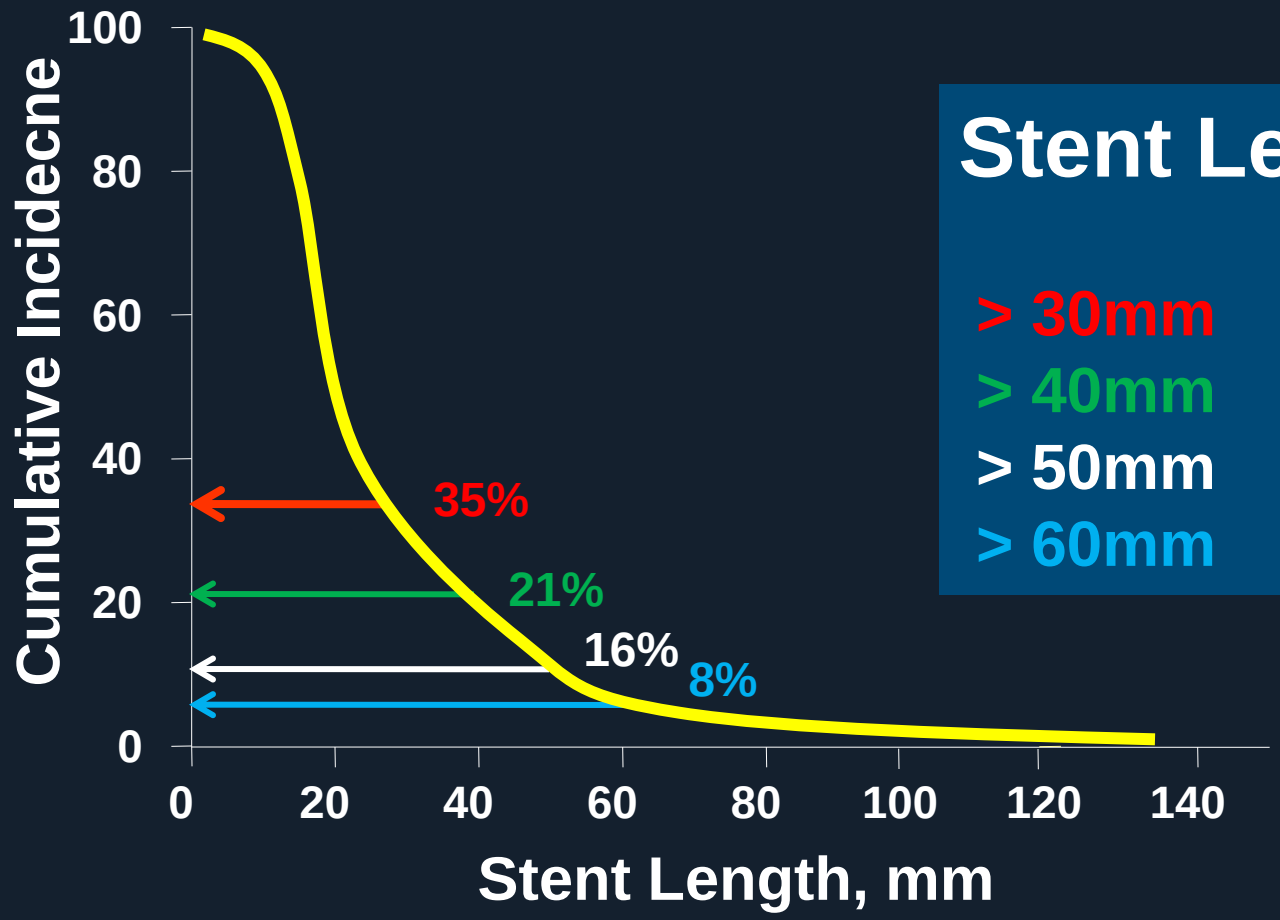
# Tandem Lesions Evaluation

Jung-Min Ahn, MD

Heart Institute, University of Ulsan College of Medicine
Asan Medical Center, Seoul, Korea

