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EARLY RECOGNITION AND MANAGEMENT OF ACUTE LIFE-THREATENING HAEMOPTYSIS IN A PATIENT WITH NEWLY DIAGNOSED TUBERCULOSIS

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ABSTRACT

Haemoptysis is a common complication in tuberculosis and can lead to significant mortality if not appropriately assessed and treated. Despite this significance, there is no clear consensus on severity scoring, which can make clinical decision making difficult, especially in haemodynamically stable patients with good physiological reserve, where clinicians are often reluctant to hastily pursue invasive treatments. The following case report describes the early recognition and management of acute life-threatening haemoptysis in a 22-year-old male with newly diagnosed tuberculosis. Following prompt evaluation by the multidisciplinary team, he proceeded to successful bronchial artery embolization to a branch of the right bronchial artery. A literature review on treatment recommendations for haemoptysis in tuberculosis was conducted.

KEYWORDS

Tuberculosis, haemoptysis, bronchial artery embolization

LEARNING POINTS

- There is no clear consensus on haemoptysis severity grading, which subsequently impacts clinical decision making.
- Bronchial artery embolization offers a safe, efficacious treatment modality for haemoptysis, and clinicians should be familiar with its indications and potential complications.

INTRODUCTION/BACKGROUND

Haemoptysis, the expectoration of blood from the lower respiratory tract, is common in pulmonary disease, and can be confronting for both patient and clinician. It is frequently seen in tuberculosis (TB), with up to 8% of patients with TB experiencing haemoptysis at some point in their life[1]. Classification of haemoptysis severity and guidelines for treatment have been conflicting to date. A literature

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review was conducted by searching 'haemoptysis' AND 'tuberculosis' in the PubMed database, and several pertinent articles which can provide clarity on the topic are discussed below.

CASE DESCRIPTION

A 22-year-old male without significant past medical history, presented to the emergency department with a 3-day history of haemoptysis (1 to 2 tablespoons 3 times a day) on a background of a one-month history of dry cough. He was born in India, had moved to Australia 7 months prior and denied smoking, drinking or recreational drug use.

His physical examination was unremarkable, he was haemodynamically stable and maintaining SaO_2 ≥94% on room air, and admission bloods were normal with a haemoglobin of 127g/l. Chest X-ray and a computed tomography (CT) pulmonary angiogram showed multiple regions of right upper lobe cavitating consolidation measuring 3 × 3.4 × 3.1 cm, with surrounding tree in bud nodularity *(Fig. 1)*. Acid fast bacilli were detected in his sputum which were TB polymerase chain reaction positive.

Rifampicin, isoniazid, pyrazinamide, and ethambutol were commenced for treatment of pulmonary TB. On day 3 of admission, his haemoptysis increased, having four episodes with 100 to 200 ml of frank blood expectorated per episode. Although he remained haemodynamically stable, with a heart rate between 80-130 beats per minute, a systolic blood pressure between 120-160 mmHg, and a respiratory rate between 18-25 breaths per minute, he was intermittently hypoxic during episodes of coughing, requiring high flow supplemental oxygen at 48% fraction of inspired oxygen (FiO_2) with a flow rate of 12-15 litres per minute, to maintain oxygen saturations >95%. Following discussions with specialists from the respiratory, infectious diseases, intensive care unit (ICU) and interventional radiology departments, it was felt the patient warranted urgent intervention to prevent further deterioration. He was admitted to the ICU and was intubated to provide single lung ventilation, prior to emergent interventional radiology embolization of a branch of his right bronchial artery *(Fig. 2)*. Apart from minimal expected post-procedural haemoptysis, he did not develop any rebleeding or other postoperative complications.

DISCUSSION

Tuberculosis is the most common cause of life-threatening haemoptysis in low/middle-income countries, and overall worldwide, either due to active pulmonary TB or post-infectious sequelae[1]. In high-income countries, bronchiectasis, chronic obstructive pulmonary disease, mycetoma within a cavity, or lung malignancy account for the majority of cases[1], and 20-50% are cryptogenic[2]. Haemoptysis originates from the bronchial arterial system in >90% of cases[1]. Haemoptysis can infrequently originate from the non-bronchial systemic arterial system (5%), or the pulmonary arterial system which, when caused by TB, is referred to as a Rasmussen aneurysm. A high index of suspicion for a Rasmussen aneurysm is essential in a patient with TB and haemoptysis, as a ruptured aneurysm carries a mortality rate of 50-100%[3].

