

# Embolization of Pulmonary Artery Catheter Balloon: A Rare Complication

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## Abstract

Pulmonary artery catheterization is commonly used during cardiac surgery to monitor hemodynamic parameters. However, this procedure carries many risks and complications that may arise from its insertion or manipulation, its presence in the cardiovascular system, or misinterpretation of the data derived from it. Recently, we encountered a rare case of embolization of the pulmonary artery catheter balloon, which was detected using intraoperative transesophageal echocardiography. The balloon was surgically retrieved, and the patient made an uneventful recovery.

**Keywords:** pulmonary artery catheter balloon; embolization; transesophageal echocardiography; cardiac surgery

## Introduction

A pulmonary artery catheter (PAC) is often used during cardiac surgery to monitor hemodynamic parameters that are not reliably or continuously assessable by non-invasive or less invasive methods. Despite its benefits, the use of PAC is associated with several inherent risks and complications due to its invasive nature. Potential complications can arise from (i) central venous puncture, such as arterial puncture, hematoma, pneumothorax; (ii) insertion and manipulation of PAC potentially leading to arrhythmias, catheter knotting, catheter entanglement with cardiovascular structures; (iii) the presence of PAC in the cardiovascular system which may cause thrombosis, venous embolism, pulmonary artery (PA) rupture/perforation/infarction; (iv) infection; and (v) misinterpretation of the data derived from the PAC. [1] Rupture of the PA is particularly severe complication reported in approximately 0.03%-0.2% of patients. [2] This may occur due to overinflation of the balloon, improper balloon inflation, or improper position of the PAC.

Repeated inflation of the balloon can create cracks, leading to its rupture. Damage to the balloon can also occur from a mismatched introducer sheath or repeated re-insertion maneuvers. Although rupture and embolization of the balloon are rare, they pose significant risks. An embolized balloon can travel through the bloodstream into the PA or farther, potentially resulting in complications such as PA rupture, pseudoaneurysm formation, and pulmonary hemorrhage. This report describes a case in which the PAC balloon embolized into the PA and was successfully retrieved surgically.

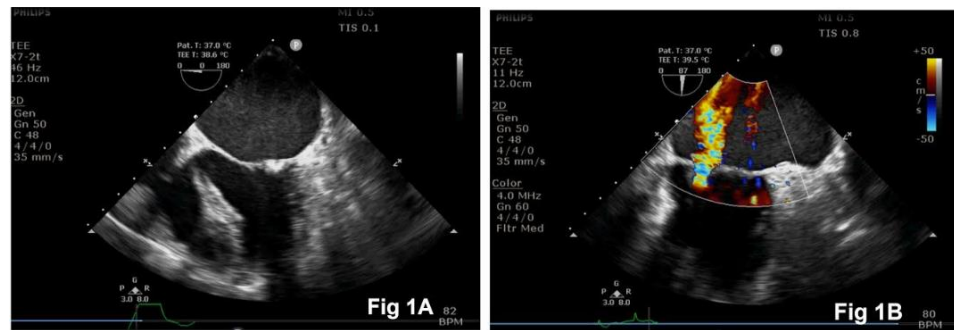
## Case Report

A 48-year-old man presented with worsening dyspnea and palpitations and was admitted for evaluation. Transthoracic echocardiography

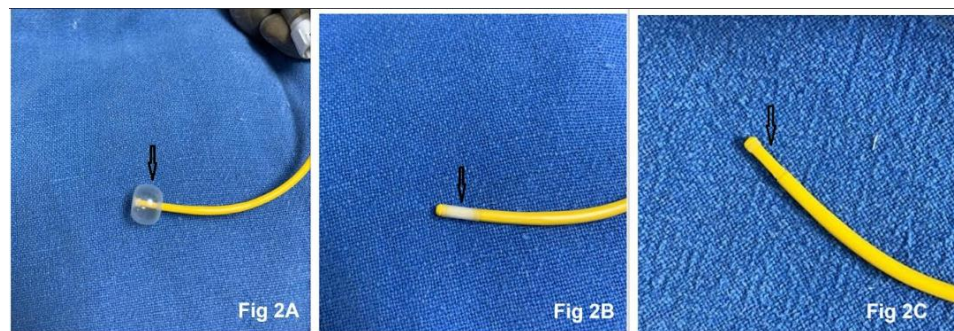
indicated severe mitral stenosis, moderate mitral regurgitation, and mild tricuspid regurgitation. The patient underwent mitral valve replacement surgery. After the induction of general anesthesia, a transesophageal echocardiography (TEE) probe was inserted, confirming the preoperative findings (Fig.1). The right internal jugular vein was cannulated for the insertion of an introducer sheath and PAC by a skilled anesthesiologist. The integrity of all ports and the inflation and deflation of the PAC balloon (Edwards Lifesciences LLC, CA, Irvine, USA) were confirmed before insertion (Fig. 2A, 2B).

