JACC: CASE REPORTS VOL. 4, NO. 12, 2022

CASE REPORT

ADVANCED

CLINICAL CASE

Multimodality Image-Guided Embolization of Bronchial Artery Pseudoaneurysm in a Patient With Aortopathy

Maria Katsarou, MD,[a,b] Ponraj Chinnadurai, MBBS, MMST,[a,c] Carlos El-Tallawi, MD,[a] Valeria Duarte, MD,[a] C. Huie Lin, MD, PhD[a]

ABSTRACT

A 59-year-old man received an incidental diagnosis of a 5-cm right para-aortic mass that was initially thought to be of venous origin. Multimodality imaging revealed a right bronchial artery pseudoaneurysm that was treated with endovascular embolization. Bronchial artery pseudoaneurysms are extremely rare and can be fatal if ruptured. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:721–726) © 2022 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 59-year-old man was referred to our institution for a progressively enlarging thoracic para-aortic mass. The patient had undergone noncontrast computed tomography at an outside hospital that revealed a 5-cm para-aortic mass in the right posterior mediastinum, which was initially thought to be of venous origin because of its proximity to the azygos vein. The patient was asymptomatic, and his clinical examination did not reveal any abnormal findings.

LEARNING OBJECTIVES

- To be able to make a differential diagnosis of bronchialartery pseudoaneurysms with multimodality imaging.
- To demonstrate that multimodality imaging and intraoperative imaging guidance techniques, such as image fusion with fluoroscopy, enable precise treatment planning and execution.

MEDICAL HISTORY

The patient's medical history was positive for hypertension and nasal skin cancer. His surgical history included a Bentall procedure, resection of right and left coronary artery ostial aneurysms, and an aortoiliac bypass for abdominal aortic and bilateral iliac artery dissection.

DIFFERENTIAL DIAGNOSIS

The causes of posterior mediastinal masses include neurogenic tumors, infectious spondylitis, meningocele, thoracic aortic aneurysms, aortic

From the [a]Houston Methodist DeBakey Heart and Vascular Center, Houston Methodist Hospital, Houston, Texas, USA; [b]Section of Vascular Surgery, Fondazione IRCCS, Ca'Granda Ospedale Maggiore Policlinico, Milan, Italy; and [c]Advanced Therapies, Siemens Medical Solutions USA Inc, Malvern, Pennsylvania, USA.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

Manuscript received February 13, 2022; revised manuscript received April 1, 2022, accepted April 13, 2022.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2022.04.004

