TRANSARTERIAL EMBOLIZATION OF BRONCHIAL ARTERY FOR HEMOPTYSIS ON END-STAGE LUNG CANCER PATIENT : A CASE SERIES

Koesbandono[1], Rio Hermawan[2], Ryan Yudistiro[3], Achmad Mulawarman Jayusman[4], Ade Nurlina[5*]

Department of Radiology, *Faculty of Medicine*, Universitas Pelita Harapan, Banten, Indonesia[1,5], *Department of Radiology*, Siloam MRCCC *Hospital*, Jakarta, Indonesia[1,2,3], *Department of Pulmonology*, Siloam MRCCC *Hospital*, Jakarta, Indonesia[4]

**Correspondence Author :* dradenurlina@gmail.com

ABSTRAK

Bronchial artery embolization (BAE) merupakan teknik endovaskular invasif minimal yang memberikan manfaat diagnostik sekaligus terapeutik dalam penanganan hemoptisis yang mengancam jiwa. Pada pasien dengan keganasan paru, BAE telah ditetapkan sebagai intervensi paliatif yang efektif, terutama ketika reseksi bedah dikontraindikasikan akibat kondisi penyakit yang lanjut. *Case series* ini mendeskripsikan dua pasien dengan hemoptisis terkait tumor, yakni satu pasien dengan adenokarsinoma paru stadium akhir dan satu pasien lainnya dengan keterlibatan metastasis paru, yang keduanya menjalani prosedur BAE superselektif menggunakan bahan emboli yang berbeda. Presentasi klinis, temuan pencitraan, teknik prosedural, dan luaran klinis ditinjau secara mendalam untuk mengevaluasi efektivitas tindakan. Pada kasus pertama, embolisasi dilakukan menggunakan partikel *polyvinyl alcohol* (PVA) berukuran 500–710 µm, sedangkan pada kasus kedua digunakan mikrosfer *Embosphere* berukuran 300–500 µm. Hasil prosedur menunjukkan bahwa kedua pasien mencapai hemostasis lengkap dengan pengurangan *vascular blush* yang signifikan tanpa disertai komplikasi pasca-prosedur. Selama masa pemantauan, tidak ditemukan adanya kekambuhan hemoptisis pada kedua pasien tersebut. Temuan ini menunjukkan bahwa BAE adalah intervensi yang aman, efektif, dan dapat diulang untuk mengontrol perdarahan pada keganasan paru. Luaran ini sejalan dengan literatur sebelumnya yang mendukung BAE sebagai pilihan paliatif esensial bagi pasien dengan kanker paru stadium lanjut atau metastatik, guna meningkatkan kualitas hidup melalui kontrol perdarahan yang optimal.

Kata kunci : adenokarsinoma, embolisasi arteri bronkial, hemoptisis, metastasis, *polyvinyl alcohol*

ABSTRACT

Bronchial artery embolization (BAE) is a critical, minimally invasive endovascular technique that offers both diagnostic and therapeutic advantages in the management of life-threatening hemoptysis. Particularly in patients suffering from pulmonary malignancy, BAE has emerged as a highly effective palliative intervention, especially when surgical resection is deemed contraindicated due to the advanced stage of the disease or the patient's clinical status. one diagnosed with end-stage lung adenocarcinoma and the other with extensive metastatic pulmonary involvement. Both individuals underwent superselective BAE, utilizing different embolic materials to achieve vessel occlusion. In the first case, embolization was successfully performed using polyvinyl alcohol (PVA) particles sized 500–710 µm, while the second case utilized Embosphere microspheres sized 300–500 µm. The results of these interventions were highly favorable, as both procedures achieved complete hemostasis, evidenced by a marked reduction in vascular blush on angiography and the absence of any procedure-related complications. Follow-up evaluations confirmed that neither patient experienced a recurrence of hemoptysis, highlighting the durability of the treatment. These findings demonstrate that BAE is a safe, effective, and repeatable intervention for controlling malignant hemoptysis. Ultimately, this case series aligns with existing literature that supports BAE as an essential palliative tool, providing a vital option for improving the quality of life in patients with advanced or metastatic lung cancer.

