
Problems in Family Practice

Hemoptysis

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Hemoptysis is an alarming symptom that should not be dismissed lightly. A thorough evaluation will lead to the correct diagnosis in 80 to 90 percent of cases. Surgery is occasionally necessary where life-threatening hemorrhage is present but, more commonly, appropriate therapy can only be determined when the etiology is discovered, thus mandating a careful, thorough diagnostic search.

Hemoptysis, the coughing up of blood, is a startling symptom which usually brings the patient promptly to the physician and results in well-deserved apprehension on the part of both.¹

The first task of the physician is to determine that, in fact, the blood has originated from the airway (larynx, trachea, bronchi) or lungs, and does not represent bleeding from the mouth, nasopharynx, or gastrointestinal tract. In the pediatric age group the vast majority of children brought to the physician by the parent for spitting up blood have a source of bleeding outside the lower respiratory tract, for example epistaxis. Sometimes the patient with true hemoptysis can describe a sensation of fluid in an area of the chest immediately prior to hemoptysis. When this occurs, it helps to localize the point of origin to a specific side and region in the tracheobronchial tree, but this is not invariably reliable.

In contrast to hematemesis, the blood is coughed up and not vomited, is often frothy as it is mixed with air and sputum, and is usually (but not always) bright red. In hematemesis the blood may be dark red or brownish in color, due to hemoglobin conversion to hematin by gastric acid. Hemoptysis may be preceded by a gurgling noise as the blood is moved by air flow in large bronchi or the trachea. The pH of the blood in hemoptysis is usually alkaline, whereas the pH of vomited blood is more likely acidic. Following an episode of hemoptysis, the sputum may be blood-tinged for several days, whereas vomited blood, unless it is aspirated, is not associated with blood-tinged sputum. Actual observation by the physician of the sputum is often helpful because occasional oxidation of inhaled bronchodilators will result in a brownish-red color which can impart a homogeneous pink color to the expectorated material.

The majority of diseases that affect the pulmonary system can result in hemoptysis, thus the list of possible etiologies is lengthy and will not be reviewed in its entirety here. Nevertheless, a division of the more common causes of hemoptysis by age, ie, children vs adults, may be of use (Tables 1 and 2).

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Table 1. Some Causes of Hemoptysis in Children

Aspirated foreign body
Bronchiectasis with Agammaglobulinemia
Cystic fibrosis
Necrotizing pneumonia
Pulmonary hemosiderosis
Congenital heart disease

Hemoptysis in Children

As children under the age of six years rarely expectorate sputum even with extensive coaching, the presence of hemoptysis may not be apparent unless the amount of hemorrhage is large. When a child does present with hemoptysis, a common etiology is an *aspirated foreign body*. This diagnosis is especially likely if coughing is pronounced and if unilateral wheezing is present. Nonopaque foreign bodies resulting in "asthma" and recurrent hemoptysis have been reported in children refractory to the usual pharmacologic management of asthma. Therefore, persistent wheezing that may be generalized in association with hemoptysis should suggest the diagnosis of an aspirated foreign body.

Bronchiectasis, an abnormal dilatation of bronchi usually related to chronic or recurrent infection and bronchial obstruction, is seen in children with agammaglobulinemia or related immunologic deficiency states, with cystic fibrosis, or following infections such as pertussis. Bronchiectasis is associated with proliferation of bronchial blood vessels that commonly rupture, resulting in hemoptysis.

Cystic fibrosis does not commonly give rise to hemoptysis until the obstructive pulmonary disease and bronchiectasis associated with it is pronounced. In such cases, hemoptysis may first appear in adolescence after many years of recurrent or chronic pulmonary infections.

Lower respiratory tract infections, especially *necrotizing pneumonias*, may result in hemoptysis. Thus, *Klebsiella*, staphylococcal, and *Pseudomonas pneumonias*, when they occur in children, may cause hemoptysis.

Idiopathic pulmonary hemosiderosis, which is an uncommon disease, occurs predominantly in children and young adults, is associated with diffuse recurrent alveolar hemorrhage, and characteristically presents with expectoration of pink frothy sputum, diffuse parenchymal infiltrates on chest roentgenogram, and iron deficiency anemia.

Congenital heart disease of various types as well as other congenital pulmonary vascular abnormalities may cause hemoptysis in children.

Hemoptysis in Adults

Hemoptysis is a more frequent complaint in adults than in children, and the list of possible etiologies is considerably longer. These etiologies can be grouped into five categories: infections, neoplastic diseases, cardiovascular diseases, immunologic diseases, and miscellaneous (Table 2).

