CLINICAL STUDY

Outcomes of Esophageal Arterial Embolization for Treatment of Hemoptysis

Eui Yong Jeon, MD, Young Kwon Cho, MD, PhD, Heon Han, MD, PhD, Young Il Kim, MD, PhD, Lyo Min Kwon, MD, Yeol Lee, MD, PhD, and Jung Gi Im, MD, PhD

ABSTRACT

Purpose: To investigate safety and efficacy of esophageal arterial embolization (EAE) in addition to bronchial arterial embolization (BAE) for treatment of hemoptysis as well as the importance and characteristics of esophageal arteries in patients with hemoptysis.

Materials and Methods: Between January 2013 and December 2014, 20 patients (13 men and 7 women, mean age 58.4 y) underwent EAE in addition to BAE for hemoptysis. Retrospective review of patient records was performed to evaluate major causes of hemoptysis, treatment indications based on CT findings, esophageal angiography findings, and outcomes after embolization including clinical success rate and complications.

Results: Hemoptysis was caused by bronchiectasis (12 patients), tuberculosis (7 patients), and lobectomy (1 patient). CT showed lower lobe lung lesions in all (100%) patients. The esophageal arteries originated from the aorta between the carina and diaphragm (18 patients) or from the inferior phrenic arteries (2 patients) and were tortuous with longitudinal off-midline courses. Communications between the esophageal and the bronchial or inferior phrenic arteries were present in 12 patients. One patient who was treated using *N*-butyl cyanoacrylate developed dysphagia that resolved with medical treatment. Repeat BAE was performed in 2 patients 5 days and 20 days later, and the clinical success rate was 90% (18/20).

Conclusions: EAE in addition to BAE is safe in the treatment of hemoptysis and should be considered for lower lobe lesions.

ABBREVIATIONS

BAE = bronchial arterial embolization, EAE = esophageal arterial embolization, NBCA = *N*-butyl cyanoacrylate, PVA = polyvinyl alcohol

Nonbronchial systemic arteries, such as the intercostal arteries, the branches of the subclavian and axillary arteries, the internal mammary arteries, the inferior phrenic arteries, and rarely the esophageal arteries, can contribute to hemoptysis (1–3). Although some reports have described esophageal arterial embolization (EAE) for bleeding in the upper gastrointestinal tract, few reports have addressed the usefulness of EAE for treating hemoptysis as well as the anatomy of the esophageal arteries (3–6). Some patients with hemoptysis exhibit esophageal arterial supply to the diseased lungs, as noted during bronchial arterial embolization (BAE) procedures. The present study analyzed the anatomy of the esophageal arteries (location and distributions) on computed tomography (CT) and angiography and the angiographic and clinical outcomes of EAE in addition to BAE for hemoptysis.

MATERIALS AND METHODS

The institutional review board approved this study and waived the requirement for informed consent because of its retrospective nature. The records of 20 consecutive patients

From the Department of Radiology (E.Y.J., Y.I.K., J.G.I.), Sheikh Khalifa Specialty Hospital, Ras Al Khaimah, United Arab Emirates; Department of Radiology (Y.K.C.), Kangdong Seong-Sim Hospital, Hallym University College of Medicine, Seongan-ro, Gangdong-Gu, Seoul 134-701, Korea; Department of Radiology (H.H.), Kangwon National University Hospital, Kangwon National University College of Medicine, Kangwondaehak-gil, Chuncheon-si, Korea; and Department of Radiology (L.M.K., Y.L.), Hallym University Medical Center, Hallym University College of Medicine, Anyang-si, Gyeonggi-do, Korea. Received May 18, 2016; final revision received and accepted September 23, 2016. **Address correspondence to** Y.K.C.; E-mail: ykchoman@naver.com

Y.K.C. and H.H. contributed equally to this study.

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who underwent EAE in addition to BAE (of 109 patients) between January 2013 and December 2014 were retrospectively evaluated. The 20 patients included 13 men and 7 women, with a mean age of 58.4 years (range, 21–84 y).

BAE and EAE Procedures

The patients were treated at 2 university hospitals by 2 interventional radiologists (E.Y.J., Y.K.C.) with > 10 years of experience performing BAE. Routine selective bronchial angiography without aortography was performed through the right or left femoral arteries using 5-F shepherd hook or cobra catheters (Cook Medical, Bloomington, Indiana). Serial selection of the intercostobronchial, left upper or lower bronchial, and right lower bronchial arteries was also performed after careful chest CT evaluation of the arteries that might be contributing to the hemorrhagic lungs (eg, localized or diffuse consolidation and/or diffuse ground-glass opacities).

