

# Percutaneous Injection Therapy for a Peripheral Pulmonary Artery Pseudoaneurysm After Failed Transcatheter Coil Embolization

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**Abstract** Coil embolization to occlude the feeding artery of a pseudoaneurysm is an effective treatment to control hemoptysis. However, a feeding artery of the pseudoaneurysm may not be identified at pulmonary angiography, resulting in a failure to obtain embolization. We describe here two cases of a Rasmussen aneurysm that was successfully treated with percutaneous injection of thrombin (case 1) and *N*-butyl cyanoacrylate (case 2) under ultrasonographic and fluoroscopic guidance after failed transcatheter coil embolization.

**Keywords** Pulmonary arteries · Tuberculosis · Pseudoaneurysm · Ultrasound · Percutaneous procedure

## Introduction

A pulmonary artery pseudoaneurysm is the main cause of bleeding from a pulmonary artery, and an aneurysmal rupture resulting in massive hemoptysis is potentially fatal. Transcatheter coil embolization of the feeding artery is a well-accepted procedure for controlling hemoptysis. However, some reports describe cases in which a feeding

vessel suitable for coil embolization could not be identified by pulmonary angiography [1, 2]. We report two cases of a peripheral pulmonary artery pseudoaneurysm that were treated successfully with a percutaneous injection of thrombin (case 1) and *N*-butyl cyanoacrylate (case 2) under ultrasonographic and fluoroscopic guidance after a failed transcatheter coil embolization.

## Case Reports

### Case 1

A 56-year-old man with a history of chronic and active pulmonary tuberculosis was referred to our institution for the management of a massive hemoptysis. Bronchial angiography demonstrated a normal configuration, and embolization with Gelfoam particles was performed to control the hemoptysis. However, hemoptysis (>300 ml in an episode) recurred after a day and a contrast-enhanced CT scan revealed a 7-mm pseudoaneurysm within the consolidated right lower lung (Fig. 1A). Transcatheter coil embolization could not be performed because the selective right inferior pulmonary angiogram did not detect a feeding artery of the pseudoaneurysm (Fig. 1B). Transthoracic color ultrasonography was performed, which revealed a small pseudoaneurysm within the consolidative lung (Fig. 1C). After informed consent was obtained, the pseudoaneurysm was punctured directly with a 23-G micropuncture needle under ultrasonographic guidance. A small amount of contrast material was hand-injected to confirm the location of the pseudoaneurysm. Approximately 200 U (0.2 ml) bovine thrombin (Thrombin, USP; Ryeon Pharmaceutical, South Korea) was injected and then immediate thrombosis was confirmed at contrast-enhanced

