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## Case Report

# Successful percutaneous embolization of an intraoperative swan ganz catheter-related pulmonary artery injury<sup>☆</sup>

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## ARTICLE INFO

## Article history:

Received 5 July 2022

Accepted 11 July 2022

## Keywords:

Embolization

Pseudoaneurysm

Pulmonary artery

Swan Ganz catheter

## ABSTRACT

Intraoperative pulmonary artery injury due to Swan Ganz catheterization is a rare but potentially life-threatening injury which demands rapid recognition and treatment. Subsequent pseudoaneurysm formation can occur if not immediately recognized, and percutaneous embolization is a viable option for treatment in most settings. We report a case of a 59-year-old female who underwent coronary artery bypass surgery and suffered an intraoperative Swan Ganz catheter-related injury which led to life threatening hemorrhage with subsequent pulmonary artery pseudoaneurysm formation that was successfully embolized. This case report is pathognomonic for this injury and discusses risk factors, presentation, and treatment options of this rare but serious injury.

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## Introduction

Pulmonary artery (PA) pseudoaneurysm formation with arterial rupture is a rare but severe complication of PA Swan-Ganz catheterization, with an estimated incidence of 0.03%–0.2% and mortality ranging from 50–70% [1–3]. Coil embolization remains the traditional management for this rare but serious complication. We report a case of a 59-year-old female who underwent coronary artery bypass graft (CABG) surgery that was complicated by a Swan Ganz catheter induced PA pseudoaneurysm with subsequent rupture and life-threatening hemorrhage intra-operatively.

## Case report

A 59-year-old female with chronic ischemic heart disease agreed to undergo CABG after positive cardiac stress test and subsequent coronary angiography demonstrated severe stenosis of the left anterior descending, left main, and right coronary arteries. She was scheduled for CABG, with additional left atrial appendage ligation, xiphoidectomy, and endoscopic greater saphenous vein harvesting from the left leg to be performed during the same operative procedure.

Prior to the start of her surgery, general anesthesia was induced using endotracheal intubation, and a central line

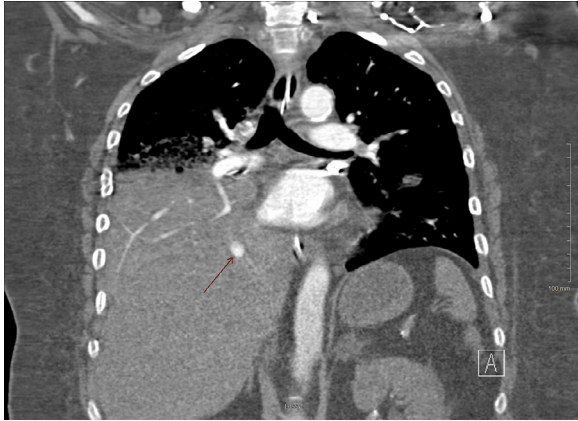
<sup>☆</sup> Competing Interests: The authors of this paper have no personal conflicts of interest to disclose.

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<https://doi.org/10.1016/j.radcr.2022.07.053>

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**Fig. 1 – Coronal enhanced CT of the chest demonstrates a small round pseudoaneurysm arising from an anterior segmental branch of the right lower lobe (arrow), with associated atelectasis of the right lower lobe due to surgical packing in the right lower lobe bronchus.**

and Swan-Ganz catheter (Edwards Lifesciences, Irvine, CA) were inserted via the right internal jugular vein for cardiopulmonary monitoring. Systolic PA pressure was measured at approximately 35 mm Hg at the beginning of the surgical procedure with the patient's Swan-Ganz catheter. The patient's CABG procedure was finished successfully without event; however, after completion of the surgery and while removing the patient from cardiopulmonary bypass, the anesthesia team reported copious bloody secretions in the endotracheal tube which were not noted during the previous portion of the surgery. Ventilation subsequently became difficult despite rigorous suctioning, and the origin of bleeding was identified as the right lower lobe bronchus following emergent bronchoscopy. After identifying the area of hemorrhage, complete bronchoscopic tamponade of the right lower lobe was performed emergently, and the airway was packed using 2 Kittner sponges ("peanuts") with appropriate subsequent hemostasis and stabilization of the patient's vital signs. The patient was then removed from cardiopulmonary bypass and was transferred to the cardiac intensive care unit (CICU) in stable condition for further workup and care. After transfer to the CICU, an urgent CT pulmonary angiogram study was performed which revealed a right lower lobe PA pseudoaneurysm (Fig. 1). The interventional radiology team was then consulted to discuss embolization of the PA pseudoaneurysm with planned endoscopic removal of the surgical "peanut" sponges by the CT surgery team at the time of embolization.