Keywords *: adenocarcinoma, bronchial artery embolization, hemoptysis, metastasis, polyvinyl alcohol*

INTRODUCTION

Interventional embolisation provides a minimally invasive method to occlude abnormal vasculature or control hemorrhage through targeted delivery of embolic agents. Clinicians use bronchial artery embolisation (BAE) as an endovascular approach for severe or recurrent hemoptysis, supported by evidence showing high technical efficacy, rapid hemostasis, and low complication rates (Joachim et al., 2022; Katerina et al., 2011; Han et al., 2019). Malignancy-related hemoptysis arises from tumor invasion, necrosis, and neovascular proliferation that generate fragile bronchial arterial channels susceptible to rupture. Investigators have reported that erosion of vascular structures and hypertrophy of bronchial arteries increase bleeding volume and recurrence in lung cancer (Evgeni et al., 2019). Additional data show that embolisation of bronchial and systemic arteries in non-small-cell lung cancer provides effective hemostasis and supports overall disease management (Fujita et al., 2014).

Clinical practice now incorporates embolisation as a treatment option across a wide spectrum of tumor-related hemoptysis. Evidence demonstrates its applicability for mild, moderate, and massive bleeding and highlights the adaptability of embolic materials based on angiographic characteristics (Jonathan et al., 2019). Investigators also report favorable outcomes using bronchial artery chemoembolisation with drug-eluting beads in advanced malignancy (Liu et al., 2016; David et al., 2019). Current literature positions BAE as a central interventional strategy for recurrent or life-threatening hemoptysis in advanced pulmonary malignancy, particularly among patients who are not candidates for surgical resection (Joachim et al., 2022; Han et al., 2019; Fujita et al., 2014).

From a pathophysiological perspective, the bronchial arteries—which arise directly from the systemic circulation—are responsible for approximately 90% of massive hemoptysis cases due to their high-pressure nature compared to the pulmonary arterial system. In the context of pulmonary malignancy, the tumor microenvironment stimulates chronic inflammation and the release of angiogenic factors. This process leads to the formation of distorted, thin-walled neovascular vessels that lack a proper muscular layer, making them highly vulnerable to shearing forces and pressure changes, which ultimately leads to catastrophic rupture. The selection of embolic agents is a critical factor in ensuring long-term procedural success and preventing early re-bleeding. While various materials are available, calibrated microspheres and polyvinyl alcohol (PVA) particles have become the mainstay of treatment due to their ability to achieve distal occlusion at the arteriolar level without causing widespread tissue necrosis. The size of the embolic agent must be carefully calibrated; particles that are too small may pass through bronchopulmonary shunts causing systemic infarction, whereas excessively large particles may only provide proximal occlusion, leading to rapid collateralization and recurrence.

Technological advancements in superselective catheterization have significantly enhanced the safety profile of BAE. The routine use of microcatheters allows interventionists to navigate tortuous vessels and reach distal targets while sparing healthy lung parenchyma. Most importantly, superselective techniques minimize the risk of "non-target embolization," particularly to the spinal arteries. Since the artery of Adamkiewicz can occasionally share a common origin with the bronchial arteries, meticulous angiographic mapping is essential to prevent devastating neurological complications such as transverse myelitis or paraplegia. Pre-procedural planning has also been revolutionized by the integration of Multidetector Computed Tomography Angiography (MDCTA). MDCTA provides a detailed "roadmap" of the bronchial and non-bronchial systemic collateral arteries, allowing the interventionalist to identify ectopic arterial origins and assess the degree of tumor vascularity before entering the angio-suite. This targeted approach reduces procedure time, limits contrast medium exposure,

and increases the technical success rate, especially in complex cases where the anatomy has been distorted by tumor growth or previous radiation therapy.

Despite its high immediate success rate, BAE in the setting of advanced malignancy is often considered a palliative "bridge" rather than a curative measure. Because the underlying primary tumor remains, the stimulus for angiogenesis persists, necessitating a multidisciplinary approach that combines interventional radiology with medical oncology and palliative care. Long-term management focuses on stabilizing the patient's quality of life and preventing the psychological trauma associated with recurrent choking on blood. The present case series evaluates two individuals with tumor-related hemoptysis and demonstrates the angiographic findings, procedural techniques, and clinical outcomes following bronchial artery embolisation. By highlighting these cases, we aim to reinforce the clinical utility of BAE as a safe and effective pillar in the management of malignant hemoptysis.