JACC: CASE REPORTS, VOL. 4, NO. 12, 2022
JUNE 15, 2022:721–726

ABBREVIATIONS AND ACRONYMS

BA = bronchial artery

CT = computed tomography

CTA = computed tomographic angiography

EBUS-FNA = endobronchial ultrasound fine needle aspiration

MR = magnetic resonance

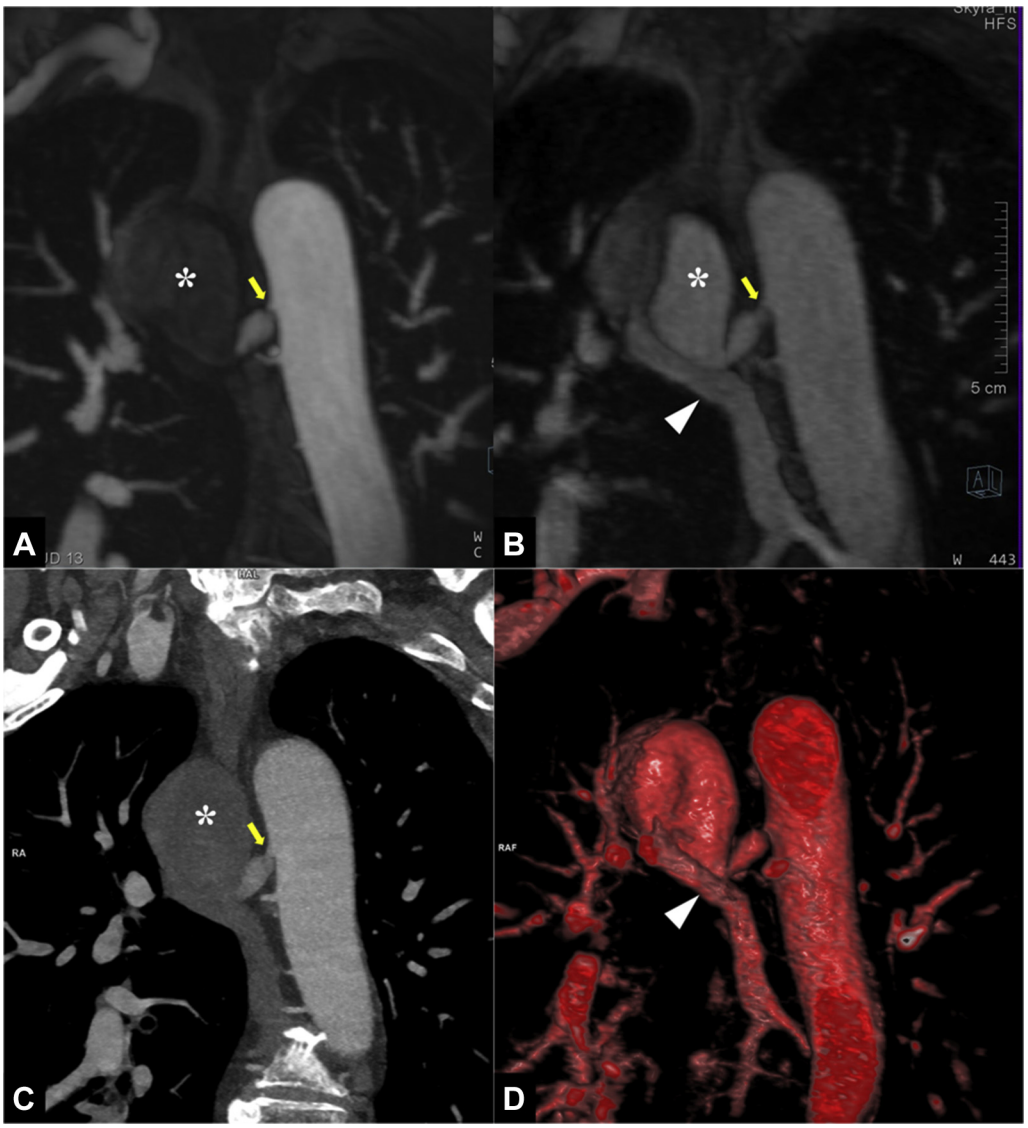
TEVAR = thoracic endovascular aortic repair

dissection, dilated azygos vein, esophageal varices and tumors, lymphomas, and lymphadenopathies.[1]