Classification of haemoptysis severity in the literature has been conflicting. Most sources divide haemoptysis into 'massive' and 'non-massive', however no consensus on a cut-off volume has been established. Massive haemoptysis has been described as anything from 100 to 1,000 ml in 24 hours[1,2], but Ibrahim has proposed a new definition of 'life-threatening haemoptysis' with a minimum cut off of 100 ml in 24 hours, as this is the lowest volume of haemoptysis demonstrated to threaten the life of a patient. Their definition also expands to include any haemoptysis that impacts gas exchange, airway obstruction or haemodynamic instability, and so provides a much more illustrative guide than a cut off volume alone[4]. However, mortality in haemoptysis is a result of asphyxiation rather than exsanguination, limiting the use of haemodynamic compromise, or a drop in haemoglobin, as prognostic markers. Additional factors to consider are the rate of bleeding, the patient's ability to maintain their airway and expectorate blood, the patient's physiological reserve, and the available treatment modalities. An important caveat to this risk stratification is patients with adequate physiological reserve who can maintain their airway, as is often the case in younger patients with active pulmonary TB and no comorbidities. This should not preclude patients from treatment, as haemoptysis can rapidly progress to life-threatening respiratory failure if left untreated, and delivery of available treatments should not be delayed[1].

Regarding imaging, multidetector CT is highly effective at localising bleeding from bronchial vasculature and is more sensitive than both plain chest radiograph and bronchoscopy in identifying the underlying cause of haemoptysis[1,5]. CT angiography is performed to identify the anatomy of the bronchial arteries, assess if they are hypertrophied

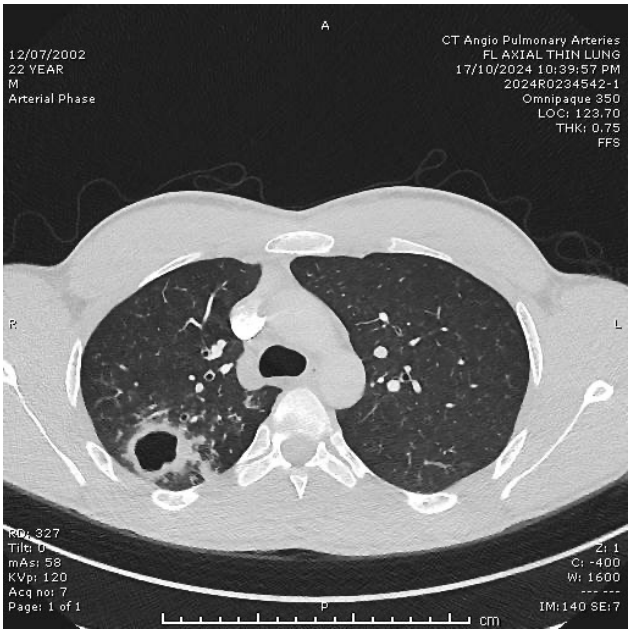


Figure 1. CTPA demonstrating right upper lobe cavitation.



Figure 2. Chest angiography pre-embolization demonstrating abnormal parenchymal hypervascularity in right upper lobe (left). Post-embolization of right bronchial artery branch demonstrating resolution of previous abnormal parenchymal hypervascularity (right).

and visualise abnormal hypervascularity within the lung parenchyma supplied by the bronchial artery. CT angiography can also be used to identify a Rasmussen aneurysm if present, or bleeding from non-bronchial systemic arteries.

Initial management principles involve recognising that life-threating haemoptysis can occur with as little as 100 ml of blood, and clinicians should have a low threshold to escalate care and consult the respiratory, ICU, interventional radiology and thoracic surgery teams in all patients presenting with acute haemoptysis. Promptly obtaining appropriate imaging is imperative to identify the source of bleeding, so that patients can be nursed lying down on the side of the affected lung to prevent aspiration of blood into the unaffected lung, reducing the risk of asphyxiation. Supplemental oxygen should be delivered as required. Wide-bore intravenous access should be obtained, bloods sent for coagulation studies and blood group analysis, and blood products should be crossmatched and made available. Antifibrinolytics such as tranexamic acid can be administered, either intravenously or via nebuliser, to reduce the rate of bleeding[1].

