In the name of God

Rule of IR in management of hemoptysis

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- The management of life-threatening hemoptysis demands a well-integrated, multidisciplinary approach

- Bronchial artery embolization (introduced in 1974) serves as both first-line therapy for massive hemoptysis, and as a bridge to more definitive therapies targeted to the underlying etiology

- Bronchial artery embolization possesses high rates of immediate clinical success coupled with low complication rates

- Although useful guidelines are present, no consensus has yet been reached providing a clear delineation between massive and nonmassive hemoptysis

- Reported volumes defining massive hemoptysis range from 200 to 1000 mL over a 24-hour interval, but volume documented as > 300 mL appears to be most frequently accepted

- In addition, particular attention must be paid to patients with chronic hemoptysis averaging > 100 mL per day for 3 or more days

- It is well known that bronchial arteries comprise the vast majority of instances of hemoptysis. However, it has been reported that up to 5% of patients presenting with hemoptysis have the pulmonary artery as the offending vascular bed

- In the majority of instances, hemoptysis arises from the bronchial arteries due to changes in the terminal vascular bed leading to alteration in normal flow and distribution

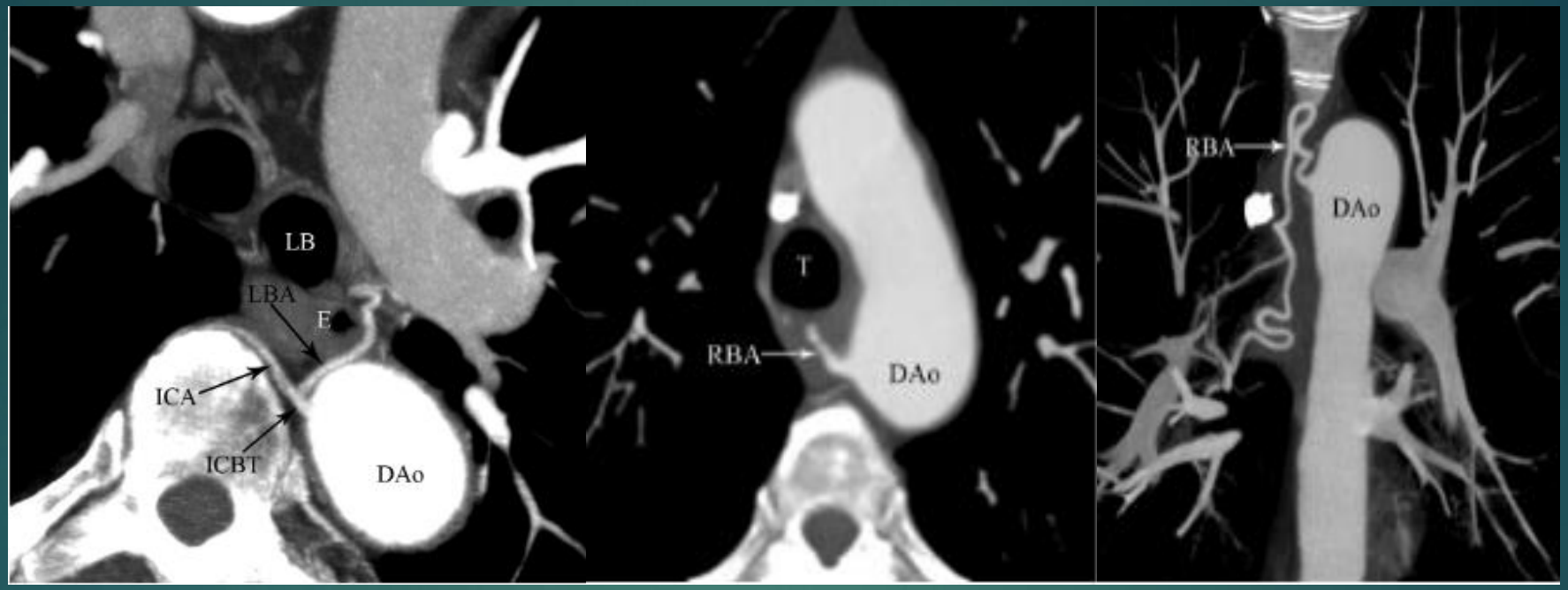
- The bronchial and pulmonary arteries comprise a divided blood supply to the lungs. The bronchial arteries course in conjunction with these structures to the level of the respiratory bronchus, where their terminal branches achieve significant overlap with the pulmonary arterial circulation

- The bronchial arterial distribution not only supplies the bronchi and interstitium of the lung, but also contributes to the visceral pleura, the aortic and pulmonary artery vasa vasorum, lymph nodes, connective tissue and middle one-third of the esophagus

- They are termed orthotopic when they originate between the superior endplate of the T5 vertebral body and the inferior endplate of the T6 vertebral body

- A proposed landmark for orthotopic bronchial arteries at angiography is 1 cm above or below the level of the left main bronchus as it crosses the descending thoracic aorta

