**ARTICLE INFO**

**ABSTRACT**

Introduction: Since there has been a wide spread use of plastic catheter and tubing for placement of continuous dialysis, parenteral nutrition, central line insertions and other port catheter insertions, there has been an increase in incidence of "lost" tubing, broken tubing or a component of the entire assembly within the vascular tree or other tissues. Aims & Objectives: To understand and review the various techniques and outcomes used by the Interventional Radiology department in management of retrieval of intravascular foreign bodies. Materials and methods: Patients referred to the department of Interventional radiology on an Emergency or elective basis were evaluated on Ultrasound, CT or DSA and were treated under fluoroscopy and ultrasound guidance with informed consent on elective cases. Results: Of 13 cases referred to the department of Vascular and Interventional Radiology 3 cases were iatrogenic complications occurred during performing the procedures in the department while 10 cases were referred for other departments. All the procedures went uneventful without any complications. Snare was the most common retrieval device used for IFB removal in most of the cases (11 cases), balloon was used in one case. Femoral (venous) access was most common access used. Conclusion: Vascular and interventional radiology is a recent upcoming branch which due to advances in physics and technology has provide a vast spectrum of possibilities in therapy of patients through minimal access and lesser morbidity. A proper technique, equipment and approach is necessary for each of such cases so as to tackle them without causing any additional injury to the vasculature.

**CLASSIFICATION OF INTRAVASCULAR FOREIGN BODIES [1]**

<table>
<thead>
<tr>
<th>Long and skinny</th>
<th>Round and slippery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment of central venous catheter</td>
<td>Bullets and Shotgun pellets</td>
</tr>
<tr>
<td>Fragment of TWC filter</td>
<td>Embolization coils</td>
</tr>
<tr>
<td>Fractured guide wire</td>
<td>Ureretic and bile duct calculi</td>
</tr>
<tr>
<td>Balloon and/or tip of angioplasty catheter</td>
<td>Atrial septal occluders</td>
</tr>
<tr>
<td>Migrating stents</td>
<td>Pressure balls and beads</td>
</tr>
</tbody>
</table>

Good case planning, appropriate availability of the equipment for the trade and a certain level of expertise in the use of this equipment and there retrieval techniques is necessary for a better outcome in an already complicated case.

**III] AIMS AND OBJECTIVES:**

To understand and review the various techniques and outcomes used by the Interventional Radiology department in management of retrieval of intravascular foreign bodies.
### IV] MATERIAL AND METHODS:

Patients referred to the department of Interventional radiology for foreign body removal on an Emergency or elective basis were evaluated on Ultrasound, CT or DSA and were treated under fluoroscopy and ultrasound guidance with informed consent on elective cases.

#### VI) OBSERVATIONS & RESULTS:

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Age/Sex</th>
<th>Cause of Reference</th>
<th>Patient General Condition</th>
<th>Access Taken</th>
<th>Special Device Is Any</th>
<th>Post Procedure Complications/ Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53y/m</td>
<td>Retained Central Line Wire in the IVC for Removal.</td>
<td>Stable</td>
<td>Femoral Venous</td>
<td>Snare</td>
<td>NIL/Proximal End Grab</td>
</tr>
<tr>
<td>2</td>
<td>1y/m</td>
<td>Retained Left SVC-BRA CH PICC Line</td>
<td>Stable</td>
<td>Left Femoral Venous</td>
<td>Snare</td>
<td>NIL/Distal End Grab</td>
</tr>
<tr>
<td>3</td>
<td>53y/m</td>
<td>Retained Guidewire of Central Line</td>
<td>Stable</td>
<td>Right Jugular</td>
<td>NIL/Proximal End Grab</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>45y/m</td>
<td>Retained IVC Guidewire</td>
<td>Stable</td>
<td>Left Femoral Venous</td>
<td>Snare</td>
<td>NIL/Proximal End Grab</td>
</tr>
<tr>
<td>5</td>
<td>65y/f</td>
<td>Displaced Perclose Wire Removal</td>
<td>Unstable</td>
<td>Right Jugular</td>
<td>Snare</td>
<td>Had to Shift to CVTS/Distal End Grab</td>
</tr>
<tr>
<td>6</td>
<td>40y/f</td>
<td>Displaced Right Femoral Guidewire</td>
<td>Stable</td>
<td>Left Femoral Venous</td>
<td>Snare</td>
<td>NIL/Proximal End Grab</td>
</tr>
<tr>
<td>7</td>
<td>7y/m</td>
<td>Solitary Kidney with D-J Stent Removal</td>
<td>Stable</td>
<td>Percutanous</td>
<td>Snare</td>
<td>NIL/</td>
</tr>
<tr>
<td>8</td>
<td>41y/m</td>
<td>Right Sided Displaced PICC Line Removal</td>
<td>Stable</td>
<td>Right Femoral Venous</td>
<td>Snare, SIMS</td>
<td>NIL/Distal End Grab</td>
</tr>
<tr>
<td>9</td>
<td>19y/m</td>
<td>Displaced Right MLA Coil Retrieval during Parent Vessel Occlusion</td>
<td>Unstable</td>
<td>Right Femoral Artery</td>
<td>Microsnare</td>
<td>NIL/Guidewire as Snare + Proximal End Grab</td>
</tr>
</tbody>
</table>

