Management of life-threatening haemoptysis

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Massive haemoptysis represents a major medical emergency that is associated with a high mortality. Here we present two cases of life-threatening haemoptysis, the first caused by rupture of an aortic aneurysm into the lung in a 37-yr-old woman with polyarteritis nodosa and the second caused by massive bleeding from an angiectatic vascular malformation in the right main bronchus in a 21-yr-old woman. Fibreoptic bronchoscopy played an essential role in the diagnostic process and management of the respiratory tract. Diagnosis in the first case was obtained by CT scan and the aneurysm was treated surgically. In the second case, bronchial arteriography contributed to both definitive diagnosis and treatment. Initial cardiorespiratory management, diagnostic procedures and definitive therapy are described and reviewed. Adequate early management of the cardiorespiratory system is essential to the outcome. Aggressive measures to elucidate the cause of haemoptysis and prompt therapy are warranted because of the high risk of recurrence.

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Case reports

Patient 1

A 37-yr-old woman was admitted to a neighbouring hospital with massive haemoptysis. She had a long history of polyarteritis nodosa. During the 3 months before the admission she suffered from frequent episodes of coughing.
Upon admission she was intubated; however, attempts to insert a double-lumen tube failed because of stenosis of the left main bronchus. Chest radiography revealed opacities in the left lung (Fig. 1). Because of recurrent haemoptysis with an estimated blood loss exceeding 1000 ml, the patient required blood transfusion and fluid replacement. Following cardiovascular stabilization, the patient was transferred to the University Hospital. Fibreoptic bronchoscopy revealed an 80% stenosis of the left main bronchus and bleeding from the left lung. Endotracheal intubation with a right-sided double-lumen tube (Broncho-Cath, Mallinckrodt Medical Ltd, Athlone, Ireland) was accomplished. CT scan showed a large aneurysm of the descending aorta (15 cm diameter) that had ruptured into the upper lobe of the left lung (Fig. 2). Emergency repair of the aneurysm through a left posterolateral thoracotomy was undertaken. The operation was performed on cardiopulmonary bypass and the aorta reconstructed with a Hemashield dacron graft. The rupture in the upper lobe of the left lung was sutured. The patient’s trachea was extubated on the day after surgery but shortly afterwards had to be reintubated for a further day. Bronchoscopy and suction were required to clear the airways. The postoperative course was otherwise uneventful, and the patient was discharged on the 18th postoperative day. Two and a half years later the patient underwent uneventful prophylactic surgery with reconstruction of the ascending aorta because of progressive dilatation of the ascending aorta. Histological examination of the resected aneurysm revealed atherosclerosis but no signs of polyarteritis nodosa. On follow-up 5 yr later she remained free from haemoptysis.

Patient 2

A 21-yr-old, previously healthy woman was admitted to her local hospital with massive haemoptysis that started suddenly 2 h prior to admission. On admission she was in haemorrhagic shock and received a 2000 ml blood transfusion. Her trachea was immediately intubated with a single-lumen endotracheal tube. Chest radiography and CT scan showed extensive alveolar infiltrates in both lungs. Emergent fibreoptic bronchoscopy failed to localize the side of bleeding because of flooding of the field with blood.

The patient was transferred to the University Hospital. Upon admission she was haemodynamically stable but presented with an arterial oxygen saturation of 70%. Fibreoptic bronchoscopy was repeated to clear the airways...
of blood and clots, and to localize the source of bleeding. A slightly elevated bluish structure in the right main stem bronchus was found, which was thought to be a vascular malformation. After intrabronchial infusion of epinephrine, tranexamic acid and iced saline lavage, the bleeding diminished. Thereafter a left-sided double-lumen tube (Broncho-Cath, Mallinckrodt Medical Ltd, Athlone, Ireland) was sited (Fig. 3). To reduce the risk of re-bleeding, the patient also received desmopressin and tranexamic acid systemically.

Selective bronchial and intercostal artery angiography, aortography and bilateral angiography of the internal thoracic arteries were performed. They revealed two small aneurysmal dilatations and confirmed the suspicion of bleeding from a vascular malformation of the bronchial arteries (Fig. 4). An intimal dissection of the bleeding bronchial artery was caused during attempts to achieve therapeutic embolization. This, however, permanently stopped the bleeding.

The patient required prolonged mechanical ventilation and even ECMO was considered because of hypoxaemia. However, the patient slowly improved and was discharged to the ward after 34 days in the ICU. Later evaluation for a systemic generalized disorder or hereditary trait was negative. It was assumed that the bleeding had resulted from congenital aneurysmal malformations of the bronchial artery. The patient was in good health on 3-yr follow-up.

**Discussion**

These case reports illustrate the importance of respiratory management and early diagnosis for correct definitive treatment in life-threatening haemoptysis. Death from haemoptysis is rarely caused by exsanguination, but rather by asphyxia resulting from flooding of the airways and alveoli with blood.\(^6\) In our first patient the source of haemoptysis was a ruptured aneurysm of the descending aorta. The second case illustrates a typical cause of massive haemoptysis in young healthy individuals. The clinical course was complicated because of the magnitude of bleeding from the respiratory tract, which initially also threatened the circulatory state of the patient and caused protracted pulmonary dysfunction requiring mechanical ventilation for a month.

The definition of massive haemoptysis varies from 100 to 600 ml of blood loss per 24 h.\(^1\)\(^-\)\(^4\)\(^6\)\(^-\)\(^8\) In our opinion, quantification of haemoptysis may be difficult and, from a clinical point of view, such criteria are not useful. Obviously, haemoptysis that jeopardizes respiratory function should be treated as a medical emergency.

