Optimal Stent Deployment in the DES Era

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Is there a role for “bigger is better” in drug eluting stents?
Optimal Stent Area (IVUS) and Restenosis in DES.

IVUS Stent area and Outcome at 6 months.

319 Cypher lesions

- TLR
  - Minimal stent CSA (mm²)
  - <6: 5.7, P=0.03
  - 6-7.5: 0
  - >7.5: 0

- MACE
  - Minimal stent CSA (mm²)
  - <6: 8
  - 6-7.5: 2, P=0.10
  - >7.5: 1.5
2,575 patients were treated with 4,722 Cypher stents.
21 (0.8%) had stent thrombosis of whom 15 had IVUS
12/15 SES thrombosis lesions has stent CSA <5.0mm² (vs 13/45 controls)
First Conclusion

“Bigger is better”
is valid in drug eluting stents

A minimum area > 5.5 mm²
is associated with less restenosis and
less thrombosis
What Pressure is necessary for optimal stent expansion?
Cypher Stents: Deployment Pressure and Optimal Stent expansion.
WHC: Cheneau et al. CCI 2005;65:222-6

Full Expansion (Music Criteria)

P=0.001

Minimal Stent CSA

14 atm  20 atm

8/53 (15%)

32/53 (60%)

14 atm  20 atm

5.0 ± 1.3  6.4 ± 1.7

+29%
Stent Expansion

WHC: Javaid et al. CV Revasc Medic 2006; 7:208-211

% Unexpanded by Music Criteria

14 atm

20 atm

Cypher

Taxus
A fully expanded balloon does not insure that the stent is fully expanded
Focal ISRS

Balloon fully expanded. (20 atmospheres)

DES for Focal ISRS.
Unexpanded Stent after 20 atm.
IVUS-Guided Stenting

Comparison of IVUS and QCA post-stent + adjunct PTCA
(N=616)

r=0.145, p=0.0027
Second Conclusion

High pressure is required for full stent expansion.
Optimal stent expansion can only be proven with IVUS.
Non compliant balloon required for rigid plaques.
Stent Length
is best defined by IVUS
<table>
<thead>
<tr>
<th>First Lesion</th>
<th>Reference</th>
<th>Second Lesion</th>
<th>Distal Vessel</th>
</tr>
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<td><img src="image2.png" alt="Reference Image" /></td>
<td><img src="image3.png" alt="Second Lesion Image" /></td>
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<td><img src="image11.png" alt="Second Lesion Image" /></td>
<td><img src="image12.png" alt="Distal Vessel Image" /></td>
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Lesion Length: IVUS vs QCA

WHC: Mintz et al 1996

Lesion length by QCA has very poor correlation with the true lesion length by IVUS

WHC. Mintz et al
Third Conclusion

IVUS guidance allows for better definition of lesion length, and stent length.
Implications of Stent Malapposition
• **Stent Malapposition has no Clinical Consequences:**
  – MY Hong. Circulation
  – Sirius Trial
  – Taxus Metanalysis
  – WHC SES series
  – Hoffman, Heart 2007

• **Stent Malapposition can lead to Stent Thrombosis:**
  – Cook
  – Ge
Early vs. Late Incomplete Apposition in DES

29 months follow up in 195 DES (175 SES + 20 PES) with IVUS at 6-8 months

5.1% with acquired malapposition: due to positive remodeling
Malapposition of portions of the stent occurs in \( \pm 12\% \) of cases.

Malapposition (mild to moderate) has no clinical consequences in the first 12 months. Long term outcome still undefined. Late acquired malapposition has more events.

Full stent Expansion more important than Malapposition.
Vessel Size Remodeling.
Positive Remodeling:
large plaque mass.
plaque is soft.
more likely to have thrombus.
associated with higher CRP.
More common in young people.
Very common in acute coronary syndrome.
More common no reflow during PCI.

Negative Remodeling:
less plaque mass
plaques are fibrotic.
less likely to have thrombus.
Vessel Remodeling and ISRS

Okura et al. JACC 2001, 37: 1031-35

Positive Remodeling

Intermed. or Negative Remodeling
Remodeling and RS in DES.

ASPECT (ASian Paclitaxel-Eluting Stent Clinical Trial)
236 patients with mild (<50%) LMCA stenosis by angiography
Fifth Conclusion

Lesions with positive remodeling have more restenosis. Strategies to minimize restenosis are most important in this group.
Calcified Lesions and Ostial Lesions
IVUS of LAD
Sixth Conclusion

IVUS:

Finds unsuspected severe calcification. Permits optimal planning and outcome of stenting in ostial and bifurcation lesions. Unfavorable lesions are not dilated and are sent for surgery.
Stent expansion to at least 5.5 m$^2$ has less restenosis and less thrombosis.

Need for high deployment pressure.

Adequate Expansion is different from Malapposition

Early Malapposition not proven to have clinical consequences. Late acquired malapposition has more events.

IVUS allows optimal stenting of calcified, ostial and bifurcations lesions.