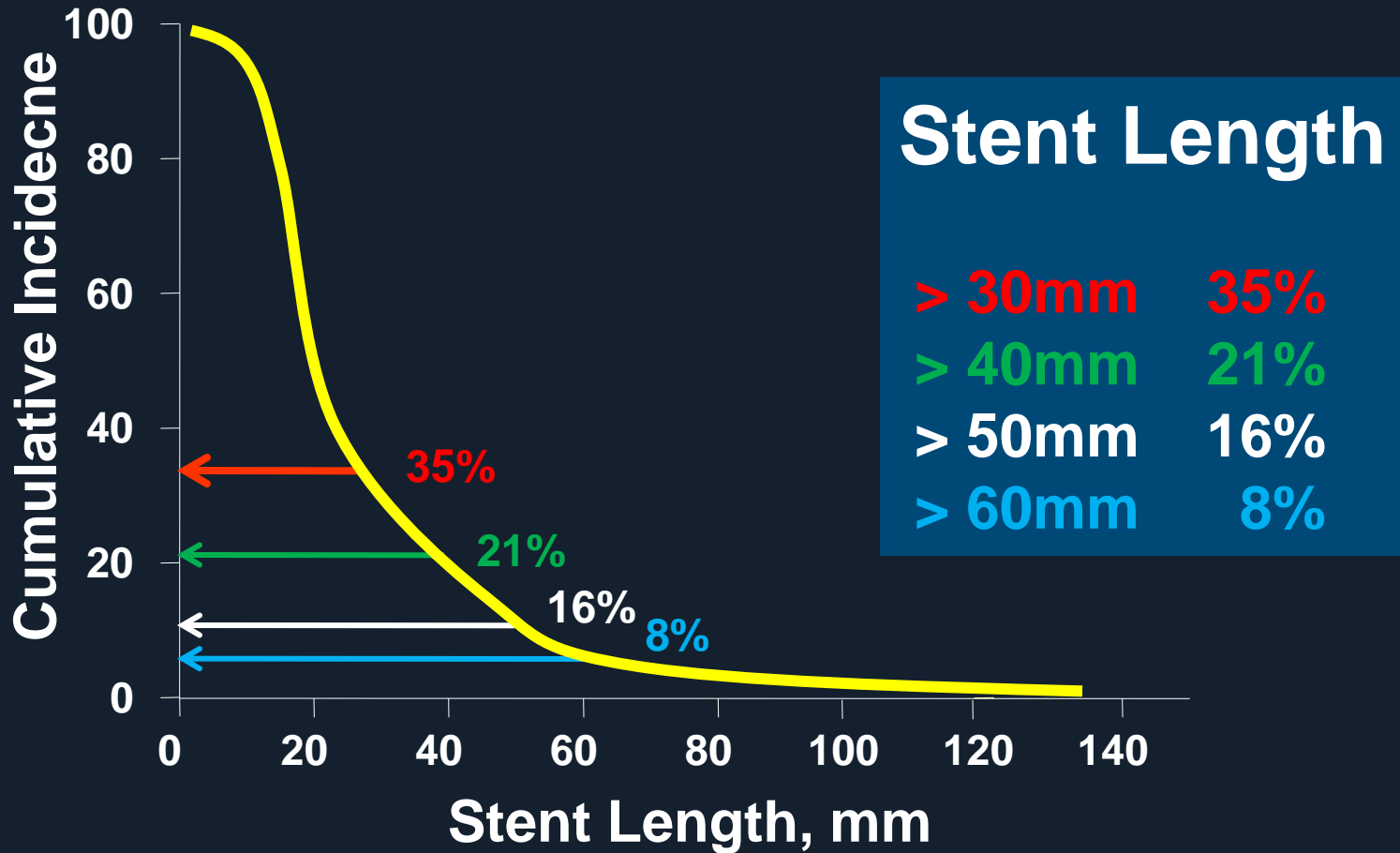# Long Lesion and Tandem Lesion

Jung-Min Ahn, MD
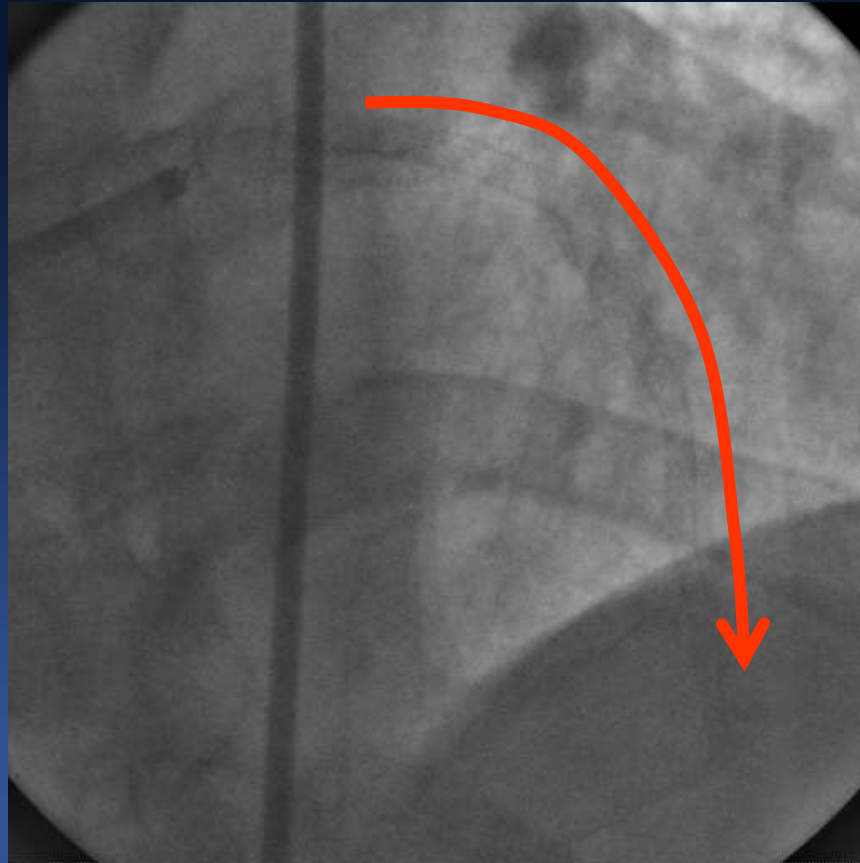
Heart Institute, University of Ulsan College of Medicine
Asan Medical Center, Seoul, Korea

