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Authors

Liu, Kenneth

Gupta, Sachin

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CLINICAL VIGNETTE

Management Techniques for an Unusual Cause of Massive Hemoptysis

Kenneth Liu, M.D., and Sachin Gupta, M.D.

Introduction

Massive hemoptysis is generally defined as the expectoration of blood at an amount and rate that is acutely life-threatening. A quantity of 600 mL over 24 hours is a common threshold, but the exact amount can vary across practices.[1,2] We present the evaluation and management of a case of massive hemoptysis with an unusual cause and highlights the therapeutic use of lung isolation and bronchial artery embolization.

Case Report

A 53-year-old man under conservatorship due to severe schizophrenia with a history of diabetes and hypertension presented to the emergency room with an acute onset of hemoptysis and pleuritic chest pain. During the initial evaluation over several hours, he continued to cough dark blood and small clots totaling an estimated 500 mL. His laboratory evaluation showed a normal hematocrit of 45% and no other remarkable findings, including normal coagulation tests. His blood pressure and heart rate were normal, and he had an oxygen saturation of 96% on 2 L O_2. CT scan showed a large cavitating pulmonary lesion with surrounding consolidation and bronchiectasis in the left lower lobe and a proximal 1 cm calcified broncholith. Due to continued hemoptysis, the patient was intubated with a single-lumen endotracheal tube in the emergency room and was placed under sedation and mechanical ventilation. Broad spectrum empiric antibiotics were administered, though no antituberculous therapy was initiated. Chart review documented three evaluations for left lower lobe bronchiectasis, positive PPD, and mild hemoptysis over the past 10 years with empirical treatment with a multidrug tuberculosis regimen during the most recent episode.

On the evening of admission, fiberoptic bronchoscopic examination through the endotracheal tube demonstrated mild bleeding from the left lower lobe, as well as a mucosal protrusion resembling a foreign body or broncholith. Following bronchial washings, a 5 Fr bronchial blocker was inflated into the bronchus under endoscopic visualization to isolate the bleeding from the rest of the lung. Later during the night of admission, emergency thoracic aortogram and left bronchial artery embolization was performed in an angiography suite. During the procedure, the patient maintained normal hemodynamics without significant difficulties in oxygenation or ventilation. There were no significant decreases in hematocrit during serial testing.

The following day, the patient was taken to the operating room for thoracotomy and planned left lower lobectomy. A new bronchial blocker was placed into a more proximal position at the left mainstem bronchus below the carina. Left lower lobectomy was performed, and the cystic, hemorrhagic specimen was sent for pathologic examination. A 1 cm rounded piece of striated plastic foreign body was removed from the specimen's bronchus, similar to a tire stem cap. Pathologic analysis of the left lower lobe showed alveolar hemorrhage, acute and chronic inflammation, and bronchiectasis.

The postoperative course was complicated by a period of hypotension that resolved with treatment for hypovolemia and sepsis. The patient was extubated on the second postoperative day. The microbiology studies of bronchoalveolar lavage fluid, sputum, and surgical tissue – including bacterial, anaerobic, fungal, and AFB stains and cultures, as well as tuberculosis PCR – were positive for E. coli and Citrobacter. Broad spectrum antibiotics were narrowed to ceftriaxone according to bacterial sensitivity. His recovery was complicated by mucous plugging and left upper lobe collapse that was treated with bronchoscopy and suctioning. His postoperative chest tubes were removed over the course of a week. He was discharged three weeks from admission able to ambulate and breathe comfortably on room air.

Discussion

Life-threatening hemoptysis can have various causes with the most common being bronchiectasis, infections including fungal and tuberculosis, and bronchogenic carcinoma.[3] Other etiologies such as autoimmune diseases or vasculitis (e.g., Goodpasture's syndrome), severe pulmonary hypertension, or arteriovenous malformations are much rarer or, in the case of bronchitis, more likely to cause much milder forms of bleeding.[4] The dilated airways seen in bronchiectasis, resulting from chronic inflammation of various causes, become supplied by enlarged and tortuous bronchial circulation vessels. In cases of chronic lung diseases, bronchial arteries may also proliferate to replace reduced flow from the lower pressure pulmonary circulation. Accordingly, 90-95% of cases of massive hemoptysis originate from the bronchial circulation under higher systemic blood pressure.[5]

Several management and therapeutic options in massive hemoptysis are illustrated in the above case. Because massive hemoptysis can result in death due to impairment of pulmonary gas exchange, endotracheal intubation provides a means to control oxygenation and ventilation, a patent airway and

conduit for suctioning, and allows for easier performance of fiberoptic bronchoscopy.

