Evaluation of nonlife-threatening hemoptysis in adults

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INTRODUCTION

Hemoptysis, or the expectoration of blood, can range from blood-streaking of sputum to gross blood in the absence of any accompanying sputum. Hemoptysis has a broad differential, but the cause can be determined in the majority of patients (table 1). It is important to identify the cause and location of bleeding in order to guide treatment.

The evaluation of hemoptysis that is not immediately life-threatening will be reviewed here. The acute evaluation and management of life-threatening hemoptysis and the spectrum of causes of hemoptysis are discussed separately. (See "Evaluation and management of life-threatening hemoptysis" and "Etiology of hemoptysis in adults".)

DEFINITIONS

The term hemoptysis typically refers to expectoration of blood originating from the lower respiratory tract. Bronchitis, bronchogenic carcinoma, and bronchiectasis are the most common causes of hemoptysis in developed countries, while infections due to *Mycobacterium tuberculosis* and *Paragonimus westermani* are more common causes in endemic countries. The various causes of hemoptysis are discussed separately (table 1). (See "Etiology of hemoptysis in adults".)

- **Life-threatening hemoptysis** – The term **life-threatening hemoptysis** (also called massive hemoptysis) is reserved for bleeding that is potentially acutely life-threatening; it has been defined by a number of different criteria, ranging from 100 mL to more than 600 mL of blood over a 24-hour period [1,2]. However, it is difficult to quantify the amount of blood that a patient has expectorated before seeking medical attention, so any criterion based on the volume of blood cannot be used precisely. We generally prefer the term "life-threatening hemoptysis," referring to hemoptysis that causes airway obstruction, significantly abnormal gas exchange, or hemodynamic instability [3]. In our clinical practice, we also consider hemoptysis to be life-threatening when there has been approximately 150 mL of blood expectorated in a 24-hour period or bleeding at a rate ≥100 mL/hour [3].

  The evaluation and management of life-threatening hemoptysis, which requires a prompt response to ensure adequate airway protection, maintenance of oxygenation and ventilation, and control of hemoptysis, is discussed separately. (See "Evaluation and management of life-threatening hemoptysis".)

- **Pseudohemoptysis** – Blood from the upper respiratory tract and the upper gastrointestinal tract can also be expectorated and, thus, mimic blood coming from the lower respiratory tract. This is called pseudohemoptysis.

INITIAL EVALUATION

Once it has been determined that the patient is not experiencing respiratory compromise or immediately life-threatening hemoptysis (ie, no evidence of tachypnea, tachycardia, use of accessory muscles, or cyanosis), the goals of the initial evaluation are to determine the frequency and severity of bleeding, localize the source of bleeding, and develop an initial differential diagnosis (table 1 and algorithm 1). (See "Etiology of hemoptysis in adults".)

History — The directed history for patients presenting with hemoptysis should include an assessment of the pattern and severity of hemoptysis, degree of respiratory impairment, and clues to the etiology. As part of the history it is helpful to characterize the hemoptysis, associated symptoms, cigarette smoking history, comorbidities, and family history. A review of medications and questions aimed at ruling out pseudohemoptysis should also be asked. A set of potentially useful questions is included in the table (table 2).

Certain features are associated with an increased risk of lung malignancy and should be explored as part of the initial evaluation. Questions regarding risk factors for lung malignancy

are provided in the table (table 2). (See "Cigarette smoking and other possible risk factors for lung cancer".)

Physical examination — The directed physical examination for the initial evaluation of hemoptysis combines assessment of the degree of respiratory compromise (if any) with examination for clues of extrapulmonary disease and is described in the table (table 3). As examples, a focal wheeze might indicate an obstructing lesion in the airway, while telangiectasia might be a clue to Osler-Weber-Rendu (picture 1), and palpable purpura a clue to vasculitis (picture 2).

Laboratory studies — Laboratory studies that are useful in the majority of patients include hemoglobin and hematocrit (to assess the chronicity and magnitude of bleeding), white blood cell count and differential (evidence for infection), urinalysis and renal function (to screen for pulmonary-renal syndromes such as Goodpasture syndrome or granulomatosis with polyangiitis), liver function tests, and a coagulation profile (to exclude thrombocytopenia or another bleeding disorder as a contributing factor). However, the severity of an acute episode of hemoptysis cannot be judged by the patient's hemoglobin and hematocrit, since the acute and potentially life-threatening danger is from asphyxiation rather than blood loss. Conversely, patients can have significant reductions in hemoglobin and hematocrit from alveolar hemorrhage with only small amounts of hemoptysis, as in idiopathic pulmonary hemosiderosis. (See "Idiopathic pulmonary hemosiderosis", section on 'Iron deficiency anemia'.)

Additional lab studies, as determined by the clinical presentation and chest radiograph, may include sputum culture (including mycobacteria) and serologic testing (eg, antinuclear antibodies, antineutrophil cytoplasmic antibodies, antiglomerular basement membrane antibodies, anticardiolipin antibodies, and/or interferon-gamma release assay). Respiratory viral panels can be considered in the appropriate clinical context, particularly given that spontaneous hemoptysis can be an unusual but initial presentation of coronavirus disease 2019 (COVID-19) [4].

A chest radiograph showing one or more apical cavities would be consistent with reactivation tuberculosis and lead to cultures, while multiple nodules, cavities, or diffuse opacities (suggestive of hemorrhage) in a patient without risk factors for tuberculosis might lead to a serologic evaluation for vasculitis; sometimes both possibilities are explored simultaneously. On the other hand, a patient with a long-term smoking history and a central mass would generally not need these serologic studies.

