

Chapter 21 – Hemoptysis

NOTE: CONTENT CONTAINED IN THIS DOCUMENT IS TAKEN FROM ROSEN'S EMERGENCY MEDICINE 9th Ed.

Italicized text is quoted directly from Rosen's.

Key Concepts

1. *Hemoptysis is caused by infection, trauma, cancer, coagulopathy, or as a complication of invasive pulmonary procedure.*
2. *Plain radiographs are the initial screening tests in most cases of massive hemoptysis, although CT scans are more sensitive and can supplant plain chest x-rays as the initial diagnostic test.*
3. *Bronchial artery embolization is highly effective, with hemostasis rates ranging from 85% to 95%.*
4. *With massive hemoptysis, hypoxia is the more immediate concern than volume resuscitation, and early intubation to ensure adequate oxygenation is paramount.*
5. *If a tracheo-innominate artery fistula (TIF) is suspected, then overinflation of the tracheostomy balloon or digital pressure at the site of bleeding should be performed for immediate hemorrhage control.*

Rosen's in Perspective

In this episode, we cover Chapter 21 in Rosen's 9th Edition - Hemoptysis. Here we will cover the pathophysiology of hemoptysis, its differential diagnosis, and some hacks to deal with the rare but life-threatening causes of massive hemoptysis. We will not be focusing on pulmonary embolisms in this episode, but you can find some of the information on the topic in [CRACKCast episode 88](#).

Key points to start off:

First, most cases of hemoptysis are not life-threatening, with most cases attributable to acute or chronic bronchitis. In these cases, hemoptysis results from damaged capillaries in the tracheobronchial tree. Small-volume hemoptysis in patients presenting with a viral URTI is usually not a cause for alarm.

Second, the causes of hemoptysis have evolved over time and vary by country and region. In developed countries, cases of massive hemoptysis secondary to pneumonia and bleeding diathesis are more common, whereas cases secondary to tuberculosis and bronchiectasis are decreasing. Be aware, that etiology varies by population, and for our international listeners, and

for providers working with patient populations with a higher prevalence of TB (as Owen and I do), cases caused by TB may be much more common.

Last, patients with hemoptysis often require multidisciplinary care. As a humble practitioner of Emergency Medicine, it is unlikely that you will have to tackle serious cases of hemoptysis alone. So, make sure to engage consultants early, particularly when managing patients with massive hemoptysis.

Core Questions

1. Define “massive hemoptysis”.
2. Which vessels, when injured, are typically associated with small and massive hemoptysis, and how do the vessel characteristics influence the degree of bleeding?
3. Outline an approach to the history and physical examination for a patient presenting with hemoptysis.
4. Outline the differential diagnosis for hemoptysis and highlight five critical and five emergent diagnoses that cause hemoptysis. (Box 21.1 and 21.2)
5. What ancillary tests are warranted in the patient with hemoptysis?
6. Detail the utility of imaging studies in patients with hemoptysis.
7. Detail the diagnostic approach to the patient with hemoptysis. (Figure 21.1)
8. Outline an approach to managing the patient with hemoptysis. (Figure 21.2)
9. What two maneuvers can be used to address massive hemoptysis from a suspected tracheo-innominate fistula (TIF)?
10. What strategies can be used to improve oxygenation in the patient with massive hemoptysis?

Wisecracks

1. List one gynecologic cause of hemoptysis.
2. List five causes of massive hemoptysis.
3. What is the most lethal consequence of massive hemoptysis?

Core Questions:

[1] Define "massive hemoptysis"

- Massive Hemoptysis (per Rosen’s 9th Edition) - 100 to 600 ml of blood loss in any 24-hour period, which can result in hemodynamic instability, shock, or impaired alveolar gas exchange and has a mortality rate approaching 80%.
- Based on the definition offered by Rosen’s, a patient with massive hemoptysis will be coughing up a minimum of roughly a half cup of blood in a 24-hour period



- As allude to in Rosen's, the definition varies widely. Some have advocated for the term “massive hemoptysis” to be changed to “life-threatening hemoptysis”, as even a small amount of blood loss can alter gas exchange and hemodynamic stability in vulnerable patients. Further, it is difficult to exactly quantify the volume of blood loss through expectoration.

