



Review Article

Diagnosis and Management Update of Hemoptysis

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Abstract

Hemoptysis is defined as the spitting of blood derived from the lungs or bronchial tubes as a result of pulmonary or bronchial hemorrhage¹. Hemoptysis is classified as nonmassive or massive based on the volume of blood loss; however, there are no uniform definitions for these categories². In this article, hemoptysis is considered nonmassive if blood loss is less than 200 mL per day³. The lungs receive blood from the pulmonary and bronchial arterial systems⁴. The low-pressure pulmonary system tends to produce small-volume hemoptysis, whereas bleeding from the bronchial system, which is at systemic pressure, tends to be profuse⁴.

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Causes of Hemoptysis

In the primary care setting, the most common causes of hemoptysis are acute and chronic

bronchitis, pneumonia, tuberculosis, and lung cancer. The differential diagnosis and underlying etiologies are listed in table 1.

Table 1: Differential Diagnosis of Hemoptysis

Source other than the lower respiratory tract	Pulmonary parenchymal source	Primary vascular source
Upper airway (nasopharyngeal) bleeding	Lung abscess	Arteriovenous malformation
Gastrointestinal bleeding	Pneumonia	Pulmonary embolism
Tracheobronchial source Neoplasm (bronchogenic carcinoma, endobronchial metastatic tumor, Kaposi's sarcoma, bronchial carcinoid)	Tuberculosis	Elevated pulmonary venous pressure (especially mitral stenosis)
Bronchitis (acute or chronic)	Mycetoma ("fungus ball")	Pulmonary artery rupture secondary to balloon-tip pulmonary artery catheter manipulation
Bronchiectasis	Goodpasture's syndrome	Miscellaneous and rare causes
Broncholithiasis	Idiopathic pulmonary hemosiderosis	Pulmonary endometriosis
Airway trauma	Wegener's granulomatosis	Systemic coagulopathy or use of anticoagulants or thrombolytic agents
Foreign body	Lupus pneumonitis	
	Long contusion	

Infection

Infection is the most common cause of hemoptysis, accounting for 60 to 70 percent of cases⁵. In a retrospective study⁶ of inpatient and

outpatient hemoptysis in the United States, bronchitis caused 26 percent of cases, pneumonia caused 10 percent, and tuberculosis accounted for 8 percent. Invasive bacteria (e.g., *Staphylococcus*

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aureus, *Pseudomonas aeruginosa*) or fungi (e.g., *Aspergillus* species) are the most common infectious causes of hemoptysis. Viruses such as influenza also may cause severe hemoptysis⁷. Human immunodeficiency virus (HIV) infection predisposes patients to several conditions that may produce hemoptysis, including pulmonary Kaposi's sarcoma⁸.

Cancer

Primary lung cancers account for 23 percent of cases of hemoptysis in the United States⁶. Bronchogenic carcinoma is a common lung cancer responsible for hemoptysis in 5 to 44 percent of all cases^{9,10}. Bleeding from malignant or benign tumors can be secondary to superficial mucosal invasion, erosion into blood vessels, or highly vascular lesions.

Pulmonary Venous Hypertension

Cardiovascular conditions that result in pulmonary venous hypertension can cause cardiac hemoptysis. The most common of these is left ventricular systolic heart failure. Other cardiovascular causes include severe mitral stenosis and pulmonary embolism. Although hemoptysis is a recognized pulmonary embolism symptom, pulmonary embolism is an uncommon cause of hemoptysis. For example, in a patient without underlying cardiopulmonary disease, the positive and negative likelihood ratios for hemoptysis in pulmonary embolism are 1.6 and 0.95, respectively. Therefore, the presence or absence of hemoptysis alone has no significant effect on the likelihood of pulmonary embolism¹¹.

Idiopathy

Idiopathic hemoptysis is a diagnosis of exclusion. In 7 to 34 percent of patients with hemoptysis, no identifiable cause can be found after careful evaluation^{6, 12, 13}. Prognosis for idiopathic hemoptysis usually is good, and the majority of patients have resolution of bleeding within six months of evaluation¹⁴.

Hemoptysis in Children

The major cause of hemoptysis in children is lower respiratory tract infection. The second most

common cause is foreign body aspiration, with most cases occurring in children younger than four years. Another important cause is bronchiectasis, which often is secondary to cystic fibrosis. Primary pulmonary tuberculosis is a rare cause estimated to occur in less than 1 percent of cases¹⁵. Although uncommon, trauma is another possible cause. Blunt-force trauma may result in hemoptysis secondary to pulmonary contusion and hemorrhage. Bleeding caused by suffocation, deliberate or accidental, also should be considered¹⁶.