Infections

Chronic bronchitis is one of the most frequent causes of mild hemoptysis. A history of chronic productive cough, usually with a history of cigarette smoking, is present. Caution is advised in attributing hemoptysis to chronic bronchitis as more serious diseases, such as lung cancer, also occur predominantly in cigarette smokers.

Bronchiectasis, if it is symptomatic, is accompanied by hemoptysis in about 50 percent of cases. Chronic bronchitis and bronchiectasis were the major causes of hemoptysis in adults in one recent study.² Bronchography establishes a diagnosis of bronchiectasis in most cases. Unlike bronchiectasis of the lower lobes that usually is symptomatic with chronic production of copious amounts of

purulent sputum, the upper lobe bronchiectasis that is a common consequence of healed apical tuberculosis is often "dry," without sputum production. Both varieties may cause hemoptysis, and in "dry" bronchiectasis it may be the only symptom.

Lung abscess, frequently due to an indolent anaerobic infection especially in patients who have had seizures or unconsciousness with aspiration, has become a major cause of hemoptysis in adults. It should be noted that lung abscess is usually a roentgenographic diagnosis and does not define the etiology. Not uncommonly, the bleeding actually originates from a tumor or foreign body beyond which the abscess develops. Bronchoscopy is always indicated in cases of lung abscess to exclude these two possibilities and establish the etiology. Major hemoptysis occurs in about five percent of cases of lung abscess and is one clear indication for surgical resection.

Pulmonary tuberculosis was, in the past, a very common cause of hemoptysis in adults, being the leading etiologic factor in several reported studies.³ Aneurysms of bronchial vessels within tuberculosis cavities, named after Rasmussen who originally described them in 1868, are a cause of massive hemoptysis. Bronchiectasis resulting from the healing of tuberculosis contributes to the frequency of bleeding. Although the incidence of tuberculosis is declining, hemoptysis is still the presenting symptom in this disease in some cases. This accentuates the need for adequate sputum examination for the tubercle bacillus in all cases of hemoptysis.

Bacterial pneumonias are occasionally associated with mild hemoptysis, particularly in necrotizing pneumonias. A slowly clearing pneumonia or recurrent pneumonia in one segment or lobe suggests an obstructing lesion and is an indication for further diagnostic work-up.

Hemoptysis is an occasional manifestation in a number of *parasitic and fungal pneumonias*. In current practice, the presence of a mycetoma (fungus ball) has become an increasingly important cause of hemoptysis. A mycetoma is a saprophytic growth of fungus within a preexisting cavity or bulla. It has a characteristic radiologic appearance of a mass, often mobile, within the cavity with a "meniscus" of air at the top. In most instances, the fungus involved is *Aspergillus*, but cases due to *Candida* have been described.

Table 2. Some Causes of Hemoptysis in Adults

Infections
Chronic bronchitis
Bronchiectasis
Lung abscess
Pulmonary tuberculosis
Bacterial pneumonias
Parasitic and fungal pneumonias
Neoplastic Diseases
Bronchogenic carcinoma
Bronchial adenoma
Metastatic carcinoma in lung
Cardiovascular Diseases
Pulmonary infarction
Mitral stenosis
Pulmonary Arteriovenous Fistula
Telangiectatic bronchial wall vessels
Immunologic Diseases
Collagen vascular disease
Systemic lupus erythematosus
Wegener granulomatosis
Periarteritis nodosa
Goodpasture syndrome
Miscellaneous
Thoracic trauma
Broncholith
Bullae and cysts
Iatrogenic causes
Excessive anticoagulation
Idiopathic causes

Neoplastic Diseases

Hemoptysis occurs in over 50 percent of cases of *bronchogenic carcinoma* at some time in the course of the disease. The bleeding is usually not profuse, but the seriousness of this disease demands a thorough diagnostic evaluation. A normal chest roentgenogram does not exclude this diagnosis even though hemoptysis is usually a late symptom of lung cancer rather than an early one. With fiberoptic bronchoscopy and adequate sputum cytologic examination a diagnosis can usually be readily established.

Bronchial adenoma, a vascular tumor found usually in large airways, is accompanied by hemoptysis in about 50 percent of cases. Surgical resection is curative.

Metastatic tumors in the lung are often asymptomatic but may grow into the bronchial tree, causing hemoptysis.