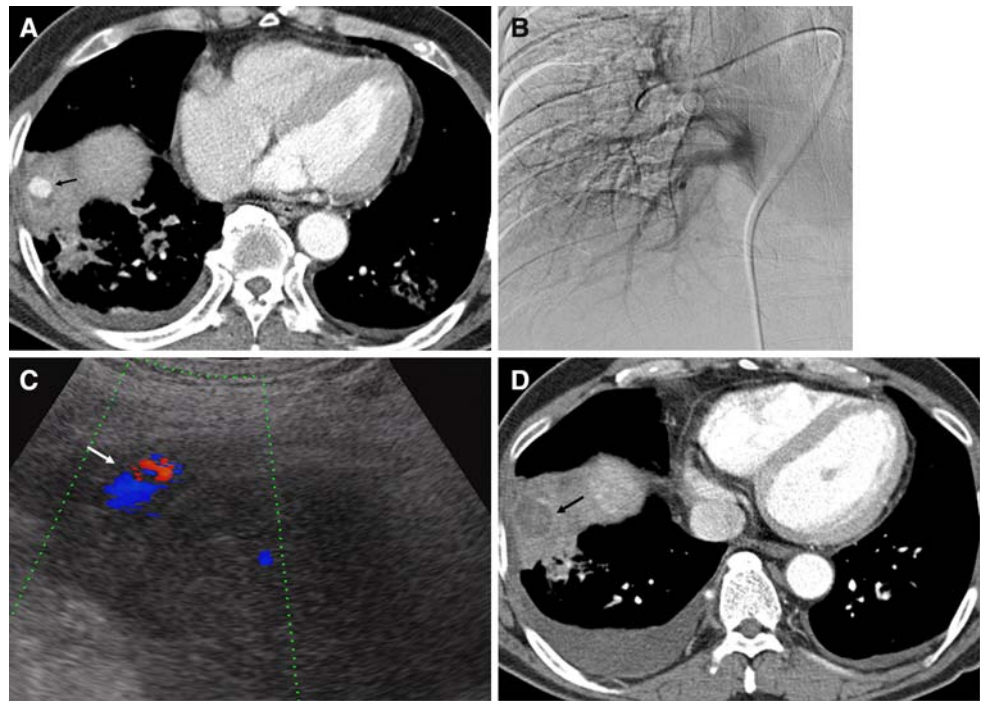
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**Fig. 1** A 56-year-old man with pulmonary tuberculosis. (A) A contrast-enhanced chest CT scan after ineffective bronchial artery embolization shows a pseudoaneurysm (arrow) within the consolidative right lower lung. (B) Delayed phase of selective right inferior pulmonary angiography shows no contrast filling of the pseudoaneurysm or feeding artery. (C) Transthoracic duplex ultrasonography reveals a vascular flow in the pseudoaneurysm (white arrow), facilitated by a pleural effusion. (D) A contrast-enhanced chest CT scan after thrombin injection demonstrates a thrombus-filled pseudoaneurysm (arrow)



CT scan (Fig. 1D). The hemoptysis resolved after the procedure and the patient was discharged after 7 days. Repeated chest radiography revealed a decrease in the size of the parenchymal consolidation and no recurrence of the hemoptysis during the 6-month follow-up.