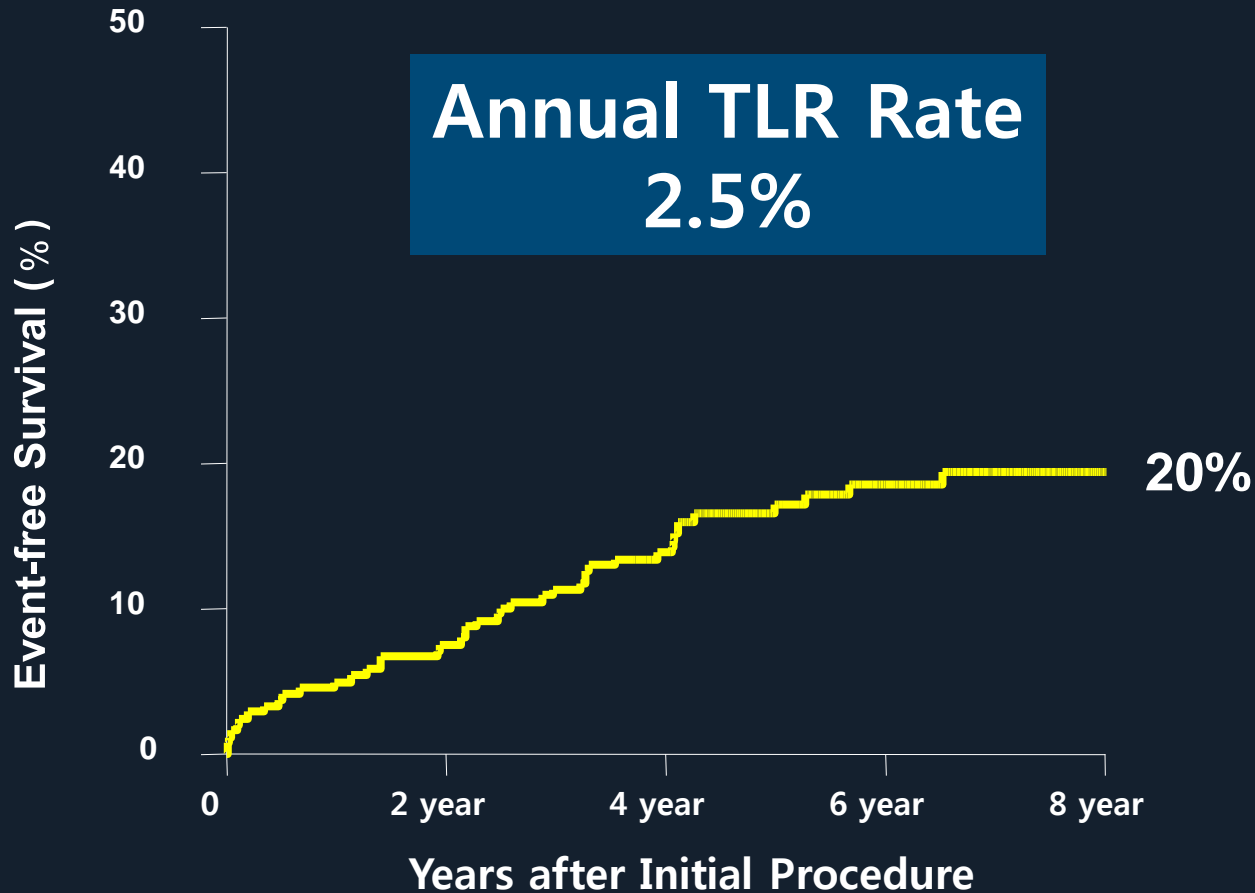# Incidence of Long Stenting

Data from IRIS DES registry

"Full Metal Jacket"

Multiple or overlapping stent implantation

8 Year Follow-up of FMJ

Event Rate is Acceptable

Annual TLR Rate 2.5%

Event-free Survival (%)

20%

Years after Initial Procedure

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

Stent Length and Outcomes

3-Year Incidence of MACE

BMS(N=3790) DES(N=4581)

SES=3545/PES=1036

P<0.001

Quartiles of Total Stent Length

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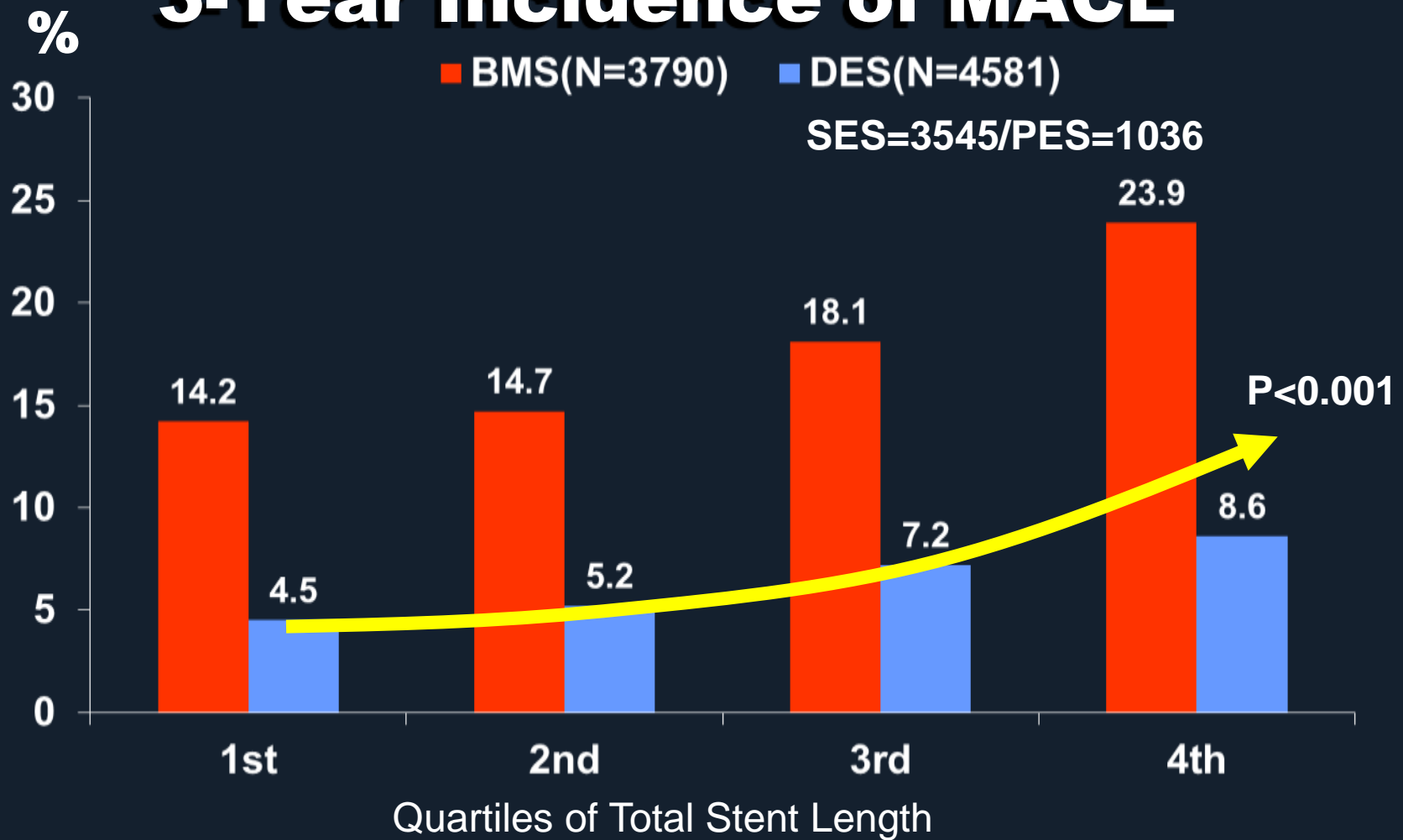
How Long?