CASE PRESENTATIONS

Case 1 – Lung Adenocarcinoma (End-Stage Primary Tumor)

A 60-year-old female presented with recurrent hemoptysis of approximately 5–15 mL per episode accompanied by progressive anemia (hemoglobin < 10 g/dL) and chronic cough. The patient had a known history of stage IV right-lung adenocarcinoma that had been treated with systemic chemotherapy and radiotherapy but continued to experience intermittent bleeding. She had no history of congenital, hereditary, or coagulopathic disorders. Chest radiography demonstrated a large, irregular, spiculated mass in the right middle lobe with associated right-sided pleural effusion. Contrast-enhanced computed tomography (CECT) revealed a 4.5-cm spiculated mass invading the segmental bronchus, accompanied by multiple mediastinal lymphadenopathies (stations 2R, 4R, and 10). Further evaluation in March 2023 showed hepatic and osseous metastases as well as a pathological compression fracture of the cervical spine with myelopathy, confirming disseminated disease consistent with an end-stage presentation.

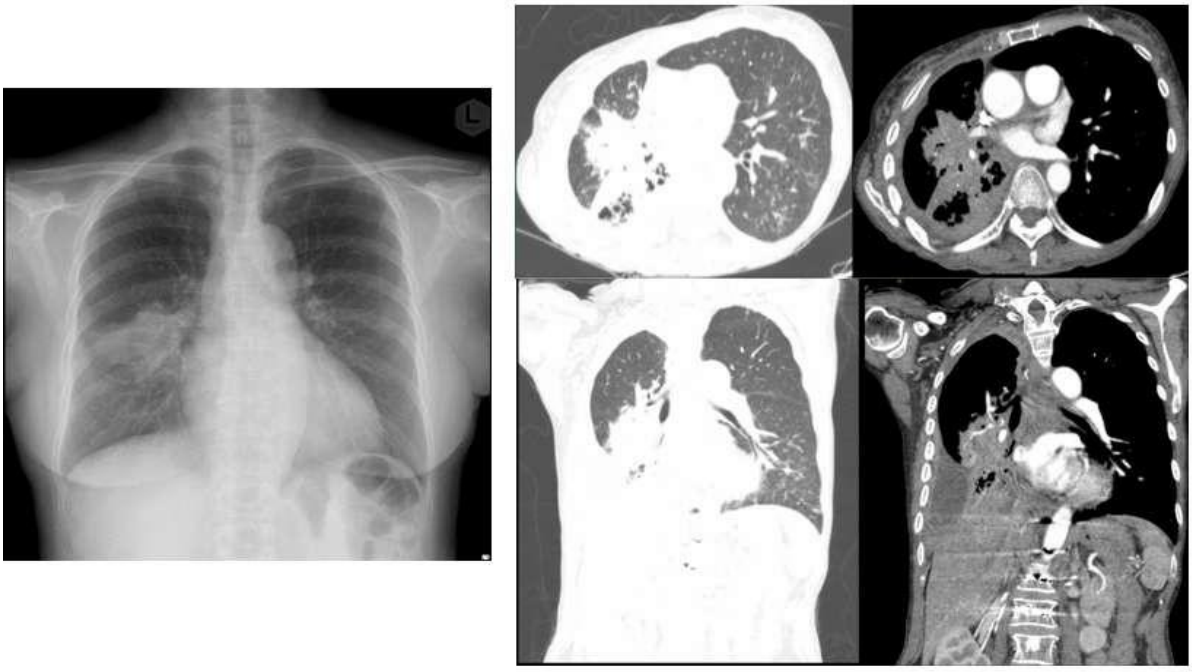

Figure 1. Chest radiograph (PA) and contrast-enhanced CT of the thorax demonstrate a large spiculated mass in the right middle lobe, accompanied by a right-sided pleural effusion

