abstract

*Hemoptysis is an important clinical problem that is especially ominous when seen in older patients. The main causes of hemoptysis in first world nations are bronchogenic carcinoma, bronchitis, and bronchiectasis. In older patients cancer remains the main concern, especially if there is a smoking history. The diagnostic approach to nonmassive hemoptysis starts with a chest x-ray, followed by a CT scan and then fibre optic bronchoscopy, which is well tolerated by older adults. In massive hemoptysis, chest x-ray is usually followed immediately by fibre optic or rigid bronchoscopy. Older patients require closer monitoring due to poor cardiopulmonary reserve; management options include endoscopic interventions, bronchial artery embolization, surgery, and radiation.*

***Key words:*** *hemoptysis, etiology, management, older adults, bronchiectasis*

# Hemoptysis in Older Adults: Etiology, Diagnosis, and Management

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Hemoptysis is defined as the coughing up of blood derived from the airways or the lungs; it is a term that can be traced back to its ancient Greek roots, *haima* (blood) and *ptysis* (spitting). As a clinical symptom, it is important not only in that it creates anxiety for both the patient and the physician but also because it can often portend a truly life-threatening condition, especially in the older population.

## Etiology of Hemoptysis

The traditional list of the causes of hemoptysis is long and diverse (Table 1), but only a handful of causes account for the majority of clinically encountered cases. The distribution of these primary etiologies has changed over the last few decades and still varies among different populations. Most American case series from the 1940s and 1950s showed tuberculosis (TB), bronchiectasis, and bronchogenic carcinoma as the leading causes, each accounting for approximately 20% of cases. More contemporary series from first world medical centres have shown bronchogenic carcinoma, bronchitis, and bronchiectasis to be the leading causes, with 15–30% of cases remaining undiagnosed ("cryptogenic hemoptysis") and with TB being a rarity.[1] On the other hand, reports from inner city New York and several centres across Africa continue to show TB as the leading cause,[2] clearly reflecting the high prevalence of TB in these populations.

Few studies have specifically addressed the etiology of hemoptysis in the older population, but retrospective studies have consistently shown a higher prevalence of lung cancer in older smokers presenting with hemoptysis, and this remains the principal concern in this population. The largest retrospective study in the United States showed that the most important predictors of cancer in the population presenting with hemoptysis was age >50, a smoking history >40 pack-years, and male sex.[3] Today, with the aging population of female smokers and the alarming increases in female lung cancer rates, clinical suspicion of malignancy should be high in females with a smoking history. Furthermore, in a study of patients initially diagnosed with cryptogenic hemoptysis on the basis of a normal chest x-ray and bronchoscopy, seven out of 115 patients (six percent) developed bronchogenic carcinoma within three years of initial presentation, all of whom were smokers aged greater than 40.[4] The only prospective evaluation of the causes of hemoptysis in older patients was performed by Wong *et al.* in Malaysia; they compared the causes of hemoptysis in a series of patients aged 60 or more to those in younger patients. In the older age group, bronchogenic carcinoma was the leading cause, accounting for 49.3% of cases; in the younger individuals, active pulmonary TB was the leading cause, accounting for 27% of cases, while bronchogenic carcinoma was the second most prevalent, accounting for 19.1%.[5] Given the comparatively low prevalence of TB in the North American population, it is

**Table 1a: Causes of Hemoptysis***

| Airway Disease | Parenchymal Disease | Vascular Conditions |
|---|---|---|
| acute or chronic bronchitis | infection:<br>TB<br>atypical mycobacteria<br>invasive fungal<br>pneumonia<br>fungus ball<br>lung abscess<br>necrotizing bacterial pneumonia<br>parasitic infection | left atrial hypertension (e.g., mitral stenosis) |
| bronchiectasis | | pulmonary edema with pulmonary infarct |
| neoplasms:<br>bronchogenic Ca<br>metastatic Ca<br>**bronchial adenoma** | | **venous obstructive condition (e.g. veno-occlusive disease)** |
| foreign bodies | | **pulmonary arteroivenous malformation** |
| airways trauma | inflammatory:<br>**Goodpasture's**<br>**Wegener's granulomatosis**<br>**vasculitis**<br>**idiopathic pulmonary hemosiderosis** | **primary pulmonary hypertension** |
| bronchovascular fistulae (e.g., aortic aneurysm) | | **anomalous vessel** |

*Causes unlikely to be seen in the older population are in bold face[2,3,5,8]

conceivable that cancer accounts for an even greater proportion of cases among our native aging population; on the other hand, both TB and cancer are important considerations in recent older immigrants from developing nations.

