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Case Report

# Asymptomatic Catheter Fracture Embolization - The Risks and Benefits of Retrieval

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## Abstract

A 28-year-old man presented with a three-day history of bilateral loin pain, fever and acute kidney injury. During routine investigations, chest x-ray incidentally revealed a foreign body projected over the mediastinum at the level of the pulmonary arteries.

Computed tomography (CT) of the chest confirmed a coiled metallic wire extending into both pulmonary arteries. Trans-thoracic echocardiogram demonstrated a marginally dilated left ventricle and left atrium with mild mitral regurgitation, as well as a mobile, echogenic structure within the pulmonary arteries.

Review of the patient's medical history revealed a previous traumatic brain injury and during the course of his medical treatment, a peripheral inserted central catheter (PICC) had been inserted. The catheter had subsequently been removed by the patient. The fractured PICC was discovered incidentally three years later. The patient eventually underwent successful endovascular removal. This case highlights the importance of diligence inspection and documentation during the insertion and removal of central catheters.

**Keywords:** Central Venous Catheter; Peripherally Inserted Central Catheter; Embolization; Fractured Catheter; Pulmonary Arteries

## Abbreviations

AKI: Acute Kidney Injury; CT: Computed Tomography; CXR: Chest X-ray; CVC: Central Venous Catheter; ED: Emergency Department; ICU: Intensive Care Unit; PICC: Peripherally Inserted Central Catheter

## Introduction

Central catheterisation, including central venous catheter (CVC) and peripheral inserted central catheter (PICC), refers to intravascular access that delivers injectate into a large central vein. Patients considered for central catheterisation include those requiring medications that irritate smaller peripheral veins, parenteral nutrition and chemotherapies, as well as patients requiring central venous pressure measurement and patients with difficult peripheral access [1,2].

Reported complication rates of PICC has an event rate of 11.1 per 1,000 catheter days, with the most common complications being occlusion (8.9%), accidental withdrawal (8.9%) and infection (6.3%) [3]. PICC fracture and embolization is a rare but potentially lethal complication with an estimated incidence rate of 0.1% [4].

Regardless of the nature of the complication, cardiovascular complications can be extremely serious and include myocardial or valvular tissue damage, myocardial infarction, arrhythmias, infection including endocarditis, thrombus formation and pulmonary embolism [4,5]. Although catheter related thrombosis and infection are uncommon, both CVC and PICC should be removed promptly when no longer required [5]. Complications from central catheters may be recognised early by completing post-removal checks as described previously by Pande., *et al.* and Mattox., *et al.* in addition to the initial routine checks made on insertion [6]. In situations where complications arise, a multidisciplinary approach should be adopted to discuss a risk versus benefit analysis of potential retrieval as part of a patient-centred approach.

## Case Report

A 28-year-old male presented to the emergency department (ED) of a regional hospital complaining of bilateral loin pain, fever and associated abdominal pain and vomiting. The initial working diagnosis of pyelonephritis was formulated based on his clinical presentation. On further investigations (blood tests, urine analysis, urine culture, and blood culture), it was found that the

only abnormality was the deranged creatinine level. Hence, the patient was treated for pre-renal acute kidney injury (AKI) in the context of dehydration. As the patient was febrile when he presented to the ED, a chest X-Ray was performed as part of the sepsis work-up. It was through the chest X-Ray images (Figure 1) that a foreign body projected over the mediastinum was incidentally discovered. No other abnormalities (i.e. consolidation, pleural effusion, pneumothorax, and atelectasis) were found on the X-ray. The object was at the level of the pulmonary arteries, with one tip projected over the left pulmonary artery and the other extending beyond the marking of the right descending pulmonary artery and casting a shadow over the right lower lobe parenchyma. Radiological reporting indicated the foreign body was likely to be a coiled up double lumen foreign body with metallic wire component alongside, potentially an intravascular catheter. Taking into account the negative blood cultures, inflammatory markers, chest X-ray and presenting clinical signs, it was unlikely that the retained foreign body was infected.

**Figure 1:** Chest X-ray showing the PICC in the pulmonary vasculature (marked by arrows) in PA view.

Further investigation of the patient's medical records revealed that the patient was admitted to an intensive care unit (ICU) for a traumatic head injury in 2015, where he was treated for an intracranial haemorrhage that ultimately required a craniotomy. The patient remained in ICU for 7 days, during which a PICC was inserted into his left arm. On his 4th day in the ICU, the patient developed fever and cultures from the lumens of the PICC revealed growth of methicillin-susceptible Staphylococcus aureus, coagulase-negative Staphylococcus and gram-positive Bacillus. However, PICC was removed by the patient on the 5th day due to agitation and confusion. This suspected infection was initially treated with intravenous piperacillin plus tazobactam followed by 5 days of intravenous flucloxacillin after lumen culture results were back. Documentation regarding its removal was scarce but not suggestive of complications. He was subsequently discharged from ICU after seven days and spent a further nine days under the rehabilitation medical team. He received no further imaging. The patient made a full recovery with no residual signs or symptoms from his brain injury.