- RBA and LBA
- CBT common bronchial trunk
- ICBT intercostal-bronchial trunk
- IC-CBT intercostal-common bronchial trunk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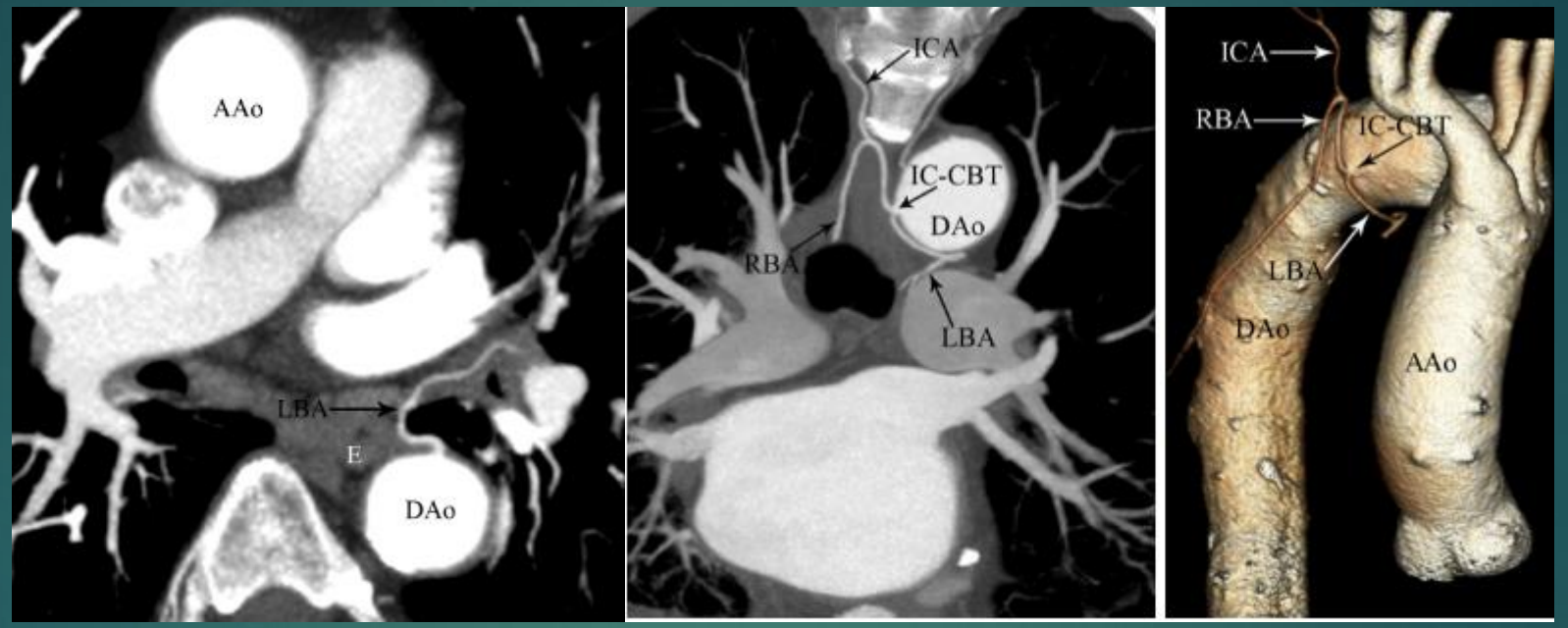
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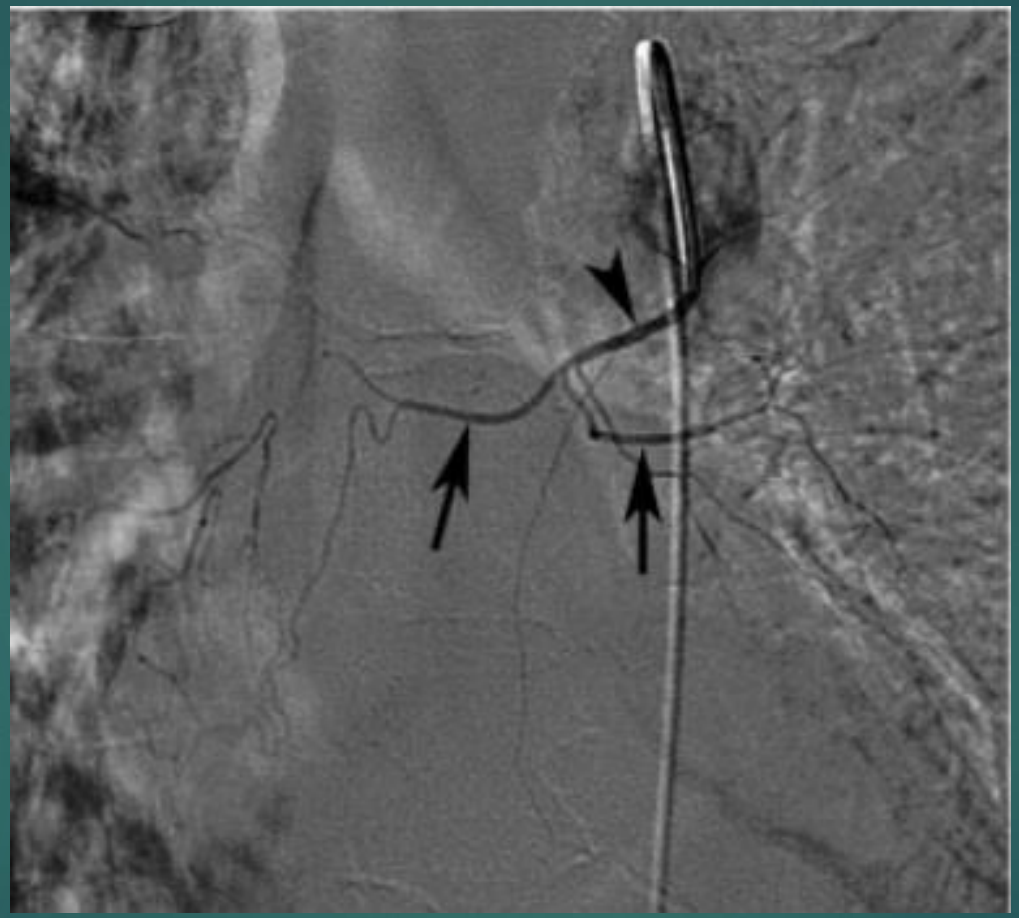
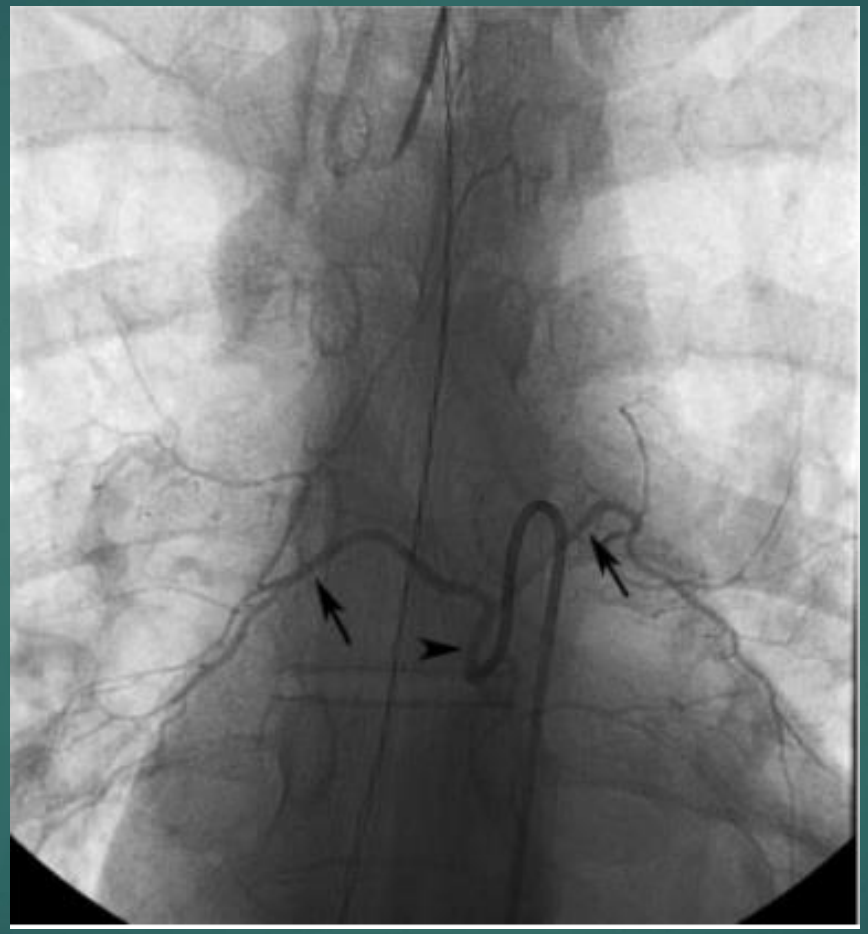
- When originating from the aorta, the branching pattern exhibits several variations including four classic patterns as previously described by Cauldwell et al :