Another important consideration in the differential diagnosis of hemoptysis in the older population is the improbability of certain diagnoses. For example, a new diagnosis of inflammatory causes such as Wegener's granulomatosis, Goodpasture's syndrome, vasculitis, or idiopathic pulmonary hemosiderosis is highly unlikely. On the other hand, since older patients have a much higher incidence of rheumatic mitral stenosis than the younger population, they are at higher risk for cardiogenic hemoptysis. Furthermore, given the greater proportion of aging patients taking warfarin, hemoptysis secondary to a bleeding diathesis is likely to be much more common in this group as well. Finally, older patients may have diminished immunity and / or an increased risk of aspiration due to a depressed level of consciousness, oropharyngeal dysynchrony, or alterations in deglutition due to stroke, senile dementia, medications, or Parkinson's disease;[6] for these reasons, they are at greater risk for necrotizing pneumonias as a cause for hemoptysis. Along the same lines, frail older adults may not be able to expectorate sputum for neuromuscular reasons. In addition, women of this age group often do not expectorate sputum for social reasons. In these cases, hemoptysis may be underdiagnosed and silent hemoptysis may present as a positive fecal occult blood test, leading to a futile investigation of the gastrointestinal tract and a delay in the identification of pulmonary pathology.

**Table 1b: Causes of Hemoptysis***

| Congenital Conditions | Miscellaneous |
|---|---|
| **sequestration** | bleeding diathesis |
| **bronchial cyst** | broncholithiasis |
| | **catamennial** |
| | **cocaine use** |
| | acid/toxic gas inhalation |
| | malingering |
| | iatrogenic |
| | cryptogenic |

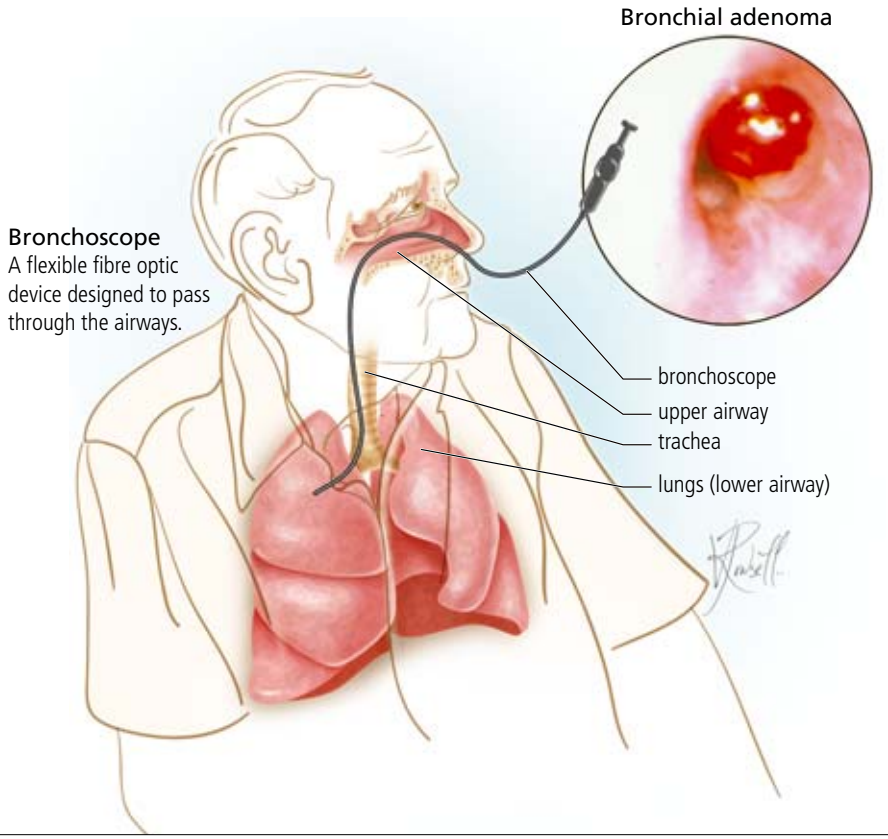
*Causes unlikely to be seen in the older population are in bold face[2,3,5,8]

