Device loss and retrieval

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The incidence of devices loss during percutaneous interventions has significantly declined in recent years (Improvement in equipments design and technology, universal use of pre-mounted stents ...)

However; device loss still occur and it could represent a hard experience because the operator may not be familiar with retrieval techniques and equipments and these latter are not so frequently used.

Most devices that are lost during PCI are stents and rarely wire tip fragments, balloons and balloon catheter fragments.
Background

- 1971: Dotter compiled a list of 29 successful “nonoperative recoveries,”

- Descriptions of foreign body retrieval have been disseminated in most recent textbooks of angiography and percutaneous retrieval has become widely practiced.

- Although earlier reports concentrated on objects such as broken catheter and guide wires, today, the spectrum of endoluminal foreign objects has broadened to include items such as embolization coils and endovascular stent components, valves, PFO, ASD, VSD Closures Devices …..
Percutaneous devices currently used by interventional cardiologists & radiologists

- Venous cannula and central catheters, sheaths, angio wires & catheters
- Coronary balloons
- Atrial septal occluders
- Coronary stents
- Percutaneous valves
- Coronary guidewires
- Coils
- Filter Wire EZ
- Caval Filter
First Device used for the retrieval of endovascular foreign bodies...

How to make a homemade snare: all you need an exchange coronary guidewire and 5F diagnostic catheter (usually multipurpose)
The tools available for foreign body retrieval have rapidly evolved in the past decade...

EN Snare, Merit Medical Systems

Allegator Retrieval Device, eV3

In-Time Retrieval Device, Boston Scientific

Segura Basket

Loop snares

Texan Foreign Body Retrieval Device, IDev
Retrieval Devices

- Retrieval devices are available in small sizes which fit with any catheter or sheath used for diagnostic procedure.
- The use of guide catheters or large sheaths depends on the size of the device to retrieve.
- Nitilol Goose-Neck Snares have no sharp edges but very smooth and flexible, so extremely safe for intravascular use.
- Forceps and baskets have rigid tips and can potentially grasp the vessel wall next to the foreign body and require more caution and experience.
Loop Snares are most frequently used

- Snares can be effectively used when the foreign body or the device has a free end or located on a guide wire.

- Frequently, endovascular lost device should be manipulated by wires or catheters (pig tail or different shape) into another position until it moves to a more favorable position for snaring (from a perpendicular position to a parallel position to the vessel).

- These manoeuvres can also complicate the procedure of retrieval because of uncontrolled embolization (following the blood flow direction).
Feasibility of lost devices retrieval depends on device shape and size:

**Long and Skinny**
- Segment of central venous catheter
- Fragment of IVC filter
- Fractured guidewire
- Balloon and/or tip of angioplasty catheter
- Intravascular stents

**Round and Slippery**
- Embolization coils
- Atrial and ventricular septal occluders
- Valves
Wire  Sup Cava – RA - RV – Inf Cava

D.O. 67 yrs, male

Wire 45 cm length, lost probably 4 months back during giugular venous sheath placement

Wire loop in RV engaged in tricuspid papillary muscles
Distal tip was engaged in small side branch

Proximal tip was snared in sup. cava and pulled back softly
Wire Sup Cava – RA - RV – Inf Cava

Sanred tip in inf cava

Distal tip in RV

Wire loop still engaged in papillay m.

Wire completely retrieved into the sheath
Catheter fragment in PA

The most frequently lost device is stent, slipping of the delivery balloon in the coronary circulation.
Mechanisms for stent loss during PCI:

- The stent may stripped free of the delivery balloon while it is being advanced into a diseased artery.

- After unsuccessful attempts to advance the stent through the target lesion (particularly in calcified and tortuous lesions), the stent may become stuck within the lesion; when withdrawn back, the stent may come free of the balloon.

- After unsuccessful advancement of the stent, withdrawing the system back into guiding catheter, the proximal edge of the stent may catch the guide catheter tip and the stent may be stripped from the balloon.
Risk for stent loss during PCI

- **Patients-related factors**: Calcifications, tortuosity, lesion severity

- **Equipment-related factors**: poor guide or wire support makes necessary the withdrawal of the stent, stent crimping defect,

- **Operator-related factors**: lesion preparation with adequate predilatation (2% of stent loss in primary stenting vs 0.5% in predilatation strategy), forceful withdrawal of the stent in guide catheter when a resistance is encountered, exaggerated pushing of the stent in calcified and tortuous arteries.
Lost Stent retrieval

- Stents are designed to remain at sites within the vascular system. Might be difficult to remove because of their size and rigidity.

- The first consideration with lost stents is to evaluate if it is possible to deploy the stent at the loss position or to move it to a stable and safer alternate site.

