Is it safe to embolize a central pulmonary artery? — a case report

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Abstract: Pulmonary arterial embolization is a common and accepted treatment for a somewhat rare group of lesions that involve the pulmonary arterial tree such as pseudoaneurysms, aneurysms, and arteriovenous fistulae. Therapeutic intervention is localized to the lesion and rarely used for en bloc embolization of large lung territories. Embolization of a central right or left pulmonary artery to cut off blood supply to an entire lung has not been reported. We present a case in which embolization of the left main pulmonary artery was performed and was well tolerated by the patient. The purpose of our case report is to share our experience of the efficacy and safety of this procedure.

Keywords: Pulmonary artery embolization; arteriovenous shunting; pneumonectomy

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Introduction

Pulmonary arterial embolization is performed to occlude select pulmonary artery branches in patients with conditions such as pseudoaneurysms, true aneurysms, or arteriovenous malformations (AVMs). Clinically relevant shortness of breath, pulmonary arterial hypertension, recurrent hemoptysis, prevention of life-threatening hemorrhage, prevention of paradoxical embolism (through AVM), are considered indications of treatment (1). In these cases, a segmental or smaller artery is embolized (2-11). Embolization provides the benefit of treating the above-mentioned entities without performing thoracotomy and resection, which require patients be placed under general anesthesia for a surgical procedure. This way, patients who are not candidates for surgery and/or general anesthesia can have potentially fatal condition treated without the morbidity associated with a surgical procedure. To our knowledge, purposeful en bloc pulmonary artery embolization of an entire lung has not been reported.

Case presentation

A 42-year-old male with no past medical history presented to an outside facility with chest pain, cough and fever. Work up included a contrast enhanced chest CT, which was significant for complete left lung collapse, presumed secondary to a bronchial mass. Subsequent bronchoscopies and trans-bronchial biopsies were non-diagnostic. Bare metal stent was placed in the left main stem bronchus in attempt to open the collapsed lung. He was subsequently transferred to our institution for further management. Follow-up imaging showed no change in complete collapse of the left lung, ipsilateral mediastinal shift, and new completely occluded left main stem bronchus stent (Figure 1). The collapsed lung tissue demonstrated good contrast enhancement (Figure 1), indicating preserved blood flow. There was no evidence of a pulmonary or mediastinal lesion compressing the bronchus. Repeat bronchoscopy showed completely occluded bronchial stent. Attempts to re-open the stent were unsuccessful. Attempt to remove
the stent resulted in bronchial tear and extensive pneumo-
mediastinum and subcutaneous emphysema (Figure 2). 
Cardiothoracic surgery was consulted for further 
management. The patient had blood oxygen saturation 
level of 90% on room air. Based on CT images and overall 
clinical picture, it was determined that the patient’s chest 
pain and low oxygen saturation was secondary to shunting 
of blood in the collapsed left lung; and his cough was 
secondary to an indolent infectious/inflammatory process 
in the collapsed lung. After a multidisciplinary discussion, 
a decision was made to perform a left pneumonectomy. 
He was considered high-risk because of the now distorted 
anatomy with pulmonary blood flow shunt, presence of 
bronchial tear, pneumomediastinum and a metal stent in 
the bronchus. Interventional radiology was consulted for 
embolization of the left main pulmonary artery. The main 
aim of en bloc pulmonary artery embolization of the left 
pulmonary artery was to help reduce bleeding risks during 
pneumonectomy. A secondary aim was to shut down the 
shunting of blood in the left lung and to allow pulmonary 
circulation to adapt to occluded left pulmonary artery 
prior to pneumonectomy, although this was not critical as 
pneumonectomy is a well-established surgery that can be 
safely performed without prior occlusion of pulmonary 
arteries. Details of the embolization procedure are described 
in the “Embolization Technique” section below. Following 
an uneventful embolization of the left pulmonary artery, the 
patient reported no new symptoms. The patient’s oxygen 
saturation level slightly improved to 93–94% on room air. 
Three days after embolization, the patient underwent left 
pneumonectomy with minimal intra-operative blood loss. 
The gross specimen is depicted in Figure 3. The postsurgical 
course was complicated by small left hemothorax, which 
required thoracotomy and cauteryization of a small artery.
in the chest wall. The remainder of the patient’s hospital course was unremarkable and the patient was subsequently discharged. The exact cause of lung collapse could not be determined even on explant lung pathological examination, which demonstrated no significant interstitial fibrosis, granulomatous inflammation, vasculitis, or mass lesion in lung parenchyma. There was bronchiolitis with foci of organizing fibrosis and granulation tissue. Bronchial cartilage demonstrated no specific pathologic changes. Patient was a construction worker and exposure to toxic fumes or aspiration of toxic fluid was considered the most likely etiology. At 1 year follow-up, his clinical exam was unremarkable, the patient was asymptomatic and his oxygen saturation was 98% on room air compared to 90% prior to embolization and surgery.

