Preliminary Experience of Endovascular Embolization Using *N*-Butyl Cyanoacrylate for Hemoptysis due to Infectious Pulmonary Artery Pseudoaneurysms via Systemic Arterial Approach

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ABSTRACT

We report 5 patients with hemoptysis due to infectious pulmonary artery pseudoaneurysm (PAP) treated with endovascular embolization using *N*-butyl cyanoacrylate (NBCA) injected via bronchial and nonbronchial systemic arterial approaches. Infectious diseases included inactive tuberculosis (n = 3), nontuberculous mycobacteriosis (n = 1), and chronic infection of unknown origin (n = 1). Seven PAPs were detected on selective systemic angiography, and injection of NBCA was performed. Disappearance of all PAPs was confirmed on systemic arteriography after the intervention. In all patients, hemoptysis was stopped without major complications, and it did not recur during the follow-up period (mean, 351 d; range, 285–427 d).

ABBREVIATIONS

NBCA = *N*-butyl cyanoacrylate, PAP = pulmonary artery pseudoaneurysm

Hemoptysis refers to bleeding from the tracheobronchial tree and/or pulmonary parenchyma. It is classified into the following three grades according to the amount of blood discharge over 24 hours: minor, < 30 mL of blood; moderate to severe, 30–300 mL; and massive, > 300 mL (1). Pulmonary artery pseudoaneurysm (PAP) is an uncommon cause of massive hemoptysis. Previous studies have reported that PAP occurs in 5%–11% of patients treated for hemoptysis (2,3), and the mortality rate associated with PAP rupture is high (4,5). Because the mortality and morbidity rates of emergency surgery for patients with massive hemoptysis are > 40% (6), endovascular embolization is recognized as the standard treatment option for hemoptysis caused by PAP. Studies have suggested that *N*-butyl cyanoacrylate (NBCA) is an effective embolic material for controlling hemoptysis during bronchial and nonbronchial systemic artery embolization (7–9). We hypothesized that NBCA could be used for embolization of PAPs detected on systemic arteriography through systemic–pulmonary artery shunts. This study reports our initial experience of endovascular embolization of infectious PAPs using NBCA injected via bronchial and nonbronchial systemic arterial approaches.

MATERIALS AND METHODS

Institutional review board approval was obtained for this retrospective study, and the requirement for informed consent was waived. From June 2014 to February 2015, all five patients who presented with hemoptysis due to PAP caused by pulmonary infectious diseases were reviewed at Kawasaki Municipal Hospital. Two radiologists (H.T., I.H.) reviewed the computed tomography (CT) angiography images and medical records of the patients and treated the PAPs with endovascular embolization. Table 1 summarizes the patients' characteristics.

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Figure E1 is available online at *www.jvir.org*.

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Table 1. Characteristics of Five Patients with Hemoptysis of PAPs

Case	Age (y)/Sex	Causes of Hemoptysis	Location	Comorbidity and Previous History	Amount of Hemoptysis*	Patient Condition
1	67/M	NTM	LUL	Advanced LC, COPD	Massive	ARF
2	68/M	Inactive Tb	LUL	None	Moderate to severe	Stable
3	59/M	Inactive Tb	LUL	Embolization of PAPs, COPD	Moderate to severe	Stable
4	56/M	Cavitary infection	RUL	Interstitial pneumonia	Massive	Stable
5	75/M	Inactive Tb	RUL	Lobectomy of RLL due to LC	Minor	Stable

ARF = acute respiratory failure; COPD = chronic obstructive pulmonary disease; LC = lung carcinoma; LUL = left upper lobe; M = male; NTM = nontuberculous mycobacteriosis; PAPs = pulmonary artery pseudoaneurysms; RLL = right lower lobe; RUL = right upper lobe; Tb = tuberculosis.

* The amount of blood discharged over 24 hours: minor, < 30 mL of blood; moderate to severe, 30–300 mL; massive, > 300 mL.