Stent Length 40 mm By IVUS

Hong MK, Park SJ, et al. Eur Heart J 2006 Jun;27(11):1305-10
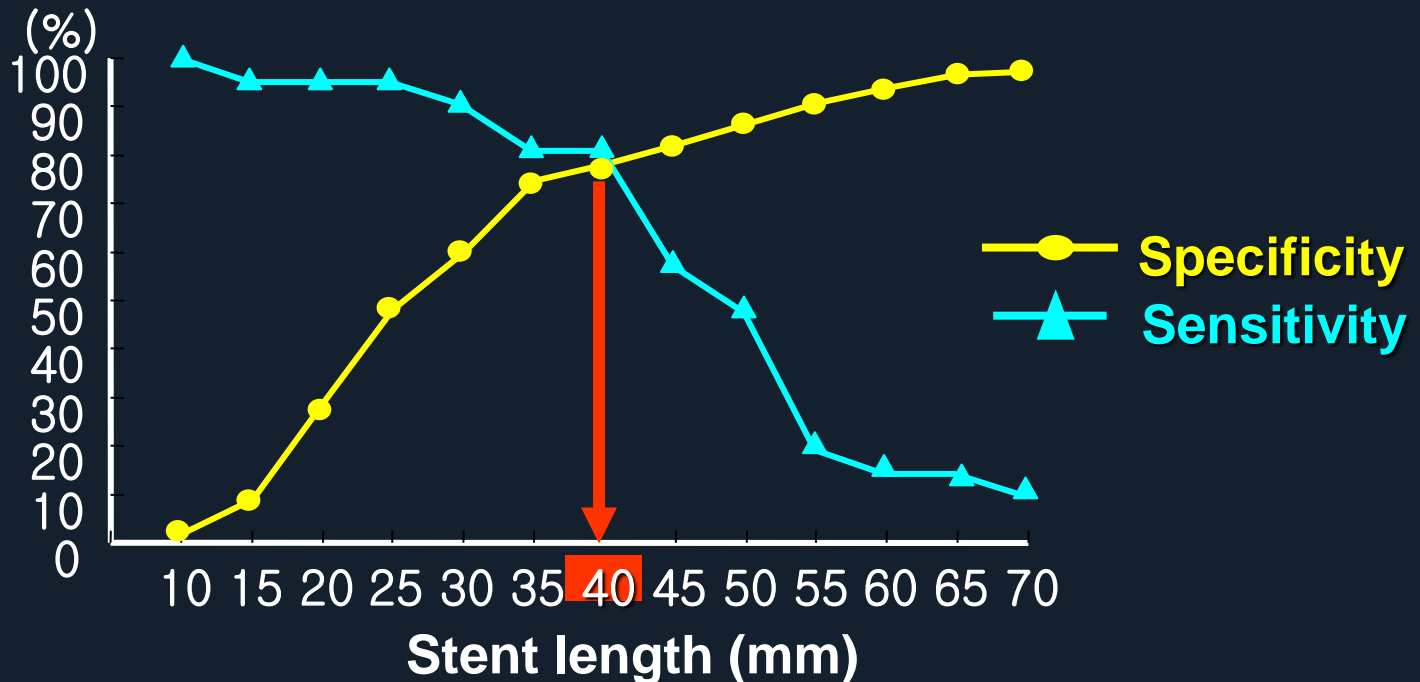
How Long? In-Stent Restenosis