**Initial management**

The first priorities in treating the patient with life-threatening haemoptysis are to maintain the airway, optimize
Oxygenation and stabilize the haemodynamic status. Intubation with a single-lumen endotracheal tube is recommended until the bleeding is localized. In patients with lateralized or localized persistent bleeding, immediate control of the airway may be achieved by insertion of a double-lumen endobronchial tube to isolate and ventilate the lungs separately, or by endobronchial tamponade with, for instance, a Fogarty catheter.9–12

Selective main-stem intubation into the uninvolved bronchus to protect the contralateral side is an alternative to the double-lumen tube if the bleeding side is known. However, with this method there is loss of access to the side of bleeding for suctioning and bronchoscopic examination. The need to clear the airways of blood and clots should influence the decision in the choice of tubes, as clearance of blood is more difficult through the double-lumen tube. Furthermore, a normal fibreoptic bronchoscope cannot be introduced through a double-lumen tube and the risk of occlusion by clots must be considered. Our second patient first received a single-lumen endotracheal tube and later, when the bleeding source had been identified, a double-lumen tube was introduced.

When the side of bleeding is identified it is generally accepted that the patient should be placed with the bleeding side down to prevent aspiration into the uninvolved lung. Systemic therapy directed at improving coagulation deserves consideration. Also, bronchoscopy may be useful for topical haemostatic treatment.13

Diagnostic procedures
Occasionally in life-threatening haemoptysis the treatment has to be based on presumptive, rather than conclusive, diagnosis. It is essential to achieve early identification of which lung or lobe/segment is the source of bleeding.

Bronchoscopy, preferably during active bleeding, should be performed to lateralize the bleeding side, to identify the part of the lung that may have to be urgently excised and, if possible, to identify the cause of the bleeding.7 Rigid bronchoscopy obviously provides better scope for suctioning but does not generally allow visualization of upper lobes and peripheral lesions. The two methods of bronchoscopy can be used in conjunction with one another by passing the fibreoptic bronchoscope through the rigid instrument.7 In our first patient, the bleeding lung was identified by means of fibreoptic bronchoscopy; in the second, a presumptive diagnosis was made at the second attempt. Major ongoing bleeding in the lungs can render it impossible to identify or even lateralize the bleeding with fibreoptic bronchoscopy. In both patients, however, fibreoptic bronchoscopy contributed to the successful management of the respiratory tract. The choice of bronchoscopy method depends not only on the situation of the patients but is also influenced by availability of special equipment and expertise. Both our patients were intubated. We therefore considered it advisable to use fibreoptic bronchoscopy. Furthermore, fibreoptic bronchoscopy can be performed at the patient’s bedside. However, as mentioned earlier, the availability of expertise determines the method in the immediate management of these patients. Use of the rigid bronoscope is declining and fewer institutions are now providing training in this technique.7 Repeated fibreoptic bronchoscopy with instillation of cold epinephrine–saline in intubated patients with life-threatening haemoptysis was successful in 6 out of 7 patients.13

Chest radiography and CT scan are also useful diagnostic tools. In our first patient a CT scan demonstrated an aneurysm of the descending aorta that had ruptured into the left lung (Fig. 2). However, the site of intra-bronchial haemorrhage is localized with reasonable confidence in only 63% by a combination of these diagnostic techniques.1

The lungs have a dual vascular supply, being served by both the pulmonary and bronchial circulations. Selective bronchial arteriography is an important diagnostic technique with therapeutic applications in these cases.14 In our second patient, bronchial arteriography confirmed the suspicion of a vascular malformation. Occasionally, pulmonary angiography has to be considered, such as in suspected pulmonary embolism or Rasmussen’s aneurysm.15,16

Echocardiography may reveal rare cardiac causes of massive haemoptysis such as bacterial endocarditis or mitral stenosis.17,18 Infectious, vasculitic and other systemic diseases should not be overlooked in the search for the cause of bleeding.1,2,19

Causes and treatment
Outside the Western world, tuberculosis remains the most common cause of massive haemoptysis.1 The majority of the patients have bronchiectasias or cavitation. In Western countries, however, neoplastic disease of the lung is the most common cause of massive haemoptysis.6 Other major causes of massive haemoptysis include aspergilloma and bronchiectasias.6,20

A history of haemoptysis in association with menstruation suggests pulmonary endometriosis.21 Haemoptysis in the early postoperative period should suggest the possibility of injury to the pulmonary vessels by a Swan–Ganz catheter.11,22 Haemoptysis may occur as a late complication of surgical procedures such as pseudoaneurysms after aortic graft surgery or because of retained foreign bodies after pulmonary procedures.23,24

Definitive treatment depends on the cause and anatomical localization of massive haemoptysis. As in our first patient, bleeding from large systemic arteries and aneurysms into the bronchial tree necessitate immediate surgery.17,25,26 Endovascular stents may provide an alternative to surgery in selected cases.23 Bleeding from bronchial or other small systemic arteries is treated preferably by selective embolization, as was attempted in our second patient.14,27 A thorough understanding of bronchial arterial anatomy is
required to avoid potential complications, in particular transverse myelitis. Immediate control of haemoptysis by bronchial artery embolization has been reported in between 75% and 90% of patients.

In conclusion, massive haemoptysis should be considered as a life-threatening medical emergency. A well co-ordinated strategy involving different medical and surgical specialists is required for successful management. Control of the respiratory tract is the first priority and should be followed by aggressive measures to identify the source of bleeding, and prompt treatment. Because of the high incidence of recurrent haemoptysis, these patients should not be discharged from hospital before the definitive diagnosis and, if possible, definitive treatment.

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