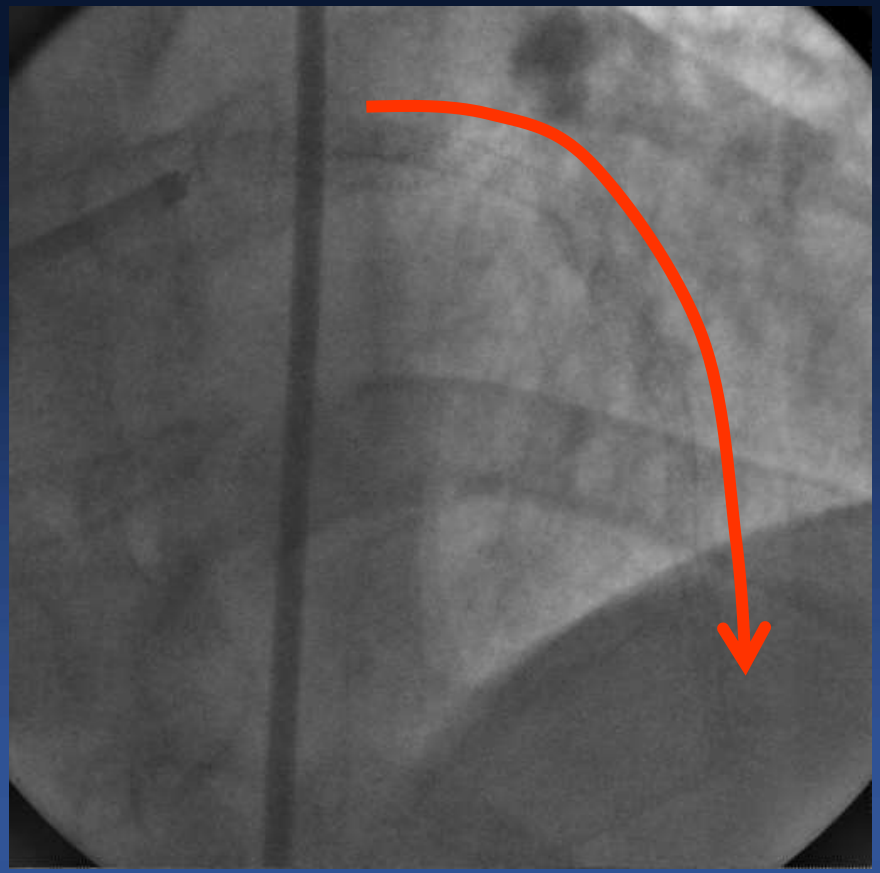
# Incidence of Long Stenting



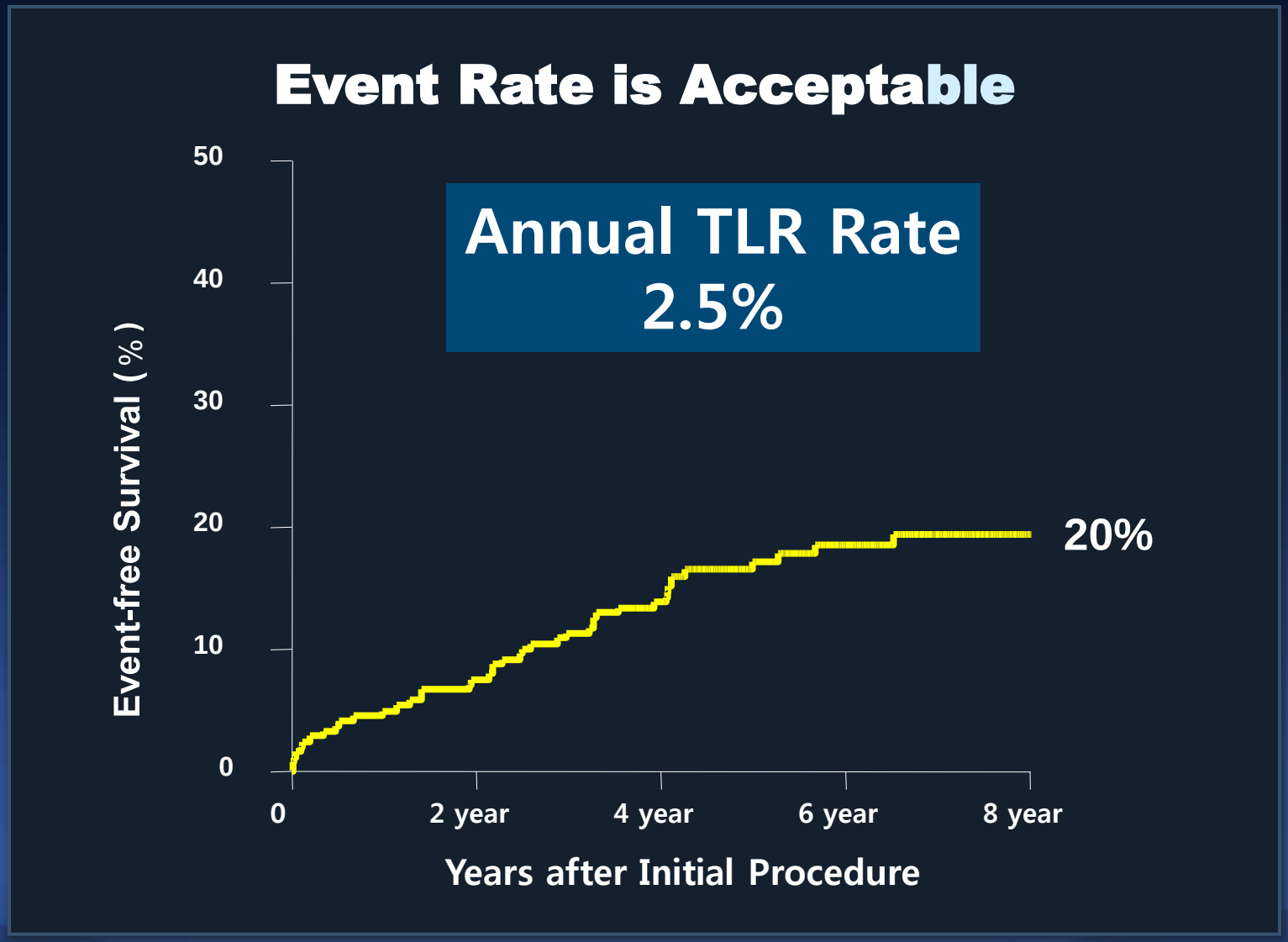

Data from IRIS DES registry

# “Full Metal Jacket”

**Multiple or overlapping stent implantation**

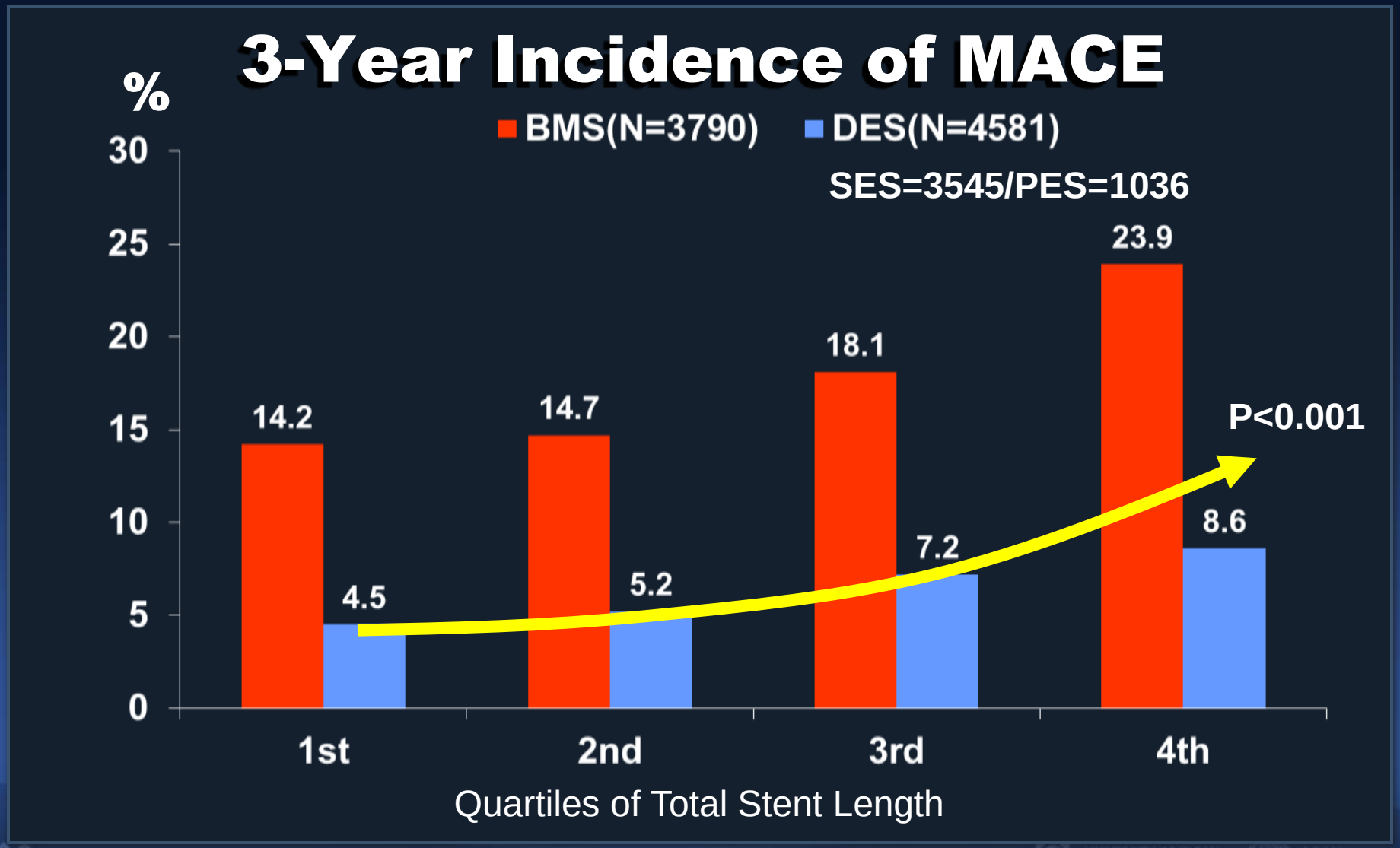