- The type 1 configuration (40.6%) is comprised of a solitary right bronchial artery arising from an intercostobronchial trunk in conjunction with two left bronchial arteries of separate origin

- Type 2 (21.3%) consists of a single right bronchial artery from an intercostobronchial trunk along with a single left bronchial artery.
- Type 3 has two right bronchial arteries, one of which is in conjunction with an intercostobronchial trunk, and two left bronchial arteries.
- Type 4 is two right bronchial arteries, one arising from an intercostobronchial trunk with a solitary left bronchial artery

Figure 1 The four most prevalent patterns of bronchial artery anatomy. Type I: single right bronchial artery via intercostobronchial trunk (ICBT), paired left bronchial arteries. Type II: single right bronchial artery via ICBT, single left bronchial artery. Type III: paired right bronchial arteries with one from ICBT, paired left bronchial arteries. Type IV: paired right bronchial arteries with one from ICBT, solitary left bronchial artery.





- Bronchial arteries that originate elsewhere in the aorta or from other vasculature are termed ectopic

- In a CT angiographic study that evaluated hemoptysis, 64% of patients had orthotopic bronchial arteries, and the remaining 36% had at least one ectopic bronchial artery, most commonly originating from the undersurface of the aortic arch

Potential ectopic sites of origin

- inferior aortic arch
- distal descending thoracic aorta
- subclavian artery
- brachiocephalic trunk
- thyrocervical trunk
- costocervical trunk
- internal mammary artery
- coronary artery
- abdominal aorta
- inferior phrenic

- Bronchial arteries that originate from a coronary artery may be inconsequential or may cause myocardial infarction or angina due to a coronary steal phenomenon


