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The Role of Image Guided Minimal Access Surgery in Retrieving Intravascular Foreign Bodies: A Case Series

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Abstract

Over the last decade, procedures performed by interventional radiologists have become an increasingly attractive option for the retrieval of intravascular foreign bodies, avoiding open surgery. We present three cases of intravascular foreign body retrieval by the interventional radiology (IR), highlighting the importance of IR in managing these patients.

Case 1: Very rare self-inflicted injury with a sharp metal foreign body. Multi-disciplinary team approach used to achieve successful endovascular retrieval, a true multi-disciplinary approach used.

Case 2: Retrieval of a misplaced guide wire during routine insertion of a central line. The wire was initially lying in the brachiocephalic vein but subsequently migrated down to the IVC at the time of removal.

Case 3: A tunneled central line fractured inside the chest. The distal fragment migrated from the right atrium into the right ventricle and was retrieved using an endovascular snare.

These cases highlight the cross-specialty role of IR, and the benefits of using a percutaneous endovascular approach over the more traditional method of open surgical removal.

Key words

Interventional radiology, Vascular radiology, Foreign body removal

List of Abbreviations

CXR: Chest X-Ray, AXR: Abdominal X-Ray, PHS: Pin-Hole Surgery, IR: Interventional Radiology, IVC: Inferior Vena Cava, CT: Computer Tomography

Introduction

Pin-hole surgery (PHS) performed by IR's (interventional radiologists) has increasingly played a key role in managing acutely ill patients and also to provide minimally invasive alternatives to open surgery for elective procedures. Other hospital-based specialties place central lines, dialysis catheters or cardiac devices percutaneously using the Seldinger technique. The last decade has seen an increased use of central lines and percutaneous cardiac devices, and there has been an increase in the associated complications, including device fracture, and misplacement [1-4]. If left *in situ*, a fractured central line or retained displaced guidewire from central line insertion may cause cardiac arrhythmias, thromboemboli and sepsis [2-4]. Open surgery was the only method available to

rectify this until 1964 when Thomas and colleagues described the first successful endovascular retrieval of a guide wire [3, 4]. Since then, Interventional Radiology has played an increasingly important role in this field. Percutaneous retrieval can be considered the gold standard due to a high recovery rate and minimal complications, as these foreign bodies can often be difficult to access via a surgical approach [3-7]. In this pictorial review we describe three cases of intravascular foreign body retrieval to highlight use of PHS in managing such patients.

Methods

Case 1

A 22-year-old lady presented to accident and emergency with chest pain. A subsequent chest X-ray (CXR) showed multiple foreign bodies within the thorax, shown by arrows in figure 1. She had a long history of percutaneously inserting metal objects into her skin (both into her chest and abdomen), and so these were thought to be an old finding, as she did not say she had inserted any more objects recently. She was discharged as no other sinister cause for her chest pain could be identified. She then represented with ongoing chest pain and palpitations, a repeat CXR showed that one of the objects had moved compared to the film taken earlier, as shown by further arrows indicating the object movement (Figure 2). Previous imaging done in the past of this patient demonstrates further foreign body insertion, but this time intra-abdominal objects, seen here on lateral abdominal X-ray (AXR), with arrows pointing to foreign bodies within the abdominal subcutaneous tissue (Figures 3A and 3B). A CT (computer tomography) scan showed confirmed the multiple abnormalities seen on the CXR were in-fact subcutaneous, and some intra-parenchymal within the lung tissue. However, there was one interesting finding. An 8 cm slightly angulated object was seen within her right atrium and right ventricle, and it seemed like the posterior aspect was encroaching the posterior cardiac wall, shown here on the sagittal slice (Figure 4). Here is an axial CT slice, showing the relationship between the thorax and these inserted objects, (arrows to indicate), in this image, two of the objects are within the lung parenchyma and one is intra-cardiac (Figure 5). During the patient's self-harming ritual of inserting objects percutaneously, we assume on this occasion she had inadvertently pushed this object into the brachiocephalic vein, and it had migrated into the right side of her heart, crossing the tricuspid valve as seen in the earlier imaging.