[2] Which vessels, when injured, are typically associated with small and massive hemoptysis, and how do the vessel characteristics influence the degree of bleeding"

- In patients with **small-volume hemoptysis**, blood typically originates from the **capillaries** of the tracheobronchial tree. This low flow, low pressure oozing only results in small amounts of blood to be present in the sputum.
- The **most common** vessels involved in **massive hemoptysis** are **bronchial arteries**. These vessels, while not large in calibre in comparison to other arteries in the body, are highly pressurized, and bleed profusely when injured. The bronchial circulation is responsible for up to 90% of massive hemoptysis cases.
- **Pulmonary arteries** are another source of **massive hemoptysis**, owing to their large calibre large blood flow. However, they are relatively low-pressure vessels compared to bronchial arteries, so are a relatively **less common** cause of hemoptysis.

[3] Outline an approach to the history and physical examination for a patient presenting with hemoptysis.

History of present illness:

1. Differentiate between sources of blood that are pulmonary and extrapulmonary. This can take some time, but in general, interrogate the nasopharynx, pharynx, oropharynx, and GI tract in your history by asking about following:
 - Recent trauma, surgery, or other insult to the face, nose, mouth?
 - Recent epistaxis?
 - Foreign body or toxic ingestions that could have potentially damaged the nose, mouth, throat, or GI tract?
 - History of retching, hematemesis, GI bleeding, esophagitis, endoscopy?
 - Is the sputum red or clotted versus black/brown/coffee-ground appearing?
2. Determine the time-course, volume, and appearance of expectorated blood. Also inquire as to the chronicity of these symptoms or previous episodes of hemoptysis.

Review of systems:

1. Target other potential red-flag symptoms in cardiac, respiratory, and gastrointestinal domains

Past medical history:



1. Ask if the patient has any systemic etiologies including:
 - Goodpasture's Syndrome
 - Wegner's Granulomatosis
 - Systemic Lupus Erythematosus
 - Coagulopathies
 - Platelet aggregation pathology
 - Hypercoagulable states
 - Previous venous thromboembolic disease
2. Determine if the patient has undergone any transcutaneous or transbronchial procedures that can cause immediate or delayed postprocedural bleeding such as:
 - Lung biopsy
 - Swan-Ganz catheterization
 - Bronchoscopy
3. Ask about other things that can independently predict increased in-hospital mortality:
 - History of chronic alcoholism
 - Cancer
 - Pulmonary fungal infections

Social history:

1. Take a thorough smoking history. Hemoptysis may be caused by secondary effects of chronic tobacco smoking (e.g. lung cancer). However, it may also result from direct effects of other inhaled substances. Ask about:
 - Marijuana
 - Crack Cocaine
 - Methamphetamines
 - Other drugs of abuse
2. Ask about history of TB, known exposure to TB, or risk factors for TB exposure including:
 - Homelessness
 - Crowded living arrangements
 - Travel

Physical exam:

- Targeted physical examination of the following domains is essential for the patient with hemoptysis:
 - **HEENT** - looking for sources of bleeding in the nasopharynx and oropharynx
 - **Cardiac** - listening for clues that may point you toward evidence of cardiac dysfunction, endocarditis, etc.
 - **Respiratory** - remember that you may be able to identify the source of bleeding with focal adventitious sounds
 - **Peripheral vascular** - looking for signs of VTE in the limbs
 - **Dermatologic** - look for findings that may indicate a systemic etiology (e.g., SLE, vasculitis, thrombocytopenia, etc.)

[4] Outline the differential diagnosis for hemoptysis and highlight five critical and five emergent diagnoses that cause hemoptysis. (Box 21.1 and 21.2)

The following tables are constructed from boxes 21.1 and 21.2 in Rosen's 9th Edition. Please see the text for more information.

Box 21.1 - Differential Diagnosis of Hemoptysis	
Airway Bronchitis (acute or chronic) Bronchiectasis Neoplasm (primary or metastatic) Trauma Foreign body	Parenchymal Tuberculosis Pneumonia Pulmonary abscess Fungal infection Neoplasm
Vascular Pulmonary embolism AVM Aortic aneurysm PHTN Vasculitis	Hematologic Coagulopathy DIC Platelet dysfunction Thrombocytopenia
Cardiac congenital heart disease valvular heart disease endocarditis	Miscellaneous cocaine post procedural injury tracheal arterial fistula SLE

Box 21.2 - Critical and Emergent Diagnoses in Patients Presenting with Hemoptysis	
Critical DIC Tracheo-innominate Artery Fistula (TIF) Aortabronchial fistula Iatrogenic (post-procedural) hemoptysis PE	Emergent Trauma Bronchiectasis Pneumonia Pulmonary abscess/Fungal infection Oral anticoagulant overdose Endocarditis

[5] What ancillary tests are warranted in the patient with hemoptysis?