**Embolization technique**

Access was obtained into the left main pulmonary artery via right common femoral vein using angled GLIDECATH (Terumo, Somerset, NJ, USA) and hydrophilic GLIDEWIRE (Terumo, Somerset, NJ, USA). Left pulmonary angiogram was performed using an Omni flush catheter (AngioDynamics, Latham, NY, USA). A 2.8 French Progreat microcatheter (Terumo Somerset, NJ, USA) was coaxially advanced through the GLIDECATH and multiple detachable coils were deployed in the left main pulmonary artery. Few smaller branches arising proximal to the coil mass were selectively embolized, to avoid extending the coil mass into the proximal left main pulmonary artery and therefore avoid difficulty in clamping this artery during surgery. The coils used were standard and soft Ruby embolization coils (Penumbra, Inc., Alameda, CA, USA) and Azur 0.018 inch detachable HydroCoils (Terumo, Somerset, NJ, USA). Figure 4 is the post embolization angiogram showing complete cessation of blood flow in the left pulmonary artery circulation.

**Discussion**

Pulmonary arterial interventions are used to treat a wide
variety of pathologies. Catheter directed or mechanical thrombolysis of pulmonary emboli and angioplasty and/or stenting of stenosed pulmonary arteries are done to restore normal flow through the pulmonary arterial circulation (1). On the other hand, embolization is performed to occlude pulmonary artery branches in patients with conditions such as pseudoaneurysms, true aneurysms, or AVMs. Pseudoaneurysms can be caused by varying pathologies: necrotizing pneumonia, bacterial endocarditis, mucormycosis, tuberculosis, vasculitides (Behcet’s), iatrogenic trauma from Swan-Ganz or Cournard catheters, congenital heart disease, and necrotic cavitary lung carcinoma (1-3,5-10). True pulmonary artery aneurysms are extremely rare and the etiology is still unclear. AVMs are congenital in nature and are treated if they are symptomatic or if the feeding artery is 3 mm or more in diameter. Metallic coils, vascular plugs, acrylic glue, and detachable balloons have been described in the literature as being used to achieve embolization (1-3,9). A percutaneous embolization is typically preferred over surgical resection of such lesions as it is minimally invasive and has very little recovery time.

The case presented in this report is unique in that the pulmonary arterial supply to the entire left lung was closed off by embolization of the left main pulmonary artery. There are previously reported cases of temporary unilateral pulmonary artery occlusion done to perform tests to predict morbidity and mortality prior to pneumonectomy (12,13). However, no cases of irreversible occlusion of a central pulmonary artery were found. In our case, occlusion achieved with embolization coils was irreversible. The embolization helped reduce blood loss during pneumonectomy in this patient who was considered high risk for surgery. Embolization also terminated the effective “shunt” created by a collapsed, non-functioning but well perfused lung. It is important to note that our patient had no other past medical history and his functioning right lung was able to sufficiently compensate for non-functioning left lung. This case demonstrates that it is feasible and safe to permanently embolize the pulmonary arterial supply of an entire lung in carefully selected patients.

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None.

Footnote
Conflicts of Interest: The authors have no conflicts of interest to declare.

References

Figure 4 Post-embolization digital subtraction angiogram demonstrating complete cessation of blood flow in left main pulmonary artery.