The case was brought to the IR team by the cardiology

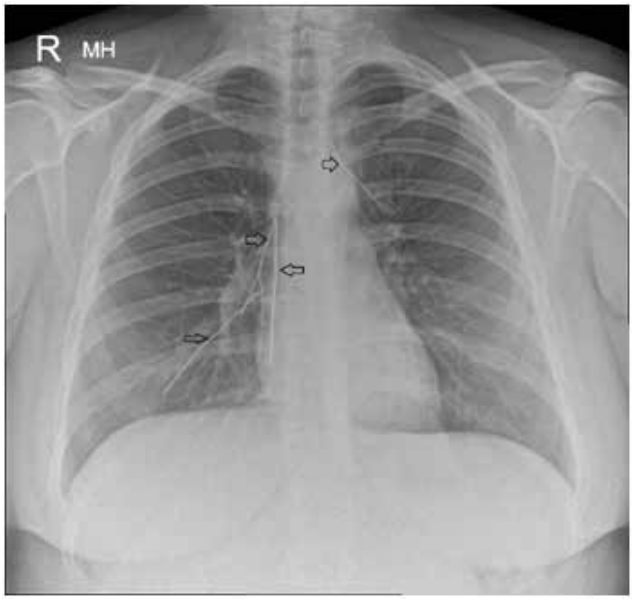

Figure 1: Erect PA chest X-Ray, arrows showing multiple foreign bodies within the chest.

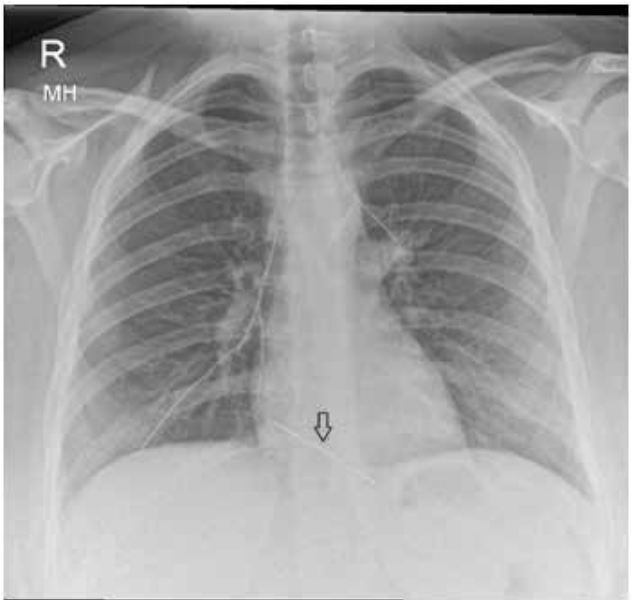

Figure 2: Repeat chest X-Ray, with arrow demonstrating that one fragment had migrated.

Figure 3A: Erect abdominal X-Ray showing foreign bodies within the abdominal cavity. Shown by arrows.

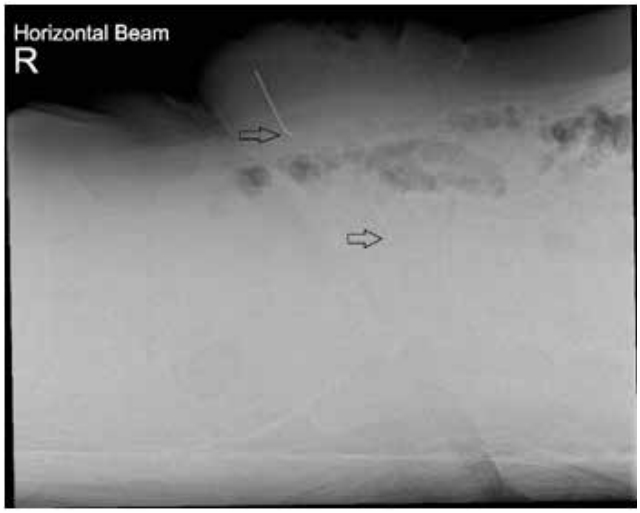

Figure 3B: Lateral abdominal X-Ray demonstrating the same foreign bodies in the subcutaneous fat.