## Case 2

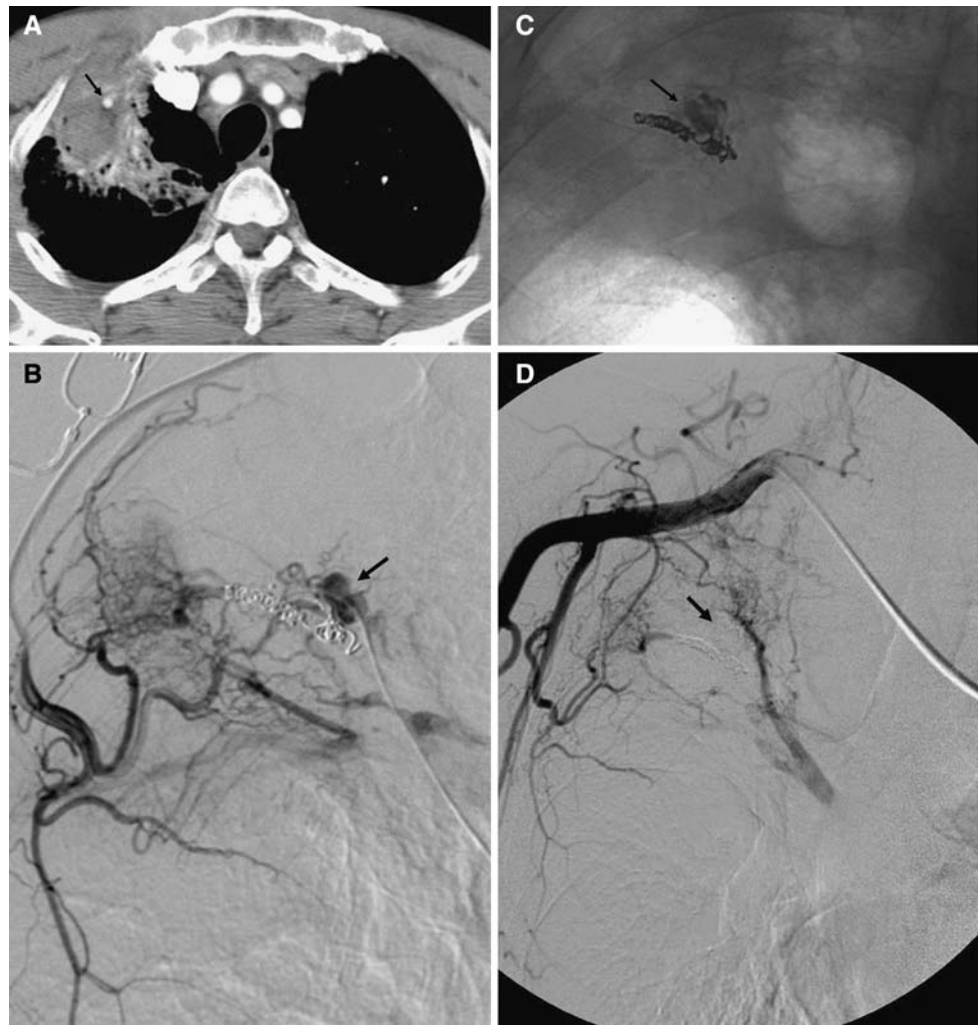
A 46-year-old man presented with two episodes of massive hemoptysis for 3 days. Hemoptysis continued at a rate of 100 ml/24 h for 2 days and increased to a rate of 300 ml/day upon admission. The patient had a history of multi-drug-resistant pulmonary tuberculosis and had been taking antituberculosis medication for 6 months. The initial hemoglobin level and hematocrit were 11.4 g/dl and 32%, respectively. The oxygen saturation was 95% under 3-l oxygen distraction through a nasal cannula. The initial CT scan demonstrated the presence of a 6-mm pseudoaneurysm in the consolidated parenchyma in the tuberculous cavity of the right upper lobe (Fig. 2A). First, bronchial and nonbronchial systemic arterial embolization was performed. In subclavian angiography, the pseudoaneurysm was demonstrated by multiple collateral arteries to a pulmonary arterial shunt. Selective pulmonary angiography and coil embolization of the suspected feeding branch were carried out. After coil embolization of the pulmonary artery, subsequent subclavian angiography demonstrated persistent filling of the pseudoaneurysm through a systemic-to-pulmonary arterial shunt (Fig. 2B). We performed transthoracic ultrasonography and found a small pseudoaneurysm within the consolidated lung. After informed

consent was obtained, the pseudoaneurysm was punctured directly with a 23-G micropuncture needle under ultrasonographic guidance. Angiography with a small amount of contrast material that was hand-injected demonstrated a pseudoaneurysm and small feeding artery. Two-tenths milliliter of a 50% mixture of NBCA (Histoacryl B; Braun, Germany) and Lipiodol (Guerbet, Aulnay-Sous-Bois, France) was injected and an immediate glue cast was verified under fluoroscopy (Fig. 2C). A subsequent right subclavian angiogram demonstrated cessation of contrast filling within the pseudoaneurysm (Fig. 2D). Hemoptysis stopped after the procedure and the patient was discharged after 7 days. The patient has been taking antituberculosis medication and there has been no recurrence of the hemoptysis during the 6-month follow-up. However, the patient underwent a right upper lobectomy due to the ineffectiveness of the antituberculosis medication.

## Discussion

Recently, endovascular technique is often considered as an alternative treatment to surgery in patients with massive hemoptysis who have a small respiratory reserve due to extensive lung destruction. Transcatheter coil embolization of the feeding artery or filling of the sac itself with coils has played a major role in the management of a pulmonary artery pseudoaneurysm. However, a selective or superselective pulmonary angiogram may fail to demonstrate the feeding artery and the pseudoaneurysm. Kierse and colleagues [3] have suggested several possible causes for failure to