Right

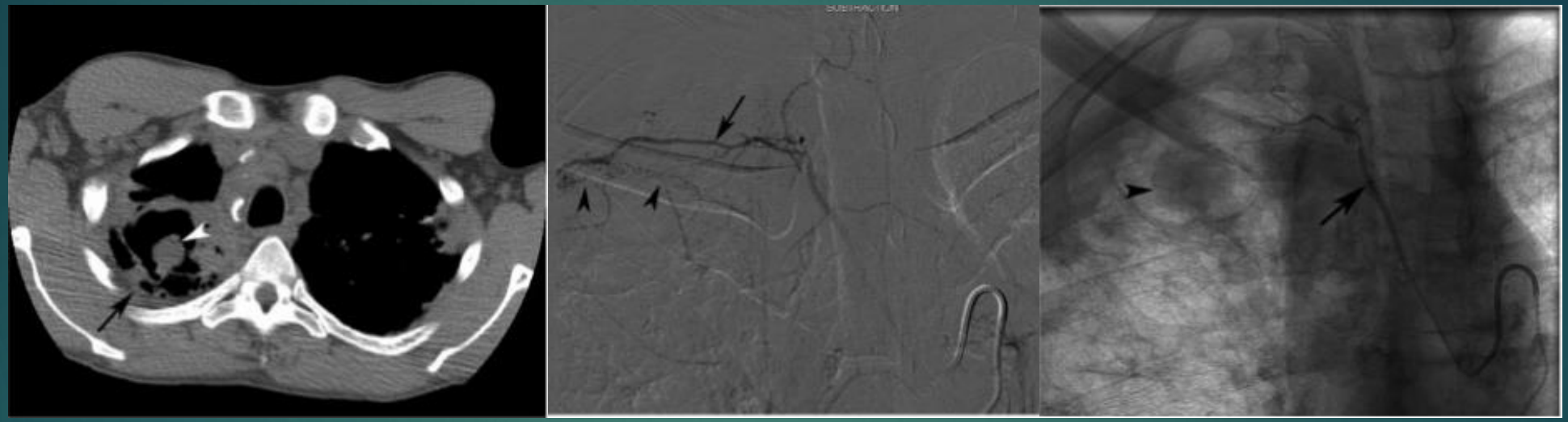
- Systemic nonbronchial arteries

- Intercostal arteries
- Subclavian artery branches
- Axillary artery branches
- thyrocervical trunk
- internal mammary artery
- abdominal aorta
- inferior phrenic artery
- celiac trunk branches

- Systemic nonbronchial collateral arteries do not adhere to this pattern, instead following a transpleural course or potentially ascend via the inferior pulmonary ligament, never joining the bronchial tree

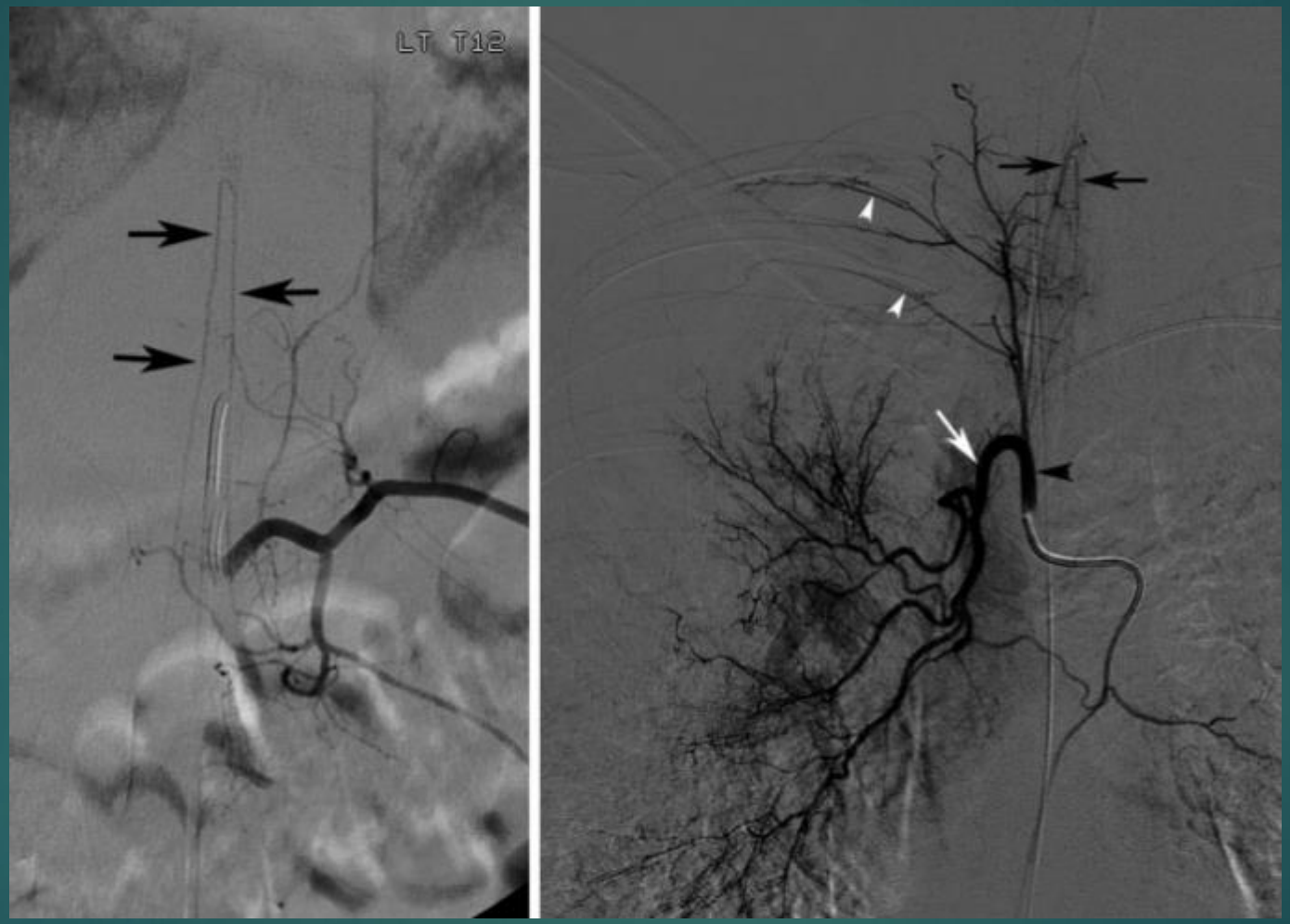
- Nonbronchial systemic collaterals should be investigated and treated concurrently with the hypertrophied bronchial arteries at the time of initial arteriogram when possible