- Rosen's 9th Edition suggests the following list:
 - CBC
 - Coagulation profile
 - Renal function testing
 - Type and crossmatch
 - Also consider:
 - BNP, D-dimer, troponin

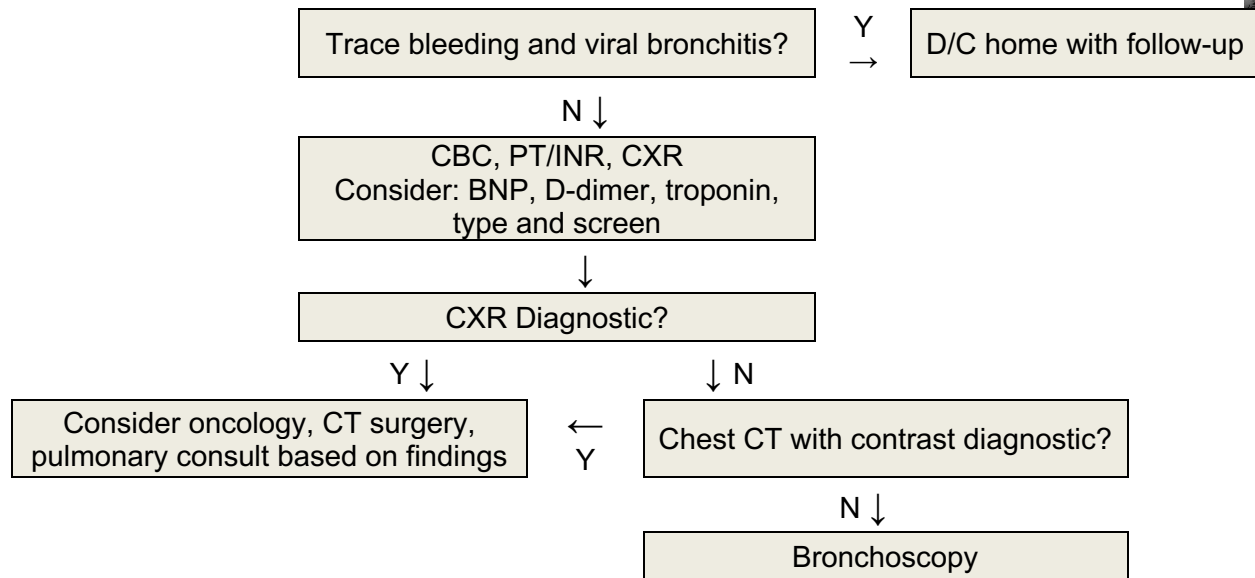
- Owen and I have added some more onto this list:
 - EKG
 - Liver enzymes and function testing (if suspected or confirmed history of cirrhosis)
 - VBG with lactate (if acutely unstable, pre-existing lung disease, or concerns about ventilation and oxygenation)

[6] Detail the utility of imaging studies in patients with hemoptysis.

- **Chest X-ray**
 - Generally, a decent first-line imaging modality in the ED.
 - Will screen for infection or large malignancies
 - In patients with small-volume hemoptysis, this plays a minor role as it has poor sensitivity in this population. Often, it is unable to accurately identify the cause of this patient's hemoptysis.
 - In patients with massive hemoptysis, plain films can localize the site of hemorrhage in 80% of cases
 - Its practical advantages include: easy get at the bedside, cheap, and provides a very low-dose of radiation
 - Rosen's recommends use in healthy patients with blood-stained sputum or intermittent small-volume hemoptysis in the context of an acute or subacute respiratory infection and normal vital signs
- **CT Chest**
 - Test of choice for BOTH bronchial and non-bronchial causes of massive hemoptysis
 - Diagnostically comparable to angiography
 - More available than conventional angiography
 - Consider getting in patients with moderate to massive hemoptysis or in patients with risk factors for serious pathology (i.e., smokers, oncology patients) even if they have a normal chest radiograph
- **Angiography**
 - Typically, not a test that can be ordered from most ED's
 - This is the test of choice for the patient in which the causes of hemoptysis are known (e.g., malignancy), if bronchial artery hemorrhage is suspected, or when we are considering angiography-assisted vessel embolization

[7] Detail the diagnostic approach to the patient with hemoptysis. (Figure 21.1)

This approach to diagnosing the aetiology of a patient's hemoptysis is adapted from Figure 21.1 in Rosen' 9th Edition. Please see this figure for further clarification.



Reproduced from Figure 21.1 of Rosen's 9E.

[8] Outline an approach to managing the patient with hemoptysis. (Figure 21.2)

This approach to diagnosing the aetiology of a patient's hemoptysis is adapted from Figure 21.2 in Rosen' 9th Edition. Please see this figure for further clarification.