# 8 Year Follow-up of FMJ




Lee CW, Park SJ, et al, CCI. 2014 Sep 1;84(3):361-5.

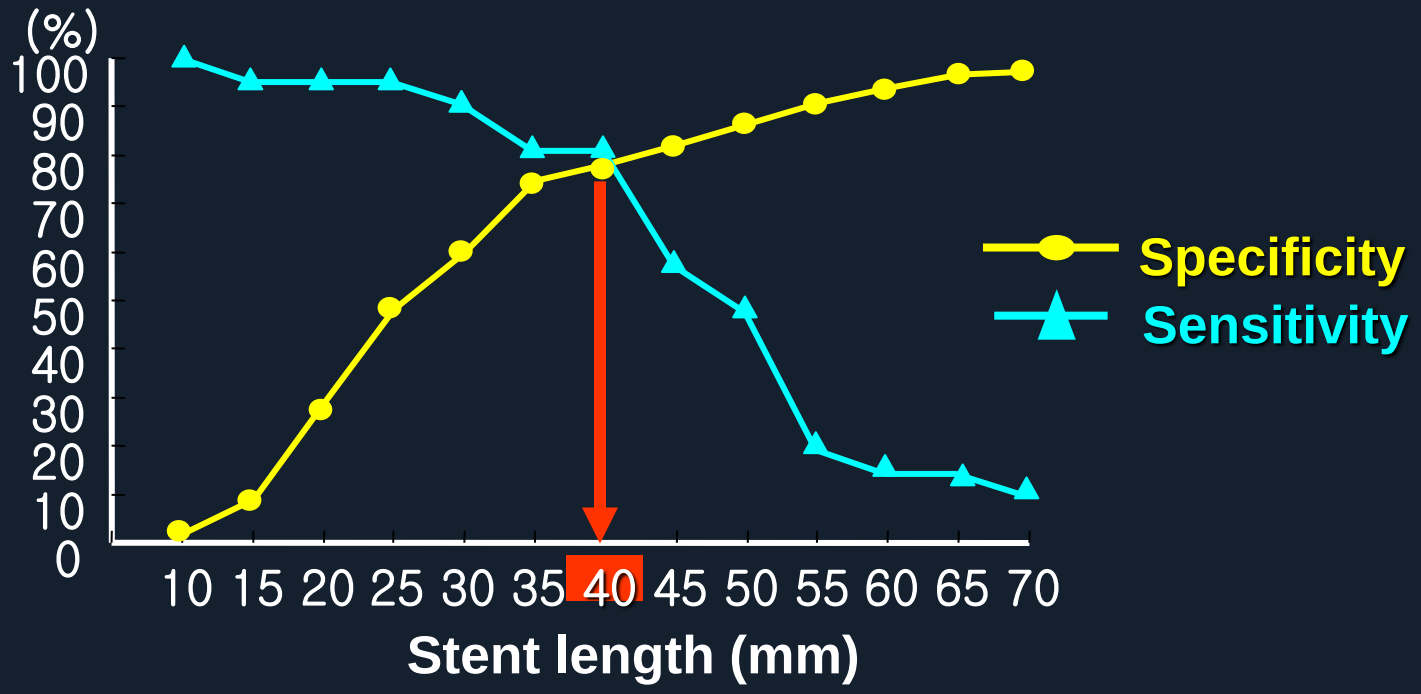
# Stent Length and Outcomes




*Data from ASAN PCI registry (Year 1997-2006)

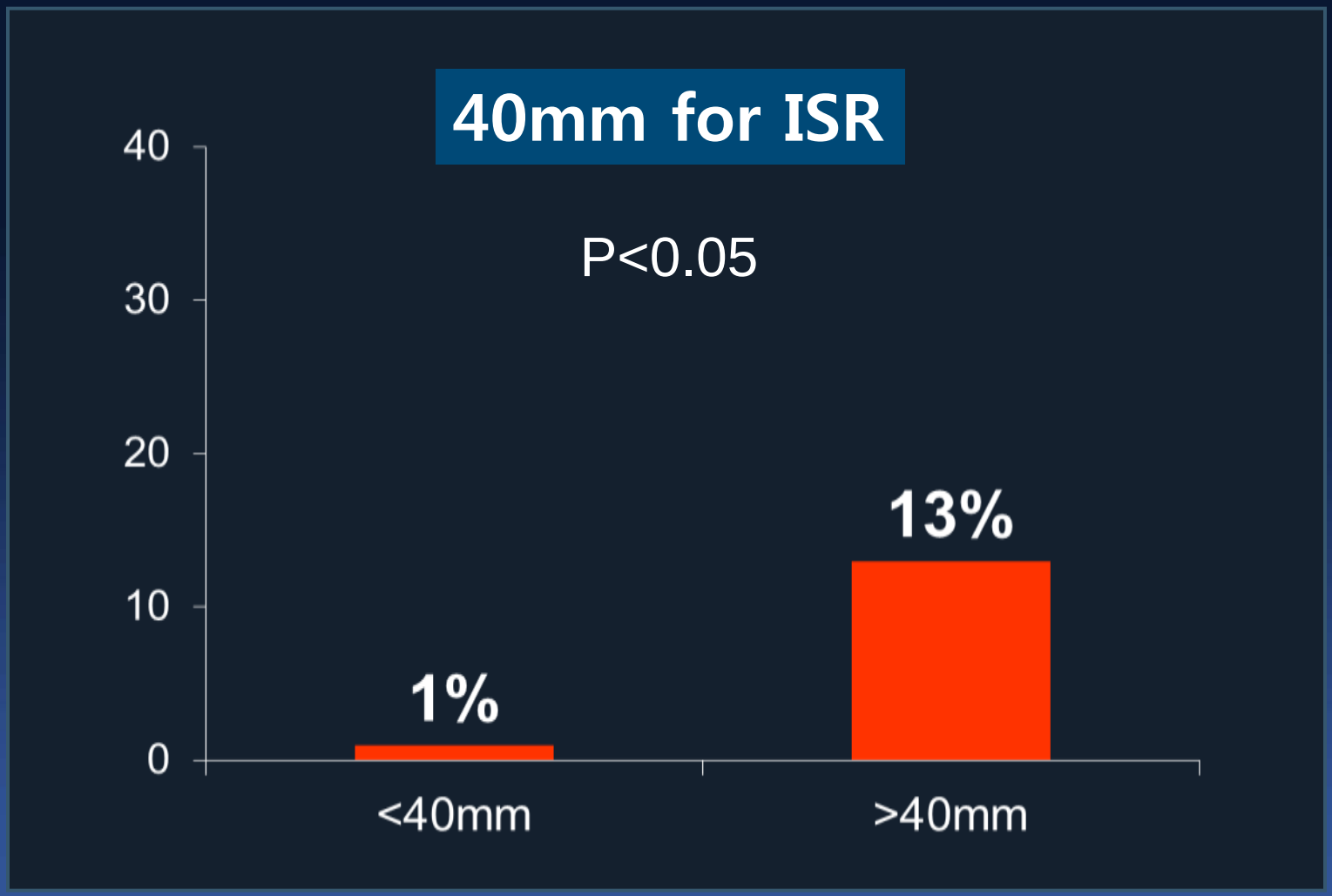
# How Long?