Patient History

Historic clues are useful for differentiating hemoptysis from hematemesis (Table 2). Patient history also can help identify the anatomic site of bleeding, differentiate between hemoptysis and pseudohemoptysis, and narrow the differential diagnosis (Table 3). Factors such as age, nutrition status, and comorbid conditions can assist in the diagnosis and management of hemoptysis.

Table 2: Differentiating Features of Hemoptysis and Hematemesis

Hemoptysis	Hematemesis
History	
Absence of nausea and vomiting	Presence of nausea and vomiting
Lung disease	Gastric or hepatic disease
Asphyxia possible	Asphyxia unusual
Sputum examination	
Frothy	Rarely frothy
Liquid or clotted appearance	Coffee ground appearance
Bright red or pink	Brown to black
Laboratory	
Alkaline pH	Acidic pH
Mixed with macrophages and neutrophils	Mixed with food particles

Once true hemoptysis is suspected, the investigation should focus on the respiratory system. Blood from the lower bronchial tree typically induces cough, whereas a history of epistaxis or expectorating without cough would be consistent with an upper respiratory source but does not exclude a lower tract site.

Bleeding is difficult to quantify clinically. Patients may find it difficult to discern whether they are throwing up, coughing, or spitting out bloody material. The amount of blood loss usually is overestimated by patients and physicians, but an attempt to determine the volume and rate of blood loss should be made. Methods of determination include observing as the patient coughs and the use of a graduated container. Blood-streaked sputum deserves the same diagnostic consideration as blood alone. The amount or frequency of bleeding does not correlate with the diagnosis or incidence of cancer.

Table 3: Diagnostic Clues in Hemoptysis: Physical History

Clinical clues	Suggested diagnosis
Anticoagulant use	Medication effect, coagulation disorder
Association with menses	Catamenial hemoptysis
Dyspnea on exertion, fatigue, orthopnea, paroxysmal nocturnal dyspnea, frothy pink sputum	Congestive heart failure, left ventricular dysfunction, mitral valve stenosis
Fever, productive cough	Upper respiratory infection, acute sinusitis, acute bronchitis, pneumonia, lung abscess
History of breast, colon, or renal cancers	Endobronchial metastatic disease of lungs
History of chronic lung disease, recurrent lower respiratory track infection, cough with copious purulent sputum	Bronchiectasis, lung abscess
HIV, immunosuppression	Neoplasia, tuberculosis, Kaposi's sarcoma
Nausea, vomiting, melena, alcoholism, chronic use of nonsteroidal anti-inflammatory drugs	Gastritis, gastric or peptic ulcer, esophageal varices
Pleuritic chest pain, calf tenderness	Pulmonary embolism or infarction
Tobacco use	Acute bronchitis, chronic bronchitis, lung cancer, pneumonia
Travel history	Tuberculosis, parasites (e.g., paragonimiasis, schistosomiasis, amebiasis, leptospirosis), biologic agents (e.g., plague, tularemia, T2 mycotoxin)
Weight loss	Emphysema, lung cancer, tuberculosis, bronchiectasis, lung abscess, HIV

It is helpful to determine whether there have been previous episodes of hemoptysis and what diagnostic assessments have been done. Mild hemoptysis recurring sporadically over a few years is common in smokers who have chronic bronchitis punctuated with superimposed acute bronchitis. Because smoking is an important risk factor, these patients are at higher risk for lung cancer¹⁷. Chronic obstructive pulmonary disease also is an independent risk factor for hemoptysis.

Environmental exposure to asbestos, arsenic, chromium, nickel, and certain ethers increases risk for hemoptysis. Bronchial adenomas, although malignant, are slow growing and may present with occasional bleeding over many years. Malignancy in general, especially adenocarcinomas, can induce a hypercoagulable state, thereby increasing the risk for a pulmonary embolism. A history of chronic, purulent sputum production and frequent pneumonias, including tuberculosis, may represent bronchiectasis. Association of hemoptysis with menses (i.e., catamenial hemoptysis) may represent intrathoracic endometriosis¹⁸.

A travel history may be helpful. Tuberculosis is endemic in many parts of the world, and parasitic etiologies should be considered^{19, 20}. In regions where drinking from springs is common, there are case reports of hemoptysis caused by leeches attaching to the upper respiratory tract mucosa²¹.

Physical Examination

Historic clues often will narrow the differential diagnosis and help focus the physical examination (Table 4). Examining the expectoration may help localize the source of bleeding⁴. The physician should record vital signs, including pulse oximetry levels, to document fever, tachycardia, tachypnea, weight changes, and hypoxia. Constitutional signs such as cachexia and level of patient distress also should be noted. The skin and mucous membranes should be inspected for cyanosis, pallor, ecchymoses, telangiectasia, gingivitis, or evidence of bleeding from the oral or nasal mucosa.