INVESTIGATIONS

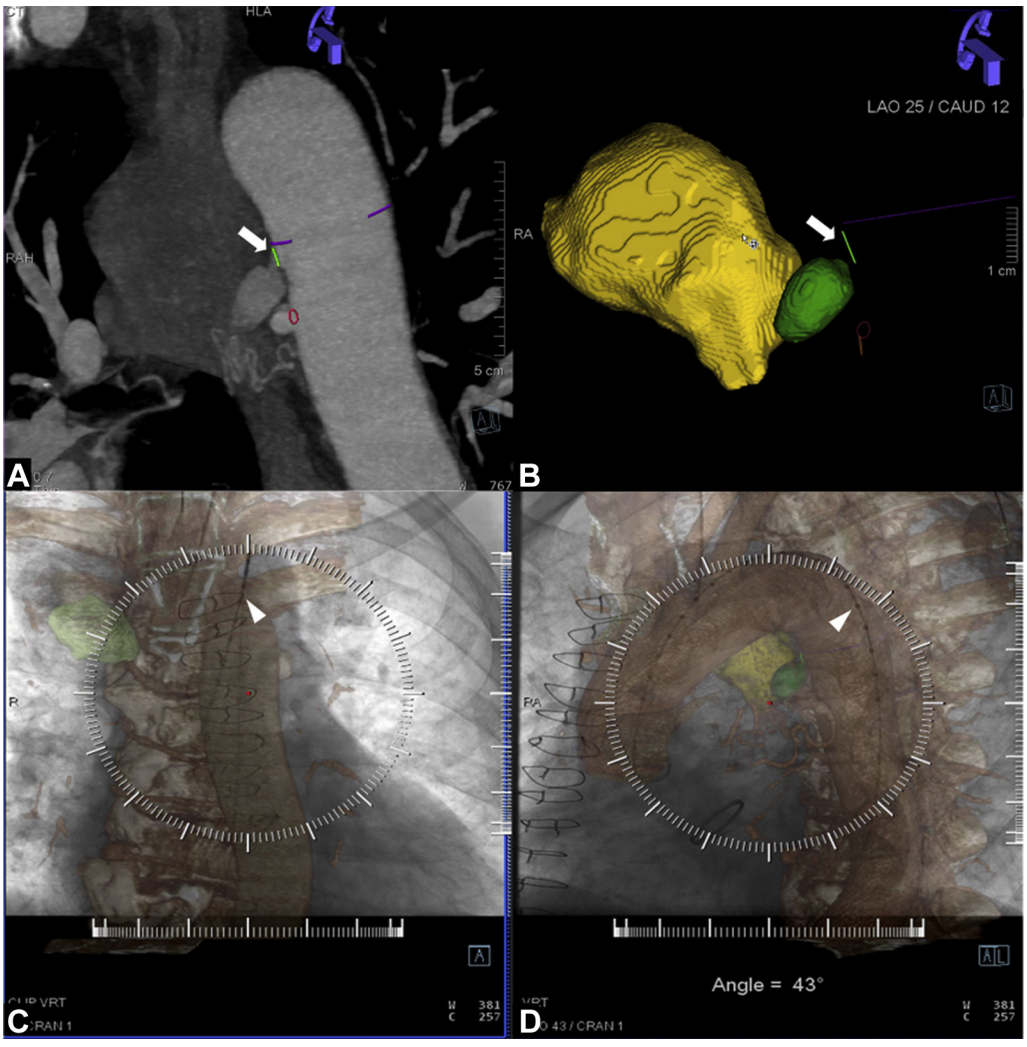
Time-resolved, cardiac magnetic resonance (MR) angiography revealed a 5.5 × 4.5 cm, partially thrombosed pseudoaneurysm to the right of the proximal descending thoracic aorta, connected by a narrow stalk at the level of the right bronchial artery (BA) origin (Figure 1). This unusual sac morphology with a connecting stalk and the partial sac thrombosis led to its categorization as a pseudoaneurysm over a true aneurysm. The mass was determined to be of arterial nature based on its anatomical characteristics and evidence of arterial pulsation. The venous phase of time-resolved MR did not reveal any connection to the azygos vein (Figure 1). Cardiac-gated CTA confirmed an ectatic

FIGURE 1 Preoperative Imaging



Coronal views of time-resolved magnetic resonance angiography **(A)** and venography **(B)**, computed tomography angiography **(C)**, and 3D reconstruction of magnetic resonance venography of a 5.5 × 4.5 cm partially thrombosed right bronchial artery pseudoaneurysm **(*)**. The pseudoaneurysm is connected to the thoracic aorta by a narrow stalk **(yellow arrows)** and is formed by a smaller proximal and a large distal chamber. It is near the azygos vein **(white arrow heads)**, but magnetic resonance did not reveal any direct connection between the 2 structures.

FIGURE 2 **Preprocedural Planning**



Marking the ostia of bronchial **(green lines and white arrows)** and intercostal **(red circle)** arteries with fusion techniques **(A)**. The pseudoaneurysm was semiautomatically segmented, highlighting the 2 chambers **(B)**. Anteroposterior and left anterior oblique fluoroscopic views were overlayed on the preprocedural gated computed tomography angiography **(C, D)**.

and tortuous right BA immediately cranial to the pseudoaneurysmal neck that appeared to feed into the bronchopulmonary collaterals in the right hilar region.

