CASE REPORT

Emergency management of massive haemoptysis

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SUMMARY

In this manuscript, we present a rare case of massive haemoptysis secondary to rupture of a pulmonary artery aneurysm, which was unusual for having occurred in the absence of tuberculosis or a vasculitis. We describe the emergency management of this that ultimately resulted in the patient's survival from both an anaesthetic and surgical perspective, as well as discuss the role of interventional radiology in this situation.

BACKGROUND

Pulmonary artery aneurysms are a rare underlying cause of massive haemoptysis, an emergency presentation of which has a mortality rate that exceeds 50%. Classically, pulmonary artery aneurysms are associated with tuberculosis (TB) (Rasmussen aneurysm), or underlying connective tissue disease, and the majority of existing literature recommends arterial embolisation as first line management.

We present a rare case of massive haemoptysis secondary to rupture of a pulmonary artery aneurysm occurring in the absence of either of these conditions. In this case, an attempt at arterial embolisation would likely have proved fatal, whereas achieving definitive control of the airway by isolation of the affected lung with a double lumen tube followed by emergency lobectomy resulted in the patient's survival.

CASE PRESENTATION

A 36-year-old man presented to hospital with a 12-hour history of fever, pleuritic chest pain and cough productive of white sputum. He subsequently had a first episode of small volume haemoptysis while in the emergency department.

Past medical history included chronic sinusitis, incision and drainage of axillary abscess, previous cigarette and methamphetamine smoking, and mastoiditis with associated meningitis requiring mastoidectomy 13 years prior to this presentation.

He was initially admitted to the Respiratory medicine unit and treated empirically for presumed pneumonia with broad spectrum IV antibiotics.

Following further episodes of small volume haemoptysis on the Respiratory ward, CT angiography of the systemic circulation was done to investigate potential bronchial artery source. This identified a cavitating lung lesion in the left lower lobe without any mass or bronchial artery source of bleeding identified. Recommendation was made for follow-up Computed Tomography Pulmonary Angiogram (CTPA) to exclude bronchial artery aneurysm in association with necrotising

pneumonia, which was done and reported an aneurysm of a branch of the left pulmonary artery (figure 1)(figure 2).

Bronchoscopy confirmed cavitating lung lesion and blood in the left lower lobe, again without any mass or bleeding source being identified. Bronchial washings, sputum and blood cultures grew *Klebsiella oxytoca* and streptococci, and antibiotic treatment was targeted appropriately. No acid fast bacilli were found, there was no evidence of viral infection on PCR, and antineutrophil cytoplasmic antibody and anti-glomerular basement membrane were negative.

Following unsuccessful attempts to drain a pleural effusion identified by chest X-ray on the ward, a chest drain was inserted under radiologic guidance on day six of admission, draining approximately 40 mL of clots, and the patient was referred to cardiothoracic surgery for consideration of decortication.

The possibility of embolisation at this time was discussed between interventional radiology and the Respiratory team, however ultimately a decision was made by the respiratory physicians not to proceed, and instead to treat the patient in an expectant fashion while awaiting cardiothoracic review. Rationale for this decision was that given the underlying clinical condition (pneumonia and a non-functioning lung lobe), embolisation would be only a temporising measure in a patient ultimately requiring decortication and lobectomy for definitive management. Minimally invasive options, such as Video Assisted Thoracoscopic Surgery (VATS), were not an option due to the complete destruction of the lower lobe with the lower half of the thorax containing a significant volume of purulent material and dense fibrin requiring complete clearance to enable expansion of the remaining lung.

Consequently, it was decided that the risks of a technically difficult subselective embolisation of a pulmonary artery in a lung with distorted anatomy from necrotising pneumonia may outweigh the potential benefit. In addition, this hospital does not have a hybrid-operating suite permitting radiological intervention in an environment where it is possible to proceed directly to surgery if necessary.