To further define the foreign body, computed tomography (CT) of the chest (Figure 2) revealed a coiled up foreign body in the left and right pulmonary artery. One end of the object was situated in the proximal part of the left upper lobe branch of the lungs, with the opposite end of the coiled wire situated in the right middle lobar branch, reaching a point approximately two centimetres from the pleural surface. There was no evidence of perforation of the pulmonary arteries or pulmonary parenchymal injury. An echocardiogram demonstrated marginally dilated left ventricle and left atrium with mild mitral regurgitation and two parallel, mobile, highly echogenic structure within the pulmonary artery, extending into both branches (Figure 3). No potential source of paradoxical emboli was found (e.g. patient foramen ovale or ventricular septal defect). When combined with the clinical history, these findings were suggestive of a fractured PICC line.

**Figure 2:** Computed tomography chest in coronal view showing PICC in pulmonary arteries (marked by arrows).

The patient was treated with slow intravenous fluids for his AKI and was advised against taking body-building supplements and anabolic steroids. He made a full recovery with no complications and was referred to cardiothoracic surgery at a tertiary hospital for further discussion and management of the embolized catheter fragment.

**Figure 3:** Echocardiogram showing the pulmonary artery and the ascending aorta from suprasternal view. In the centre of the image is the right pulmonary artery with echo-dense, mobile, parallel structure representing coiled PICC line protruding into the main pulmonary artery.

A subsequent multidisciplinary team meeting involving interventional radiology and cardiothoracic surgical teams discussed the risk versus benefit analysis. As the patient was asymptomatic for greater than three years and no acute infection or trauma was discovered, the decision to avoid endovascular or surgical intervention and continue with conservative management was unanimous as fragments that have remained intravascular over a prolonged period of time may be endothelialised and therefore be at low risk of complications. The initial risk assessment was that removal may result in rupture of pulmonary arteries, which would be inevitably fatal.

Not pleased with this decision, the patient sought out a second opinion from an interventional cardiologist who agreed to attempt removal of the foreign body via endovascular technique based on evidence from the literature [7]. The decision was made after careful consideration of the clinical history alongside imaging which showed no signs of calcification of the open ends of the catheter fragment, thrombus or endothelialisation. The patient was electively admitted under the cardiology team and the catheter was removed under transoesophageal echocardiogram guidance, via the right femoral vein using a 6F coronary guide catheter and a 25 mm Gooseneck snare. The fragment was apparently reported to be not deeply embedded and was easily removed with light traction. There was no thrombus or visible tissue on the retrieved fragment. Catheter fragment was not cultured after removal as there were no clinical and objective signs of infection. Post-operatively the patient was admitted to the coronary cardiac unit for observation and had an uncomplicated recovery. He was discharged from the hospital on the same day.

## Discussion

Reported complication rates of PICC lines, including catheter fracture, are well documented but highly variable due to the heterogeneous patient populations. In most cases, the first sign associated with catheter fracture is catheter dysfunction. Other signs and symptoms include arrhythmias, pulmonary symptoms (i.e. dyspnoea, cough, and pleuritic chest pain), and septicaemia [8]. However, asymptomatic catheter fracture with ensuing embolization into the pulmonary arteries is rare, with few cases reported [9-12].

Results of a systematic review of intravascular embolization of venous catheter (PICC and CVC) between 1985 and 2007 published by Surov., *et al*. in 2009 suggested that 40.9% of the fractured line occurred due to the 'pinch-off syndrome', with the most common site of occurrence in the infraclavicular region with CVC's [8]. In 1984, Aitken and Minton coined the term "pinch-off sign" to describe the compression of the CVC seen on the post-insertion chest X-Rays of four patients [13]. Using radiological evaluation, subsequent scales and guidelines were then created to indicate the likely requirement of catheter removal to prevent potential fracture [14]. Disconnection between catheter from manifold and material fatigue have also been found to contribute to catheter fragmentation [9].