## *Stent Length 40 mm By IVUS*



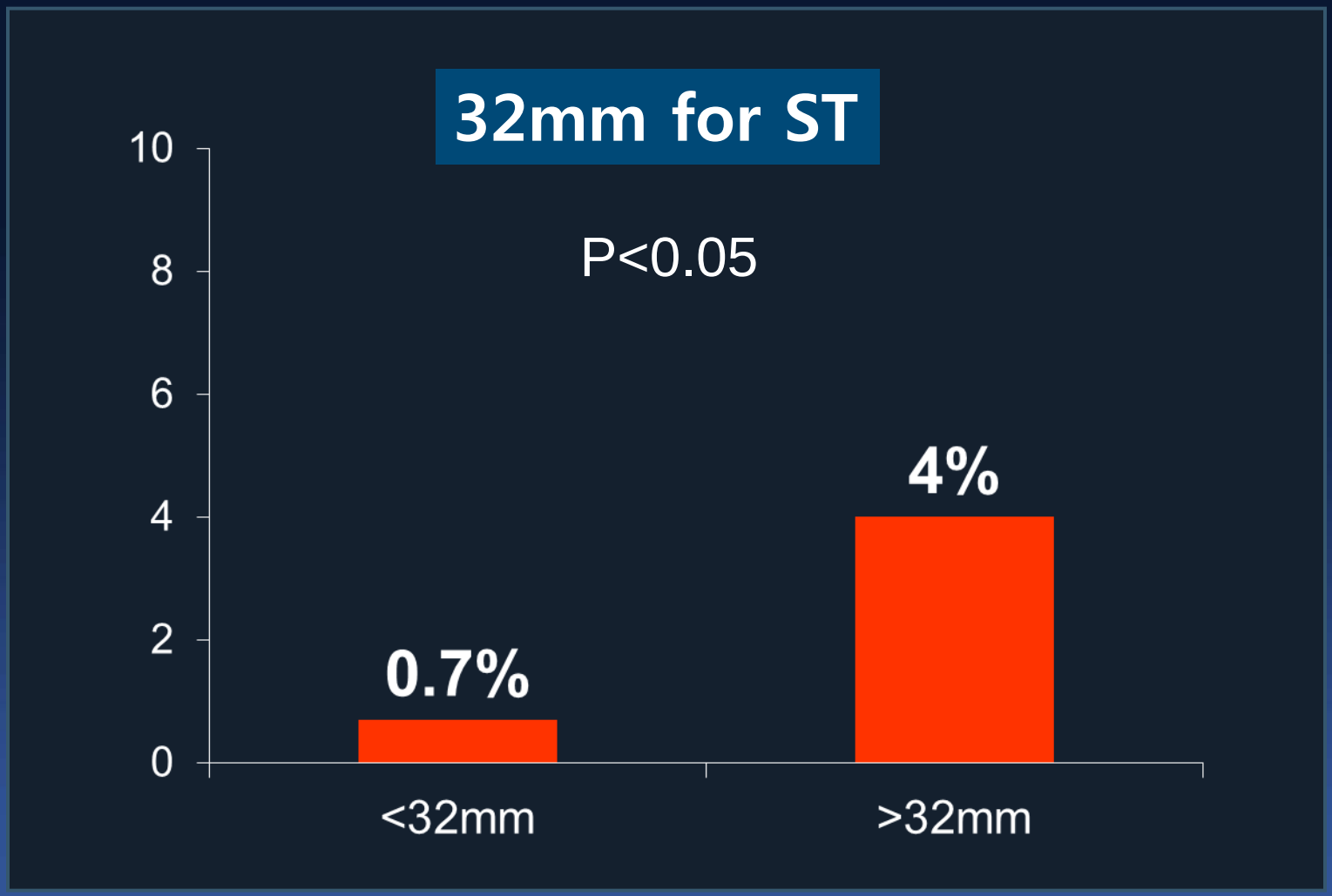

Hong MK, Park SJ, et al. Eur Heart J 2006 Jun;27(11):1305-10

# How Long? In-Stent Restenosis




Hong MK, Park SJ, et al. Eur Heart J 2006 Jun;27(11):1305-10

# How Long? Stent Thrombosis

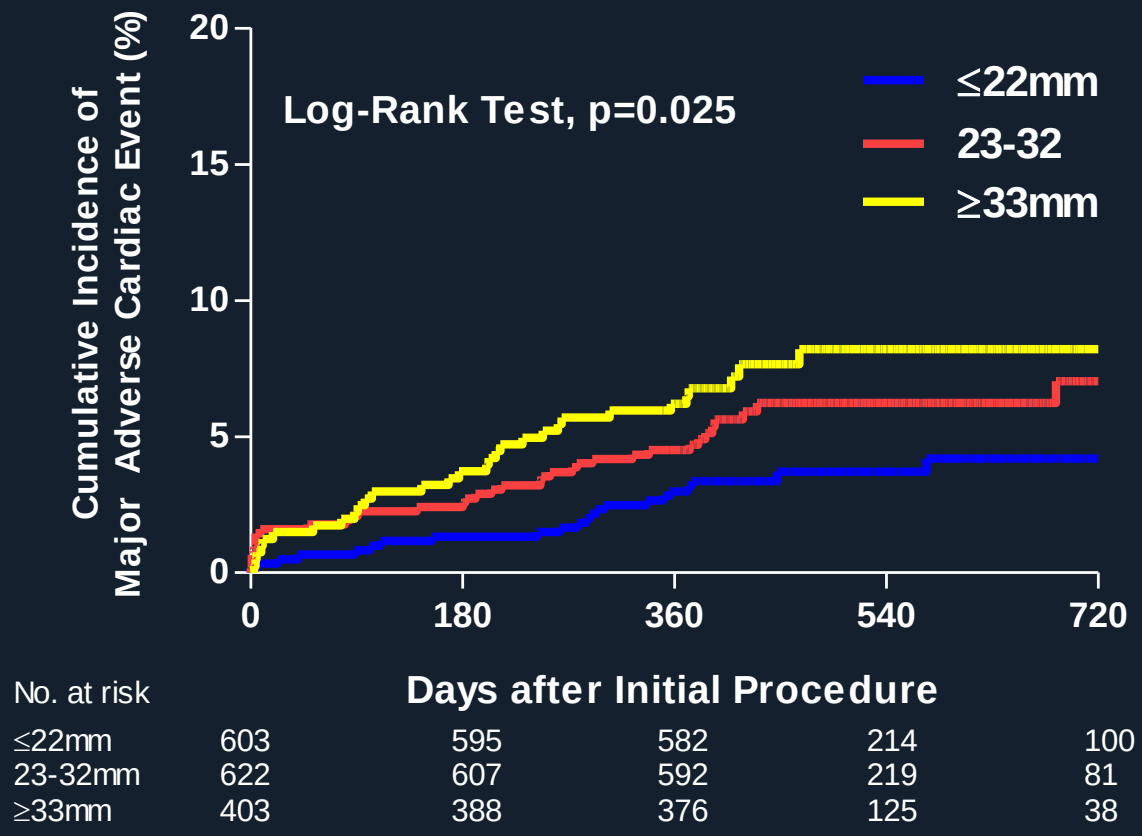



Suh J, Park SJ, et al. JACC Cardiovascular interventions 2010;3:383-9

# One Longest Stent (38-40mm) is Effective and Safe

# IVUS Utilization Modify the Stent Length Effect On Clinical Outcomes

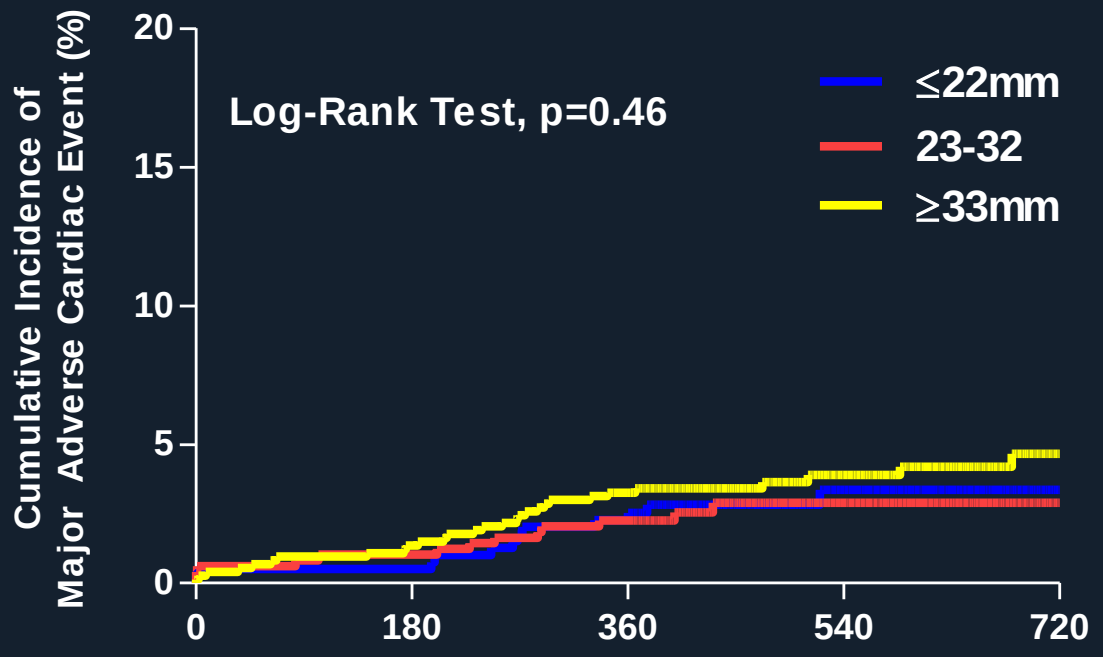
## Without IVUS




Ahn JM, Park SJ et al. Am J Cardiol 2013;111:829-35

# IVUS Utilization Modify the Stent Length Effect On Clinical Outcomes

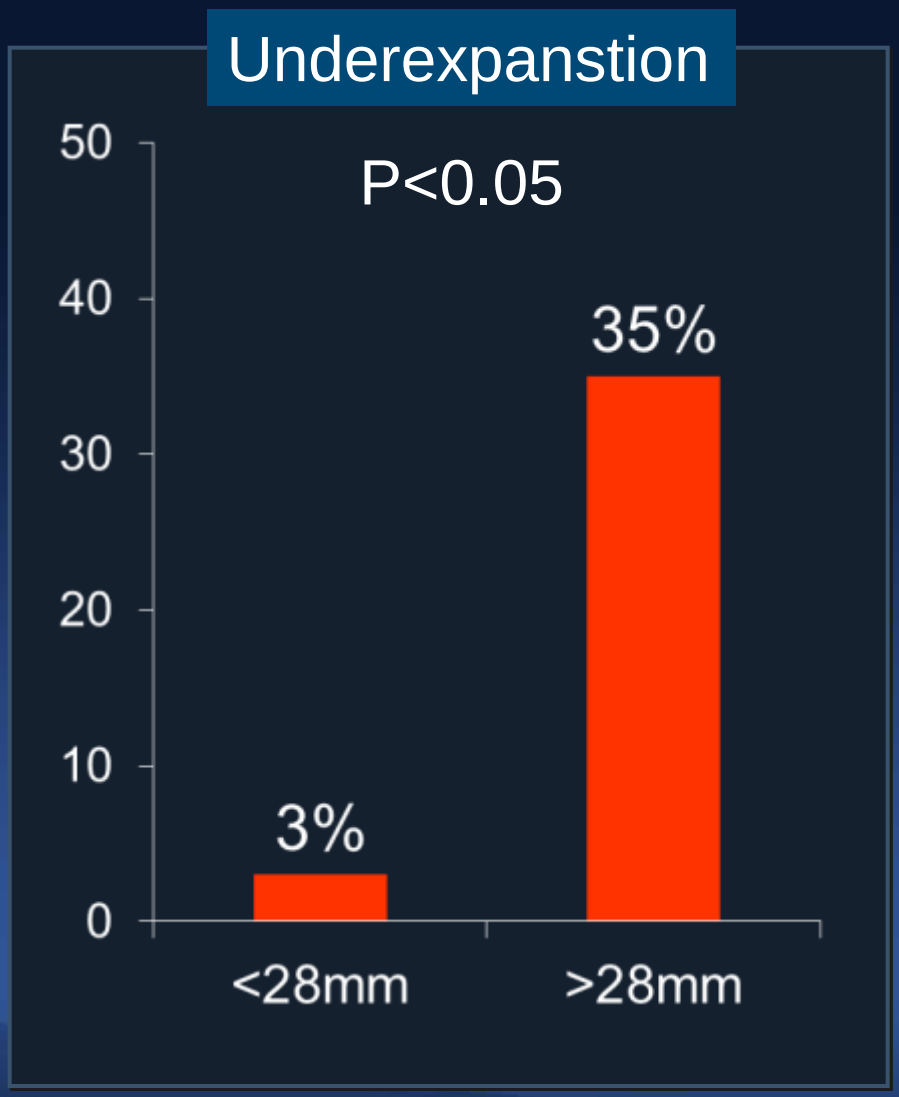
## With IVUS

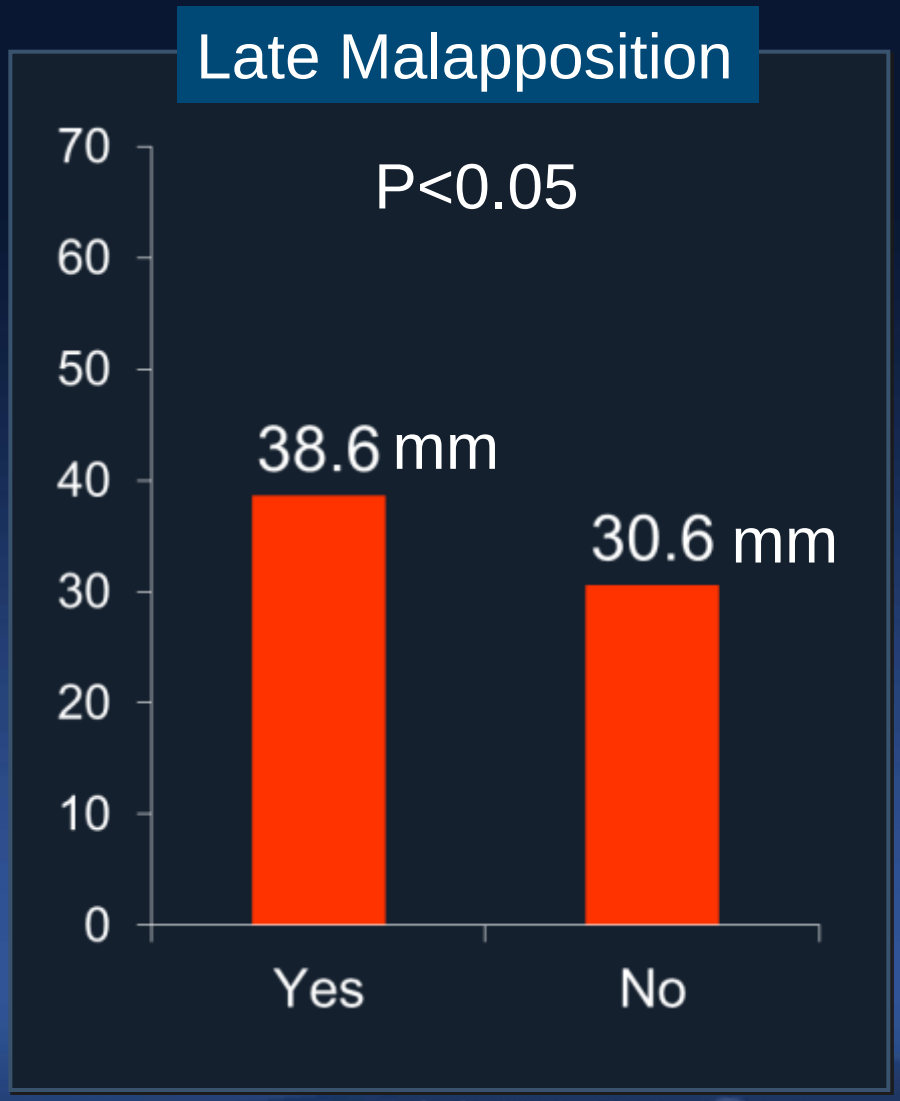



| No. at risk | | | | | |
|---|---|---|---|---|---|
| ≤22mm | 395 | 393 | 386 | 169 | 55 |
| 23-32mm | 487 | 482 | 476 | 221 | 72 |
| ≥33mm | 734 | 724 | 709 | 355 | 116 |