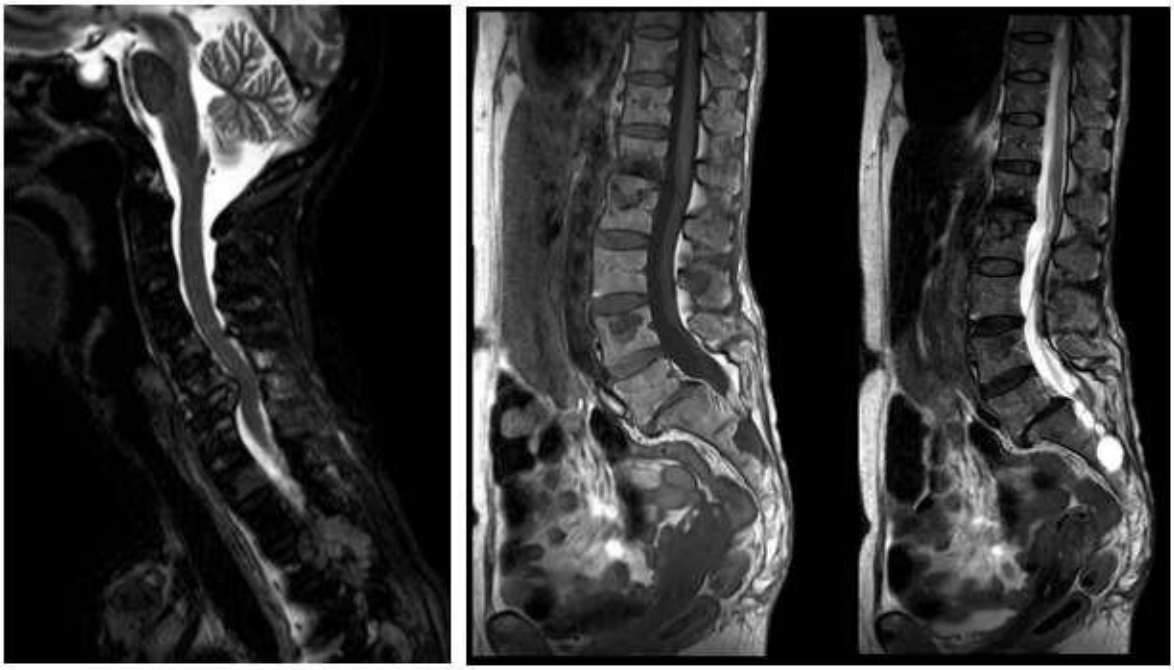

Figure 2. Sagittal MRI of the cervical spine (T2) demonstrates a severe pathological compression fracture at C6 with retropulsion and associated myelopathy, while sagittal lumbar MRI (T1/T2 with contrast) shows multilevel lytic–sclerotic vertebral lesions and grade II L5–S1 spondylolisthesis

Given the recurrent hemoptysis and the patient's poor surgical candidacy, bronchial artery embolization (BAE) was performed on September 11, 2023. Selective bronchial arteriography revealed tortuosity, hypertrophy, and active contrast pooling arising from both the superior and inferior right bronchial arteries, confirming the site of bleeding. Under fluoroscopic guidance, a superselective embolization was performed using polyvinyl alcohol (PVA) particles measuring 500–710 µm as the embolic agent. Particles smaller than 200 µm or liquid embolic materials were avoided to minimize the risk of distal tissue infarction.

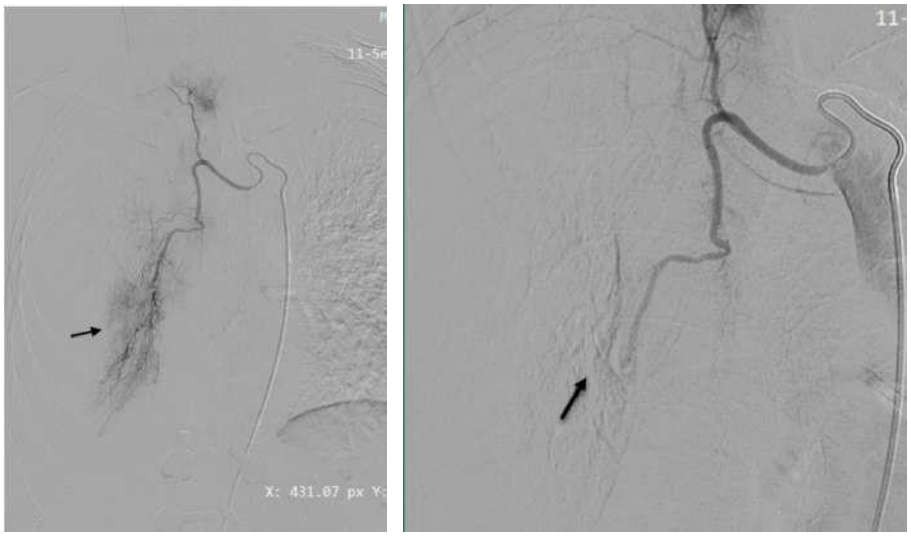

Figure 3. Late arterial phase bronchial arteriography demonstrates contrast pooling from the superior and inferior right bronchial arteries, followed by post-embolization superselective angiography of the right inferior bronchial artery showing markedly reduced residual contrast pooling (black arrow)

Post-embolization angiography demonstrated complete disappearance of contrast pooling and a marked reduction in abnormal vascularity, indicating successful occlusion of the

bleeding vessels. The patient experienced immediate cessation of hemoptysis with no procedural complications such as chest pain, dysphagia, or spinal ischemia. She remained free of recurrent bleeding during the three-month follow-up period, and her hemoglobin levels stabilized.