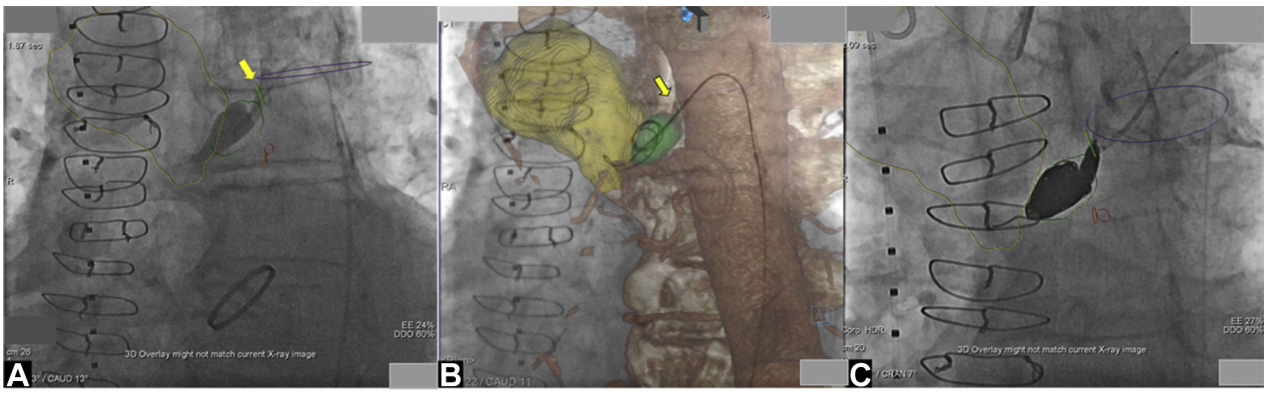
The CT images were imported into the 3D post-processing workstation in the cardiac catheterization laboratory for preprocedural planning. The ostia of the bronchial and intercostal arteries were electronically marked, and the pseudoaneurysm was segmented semiautomatically using stroke-based segmentation tools (Figure 2).

MANAGEMENT

Under general anesthesia, a 6-F sheath was placed percutaneously in the right femoral artery. A 7-F sheath was placed in the right common femoral vein. From the arterial access, a pigtail catheter was advanced over a Wholey wire (Medtronic Inc) and placed in the aortic root along the outer curve of the aorta. Two fluoroscopic images were acquired at anteroposterior and left anterior oblique views to enable coregistration of preprocedural gated CTA

JACC: CASE REPORTS, VOL. 4, NO. 12, 2022
JUNE 15, 2022:721–726

FIGURE 3 Intraoperative Fluoroscopy Images



A guidewire was used to cannulate the right bronchial artery and was advanced into the distal chamber of the pseudoaneurysm using fusion guidance **(A)**. The proximal chamber was embolized with coils **(B)**. At completion angiography, the pseudoaneurysm is packed with coils. and no contrast opacification is detected **(C)**.

data with fluoroscopy (Figure 2) using commercially available tools (syngo.via 2D3D fusion, Siemens Healthineers). After image fusion, the right BA ostium and the segmented contours of the pseudoaneurysm were overlaid on fluoroscopy to facilitate cannulation. Fluoroscopy confirmed the BA pseudoaneurysm arising from the thoracic aorta, that proceeded into a 12-mm pseudoaneurysm stalk followed by a second channel into a slow-filling ~5-cm para-aortic pseudoaneurysm, that looked amenable to embolization (Figure 3A).

A 5-F TorqVue LP sheath (Abbott Laboratories) and a Simmons 1 catheter (Terumo) were positioned at the T4/T5 level in the descending aorta. Then, using CT image fusion guidance, the guidewire was used to cannulate the right BA (Figure 3A, Video 1). However, advancement of the sheath into the pseudoaneurysm was challenging, which resulted in the adoption of a coil embolization-only strategy. The guidewire was then exchanged for a 150-cm Lantern 90 delivery microcatheter (Penumbra Inc.) inside the proximal pseudoaneurysm. A 12-mm × 60-cm Ruby standard coil and a 12-mm × 40-cm Ruby soft coil (Penumbra Inc) were deployed as framing coils inside the pseudoaneurysm (Figure 3B, Video 2), followed by a 15 and a 45 cm packing coil.