In our institute following is a collective experience for 3 years from Jan 2017 to Jan 2020, which includes a referral of 13 cases of complicated foreign body retrieval. Of these cases 7 were male and 5 females.

Of the 13 cases referred to the department of Vascular and Interventional Radiology 3 cases were iatrogenic complications occurred during performing the procedures in the department while 10 cases were referred for other departments. All the procedures went uneventful without any complications. Snare was the most common retrieval device used for IFB removal in most of the cases (12 cases), balloon was used in 1 case. Femoral (venous) access was most common access used.

#### VI) DISCUSSION:

**APPROACH, DEVICES AND TECHNIQUES FOR FOREIGN BODY RETRIEVAL:**

1. Imaging to find the lost foreign body:

   It is the first and crucial step in identification and proper position of the foreign body. It involves to determine the size, shape, location and make of the foreign body involving any of the possible modality available and that time with taking into consideration the general condition of the patient. In our institute CT with or without contrast is the most commonly sorted modality available with gives complete information regarding the position, size, shape of the FB’s as also the component of the foreign body within the vascular tree and the component in the extra-vascular space.[2]

   Ultrasound may be used for certain superficial structures and gives us the advantage of being able to image simultaneously during and post removal.
Fluoroscopy has a role mostly during removal of the FB and not during initial survey due to its high radiation dose and being able to give information only of a single plane at a time.

2. Decision regarding whether to remove the foreign body or not:

A multidisciplinary team approach and model is necessary to evaluate whether removal of the FB would be helpful / not for the patient taking into consideration the general condition and comorbidity.

Also regarding the approach for foreign body removal is also decided whether to go for a much radical / surgical approach or a precise and small Endovascular approach taking a pinhole surgical approach for removal of the foreign bodies.

3. Retrieval devices and methods:

The most commonly used retrieval devices includes snares and forceps [Fig 1 and 2]. A loop snare can also be easily created using a 0.035 guide wire (double length) with a 6 Fr guiding catheter. Similar can be applied for a 0.014 double length guide wire with a 5 Fr angiographic catheter.[3]

Snares have an excellent safety profile and are relativelyatraumatic. They are simple to use and are effective for achieving a good success rate of IFB retrieval, even in inexperienced hands.[3]

4. Techniques:

A) PROXIMAL GRAB TECHNIQUE [Fig 3]:

One of the most basic technique for extraction of a FB. Here an appropriate sized snare with the help of a 4 Fr or 5 Fr catheter is inserted in the respected vessel where the FB is dislodged. Then the catheter is pulled back to deploy the snare in the vessel and the entire system is advanced to the proximal or free end portion of the FB. If this is not possible then an angled catheter can be used / a different access can be helpful.[4]

Disadvantages:
Not possible for rigid FB
For FB with sharp or pointed edges
B) DISTAL WIRE GRAB TECHNIQUE [Fig 4]:

In this technique catheter is passed through the IFB and snare / micro snare is passed distal to the FB. Then using the snare the distal part of the foreign body is grasped and constrained between the catheter and guide wire. This is useful to keep the alignment of the guide wire parallel.

