Endovascular management of Hemoptysis

Dr. Ayman Alsibaie
Disclosure

Speaker name:
Dr. Ayman Al-Sibaie

I have the following potential conflicts of interest to report:

- [x] Consulting
- [ ] Employment in industry
- [x] Stockholder of a healthcare company
- [ ] Owner of a healthcare company
- [ ] Other(s)

- [x] I do not have any potential conflict of interest
Bleeding that originates from the lower respiratory tract.

Massive hemoptysis 300-600 ml per 24H
• **Pulmonary perfusion**
  - 99% pulmonary arteries
  - 1% bronchial arteries

• **Origin of Hemoptysis**
  - 90% bronchial arteries
  - 10% non-bronchial arteries
    - Pulmonary artery
    - Aorta

*Remy et al The bronchial circulation 1992*
Pathophysiology of hemoptysis

Decreased pulmonary circulation
- hypoxic vasoconstriction
- Thrombosis
- Vasculitis

Angioneogenesis
- Chronic infection
- Tumor
Hemoptysis

• Diagnostics:
  – History / Physical examination
  – Blood test/ Sputum culture
  – Bronchoscopy
  – CT Angiography
CT Angiography

Underlying lung pathology

Roadmap for intervention procedure
• **Bronchial artery**
  
  – Artery running along the **main bronchi**
  
  - Origin descending thoracic aorta
    
    **T5-T6**
  
  (at level of carina/left main bronchus)
Cauldwell patterns of orthotopic bronchial artery branching

Type I: 45%
Type II: 21%
Type III: 20%
Type IV: 10%

_Caldwell et al Surg Gynecol Obstet 1948_
Ectopic bronchial arteries

1. Subclavian
2. Internal mammary
3. Pericardiacoophrenic
4. Brachiocephalic
5. Costocervical trunk
6. Inferior phrenic
7. Abdominal aorta
Hemoptysis

Conservative treatment

High mortality rate

55-95%
Treatment of hemoptysis by embolization of bronchial arteries.

Rémy J, Arnaud A, Fardou H, Giraud R, Voisin C.
Angiographic findings

- Extravasation of contrast medium (3-10%)
- Hypertrophic arteries
- Tortuous arteries
- Neovascularity
- Staining
- Hypervascularity
- Shunting into pulmonary circulation
- Artery aneurysm
Extravasation of contrast medium

Hypervascularity

Tortuous arteries

Shunting into pulmonary circulation

Artery Aneurysm

Systemic artery-pulmonary artery shunting

Case 1
Case 2

Embolization technique

- **4-5F Catheters**
  - Cobra
  - Sim
  - Headhunter

- **Microcatheters**
Embolizing agents
Embolization material

gelfoam

coils

pva particles

NBCA
Bronchial artery embolization in hemoptysis: a systematic review

Ananya Panda
Ashu Seith Bhalla
Ankur Goyal

ABSTRACT
We systematically reviewed the role of bronchial artery embolization (BAE) in hemoptysis. Literature search was done for studies on BAE published between 1976 and 2016. Twenty-two studies published in English, with sample size of at least 50 patients, reporting indications, technique, efficacy, and follow-up were included in the final analysis. Common indications for BAE included tuberculosis (TB), post-tubercular sequelae, bronchiectasis, and aspergillomas. Most common embolizing agent used was polyvinyl alcohol (size, 300–600 μm) with increasing use of glue in recent years. Overall immediate clinical success rate of BAE, defined as complete cessation of hemoptysis, varied from 70%–99%. However, recurrence rate remains high, ranging from 10%–57%, due to incomplete initial embolization, recanalization of previously embolized arteries, and recruitment of new collaterals. Presence of nonbronchial systemic collaterals, bronchopulmonary shunting, aspergillomas, reactivation TB, and multidrug resistant TB were associated with significantly higher recurrence rates ($P < 0.05$). Rate of major complications remained negligible and stable over time with median incidence of 0.1% (0%–6.6%). Despite high hemoptysis re-
tortuosity, dissection or vasospasm, ostial narrowing and acute or multiple branching. Nonbronchial vascularized bronchial arteries contributed aggregated human albumin, and hypertonic saline. Embolizing agents became more contemporary with availability of gelatin sponge, microspheres, and PVA particles. Embolization of bronchial arteries was initially performed using gelatin sponge, microspheres, and PVA particles. Gelatin sponge is resorbable, and it acts as a temporary occluding agent. PVA particles are nonresorbable and thus act as a permanent occluding agent, and is also available in a variety of sizes. The disadvantages of PVA include clumping within the microcatheter leading to more proximal occlusion and catheter blockage. It is also not advisable to use PVA particles larger than 355 μm in diameter as this can potentially result in anastomotic leakage, and occlusion of the airways (3). Microspheres are available in three sizes: 100–300 μm, 250–1300 μm, and 800–2000 μm, and they are delivered through a 3 F microcatheter.