- Weigh the risks associated with the retrieval maneuver, such as permanent vascular wall trauma, vessel peroration or rupture, against the benefit to the patient from the percutaneous procedure.

- The rescue technique used for the retrieval of incorrectly positioned stents depends in great degree on the type of stent involved (self- or balloon-expandable, size, radio-opacity, flexibility, compressibility, rigidity, the radial expansion force.)
Proximal loss of stents:

If stent is lost distally with a wire still across can probably best be left in situ and gradually expanded from low profile to normal ballooning.
If stent is lost proximally, with a wire still across the retrieval of the stent can be attempted by crossing the stent with a small balloon, inflating the balloon distally to the stent and retrieving guiding catheter, balloon wire and the stent all together.

Proximal loss of stents:
Retrieval of lost stent with the “Two Wire Technique”

Dislodged stent on the wire

A second wire is advanced through the stent struts or beside the stent

Twisting the two wires together, the twisted end can trap the stent

Withdraw the two wires with the stent to guiding catheter then the whole system (catheter, wires & stent)
Proximal loss of stents:

If stent is lost proximally without a wire across goose-neck snaring can be attempted to retrieve the stent, leaving a safety wire beside.
Retrieval of coronary stent from left main

F.L., 78 yrs, male
Multivessel coronary artery disease
PCI - LAD: Radial approach
Retrieval of coronary stent from left main

Predilatation at prox and med LAD

Cypher 3.0x 23 mm at med LAD
Retrieval of coronary stent from left main

Second stent Cypher 3.0 x 18 mm for proximal LAD did not advance. The stent became stuck in prox lesion and free of the balloon, but still crossed by the guidewire.
Retrieval of coronary stent from left main

A small balloon (Maverick 2.0 x 15 mm) was advanced on the wire, into the stent. Then balloon was inflated at 6 atm and the whole system (guide cath, guidewire, balloon and stent) was gently pulled back into ascending aorta, to anonymous trunk, to barchial artery and finally to radial artery. Stent was fully deployed in radial artery.
Retrieval of coronary stent from left main

The stent recrossed with guide catheter to complete LAD-PCI

Prox LAD predilatation with a larger balloon

Prox LAD Stenting

Final LAD PCI result
Retrieval of Lost coronary stent

**I Step:**

- Transfer it away from coronary circulation, preferably below the level of the renal arteries
Retrieval of Lost coronary stent

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II Step:
- Remove the lost stent from periferal circulation with retrieval devices.
  - Loop snares is the mostly common used (widely available and easy and safe to use).
Retrieval of Lost coronary stent

- Retrieval of deformed stents can complicate extraction through the femoral sheath creating the risk for femoral artery laceration:

- Potential solutions:
  - Safety wire in femoral artery (through the same sheath used for snaring)
  - Upsizing the femoral sheath
  - A Large sheath in contralateral femoral artery
Retrieval of Lost coronary stent

Alternatively to retrieval of lost stents from peripheral circulation:

- Stent crushing with appropriately sized stent for iliac or femoral artery (deployment of lost coronary stents at this level is rarely used because the much smaller size of coronary stents)

- Allow distal embolization of the lost stent (it usually carries very low risk for complications)

- If radial approach the stent can be deployed at radial artery level
Radial Artery perforation following stent retrieval

Radial artery perforation caused by lost stent retrieval with a snare system treated successfully with a covered stent.
If stent is lost distally with a wire still across can probably best be left in situ and gradually expanded from low profile to normal ballooning.
If stent is lost distally with no wire across can probably best be to crush as distally as possible. It also could be attempted to cross the stent with a guide wire and to expanded progressively to adequate size.
“Late” stent migration !!

Severe ostial LM stenosis

Stent positioning

Stent deployment

Final result
“Late” stent migration !!

40 days later: ostial restenosis .. IVUS: No stent – Intimal Proliferation
“Late” stent migration!!

Stent in distal left femoral artery
Fractured Guide Wires

- Distal soft tip of guide wires is made from a spring coil and might fracture if caught in a coronary lesion or in small side branch. It also could be unravel because it is made of a spring coil.

