Hemoptysis is defined as the expectoration of blood from the respiratory tract that originates below the vocal cords. Most cases are mild and consist of blood-tinged sputum or minute amounts of frank blood. The most common cause of small-volume hemoptysis is bronchitis. Rarely, hemoptysis is accompanied by massive blood loss, generally accepted as 100 to 600 mL of blood loss in any 24-hour period. In addition to manifesting as hemoptysis, endobronchial bleeding may impair alveolar oxygen exchange and cause significant morbidity and mortality. Rapid blood loss can also result in hemodynamic instability and shock.

Although hemoptysis is a common complaint in emergency populations, only 1 to 5% of hemoptysis patients have massive or life-threatening hemorrhage, with mortality rates approaching 80%. Large, contemporary series of patients with massive hemoptysis are lacking. Most etiologic data originate from small, often rural studies where tuberculosis (TB) and bronchiectasis are responsible for the vast majority of cases. In developed nations, cancer, cystic fibrosis, arteriovenous malformations, and postprocedural complications play a more prominent role. Pediatric hemoptysis is rare but can be caused by infection, congenital heart disease, cystic fibrosis, or bleeding from a preexisting tracheostomy.

Iatrogenic hemoptysis may complicate 2 to 10% of all endobronchial procedures, especially percutaneous lung biopsies. Additionally, bleeding can be exacerbated by coagulopathy and thrombocytopenia. An uncommon cause includes ectopic endometrial tissue within the lung that can result in monthly catamenial episodes of hemoptysis. Diffuse alveolar hemorrhage can be seen with autoimmune vasculitides such as Wegener’s granulomatosis, systemic lupus erythematosus, and Goodpasture’s syndrome. Still others include pulmonary hereditary telangiectasias and hydatiform infections.

When a patient presents with apparent hemoptysis, two other potential sources of bleeding should be investigated. Nasal, oral, or hypopharyngeal bleeding sometimes inadvertently contaminates the tracheobronchial tree and can mimic true hemoptysis. The clinician should closely inspect the nasopharynx and oral cavity to exclude this possibility. Differentiating hemoptysis from a gastric or proximal duodenal source of bleeding is the principle diagnostic dilemma, since further evaluation and management follow divergent pathways. Usually, this can be done by the patient and physician discriminating coughing from vomiting. In unclear cases, inspection and pH testing may help to distinguish gastrointestinal from tracheobronchial hemorrhage. Unless an active, brisk upper GI hemorrhage is present, the acidification of blood in the stomach results in fragmentation and
darkening of its color. This produces specks of brown or black material often referred to as “coffee-grounds” emesis. Pulmonary blood appears bright red or as slightly darker clots and is alkaline.

**Rapid Assessment and Stabilization**

Although hemodynamic instability can occur as a result of hemorrhage, the most lethal sequela of massive hemoptysis is hypoxia resulting from the ventilation-perfusion mismatch that occurs as small airways and alveoli are submerged with blood. The clinician should consider the standard indications for emergency airway management in such cases. As a mitigating maneuver in patients with a known lateralizing source of bleeding, the “lung down” position can be employed in which the patient is positioned so the bleeding lung is more dependent. This position can promote continued protection and ventilation of the unaffected lung and improve oxygenation.\(^{10,11}\) Large-bore (8.0) endotracheal tubes should be used to facilitate emergent fiberoptic bronchoscopy. In selected cases of confirmed left-sided bleeding, a single-lumen right-mainstem intubation can be successfully performed by advancing the tube in either the neutral position or by using a 90° rotational technique.\(^{12}\) Left-mainstem intubations are more difficult and should be attempted with caution.

The use of double-lumen endotracheal tubes for lung isolation should be reserved for dire circumstances and usually requires an experienced anesthetist. The correct positioning of blindly placed double-lumen tubes is difficult and requires confirmation by auscultation and fiberoptic bronchoscopy, both of which have severely impaired accuracy in massive hemoptysis. Complications of double-lumen tubes include unilateral and bilateral pneumothorax, pneumomediastinum, carinal rupture, lobar collapse, and tube malposition.\(^{13}\)

**Pivotal Findings**

**History**

Although patient reports of bleeding severity are historically inaccurate, a rough estimate of the rate, volume, and appearance of expectorated blood should be obtained.

Any history of parenchymal pulmonary disorders should be obtained, including the presence of bronchiectasis, recurrent pneumonia, chronic obstructive pulmonary disease, bronchitis, TB, and fungal infection. Inflammatory disorders that secondarily involve the lungs or pulmonary vasculature include Wegener’s granulomatosis, Goodpasture’s syndrome, and systemic lupus erythematosus. Risk factors for platelet dysfunction, thrombocytopenia, and coagulopathy may be present. Hypercoagulable states can contribute to deep venous thrombi and pulmonary embolism.

The presence of primary or metastatic cancer can cause hemoptysis by erosion into pulmonary and bronchial vessels. Recent percutaneous or transbronchial procedures can cause immediate or delayed postprocedural bleeding, and any recent history of trauma should also be noted. A pertinent travel history to areas endemic with TB or pulmonary paragonimiasis is crucial.