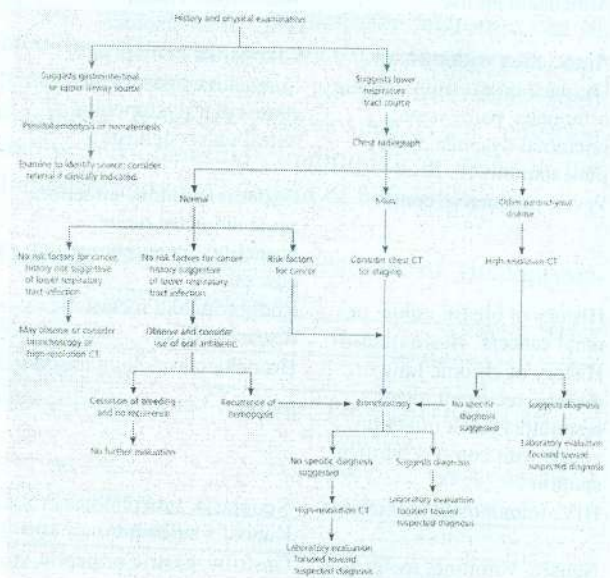
Table 4: Diagnostic Clues in Hemoptysis: Physical Examination

Clinical clues	Suggested diagnosis
Cachexia, clubbing, voice hoarseness, Cushing's syndrome, hyperpigmentation, Horner's syndrome Clubbing	Bronchogenic carcinoma, small cell lung cancer, other primary lung cancers Primary lung cancer, bronchiectasis, lung abscess, severe chronic lung disease, secondary lung metastases Pneumonia
Dullness to percussion, fever, unilateral rales	Pneumonia
Facial tenderness, fever, mucopurulent nasal discharge, postnasal drainage	Acute upper respiratory infection, acute sinusitis
Fever, tachypnea, hypoxia, hypertrophied accessory respiratory muscles, barrel chest, intercostal retractions, pursed lip breathing, rhonchi, wheezing, tympani to percussion, distant heart sounds	Acute exacerbation of chronic bronchitis, primary lung cancer, pneumonia
Gingival thickening, mulberry gingivitis, saddle nose, nasal septum perforation	Wegener's granulomatosis
Heart murmur, pectus excavatum	Mitral valve stenosis
Lymph node enlargement, cachexia, violaceous tumors on skin	Kaposi's sarcoma secondary to human immunodeficiency virus infection
Orofacial and mucous membrane telangiectasia, epistaxis	Osler-Weber-Rendu disease
Tachycardia, tachypnea, hypoxia, jugulovenous distention, S3 gallop, decreased lung sounds, bilateral rales, dullness to percussion in lower lung fields	Congestive heart failure caused by left ventricular dysfunction or severe mitral valve stenosis
Tachypnea, tachycardia, dyspnea, fixed split S2, pleural friction rub, unilateral leg pain and edema	Pulmonary thromboembolic disease
Tympani to percussion over lung apices, cachexia	Tuberculosis

The examination for lymph node enlargement should include the neck, supraclavicular region, and axillae. The cardiovascular examination includes an evaluation for jugular venous distention, abnormal heart sounds, and edema. The physician should check the chest and lungs for signs of consolidation, wheezing, rales, and trauma. The abdominal examination should focus on signs of hepatic congestion or masses, with an inspection of the extremities for signs of edema, cyanosis, or clubbing^{4,27}.

Diagnostic Evaluation

An algorithm (figure-1) for the evaluation of nonmassive hemoptysis. After a careful history and examination, a chest radiograph should be obtained (Table 5). If a diagnosis remains unclear, further imaging with chest computed tomography (CT) or direct visualization with bronchoscopy often is indicated. In high-risk patients with a normal chest radiograph, fiberoptic bronchoscopy should be considered to rule out malignancy. Risk factors that increase the likelihood of finding lung cancer on bronchoscopy include male sex, older than 40 years, a smoking history of more than 40 pack-years, and duration of hemoptysis for more than one week²³.

**Fig. 1:** Diagnosing Nonmassive Hemoptysis

Fiberoptic bronchoscopy is preferred if neoplasia is suspected; it is diagnostic for central endobronchial disease and allows for direct visualization of the bleeding site. It also permits tissue biopsy, bronchial lavage, or brushings for pathologic diagnosis. Fiberoptic bronchoscopy also can provide direct therapy in cases of continued bleeding. Rigid bronchoscopy is the preferred tool for cases of massive bleeding because of its greater suctioning and airway maintenance capabilities.