The most common preferred embolizing agent was polyvinyl alcohol (PVA; size range, 150–1200 μm) with most commonly used size being 300–500 μm. Studies by few authors also used microspheres in the size range of 100–900 μm and 250–1300 μm (9, 12). Microspheres are hydrophilic and are more uniform in size compared with PVA and thus less prone for clumping within catheters (3).
Liquid embolizing agents such as n-Butyl-2-cyanoacrylate (NBCA) were less preferred earlier as the primary embolizing agent due to the need for greater expertise and more chances of necrosis and other complications. However, Woo et al. (6) recently published a study comparing the safety and efficacy of NBCA versus PVA. In their study, 293 patients embolized with PVA were compared with 113 patients embolized with NBCA. There were no statistically significant differences in the technical and clinical success and complication rates between the groups. NBCA was associated with a better hemoptysis control rate in patients with bronchiectasis. Patients embolized with NBCA also experienced a higher long-term hemoptysis-free survival rate. This was attributed to lower same-vessel recanalization rate with NBCA than with PVA (6).  

Outcomes of BAE  
The outcomes of BAE were described in surgery. Recurrences were further divided into early recurrences within 2 weeks to 3 months of BAE and late recurrences occurring after 3 months. The immediate clinical success of BAE varied from 70%–99% in various studies (Table 1). The hemoptysis recurrence rate was as high as 9.8%–57.5% in studies published after
Cases
Bronchiectasis with active bleeding
Pre-embolization
Post-embolization
Post-embolization Final
CASE 2

Lung mass
CASE 3

Bronchiactasis

Image of medical imaging with annotations and labels.
Cystic Fibrosis
CASE 6

Pulmonary Tuberculosis
Complications

- Transient chest/ back pain and dysphagia
- Post-embolization syndrome comprising of fever, leukocytosis, and pain was another common, self-limiting complication
- Procedure related: Contrast media hypersensitivity, groin puncture hematomas, and femoral artery pseudoaneurysms at puncture site.
- Vascular injuries such as vasospasm, dissection and perforation with wire or catheter
- Neurologic complications due to spinal cord ischemia leading to transient or permanent paraparesis or paraplegia

The median incidence of major complication is 0.1% (0%–6.6%)
Bronchial artery embolization complications

- Chest pain: 24% - 91%
- Dysphagia: 1% - 18%
- Dissection of bronchial artery: 1% - 11%
- Dissection of aorta: 1% - 6%
- Spinal cord ischemia: 1% - 6%

Aortic necrosis, broncho-esophageal fistula, nontarget organ embolization, Horner syndrome, transient cortical blindness...

Walker C.M. et al. RadioGraphics 2015.35.32
Ittrich H et al. Rofo 2015, 187,248
Conclusion

• CT-Angiography is the best diagnostic modality:
  ✓ Detect underlying disease
  ✓ Localize bleeding site
  ✓ Road map for interventional radiologist

• BAE is an effective treatment of massive hemoptysis with low incidence of complications

• BAE does not address the underlying disease
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