Figure 4: Sagittal CT slice, showing a metal intra-cardiac foreign body, with the sharp distal end abutting the posterior cardiac wall, dangerously close to the vena cava.

team to enquire if percutaneous removal would be possible in order to avoid open heart surgery in someone so young. A true multi-disciplinary approach was undertaken in this case. From the sagittal CT slices, it looked like the distal aspect of the object was abutting the posterior cardiac wall, and if this was the case then IR retrieval would have been much more dangerous given the potential damage to the endocardium and possibly vena cava. Under general anesthetic an intra-operative trans-oesophageal echocardiogram (TOE) was performed and showed that the object was lying across the tricuspid valve (seen in figure 6, with bold arrow pointing to intracardiac object, and smaller arrows indicating the other foreign bodies) but was mobile and had not injured or pierced the tricuspid valve leaflets, meaning an attempt as IR retrieval was possible.

Figure 5: Axial CT slice showing the relationship between the several foreign bodies within the chest, two in the lung parenchyma and the one intracardiac object.

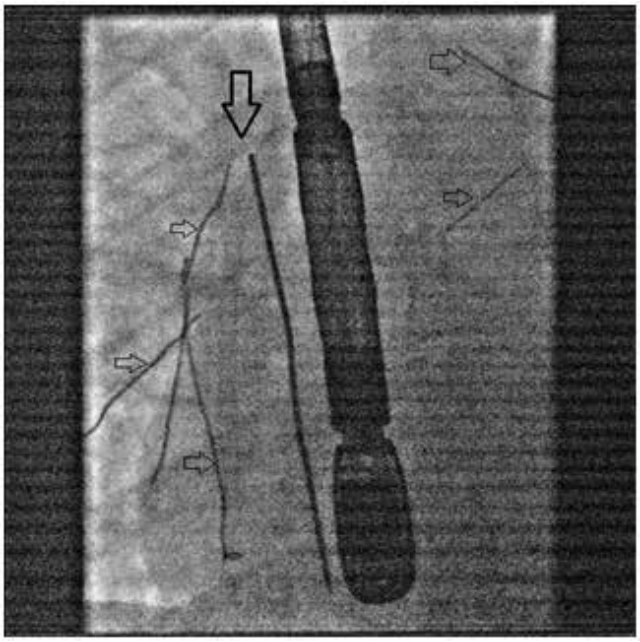

Figure 6: Fluoroscopy image taken during trans-oesophageal echocardiogram, demonstrating the motile object.

A true multi-disciplinary approach was undertaken in this case. The interventional cardiologists were on hand and performed an intra-operative TOE to assess motility of the object, the cardiothoracic surgeons and perfusionists were scrubbed ready to go to theatre, either if retrieval was not possible via pin-hole surgery, or if cardiac damage occurred. The vascular surgeons were on hand, should any vascular damage occur during the procedure, along with the anesthetic team to provide a general anesthetic. The distal angulation of the object meant that the IR team could not grasp it at any distal point, as this would