The causes of the PAPs included inactive tuberculosis in three patients (cases 2–4) and nontuberculous mycobacteriosis in one patient (case 1). These infections were inactive, and no antibiotics were administered. In one patient (case 4), chronic infection of unknown origin was diagnosed for the first time on admission. Four patients (cases 1–4) presented with moderate to severe or massive hemoptysis on admission, and one patient (case 5) presented with minor hemoptysis.

CT angiography was performed before endovascular embolization for all patients. CT angiography scanning was initiated at 7 seconds and 25 seconds following the start of intravenous injection of 100 mL of contrast material (Omnipaque 300; Daiich Sankyo Company, Tokyo, Japan) at 5 mL/sec Selective angiography of the bronchial and nonbronchial systemic arteries was performed for all patients. For bronchial and intercostal arteriography, a 5-F Amplatz Left 1.0 or 5-F Michaelson catheter (Terumo, Tokyo, Japan) was inserted via the right femoral artery (n = 5). For angiography of the subclavian arterial branches, a 4-F Headhunter (MEDIKIT Co, Ltd, Nagoya, Japan) or 5-F internal mammary catheter (Terumo, Tokyo, Japan) was inserted via the femoral artery (n = 2) or unilateral brachial artery (n = 3), respectively. After the PAPs were visualized through systemic–pulmonary artery shunts, a 1.7-F microcatheter (Veloute; Asahi Intec Co, Ltd, Nagoya, Japan) was advanced into the feeding artery near each PAP. After selective arteriography using the microcatheter, NBCA diluted with ethiodized oil (Lipiodol; Guerbet, Villepinte, France) at a ratio of 1:4–1:7 was injected as the embolic material. Arteriography was performed after embolization to confirm the disappearance of the PAP. Selective embolization of systemic arteries with evident systemic–pulmonary artery shunts using NBCA/Lipiodol and/or gelatin sponge particles (Serescue; Nippon Kayaku, Tokyo, Japan) was also performed, as these arteries were probable sources of hemoptysis.

One patient (case 1) developed acute respiratory failure secondary to massive hemoptysis and chronic obstructive pulmonary disease. Intubation was performed, and mechanical ventilation was introduced by an anesthesiologist during embolization.

RESULTS

Table 2 summarizes the embolization results and clinical outcomes. PAP was suspected on CT angiography and diagnosed on systemic arteriography in four patients (cases 1–3 and 5) (**Fig a**, and **Fig E1a** [available online at *www.jvir.org*]). In one patient (case 4), the PAP was not evident on CT angiography images but was demonstrated on systemic arteriography. In all patients, dilated and tortuous bronchial and nonbronchial systemic artery hypertrophy was observed as well as a systemic–pulmonary artery shunt.

Seven PAPs (two in cases 2 and 3 and one in cases 1, 4, and 5) were detected on selective systemic angiography (**Fig b**, and **Fig E1b** [available online at *www.jvir.org*]) and were treated with endovascular embolization (**Fig c**, and **Fig E1c** [available online at *www.jvir.org*]). Successful embolization of the feeding arteries was achieved, and all PAPs completely disappeared on systemic arteriography after embolization in all patients (**Fig d**, and **Fig E1d** [available online at *www.jvir.org*]). In two patients (cases 1 and 5), NBCA/Lipiodol entered the PAPs, and NBCA/Lipiodol accumulation was confirmed during the procedure (**Fig c**). Embolization in 14 and 26 systemic arteries with systemic–pulmonary artery shunts was achieved using gelatin sponge particles and NBCA/Lipiodol, respectively, except for the superior branch of the left bronchial artery and the inferior branch of the right bronchial artery in cases 2 and 4, respectively, in which the microcatheter could not be advanced because of their tortuosity. Although residual systemic–pulmonary artery shunts were visualized in these two cases, the shunts were decreased in all cases. Hemoptysis was stopped immediately, and no major complications were recorded in any of the patients in their medical records. Three patients (cases 1–3) complained of chest and/or back pain as minor complications, which were easily controlled by oral analgesics or spontaneously resolved.

The patients were discharged within 1 week after the procedures were performed, and their medical treatments were continued in the Outpatient Department of Respiratory Medicine. Follow-up CT angiography evaluations using the same protocol as that described