Utilizing pressure monitoring and waveform analysis, a 7.5F PAC was inserted through an 8.5F introducer sheath. After obtaining the right atrial pressure waveform at a depth of 20 cm, the balloon was inflated with a 1.5-ml syringe. However, the right ventricular pressure waveform could not be obtained until a depth of 30 cm. The balloon was deflated, and the PAC was retracted to 20 cm. During the second attempt to insert the PAC, the balloon failed to inflate, indicating a loss of resistance consistent with balloon rupture. Upon withdrawing the PAC from the sheath, it was noted that while the catheter remained intact, the balloon was notably missing (Fig. 2C). At this point, rupture of the balloon and its migration into the circulatory system were suspected. An immediate TEE evaluation showed the ruptured balloon floating in the main PA, just distal to the pulmonary valve.

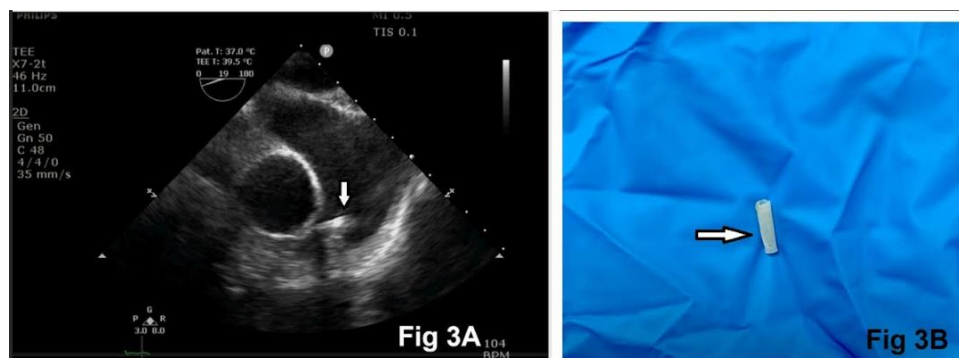
Following sternotomy, the initiation of cardiopulmonary bypass, and cold cardioplegic arrest, the embolized balloon was retrieved from the main PA through a vertical incision. The planned surgical procedure continued without complication, and the postoperative course was unremarkable.



**Figure 1:** Intraoperative transesophageal echocardiography images showing mitral stenosis (Fig. 1A) and mitral regurgitation (Fig. 1B).



**Figure 2:** Photographs of the pulmonary artery catheter, arrows representing inflated balloon (Fig. 2A), deflated balloon (Fig. 2B), and missing (embolized) balloon (Fig. 2C).



**Figure 3:** Transesophageal echocardiography ascending aorta short-axis view showing embolized balloon in the main pulmonary artery (arrow), just distal to the pulmonary valve (Figure. 3A). Surgically retrieved balloon of the pulmonary artery catheter (arrow, Figure. 3B).

## Discussion

Rupture and embolization of the PAC balloon are extremely rare but serious complications. Possible mechanisms for balloon rupture include: (i) repeated inflation leading to cracks, (ii) the use of high pressure/high volume over a prolonged duration, (iii) the use of nitrous oxide during anesthesia resulting in increased balloon diameter, (iv) repeated re-insertion maneuvers, and (v) mismatched introducer sheaths. Rupture can occur due to structural failures of the catheter or complications arising during or after catheter placement. In severe cases, balloon fragments can separate from the catheter and travel through the circulatory system, which poses significant risks that cannot be underestimated. We advocate for heightened awareness and vigilance regarding these complications in order to safeguard patient outcomes.

A similar case of a balloon separated from the PAC during an attempted removal through the introducer sheath has been reported by Helena et al. [4] However, they found the intact balloon inside the introducer sheath, and it did not embolize. Passage through a size mismatched introducer sheath, as well as repeated PAC re-insertions, can also cause balloon damage. The breaking and embolization of a catheter fragment into the

pulmonary vascular system are rare and, in most cases, benign. However, Racionera et al have described severe pulmonary hypertension due to embolization of PAC fragments into the right PA. [5] The fragments disappeared with the movements of the fragment along with the flow of blood to the lung periphery. Balloon rupture followed by embolization and migration to PA can also occur during percutaneous transluminal angioplasty of the arteriovenous fistula. The preferred method for removal of a ruptured balloon during angioplasty is endovascular retrieval using additional distal access and a gooseneck snare. [6] Sometimes, surgical removal is required because attempts at removal using the endovascular technique adversely affect patient safety and result in vessel injury.

The embolized balloon or its fragments can lodge in a blood vessel, potentially causing serious complications like thrombosis, myocardial injury, arrhythmias, or perforation of a blood vessel. The embolization of the balloon into the PA can lead to rupture of the PA, pseudoaneurysm formation, and pulmonary hemorrhage. Depending upon the severity of PA rupture, the patient may experience hemoptysis, chest pain, or dyspnea. Pulmonary angiography or computed tomography of the PA (CTPA) is the gold standard for diagnosing PA rupture and

pseudoaneurysm. Pulmonary angiography and CTPA can also be used to detect the position of the embolized balloon or its fragments, if they move far distally and are not visible during surgery. If a catheter fragment embolizes, it needs to be retrieved to prevent further complications, often through procedures like percutaneous extraction or surgery.

In conclusion, PA catheter balloon rupture and embolization is a serious complication that requires prompt diagnosis and treatment to prevent potentially life-threatening outcomes.

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