40mm for ISR
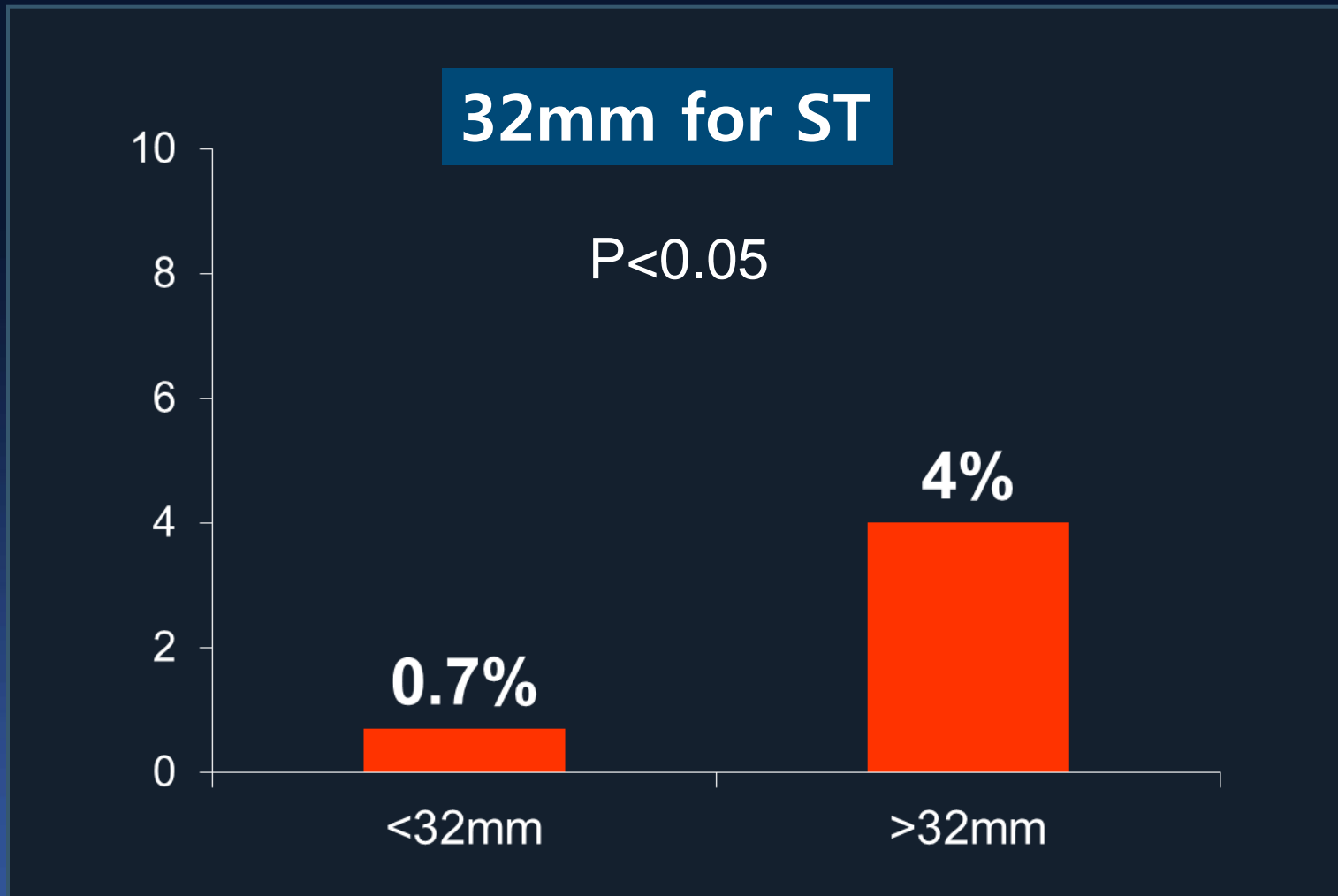
P<0.05

13%

1%
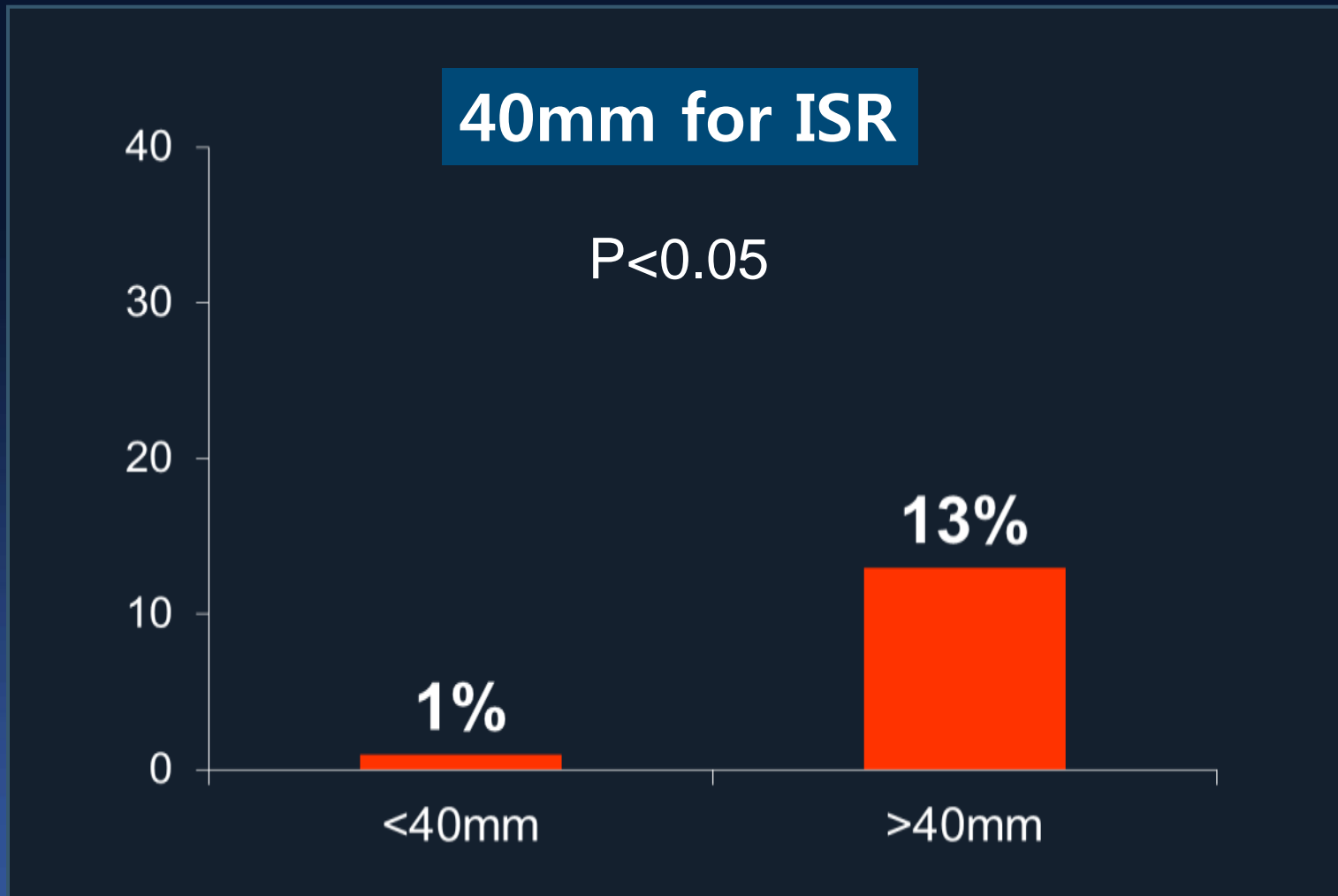
<40mm

>40mm

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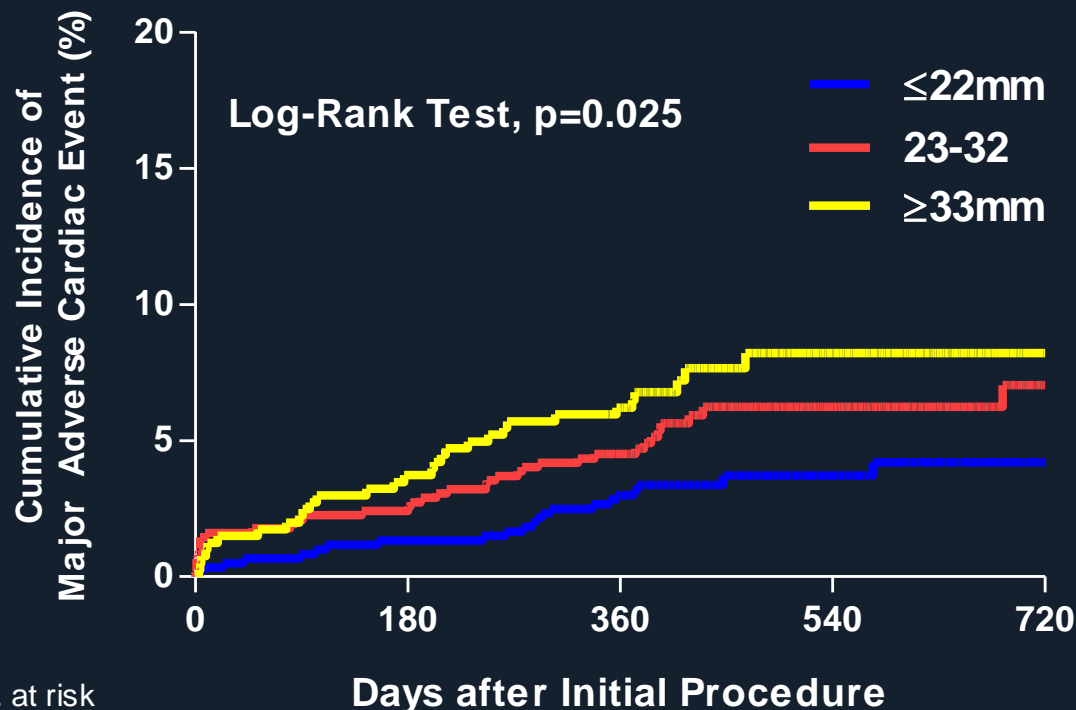
How Long? Stent Thrombosis

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

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

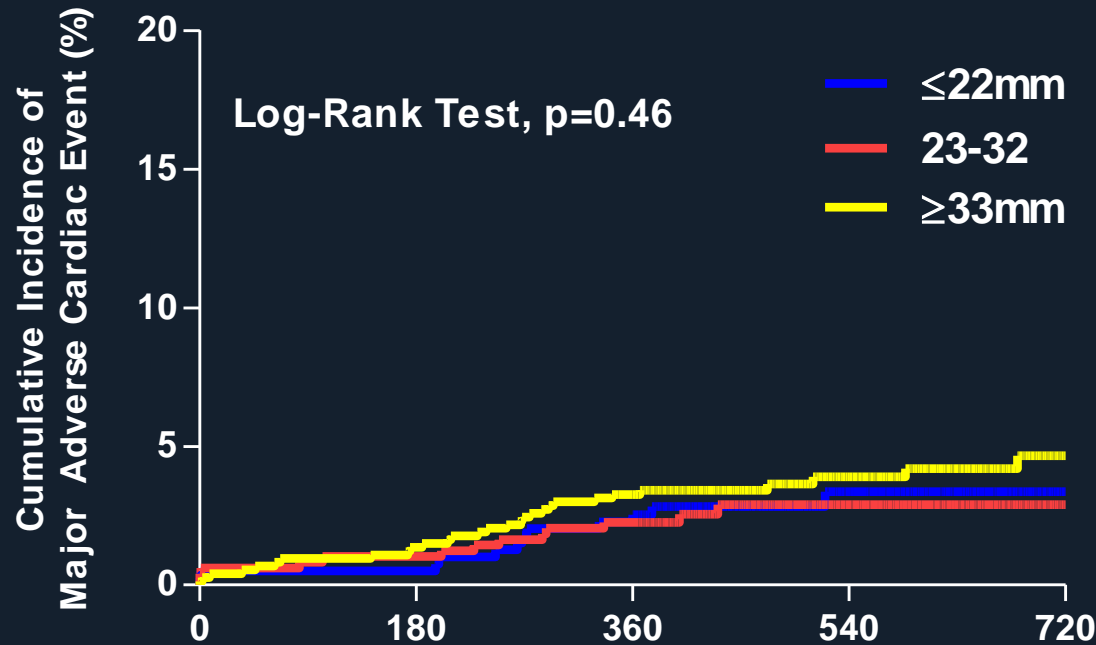# IVUS Utilization Modify the Stent Length Effect On Clinical Outcomes