- Early recurrence of hemoptysis following an apparently, at least technically, successful bronchial artery embolization of typically configured bronchial arteries should prompt investigation of suspected systemic contribution



- The anterior spinal artery courses along the ventral surface of the spinal cord receiving collaterals from up to eight anterior segmental medullary arteries throughout its course

- Angiographically, these assume the classic "hairpin" configuration. The most prominent of these, the artery of Adamkiewicz, arises in the majority of cases from an intercostal artery at T8–L1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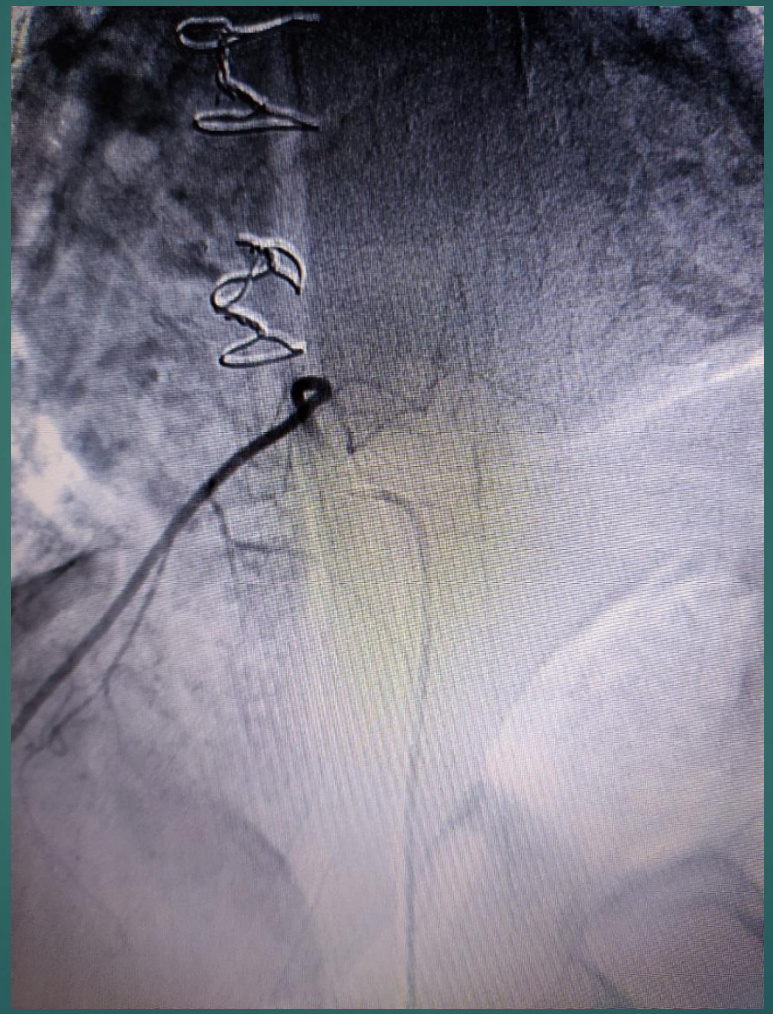


- Contribution to one or more of these medullary arteries in the thorax is documented in 5– 10% of cases involving the intercostal branch of an intercostobronchial trunk. The true incidence is unknown, however, and may in fact be over reported

- Nontarget embolization of the medullary artery has been associated with transverse myelitis

- **Multidetector computed tomography with angiography** is a **primary noninvasive imaging technique** for both the localization of hemorrhage and identification of the causative etiology of hemoptysis.

- There are studies suggesting that multidetector CT may be more accurate than arteriography at delineating the origin and course of both the bronchial and nonbronchial systemic arteries, especially when combined with 3D reconstructions

- Signs of a bleeding vessel

- Hypertrophied vessel—diameter >1.5 mm
- Tortuosity of the vessel
- Parenchymal enhancement
- Bronchopulmonary shunt
- An active leak from the vessel (10%)
- Neovascularity
- Aneurysm formation

- Outcomes for Bronchial Artery Embolization for Hemoptysis Multiple studies have established transcatheter embolization as an effective treatment for massive hemoptysis arising from both the bronchial and nonbronchial systemic circulation

- As technology has evolved, a tendency toward increased immediate clinical success has been realized. Technical success occurs in greater than 90% of interventions, with associated clinical success immediately postembolization attainable in 73–99% of patients.

