How to manage device embolization?

Swiss Fellow Course Interventional Cardiology

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Definitions

Coronary interventions:
• Stent loss: stent dislodgment from delivery balloon catheter which may lead to embolization

Structural interventions:
• Embolization/migration: acute or late movement of a device from its implantation site
STENT LOSS
Stent loss

• Failure to deliver a stent to the target site occurs in 4-8% of coronary procedures
• As a consequence, the undeployed stent needs to be retrieved into the guiding catheter
• This may lead to stent dislodgement from the delivery balloon catheter and subsequent stent embolization
Stent loss

• Incidence:
  – 1-3% in series in 1990s
  – 0.2-0.5% in more recent series

• Outcome:
  – Mortality 4%
  – MACE 19% (death, MI, CABG, CVA, bleeding)
Favoring factors

• Moderate to severe vessel calcification
• Proximal tortuosity/angulation
• Incomplete lesion preparation
• Insufficient guiding catheter and/or guidewire support
• Advancing or retrieving a stent through a previously placed one
• Retraction of undeployed stent into the guiding catheter
• Use of longer stents
• Use of manually crimped stents
Treatment

Small-balloon technique

Double-wire technique

Fassa AA, Roffi M. In: Mukherjee D, Bates ER, Roffi M, et al. (Eds.), *Cardiovascular catheterization and intervention* 2010
Where is the lost stent?

Can you retrieve with small balloon or double-wire?
- yes
- no

Can you crush or deploy it?
- yes
- no

Call surgeon

Coronary

Can you retrieve it easily?
- no
- yes

Can you leave it?
- yes
- no

Peripheral

Can you? yes

no
Stent loss prevention

- Don’t shove the stent down the artery if it doesn’t advance!
- Prepare lesion correctly (predilate, rotablate)
- Improve support (stiffer wire, buddy wire, guiding support, mother-and-child technique)
- Check proper alignment between guiding and stent during retrieval
DEVICE EMBOLIZATION DURING PFO/ASD/LAA CLOSURE
Incidence

• PFO closure: ≈1%

• ASD closure: 1.2-2.4%

• LAA occlusion: 3.9%
Causal factors

- PFO: atrial septum aneurysm, thick septum secundum, long tunnel
- ASD: inadequate sizing (sizing balloon with TEE!), large ASD (>38 mm), lack of rim (<5 mm)
- LAAO: inadequate sizing (under and oversizing), inadequate hydration (unexpanded LAA), shallow landing zone, incorrect device apposition
LAAO device embolization

Fig. 2. Timing of embolization.

Fig. 3. Anatomical location in case of embolization.

Aminian A et al., Catheter Cardiovasc Interv 2015
LAAO device embolization

- Percutaneous retrieval:
  - Snare 6 cases
  - Biotome 1 case
  - N/A 10 Cases

Aminian A et al., *Catheter Cardiovasc Interv* 2015
Device embolization during PFO/ASD/LAA closure

• Size correctly! (importance of TEE guidance)
• Plan retrieval through antegrade or retrograde approach according to embolization site
• Use snare or biotome for retrieval
• Try to catch the central screw button with the snare, if not possible use biotome
• For retrieval, use an equivalent or larger sheath than the delivery sheath
• If you’re stuck, call the surgeon!
DEVICE EMBOLIZATION DURING TAVI
Valve embolization

• Incidence: 0.1-1.3%
  – SAPIEN: 1.0% before 2013, 0.1% in PARTNER-2 trial, 0% in SAPIEN-3
  – CoreValve: 2.3% before 2013, 0% in US CoreValve trial
• Associated with high 30-day mortality (27% in PARTNER-1)
• Mechanisms:
  – Implantation of an undersized valve
  – Incorrect positioning (too high or too low)
  – Balloon-expandable valves: rapid pacing terminated before complete deflation of the balloon
Prevention