**Fig. 2** A 46-year-old man with pulmonary tuberculosis. **(A)** A contrast-enhanced chest CT scan shows a pseudoaneurysm (arrow) in the right upper lobe. **(B)** After embolization of the feeding artery, selective lateral thoracic arteriography shows persistent filling of the pseudoaneurysm (arrow) via the systemic to pulmonary shunt. **(C)** After percutaneous injection therapy, glue cast within the pseudoaneurysm (arrow) was verified under fluoroscopy. **(D)** Final subclavian angiography demonstrates cessation of contrast filling within the pseudoaneurysm (arrow)



demonstrate a pseudoaneurysm on the pulmonary angiogram. First, the peripheral position of the vascular lesions results in an inadequate amount of contrast medium that is able to reach the lesion to permit visualization on the angiogram. Second, there is a flap of vascular tissue that acts as a valve preventing sufficient filling of the aneurysm until the catheter has been advanced to a peripheral position in the vessel. Third, thrombus formation within the sac impedes contrast filling. Fourth, the very slow exchange of intravascular aneurysmal blood does not allow adequate contrast enhancement of the aneurysm on the angiogram. No feeding artery could be identified that was suitable for transcatheter coil embolization. Fortunately, the pseudoaneurysm could be identified at transthoracic ultrasonography owing to pleural attached parenchymal consolidation, as described in previous reports [1, 2]. It was extremely difficult to determine precisely whether the origin of the pseudoaneurysm was the bronchial artery or the pulmonary artery because the pseudoaneurysms were not clearly defined by bronchial angiography and pulmonary angiography.

The reasons why the origin of the pseudoaneurysm might have been the pulmonary artery rather than the bronchial artery are as follows. First, the pseudoaneurysms were not directly connected to the bronchial or nonbronchial systemic artery according to bronchial or nonbronchial systemic angiography and there was a persistent flow signal within the pseudoaneurysm at color sonography despite the bronchial and nonbronchial systemic arterial embolization. Second, a small peripheral pulmonary artery pseudoaneurysm may not be detected by pulmonary angiography. The reason for this was explained by Kierse et al. [3]. Third, in case 2, subclavian angiography demonstrated the distal branch of the pulmonary artery earlier than the pseudoaneurysm. The pseudoaneurysm would have been demonstrated earlier than the distal branch pulmonary artery if the pseudoaneurysm originated from the bronchial or nonbronchial systemic arterial origin. Percutaneous embolization by ultrasound-guided thrombin injection has been used for the treatment of iatrogenic pseudoaneurysms of the femoral artery and, in some limited cases, for a visceral artery aneurysm [4, 5].

Hovis and colleagues [2] reported successful percutaneous treatment of a pulmonary artery pseudoaneurysm with thrombin after failed transcatheter coil embolization. We treated the pseudoaneurysm using the same method. The complications related to thrombin injection are reperfusion within the pseudoaneurysm, thromboembolic complication, and allergic reaction [4]. NBCA has been widely used as a liquid embolic material and it offers the advantage of permanent occlusion of the vessel. There are several reports on the embolization of a pulmonary artery pseudoaneurysm with NBCA in patients with Behcet's disease. These reports suggested that embolization of a pulmonary artery pseudoaneurysm with NBCA is an effective treatment for controlling hemoptysis. However, bronchial erosion with fistula formation and pulmonary infarction can occur [6, 7]. We used a different embolic agent that was dependent on the angiographic findings after direct puncture of a pseudoaneurysm. For case 1, we safely used bovine thrombin as an embolic agent, as contrast medium injection confirmed no reflux of the contrast medium to the feeding artery or draining vein of the pseudoaneurysm. However, for case 2, contrast medium injection throughout the pseudoaneurysm revealed contrast medium reflux to the feeding vessels of the pseudoaneurysm. Thus we used NBCA instead of bovine thrombin because diluted NBCA with idonized oil has the proper radiopacity to prevent reflux of the embolic material to the feeding vessel as visualized under fluoroscopy.

In summary, percutaneous injection therapy of a peripheral pulmonary artery pseudoaneurysm after failed

transcatheter embolization may be a feasible method if the lesion is identified at transthoracic ultrasonography owing to pleural effusion or surrounding parenchymal consolidation.

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