Ahn JM, Park SJ et al. Am J Cardiol 2013;111:829-35

# Stent Length and Optimal Stenting



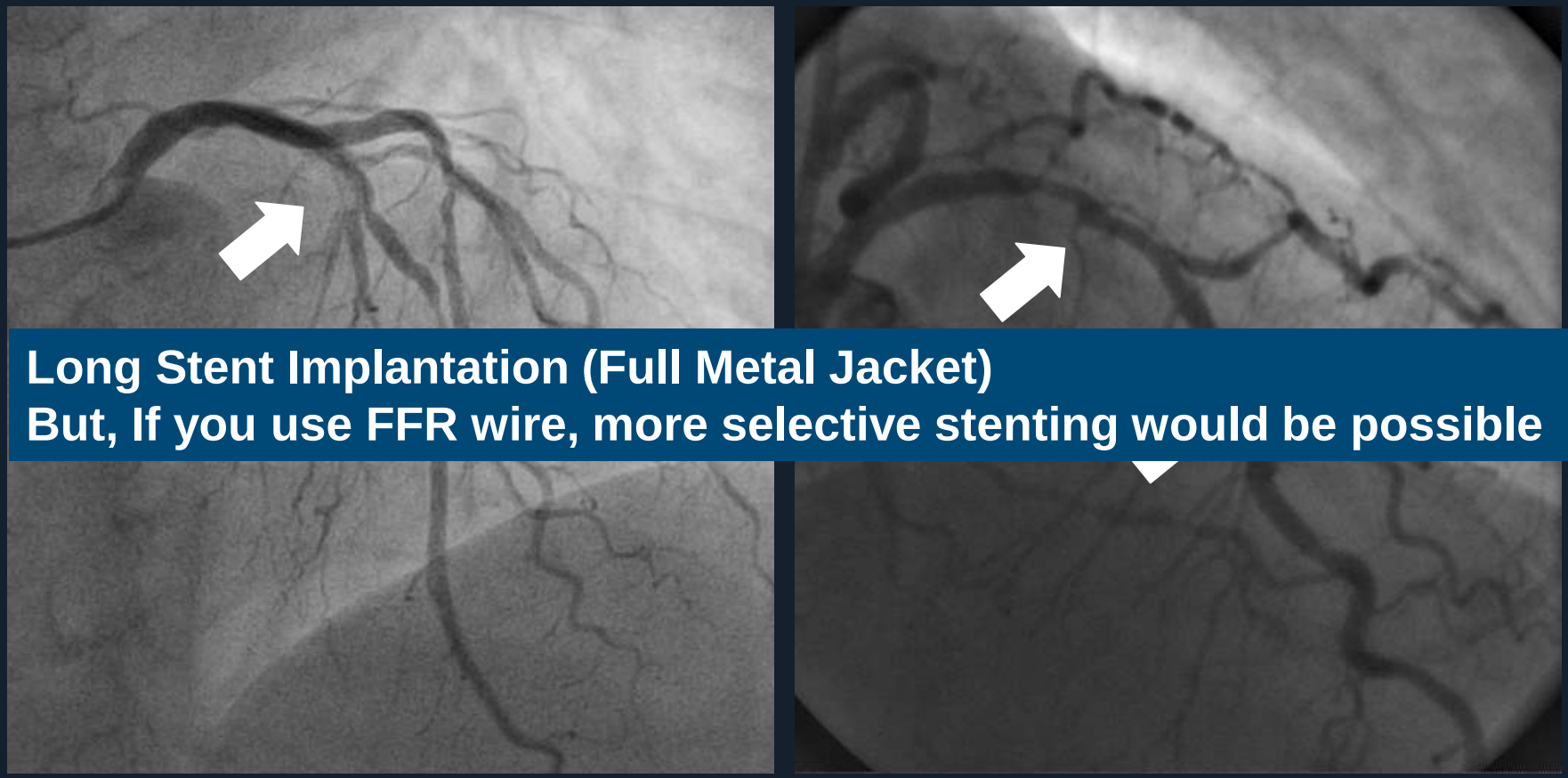




Kang SJ, et al Circ Cardiovasc Interv 2011;4:9-14

Hong MK, et al Circulation 2006;113:414-419

# Tandem Lesions

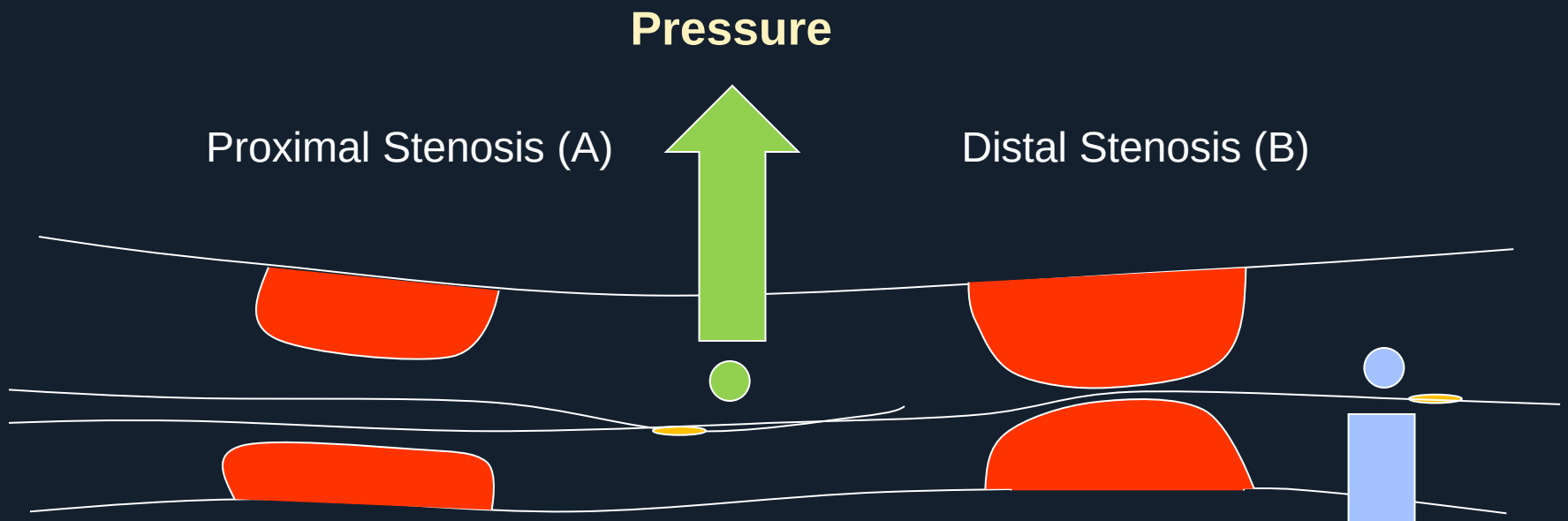
**Multiple stenoses in series along one coronary artery**