shear the vessel or damage the heart once it was moved down towards the exit point in the femoral vessels. Bilateral femoral (venous) access was gained via Cordis 10Fr brite tip sheath (Cardinal Health, Baar, Switzerland). It was then realized that the angulation meant that the distal end was unable to be used to remove the object with it in its slightly oblique position, so further access was needed. Ideally an approach via the right internal jugular vein would have been used, but unfortunately it was occluded. Access therefore had to be sought from the left subclavian vein (6 Fr Sheath). During this second route of access, the object migrated down from its original intra-cardiac position to further down into the inferior vena cava (IVC). Having these points of access, the object could safely then be manipulated into an optimum position to be snared (using a 12/20 en-snare trieve, Merit Medical USA), at the very distal aspect, and removed via 10 Fr sheath through the right common femoral vein. The retrieved metal object transpired to be the metal frame from the leg of a pair of glasses, as seen in figures 7 and 8, with the object measures against a standard blunt needle and a ruler. This remarkably rare case showcases the role of IR can play in an MDT setting to deliver the best patient care and achieve brilliant results in extra-ordinary cases such as Young et al., [8].

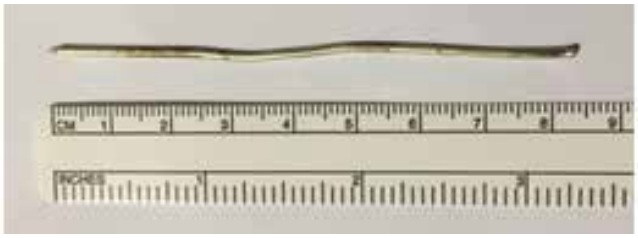

Figure 7: Removed foreign body, measured compared to a ruler.

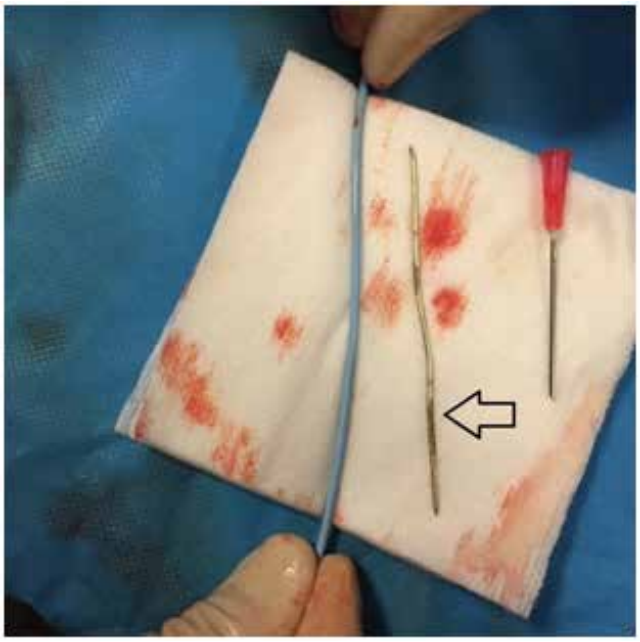

Figure 8: Removed foreign body held against a blunt drawing-up needle for size comparison.

Case 2

A 75-year-old male patient was having a central line inserted for post-operative fluid management. As per normal practice, the procedure was undertaken with the guide wire being placed into the internal jugular vein by a junior member of the anesthetic team. Unfortunately, during the procedure,

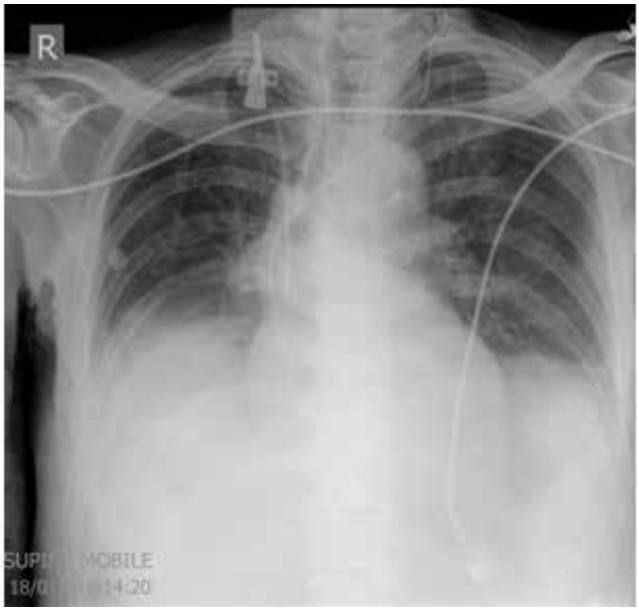

Figure 9: Supine CXR showing the guide wire lost within the chest, arrows pointing to the proximal aspect within the thoracic cavity.

