

Bronchial artery embolization with an ethylene vinyl alcohol copolymer agent (Squid) and polyvinyl alcohol particles for treatment of hemoptysis

Filippo Piacentino 

Federico Fontana 

Marco Curti 

Andrea Coppola 

Massimo Venturini 

ABSTRACT

Bronchial artery embolization (BAE) is considered the first choice treatment for hemoptysis. To our knowledge no cases of BAE using a recent ethylene vinyl alcohol copolymer agent (Squid) have been previously mentioned. Two cases of BAE for remitting hemoptysis using Squid and polyvinyl alcohol particles are reported in this technical note. The final angiographic control confirmed full exclusion of the target territory in both cases. Both patients felt some chest pain immediately after the embolization, not requiring any medications. No more episodes of hemoptysis occurred in the following 3 months after the procedure.

Bronchial artery embolization (BAE) is considered the first choice treatment for hemoptysis. Hemoptysis is often caused by active tuberculosis and post tuberculosis sequelae including fibrosis. Other indications for BAE include malignancy, pneumoconiosis, cystic fibrosis, sarcoidosis, and lung infections. (1).

Several embolic agents were previously used in BAE, including microparticles, coils, adhesive and nonadhesive liquid embolizing agents. To our knowledge, no cases of BAE using a recent ethylene vinyl alcohol copolymer agent (Squid) have been previously mentioned. Here, we report two cases of BAE using Squid and polyvinyl alcohol (PVA) particles.

Technique

Case 1. A 75-year-old woman with a history of chronic inflammatory lung disease was admitted to our emergency department for recurrent episodes of hemoptysis in the past 3 weeks. The last hemoptysis event resulted in hypotension (95/60 mmHg) and tachycardia (>110 bpm). Prior to BAE, bronchoscopy and contrast-enhanced computed tomography (CECT) examinations were performed to identify the underlying cause and extent of pulmonary diseases, to localize possible bleeding foci and to predict culprit vessels. The CECT revealed dysplastic and hypertrophic bronchial arteries with a common trunk of the bronchial artery that originated from the arch of the aorta at 11 o'clock with a markedly tortuous course (diameter 4 mm); a left branch tributary of the ipsilateral posterolateral pyramid which, according to bronchoscopy, was the site of bleeding. In the lower lobe of the left lung, multiple bronchiectasis, partly cleansed with large areas of interstitial fibrosis, expression of chronic inflammation outcomes was found (Fig. 1).

Case 2. An 83-year-old man with a history of penetrating peptic ulcer previously treated with Billroth II gastrectomy, was admitted to our emergency department, with multiple episodes of hemoptysis but no emetic episodes. Fibroscopy showed traces of blood in the pyriform sinuses; therefore with the suspicion of recurrent bleeding peptic ulcer, a gastroscopy was executed excluding upper gastrointestinal tract bleeding. CECT was performed, which underlined the presence of dysplastic and hypertrophic bronchial arteries with associated signs of bleeding at the level of the superior right lobe.

BAEs were performed in an angiographic room following a preliminary digital subtraction angiography (DSA) of the thoracic aorta, through a transfemoral access in both cases. In Case 1, the ostium of the common trunk of the bronchial artery was engaged with an hydrophilic wire (J 0.035-inch, Terumo) and a multipurpose 5 F catheter (Cordis); instead in Case 2, a Simmons 1 was used to identify the bronchial trunk and then a multipurpose type 2 was used

From the Department of Radiology (C.M. ✉ curti.marco.33@gmail.com), Insubria University, Varese, Italy.

Received 28 July 2020; revision requested 23 September 2020; last revision received 21 October 2020; accepted 3 November 2020.

Published online 18 October 2021.

DOI 10.5152/dir.2021.20601

You may cite this article as: Piacentino F, Fontana F, Curti M, Coppola A, Venturini M. Bronchial artery embolization (BAE) with an ethylene vinyl alcohol copolymer agent (Squid) and polyvinyl alcohol (PVA) particles for treatment of hemoptysis. *Diagn Interv Radiol* 2021; 27:786–788.