1. Small-volume versus Large-volume

- If small-volume, assess hemodynamically or hypoxia.
 - i. If present, proceed to step two.
 - ii. If not, admit or observe until consults and further evaluation can be performed
- If moderate to massive hemoptysis, proceed to step two.

2. Determine Stability

- If unstable, consider placing in "bleeding lung-down" position
- Place two large-bore IV's
- Put on cardiac monitors, pulse oximeters
- Consider intubation

3. Determine Potential for Bronchial Artery Hemorrhage

- If the bleed is suspected to be secondary to a bronchial artery hemorrhage, consult cardiothoracic surgery and pulmonology consult for potential angiogram
- If not thought to be the culprit, consult cardiothoracic surgery and pulmonology

[9] What two maneuvers can be used to address massive hemoptysis from a suspected tracheo-innominate fistula (TIF)?



- Tracheo-innominate fistulae are typically consequences of pressure. They are, in almost all cases, an iatrogenic complication (e.g., tracheostomy) that cause a fistula to form between the innominate artery (brachiocephalic artery) and the trachea itself. These things can bleed like stink, and need immediate management when they present.
- If a TIF is suspected:
 - Immediately attempt to over-inflate the tracheostomy tube balloon at the bedside. This may tamponade the bleeding and patch them through until they can be seen by our surgical colleagues.
 - If this fails in the patient with a tracheostomy site, remove the tracheostomy tube and insert your index finger. The patient needs to be intubated IMMEDIATELY. Next, apply pressure to the source of bleeding to directly tamponade it (referred to as Utley's maneuver)
 - As we alluded to above, this is a surgical issue. This person needs emergent surgery to correct the issue, so get your consultants involved early.

[10] What strategies can be used to improve oxygenation in the patient with massive hemoptysis?

There are several strategies you can employ to help save the life of your next patient with massive hemoptysis. Rosen's details three of these strategies. These are detailed below:

- Bleeding-Lung Down Positioning:
 - If your patient has a known or suspected source of bleeding (i.e., left-lung or right-lung), consider placing them in a position where the "bad" lung is in a dependent position. This places the unaffected lung above the source of bleeding, thus protecting it from overflow. Additionally, it will allow you to improve oxygenation and ventilation of the unaffected lung, potentially saving your patient the hassle of a hypoxic arrest.
 - Right or Left Mainstem Intubation:
 - Again, if the patient has a known or suspected source of bleeding, a single-lumen mainstem intubation can be performed. Keep in mind that left mainstem intubations are tricky, but the right mainstem bronchus is not too difficult to intubate. To do it, either advance in a neutral position past the point where you usually would, or use the 90-degree rotational technique in which the tube is rotated 90 degrees in the direction of the desired placement and advanced until you meet resistance.
 - Double Lumen ETT Intubation:
 - This may be out of the scope of most ED MD's, but you can use a double-lumen ETT for lung isolation. Often, you need fiberoptic bronchoscopy to confirm placement, which can be difficult in the patient with massive hemoptysis. Some complications like bilateral pneumothoraces, pneumomediastinum, carinal rupture, lobar collapse, and tube malposition are more common with these ETT's, so get Anesthesia involved ASAP if you are considering using them.
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Wisecracks:

[1] List one gynecologic cause of hemoptysis.

Answer: Catamenial Hemoptysis

As peculiar as it may sound, this is an issue for some people. Catamenial hemoptysis occurs as the result of either intrabronchial or lung parenchymal invasion of endometrial tissue. This is a subset of extrapelvic endometriosis.

[2] List five causes of massive hemoptysis.

Answer:

- Bronchiectasis
- TB
- Malignancy
- AVM
- TEF
- Aortobronchial Fistula
- Lung Abscess
- SLE
- Goodpasture's Syndrome
- Wegner's Granulomatosis
- Bleeding Diathesis
- Iatrogenic
- Telangiectasias
- Fungal Pulmonary Infection

Always a good list to have on-hand for your next pimp session. While it is not comprehensive, it will help the next time you encounter a patient with massive hemoptysis.

[3] What is the most lethal consequence of massive hemoptysis?

Answer: Ventilation-Perfusion Mismatch

Remember, although hemodynamic instability and hemorrhagic shock can result from massive hemoptysis, the most life-threatening consequence of bloody lungs occurs after the small airways and alveoli are filled with the red stuff. It is hard to ventilate lungs filled to the brim with any fluid, so get your intubation set up ASAP in these patients.