In contrast, the main cause of catheter fracture or fragmentation for PICC lines was due to removal or catheter exchange [8]. The study by Chow., *et al*. demonstrated that the side of PICC line insertion, as well as flexion or bending of the catheter was unlikely to increase the risk of catheter fracture, but instead, catheters were vulnerable to fracture when rotational torque and twisting forces were applied [10]. Clinically, this may occur during episodes of restlessness, seizure disorders from various pathologies, or upon removal of the catheter, which was likely to be the underlying cause in this patient [10,14].

A study done by Surov., et al. provided evidence that catheter fragments typically embolize within the pulmonary arteries (35%) and several other locations which includes right atrium (27.6%), right ventricle (22%) and superior vena cava or peripheral veins (15.4%) [8]. Location of embolic fragment may affect mortality and morbidity, with catheter fragments trapped within the right ventricles having the highest mortality and pulmonary arteries having the lowest mortality [8].

Complications resulting from catheter fracture and ensuing embolization can be avoided by taking specific precautionary measures as described by Pande., *et al.* [6] and Mattox., *et al.* [15] Apart from pre/post-insertion checks, post removal checks can be useful to reduce the incidence rate of catheter fracture and embolization (Table 1). One preventable cause of catheter fracture is the removal of a PICC against resistance. The cause of the resistance is due to vasospasm during the removal process and forceful removal can result in catheter fracture and embolization. Regardless of the presence of resistance during removal, the integrity of the catheter should be inspected post removal. Length of the catheter should also be measured and compared to the documented insertion length to decrease the risk of missed catheter fracture [15].

The most common technique used for the removal of catheter fragment is the percutaneous interventional techniques [8,10]. Depending on the condition of the embolized catheter, various tools can be used such as loop snares (most common), fogarty balloon, hooked guide wires, and dormia baskets. Loop snares are commonly used due to its availability and flexible nature to transverse through vessels as necessary. The emergence of nitinol loop snares has proven advantageous in removals as they are able to maintain their shape intravascularly [16]. However, the downside of loop snares is that lack of strong gripping capabilities Basket snares are purported to be the better option in the setting of adherent catheters or those without a free edge [7]. If percutaneous techniques are unsuccessful, surgical interventions may be required. The review by Carroll., *et al*. [17] discusses the considerations and preferred method of catheter retrieval and serves as a useful reference for selection of retrieval procedure.

The method to determine whether the intravascular foreign body is firmly endothelialised to the vessel wall is not well established and relies on the assessment of the duration that the fragment has been left intravascular and radiological evidence [17]. CT scan can help to determine if any calcification has occurred at the open ends of the catheter fragment, presence of thrombus or fibrin sheath [18]. These factors may help guide the decision making process of endovascular/surgical retrieval versus conservative management.

Due to the very small number of similar reported cases, there are no available evidence-based guidelines regarding removal or conservative management at the time of publishing this case. Conservative management entails leaving the catheter fragment in-situ and monitoring the patient through imaging. Nevertheless, it is important for patients to understand the risks. The risks of conservative management includes arrhythmias, endocarditis and pneumonia secondary to septic embolism, pulmonary embolism and cor pulmonale [19]. With these established risks involved, most studies have suggested endovascular removal should be seriously considered. However, the risks involved in the retrieval process should also be considered as it has significant morbidity and mortality. Risks include vessel perforation, ventricular perforation, artery spasm and dislodgement of thrombus, if present [12]. As such, multidisciplinary expert opinion on a case-by-case basis should be sought, in consultation with the patient, to determine if the catheter should be removed or treated conservatively. The

| Pre-insertion | Post-insertion | Post- removal |
|---|---|---|
| • Inspect catheter for damage or fracture<br>• Positioning of arm to be considered while placing catheter tip | • Cautious use of sharp instrument while altering length of PICC and protect device from twisting, bending, entanglement, and acute flexion<br>• Secure PICC in position adequately<br>• Inspection of PICC exit site should be conducted during dressing change<br>• Recognize precursor and early signs/symptoms of device damage<br>• Always follow manufacture guidelines on flushing | • Check integrity of catheter<br>• Do not remove a PICC against resistance as it increases the risk of catheter fracture<br>• Check length of catheter before insertion and after removal<br>• Proper documentation and handover<br>• Consider embolism as potential cause of palpitation or arrhythmias after removal of PICC<br>• If PICC damage is suspected, retain the device in a clean container for further examination<br>• If concerned about embolization, request a CXR post removal<br>• Disclose events to patient and family members according to organization and professional guidelines |

**Table 1:** Measures to reduce the risk of catheter fracture and embolization, and to increase the likelihood of early detection and management [6,15].