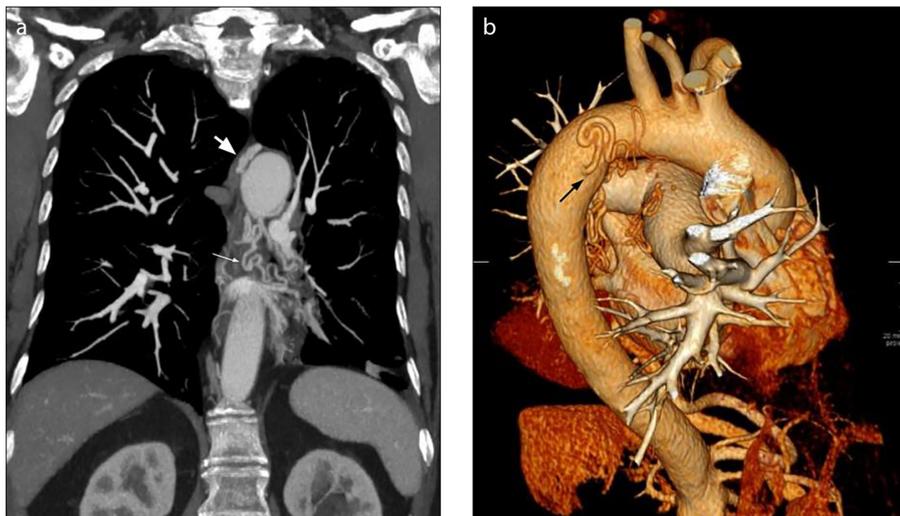


Figure 1. a, b. CT angiography curved multiplanar reconstruction on the coronal plane (a) demonstrates the hypertrophic circle of the left bronchial artery at the level of the mediastinal adipose tissue (white arrow), and the origin at 11 o'clock from the superior-medial wall of the descending portion of the aortic arch (arrowhead). Three-dimensional volume rendering CT angiography image (b) confirms the presence of an important hypertrophic circle of the common trunk of the bronchial artery and of the left bronchial artery (arrow).

for the engagement. To perform the selective embolization, a microcatheter of 2.9 F in Case 1 and 2.0 F in Case 2 (Progreat, Terumo) was advanced in the hyperplastic bronchial artery. First a peripheral microcirculation embolization was performed using microparticles (Contour Emboli 500–700 μm in Case 1 and Contour Emboli 300–500 μm in Case 2, Boston Scientific). After injection of about 1 vial of suitably diluted microparticles, a control DSA showed marked reduction in peripheral vascularization with patency of the proximal part of the bronchial artery.

Then the dead space of the microcatheter was filled with dimethyl sulfoxide (DMSO) solvent 0.4 mL in Case 1 and 0.3 mL in Case 2. Finally, one vial (1 mL) of Squid 12 was slowly injected in about 30 seconds in both cases. When Squid reflux of about 1 cm occurred, the injection was terminated

and the microcatheter was pulled out (Fig. 2). At the final angiographic control, full exclusion of the target territory was obtained with preservation of the small right bronchial artery in Case 1 and of the collaterals to the inferior thyroid artery in Case 2.

Both patients felt some chest pain immediately after the embolization not requiring any medications.

The day after the procedure an arterial blood gas analysis showed normal parameters. No more episodes of hemoptysis occurred in the 3 months after the procedure in both patients.

Discussion

Different embolic agents such as microparticles, coils and liquid embolic agents have been used for BAE (2). Microparticles appear very effective on distal microcirculation. Their use can prevent recurrence of hemoptysis due to recanalization of the bronchial artery or revascularization of the distal microcirculation through extra bronchial collaterals in case of too proximal embolization. PVA particles of 350–700 μm are the most frequently used: a smaller size of PVA particles can increase the risk of spinal ischemia in case of accidental reflux in the spinal arteries (3). The disadvantages of PVA particles are clumping within the microcatheter leading to more proximal occlusion or blocking the catheter as shown by Ao et al. (2).

Coils offer an excellent alternative, with high success rates; however, in case of a

tortuous course (V-shaped) in which the microcatheter is struggling to enter, the use of coils can be problematic (4). Liquid embolizing agents overcome these problems. In literature the most used adhesive liquid agent is surely n-Butyl-2-cyanoacrylate (NBCA). In a large study of Woo et al. (5) including a series of 400 patients (293 embolized with PVA and 113 with NBCA) no differences were found between the two agents, but patients embolized with NBCA had a higher long-term hemoptysis-free survival rate (5).