C) CO-AXIAL SNARE TECHNIQUE [Fig 5]:

This method is useful in entrapping tubular foreign bodies. Another guide wire is passed parallel to the snare catheter and negotiated with in the tubular foreign body. The snare is passed prior through the guide wire and the proximal part of the IFB is then grasped along with the guide wire and entire system is then pulled back en mass. This method makes sure that the FB is in alignment with the vessel during retrieval.

D) LATERAL GRASP TECHNIQUE [Fig 6]:

Here the snare is passed distal to the IFB and deployed widely. The guide wire is passed along the other side of the FB. The guide wire is then grasped by the snare while pinching the FB in between which can then be retrieved.

E) USE OF DORMIA'S BASKET [Fig 7]:

Made up of two nitinol wire spirals with unfurl on deployment. The catheters used are 3Fr which cause least damage to vessel wall and can be handled with single operator.

Advantages:
Single handle use
Wide wire loop which helps in encircling FB, Stent and other bodies
Cheap
Can be used in wider caliber vessels
Disadvantages:
Cannot be used in smaller caliber vessel
Endothelial damage risk
Difficult to guide

F) SMALL BALLOON CATHETER TECHNIQUE [Fig 8]:

This technique is useful in retrieval of stents. Here a guide wire is passed through the deployed stents through a snare. Over the wire a non- compliant low profile balloon is deployed distal to the foreign body. The balloon is then inflated just to capture the stent which is then pulled back into the snare catheter.

Here it is important to select the proper profile of the balloon to guide into the FB.

G) GUIDE WIRE AS SNARE (HAIR-PIN TRAP) [Fig 9]:

A double length terumo wire and 6 Fr guiding catheter can act as a home-made snare loop which can be used for retrieval. The distal few centimeters of the guidewire is looped to form a hairpin turn and inserted in the catheter. The catheter is passed distal to the stent and the hook is released and pulled back to hook the lost stent. The distal part of the tip is then guided back to the guiding catheter where it is trapped by the balloon forming the hairpin trap.

Another example includes use of a 0.010 micro wire through a micro-catheter to form a 2mm goose-neck snare which can be used in neurointervention cases for coil retrieval [Fig 10].

H) TWO WIRE TECHNIQUE:

One wire is passed through the stent lumen and the other stiff wire is passed through the stent struts. Both these wires are then intertwined and torqued to make a pincer – like grip around the lost stent and retrieve the stent.

I) INTRA-VASCULAR RETREIVAL FORCEPS OR BILIARY / MYOCARDIAL BIOPSY FORCEPS:

Dedicated steerable intravascular forceps with jaws are now available which can be guided through 3F to 12 Fr catheters into the desired position. It has the advantage of not requiring the free edge of the FB for removal, however has the disadvantage of causing trauma or injury to the vessel wall.

Overall, prevention of IFB is the most ideal scenario in management of patient during intervention, however in this era of increasing non - invasive procedures with multiple hands involved such a scenario is rarely seen. Hence appropriate and immediate
retrieval of foreign body is essential for the patient outcome on the longer run. For this it is essential to recognize and diagnose the exact position of the foreign body at the first place with multi-modality approach.

The best way to manage a lost foreign body is by urgent retrieval and one should always consider a multi-modality approach with consideration of surgical retrieval also as an option and provide the best possible alternative for the patient at the given time.

Endovascular or pin-hole approach has an added advantage of decreasing the exposure of the subcutaneous / internal tissues to the foreign environment and thus preventing further added complications by infection or sepsis, however it has an added advantage of restricted field of view , availability of a adequate infra-structure like Fluoroscopy and other hardware with expertise of the operator for the same.

Proper training and experience in the field of Interventional Radiology with further exposure of the training residents and Fellows in this field of Radiology with early introduction of the residents to this field is essential for prevention of such complications as well as teaching them how to tackle such situations at the earliest.

In our experience for 2 years in our institute we had limited experience with snare catheter being our principal retrieval catheter, however this is mostly as our experience was limited to retained guidewires kept inadvertently by young inexperienced operators. However on a different setup with different specialties the role of instruments would differ as well as the technique and investigating or research would be helpful for further modification and studies.

VII] REPRESENTATIVE CASES:
Case 1 [Fig 11]:
A 4 Y / M patient with a coiled DJ stent in the right renal pelvis which was inserted i/v/o Pelvi-ureteric junction obstruction and could not be retrieved through cystoscopy was managed by IR by using a right percutaneous approach via the right renal pelvis. A 6 Fr sheath was inserted and simple amplatz goose neck snare was used for retrieval. The method used was a distal grab technique. IR provided immediate retrieval without any serious complications.