If heart failure is suspected as a contributing cause, a plasma brain natriuretic peptide (BNP) or N-terminal pro-BNP (NT-proBNP) level may be helpful.

Sputum cytology is rarely indicated in patients who will undergo bronchoscopy, as bronchoscopic specimens have a much higher likelihood of identifying cancer. However, if the chest radiograph suggests a primary lung cancer and the patient is not a candidate for bronchoscopy, sputum cytology may be diagnostic. (See "Procedures for tissue biopsy in patients with suspected non-small cell lung cancer", section on 'Sputum cytology' and "Flexible bronchoscopy in adults: Indications and contraindications".)

Adequacy of oxygenation is assessed with pulse oximetry or arterial blood gas analysis. Patients with risk factors for pulmonary embolism, particularly those with a reduced pulse oxygen saturation, should undergo further evaluation for pulmonary embolism (eg, D-dimer or CT pulmonary angiogram). (See "Clinical presentation, evaluation, and diagnosis of the nonpregnant adult with suspected acute pulmonary embolism".)

Imaging — The most important initial study, beyond history and physical examination, for all patients presenting with hemoptysis is a chest radiograph, as it is usually readily available and can help direct care [5,6]. Many patients will also need chest computed tomography (CT) to fully evaluate the source of hemoptysis [5,7]. The CT scan should typically be done with contrast, unless there is a strong suspicion for bronchiectasis or the patient has contrast media sensitivity or renal insufficiency. Analysis of thin sections (eg, 1 mm slices) is necessary for adequate evaluation of possible bronchiectasis. If pulmonary embolism is suspected, a CT pulmonary angiogram imaging protocol should be used.

Abnormal findings on a chest radiograph may be suggestive of a variety of specific causes of hemoptysis (eg, primary lung neoplasm, tuberculosis, aspergilloma, mitral stenosis with pulmonary edema) or may show an abnormality that requires further investigation to determine the etiology. While a normal chest radiograph is reassuring, it does not entirely exclude a malignancy or other processes that require specific treatment, as described below [5]. (See 'Patients with a normal chest radiograph' below.)

DIRECTED EVALUATION BASED ON PRESENTATION

Further evaluation is directed by the results of the initial evaluation and the course and recurrence of hemoptysis. In addition, certain studies can help identify a cause that is not suspected based on the initial evaluation (algorithm 1).

Further tests may include computed tomography (CT), flexible bronchoscopy, echocardiography, and bronchial or pulmonary angiography. Flexible bronchoscopy is particularly useful, often allowing localization of the site of hemoptysis and visualization of the

endobronchial pathology causing the bleeding [8]. Most CT scanners now use multidetector CT (MDCT) technology and generate thin sections that provide complementary information to flexible bronchoscopy [9]. (See "High resolution computed tomography of the lungs".)

The evaluation and management of life-threatening hemoptysis is described separately. (See "Evaluation and management of life-threatening hemoptysis".)

Patients with a normal chest radiograph — A normal chest radiograph must be evaluated in the context of the clinical presentation of hemoptysis and does not exclude the possibility of lung malignancy or bronchiectasis [10-12].

As an example, among 270 patients (90 percent former or active smokers) with hemoptysis and a normal chest radiograph, approximately 10 percent were found to have a lung malignancy [11]. In other case series, radiographically silent endobronchial malignancy was found by flexible bronchoscopy in less than 5 percent [13-15]. Nonmalignant causes of hemoptysis, such as bronchiectasis or disorders affecting the pulmonary vasculature, may be missed on the initial chest radiograph, but identified by CT. Among patients with large amounts of hemoptysis and a normal chest radiograph, approximately 70 percent are found to have bronchiectasis on CT [16].

Minimal hemoptysis with likely infectious cause — For patients who present with self-limited expectoration of less than 30 mL of blood, a known or likely benign cause (eg, bronchitis or exacerbation of known bronchiectasis), absent risk factors for lung malignancy, and a normal chest radiograph, we typically observe (if viral infection suspected) or treat bacterial infection (if present), deferring further evaluation pending a recurrence or increase in the amount of hemoptysis [5]. However, with recurrence, persistence (typically beyond one week) or worsening of symptoms, high risk factors for cancer, or absence of a likely benign cause, further evaluation with bronchoscopy and/or CT scan is recommended. (See "Cigarette smoking and other possible risk factors for lung cancer".)

Active hemoptysis without a clear or benign cause — For patients who present to the emergency department or outpatient office with hemoptysis that is active but not life-threatening (eg, 30 mL to 100 mL in 24 hours), without a clear or likely benign cause (eg, exacerbation of known bronchiectasis), and with a normal or nonlocalizing chest radiograph, we typically obtain a CT scan with contrast. Unless CT provides a clear diagnosis, this is often followed by flexible bronchoscopy, which is an important component of the evaluation, particularly in patients with risk factors for malignancy [5,6].

Pulmonary embolism is a rare cause of hemoptysis; when suspected, CT pulmonary angiography would be preferred. (See "Flexible bronchoscopy in adults: Overview".)

Flexible bronchoscopy and CT are, in many ways, complementary studies, each with specific advantages in certain clinical situations [9,17]. CT appears preferable for bronchiectasis, carcinomas, and arteriovenous malformations, while flexible bronchoscopy appears better for subtle mucosal abnormalities (eg, bronchitis, Dieulafoy disease, Kaposi sarcoma). Flexible bronchoscopy has the additional advantage of providing a method to obtain pathologic or cytologic specimens.