## Diagnostic Evaluation of Hemoptysis

In the diagnostic evaluation of hemoptysis the first step is to rule out pseudohemoptysis, i.e., the coughing of blood originating in the nasopharynx or oropharynx and hematemesis, the vomiting of blood.[1] Next, determination of the quantity of hemoptysis guides both diagnostic and therapeutic decisions, with the arbitrary distinction being between massive hemoptysis, defined as >600ml/24 hrs in most clinical series,[7] and nonmassive hemoptysis,

**Figure 1: An Example of Hemoptysis Diagnosis and Presentation**

A diagnosis of hemoptysis can be made by physical examination, chest x-rays and most importantly, CT scan followed by bronchoscopy. In this illustration, an older man presents with severe cough and blood-streaked sputum. The diagnosis was hemoptysis due to bronchial adenoma. Some of the other possible causes of hemoptysis are acute or chronic bronchitis, cystic lesions, pneumonia, bronchiectasis, and malignancy.

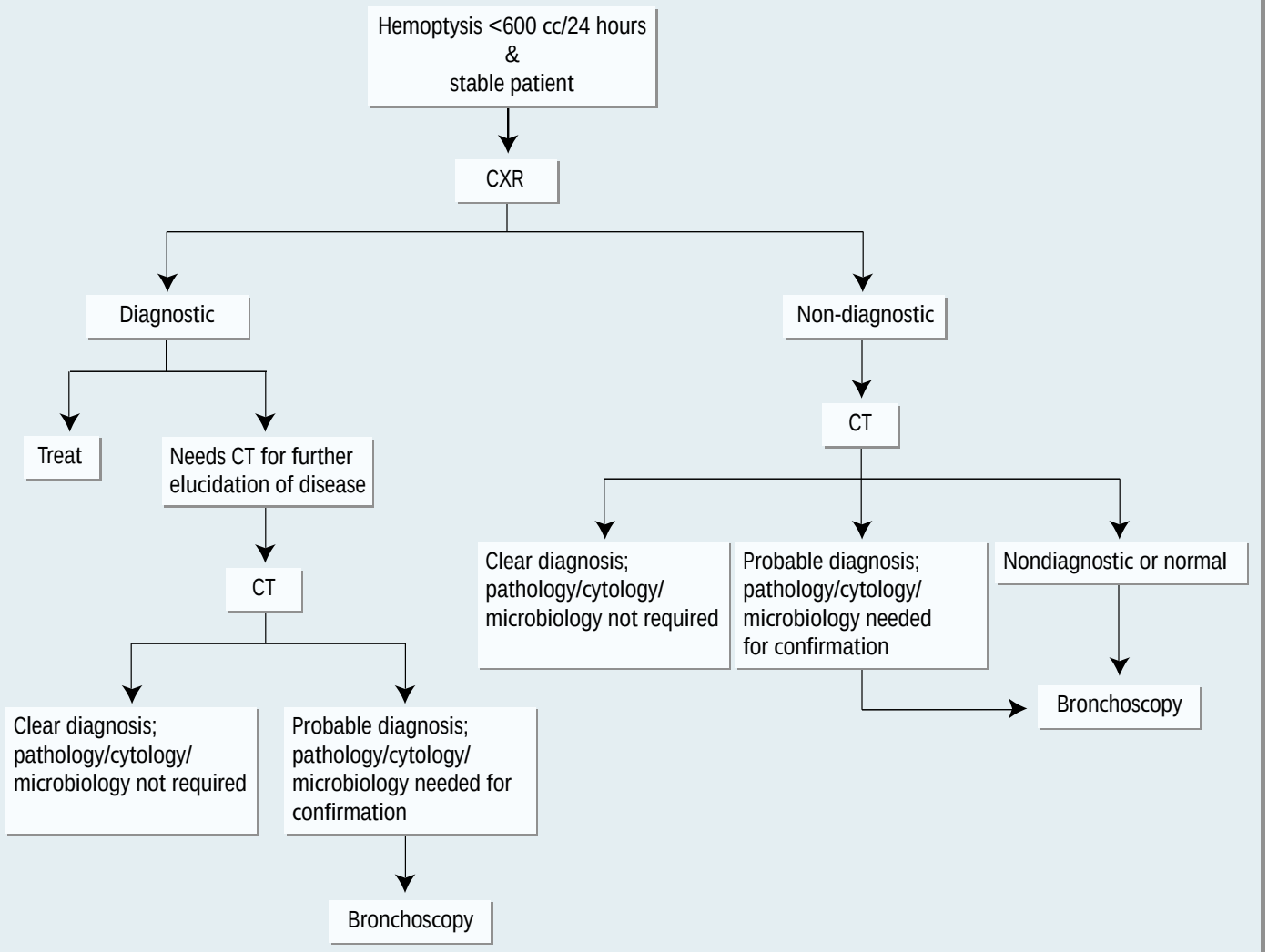



< 600ml / 24hrs. There is obviously a clinical continuum between these two entities, and management decisions therein are guided by a patient's hemodynamic stability, pulmonary gas exchange, and airway protection.

In cases of both massive and nonmassive hemoptysis, chest x-ray (CXR) is the initial diagnostic modality of choice. Important findings include a focal mass with lymphadenopathy, fibrocavitary disease, airspace infiltrates, thickened bronchial walls from bronchiectasis, or evidence of CHF.[8] However, in cases of nonmassive hemoptysis, CXRs are normal 20–30% of the time.[9] Also, in older patients in particular, if there is a degree of cognitive impairment, effective CXRs may be difficult to obtain due to a lack of cooperation, and even when obtained, may be harder to interpret given the increased prevalence of co-existing, unrelated cardiopulmonary disease. Though the place of CT scan versus fibre optic bronchoscopy has been debated in the past, with improvements in CT scanning technology recent work has established the role of CT as the modality of choice to follow routine CXR. In particular, CT has been shown to be of great value in identifying bronchiectasis, small peripheral tumours, arteriovenous malformations, and pulmonary emboli, all of which are easily missed on both CXR and bronchoscopy.