The new generation of nonadhesive liquid embolizing agents has further advantages; the first to be used was Onyx with few studies presented in the literature. Nonadhesive liquid agents (Onyx, Squid) have excellent embolizing capacity of the treated vessel and are able to reach vessels with a diameter of 80 microns. However, they also have some disadvantages such as the need to use compatible microcatheters, the cost, and the mandatory use of DMSO which can cause vasospasm, endothelial wall damage, and pain (6). Unlike Onyx, Squid has 30% less tantalum, producing fewer metallic artifacts on CT (7). This advantage is also due to the smaller size of tantalum particles which allow a better distribution with consequent reduction of the beam hardening artifacts. In the literature, CT artifacts that caused difficulties in discriminating the patency of the vessel have been documented and in some cases an accurate evaluation of vessel revascularization could be difficult. Squid is available in 3 different combinations: 12, 18, and 34, characterized by progressively increasing density and viscosity, with the “low density” variant which differs from the standard for a lower concentration of tantalum of about 30%. The less viscous concentration 12 (Onyx not available in this formulation) can allow a more distal vascular penetration when necessary. The higher the number, the faster the cast solidifies and the lower is the ability to spread (8). Based on previous considerations, a first round of embolization was made using medium size PVA particles (500–700 μm) with the aim of saturating the distal microcirculation. Particles guarantee good distal infiltration without the risk of nontarget embolization such as the coronary or medullary vessels in case of anatomical variants. Subsequently, we used Squid 12 due to its low viscosity allowing complete occlusion of the main trunk, without risk of reflux towards the ostium in the aorta. The risk of nontarget emboliza-

Main points

- Bronchial artery embolization (BAE) is commonly the first choice treatment for hemoptysis.
- To our knowledge no cases of BAE using a recent ethylene vinyl alcohol copolymer agent (Squid) have been previously mentioned.
- In our preliminary experience based on 2 cases, BAE was successfully performed with Squid and polyvinyl alcohol particles without complications; no further episodes of hemoptysis occurred in the 3 months after the procedure in either patient.

