the inflammatory process of tuberculosis weakens the artery wall, which can result in the creation of a pseudoaneurysm that can burst and produce severe hemoptysis.[6]

#### *2.2.1. Process*

- Formation of Tuberculous Cavities: The development of a tuberculous cavity in the lung, typically in the upper lobes and in a peripheral location, is the main disease.[8]
- Erosion Due to inflammation: The arterial wall of a pulmonary artery branch that is inside or next to the cavity is eroded by the tuberculous infection.[3]
- Infiltration of Granulation Tissue: Granulation tissue infiltrates the adventitia and media of the artery as a result of the inflammation.[13]
- Replacement of Fibrin: The artery wall thins as a result of fibrin gradually replacing the granulation tissue.[3]
- Formation of pseudoaneurysms (It develops a fake aneurysm, which is devoid of a full, typical vessel wall structure): A pseudoaneurysm, or localized artery dilatation, is the result of the arterial wall becoming thinner and weaker.[3]
- Hemoptysis and Rupture: Massive hemoptysis, or coughing up blood, is a potentially fatal consequence of the pseudoaneurysm rupturing.[3]

## 3. Features of Radiography

- CT Angiogram of the Pulmonary: The best imaging technique for observing Rasmussen aneurysms is this one.[7]
- Dilatation of the Focal Area: Usually located close to a tuberculous cavity, the aneurysm manifests as a focal outpouching or dilatation of a pulmonary artery branch.[7]
- The Arterial Wall's Thinning: The inflammatory process causes the pulmonary artery wall to weaken and thin.[14]
- Forming Pseudoaneurysms: Since the aneurysm lacks a typical artery wall structure, it is truly a pseudoaneurysm.[9]
- Cavitation: Usually, the aneurysm is located inside or next to a tuberculous cavity.[14]
- Bleeding: Aneurysm rupture may result in hemoptysis, or coughing up blood.[7]
- Systemic Artery Participation: Systemic artery-to-pulmonary artery shunting can sometimes make Rasmussen aneurysms easier to see on bronchial or non-bronchial systemic arteriograms.[15]

## 4. History and Background

Fritz Valdemar Rasmussen originally characterized it in 1868.[9] Rasmussen aneurysms were once thought to be a prevalent cause of hemoptysis, especially in instances of tuberculosis. However, modern understanding has changed as a result of developments in medical research and antibiotic therapy. According to current medical knowledge, less than 10% of hemoptysis cases are caused by pulmonary artery aneurysms, with the bulk of cases being more directly associated with bleeding from the systemic bronchial arteries inside the lung. Medical experts' methods for diagnosing and treating hemoptysis in clinical practice have changed significantly as a result of this change.[6][16]

### 4.1. Differential diagnosis

- Embolism of the Pulmonary System: It is important to distinguish between pulmonary embolism, which can also result in hemoptysis, and tuberculosis patients.[17]
- Cavitary Lesion Bleeding: A comprehensive evaluation is necessary because hemoptysis can also be caused by other cavitary diseases in the lung that are unrelated to tuberculosis.[18]
- Bronchiectasis: Hemoptysis can also result from bronchiectasis, which is frequently linked to tuberculosis, especially in patients with chronic lung illness.[18]
- Pseudoaneurysms in other forms: It is necessary to take into account different forms of pulmonary artery pseudoaneurysms, whether they are mycotic (linked to infection), iatrogenic (from Swan-Ganz catheters, for example), or connected to other illnesses like Behcet's disease or Hughes-Stovin syndrome.[7]
- An aspergilloma (or) fungal ball: In addition to causing hemoptysis, fungal balls inside lung cavities might be challenging to differentiate on imaging from Rasmussen aneurysms.[19]
- Lung Cancer: Hemoptysis can also be a symptom of lung cancer, particularly if there are cavitary lesions.[19]
- Additional Reasons for Hemoptysis: Hemoptysis can also result from a number of different disorders that should be taken into consideration, including trauma, bronchial artery aneurysms, and arteriovenous malformations.[7]

### 4.2. Management

#### *4.2.1. Embolization (or) endovascular treatment*

- Embolization via Trans Catheterization: After inserting a catheter into the pulmonary artery, the aneurysm is blocked off using coils, adhesive, or gel foam, among other materials.[15]
- Approaching the Systemic and Pulmonary Arteries: To guarantee total closure of the aneurysm and any associated blood vessels, embolization can be carried out via the pulmonary and systemic arteries.[15]
- Concurrent Devascularization: Devascularization the pseudoaneurysm and any fistulas (connections) between the pulmonary and systemic arteries at the same time could be a novel strategy.[15]
- Injection of Mixtures: To help seal the aneurysm, a mixture of iodized oil and n-butyl cyanoacrylate (NBCA) may be administered, frequently with balloon occlusion.[9]