Completion angiography demonstrated dense packing of the proximal pseudoaneurysm and no contrast opacification of the distal pseudoaneurysm (Figure 3C, Video 3). The patient was discharged on postoperative day 2 without complications.

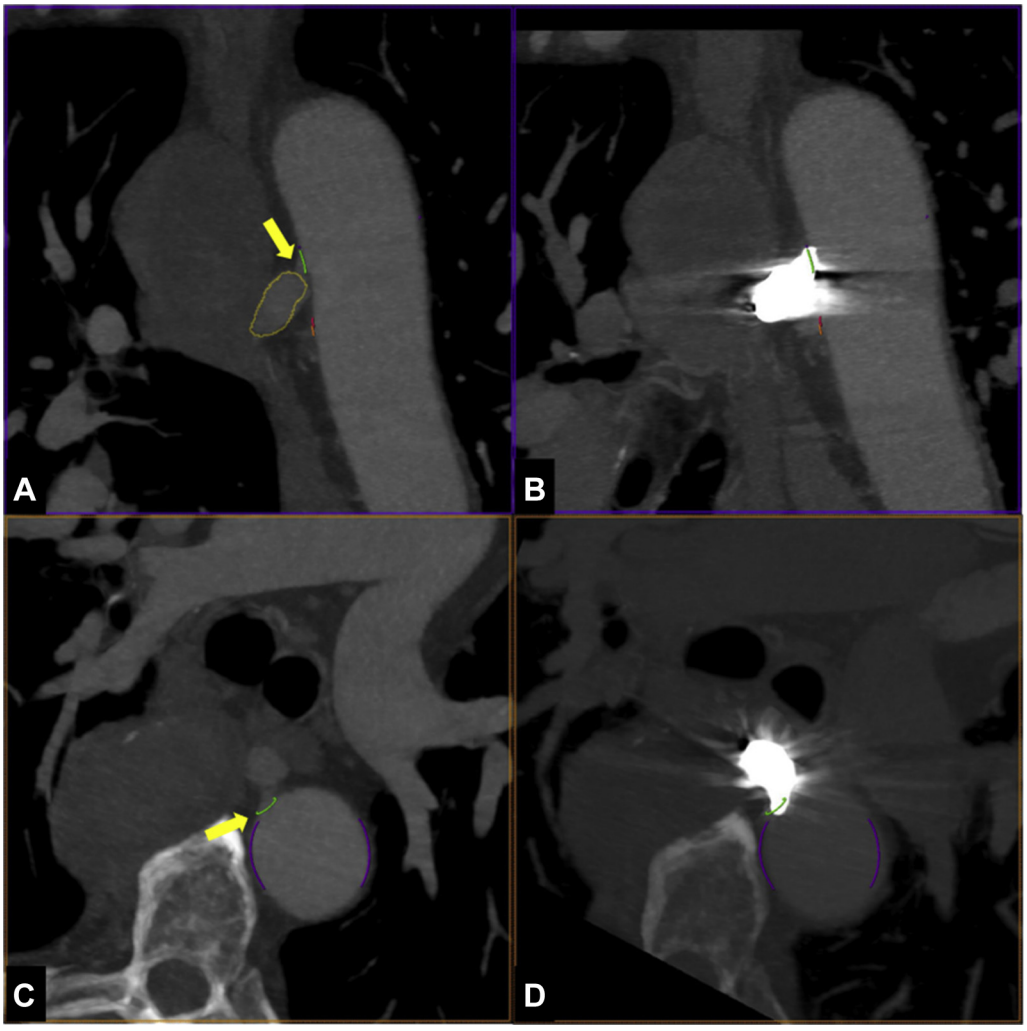
DISCUSSION

BA pseudoaneurysms are extremely rare clinical entities, with very few cases reported in the literature (Table 1).[2-16] Although rare, they can be fatal when ruptured.

