Longitudinal deformation of contemporary coronary stents: A single center experience

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ICE 2012
14-15 Dec. GRAND SERAI HOTEL, Giannena, Greece
Contemporary new generations of drug eluting stents are designed with thinner struts to give better delivery and conformability.

This added advantage is at the expense of longitudinal strength and stability whereby more longitudinal stent deformation cases are reported.
Longitudinal stent deformations (LSD) were defined as fluoroscopically visible longitudinal shortening of the implanted stent with concertina-like stent-strut crowding/deformation.

The magnitude of this phenomenon has not been systematically studied.
Flexibility

Axial Strength
Figure 1. Intrication of various mechanical properties of stent platforms. The longitudinal compressive strength can become an additional criterion required in the selection of stents. It depends on the three-dimensional stent design, strut thickness, strut width and the alloy used with its intrinsic elastic modulus.
Figure 2. Stent designs evaluated for the longitudinal compression behaviour and their classification into four different families.
Compression Mechanism

- Cypher: 34.8% (23 mm)
- Promus Element: 39.1% (23 mm)
- Resolute Integrity: 15.4% (26 mm)
- Taxus Liberté: 30.4% (23 mm)
- Xience Prime: 18.2% (22 mm)

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Figure 7. Diagram demonstrating mechanism of proximal stent edge deformation by balloon catheter or other device, as a result of guidewire bias. Illustration for information purposes, not indicative of actual size or clinical outcome.
Figure 5. *Longitudinal compression under a clinically relevant force of 50 gf (bare metal versions of these platforms were used for testing)*
Improved radiopacity with the PtCr Stent Series allows for easier identification of stent deformation compared to other, less visible stents.
The aim of this study was to assess the incidence, possible causes, the management, and the clinical impact of LSD at our institution.
Methods

- The number of interventional procedures performed and the total number and type of stents deployed between January 2009 and May 2012 were recorded.

- The rate of stent deformation was estimated by dividing recorded cases of deformation by the number of implanted stents for each platform during the study period.
During the study period a total of 1219 percutaneous coronary interventions were performed at our institution with a total of 2416 stents implanted (1.98 stents per procedure).

The most frequently used stents were Promus Element (45.1%) and Xience/Promus (24.8%). Three cases of LSD were identified representing 0.24% of cases and affected 0.12% of stents deployed.
The rate of stent deformation varied from 0% in several stent types to 0.55% in the case of the Promus Element stent.

There were several mechanisms for this complication including compression by post-dilatation balloons in two patients and guide catheter in one patient.

Wire bias was identified as a predisposing factor for LSD in 2 cases. All patients were treated with post-dilatation and/or additional stenting.

No adverse events occurred at a mean follow-up of 5.2 months.
CASE 1

✓ 56 years old man
✓ History of MI (inferior) 1995
✓ PCI 1998 LAD (bare metal stent), RCA total occlusion
✓ Recent hospitalization for unstable angina
After removal of the jailed guide wire in diagonal branch and intubation of guide catheter
Promus Element 4.0X12mm
The patient is asymptomatic at F/U
CASE 2

51 years old man

Risk factors: Hypertension, hyperlipidemia, positive family history

Positive stress test
Mini-crush technique

D1: Promus element 2.5X20mm
LAD: Promus element 2.75X20mm

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Quantum 3.0X15mm for post-dilatation
Kissing balloons and post-dilatation with Quantum 3.5X8mm
The patient is asymptomatic at F/U
Case 3

74 years old man

Risk factors: Hypertension, diabetes, smoking

Recent hospitalization for ACS
Promus Element 2.5X28mm
Quantum 2.75X12mm for post-dilatation
The patient is asymptomatic at F/U
Conclusion

Longitudinal Stent Deformation is a rare but emerging issue related to newer design DES and can occur secondary to a variety of mechanisms and identification is important as, left untreated, it may be associated with a risk of stent thrombosis.
In our practice LSD was a rare observation only seen with the Promus Element stent (this could bias against stents with improved radioopacity). Interventional cardiologists should be aware that longitudinal distortion can happen, and should incorporate simple strategies into their routine practice to lessen the likelihood of it occurring.
Ευχαριστώ για την προσοχή σας !!!

Force-strain testing system FMT-310A5 from Alluris GmbH, Freiburg, Germany.