Abbreviations: PICC: Peripherally Inserted Central Catheter; CXR: Chest X-ray.

practitioner must understand, however, that a good majority of intravascular foreign bodies tend to be asymptomatic, and leaving a device in-situ is a reasonable decision if the risks of removal is deemed too high compared to the perceived benefits, especially in the moribund patients . A potential exception to this is when the catheter fragment embolises in the heart, that risks the development of arrthymias or the occlusion of the pulmonary arteries or veins.

## Conclusion

This case highlights the importance of diligence inspection and documentation during the insertion and removal of central catheters. It was fortunate that the patient remained asymptomatic and did not suffer any complication post endovascular removal of the catheter fragment. Nevertheless, preventative measures including careful inspection and documentation during CVC and PICC lines insertion and removal can be useful in ensuring catheter fractures are identified and managed early. This case also highlights the difficult nature of decisions regarding endovascular removal or conservative management. In this case, the patient wanted the catheter removed after he was made aware of its existence and subsequently sought a clinician willing to attempt removal with consideration of a multitude of safety factors.

## Conflict of Interest

The authors declare that there is no conflict of interest.

## Bibliography

1. Boiza AL., *et al*. "Peripherally inserted central venous catheter (PICC Line)". *Oxymag* 25.126 (2012): 10-12.

2. Johnston AJ., *et al*. "Defining peripherally inserted central catheter tip position and an evaluation of insertions in one unit". *Anaesthesia* 68.5 (2013): 484-491.

3. Grau D., *et al*. "Complications with peripherally inserted central catheters (PICCs) used in hospitalized patients and outpatients: a prospective cohort study". *Antimicrobial Resistance and Infection Control* 6 (2017): 1-8.

4. Biswas S and P McNerney. "Ventricular tachycardia from a central line fracture fragment embolus: a rare complication of a commonly used procedure-a case report and review of the relevant literature". *Case Reports in Critical Care* (2015): 265326.

5. Kornbau C., *et al*. "Central line complications". *International Journal of Critical Illness and Injury Science* 5.3 (2015): 170-178.

6. Pande S., *et al*. "Migration of entire peripherally-inserted central catheter to pulmonary arteries: An unusual complication". *Indian Journal of Medical and Paediatric Oncology* 28.1 (2007): 33-36.

7. Schechter MA., *et al*. "Retrieval of iatrogenic intravascular foreign bodies". *Journal of Vascular Surgery* 57.1 (2013): 276-281.

8. Surov A., *et al*. "Intravascular embolization of venous catheter-causes, clinical signs, and management: a systematic review". *Journal of Parenteral and Enteral Nutrition* 33.6 (2009): 677-685.

9. Thanigaraj S., *et al*. "Retrieval of an IV catheter fragment from the pulmonary artery 11 years after embolization". *Chest* 117.4 (2000): 1209-1211.

10. Chow LM., *et al*. "Peripherally inserted central catheter (PICC) fracture and embolization in the pediatric population". *Journal of Pediatrics* 142 (2003): 141-144.

11. Lee D and K Shaffer. "Wandering catheter through pulmonary vasculature". *Radiology Case Reports* 1.3 (2006): 103-107.

12. Teoh CW., *et al*. "Successful image-guided retrieval of an embolized fragment of a fractured haemodialysis catheter tip from the pulmonary artery". *Case Reports in Nephrology and Dialysis* 6 (2016): 21-25.

13. Aitken DR and JP Minton. The "pinch-off sign": a warning of impending problems with permanent subclavian catheters". *The American Journal of Surgery* 148 (1984): 633-636.

14. Hinke DH., *et al*. "Pinch-off syndrome: a complication of implantable subclavian venous access devices". *Radiology* 177 (1990): 353-356.

15. Mattox EA. "Complications of peripheral venous access devices: prevention, detection, and recovery strategies". *Critical Care Nurse* 37.2 (2017): e1-e14.

16. Yedlicka Jr JW., *et al*. "Nitinol gooseneck snare for removal of foreign bodies: experimental study and clinical evaluation". *Radiology* 178 (1991): 691-693.

17. Carroll MI., *et al*. "Endovascular foreign body retrieval". *Journal of Vascular Surgery* 57.2 (2013): 459-463.

18. Krausz DJ., *et al*. "Retained fibrin sheaths: chest computed tomography findings and clinical associations". *Journal of Thoracic Imaging* 29.2 (2014): 118-124.

19. Tateishi M and Y Tomizawa. "Intravascular foreign bodies: danger of unretrieved fragmented medical devices". *Journal of Artificial Organs* 12.2 (2009): 80-89.