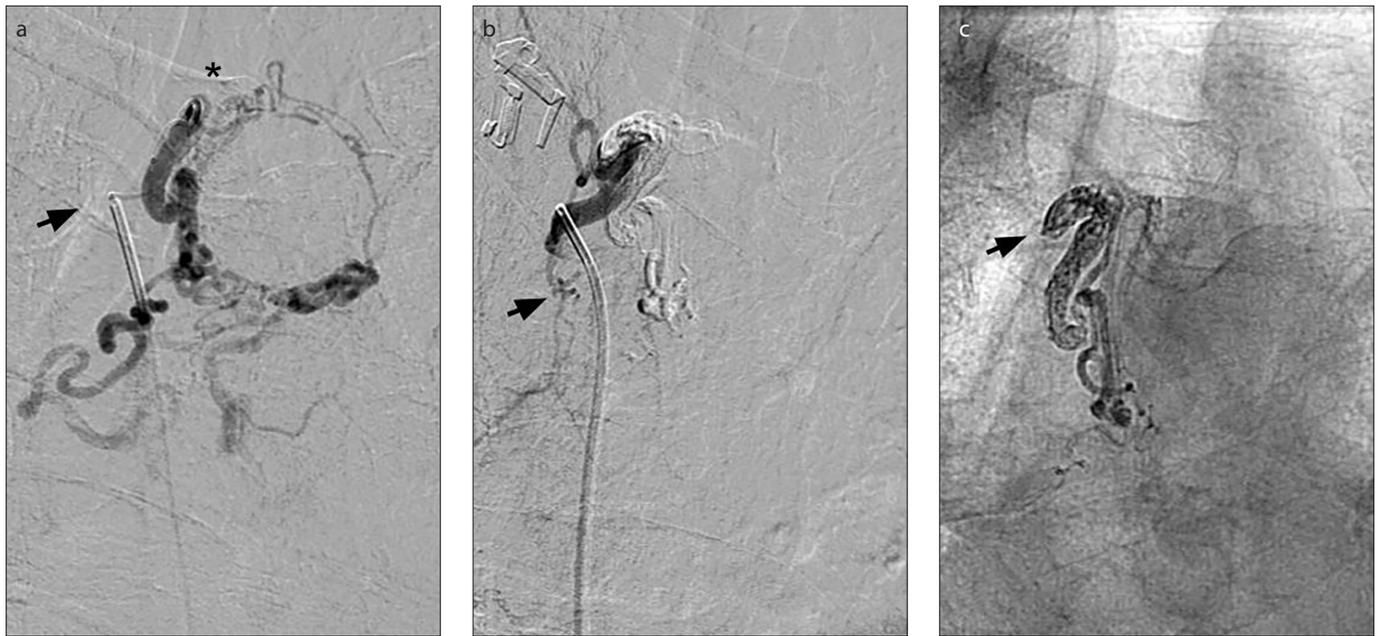


Figure 2. a–c. DSA image (a) shows 5 F multipurpose catheter (Cordis, Terumo) with distal end at the level of the origin of the common trunk of the bronchial artery (*arrowhead*) and 2.9 F (Terumo) microcatheter with distal end at the distal portion of the common trunk of the bronchial artery (*asterisk*). The arteriographic study demonstrates hypertrophic circulation of the common trunk (*arrow*) and left bronchial artery with branches surrounding the arch. Post procedural elective bronchial artery angiography image (b) shows the complete embolization of the left bronchial arteries and the patency of the right branches (*arrowhead*). Post procedural fluoroscopy control image (c) demonstrates correct distribution of the radiopaque embolizing fluid due to the tantalum powder inside the left bronchial branches (*arrowhead*).

tion potentially leading to complications is reported to be higher using adhesive liquid embolics such as glue, which spread in a flow-dependent manner and may be displaced during microcatheter retraction, if stuck to its tip (9).

In conclusion, based on our preliminary experience with 2 cases, BAE was successfully performed with Squid and PVA particles without complications. However, further studies with a larger cohort of patients and with a longer follow-up will be necessary to validate the association of Squid and PVA particles in BAE.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Loffroy R, Favelier S, Genson PY, Guiu B. Onyx for embolization of life-threatening hemoptysis: a promising but luxury embolic agent! *Cardiovasc Intervent Radiol* 2012; 35:221. [\[Crossref\]](#)
2. Ao M, Guo SL, Zhang XD, Li YL, Li Y, Li Q. First case in China: Onyx for bronchial artery embolization in treatment of refractory massive hemoptysis in one case. *J Thorac Dis* 2013; 5:98–102. [\[Crossref\]](#)
3. Yoon W, Kim JK, Kim YH, Chung TW, Kang HK. Bronchial and nonbronchial systemic artery embolization for life-threatening hemoptysis: a comprehensive review. *Radiographics* 2002; 22:1395–1409. [\[Crossref\]](#)
4. Fruchter O, Schneer S, Rusanov V, Belenky A, Kramer MR. Bronchial artery embolization for massive hemoptysis: long-term follow-up. *Asian Cardiovasc Thorac Ann* 2015; 23:55–60. [\[Crossref\]](#)
5. Woo S, Yoon CJ, Chung JW, et al. Bronchial artery embolization to control hemoptysis: comparison of N-butyl-2-cyanoacrylate and polyvinyl alcohol particles. *Radiology* 2013; 269:594–602. [\[Crossref\]](#)
6. Izaaryene J, Vidal V, Bartoli JM, Gaubert JY. Multiple bronchial artery aneurysms: Successful treatment with ethylene-vinyl alcohol copolymer (Onyx®). *Diagn Interv Imaging* 2016; 97:125–127. [\[Crossref\]](#)
7. Pop R, Mertz L, Ilyes A, et al. Beam hardening artifacts of liquid embolic agents: comparison between Squid and Onyx. *J Neurointerv Surg* 2019; 11:706–709. [\[Crossref\]](#)
8. Bailey MA, McPherson SJ, Troxler MA, Peach AH, Patel JV, Scott DJ. Ischemic skin ulceration complicating glue embolization of type II endoleak after endovascular aneurysm repair. *J Vasc Interv Radiol* 2011; 22:163–167. [\[Crossref\]](#)
9. Venturini M, Lanza C, Marra P, et al. Transcatheter embolization with Squid, combined with other embolic agents or alone, in different abdominal diseases: a single-center experience in 30 patients. *CVIR Endovasc* 2019; 2:8. [\[Crossref\]](#)