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

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

IVUS-XPL Trial

(Implanted stent ≥28 mm in length)

Hong SJ, Hong MK et al. JAMA. 2015;314(20):2155-2163
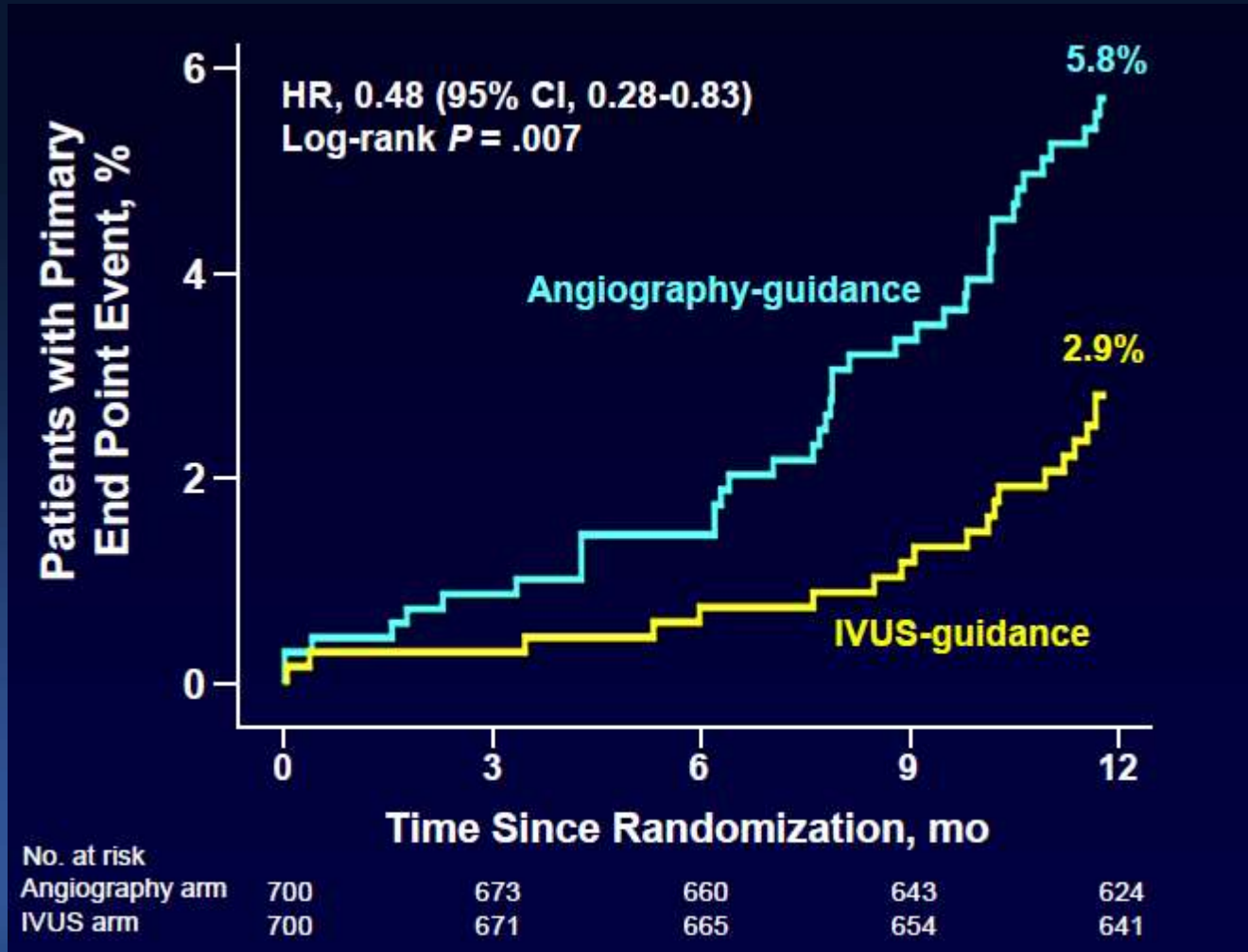
Stent Length and Optimal Stenting