- In one study of 91 patients with hemoptysis, CT demonstrated all tumors seen by bronchoscopy, as well as several which were beyond bronchoscopic range [18]. On the other hand, high resolution CT (HRCT) did not detect bronchitis or a small papilloma which could be seen by bronchoscopy.

- In a separate report of 57 patients, modified HRCT was particularly useful in diagnosing bronchiectasis and aspergillomas, while bronchoscopy was diagnostic of bronchitis and mucosal lesions such as Kaposi sarcoma [19].

- Among 50 patients with hemoptysis and a normal or nonlocalizing chest radiograph, a definitive diagnosis was established by HRCT or flexible bronchoscopy in 17 (34 percent); HRCT was diagnostic in 15 (30 percent), and flexible bronchoscopy was diagnostic in 5 (10 percent) [20]. In three patients with bronchial adenomas (bronchial carcinoid), the diagnosis was suspected on HRCT, but bronchoscopy provided the tissue diagnosis.

In general, we aim to perform bronchoscopy during the period of active hemoptysis in hopes of improving diagnostic yield, although data in support of this practice are limited. In a retrospective study, flexible bronchoscopy performed acutely (during hemoptysis or within 48 hours after hemoptysis stopped) was more likely to visualize active bleeding (41 versus 8 percent) or its site (34 versus 11 percent) than delayed bronchoscopy [21]. However, the clinical outcome was not significantly different between the early and delayed groups. With ongoing active bleeding or difficulty with timely scheduling of bronchoscopy as an outpatient, hospitalization for monitoring and for expedited evaluation is often indicated.

Recurrent hemoptysis or risk factors for malignancy — For patients with recurrent hemoptysis, we typically recommend a CT scan of the chest, even if they have a normal chest radiograph. The main causes of recurrent hemoptysis in a patient with a normal chest radiograph are bronchiectasis, carcinoid tumors, catamenial hemoptysis (from endobronchial endometriosis in women), pulmonary arteriovenous malformation, pseudohemoptysis due to extrapulmonary sources (eg, nasal or gastrointestinal), and foreign bodies.

Lung malignancy is found in approximately 10 percent of patients with hemoptysis who have risk factors for lung cancer and a normal chest radiograph [8,11]. However, this number

becomes much smaller when the CT scan is unrevealing for evidence of malignancy.

A study from Denmark found that the vast majority of cases of hemoptysis with no malignancy suspected on CT were either cryptogenic or benign in etiology [22,23]. Bronchoscopy was performed in 92 percent of 1185 patients evaluated for hemoptysis who had no evidence of malignancy on CT. Eighty-three percent were deemed to have cryptogenic hemoptysis, 13 percent had a respiratory tract infection, and 2 percent had bronchiectasis. Importantly, none had malignancy identified.

A list of questions to evaluate the risk of lung malignancy is provided in the table (table 2). Of note, hemoptysis due to malignancy is often a small volume [5,6]. A number of studies have examined the role of CT in identifying malignancy in patients with a normal chest radiograph [6,11-13,15,24], and current guidelines support obtaining a chest CT with contrast in this setting.

The reasons for performing CT prior to bronchoscopy in these patients include the following:

- Bronchoscopy can miss bronchiectasis and small tumors.
- Certain CT diagnoses in patients at a low risk for malignancy (eg, bronchiectasis or a pulmonary arteriovenous malformation) can make bronchoscopy unnecessary.
- CT may be helpful in guiding the exact procedure selected for bronchoscopy (eg, flexible bronchoscopy versus endobronchial ultrasound/advanced navigation guided bronchoscopy) [5,16,19].

Bronchoscopy is indicated in those in whom a CT is unrevealing or in those in whom the CT reveals an abnormality that requires a tissue diagnosis (eg, suspected malignancy). The potential advantages of bronchoscopy in this setting include identifying small endobronchial tumors or lesions (eg, Dieulafoy anomaly, bronchitis, foreign body) that may have been missed on CT scan. In addition, bronchoscopy enables samples to be obtained for microbiologic, cytologic, and histopathologic analysis and determination of whether bronchoscopic interventions (eg, laser, argon plasma coagulation, cautery) would be appropriate.

Chest radiograph suggestive of bronchogenic cancer — In addition to clinical features suggestive of malignancy, certain chest radiographic features are also suggestive of bronchogenic cancer [5,6]. These features include a pulmonary nodule that is new, enlarging, or larger than 8 mm. Nodules that are 8 to 20 mm are associated with an 18 percent risk of malignancy; those that are >20 mm have a 50 percent risk of malignancy. (See "Diagnostic evaluation of the incidental pulmonary nodule", section on 'Nodule features'.)

When evaluating pulmonary nodules, it is generally preferable to obtain contrast-enhanced CT of the chest prior to bronchoscopy for preliminary staging and to guide tissue sampling at the time of bronchoscopy (eg, endobronchial biopsy, endobronchial ultrasound-guided needle aspiration [EBUS-TBNA], transesophageal endoscopic ultrasound fine needle aspiration [EUS-FNA] of a lymph node). In some cases, a combination of procedures or surgical resection will be needed to ascertain the diagnosis. (See "Selection of modality for diagnosis and staging of patients with suspected non-small cell lung cancer".)

Chest imaging with multiple nodules or cavitary opacities — Nodules and areas of consolidation with cavitation need evaluation for infection (eg, necrotizing pneumonia, mycobacterial, fungal, parasitic), inflammatory processes (eg, granulomatosis with polyangiitis), and malignancy (eg, lymphoma, metastatic cancer).