Cardiovascular Diseases

Hemoptysis is a symptom in 25 percent of cases of *pulmonary infarction*. The bleeding is rarely massive and is typically associated with shortness of breath and pleuritic chest pain. A friction rub is sometimes noted and, rarely, frank pleural effusion may be present. Occasionally, an infarct may cavitate, simulating a bacterial lung abscess. The serious prognostic implications of pulmonary embolic disease emphasize the necessity to consider the possible presence of this condition in all patients with hemoptysis.

Mitral stenosis (or any other cause of pulmonary venous hypertension) can result in hemoptysis, probably due to rupture of distended pulmonary capillaries or bronchial veins. Expectoration of blood is seen in 10 to 20 percent of cases of mitral stenosis, may occur in mild as well as severe stenosis, and frequently follows exercise. Rarely, massive hemoptysis occurs resulting in death. Valvular surgery, by reducing the pulmonary vascular pressures, has led to cessation of the hemoptysis.

Pulmonary arteriovenous fistula, usually presenting radiologically as a solitary mass or nodule, may result in expectoration of blood. Cutaneous changes of hereditary hemorrhagic telangiectasia are usually present.

Several recent reports have indicated that careful fiberoptic bronchoscopic examination of segmental and subsegmental bronchi may reveal multiple *telangiectatic bronchial wall vessels* in some patients in whom no other cause for hemoptysis can be found.⁴ The etiology of these bronchial telangiectases is not understood. Some of the cases diagnosed in the past as "idiopathic hemoptysis" probably fall into this category.

Immunologic Diseases

A number of immunologic diseases, including *systemic lupus erythematosus*, *periarthritis nodosa*, and *Wegener granulomatosis* occasionally result in hemoptysis, probably related to the associated necrotizing pulmonary vasculitis. *Goodpasture syndrome*, which occurs primarily in young adults, with antibodies formed against both glomerular and alveolar basement membranes, results in recurrent diffuse alveolar hemorrhage that usually, but not always, results in hemoptysis. Progressive renal failure always occurs if the

patient does not first succumb from pulmonary insufficiency.

Miscellaneous

Thoracic trauma due to a puncture wound, rib fracture, or blunt contusion may result in expectoration of blood. Rarely, a blunt rapid deceleration chest injury such as a steering wheel injury will fracture a bronchus. This syndrome should be suspected in the presence of pneumomediastinum, pneumothorax, subcutaneous emphysema, and hemoptysis.

A *broncholith* results from a calcified lymph node eroding into the airway. Hemoptysis may be the only symptom, but a history of coughing up "stones" is present in 50 percent of cases. Bronchoscopy usually allows visualization of the eroding, calcified particle with its associated hemorrhage.

An uncommon cause of massive hemoptysis is rupture of a blood vessel in the wall of an emphysematous *bullae* or *cyst*. Considering the frequency of bullae in patients with pulmonary emphysema, it is surprising that this is not more commonly seen.

Iatrogenic causes of hemoptysis usually present no diagnostic problem. Bronchoscopic bronchial or transbronchial biopsy, percutaneous needle aspiration of lung, and transtracheal needle aspiration often cause minimal, and occasionally massive, hemoptysis. Hemoptysis may accompany the use of the Swan-Ganz catheter. Erosion into the innominate artery with massive bleeding is occasionally seen with chronic endotracheal tube or tracheostomy tube placement where the trachea is eroded anteriorly. *Excessive anticoagulation* may result in alveolar hemorrhage with an alveolar filling pattern on chest roentgenogram that is often diffuse in extent. An underlying bronchial lesion must be suspected in these cases, particularly if the radiologic involvement is localized rather than diffuse.

Even after careful evaluation, 10 to 20 percent of cases of hemoptysis have no identifiable cause, ie, are *idiopathic*. The diagnosis of idiopathic (essential) hemoptysis should not be made unless all the following criteria are satisfied: (1) a normal chest x-ray, (2) a normal fiberoptic bronchoscopic examination, (3) a normal bronchographic examination, and (4) sputum examinations negative for tubercle bacilli and malignant cells.

Procedure	Comment
1. History	the minimum
2. Physical examination	
3. Chest film posterior-anterior and lateral	
4. Sputum examination culture including mycobacterium tuberculosis cytology	diagnosis made in majority of cases
5. Fiberoptic bronchoscopy	
6. Special roentgenograms apical lordotic views lateral decubitus views tomograms bronchograms	for apical disease for effusion masses, hilar lesions diagnostic in bronchiectasis
7. Ventilation-perfusion lung scans	pulmonary infarction and emboli
8. Pulmonary angiogram	pulmonary infarction or arteriovenous fistula
9. Thoracentesis	
10. Biopsy scalene node, mediastinal node bronchoscopic biopsy percutaneous needle aspiration open lung biopsy	
11. Blood studies complete blood count, fungal serologies, bleeding studies	
12. Transtracheal aspiration	

Diagnostic Studies in Hemoptysis

Every patient who experiences hemoptysis should have a careful history, physical examination, and chest roentgenogram as the minimal evaluation (Table 3).