Enlargement of the supplying artery, increased pulmonary parenchymal staining, pseudoaneurysm, and systemic-to-pulmonary arterial shunting were considered indications for embolization after selective angiography. Embolization of the suspected culprit arteries was performed serially using coaxial microcatheter superselection with a 2.5-F microcatheter (Renegade; Boston Scientific, Marlborough, Massachusetts) and 350–500 μm polyvinyl alcohol (PVA) particles (Contour; Boston Scientific). In cases with suspected systemic collateral arterial contribution to the hemoptysis, embolization of the maximum possible number of systemic arteries was performed. These arteries included the branches of the subclavian and axillary arteries, the posterior intercostal arteries, the inferior phrenic arteries, and the esophageal arteries. If selective angiography identified systemic hypervascularization in the diseased lung with a pulmonary arterial shunt from the systemic artery, the embolization was performed in the same manner as for the bronchial arteries.

Esophageal arteriography was performed when there was poor arterial supply to the diseased lung segments during the prior bronchial or systemic arteriography, when the lung lesions were located in the lower lobe and in contact with the mediastinal pleura, and when there was a suspicion of enlarged esophageal arteries based on findings on contrast-enhanced CT. EAE was performed when the diameter of the branch or trunk of the esophageal artery to the diseased lung was larger than the diameter of the ipsilateral bronchial artery or when the diameter of the esophageal artery was unusually large and significant esophageal-to-pulmonary artery shunting was observed up to the level of the ipsilateral pulmonary hilum (Table 1). The angiographic endpoint for the embolization was stasis of the contrast media in the arteries after embolization and the absence of residual areas with contrast material staining in the diseased lung segment.

The embolization material was selected based on the clinical experience of the radiologic interventionalist. The mixture ratio, volume, and injection rate were selected based on the size and flow of the target vessels, and *N*-butyl cyanoacrylate (NBCA) (Histoacryl; B. Braun Melsungen AG, Melsungen, Germany) was added to the PVA solution to block a massive shunt from the esophageal artery to the pulmonary artery. PVA particles of the same size as used for the bronchial artery (diameter 350–500 μm) were used after dilution in 15 mL of contrast agent and 5 mL of saline. The diluted PVA particles were placed in a 20-mL reservoir syringe that was connected to a 1-mL delivery syringe using a 3-way stopcock. NBCA was used in select cases with severe esophageal arterial hypertrophy and a massive pulmonary artery shunt (vs the bronchial arteries) that was accompanied by a normal or small esophageal artery from the aorta, which was communicating with another systemic artery. NBCA was mixed with ethiodized oil (Lipiodol; Guerbet, Roissy, France) at a ratio of 1:2 to 1:4. The microcatheter was flushed using a 5% dextrose solution, and 0.5–2 mL of the mixture was injected under fluoroscopic guidance.

Data Collection and Outcome Measures

The patients' medical and imaging records were evaluated to collect basic clinical characteristics, major causes and amounts of hemoptysis, findings on CT performed before embolization (location of the hemorrhagic lung lesion and any pleural contact), findings on esophageal arteriography (origin, course, shape, size relative to the bronchial artery, and communication with the bronchial and inferior phrenic arteries), and embolic materials used. The clinical outcomes after embolization were evaluated based on chart reviews of outpatient follow-up and imaging records until September 1, 2015. The clinical success of embolization for hemoptysis was defined as the cessation of hemoptysis without repeated BAE in the 30 days immediately after the embolization procedure (7).

Table 1. CT Indications for Selective Esophageal Arteriography and Subsequent Esophageal Arterial Embolization in Cases of Hemoptysis

CT Indications for Esophageal Arteriography	Angiographic Indications for Embolization
No or weak bronchial artery hypertrophy	No or weak bronchial artery contribution to lesion
Visible esophageal artery	Enlarged esophageal artery (vs bronchial artery or other systemic artery)
Enlarged esophageal artery (vs bronchial artery)	Significant lung parenchymal staining
Lower lobe lesion in contact with mediastinal pleura	Pulmonary artery shunt
Hemorrhagic lesion in lower lung	