• Adequate visualisation of the native aortic valve plane (with alignment of the 3 cups) before valve implantation

• For balloon-expandable valves, always verify the efficiency of rapid ventricular pacing before implantation, and ensure that the balloon is completely deflated before pacing is terminated.
Treatment

• Depends on
  – type of implanted prosthesis
  – the site of final deployment
  – the potential haemodynamic consequences
• Self-expanding valves: snaring
• Balloon expandable valve:
  – Aortic migration: retrieval in descending aorta
  – Ventricular migration: surgery, transapical extraction, balloon recapture & repositioning
Fassa AA et al., *Nat Rev Cardiol* 2013
Fassa AA et al., *Nat Rev Cardiol* 2013
Outcome of Patients After Transcatheter Aortic Valve Embolization

Edgar L. W. Tay, MD,* Ronen Gurvitch, MD,* Namal Wijeysinghe, MD,* Fabian Nietlispach, MD,* Jonathon Leipsic,* David A. Wood, MD,* Gerald Yong, MD,† Anson Cheung, MD,* Jian Ye, MD* Samuel V. Lichtenstein, MD,* Ronald Carere, MD,* Christopher Thompson, MD,* John G. Webb, MD*

Conclusions Clinical outcomes remain good when THV embolization is managed effectively. There are no apparent hemodynamic consequences of a second valve placed in the series. These embolized valves remain in a stable position with no evidence of strut fractures at mid-term follow-up.

JACC Cardiovasc Interv 2011
DEVICE EMBOLIZATION DURING OFF-LABEL COMPASSIONATE (=CRAZY) INTERVENTIONS
• 42 year-old patient operated 5x for mitral valve replacement
• Severe mitral prosthesis stenosis
• Acute heart failure with shock and multiple organ failure
• Decision to perform emergency transseptal mitral valve in valve implantation

Fassa AA et al., *EuroIntervention* 2013
Successful transseptal implantation of a Sapien XT valve under ECMO
Implantation of a second Sapien XT valve (with additional contrast)
Final result

- Good final result of the “second” valve (mean gradient 3 mmHg, grade I regurgitation)
- “First” valve moving freely in the left atrium
• Overall favourable evolution during the 2 weeks following the procedure, with weaning from mechanical ventilation, ECMO and inotropes

• However, on the 14\textsuperscript{th} day after the procedure, abrupt recurrence of heart failure due to entrapment of the mobile valve in the implanted valve in a reverse position
New emergency procedure to dislodge the entrapped valve
LAA occlusion with a SAPIEN XT valve...
« Nature is the best physician. It cures three-quarters of the diseases and never speaks ill of its colleagues. »

*Louis Pasteur*
Conclusion

• Device embolization during cardiac interventions is rare.
• Interventionists should rely on multi-modality imaging during structural interventions, which allows planning, preparation and guidance of the procedure as well as adequate device sizing, in order to decrease the occurrence of this complication.
Conclusion

• Operators must be familiar with the appropriate treatment strategies in case of embolism of the device they implant in a patient.

• Asking for help from a surgeon is never shameful, it may actually save the patient!
Thank you!
General management of device embolization

1. Can you retrieve the device?
   - Yes: Retrieve it
   - No:
     - Can you leave the device where it is?
       - Yes: Leave it
       - No:
         - Can you move the device to somewhere less harmful?
           - Yes: Move it
           - No: Call surgeon
DEVICE EMBOLIZATION DURING STRUCTURAL PROCEDURES
Percutaneous Rescue of Embolized Valve in LA

Rescue with a 30 mm Amplatzer Septal Occluder Device

Courtesy of Dr William O’Neil & Dr Mayra Guerrero
Left Ventricular Embolization of an Aortic Balloon-Expandable Bioprosthesis

Balloon Capture and Reimpaction as an Alternative to Emergent Conversion to Open-Heart Surgery

Dumonteil N et al., JACC Cardiovasc Intervention 2013