Case 2 – Metastatic Lung Involvement (Secondary Tumor)

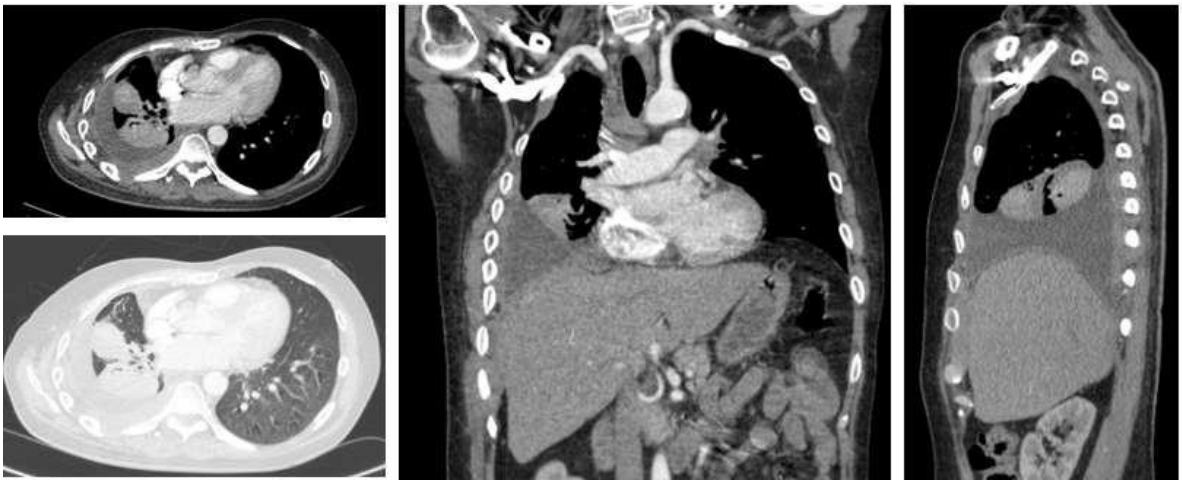

Figure 4. High-resolution computed tomography of the thorax shows lobulated soft-tissue lesions in the right lower lobe (largest 4.4 × 3.7 cm) with intralesional calcification, adjacent atelectasis, and anterior chest-wall infiltration, consistent with metastatic pulmonary involvement