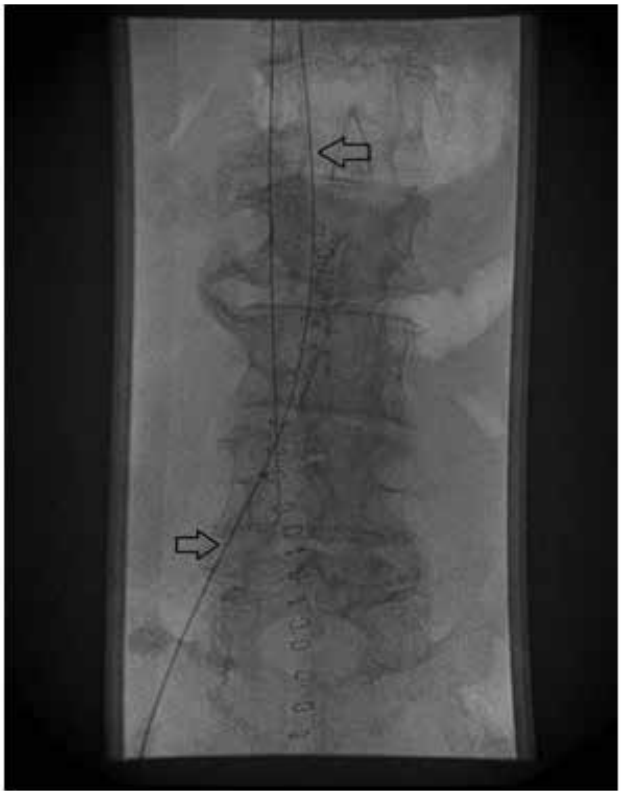

Figure 10: Fluoroscopy image showing the wire which had moved down into the IVC, arrows to show the proximal end of the wire.

the guide wire became misplaced inside the thorax of the patient and became un-retrievable by the anesthetist. A CXR revealed the location of the lost guide wire, still in the thoracic vessels as shown in figure 9, arrows to show the proximal aspect of the wire. The anesthetic team then contacted the IR team, who were happy to attempt pin-hole retrieval. The patient was then transferred to the larger hospital and to the IR department. Further imaging showed that the wire had in fact migrated down from the left subclavian vein into to the right atrium and inferior vena cava, as shown in figure 10. The guidewire was successfully removed via pinhole surgery using a 12/20 Atrieve vascular snare kit (Argon Medical Devices Inc, Texas, USA) via a Cordis 6Fr brite tip sheath (Cardinal Health, Baar, Switzerland) in the right common femoral vein.

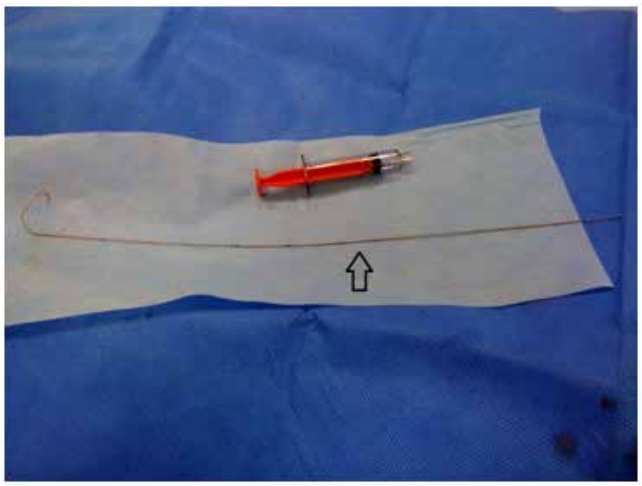

Figure 11: Picture of the removed guide wire, against a normal syringe for size comparison

Figure 11 shows the removed guide wire, size comparison with a common syringe. The patient recovered well from his ordeal with minimal scarring and avoided all of the risks of open vascular surgery, and risks of leaving the guide wire in situ long term. This is a very common consequence of invasive medical procedures, as the seldinger technique of guide wire insertion is a preferred method of insertion of many drains, catheters and forms of vascular access.