Appropriate laboratory tests include sputum Gram and acid fast stains, blood cultures, antineutrophil cytoplasmic antibody test, and serologic tests for mycobacterial or fungal infection (eg, interferon-gamma release assay, histoplasma polysaccharide antigen, cryptococcal antigen, beta-D-glucan).

In general, when multiple nodules, cavitating nodules, or necrotizing pneumonia is seen or suspected based on the chest radiograph, the next step is CT to characterize the abnormalities and identify any additional lung or mediastinal lesions. CT is often helpful in guiding invasive diagnostic procedures.

Bronchoscopy with bronchoalveolar lavage (under appropriate precautions for tuberculosis) is generally performed when there is cavitation to obtain samples for culture and cytology. For multiple non-cavitating nodules, particularly those in a peripheral location, transthoracic needle aspiration or lung biopsy via video-assisted thoracoscopic surgery or thoracotomy may be more likely to yield a diagnosis. (See "Basic principles and technique of bronchoalveolar lavage" and "Diagnostic evaluation of the incidental pulmonary nodule", section on 'Management options'.)

Chest imaging showing diffuse opacities — The differential diagnosis of diffuse opacities in a patient with hemoptysis is broad and includes infectious, inflammatory, vascular, and malignant processes, as well as drug or toxin exposure (table 1).

Diffuse ground glass or consolidative opacities raise the possibility of heart failure, diffuse alveolar hemorrhage, granulomatosis with polyangiitis, antiglomerular basement membrane antibody (Goodpasture) disease, and idiopathic pulmonary hemosiderosis. Thus, appropriate laboratory tests include a plasma brain natriuretic peptide (BNP, or N-terminal pro-BNP) level, screening for bleeding disorders, and serologic testing for antinuclear, antineutrophil cytoplasmic, antiglomerular basement membrane, and antiphospholipid antibodies, which are

all associated with diffuse alveolar hemorrhage. Serologic testing for antibodies associated with celiac disease may support a diagnosis of idiopathic pulmonary hemosiderosis. (See "Determining the etiology and severity of heart failure or cardiomyopathy" and "The diffuse alveolar hemorrhage syndromes" and "Granulomatosis with polyangiitis and microscopic polyangiitis: Clinical manifestations and diagnosis" and "Anti-GBM (Goodpasture) disease: Pathogenesis, clinical manifestations, and diagnosis" and "Diagnosis of antiphospholipid syndrome" and "Idiopathic pulmonary hemosiderosis".)

In addition to the laboratory evaluation, an echocardiogram may be indicated to more fully evaluate for valvular heart disease or left ventricular dysfunction.

The diagnosis of alveolar hemorrhage is made by three sequential bronchoalveolar lavages (BAL) in a single location, showing progressively more hemorrhagic effluent, although BAL may be falsely negative and may not identify the etiology of the alveolar hemorrhage. In the setting of acute respiratory distress syndrome (ARDS), culture and cytologic analysis of BAL fluid can be helpful in identifying an infectious agent responsible for the syndrome. (See "The diffuse alveolar hemorrhage syndromes", section on 'Bronchoalveolar lavage' and "The diffuse alveolar hemorrhage syndromes", section on 'Biopsy'.)

A skin biopsy may be diagnostic in patients with skin lesions suggestive of vasculitis, and fat pad biopsy should be obtained in patients with suspected amyloidosis. A lung or kidney biopsy may be necessary when the above evaluation is not diagnostic. (See "Evaluation of adults with cutaneous lesions of vasculitis".)

Recurrent hemoptysis with normal CT — For patients with recurrent hemoptysis and a normal CT scan, flexible bronchoscopy may yield a diagnosis. If bronchoscopy is negative, pseudohemoptysis has been excluded, and the patient is not on anticoagulant therapy, the patient is considered to have cryptogenic hemoptysis.

Repeat investigation with recurrent events may eventually identify a cause. Among 228 patients with recurrent hemoptysis and no culprit lesions on CT scan, a possible lower airway source of bleeding was identified on bronchoscopy in 37 patients (16 percent) [12]. Of the 191 patients with a negative CT and negative bronchoscopy, 43 had an upper airway source of bleeding or were using anticoagulants. The remaining 148 were followed for a mean of 781 days and hemoptysis recurred in 20 percent. Of these patients, five had catamenial hemoptysis, one had pulmonary tuberculosis, and one had polyarteritis nodosa; the others would be considered to have cryptogenic hemoptysis. In a separate series of patients from Denmark with hemoptysis and no malignancy suspected on chest CT scan, lung cancer was diagnosed in less than 2

percent over the ensuing five years [22]. (See "Etiology of hemoptysis in adults", section on 'Cryptogenic hemoptysis'.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Hemoptysis".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see "Patient education: Coughing up blood (The Basics)")

SUMMARY AND RECOMMENDATIONS

- **Etiologies** – Hemoptysis may be caused by airways disease (most common), pulmonary parenchymal disease, or pulmonary vascular disease, or may be idiopathic (table 1). (See 'Definitions' above and "Etiology of hemoptysis in adults".)

- **Triage of hemoptysis** – An essential initial step in the evaluation is to determine whether the patient has life threatening (massive) hemoptysis, which we define as hemoptysis causing airway obstruction, significant gas exchange abnormality, or hemodynamic instability. While volume criteria for life-threatening hemoptysis are not precise, we consider approximately 150 mL of expectorated blood over a 24-hour period or bleeding at a rate ≥100 mL/hour to be potentially life-threatening. The evaluation and management

of massive hemoptysis are described separately. (See 'Definitions' above and "Evaluation and management of life-threatening hemoptysis" and "Etiology of hemoptysis in adults".)