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

Hong MK, et al Circulation 2006;113:414-419
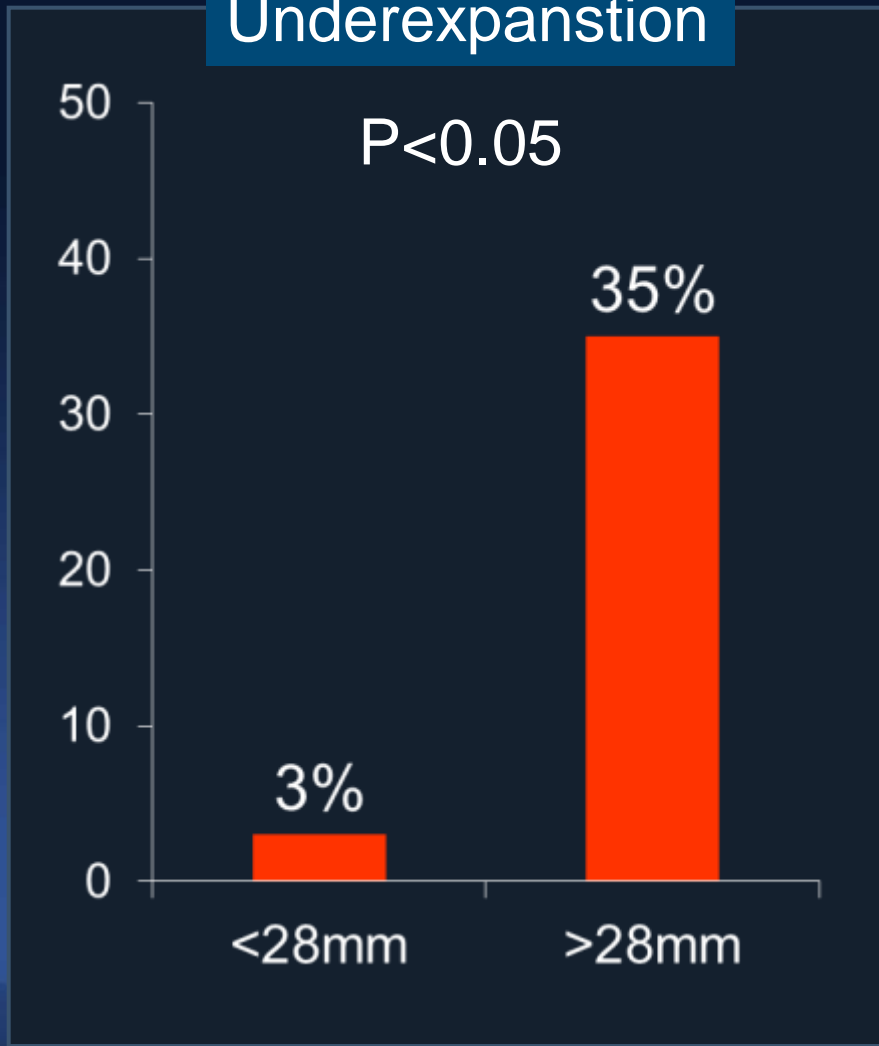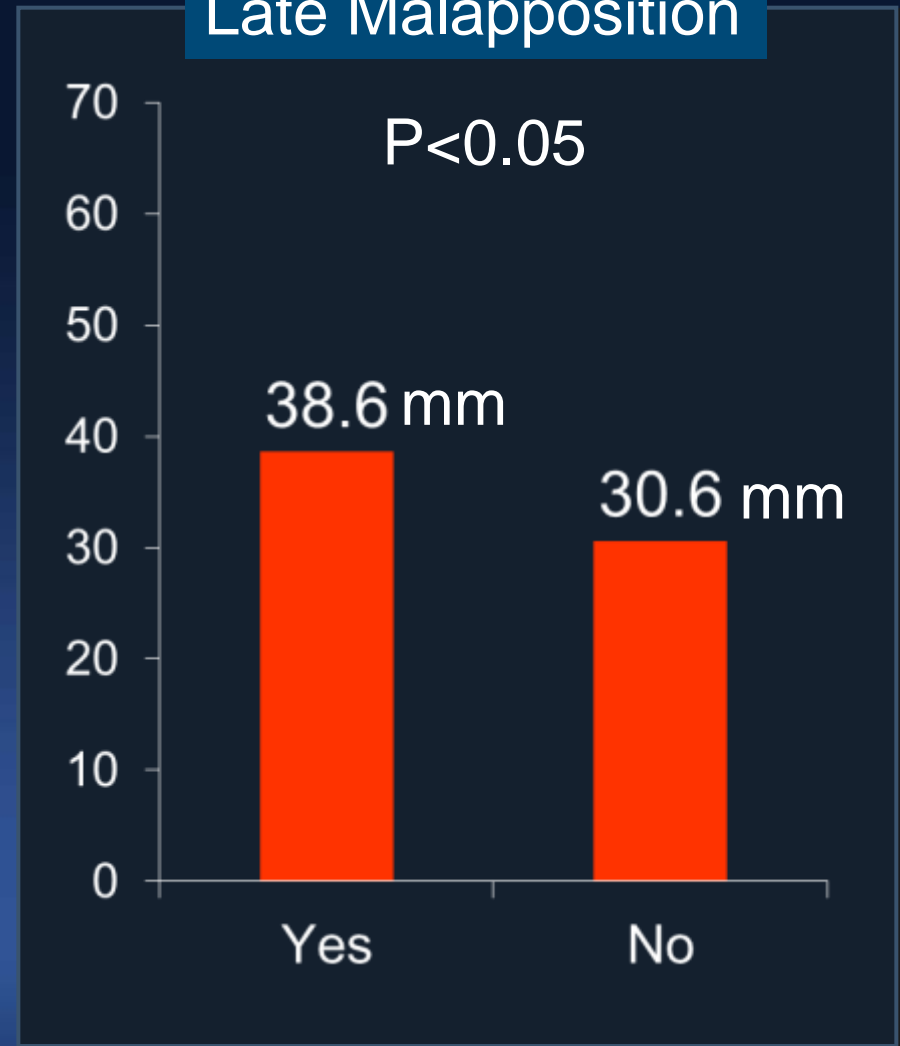
IVUS Changed the Procedure
ADAPT-DES Sub-Study

Witzenbichler B et al. Circulation. 2014 Jan 28;129(4):463-70

How Big?

Stent CSA 5.5 mm^2 By IVUS

Hong MK, Eur Heart J, 2006:27:1305 (AMC Cypher Registry)
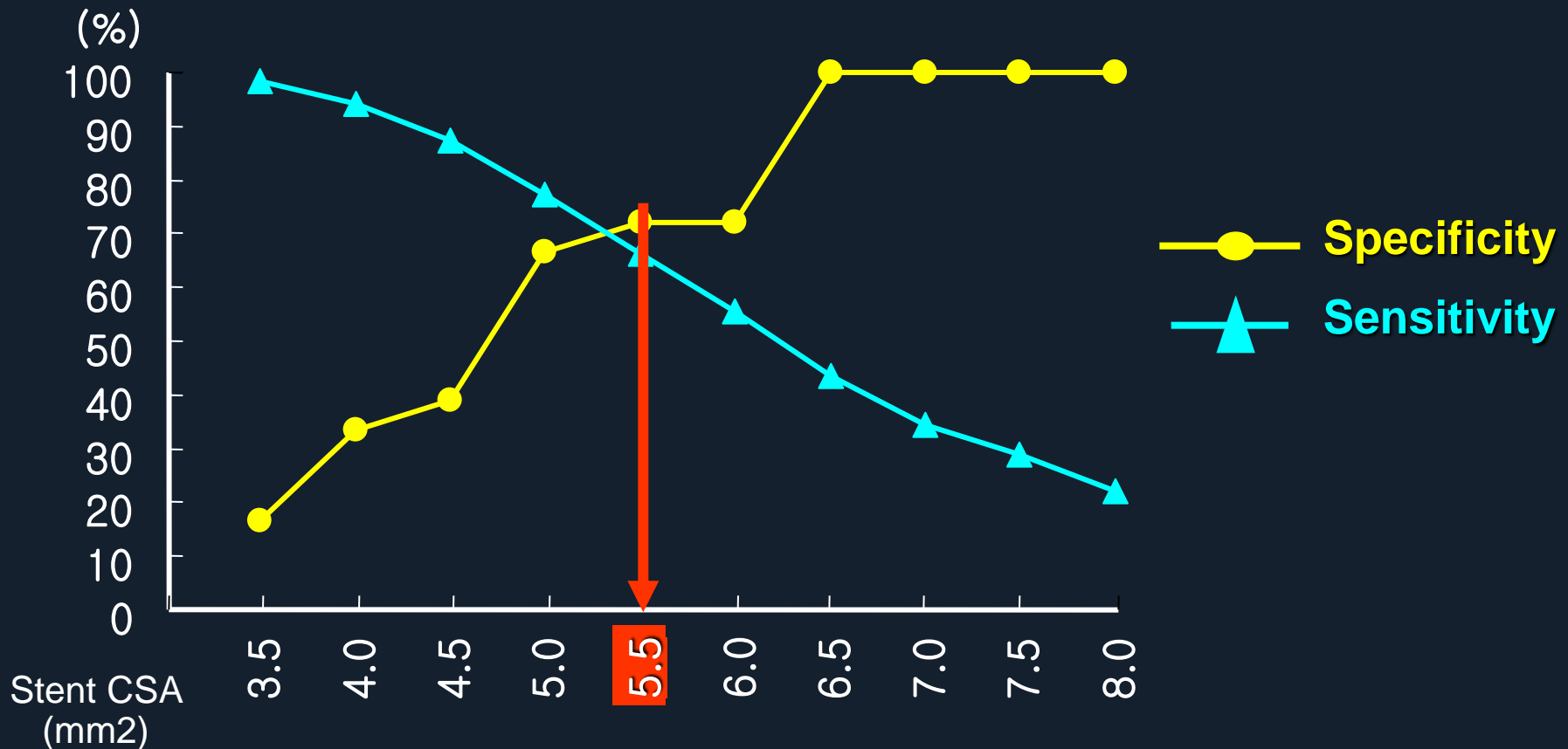
How Big? In-Stent Restenosis