#### *4.2.2. Surgical intervention*

Pneumonectomy or Lobectomy: During these operations, the lung tissue that contains the aneurysm is removed whole or in part. Usually, they are saved for situations in which endovascular therapy is impractical or unsuccessful.[20]

#### *4.2.3. Additional considerations*

- Handling Emergencies: When massive hemoptysis (lung blood) occurs, emergent endovascular embolization is frequently the recommended course of action.[6]
- Method of Careful Procedure: Because of the possibility that the aneurysm may burst during the surgery, embolization calls for extra caution.[9]
- Two Sources of Blood: Rasmussen's aneurysms might be mistaken for bronchial artery aneurysms, so it's critical to take into account the lungs' dual blood supply (pulmonary and bronchial arteries) when diagnosing and treating them.[9]
- Diagnosis and Imaging: Finding the aneurysm and directing treatment depend heavily on CT angiography.[3]

## 5. Discussion

Fritz Valdemar Rasmussen originally described the Rasmussen aneurysm in 1868[5], is an uncommon pseudoaneurysm that affects a pulmonary artery branch; it is most frequently observed in conjunction with cavitary pulmonary TB.[2][4]

Chronic tuberculous inflammation erodes the pulmonary artery wall, weakening the vessel wall and causing the creation of pseudoaneurysms that might burst and cause potentially fatal hemoptysis.[3][6]

Rasmussen aneurysms are thought to occur in 4–8% of people with cavitary TB, according to postmortem investigations [4][8], Because of its vague clinical presentation and overlap with other hemoptysis causes, it is rarely detected during life.[10] Clinicians in nations with low TB prevalence should be on the lookout for this complication due to the rise in international travel and migration from TB-endemic areas.[11]

The preferred diagnostic technique, CT pulmonary angiography, can detect focal arterial dilatation next to or inside a tuberculous cavity, which usually lacks a complete arterial wall structure (i.e., pseudoaneurysm).[7][14] It is also possible to detect the existence of systemic-to-pulmonary artery shunting, which facilitates pre-embolization planning and diagnosis.[15]

It's critical to distinguish Rasmussen aneurysm from other hemoptysis sources. Aspergillomas, pulmonary embolism, bronchiectasis, mycotic or iatrogenic pseudoaneurysms, and cancer are among the differential diagnoses.[7][17][18][19] Radiologically, fungal balls in residual TB cavities can resemble Rasmussen aneurysms, hence imaging interpretation must be done carefully.[19]

Because endovascular embolization is minimally invasive and effective at stopping bleeding, it has emerged as the recommended first-line treatment. By catheterizing the pulmonary artery, embolic agents such coils, NBCA adhesive, or gelfoam are applied.[15] Both the pulmonary and systemic arteries may be embolized in situations with dual supply or complex architecture.[9][15] In certain situations where embolization is unsuccessful or not recommended, surgical procedures such as lobectomy or pneumonectomy are taken into consideration.[20]

Accurate identification is crucial to prevent harmful or inefficient therapies because of the lungs' dual blood supply and the way hemoptysis presents with other causes.[9] When a Rasmussen aneurysm causes significant hemoptysis, prompt detection and treatment can save lives.[6]

Despite being uncommon, Rasmussen aneurysms put patients with cavitary TB at serious risk of dying from bleeding. Thanks to developments in imaging and interventional radiology, prompt embolization and early detection provide an efficient therapeutic strategy.[3][10]

## 6. Conclusion

Despite being uncommon, Rasmussen aneurysm is a dangerous vascular consequence linked to cavitary pulmonary tuberculosis that, if left untreated, can result in deadly hemoptysis. Thanks to developments in imaging and interventional techniques, minimally invasive procedures like embolization can now be used for successful therapy and early detection. The clinical significance of Rasmussen aneurysm is better understood thanks to this study, which also emphasizes how crucial it is to take it into account when TB patients exhibit hemoptysis. Particularly in TB-endemic populations, improved identification and prompt treatment can dramatically lower morbidity and mortality.

## Compliance with ethical standards

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The authors declare no conflict of interest in preparing this article

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