- **Clinical manifestations** – The evaluation of nonlife-threatening hemoptysis begins with an initial history and physical examination and assessment of oxygenation (algorithm 1). Important features of the history include age, tobacco and other smoke exposure, duration and quantity of hemoptysis, and association with symptoms of acute bronchitis or an acute exacerbation of chronic bronchitis or bronchiectasis (change in sputum, blood streaking superimposed upon purulent sputum) (table 2 and table 3). (See 'Initial evaluation' above.)

- **Laboratory studies** – Laboratory studies which may be useful depending upon the particular clinical situation include hemoglobin/hematocrit, platelet count, coagulation profile, urinalysis, blood urea nitrogen, plasma creatinine concentration, and collection of sputum for microbiologic studies. A plasma brain natriuretic peptide (BNP)/N-terminal pro-BNP (NT-proBNP) may be helpful if heart failure is a suspected contributor, while a D-dimer test would help to screen for pulmonary embolism. (See 'Laboratory studies' above.)

- **Imaging** – The most important initial study, beyond history and physical examination, for all patients presenting with hemoptysis is a chest radiograph. Abnormal findings may be suggestive of a variety of specific causes of hemoptysis, ranging from primary lung neoplasm to focal infection (tuberculosis, aspergilloma) to mitral stenosis with pulmonary edema. (See 'Imaging' above.)

- **Patients with normal imaging and without risk factors for malignancy** – No immediate further work-up is indicated if the clinical picture is not suggestive of carcinoma (eg, negative chest radiograph, age less than 40 years, no smoking history, and hemoptysis less than one week duration), particularly if acute bronchitis (blood streaking superimposed upon purulent sputum) seems likely. Such a patient should be treated for bacterial bronchitis (if indicated) and observed for recurrence of hemoptysis following improvement in purulent sputum production. (See 'Patients with a normal chest radiograph' above.)

- **Patients with abnormal imaging and/or risk factors for malignancy** – Further evaluation is indicated if the patient has risk factors for lung malignancy (eg, >40 years old and >30 pack-year smoking history) (table 2), or if the hemoptysis is recurrent or associated with radiographic abnormalities. Chest computed tomography (CT) with contrast and flexible bronchoscopy are complementary procedures, although CT is often performed first as it is less invasive, has a higher diagnostic rate, and can help direct the

selection of sampling procedures and location. (See 'Directed evaluation based on presentation' above.)

- For patients with recurrent hemoptysis and a normal CT scan, flexible bronchoscopy may yield a diagnosis. If bronchoscopy is negative, pseudohemoptysis has been excluded, and the patient is not on anticoagulant therapy, the patient is considered to have cryptogenic hemoptysis. (See 'Recurrent hemoptysis with normal CT' above.)

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GRAPHICS

Causes of hemoptysis

Airway diseases
Bronchitis: Acute or chronic
Bronchiectasis* (eg, cystic fibrosis-related)
Bronchogenic carcinoma*
Bronchial carcinoid tumor
Metastatic cancer to bronchus or trachea
Bronchovascular fistula (eg, aortic aneurysm with erosion into airway)
Dieulafoy disease (subepithelial bronchial artery)
Foreign body in airway
Broncholith
Pulmonary parenchymal diseases
Infection
Necrotizing pneumonia and lung abscess
Bacterial infections (anthrax [*Bacillus anthracis*], leptospirosis [*Leptospira* species], plague [*Yersinia pestis*], tularemia [*Francisella tularensis*])
Tuberculous* and nontuberculous mycobacterial disease
Mycetoma and other fungal infections*
Parasitic (eg, *Paragonimus westermani*, *Strongyloides*)
Viral (eg, Herpes simplex, Crimean-Congo hemorrhagic fever [CCHF], dengue virus [DENV])
Rheumatic disease
Anti-glomerular basement membrane disease (Goodpasture disease)
Granulomatosis with polyangiitis and other

Bleeding disorders and trauma
Bleeding disorders
Anticoagulant and antiplatelet medications
Disseminated intravascular coagulation (DIC)
Platelet dysfunction (eg, renal failure)
Thrombocytopenia (ITP, TTP, HUS)
von Willebrand disease
Trauma
External blunt or penetrating trauma
Airway stent
Balloon dilation of airway lesion
Bronchoscopic endobronchial or transbronchial biopsy or needle aspiration biopsy
Bronchoscopic ablative procedures (eg, cryotherapy, brachytherapy)
Erosion of tracheal tube into innominate artery
Transthoracic needle aspiration or biopsy
Vascular injury from pulmonary artery catheter
Miscellaneous
Drugs and toxins
Cocaine use
Argemone alkaloid-contaminated cooking oi (epidemic dropsy)
Bevacizumab treatment
Nitrogen dioxide toxicity (eg, silo fillers, indoor ice arenas with faulty propane powered equipment and poor ventilation)

vasculitides
Behçet disease
Primary antiphospholipid antibody syndrome
Systemic lupus erythematosus
Other
Genetic defect of collagen (eg, Ehlers-Danlos vascular type)
Endometriosis (catamenial hemoptysis)
Pulmonary vascular diseases
Heart failure (acquired or congenital)
Mitral stenosis
Pulmonary arteriovenous malformation
Pulmonary artery pseudoaneurysm (due to infection, neoplasm, or trauma)
Pulmonary embolism (eg, fat, septic, thrombotic)
Pulmonary veno-occlusive disease
Pulmonary and bronchial artery aneurysms (eg, Hughes-Stovin syndrome)