Case 3

A 58-year-old patient had a tunneled portacath inserted for treatment of metastatic cancer. This is another common medical intervention used across multiple specialties for long term administration of intravenous medications. After insertion a CXR was done to show correct placement of the distal fragment, as shown in figure 12. In this case, the patient went in for their chemo as planned, and the portacath wasn't flushing. There was no pain or history of any trauma to the site. A repeat CXR showed that there was a problem with the portacath, and the distal fragment had fractured inside the chest of the patient, and it was sitting across the right atrium and ventricle, arrows to show the distal fragment (Figure 13). Again, the skills of the IR team were called

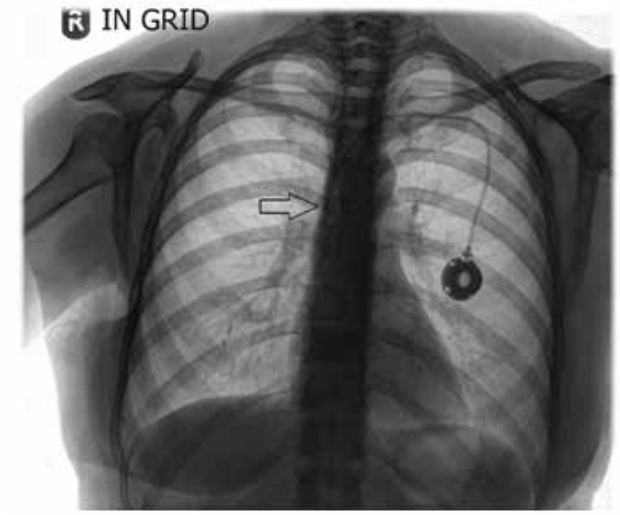

Figure 12: Erect PA CXR showing the correct position of the portacath. Arrow pointing to the normal position of the distal fragment.

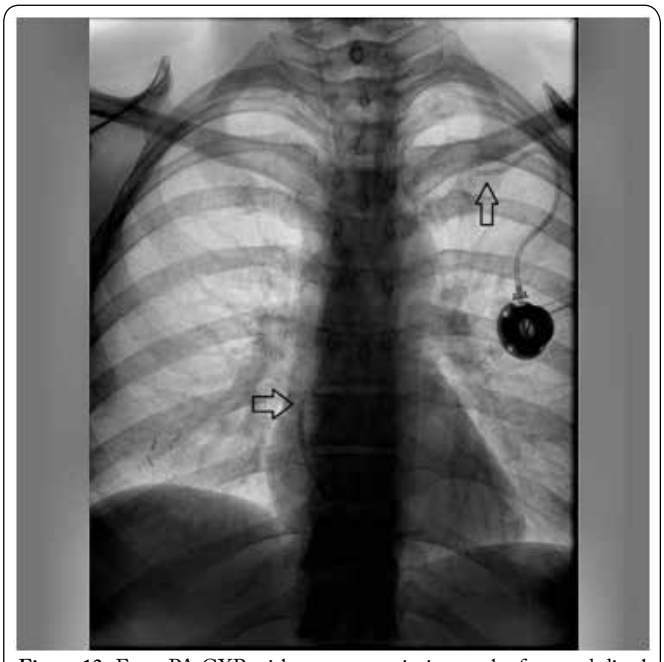

Figure 13: Erect PA CXR with an arrow pointing to the fractured distal end, now intracardiac.