5.5mm² for ISR

P<0.05

2.0% — >5.5mm2

7.4% — <5.5mm2
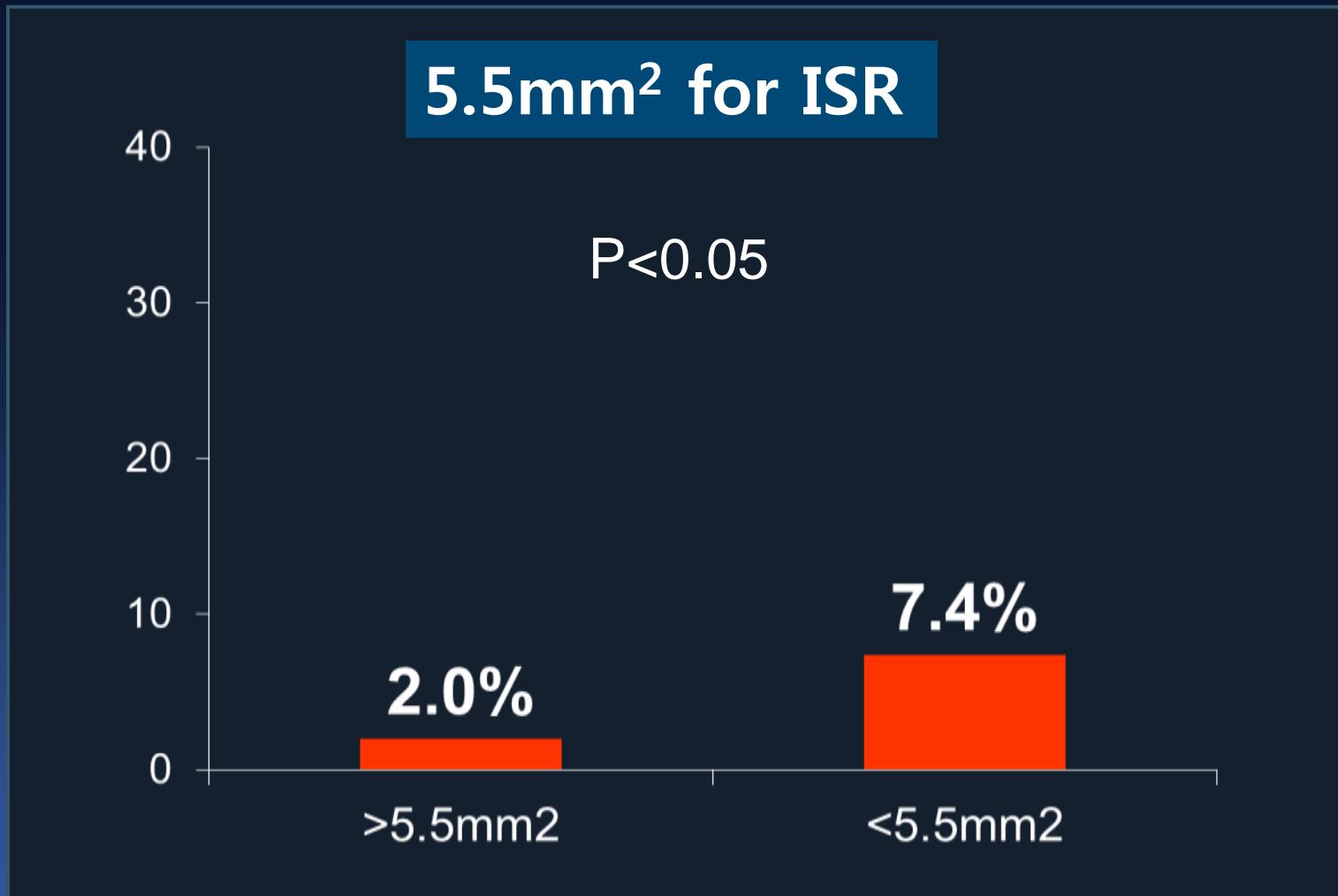
Hong MK, Park SJ, et al. Eur Heart J 2006 Jun;27(11):1305-10
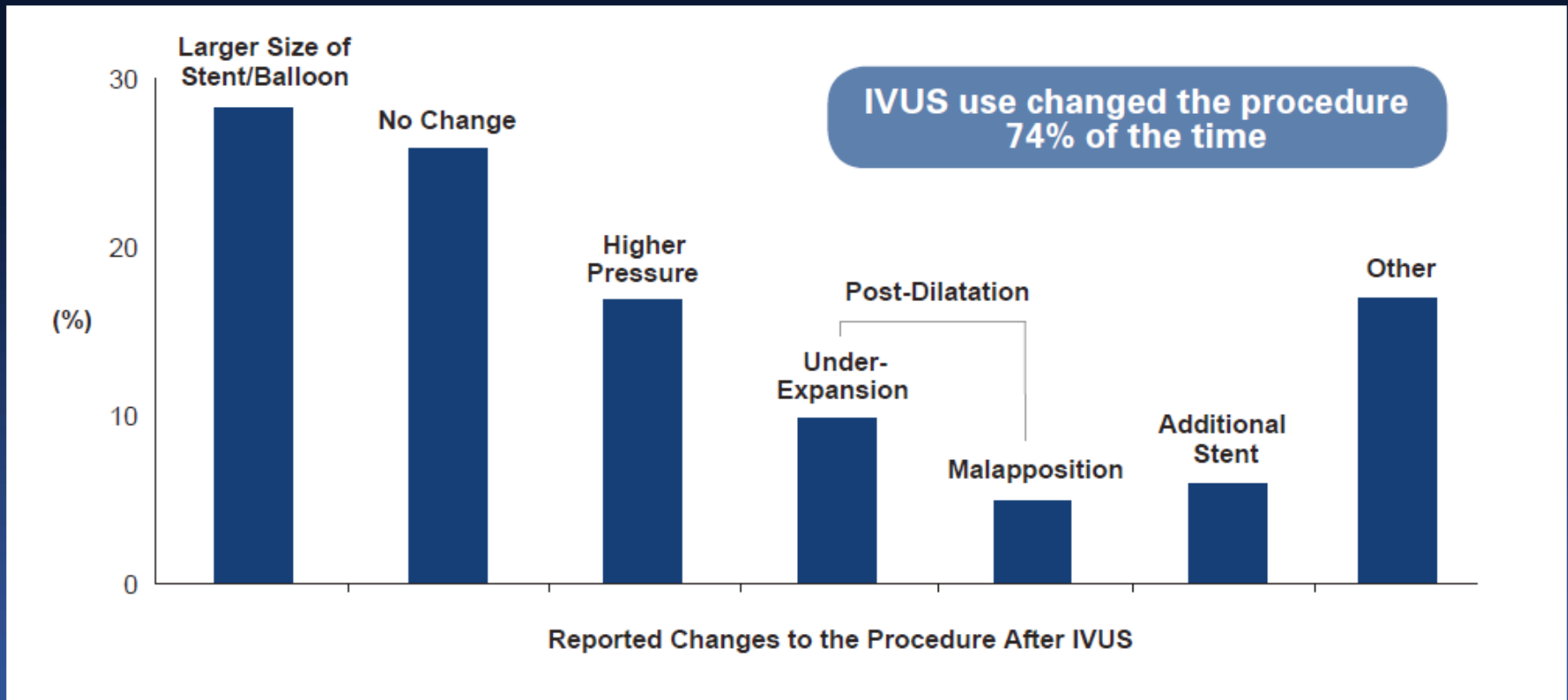
LONG-DES Randomized Trials
Long (>25mm) Native Coronary Stenosis

Study	Stent	Efficacy*	Publication
Long-DES II	SES vs. PES	SES>PES	Circulation 2006
			JACC Cardiovasc
Long DES V	EES vs. BES	EES=BES	Interv 2014
Long DES VI	EES vs. ZES	Ongoing	Ongoing