Hydralazine (hydralazine-induced vasculitis)
Riociguat
E-cigarette or vaping product use associated lung injury (EVALI)
Idiopathic/miscellaneous
Idiopathic pulmonary hemosiderosis
Amyloid
Fibrosing mediastinitis
Pseudohemoptysis
Due to aspirated blood from upper airway or gastrointestinal sources

The most common causes of life-threatening hemoptysis are marked with an asterisk. Life-threatening hemoptysis is variably defined in studies. We define it as hemoptysis that results in a life-threatening event such as serious airway obstruction, significant deterioration in gas exchange or hemodynamic instability or ≥150 mL blood expectorated in a 24-hour period or bleeding ≥100 mL per hour.

ITP: immune thrombocytopenia; TTP: thrombotic thrombocytopenic purpura; HUS: hemolytic uremic syndrome.

Graphic 96527 Version 8.0

Approach to the evaluation of nonlife-threatening hemoptysis

BOX A

Risk factors for lung malignancy:

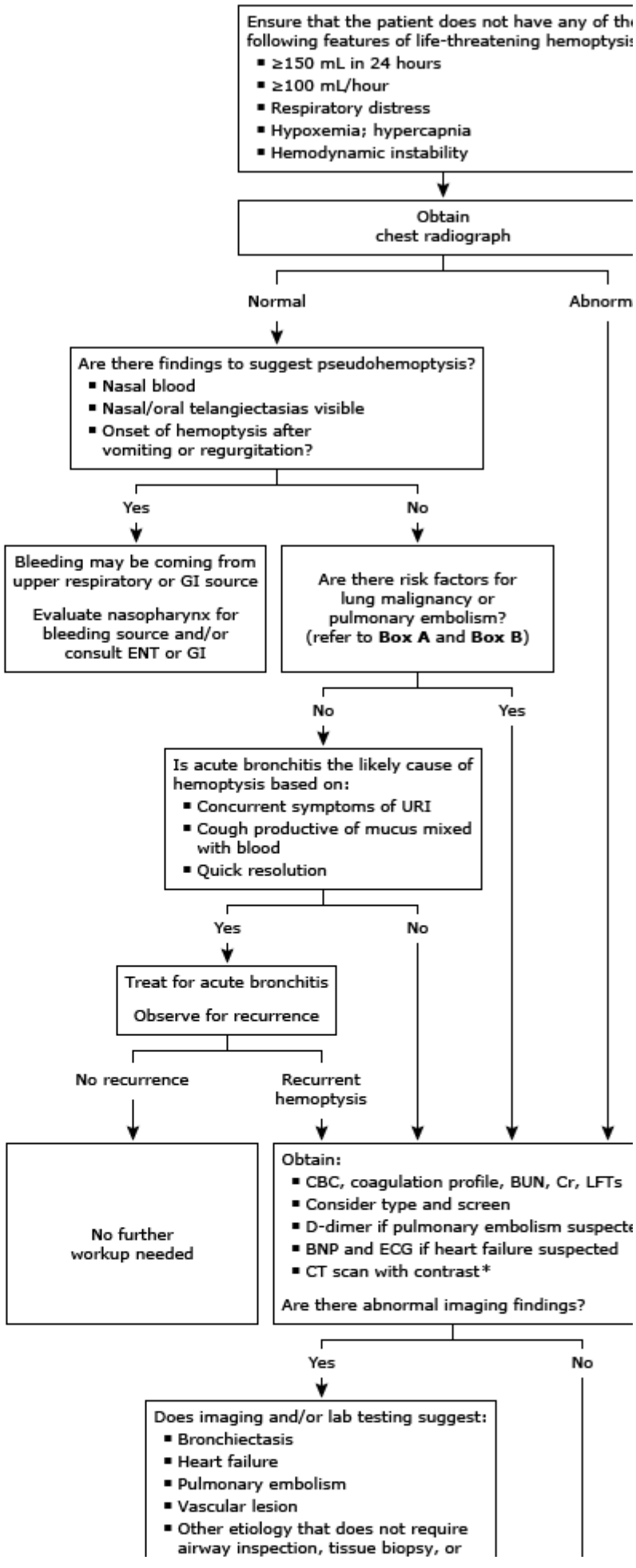
- Current or previous tobacco use
- Environmental toxins (eg, biomass smoke, passive smoke, radon)
- COPD, IPF
- HIV/AIDS
- Known cancers
- Asbestos exposure
- Prior radiation therapy (eg, Hodgkin disease)

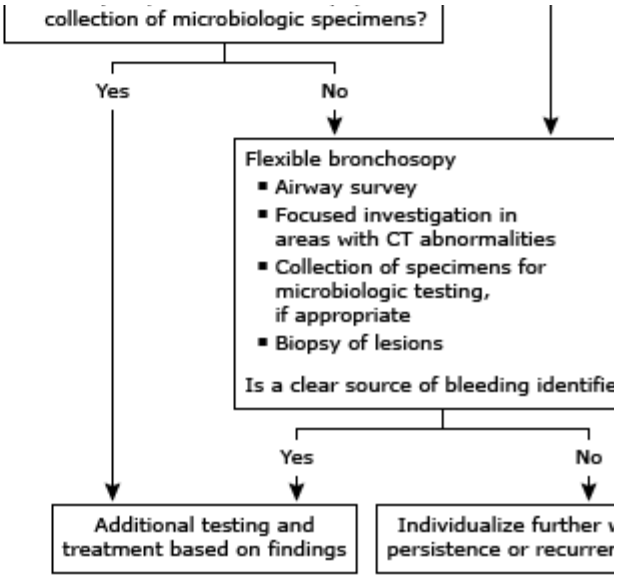
BOX B

Risk factors for pulmonary embolism:

- Prior VTE; current DVT
- Immobilization or surgery in prior 4 weeks
- Malignancy
- Pregnancy, use of oral contraceptives

Refer to UpToDate for Wells score calculator





COPD: chronic obstructive pulmonary disease; IPF: idiopathic pulmonary fibrosis; AIDS: acquired immune deficiency syndrome; VTE: venous thromboembolism; DVT: deep venous thrombosis; GI: gastroenterologist; ENT: ear, nose, and throat specialist; URI: upper respiratory tract infection; CBC: complete blood count; BUN: blood urea nitrogen; Cr: creatinine; LFTs: lung function tests; BNP: brain natriuretic peptide; ECG: electrocardiogram; CT: computed tomography; IV: intravenous; CTPA: computed tomography pulmonary angiogram.

* In general, we prefer CT scan with IV contrast to evaluate lung vasculature and parenchyma with these exceptions:

- If pulmonary embolism is suspected, we obtain CTPA with appropriate protocol.
- If strong suspicion for bronchiectasis or patient has contrast sensitivity or kidney impairment, we obtain noncontrast CT.

Graphic 130853 Version 2.0

Useful questions for the evaluation of hemoptysis

Present illness
How much blood has been coughed up in the past 24 to 48 hours?
Is the blood mixed with phlegm? Is the phlegm clear, white, or purulent?
When was the first time the hemoptysis occurred?
Is hemoptysis a new or recurrent symptom?
Is there any bleeding from the nose, gums, stomach, or rectum?
Is the patient dyspneic?
Does the patient raise phlegm (without hemoptysis) daily or frequently?
Are there other symptoms to suggest infection (eg, fever, chills, night sweats, purulent sputum)?
Has the patient had a skin rash?
Has the patient lost weight?
Any headache or bone pain?
Does the hemoptysis occur during menses?
Are there any symptoms to suggest systemic disease (eg, rash, hematuria, joint pain, or swelling)?
Comorbidities or risk factors
Does the patient currently smoke? How many packs per day? How many years?
Does the patient smoke e-cigarettes or vape? For how long? What substances (eg, nicotine, flavoring, THC) and what types of device?
Has the patient previously smoked? How many pack per day for how many years? When did they stop smoking?
Does the patient use cocaine?
Does the patient have known or suspected pulmonary, cardiac, or renal disease?
Has the patient had a thoracic procedure (eg, stent placement, pulmonary artery catheter, aortic graft) or surgery?
Has the patient had joint symptoms or a history of collagen vascular disease or associated symptoms?
Does the patient have a known or suspected bleeding disorder?
Does the patient take aspirin, nonsteroidal anti-inflammatory drugs, anti-platelet drugs, or an anticoagulant?
Are there any recent risk factors for deep vein thrombosis (DVT), such as surgery, hospitalization, travel, or immobility?
Does the patient have a history of upper airway or upper gastrointestinal disease or symptoms?

Where has the patient travelled, either recently or in the past and to what countries?
Has the patient had tuberculosis (TB) or been exposed to TB?
Is the patient at high risk for TB or unusual parasitic disorders based upon travel history?
Has the patient been exposed to trimellitic anhydride or other organic chemicals?
Has the patient been exposed to asbestos?
Family history
Have family members had problems with blood clots?
Have family members had problems with hemoptysis, brain aneurysms, epistaxis, or gastrointestinal bleeding (suggesting possible hereditary hemorrhagic telangiectasia)?

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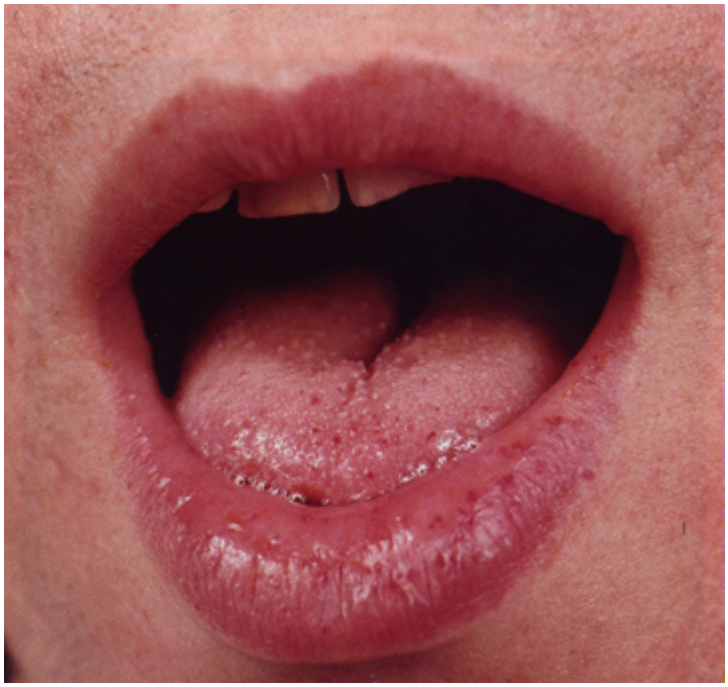
The directed physical examination for evaluation of hemoptysis