Following review and multidisciplinary discussion of the CT findings, the patient was brought to the interventional radiology fluoroscopy suite for angiography and planned embolization. The right common femoral vein was accessed using ultrasound guidance with a standard 5F micropuncture set (Angiodynamics, Latham, NY), and access was upsized to a 6F vascular sheath (Terumo, Somerset, NJ) that was positioned into the inferior vena cava. Pulmonary arteriography was then performed using a 5F pigtail PA catheter (Cordis, Hialeah, FL), which revealed the pseudoaneurysm arising in the anterior segmental branch of the right lower lobe adjacent to

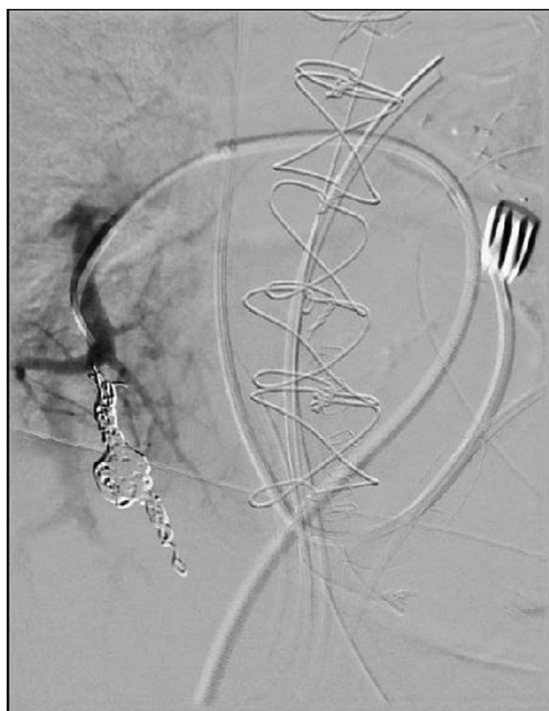


**Fig. 2 – Digital subtraction arteriogram (DSA) prior to embolization reveals a round pseudoaneurysm arising from the anterior segmental branch of the right lower lobe. Kittner sponges are noted incidentally in the right lower lobe bronchus.**

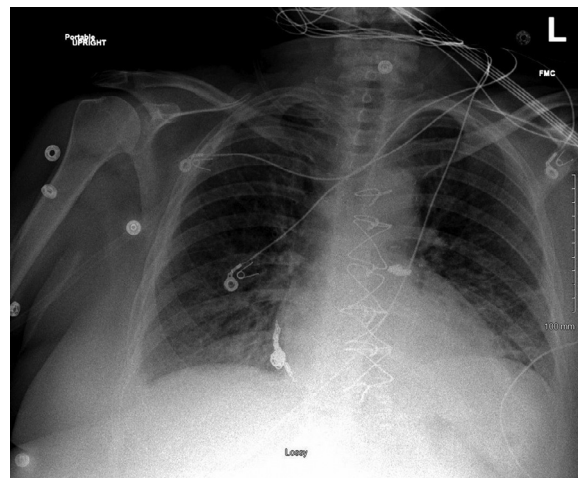
the packing material in the nearby bronchus. The PA catheter was subsequently exchanged for a 5F Kumpe catheter (Angiodynamics, Latham, NY) which was used to select the anterior segmental branch of the right lower lobe PA (Fig. 2), and the catheter was advanced distally across the neck of the pseudoaneurysm. The pseudoaneurysm and associated PA branch was then successfully coiled to stasis using a mixture of 4mm to 6mm Azur CX embolic coils (Terumo, Somerset, NJ), with complete stasis of the vessel on follow up arteriography (Fig. 3). Next, prior to removing the catheter, the cardiothoracic surgical team performed bronchoscopy while the patient remained on the angiography table and the Kittner packing "peanuts" were removed under direct visualization and no further hemorrhage was noted into the right lower lobe bronchus following saline lavage. Follow-up arteriography was then performed which revealed no further bleeding from the affected or adjacent pulmonary vessels or evidence of residual filling of the pseudoaneurysm (Fig. 4). The procedure was then terminated, and hemostasis was achieved using manual compression in the right groin following catheter and sheath removal. The patient was transferred back to the CICU for recovery and further care by the cardiothoracic surgical team. The patient was successfully extubated on post-operative day 3, however she unfortunately suffered from an aspiration event shortly thereafter requiring re-intubation. Following a short hospital stay, she successfully recovered and exhibited no further bleeding from her airway, and serial chest radiographs during her subsequent stay demonstrated clearing of her lung