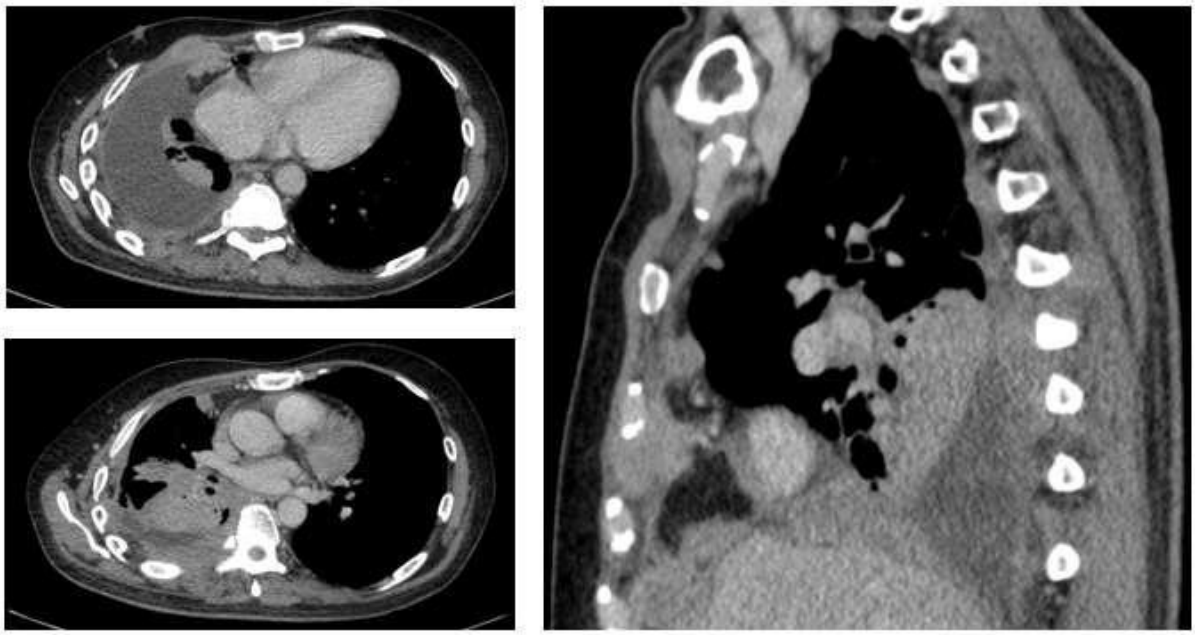

Figure 5. Contrast-enhanced CT in axial and sagittal views demonstrates an irregular soft-tissue mass along the right anterior chest wall at the level of the 3rd–4th intercostal spaces (4.3 × 2.9 × 3.0 cm), infiltrating the intercostal muscles and pericardial fat, accompanied by multiple enlarged pericardial lymph nodes (0.7–1.2 cm)

A 46-year-old male presented with recurrent hemoptysis and a history of metastatic disease involving the lungs and thoracic spine (T3–T8). The patient had previously been diagnosed with a systemic malignancy complicated by secondary pulmonary and skeletal metastases. He complained of intermittent episodes of hemoptysis over several weeks, accompanied by dyspnea and mild right-sided chest pain. High-resolution computed tomography (HRCT) of the thorax demonstrated irregular, lobulated soft-tissue lesions in the

right lower lobe, with infiltration of the anterior chest wall at the level of the third to fourth intercostal spaces. The dominant lesion measured 4.4 × 3.7 cm in the posterobasal segment, showing areas of intralesional calcification and adjacent atelectasis. Multifocal marrow replacement was identified at the thoracic vertebrae T3 and T5–T8, associated with paravertebral soft-tissue extension, intracanalar and intramedullary spread, and severe spinal canal stenosis. A small right pleural effusion was also present, consistent with advanced metastatic disease.

Given the patient's recurrent hemoptysis and high operative risk, bronchial artery embolization (BAE) was performed on September 1, 2025. Through a right femoral arterial approach, diagnostic angiography revealed hypervascular blush and contrast pooling originating from the right inferior bronchial artery, which was identified as the source of bleeding. A superselective catheterization was performed, followed by embolization using Embosphere microspheres (300–500 μm) as the embolic agent.

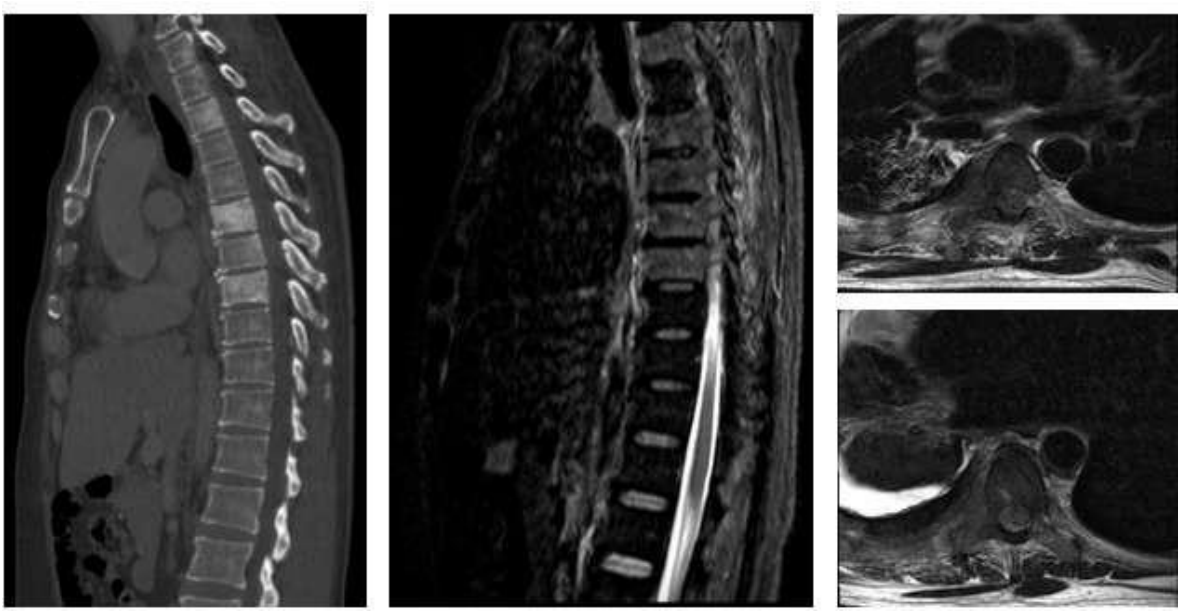

Figure 6. Sagittal CT and MRI of the thoracic spine show multifocal marrow-replacing metastatic lesions at T3 and T5–T8, demonstrating paravertebral soft-tissue extension, intracanalar and intramedullary spread, and severe spinal canal stenosis with associated cord edema, including extension into the right T6–T8 ribs