In patients that are too unstable to proceed with CT, priorities should focus on intubation with a wide-bore endotracheal tube to protect the unaffected lung, allow suctioning of obstructing blood clots, and enable passage of flexible bronchoscope to visualise and address the source of haemoptysis, however bleeding from smaller airways cannot always be accessed and haemostatic effects are usually short-lived[1]. Once stabilised, CT imaging should be obtained, and the underlying cause of bleeding should be addressed. Mortality rates of up to 40% have been reported with emergency surgical management and alternative treatment options are preferred[1].

Where available, bronchial artery embolization (BAE) has become the mainstay of treatment in patients with life-threatening haemoptysis. According to the Cardiovascular and Interventional Radiological Society of Europe, indications for BAE include any haemoptysis causing significant airway compromise or respiratory distress, ≥3 episodes of haemoptysis with ≥100ml of blood within one week, or chronic or slowly increasing bleeding episodes, as smaller 'index-bleeding' often precedes larger, life-threatening haemoptysis[6]. Arteriography seldom demonstrates active extravasation, seen in only 10-15% of cases, but other abnormalities suggestive of a bleeding source include bronchial artery hypertrophy, dilation, aneurysms, tortuosity and arteriovenous malformations[1]. Embolization agents are subsequently administered to arrest the bleeding. Several systematic reviews have looked at BAE for haemoptysis. Zheng et al (21 studies) reported an immediate success rate of 99.5%, with a recurrence rate of 23.7%[7]. Fan et al (12 studies comparing BAE with conservative therapy) reported similar success and recurrence rates. BAE compared to conservative therapy showed better clinical success rates (92.2 vs 80.9%) and reduced recurrence rates (26.5 vs 34.6%) [8]. Panda et al, whose primary indication for BAE in their 22 included studies was haemoptysis secondary to active TB or post-TB sequelae, reported immediate clinical success rates of 70-99%, and recurrence rates of 10-57%[9]. Recurrence rates varied greatly between studies and was attributable to incomplete embolization of all abnormal arteries, often due to insufficient screening or smaller arteries proving difficult to embolise, recanalization of previously embolised arteries, and recruitment of new collaterals due to progression of underlying disease. In particular, aspergillomas and multidrug-resistant TB were associated with higher recurrence rates. A non-bronchial systemic arterial source should also be considered in the event of early recurrence, and it is recommended that such collaterals are actively sought out in the initial procedure to prevent recurrence and need for repeat embolization. Alternatively, if effective

embolization is not achieved and rebleeding occurs within 72 hours, thoracic surgery can be considered[6]. A notable major complication of BAE is inadvertent embolization of a branch to the spinal artery, resulting in spinal cord ischaemia which can lead to paralysis. Fortunately, this is rare, and super selective embolization of more terminal bronchial artery branches have been shown to reduce this risk[6]. Fartoukh et al, in a randomised control trial assessing BAE in patients with mild-moderate haemoptysis (described as 100-200 ml), demonstrated a reduction in bleeding recurrence at 30 days from 44.7 to 11.8%, which may support consideration of prophylactic embolization in patients with smaller volume haemoptysis[10]. Further studies are required to determine the safety and efficacy of BAE in this cohort.

CONCLUSION

Haemoptysis is a common symptom of pulmonary tuberculosis, both in the acute setting and from post-infectious sequelae. Initial management principles include stabilising the patient, identifying the cause, isolating the unaffected lung, and involvement of a multidisciplinary team. Clinicians should be aware that haemoptysis greater than 100ml in 24 hours, or which is associated with respiratory or haemodynamic compromise, is life-threatening and must be treated accordingly. If available, bronchial artery embolization offers a minimally invasive, highly sensitive diagnostic and therapeutic modality, with low incidence of major complications. It should be considered in all patients with haemoptysis and evidence of respiratory or haemodynamic compromise to prevent further deterioration. Subsequent treatment of the underlying disease is essential in reducing the risk of recurrence.

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