Several methods exist to isolate bleeding portions of the lung from contaminating healthier portions. Lung isolation is performed by either bronchial blockers or double-lumen endotracheal tubes, commonly used in operating rooms, but also in intensive care settings as occurred in this case. There are many proprietary forms of bronchial blockers and double-lumen tubes, and the details of their use and individual advantages are beyond the scope of this article. However, these methods are all indicated for the purpose of containing the spillage of pus, blood, and other fluids or directing ventilation away from the site of surgery or a bronchopleural or bronchocutaneous fistula. A bronchial blocker is simply a balloon-tipped catheter placed through or along the side of an endotracheal tube and then inflated to obstruct a bronchial lumen. In this case, a bronchial blocker contained the bleeding from the left lower lobe and then was brought more proximally at the carina to direct ventilation into the right lung and allow better surgical exposure for a left thoracotomy. Double-lumen endotracheal tubes are essentially two fused cuffed tubes placed at or just distal to the carina. Each tube lumen can then be ventilated independently of the other.

Bronchial artery embolization is an effective nonsurgical treatment of hemoptysis with an immediate success rate of 73-98%.[6-8] There is considerable variation in the bronchial circulation anatomy, though the most common arrangement is two left bronchial arteries arising directly from the descending aorta between T5 and T6 and one right-sided artery with a common origin with an intercostal artery (intercostobronchial trunk).[9] In a significant number of cases, there are anomalous origins of arteries that arise from the aortic arch or other arterial branches, such as the brachiocephalic and internal mammary arteries.[10] Aberrant arteries may contribute to continued bleeding after embolization. Because embolization does not fix the underlying cause of bleeding, long-term recurrence rates are up to 52% due to varied causes such as recanalization of the embolized artery, revascularization, or non-bronchial bleeding sources.[9,11,12] Therefore, surgery remains the definitive treatment in cases such as that illustrated above.

There are many reported complications of bronchial artery embolization, but the most important is spinal cord ischemia.[13,14] The anterior spinal artery supplies the majority of perfusion to the spinal cord and is fed by approximately eight anterior medullary arteries.[5] Because these anterior medullary arteries originate close to the aorta and in some instances may arise from the intercostobronchial trunk, inadvertent embolization or occlusion can result in neurologic injury.[15,16]

Many institutions may lack the availability of 24-hour interventional radiology services and/or thoracic surgery coverage. In these cases or as a temporary bridge until more definitive therapy is available, endoscopic techniques may be utilized. As this case illustrates, a bronchial blocker may be utilized to limit spillage of blood to a single lobe or even segmental bronchus if easily identified.

Since 2006, when Dutau reported the first successful case, endobronchial embolization using silicone spigots (EESS), a type of silicone plug, has also been an effective treatment alternative for massive hemoptysis.[17] The silicone plug has protuberances that keep the device from dislodging in a subsegmental or segmental bronchus after deployment and a small handle for manipulation with biopsy forceps. Initially used for fistulous diseases of the lungs, multiple case reports and a nine patient case series have reported the successful treatment of massive hemoptysis.[18] The procedure has been successfully reported via a rigid bronchoscope though has been done more commonly through an endotracheal tube. Success rates are not available given the limited number of cases performed; however, EESS can be considered in those patients requiring immediate intervention, but lacking immediate access to an angiography suite or thoracic surgery.

This patient presented with massive hemoptysis secondary to an aspirated tire stem cap that resulted in a chronic post-obstructive pneumonia and bronchiectasis. The initial bleeding and clinical status was stabilized with bronchial artery embolization and lung isolation using a bronchial blocker. Lung isolation was also used to facilitate the definite management of resecting the foreign body and diseased lung lobe.

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