History

The history will often help pinpoint the etiology of the symptom. A chronic productive cough suggests chronic bronchitis or bronchiectasis, whereas a subacute illness with fever, cough, weight loss, and night sweats suggests tuberculosis or lung abscess. Recurrent pneumonias suggest an immune deficiency state, cystic fibrosis, or a partial airway obstruction. Age over 40 and a smoking history increase the likelihood of lung cancer. Dyspnea on exertion is a common complaint when mitral stenosis is present. Sudden

shortness of breath in situations conducive to the development of thrombophlebitis suggests pulmonary embolism. The coughing up of "stones" is indicative of broncholithiasis, whereas a clear history of "choking" when eating peanuts or other solids followed by intractable coughing is good evidence for foreign body aspiration. A history of anticoagulant drug use is obviously important.

Physical Examination

The *physical examination*, done with the care and time it deserves, may demonstrate that the bleeding is not from the airway or lungs or may help to define the cause of hemoptysis. Inspection of the thorax may reveal a lag on inspiration of one hemithorax suggesting the presence of an effusion, pneumonia, or lung abscess on that side. Digital clubbing is often seen in bronchiectasis, lung abscess, bronchogenic carcinoma, and cystic fi-

brosis, but rarely in chronic bronchitis or emphysema alone. Palpation may reveal tracheal shift toward the side of a contracted apex of healed tuberculosis or an atelectatic lobe due to a foreign body. Firm cervical and supraclavicular nodes indicate metastatic disease, whereas increased vocal fremitus suggests consolidation. Dullness to percussion is seen over consolidation, or pleural effusion. Auscultation may reveal only a tracheal "rattle" from the presence of unexpectored blood, but localized wheezing should suggest airflow obstruction perhaps due to an endobronchial mass or foreign body. A pleural rub may occur with pneumonia or pulmonary infarction.

Roentgenographic and Laboratory Studies

Although the etiology of the majority of cases of hemoptysis can be diagnosed with chest roentgenograms, sputum examination, and bronchoscopy, several other tests or procedures are sometimes required.

The standard posterior-anterior (PA) and lateral chest films should be obtained in all cases. Surprisingly, these studies will be entirely negative in about half of all patients with hemoptysis. A normal chest film, however, does not exclude serious disease and should rarely be the final test performed. When a lesion is present, comparison with previous films is of paramount importance. Other occasionally useful roentgenographic tests include apical lordotic views, tomography of masses or hilar lesions, and pulmonary angiograms to identify pulmonary arteriovenous fistula or emboli. One crucial radiologic study in many cases of hemoptysis is the bronchogram, as this technique delineates bronchiectasis in regions beyond the range of the fiberoptic bronchoscope. Bronchiectasis is frequently undetectable on the standard PA film but is still a common cause for hemoptysis. Endobronchial tumors can also be detected with bronchography, but care must be taken to wait until hemoptysis clears, as retained blood clots will make definitive interpretation difficult.

Sputum collection for cultures (bacteria, fungi, tubercle bacilli) and for cytologic examination should be a standard part of the evaluation of hemoptysis. The presence of blood in the sputum makes cytologic evaluation more difficult but not impossible. If the blood clots, the tumor cells frequently adhere to the surface of the clot. If the blood does not clot, the routine slide with many

red cells makes finding the tumor cells more difficult, as the red cell may overlay the cells of major interest.

Bronchoscopy provides a powerful tool in the diagnostic work-up of hemoptysis and, with rare exception, is the next test performed following chest films and sputum examination. The fiberoptic bronchoscope is capable of making directly visible the subsegmental airways beyond the reach of the standard rigid bronchoscope. If less than massive bleeding is occurring at the time of fiberoptic bronchoscopy, segmental lavaging with careful search has revealed the site of bleeding in 66 of 71 cases in a recent study.² Localization of the bleeding site is important for future surgical resection. Also, brushings or biopsy of an observed lesion frequently permits a precise diagnosis.