upon, and the patient was able to have the distal fragment successfully removed via pin-hole surgery, again avoiding an open procedure in someone with already extensive co-morbidities. The fractured segment was successfully removed under fluoroscopic guidance using a 12/20 vascular snare via the right common femoral vein (Figure 14 arrow pointing to the snare grabbing the distal aspect). Due to the nature of the material (the portacath was made from soft plastic and easy to manipulate into a sheath) the distal fragment was easily accessed and snared at the lower portion (not right at the end as with the first case we have discussed). The fractured segment was then easily retrieved and didn't cause any vascular damage on the way out, as seen in figure 15.

Figure 14: Fluoroscopy image showing the snare being used to grab the distal aspect of the fractured portacath. Arrow pointing to the snare used.

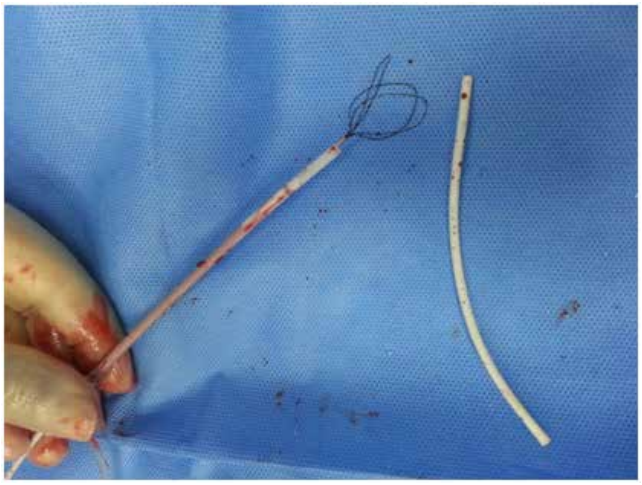

Figure 15: Picture of the removed fragment of the portacath with the snare used for retrieval.

Conclusions

This article highlights the role of PHS in successfully retrieving intravascular foreign bodies. An endovascular approach has many advantages over open surgery such as reduced hospital stays, quicker mobilization and fewer post-operative complications such as infections and poor wound healing, not to mention the significantly reduced pain involved. It generally reduces the need for a general anesthetic, and is therefore safer for those with multiple co-morbidities, indeed PHS can often be done in the day case setting. This means that the patients can be discharged quicker, thus saving on the added cost of in-patient hospital stays. There are a few relative contraindications to percutaneous removal such as inadequate visibility of the object, or the object lying partly in the blood vessel and partly within the surrounding soft tissues. Intravascular retrieval may cause vessel damage [1]. Sometimes, if a device migrates to the intra-cardiac region and damages a valve, an open approach may be preferred as this would allow for valve repair to be done at the same time [2].

The versatility of interventional techniques can be used both in everyday care, and in the more challenging cases, and both produce favorable results. With many areas of healthcare realizing that IR can open the door to many more treatment options, the impact on patient care will continue to increase. Awareness and availability of IR should be maximized wherever possible so that these incredible techniques can be offered to all patients and not just those fortunate enough to fall into a specific postcode. Although these three cases display very different causative agents and danger levels, the principal is the same, whether the procedure be a very common one for the IR teams across the country to perform, or on the other extreme end of the scale, the abilities of the IR teams are there for all specialties to take advantage of. The possibilities of IR are increasing every day with rapid advancement in technology, and thus the specialty requires constant adaptation and refinement of techniques [6].

Key Points

The increasing use of long-term venous access has accompanied the increased frequency of ruptured foreign material placed intravascularly which needs removal due to possible complications. Interventional retrieval is a safe and successful procedure, and in most cases surgical retrieval is not necessary [5]. The main reason for this review is to remind the profession that interventional radiology is always an option to consider rather than traditional open surgical approaches.

Conflict of Interest

The authors declared no conflict of interest.

Acknowledgements

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