Table 5: Diagnostic Clues in Hemoptysis: Chest Radiograph

Chest radiograph finding	Suggested diagnosis
Cardiomegaly, increased pulmonary vascular distribution	Chronic heart failure, mitral valve stenosis
Cavitary lesions	Lung abscess, tuberculosis, necrotizing carcinoma
Diffuse alveolar infiltrates	Chronic heart failure, pulmonary edema, aspiration, toxic injury
Hilar adenopathy or mass	Carcinoma, metastatic disease, infectious process, sarcoid
Hyperinflation	Chronic obstructive pulmonary disease
Lobar or segmental infiltrates	Pneumonia, thromboembolism, obstructing carcinoma
Mass lesion, nodules, granulomas	Carcinoma, metastatic disease, Wegener's granulomatosis, septic embolism, vasculitides
Normal or no change from baseline	Bronchitis, upper respiratory infection, sinusitis, pulmonary embolism
Patchy alveolar infiltrates (multiple bleeding sites)	Bleeding disorders, idiopathic pulmonary hemosiderosis, Goodpasture's syndrome

Table 6: Diagnostic Clues in Hemoptysis: Laboratory Tests

Test	Diagnostic findings
White blood cell count and differential	Elevated cell count and differential shifts may be present in upper and lower respiratory tract infections
Hemoglobin, hematocrit	Decreased in anemia
Platelet count	Decreased in thrombocytopenia
Prothrombin time, International Normalized Ratio, partial thromboplastin time	Increased in anticoagulant use, disorders of coagulation
Arterial blood gases	Hypoxia, hypercarbia
D-dimer	Elevated in pulmonary embolism
Sputum Gram stain, culture, acid-fast bacillus smear and culture	Pneumonia, lung abscess, tuberculosis, mycobacterial infections
Sputum cytology	Neoplasm
Purified protein derivative skin test	Positive increases risk for tuberculosis
Human immunodeficiency virus test	Positive increases risk for tuberculosis, Kaposi's sarcoma
Erythrocyte sedimentation rate	Elevated in infection, autoimmune disorders (e.g., Wegener's syndrome, systemic lupus erythematosus, sarcoid, Goodpasture's syndrome), may be elevated in neoplasia

High-resolution CT has become increasingly useful in the initial evaluation of hemoptysis and is preferred if parenchymal disease is suspected. Its complementary use with bronchoscopy gives a greater positive yield of pathology^{24,25} and is useful for excluding malignancy in high-risk patients²⁶. Its role in hemoptysis continues to evolve, and further studies are needed to evaluate its effect on patient management and outcome. Patients with recurrent or unexplained hemoptysis may need additional laboratory evaluation to establish a diagnosis (Table 6).

Management

Nonmassive Hemoptysis

The overall goals of management of the patient with hemoptysis are threefold: bleeding cessation, aspiration prevention, and treatment of the underlying cause. As with any potentially serious condition, evaluation of the "ABCs" (i.e., airway, breathing, and circulation) is the initial step.

The most common presentation is acute, mild hemoptysis caused by bronchitis. Low-risk patients with normal chest radiographs can be treated on an outpatient basis with close monitoring and appropriate oral antibiotics, if clinically indicated. If hemoptysis persists or remains unexplained, an outpatient evaluation by a pulmonologist should be considered.

An abnormal mass on a chest radiograph warrants an outpatient bronchoscopic examination. For patients with a normal chest radiograph and risk factors for lung cancer or recurrent hemoptysis, outpatient fiberoptic bronchoscopy also is indicated to rule out neoplasm. High-resolution CT is indicated when clinical suspicion for malignancy exists and sputum and bronchoscopy do not yield any pathology. High-resolution CT also is indicated when chest radiography reveals peripheral or other parenchymal disease.

Massive Hemoptysis

The mortality rate from massive hemoptysis depends on the bleeding rate and etiology. Hemoptysis greater than 1,000 mL per 24 hours in the presence of malignancy carries a mortality rate of 80 percent²⁷; therefore, massive hemoptysis warrants a more aggressive, expedient approach. These patients require intensive care and early consultation with a pulmonologist. In cases of

massive or life-threatening hemoptysis, diagnosis and therapy must occur simultaneously. Airway maintenance is vital because the primary mechanism of death is asphyxiation, not exsanguination. Supplemental oxygen and fluid resuscitation are essential. Assistance by a cardiothoracic surgeon should be considered because emergency surgical intervention may be needed.

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