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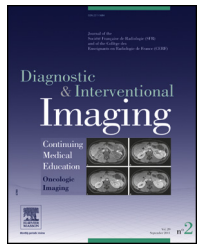

CONTINUING EDUCATION PROGRAM: FOCUS...

Severe hemoptysis: From diagnosis to embolization

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Abstract Severe hemoptysis is life-threatening to patients because of the asphyxia it causes. The diagnosis and treatment are therefore urgent and chest imaging is essential. Multidetector CT-angiography provides an exhaustive non-invasive assessment which includes localization, mechanisms, causes and severity of the hemoptysis. It is an invaluable step in preparation for endovascular treatment which is the first line invasive therapy, particularly with bronchial arteriography embolization in the majority of cases (over 90%) and erosion or rupture of the pulmonary artery in less than 10% of cases. Hemoptysis control is achieved in 65 to 92% of cases depending on the cause.

Hemoptysis is the exteriorization of red aerated blood from the mouth following a cough originating from below the glottis. It represents blood from the thoracic vascular sector passing into the respiratory sector. Hemoptysis is a common symptom in respiratory medicine. It accounts for 10 to 15% of the reasons for consultation in hospital respiratory department and is a warning signal for investigation into its cause [1,2]. Severe hemoptysis (SH) is life-threatening and has a mortality rate of over 50% without control of the bleeding [3,4]. It requires rapid and simultaneous management for both diagnostic (mechanism and cause) and therapeutic [5] purposes. Endovascular management, especially embolization of the bronchial arteries, is now the 1st line treatment [5] to control the bleeding. The

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indications for endovascular treatment are unequivocal in hemoptysis which is causing concern because of its volume (over 200 mL/24—48 h), its consequences on the respiratory system (acute respiratory failure) or if the mechanism is potentially life-threatening (erosion of the pulmonary artery) [6].

The physician (ideally the intensive care physician) faced with a case of SH should ask him/herself five questions: is this actually hemoptysis? How severe is it? What is the site? What is its cause and most likely mechanism? What treatment should be given? Multidetector CT-angiography (MDCTA) can answer a number of these questions (Fig. 1) and is essential for the radiologist before considering interventional radiology [7,8].

The use of CT angiography in severe hemoptysis

Imaging technique

The investigation should be performed in deep inspiration if possible, failing which it should be performed in free respiration [9]. All of the intrathoracic blood vessels should be enhanced using a contrast injection rate (at a concentration of 300 mg of iodine/mL) of 3.5 to 4 mL/sec with a total volume of 90 mL. Image acquisition is triggered by a region of interest (ROI) in the descending aorta from 100 Hounsfield Units for 16-row CT-scan and 150 HU for a higher row CT-scan. Coverage should begin from the lung apices (C5-C6) to the hilum of the kidneys (L1-L2), from the supra-aortic vessels to the origin of the inferior diaphragmatic arteries. It is recommended that images be started at the base of the cranium in patients with a past history of neck surgery or radiotherapy for a nasopharyngeal cancer.

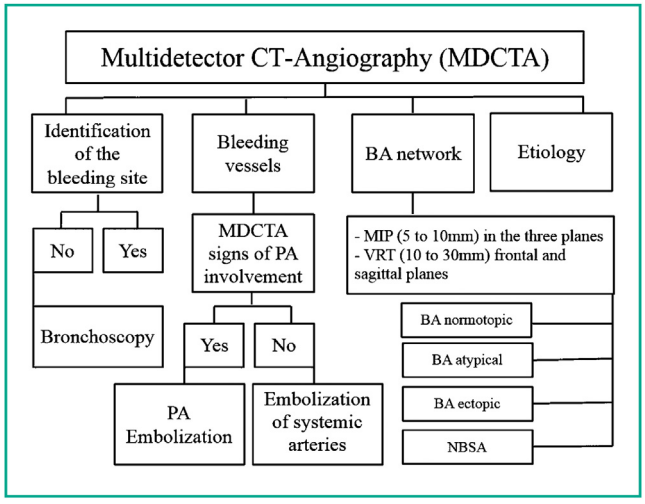

Figure 1. Interpretation algorithm and expected results of multidetector CT-angiography. MDCTA: multidetector CT-angiography; MIP: maximum intensity projection; VRT: volume rendering technique; PA: pulmonary artery; BA: bronchial artery; NBSA: non-bronchial systemic artery.

Confirmation of the hemoptysis

In the majority of cases, the clinical enquiry will establish the origin of red blood coming from the mouth. Occasionally, a diagnosis is uncertain and MDCTA can therefore demonstrates a cause and/or signs of alveolar or bronchial flooding with intraluminal clots.

Severity of the bleeding

In terms of severity, the volume of hemoptysis and respiratory consequences can clinically identify the majority of SH [6]. If the clinical enquiry however is unreliable, MDCTA may again offer assistance [7].

We have shown that the extent of parenchymal involvement on CT correlates with the magnitude of the bleed and with clinical severity. Involvement of more than 3 lobes is usually associated with exteriorized bleeding of over 200 mL/24—48 h and requires more interventionist treatment [10] even if the patient has not coughed up a large volume of blood (Fig. 2).

Site of the bleed

Lateralization (the bleeding side) and precise localization of the hemoptysis are essential for treatment. When hemoptysis is causing asphyxia, simple selective protection of the respiratory tract can only be performed when the side of the bleeding is known. Similarly, some embolization decisions in situations at high risk of complication can only be considered if the side of the hemoptysis is known with certainty. The decision to perform surgery to stop bleeds can also only be made when there is certainty as to the lobe that is to be excised.

The bleed is localized from the parenchymal window investigation that seeks to identify aground glass opacity or alveolar consolidation (Fig. 3a,b). This abnormality is of high localizing value [10—12]. The presence of several areas of ground glass opacities and/or alveolar consolidation with a relatively unaffected subpleural area should suggest the possibility of intra-alveolar hemorrhage. If a ground glass opacity image is present in the bases together with an alveolar consolidation in the upper part of the lung (Fig. 2), the site of the bleeding is the highest part and the other abnormalities are due to positional flooding [12].

Some signs reflect the cause (bronchiectasis, cavitation or pulmonary artery pseudoaneurysm) or consequence of the bleeding (endobronchial clot) and have lower localizing value.

Lung consolidation with necrosis or cavitation associated with the appearance of a pulmonary artery pseudoaneurysm (an uncommon situation) indicates a bleed originating from the pulmonary artery (Fig. 4).

The topographic diagnostic yield of MDCTA compared to clinical assessment at the patient's bedside (including the clinical enquiry, clinical examination, chest radiography and bronchoscopy) is similar and in the region of 80% [7]. As a result, in our view, bronchoscopy can be delayed.

Bronchoscopy is no longer the first line investigation to locate the bleeding and is reserved for diffuse or bilateral