**Long Stent Implantation (Full Metal Jacket)**
**But, If you use FFR wire, more selective stenting would be possible**

Park SJ, Ahn JM, et al Am J Cardiol. 2012 Dec 1;110(11):1578-84

# Hemodynamic Interaction in Tandem Lesion

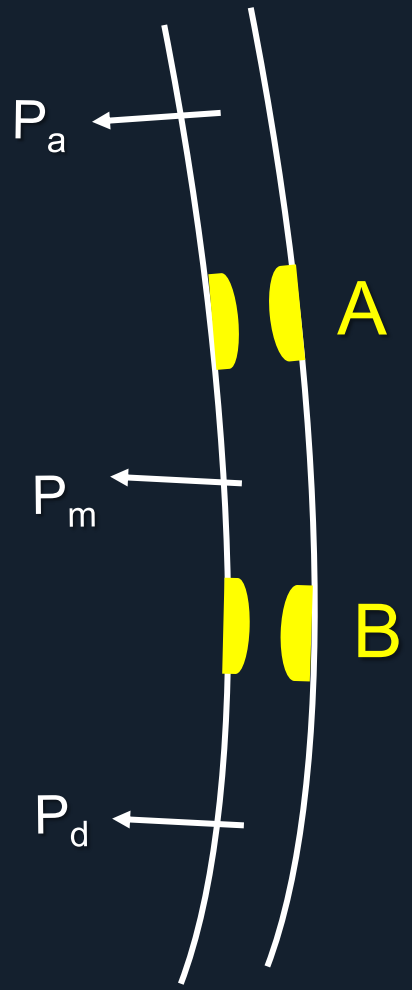



To measure FFR of Proximal Stenosis

$$FFR = \frac{Pd}{Pa}$$

FFR value of proximal stenosis should be underestimated

# The Separate Functional Significance of Tandem Stenoses



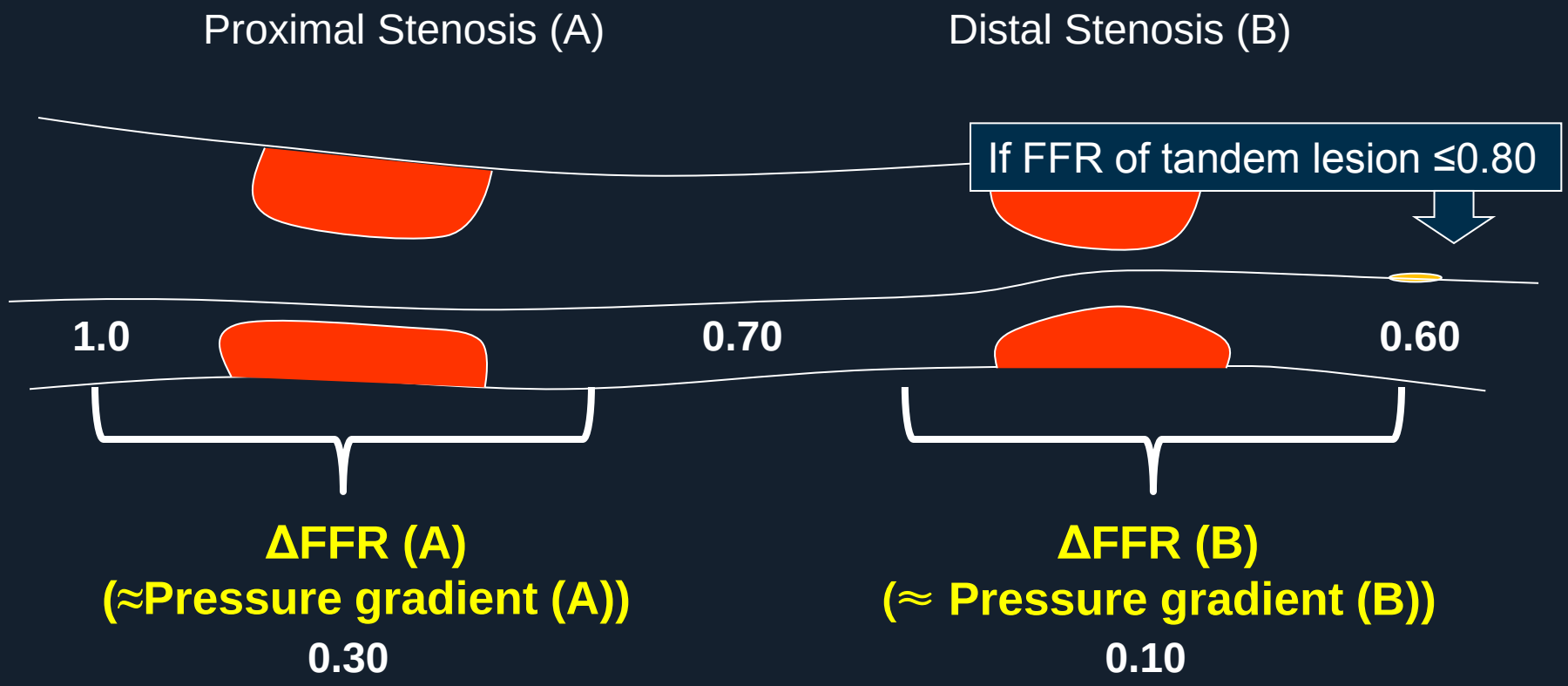

$$FFR(A)_{pred} = \frac{P_d - (P_m/P_a)\,P_w}{P_a - P_m + P_d - P_w}$$

$$FFR(B)_{pred} = \frac{(P_a - P_w)\,(P_m - P_d)}{P_a\,(P_m - P_w)}$$

**$P_w$ = Coronary occlusive pressure**

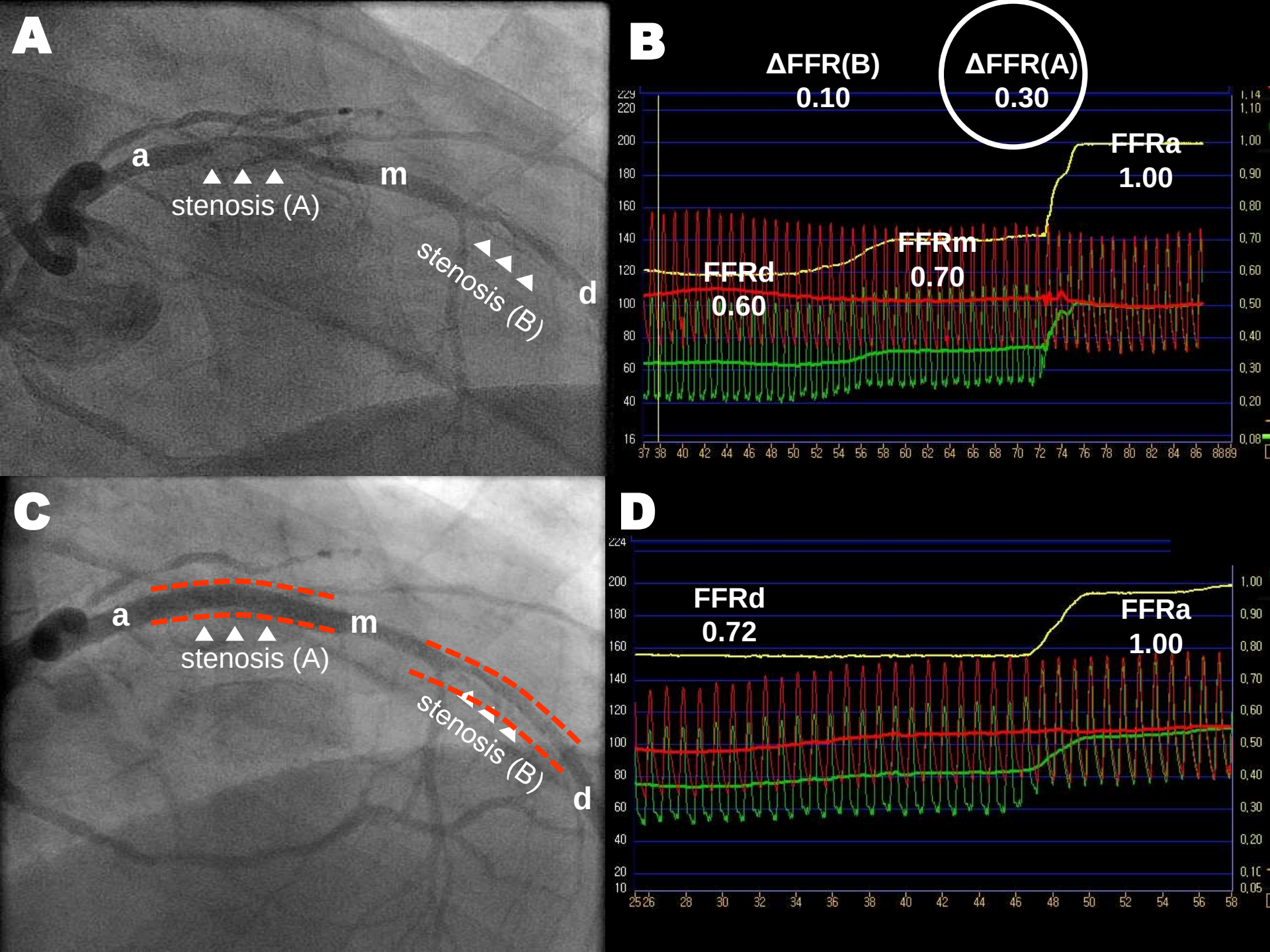
Nico H.J. Pijls and Bernard De Bruyne et al. Circulation 2000;102:2371-2377

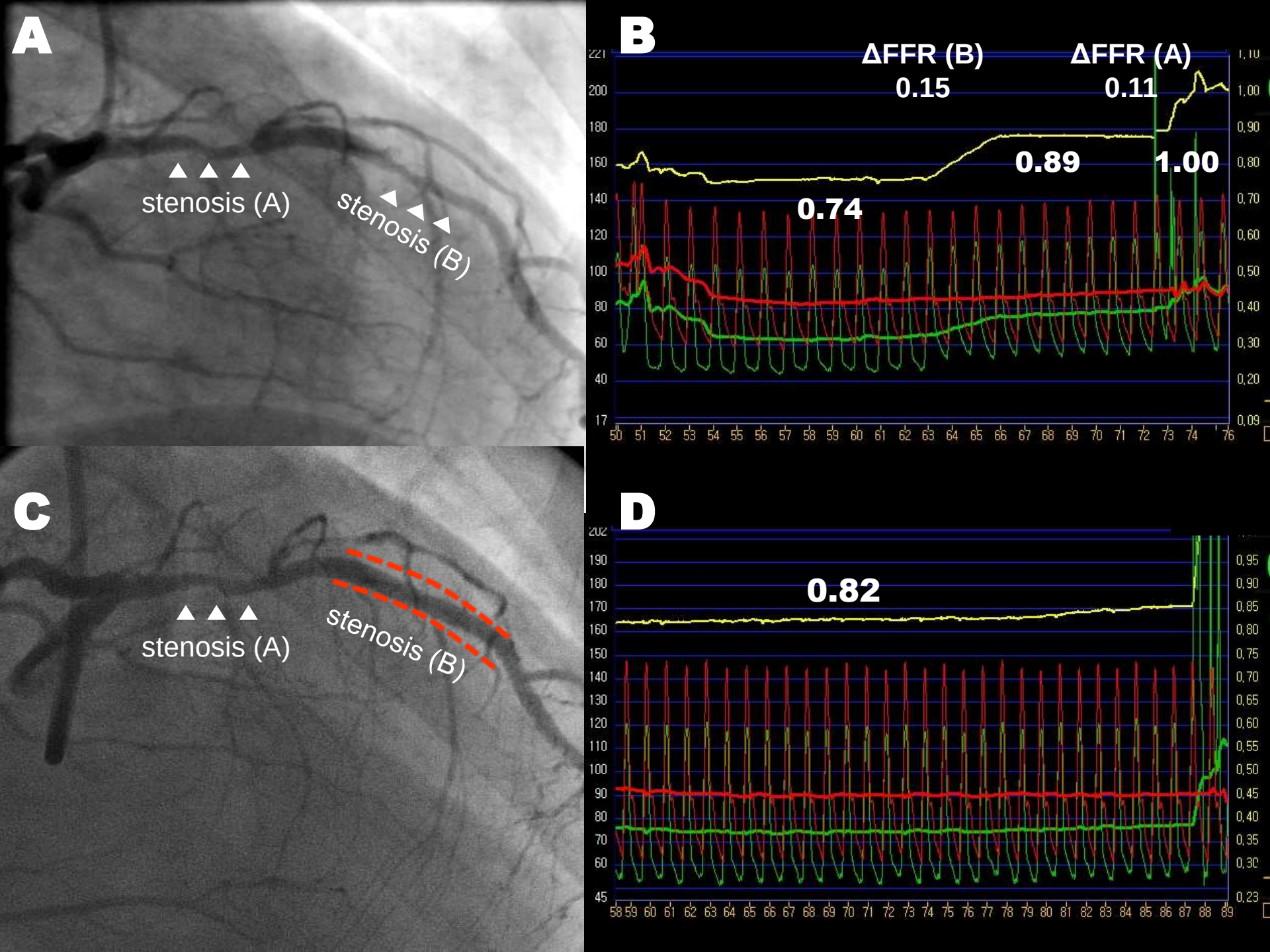
# Practical Approach: Rule of Big Δ FFR



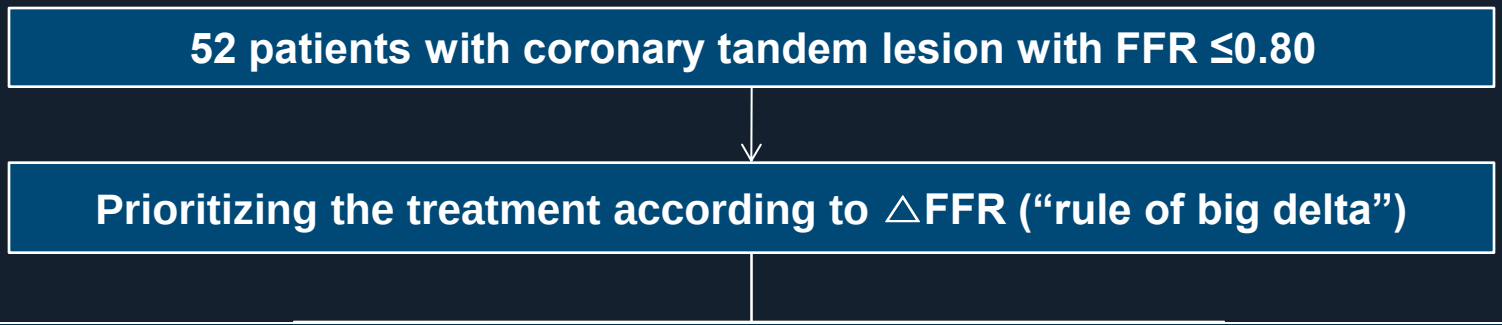

1. ΔFFR corresponds to relative functional severity
2. Perform revascularization first for lesions with more functional severity
3. This approach increase the chance of deferring PCI for the remaining lesions.