The most common clinical presentations include hemoptysis, especially when intrapulmonary, and rupture. The main causes are iatrogenic, posttraumatic and postinflammatory. Some are thought to arise from BA aneurysm degeneration. Endovascular embolization is mainly used for pseudoaneurysms arising from the bronchial arteries. However, open surgical repair involving a sternotomy or a lateral thoracotomy is an alternative option when endovascular treatment is not feasible.

We believe the pseudoaneurysm that we present in this case report to be a contained rupture of a BA aneurysm. There was no history of any interventional procedures in the previous 10 years that could point to an iatrogenic cause. No history of recent infection was reported. Moreover, our patient was using warfarin therapy since his Bentall procedure, which may have precipitated the contained rupture/enlargement of the pseudoaneurysm.

FIGURE 4 **Preoperative and Postoperative Computed Tomography Angiography**



Coronal and axial views of preoperative **(A, C)** and 6-month postoperative computed tomography angiography **(B, D)** demonstrating stable dimensions and complete exclusion of the right brachial artery pseudoaneurysm.

FOLLOW-UP

At 6 months, the patient underwent a CTA that showed a stable pseudoaneurysm of similar size without any contrast opacification (Figure 4). There were no signs of mediastinal hematoma, fluid collection, or infection.

CONCLUSIONS

Multimodality imaging is necessary for the diagnosis and treatment of bronchial artery pseudoaneurysms.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Dr Chinnadurai is a full-time Research Collaborations Manager and Senior Key Expert at Advanced Therapies Division, Siemens Medical Solutions USA, Inc. Dr Lin is a data monitoring committee member of ACI Clinical; is a speaker for Abiomed; is a proctor for Abbott; and is a course director for Gore Medical. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Maria Katsarou, Houston Methodist DeBakey Heart & Vascular Center, 6555 Fannin Street, Houston, Texas 77030, USA. E-mail: maria.katsarou@unimi.it. Twitter: @MariaKatsarou14.

TABLE 1 Cases of bronchial pseudoaneurysms in the literature

Journal	First Author	Year	Symptoms	Cause	Treatment
J Vasc Interv Radiol	Cearlock	1995	Hemoptysis	Post-traumatic	Embolization
Can Resp J	Lioulias	2008	Hemoptysis	Postbroncotomy	Open repair
Clin Imaging	Kaufman	2014	Rupture	Bronchial aneurysm degeneration	Embolization
Chest	Nguyen	2015	Rupture	Bronchial thermoplasty	Embolization
Ann Otol Rhinol Laryngol	Patel	2015	Hemoptysis	Pneumonia	Embolization
Korean J Thorac Cardiovasc Surg	Choong	2015	Asymptomatic	Post-TEVAR	Embolization
Diagn Interv Imaging	Izaaryene	2016	Dysphagia, dry cough	Incidental	Embolization
J Vasc Interv Radiol	Urlings	2017	Hemoptysis	Lung cancer	Embolization
Arch Bronchoneumol	Raboso	2018	Hemoptysis	Postlobectomy	Embolization
Vasc Endovasc Surg	Kano	2020	Asymptomatic	Racemose hemangioma	Embolization and TEVAR
Cureus	Koirala	2020	Rupture	Incidental	Embolization
Radiology	Ghonge	2021	Asymptomatic	Tuberculosis	Embolization
Arch Bronchoneumol	Recalde-Zamacona	2021	Hemoptysis	EBUS-FNA	Embolization
Cardiovasc Intervent Radiol	Braithwaite	2021	Hemoptysis	SARS-CoV-2 pneumonia	Embolization
Vasc Endovasc Surg	Kabilan	2021	Hemoptysis	Tuberculosis	Embolization

EBUS-FNA = endobronchial ultrasound fine needle aspiration; SARS-CoV-2 = severe acute respiratory syndrome-coronavirus-2; TEVAR = thoracic endovascular aortic repair.