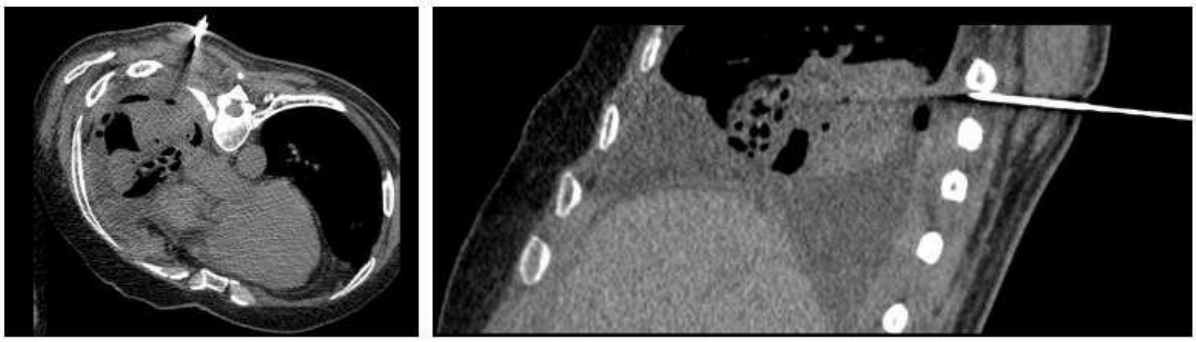

Figure 7. CT-guided transthoracic biopsy using a Quick-Core needle directed into the right posterobasal pulmonary mass, performed under real-time imaging. A small right pleural effusion is present, and no post-procedural pneumothorax or pneumomediastinum is identified

Post-embolization angiography demonstrated a marked reduction of the abnormal vascular blush and complete cessation of contrast extravasation, confirming technical success. The patient tolerated the procedure well, with no complications such as chest discomfort, ischemia, or neurologic deficits observed. Clinically, hemoptysis resolved immediately after

embolization, and the patient's condition remained stable throughout the one-month follow- up period without recurrence of bleeding.

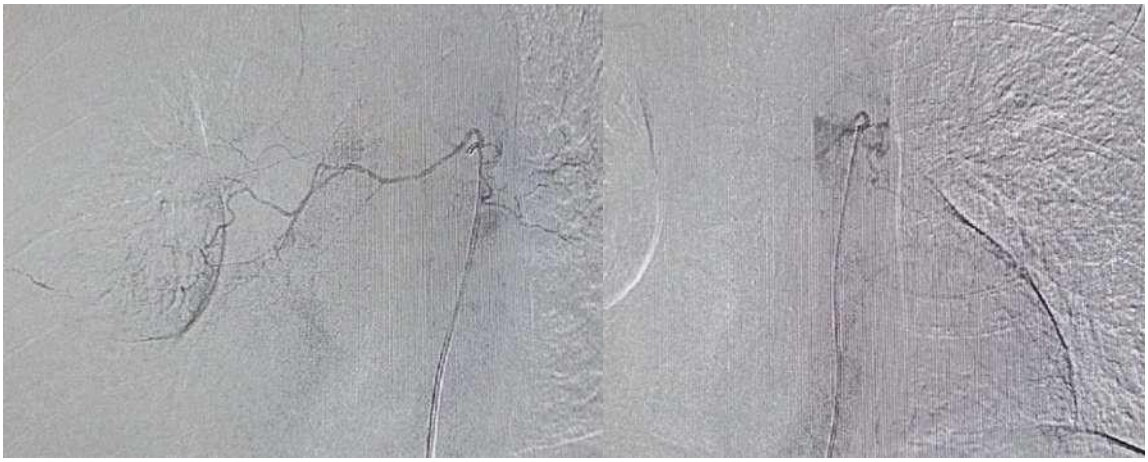

Figure 8. Late arterial phase bronchial arteriography shows arborizing contrast pooling arising from the superior and inferior right bronchial arteries. Subsequent post-embolization superselective angiography of the right inferior bronchial artery demonstrates a marked reduction in residual contrast pooling