Park SJ, Ahn JM, et al Am J Cardiol. 2012 Dec 1;110(11):1578-84.


A
a
m
stenosis (A)
stenosis (B)
d
B
ΔFFR(B)
0.10
ΔFFR(A)
0.30
FFRa
1.00
FFRm
0.70
FFRd
0.60
C
a
m
stenosis (A)
stenosis (B)
d
D
FFRd
0.72
FFRa
1.00


A
stenosis (A)
stenosis (B)
B
ΔFFR (B)
0.15
ΔFFR (A)
0.11
0.89
1.00
0.74
C
stenosis (A)
stenosis (B)
D
0.82

# According to the Rule of "Big Delta"

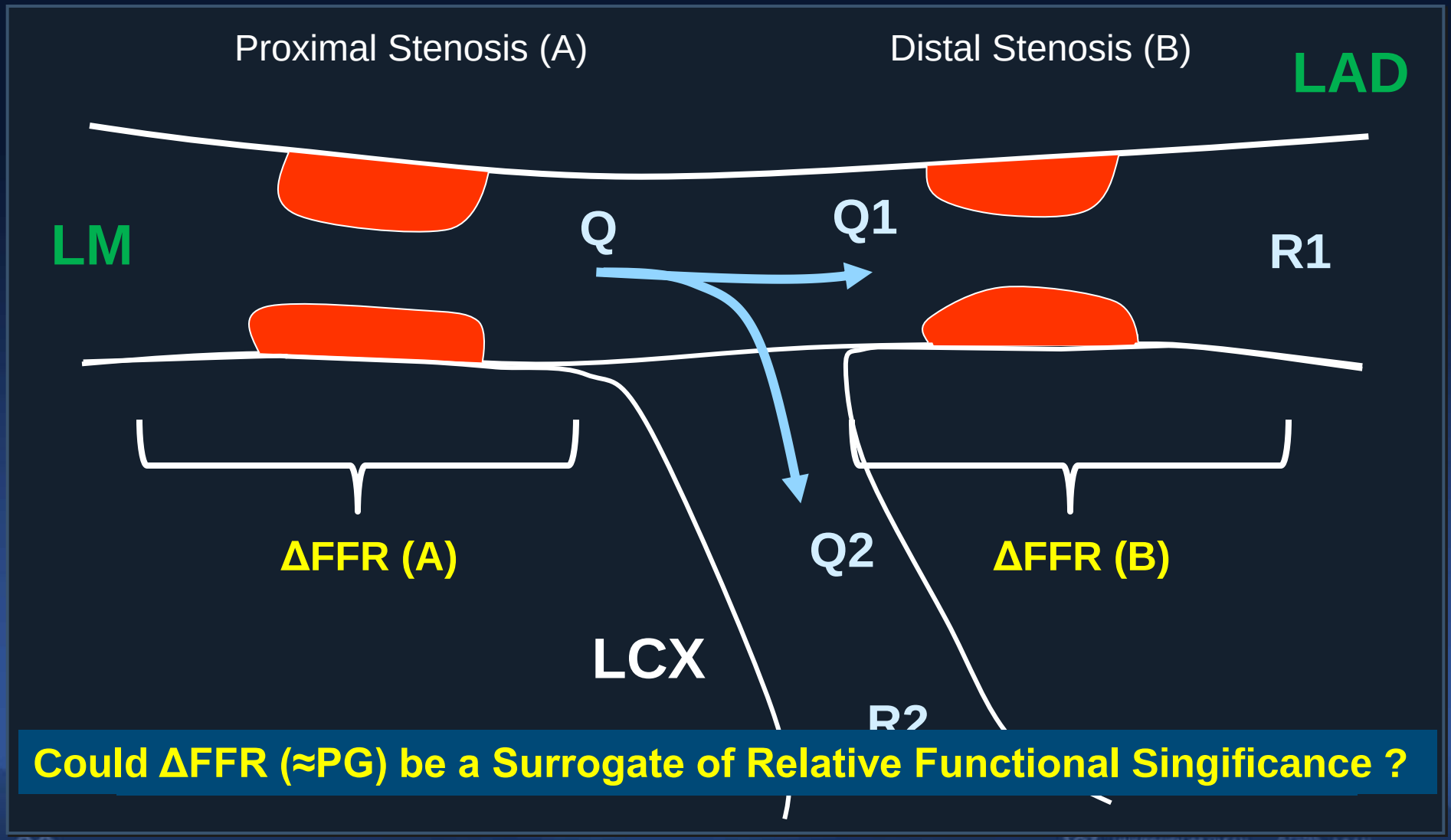



- 28 (53.8%) patients had only single-lesion Tx
- 28 (26.9%) lesions were deferred

| Proximal stenosis treated only N=16 | Both stenoses treated N=16 | Distal stenosis treated only N=12 | Both stenoses treated N=8 |
|---|---|---|---|

Park SJ, Ahn JM, et al Am J Cardiol. 2012 Dec 1;110(11):1578-84

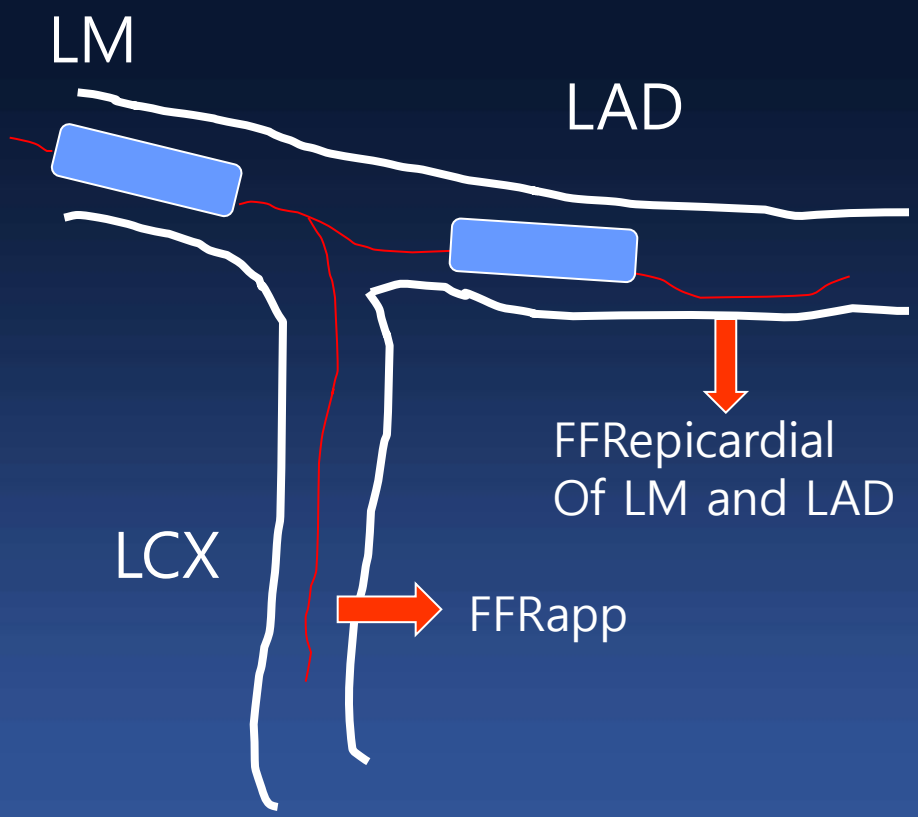
# Tandem Lesion with Interposing Side Branch like LM