[10] Also, many patients with diagnostic CXRs will need a CT scan regardless, for further delineation of the disease (e.g., for staging in lung cancer). On the other hand, bronchoscopy has proven useful in identifying such mucosal lesions as bronchitis, easily missed on CT,[11] and, in rare circumstances, in identifying malignancies manifested by early mucosal changes that were not visible on CT[2,12] (Figure 1). This is particularly important in aged patients, where squamous cell cancer—a primary mucosal lesion—accounts for a significantly greater proportion of non-small-cell lung cancer (NSCLC) cases than it does in the younger age group.[22] Moreover, bronchoscopy remains necessary for a tissue diagnosis even when CT imaging is highly suggestive of malignancy or granulomatous infection as the cause of hemoptysis. Further, several studies have suggested that CT scanning prior to bronchoscopy improves the yield of bronchoscopy by guiding bronchoscopic sampling for microbiologic and cytologic studies. Given these complimentary roles, most authors now recommend a CT scan followed by bronchoscopy in the evaluation of hemoptysis.[2,10,11] Finally, the timing of bronchoscopy is important, as studies have shown a significantly higher yield in localizing the bleeding source when bronchoscopy is performed within 48 hours of the initial bleeding.[21,13]

Though the older population is quite heterogeneous, the theoretical risks of bronchoscopy include procedure-related coronary ischemia or arrhythmias and oversedation due to delayed drug metabolism and an increased prevalence of renal dysfunction. As a result, these patients need closer cardiac evaluation and exclusion if necessary, as well as a more conservative and sequential approach to procedural systemic sedation. Still, age has not emerged as a specific risk factor for bronchoscopy complications in most comprehensive reviews,[14] and the procedure has consistently been reported to have excellent tolerability in the older population. Costello *et al.* compared bronchoscopy in patients aged 66 or more versus younger patients and found that the two groups did not differ in their toleration of the procedure or in their willingness to have a repeat procedure. Furthermore, the older patients were found to have a significantly lower cough rate, perhaps reflecting an attenuation of protective airway reflexes with age.[15] Finally, the diagnostic yield of bronchoscopy in the older age

**Figure 2: Management of Nonmassive Hemoptysis**




group is consistently comparable to that in younger patients.[14]