Complications

- Chest pain represents the most common adverse event following bronchial artery embolization occurring in 24–91%, and is self-limiting in the vast majority of cases.

- Esophageal nontarget embolization resulting in transient dysphagia occurs in up to 18% of interventions, also usually self-limiting.

- Transverse myelitis due to spinal cord ischemia is the most serious complication associated with angiography and embolization of the bronchial circulation.

- Superselective microcatheter techniques with special attention to position distal to the anterior medullary arteries has reportedly reduced the number of cases

- Cortical blindness has been reported and represents an extraordinarily rare neurologic complication. The predominant proposed pathway is from unintentional embolization of the occipital cortex in the setting of fistula formation arising from the bronchial artery to either the pulmonary veins or the vertebral arterial distribution

- Pain in the orbit or temporal region ipsilateral to the side of embolization may occur, but is thought to be referred pain rather than nontarget embolization in these territories.

- Other rare complications include bronchial stenosis, necrosis, and bronchoesophageal fistula presumably due to bronchial wall ischemia as well as ischemic necrosis of the aorta with or without associated dissection

- Pulmonary infarction and ischemic colitis have also been described, all of these consisting of isolated case reports

1-Massive (life-threatening) hemoptysis

- Massive hemoptysis is clinically subdivided into "clinically unstable" and "clinically stable"

- In unstable massive hemoptysis, the primary focus is patient stabilization and resuscitation. Bronchoscopy has become a mainstay of clearing the airways of blood clots and potentially tamponading the site of bleeding to maintain ventilation

- A treatment pathway of interventional bronchoscopy, surgery, or arteriography with artery embolization in clinically unstable patients with massive hemoptysis is based on multiple factors, including central or distal location of the site of bleeding, cardiopulmonary comorbidities, and access to interventional radiology

- Recent studies on BAE with large patient populations are primarily from Asia, where tuberculosis is typically the most common cause of hemoptysis

- Massive hemoptysis in the developed world shows a higher prevalence of malignancy over tuberculosis etiologies

- Massive hemoptysis due to an unknown cause (cryptogenic hemoptysis) has similar BAE outcomes compared with hemoptysis from a known cause

2-Nonmassive (non–life-threatening) hemoptysis

- arteriography with therapeutic BAE is increasingly utilized in nonmassive hemoptysis

- The standard of care for nonmassive hemoptysis remains conservative medical therapy; however, in cases of palliation or failure of medical therapy—that is, when repeated episodes of nonmassive hemoptysis prevents patients from their normal daily activities—BAE is considered a viable and definitive therapeutic option

3-Recurrent hemoptysis

- It is defined as repeated episodes of hemoptysis following initial treatment with either medical therapy or BAE

- Recent literature shows a trend of more commonly treating patients with nonmassive recurrent hemoptysis with interventional or surgical procedures rather than conservative therapies compared with patients with an initial presentation of nonmassive hemoptysis

- Processes contributing to recurrence include recanalization, especially when absorbable agents are utilized, as well as further angiogenesis and vascular recruitment

- Tuberculosis and aspergillus have been identified as independent risk factors for the recurrence of hemoptysis

- Patients with lung cancer carry a 10–30% risk of developing hemoptysis, and are also at risk for recurrence following embolization

- Repeat embolization is an appropriate treatment approach for recurrence of hemoptysis from all etiologies.

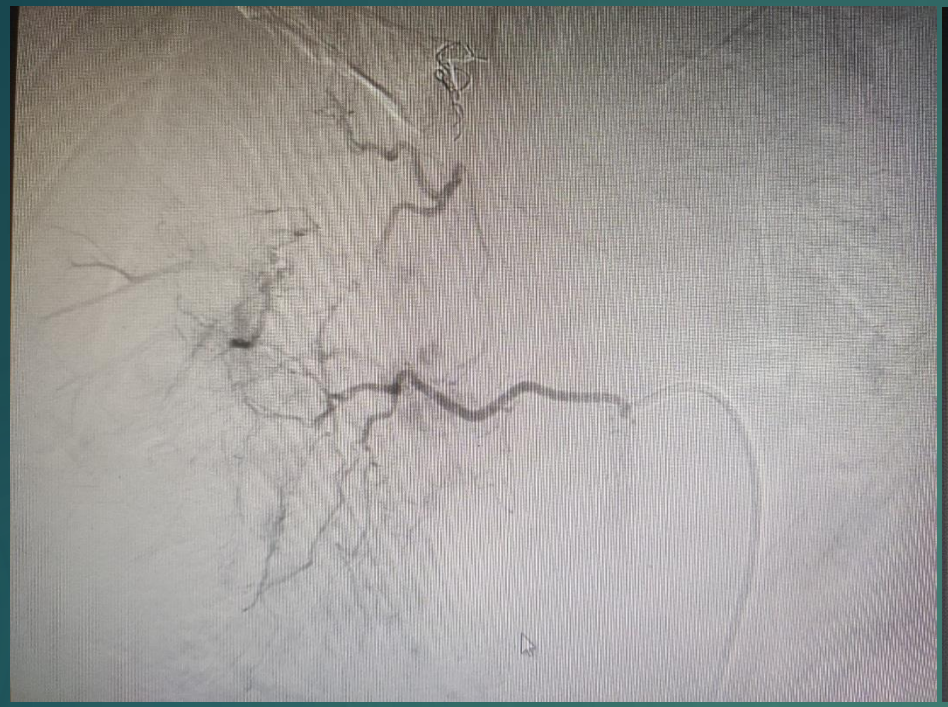
- Repeat bronchial artery embolization achieves comparable immediate clinical success and similar recurrence rates when compared with the initial embolization procedure