On the seventh day of admission, the patient developed a large volume, continuous haemoptysis associated with desaturation, hypotension and tachycardia. A 'code blue' call was made for assistance from the resuscitation team. At arrival of the code team, the patient was in extremis with most immediate threat to life being airway compromise, with blood loss and haemodynamic instability an additional threat. Estimated blood loss at this time

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Figure 1 Axial slice of CT demonstrating aneurysm.

was approximately 1 L. The attending anaesthetist arranged immediate transfer of the patient to theatre. Once in theatre, the patient was intubated using a double lumen tube to achieve isolation of the left lung. Intubation was made significantly difficult by the copious amounts of blood in the airway. In addition, ventilation was suboptimal with very high airway pressures for a time due to the large amount of blood within the lung tissue.

The patient was moved into right lateral position and underwent thoracotomy and left lower lobectomy. Ventilation improved steadily once the bleeding vessel was identified and controlled. Intraoperatively the left thorax was found to contain a multiloculated empyema with the left lower lobe chronically collapsed and destroyed by cystic change. Histology confirmed a ruptured aneurysm with pulmonary haemorrhage and pneumonia, without any vasculitis changes or granulomatous change.

Figure 2 Coronal slice of patient's CT demonstrating aneurysm.

A total of six units of packed red cells, two units of fresh frozen plasma and 1 L of albumin were transfused perioperatively.

Postoperative Intensive Care management was required for 48 hours for ventilation, invasive monitoring and inotropic support of blood pressure. Chest drains were removed on the sixth and seventh postoperative days and the patient was discharged home day eight postoperatively with a plan for follow-up in surgical outpatients.

INVESTIGATIONS

Included within case presentation.

DIFFERENTIAL DIAGNOSIS

Included within case presentation.

TREATMENT

Included within case presentation.

OUTCOME AND FOLLOW-UP

The patient was discharged home with a plan for follow-up in surgical outpatients.

DISCUSSION

Massive haemoptysis has been variably defined as the expectoration of greater than 600 mL of blood over a 24 hours period, greater than 250 mL of blood in a single episode or possibly most sensibly, bronchial blood loss causing haemodynamic or respiratory compromise.^{1–3} It is also one of the few absolute indications for one lung ventilation.

Without timely intervention, the mortality rate of massive haemoptysis exceeds 50% with the more immediate threat to life being asphyxiation rather than exsanguination.^{1 2 4 5} Rupture of an aneurysm of the pulmonary vasculature as the underlying cause is rare, with most reported cases occurring in the setting of TB—the Rasmussen aneurysm or vasculitis.^{4–10} The site of the aneurysm is more commonly the bronchial arteries, with aneurysm of the pulmonary arteries accounting for only 10% of all cases.^{2 5 6}

Our case is therefore unusual both for occurring in a young, otherwise relatively healthy patient without TB or vasculitis, and because the aneurysm arose from a pulmonary rather than bronchial artery, with the less common location in a larger vessel that also lacks a muscular wall capable of producing vasospasm possibly explaining the extreme volume of blood loss in this patient.¹¹

Despite emergency lung resection having been shown to reduce mortality to 15% during the 1960s, and documented instances of embolisation failing to control bleeding where subsequent lung resection was successful, the majority of current literature recommends embolisation as first line intervention.^{1–3 5 6 9 10 12}

This is likely due to the comparatively high morbidity of up to 50% associated with emergency pulmonary resection when compared with the generally low morbidity of embolisation.¹¹ It is also important to note that the early results showing reduction in mortality with resection are a comparison with conservative management rather than a direct comparison with embolisation.

In our case, threatened airway, volume of blood loss in excess of 1 L and haemodynamic instability rendered an initial attempt at treatment with embolisation impossible. This was due to both embolisation only being possible within the angiography suite at our institution with the patient remaining too unstable for further transfer, and the immediate availability of a surgical team in theatre whereas there would have been a considerable delay

to arrange interventional radiology in our institution—with any delay in definitive management potentially fatal in this case.