Table 1. Summary of Case Characteristics and Outcomes

Case	Age/Sex	Diagnosis	Embolic Agent	Target Artery	Hemostasis	Complication	Follow-up
1	60/F	End-stage lung adenocarcinoma	PVA 500–710 µm	Rt bronchial (sup. & inf.)	Yes	None	3 mo
2	46/M	Metastatic pulmonary lesion	Embosphere 300–500 µm	Rt inf. bronchial	Yes	None	1 mo

DISCUSSION

Hemoptysis related to malignant disease arises from tumor necrosis, vascular erosion, and proliferative neovascularization within the bronchial arterial circulation. Fragile neovessels supplied predominantly by hypertrophic bronchial arteries rupture easily and contribute to high-volume bleeding, as reported in studies evaluating lung cancer–associated hemoptysis (Evgeni et al., 2019; Han et al., 2019). Pathologic progression produces distortion and enlargement of systemic bronchial arteries, and this process increases the likelihood of clinically significant bleeding that requires targeted endovascular therapy (Fujita et al., 2014; Joachim et al., 2022). Clinicians utilize bronchial artery embolisation (BAE) to achieve selective occlusion of abnormal inflow while maintaining perfusion to functional parenchyma. Evidence demonstrates high technical and clinical success rates, particularly in cases involving tumor- associated neovascularity (Katerina et al., 2011; Han et al., 2019). The CIRSE standards recommend superselective catheterization, careful mapping of the bronchial and non- bronchial systemic circulation, and the use of embolic materials that allow controlled penetration without injuring critical spinal or esophageal branches (Joachim et al., 2022). These principles guide safe practice across benign and malignant etiologies (Jonathan ML et al., 2019).

Additional oncologic literature supports the role of interventional embolisation as part of integrated cancer management. Several investigations highlight the effectiveness of drug-eluting bead bronchial artery chemoembolisation for advanced non-small-cell lung cancer, demonstrating improved disease control and enhanced physiological stability (David et al., 2019; Liu S et al., 2016). Studies in lung adenocarcinoma further categorize advanced stages

(IIIB–IV) as unresectable and emphasize the importance of non-surgical strategies such as embolisation to support symptom management (David J et al., 2019). Imaging-based diagnostic approaches, including multidetector CT angiography, provide essential localization and etiological characterization of hemoptysis and have demonstrated superior performance compared with chest radiography alone (Anna R et al., 2018).

Clinical profiles of malignant pulmonary disease frequently include cough, dyspnea, chest discomfort, and hemoptysis, as observed in epidemiologic descriptions of lung cancer presentations (Lobat S et al., 2017). These symptoms often prompt evaluation for metastatic progression, and several studies identify lymphatic, hepatic, and osseous dissemination as common components of advanced disease that may increase the complexity of vascular bleeding control (Evgeni et al., 2019; Fujita et al., 2014). The two cases evaluated in this report demonstrate the application of BAE with tailored embolic selection. PVA particles sized 500–710 µm were used for end-stage lung adenocarcinoma, and calibrated Embosphere microspheres sized 300–500 µm were used for metastatic pulmonary disease. Both patients achieved immediate hemostasis without procedure-related complications, consistent with published outcomes documenting rapid stabilization, low recurrence, and minimal major adverse events (Joachim et al., 2022; Han et al., 2019; Jonathan ML et al., 2019).

Avoidance of embolic particles smaller than 200 µm aligned with procedural safety recommendations due to the documented association between small-particle embolisation and distal infarction (Joachim et al., 2022). Collectively, the findings from the present cases align with the evidence generated across the 13 referenced studies, demonstrating that BAE provides reliable bleeding control, maintains a favorable safety margin, and serves as an essential component of multidisciplinary care for patients with advanced primary or metastatic lung malignancy (Evgeni et al., 2019; Han et al., 2019; Fujita et al., 2014; Jonathan ML et al., 2019; Joachim et al., 2022).

CONCLUSION

The present case series supports the use of BAE as a safe, effective, and repeatable technique for managing hemoptysis in both primary and metastatic pulmonary malignancies. The procedure achieves high rates of immediate hemostasis, with durable outcomes and minimal procedural morbidity. The success observed in both cases underscores the vital role of interventional radiology in palliative oncology care and reflects current evidence demonstrating the reliability of BAE in reducing mortality and improving quality of life in patients with advanced lung cancer.

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