REFERENCES

1. Occhipinti M, Heidinger BH, Franquet E, Eisenberg RL, Banker AA, et al. Imaging the posterior mediastinum: a multimodality approach. *Diagn Interv Radiol*. 2015;21(4):293–306.

2. Kaufman C, Kabutey N-K, Sgroi M, Kim D. Bronchial artery pseudoaneurysm with symptomatic mediastinal hematoma. *Clin Imaging*. 2014;38:536–539.

3. Koirala A, Thapa A, Mahat S, Sapkota S, Sosa O. A rare case of ruptured bronchial artery pseudoaneurysm and its nonsurgical management with interventional techniques. *Cureus*. 2020;12(9):e10502.

4. Cearlock JR, Fontaine AB, Urbaneja A, Spigos DG. Endovascular treatment of a post-traumatic bronchial artery pseudoaneurysm. *J Vasc Interv Radiol*. 1995;6(3):495–496.

5. Braithwaite SA, Kearns DJ, Douglas E, et al. Tapping CR. Delayed post COVID-19 bronchial artery pseudoaneurysm treated with embolisation: letter to the editor. *Cardiovasc Intervent Radiol*. 2021;44(10):1663–1664.

6. Rofso Raboso P, García Fernández JL, Moreno Balsalobre R. Bronchial artery pseudoaneurysm after right upper lobectomy: an exceptional case. *Arch Bronconeumol*. 2019;55(1):48.

7. Urlings TAJ, Irani FG, Velaga J, Too CW. Ultrasound- and fluoroscopic-guided embolization of a bronchial artery pseudoaneurysm in a patient with lung cancer. *J Vasc Interv Radiol*. 2017;28(9):1323–1325.

8. Nguyen D-V, Murin S. Bronchial artery pseudoaneurysm with major hemorrhage after bronchial thermoplasty. *Chest*. 2016;149(4):e95–e97.

9. Patel R, Uchida D, Peter Feola G, Meier JD. Bronchial artery pseudoaneurysm as an unsuspected cause of hemoptysis in a pediatric patient. *Ann Otol Rhinol Laryngol*. 2014;123:591–595.

10. Recalde-Zamacona B, Ezponda A, Zulueta JJ, et al. Bronchial artery pseudoaneurysm and mediastinal hematoma after EBUS-TBNA. *Arch Bronconeumol*. 2021;57(2):142–143.

11. Ghonge NP. Bronchial artery pseudoaneurysm from a tuberculous lymph node. *Radiology*. 2021;300(1):37.

12. Lioulias A, Misthos P, Kokotsakis J, Papagiannakis G, Skouteli E. Recurrent massive hemoptysis due to postbronchotomy bronchial artery aneurysm: a case report. *Can Respir J*. 2008;15(3):127–128.

13. Kabilan K, Gulati M, Banday IA, et al. Myriad faces of active tuberculosis: intrapulmonary bronchial artery pseudoaneurysm. *Vasc Endovascular Surg*. 2021;56:212–215.

14. Choong AM, Mitchell K, Jenkins J. A right intercosto-bronchial artery derived from the thyrocervical trunk: an unusual cause of type II endoleak post thoracic aortic stenting. *Korean J Thorac Cardiovasc Surg*. 2015;48(2):139–141.

15. Izaaryene J, Vidal V, Bartoli J-M, Gaubert J-Y. Multiple bronchial artery aneurysms: successful treatment with ethylene-vinyl alcohol copolymer (Onyx®). *Diagn Interv Imaging*. 2016;97(1):125–127.

16. Kano M, Nishibe T, Iwahashi T, et al. Successful treatment of bronchial artery aneurysms associated with racemose hemangioma by combined therapy of transcatheter bronchial artery embolization and thoracic endovascular aortic repair. *Vasc Endovascular Surg*. 2020;54:540–543.

KEY WORDS bronchial artery pseudoaneurysm, embolization, endovascular, imaging

APPENDIX For supplemental videos, please see the online version of this paper.