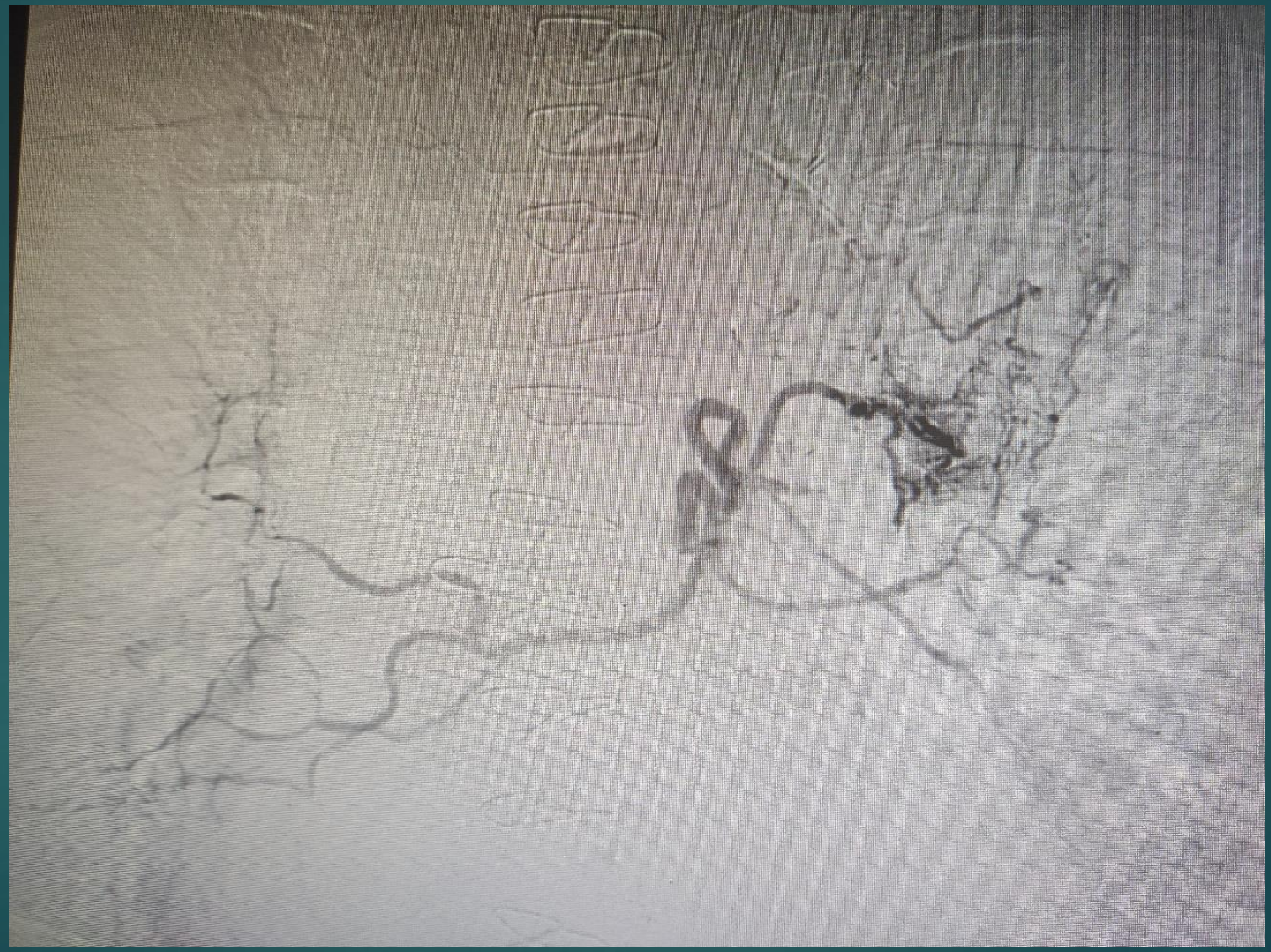
- Recurrent hemoptysis within the first year occurs in approximately 20% to 30% of a general patient population following initial BAE, higher recurrent hemoptysis rates are associated with specific conditions, namely, TB ,chronic pulmonary aspergillomas, malignancy and sarcoidosis