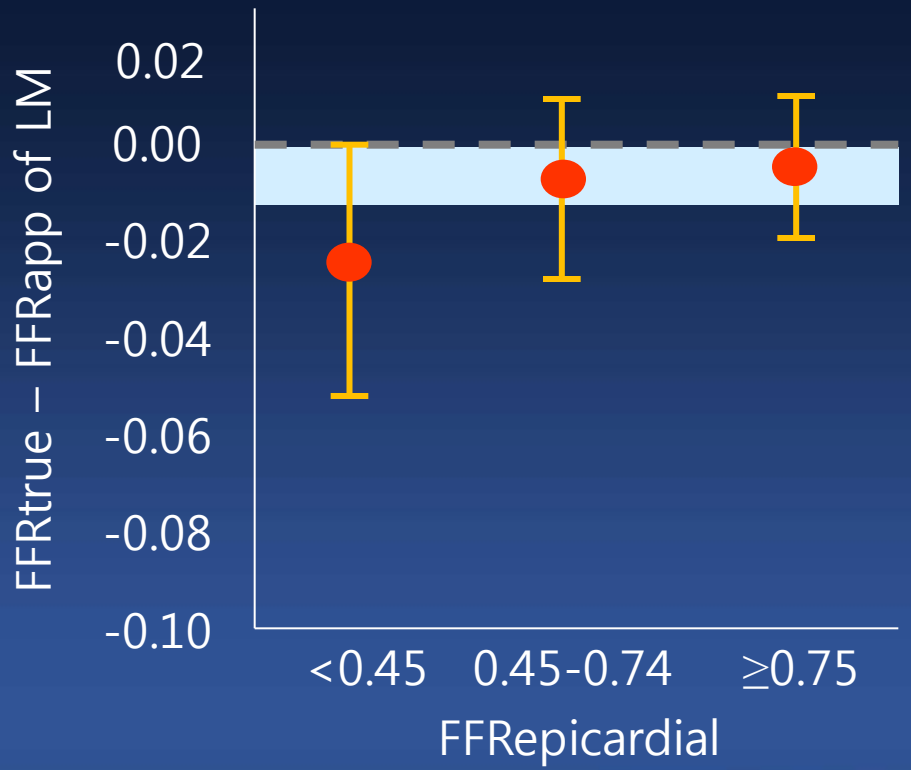

**Could ΔFFR (≈PG) be a Surrogate of Relative Functional Singificance ?**

# LM and Downstream Disease

If FFAapp was > 0.85, FFRtrue was >0.80

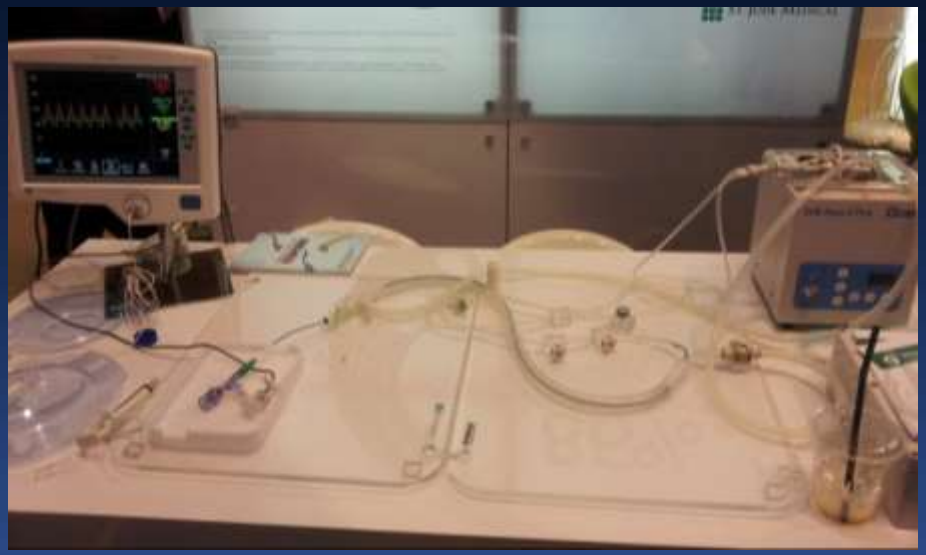



**Human Validation**

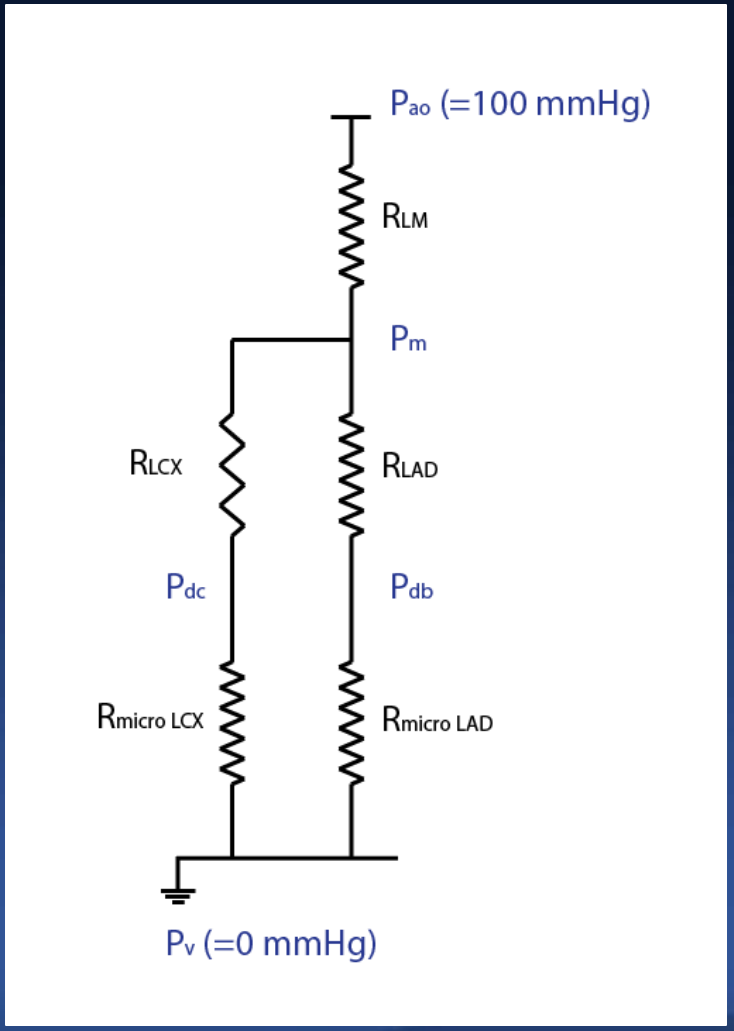



Fearon WF, et al JACC Cardiovasc Interv. 2015 Mar;8(3):398-403

# In-Vitro Simulation

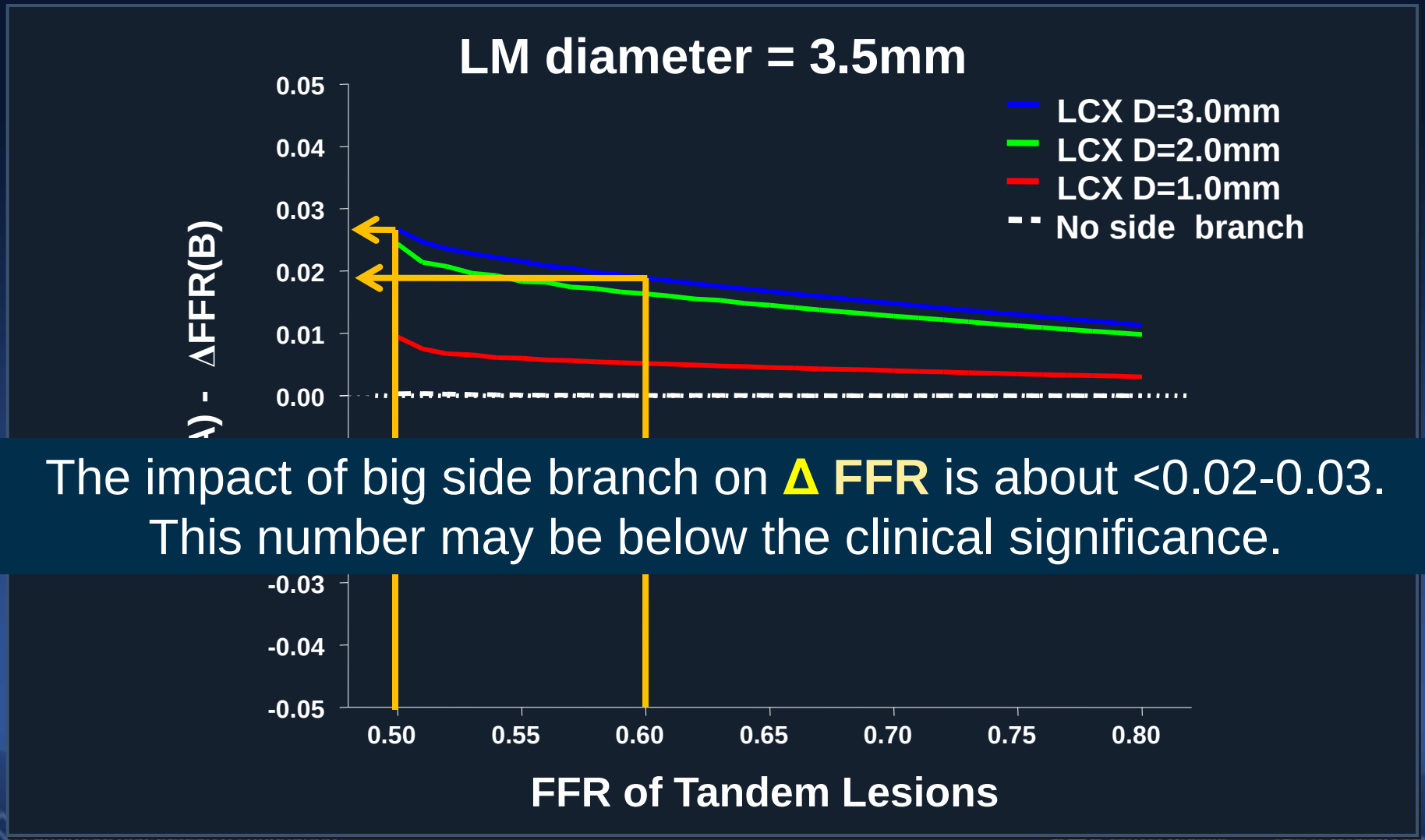


# Simulation Study



# When Two Lesions are Functionally Equal,

# $(FFR(A)_{true} = FFR(B)_{true})$




The impact of big side branch on **Δ FFR** is about <0.02-0.03.
This number may be below the clinical significance.

# Summary

- In every day practice, long stent implantation for long coronary lesion was frequently performed.
- For diffuse long coronary stenosis, single long DES (38-40mm) implantation appears safe and effective.
- IVUS use may attenuate the detrimental effect of the increase of implanted stent length, supporting the favor of IVUS utilization, particularly during PCI with the long stent implantation.

# Summary

- For functional lesion assessment of the coronary tandem lesions, ΔFFR is a useful index for determining the relative functional severity between the two stenoses.
- In this way, we can prioritize the treatment sequence and avoid unnecessary stent implantation with achieving favorable functional and clinical outcomes.