**Physical Examination**

After a primary survey and stabilization, a targeted examination might suggest the location and etiology of bleeding, but does so in less than 50% of cases.\(^{14}\) Focal adventitious breath sounds may indicate pneumonia or pulmonary abscess. A new heart murmur, especially in a febrile patient, might reflect endocarditis causing septic pulmonary emboli. Symptoms and signs of deep venous thrombosis should suggest pulmonary embolism. Ecchymoses and petechiae can indicate coagulopathy and thrombocytopenia, respectively.

**Ancillary Testing**

Initial laboratory studies include a complete blood count, coagulation tests, and a type and screen or crossmatch. Renal function tests should be obtained if vasculitis is suggested or contrast computed tomography (CT) is planned. Plain chest radiography should be ordered, although its sensitivity is marginal. A prospective study of 184 consecutive patients with varying degrees of hemoptysis reveals that more than 40% of patients with a normal chest radiograph have a positive chest CT.\(^{15}\)

In patients with massive hemoptysis, plain films may localize the site of hemorrhage in as many as 80% of patients.\(^{6}\) High-resolution multidetector CT of the chest is the principle diagnostic test for investigating both bronchial and nonbronchial arterial causes of massive hemoptysis. CT is diagnostically comparable, yet less invasive, than conventional angiography, which is now done primarily as a combined diagnostic-therapeutic modality.\(^{16,18}\) A chest CT should be obtained in the high risk patient (smokers, oncology patients) or in any patient with moderate to severe bleeding even if the initial chest radiography is normal. CT localization of hemorrhage can expedite bronchoscopic evaluation or guide subsequent interventional procedures.

**Differential Diagnosis**

Potential causes of hemoptysis vary and include systemic illnesses as well as pulmonary parenchymal disease. Box 31-1 includes the most common causes.

**Management**

Since the advent of high-resolution CT, radiologic evaluation has had an integral role in the evaluation and treatment of patients with hemoptysis. The challenge to the emergency physician is to rapidly assess the need for airway control prior to hemodynamic stabilization. Unless the initial chest radiograph is diagnostic or the patient is hemodynamically unstable, a chest CT should be obtained in most cases. Further management strategy should be developed in conjunction with pulmonary and thoracic surgery consultants, guided by the CT results (Fig. 31-1).

**Bronchoscopy**

Early bronchoscopy facilitates both localization of bleeding and therapeutic intervention. Balloon and topical hemostatic tamponade, thermocoagulation, and injection of vasoactive agents can all control arterial bleeding. Optimal timing for bronchoscopy remains conjectural. Stable patients with mild to moderate bleeding may benefit from early bronchoscopy. In unstable patients or those with brisk hemorrhaging, bronchoscopy sometimes can facilitate airway management, but is less likely to control bleeding.

Chest CT is as diagnostically accurate as bronchoscopy in locating peripheral vessels not accessible by a flexible bronchoscope.\(^{19}\) Chest CT is used to identify the bleeding site and to determine whether angiography is indicated. There may be little benefit to bronchoscopy prior to interventional angiography if a CT scan has accurately identified a bleeding source.\(^{20}\)
**Differential Diagnosis: Hemoptysis**

**Airway Disease**  
Bronchitis (acute or chronic)  
Bronchiectasis  
Neoplasm (primary and metastatic)  
Trauma  
Foreign body

**Parenchymal Disease**  
Tuberculosis  
Pneumonia/lung abscess  
Fungal infection  
Neoplasm

**Vascular Disease**  
Pulmonary embolism  
Arteriovenous malformation  
Aortic aneurysm  
Pulmonary hypertension  
Vasculitis (Wegener's granulomatosis, SLE, Goodpasture's syndrome)

**Hematologic Disease**  
Coagulopathy (cirrhosis or warfarin therapy)  
Disseminated intravascular coagulation  
Platelet dysfunction  
Thrombocytopenia

**Cardiac Disease**  
Congenital heart disease (especially in children)  
Valvular heart disease  
Endocarditis

**Miscellaneous**  
Cocaine  
Post-procedural injury  
Tracheal-arterial fistula

SLE, systemic lupus erythematosus.

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**Interventional Angiography**

Bronchial arterial embolization is an effective first-line therapy and is the procedure of choice for patients unable to tolerate surgery, or those in whom bronchoscopy was unsuccessful. Hemostatic rates range from 91 to 98%, but as many as 20 to 50% of patients have early episodes of repeat bleeding. The risk of delayed bleeding may exist for up to 36 months. In order to guide therapy, initial localization of bleeding by bronchoscopy or CT is preferred. Rare complications include arterial perforation and dissection.

**Surgery**

Emergency thoracotomy is reserved for life-threatening hemoptysis or for persistent, rapid bleeding that is uncontrolled by bronchoscopy and percutaneous embolization. Pulmonary arterial hemorrhage from tumor necrosis represents a surgical emergency.

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**DISPOSITION**

Healthy patients with blood-streaked sputum and normal vital signs do not require imaging beyond plain chest radiography and can be discharged with follow-up. High risk patients with minor hemoptysis and all patients with moderate or large amounts of hemoptysis should undergo plain chest radiography followed by emergent chest CT. Brief hospitalization or admission to an observation unit for bronchoscopy should be considered. All patients with massive hemoptysis require admission to an intensive care unit and expedited multidisciplinary treatment involving the emergency physician, pulmonologist, and thoracic surgeon.

The references for this chapter can be found online by accessing the accompanying Expert Consult website.