Case 2 [Fig 12]:
A 4y / M patient, K/C/O AML on chemotherapy with a right sided Picc line inserted 4 days back which on follow up during chemotherapy got displaced and urgent CT scan was done which revealed the Picc line in the right basilica vein and coiled in Rt atrium and Pulmonary trunk.
IR helped in removal of the Picc line by using a right femoral venous approach. The retrieval device used was a 4 fr Sims catheter. Check pulmonary angiogram was normal. Patient was extubated without any complications.

Case 3 [Fig 13]:
A 2Y old / male case of complex anomalies with right sided solitary malformed kidney with PUJ obstruction and vertebral anomalies was referred to the Vascular interventional radiology department for retrieval of a right sided non-function D-J stent with hydro-nephrosis.
A right percutaneous approach was taken and multiple attempts were made by a trefoil snare (merit) and a simple Amplatz goose neck snare which finally retrieved the catheter by distal grab technique. Post procedure check pyelogram was normal.

Case 4 [Fig 14]:
Another case of a 40 Y/F, CKD for which a right femoral Jo line insertion was attempted Outside however inadvertently the guidewire was displaced along the entire IV Cinto the SVC.
Check venogram was done with revealed no thrombosis of IVC. A left femoral venous access sheath was inserted and the guide wire was removed by proximal grab technique.

Case 5 [Fig 15]:
A 4 y / M with bone cancer on chemotherapy with a left sided Picc line with accidentally displaced line in the left brachiocephalic vein and basilica vein was referred to the IR department.
A right femoral venous approach was taken and 6 Fr sheath was inserted. A simple goose neck snare catheter was inserted for retrieval of the Picc line through right femoral approach.
Fig 3. Proximal Grab Technique. A) snare loop in mid part, B) Grab middle part of stent, C) Grab the proximal end of the stent.

Fig 4. Distal Grab Technique. Wire through stent with snare distally (left), Wire distally grabbed by the snare with retrieval of the stent (right).

Fig 5. Coaxial Snare Technique. Guide wire is passed through the stent and the proximal end of stent is grabbed with snare for retrieval.

Fig 6. Lateral Grasp Technique. Guide wire is passed along the side of the stent and snare catheter is passed along the other side (left). The distal end of the guide wire is grasped with the snare for retrieval (right).

Fig 7. Different types and sizes of Dormia basket.

Fig 8. Small Balloon catheter technique. A) Guide wire is passed through the stent with a pre-loaded balloon. B) Balloon is inflated with snare across it. C) With the help of balloon the snare is passed across the stent to capture the stent.

Fig 9. Hair-Pin Trap. A) stuck intravascular coronary stent B) use of hair pin loop by a double length terumo C) D) inflation of balloon with snare to remove stent E) F) IVUS to check for crumped stent.
Fig 10. A) A side branch aneurysm coiling with misplaced coil in parent vessel. B) A microwire introduced from the side through a catheter to form a loop extract the coil.

Fig 11. Coiled DJ stent retrieval

Fig 13. DJ Stent removal

Fig 12. PICC Line removal

Fig 14. Guidewire removal

Fig 15. PICC Line removal
VIII) CONCLUSION:

As there would continuously be an increase in the usage of intravascular guide catheters and other devices in the medical field and also as there has been an increase in usage of these device insertions by the paraclinical or inexperienced staff in the remote areas there is bound to be an increase in such incidences of retained IFB which would require urgent removal or Intervention.

A proper technique, equipment and approach is necessary for each of such cases so as to tackle them without causing any additional injury to the vasculature as well as in to the subcutaneous tissue due to percutaneous small incision approach.

IX) Acknowledgment:

Dr. Anagha Joshi, Prof & HOD, Department of Radiology, LTMG Hospital for her constant support and guidance.

REFERENCES


7) Dotter CT, Rosch J, Bilbao MK. Transluminal extraction of catheter and guide fragments from the heart and great vessels: 29 collected cases. AJR 1971;111:467-472

© Copyright 2010 BioMedSciDirect Publications IJBMR - ISSN: 0976-6685. All rights reserved.