Additional diagnostic tests are often of value depending on the clinical setting. If pleural effusion is present, a thoracentesis should always be performed unless congestive heart failure or volume overload is clearly causing the effusion. If a lung or mediastinal mass is present, scalene or mediastinal node biopsy may yield a diagnosis. Percutaneous needle aspiration biopsy of a peripheral lung mass may be helpful when less invasive procedures have failed to establish a diagnosis. If lung tissue cannot be obtained by percutaneous needle aspiration, either a transbronchial lung biopsy through the bronchoscope or an open lung biopsy through a limited thoracotomy may be necessary. Certain blood studies are sometimes indicated, such as a complete blood count, serologic titers for coccidioidomycosis when appropriate, and a screening test, such as the partial thromboplastin time, when a bleeding diathesis is suspected. When the history and chest roentgenogram are suggestive of cystic fibrosis, a sweat chloride test may be diagnostic. Transtracheal aspiration as a diagnostic test is most helpful in lung abscess or indolent pneumonia where an anaerobic organism is a possible etiologic agent. Sputum and even bronchial washings from fiberoptic bronchoscopy are usually contaminated with oropharyngeal flora.

Diagnostic Management and Therapy of Hemoptysis

The treatment of hemoptysis is the treatment of the underlying disease, making the etiologic diagnosis mandatory for proper management. The ex-

ception is in the case in which massive hemoptysis may be lethal, more commonly due to asphyxiation than to exsanguination. The major diagnostic problem here is to determine the anatomic location of hemorrhage to guide the surgeon to segmental, lobar, or lung resection. Where mitral stenosis is the cause, valvular surgery has been curative. During acute massive hemoptysis, where the site of bleeding has been identified as coming from a single lobe or segment, various tamponade procedures have been used to temporarily control bleeding and prevent asphyxiation. These include surgical packing through a rigid bronchoscope, Fogarty catheter inflation in the appropriate airway, or use of a double lumen Carlens catheter to keep one lung free of blood and well oxygenated.

In cases of less than massive hemoptysis, a more orderly approach to diagnosis can be carried out. Following chest films and sputum examination, a fiberoptic bronchoscopy is usually indicated and is often more helpful in localizing the source of bleeding if performed while hemoptysis is present. Bronchoscopy is probably unnecessary in a young person with a clearcut, acute bronchitis, severe cough, and a single episode of mild hemoptysis. Typical lobar pneumonia, diagnosed pulmonary infarction, and known mitral stenosis are other conditions where bronchoscopy is usually not needed. Bronchoscopy, especially with biopsy, is relatively contraindicated with a severe bleeding diathesis. The rigid bronchoscope is the instrument of choice when large volumes of blood are present that cannot be effectively suctioned through the small diameter channel of the fiberoptic bronchoscope. In most other cases fiberoptic bronchoscopy is indicated and is very useful.

The early recognition of cases of hemoptysis due to pulmonary infarction is of critical importance. Suspicion should be aroused if predisposing factors to thrombophlebitis are present (prolonged recumbency, obesity, recent surgery, congestive failure, birth control pills), if dyspnea and pleuritic pain are present, and if radiological findings suggestive of infarction (pleural effusion, basilar opacities, hemidiaphragmatic elevation) are noted. Lung scans are often helpful, and angiography is usually diagnostic.

Treatment during expectoration of blood includes rest, codeine for minimal cough suppression unless bleeding is massive, and an aggressive diagnostic investigation.

The Family Physician and Hemoptysis

In most instances, the patient with hemoptysis is first seen by his/her primary care physician, who thus assumes an onerous responsibility. As many of the diagnostic techniques employed (such as bronchoscopy) are not ordinarily within the purview of the family physician, referral to a specialty diagnostician is indicated in most cases. The obligations of the family physician in such cases can be outlined as follows:

1. He/she should seek early consultation if the hemorrhage is massive or potentially so. For example, the presence of a lung abscess with a "fluid level" in a patient with only mild expectoration of blood may represent a potentially massive hemoptysis.⁵

2. He/she should convince the patient of the necessity for full diagnostic studies even if the hemoptysis was minor and transitory initially.

3. He/she should recognize at an early stage the possibility of pulmonary infarction as a cause of the hemorrhage and should initiate the necessary diagnostic studies.

4. In many cases, he/she can carry out or supervise the entire diagnostic and treatment program. Conditions which are often suitable for this approach include hemoptysis in acute bronchitis or pneumonia, proven tuberculosis, mitral stenosis, anticoagulant overdosage, uncomplicated chest trauma, and cystic fibrosis. In all cases, the possible presence of neoplasms, tuberculosis, or pulmonary infarction must be constantly reconsidered.

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