**Fig. 3 – DSA following coil embolization of the pseudoaneurysm. No flow was identified distal to the coil pack or in the pseudoaneurysm following embolization.**



**Fig. 4 – Repeat DSA of the right lower lobe segmental pulmonary artery following endoscopic removal of the Kittner sponges reveals no evidence of further hemorrhage from the pseudoaneurysm site.**



**Fig. 5 – Chest x-ray prior to discharge to home shows nearly complete resolution of the atelectasis of the right lower lobe, and stable location and appearance of the coil pack within the right lower lobe segmental artery at the site of the pseudoaneurysm.**

parenchyma (Fig. 5). She was discharged home without further incident 21 days after her initial CABG surgery.

## Discussion

PA pseudoaneurysm formation with arterial rupture is a severe, life-threatening complication of Swan-Ganz pulmonary catheterization. The estimated incidence of traumatic PA pseudoaneurysms is 1 per 1600 PA catheter placements based on a study of 6245 patients [4]. Clinical signs of arterial perforation include a sudden decrease in oxygen saturation, signs of pulmonary bleeding, and hemoptysis (most common) [5], and symptom onset can occur within minutes to months of the procedure [6]. The pathogenesis of the complication is multifactorial; however, 3 hypotheses are recognized: peripheral location of the catheter tip (most common), overinflation of the balloon, and off-center positioning of the catheter after balloon inflation [5]. Risk factors for the occurrence of PA pseudoaneurysm formation with arterial rupture include pulmonary hypertension, systemic anticoagulation, long-term steroid use, age greater than 60 years, female sex, excessive catheter manipulation, balloon hyperinflation, inflation of the catheter balloon with fluid instead of air, surgically induced hypothermia, cardiac decompression, and cardiac manipulation during surgery [1,6]. The right lung is affected in 90% of cases, as the PA catheter most commonly terminates there [7].

Management of PA catheter-induced rupture mainly focuses on prevention of rapid asphyxia, as hypoxia secondary to bleeding is the most common cause of death [8]. Therapeutic options include surgery and transcatheter embolization, as described in our case, which is considered the first-line therapy and is associated with a lower morbidity and mortality than described surgical options [1,9]. Since the risk of pseudoaneurysm rebleeding is approximately 35%, it is

recommended that pseudoaneurysm rupture be treated urgently with transcatheter embolization, though patient location, disease severity, and coagulation status can all influence therapy choice and timing [10–12]. Surgical interventions include lobectomy or wedge resection of the affected lung, pneumonectomy, hilar clamping with arterial repair [9], or PA ligation [3]. Conservative management has also been described as an alternative management option for smaller vascular injuries [13]. Adjunctive therapeutic options include placement of a double-lumen endotracheal tube to prevent bleeding into the unaffected lung [8], placement of a bronchial blocker [14], thoracotomy with hematoma evacuation, [3] and placement on extracorporeal membrane oxygenation (ECMO), as one case reported that ECMO reduced the bleeding from the ruptured PA [9,15].

Most PA ruptures and/or pseudoaneurysm formations occur after catheter balloon inflation while obtaining PA occlusion tracing [3]. Prevention of PA injury can be achieved by minimizing balloon inflation time, visualizing the PA pressure tracing during balloon inflation, and halting inflation once wedge pressure is obtained [1]. The catheter should migrate with blood flow and not be pushed, and the balloon should not be deflated during catheter retraction. Additionally, a study has explored the use of thrombin injections during balloon inflation using the distal port of the Swan-Ganz catheter; this method creates a temporary tamponade that can prevent the formation of a PA pseudoaneurysm [16].

## Conclusion

Though PA catheter use rarely results in potentially fatal complications, the rapid development of a PA pseudoaneurysm and PA rupture requires urgent recognition and management. In this case, initial bronchoscopic arterial tamponade followed by urgent angiography and coil embolization of the affected pulmonary vessel was used to successfully stabilize the patient and prevent further hemorrhage.

## Patient consent

Written, informed consent was obtained from the patient for publication prior to submission of this manuscript.

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