The question of whether prophylactic embolisation when the aneurysm was first reported could have prevented the subsequent life-threatening haemoptysis was discussed with the senior interventional radiologist familiar with the case. It was felt that while prophylactic embolisation certainly may have had the potential to prevent this episode of massive haemoptysis, it would have been both technically difficult with significant associated risks, and be useful only as a temporising procedure prior to definitive management with decortication and lobectomy. Development of further vascular aneurysms in association with disease progression would also remain possible after embolisation.

Regarding the need for decortication and lobectomy for definitive management, minimally invasive techniques, such as VATS, were not an appropriate option in this patient as the left lower lobe was completely destroyed with the lower half of the thorax full of purulent material and dense fibrin, necessitating lobectomy and complete clearance of this material to permit expansion of the remaining lung.

Having thus established that decortication and lobectomy was the most appropriate option for definitive management in this patient, the next question raised by this case is of what the ideal timing for lung resection is. Morbidity and mortality risk associated with lung resection will be significant at all times, but is an even greater risk when performed in emergent circumstances such as in the patient in this case. As with embolisation, earlier surgical intervention would also have had the potential to prevent the episode of massive haemoptysis, with the additional benefits of performing the procedure on a more stable patient, and providing definitive management with a single intervention. Therefore, we would argue that once a decision for surgical intervention has been made, the procedure should be performed urgently to minimise the time period in which the patient remains at risk of acute deterioration.

Overall, we feel the management decision most critical in contributing to this patient's survival was intubating the patient in theatre using a double lumen tube enabling one lung ventilation (with clinical examination of the patient combined with pre-existing imaging enabling the anaesthetist to correctly intubate and ventilate the unaffected lung) and protection of the unaffected airways, as the most immediate threat to life at the time of acute deterioration was potential loss of airway. Performing the intubation in theatre not only provided access to necessary advanced airway equipment, but also minimised the time taken to surgical intervention and haemorrhage control once the airway was secured. Alternative options to establish a definitive airway depending on the availability of equipment and experience of the anaesthetist could include large lumen Endotracheal tube (ETT) and bronchoscopy to enable suction and or placement of endobronchial blocker, although our hospital has little experience with bronchial blockers, while the anaesthetist involved in the case was experienced in use of a double lumen tube.

In conclusion, this case not only describes an unusual presentation, but also serves as a valuable reminder that patients with haemoptysis can deteriorate rapidly with significant consequence and should not ever be considered truly 'stable', illustrates the importance of ensuring radiological or surgical interventions are undertaken promptly. Furthermore, while acknowledging the impact of case specific factors, it raises the question of whether the widespread availability of embolisation has resulted in

surgical intervention for massive haemoptysis being underutilised, particularly in the unstable patient where any delay resulting from failed embolisation prior to surgical intervention may be fatal. Finally, it reiterates the utility of following the 'A, B, C' principles of management in critical situations with a rapidly deteriorating patient.

Learning points

- ▶ A patient with haemoptysis should never be considered truly 'stable', and radiological or surgical interventions should be undertaken as expediently as possible.
- ▶ Recurrent haemoptysis should be considered a red flag alerting the clinician to the possibility of significant pathology and potential for acute deterioration, even when the haemoptysis is of small volume and imaging and endoscopic investigations are yet to identify a source.
- ▶ Pulmonary vascular aneurysms can and do still occur in the absence of classical predisposing factors such as TB or vasculitis, and clinicians must remain alert to this as a potential diagnosis in these patients.
- ▶ Surgical intervention remains an important and at times critical component of the management of patient's presenting with haemoptysis, and clinicians should not be averse to considering early surgical intervention despite the development and widespread availability of techniques such as embolisation.
- ▶ This case is a valuable reminder of the continued relevance of the 'A, B, C' principles of management in critical situations with a rapidly deteriorating patient.

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