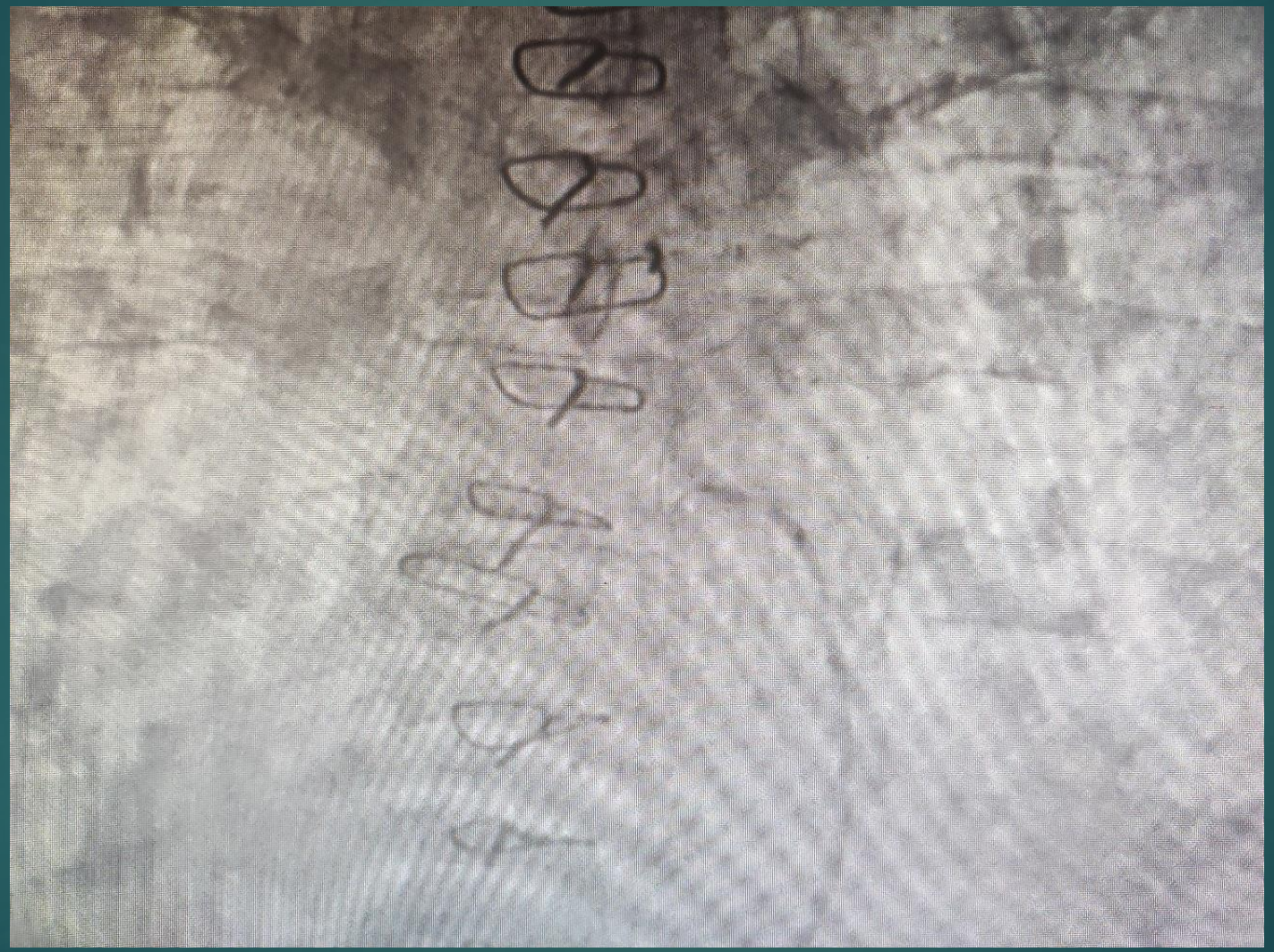
- Pulmonary arterial shunting seen at arteriography for BAE is also consistently associated with an increased rate of hemoptysis recurrence.

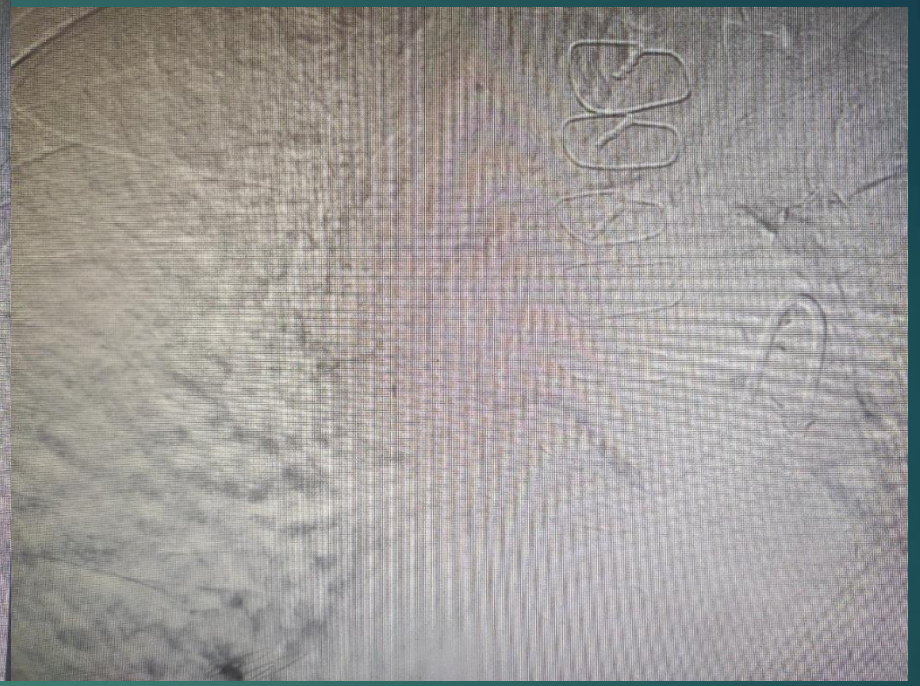
- BAE for malignancy is typically either palliative or performed as a temporizing measure prior to definitive surgery.

- Recurrent hemoptysis in patients with lung cancer is associated with a high mortality , which is attributed to the disease process rather than post-BAE procedural complications









Thank you for your attention