## Management of Hemoptysis

The management of hemoptysis centres largely on the stability of the patient and the resulting urgency of an intervention. In most cases of nonmassive hemoptysis, management is directed at the underlying cause as it is uncovered in the algorithm shown in Figure 2. On the other hand, massive hemoptysis is a medical emergency with a high rate of observed mortality, mainly from aspiration of blood and resulting asphyxiation.[16] Because of the severity of the condition, management supersedes diagnosis in most cases, and in fact, the two are often achieved simultaneously. In contrast to the nonmassive hemoptysis patients, choices in these patients are further limited by the fact that they are often not stable enough to be sent for a CT scan, and both CXR and CT scans are often not localizing as a result of diffusely aspirated blood obscuring underlying lung pathology. Since the immediate management goal is to limit the aspiration of blood by placing the patient in the "bad lung down" position, lateralization of the bleeding source is paramount in these cases.[7]

Thus, once a patient is stabilized and the airway is secured, an initial CXR is obtained and a bronchoscopy is generally recommended to follow. In this context, bronchoscopy is not only useful for localization of the bleeding source but can also be used to achieve control of bleeding with such techniques as endobronchial instillation of epinephrine, endoscopic placement of a Fogarty balloon catheter for endobronchial tamponade,[17] and laser photocoagulation for endobronchial lesions.[16] In cases where bleeding is excessive, rigid bronchoscopy can be considered, as it provides better suctioning capability and maintenance of airway patency; disadvantages include the need for general anesthesia (in most centres) and an inability to visualize the upper lobes and peripheral lesions.[7] Once the source of blood is lateralized, the other lung is protected by selective intubation, usually over the bronchoscope.

In right-sided bleeding, the endotracheal tube is advanced into the left mainstem bronchus for single lung ventilation, whereas in left-sided bleeding, the endotracheal tube remains in the trachea, and a Fogarty balloon is advanced into the left mainstem bronchus and inflated for occlusion; right mainstem intubation is preferably avoided due to the risk of right upper lobe collapse.[16] In cases of life-threatening bleeding where either initial or prolonged control is not achieved endoscopically, the next step is bronchial artery embolization (BAE). In fact, BAE is widely considered to be the most effective nonsurgical treatment for massive hemoptysis. In the largest series to date, Swanson *et al.* demonstrated a 94% success rate for immediate control of bleeding, with an 11% recurrence rate at one month; causes for hemoptysis were varied, including bronchiectasis, pulmonary hypertension, and malignancy.[18] Nevertheless, surgery remains the modality of choice in certain causes of massive hemoptysis, including aorto-bronchial fistula, arteriovenous malformation, hydatid cyst, iatrogenic pulmonary artery rupture, chest injuries, bronchial adenoma and mycetoma, as well as in failed BAE.[7] Finally, radiation has occasionally been used for control of acute massive hemoptysis but is generally reserved for palliation of nonmassive hemoptysis associated with unresectable lung cancer.[19]

In terms of special concerns related to the management of hemoptysis in older patients, one must be aware of the increased prevalence of underlying chronic lung disease and poor associated pulmonary reserve, resulting in a more rapid deterioration in gas exchange in these patients. Also, due to a lower threshold, these patients are more likely to suffer from demand ischemia as a result of the combination of anemia and elevated levels of circulating catecholamines during the acute event. In terms of management options, BAE remains an excellent choice, but angiographic dye load has to be balanced against the risk of progressive renal insufficiency. As for surgery, mortality will be elevated in the presence of a poor baseline pulmonary reserve, and some of these patients may simply not be candidates for any lung resection whatsoever, forcing a strategy of medical management.

## Conclusion

Hemoptysis is a worrisome symptom in any patient, but particularly ominous in older patients who are smokers, given the increased likelihood of an underlying diagnosis of lung cancer. The diagnostic algorithm in cases of nonmassive hemoptysis should begin with a CXR, followed by a CT scan in most cases, and finally a bronchoscopy. Older patients should be evaluated carefully for comorbidities before bronchoscopy, but generally tolerate this procedure very well. In cases of massive hemoptysis, patients are generally unstable and usually require bronchoscopy before a CT scan can be performed; when control cannot be achieved, BAE is the modality of choice, with surgery as a last resort. Because older patients with poor cardiopulmonary reserve are especially at risk for asphyxiation from aspirated blood and for coronary ischemia, closer monitoring is often necessary. As diagnostic and interventional techniques continue to improve, there is much hope for ever more rapid and accurate diagnosis and control of hemoptysis.

**Acknowledgement:** The authors would like to thank Dr. Marisa Zorzitto for her review of the manuscript and thoughtful suggestions.

No competing financial interests declared.

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