Examination of sputum at the bedside for amount and color of blood; concomitant purulent secretions
Is the patient in respiratory distress (eg, tachypneic, cyanotic, not able to speak in full sentences, using accessory muscles of respiration)?
Are there telangiectasias on the lips, tongue, or buccal mucosa to suggest that the patient may have hereditary hemorrhagic telangiectasia?
Is there blood in the anterior nose?
Does the patient have clubbing of the digits that might suggest lung cancer?
Is there a skin rash that may indicate vasculitis, systemic lupus erythematosus (SLE), fat embolism, or infective endocarditis?
Is there bruising suggestive of coagulopathy or thrombocytopenia?
Are there conjunctival hemorrhages or splinter hemorrhages under the fingernails to suggest endocarditis or vasculitis?
Are there needle tracks to suggest right-sided endocarditis?
Are there any abnormalities on chest examination (eg, focal wheeze, adventitial sounds or a bruit)?
Is there an audible chest bruit or murmur that increases with inspiration? These findings may indicate a large pulmonary arteriovenous malformation.
Is the pulmonic heart sound (P2) augmented, or are there murmurs of tricuspid regurgitation or pulmonic insufficiency? These findings with or without a right ventricular lift may suggest pulmonary hypertension.
Is there a heart murmur that might signal pulmonary vascular congestion (eg, mitral stenosis, mitral regurgitation) or endocarditis, a potential source of septic emboli?
Does the patient have asymmetric peripheral edema or a posterior calf palpable cord to indicate deep venous thrombosis?
Does the patient have peripheral edema, joint effusions, or periarticular warmth?

Graphic 96530 Version 2.0

Oral telangiectasia in hereditary hemorrhagic telangiectasia (Osler-Weber-Rendu syndrome)



Osler-Weber-Rendu syndrome (also known as hereditary hemorrhagic telangiectasia). Note the multiple 1 to 2 mm, discrete, red macular and papular telangiectases on the lower lip and tongue.

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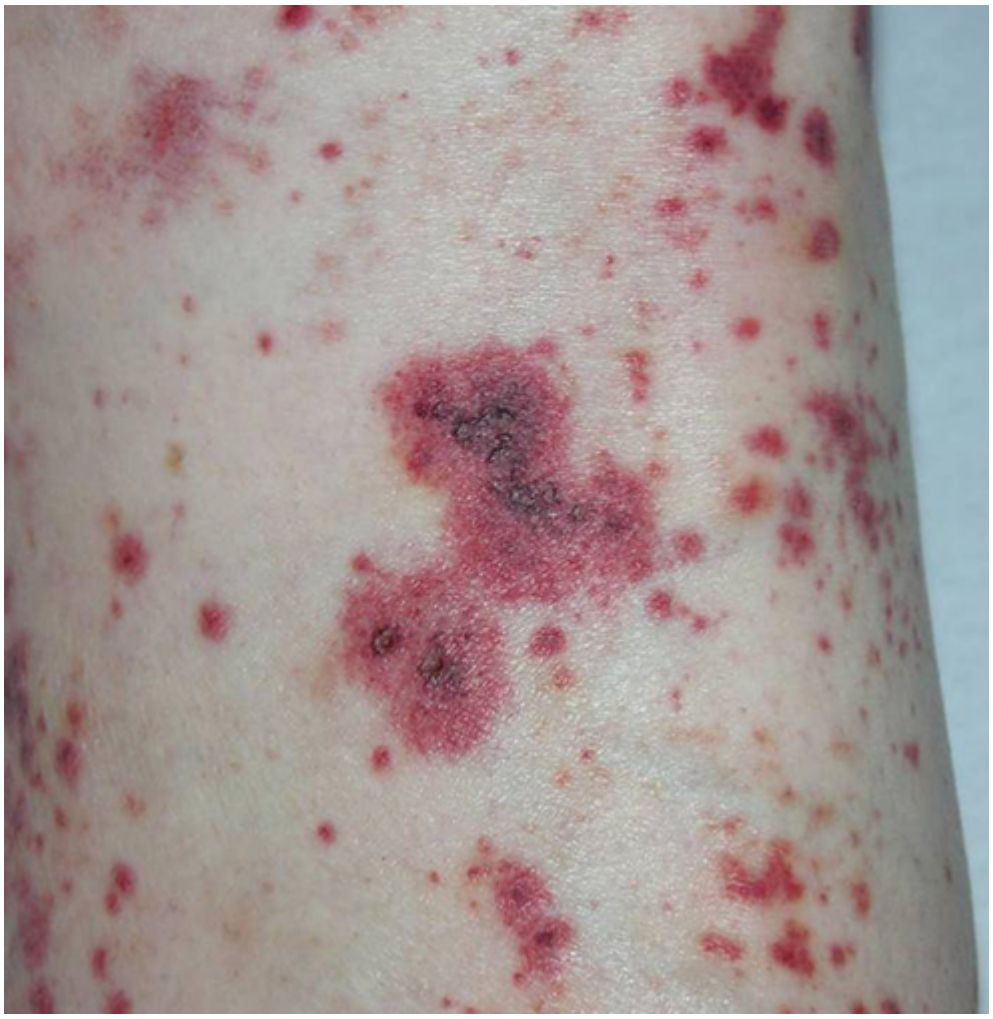
Palpable purpura



Non-blanching, palpable purpuric skin lesions found over the lower extremity of a patient with a small-vessel vasculitis affecting the skin.

Courtesy of Joseph F Merola, MD.

Graphic 51770 Version 2.0