- Possible Mechanisms of wire tip fracture:
  - Much wire twisting
  - Jialed wire by the stent, especially in calcified lesions
  - Rotablation
  - Damaged and re-used wire

Leaving the guidewire fragment in coronary circulation is associated with a very low risk of thrombosis or other complication, especially if it is located distally or in a small branch.
Fractured Guide Wires

The retrieval of guidewire fragments can be accomplished by:

1- inserting one or two wires next to the fragment and twisting the wires together, the fragment may become entrapped in those wires and removed

2- If a part of the fragment is still in the guiding catheter it could be removed entrapping it between an inflated balloon in the guiding catheter and the wall of the catheter

3- Using a retrieval device such as a snare, if it is located proximally in a large vessel.
Distal loss of wire fragments

Can be left “in situ”: high risk for vessel damage in attempting to remove it by snares.
Guidewire fragment retrieval from LAD:

PCI for prox and med LAD lesions
Guidewire fragment retrieval from LAD:

Fracture of diagonal branch guidewire tip located into the stent in prox LAD.
Guidewire fragment retrieval from LAD:

The fractured guidewire tip was snared and withdrawn.
Retrieval of rotablation wire fragment lost in distal LCX with loop snare

K. Galvick, J Blankenship, Invasive Cardiology 2005
Balloons:

- Rarely balloon dysfunction can occur causing the balloon to become trapped, most likely to occur in fibrocalcified lesions, especially with stent delivery systems.

- Avoid firm pulling back the balloon because it might remove the stent or might damage the balloon catheter (shatf) or fracture.

- In large artery it could be possible to advance the guide catheter into the vessel until it abuts the damage balloon and consequently providing more support to remove the balloon.

- Another option is to advance a second balloon on an additional wire alongside the trapped balloon and to perform several inflations which might help to remove the balloon.

- Rarely, the balloon catheter may fracture. If the proximal end of the fracture fragment is still in guide catheter it could be retrieved inflating a small balloon to trap it to the guide catheter and remove.
Percutaneous Valves

Two different valves are currently used:

- Self-expandable
- Balloon expandable

- Different characteristics and different deployment techniques
- Retrograde embolization of Core Valve (in LV) have never been reported
- Cor Valve can be completely retrieved out of the body (until 1/3 of the valve is still in the delivery sheath)
Percutaneous Valves

Causes of Valve embolization:

- Imaging: poor visualization
- Pacing: Ineffective reduction of trans aortic flow and cardiac motion (Edwards)
- Slow balloon inflation: allows balloon movement
- Positioning: Insufficient stent fixation by annulus and native leaflets
- Undersizing: valve diameter < annulus diameter
- Interference of cardiac structures (subaortic stenosis, ...)

You can try again if the problem is sizing or pacing
If mechanical problem: stay away, rediscuss and decide..
CoreValve ReValving System

Reposition of the valve
CoreValve ReValving System

Retrieval of the valve

At 2/3 of implantation
Migration of Core Valve
Percutaneous Retrieval of Core Valve

G. Sculler, TCT-MD.com, 2010
Dislodgment of a Sapien-Edwards Valve
Dislogment of a Sapien-Edwards Valve

Ascending Aorta

Aortic Arch

Thoracic Aorta
Migration of Sapien-Edwards Aortic valve into LV

T.R. 84 yrs, male, Previous CABG, Calcified severe aortic stenosis

Valve positioning
Migration of Sapien-Edwards Aortic valve into LV

Soon after deployment: acceptable result

At subsequent controls: Moving down ...

Two minutes later the valve was completely free in LV.

Surgical removal and conventional aortic valve replacement
Septal Occluders

Device embolisation (Risk varies 0.5-1%)

✓ Causes:
  ✓ Undersizing
  ✓ Improper deployment

✓ Try to avoid by:
  ✓ Gentle wiggle
  ✓ Constant pull and push
  ✓ When device is not parallel to septum, recapture and redeploy
Ampalzer retrieval from Left PA

S.G., 57 yrs, male - Obstructive Cardiomyopathy

Septal Myomectomy, Carpentier Anulus for mitral valve - Post-surgery VSD
Ampalzer retrieval from Left PA

Five minutes later ....

Amplazer embolized to left PA

Left PA angio confirms the location in left PA
Ampalzer retrieval from Left PA

Amplazer snared and pulled back to RV

..to inferior cava

..and into the sheath
Every interventionalist will, at some time or another, be confronted with the problem of device loss, fractured, or migrated.

First Rule: Do your best to prevent device loss during percutaneous procedures. (Adequate lesion or vessel preparation, adequate sizing, adequate support when difficulties can be predicted)

Evaluate first if the lost device can be left in situ with less risk for patient than the removal procedure.
Several approaches and devices for endovascular foreign bodies percutaneous retrieval, the most commonly used is the loop snare technique (easy and safe)

Until patient is stable, do not panic; watch carefully and evaluate the most convenient, easy and safe strategy.

Not all lost devices can be retrieved percutaneously or left in situ; then surgery is mandatory (intracardiac migration valves, occluder devices..)
Thank you for your kind attention