Most DESs Showed Similar Efficacy

*Primary-endpoint: in segment late luminal loss at 9 months

CardioVascular Research Foundation

UNIVERSITY OF ULSAN COLLEGE MEDICINE

ASAN Medical Center

Polymer Jacket (BRS) for Long Coronary Lesion

3 BRSs
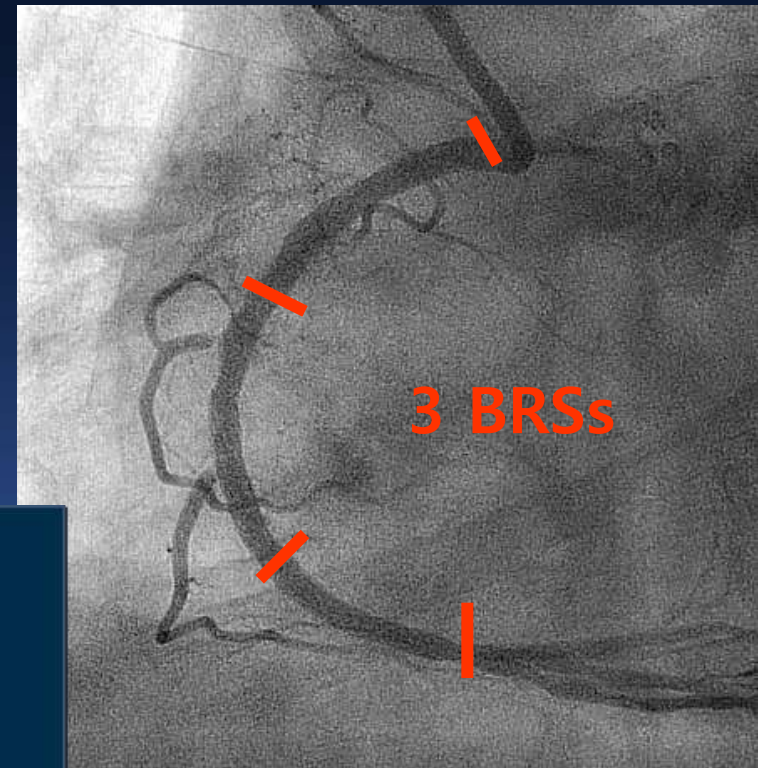
P Pre-Dilation

S Sizing Appropriately

P Post-Dilation

GHOST-EU Study @ 1 Year
Overlap vs. No Overlap BRS

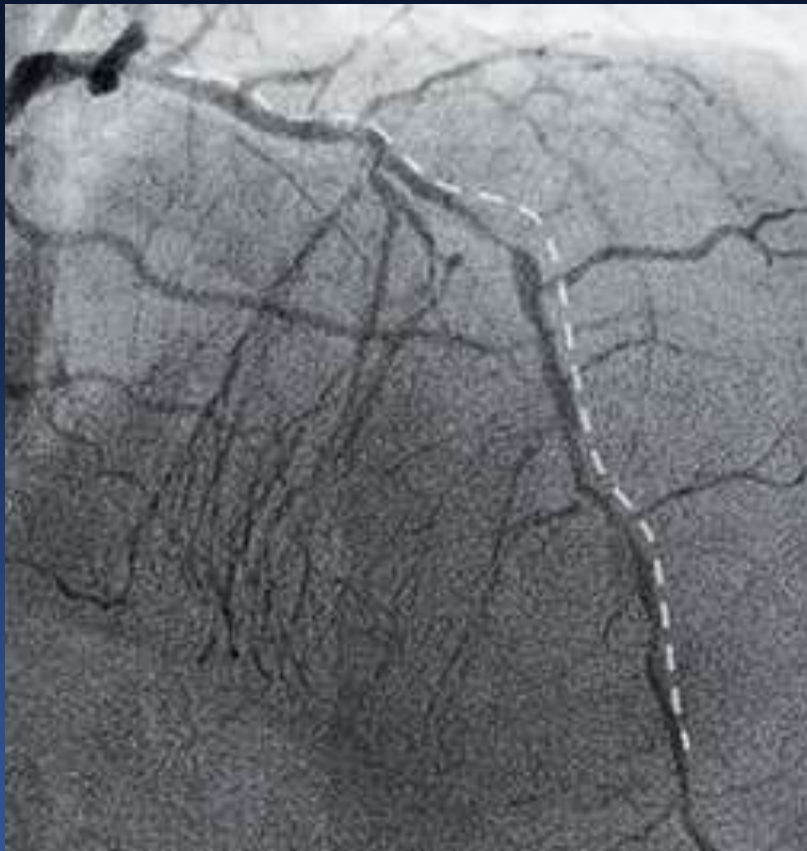|	Overlap (N=319)	No-overlap (N=1156)	P value
POCE	18.4%	18.2%	0.64
DOCE	6.6%	6.6%	0.76
Death	0.3%	2.2%	0.05
TV-MI	1.9%	3.0%	0.25
TLR	5.6%	4.9%	0.85
ST	1.6%	2.7%	0.22

UNDERDOGS Study

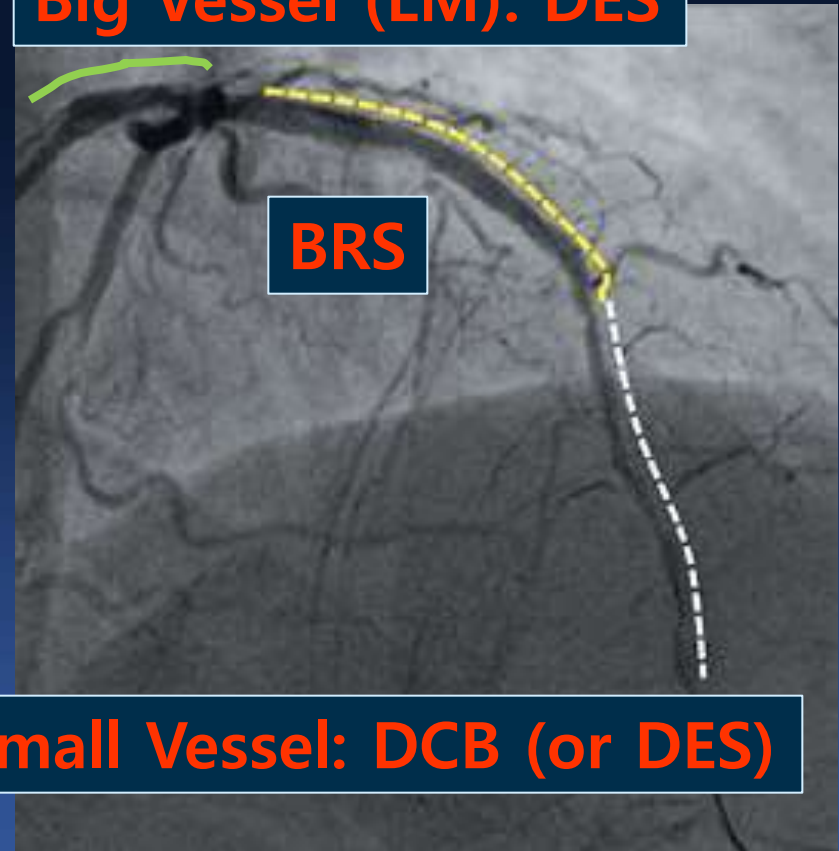## Overlapping (40mm) BRS vs. DES (*Propensity Matching*)
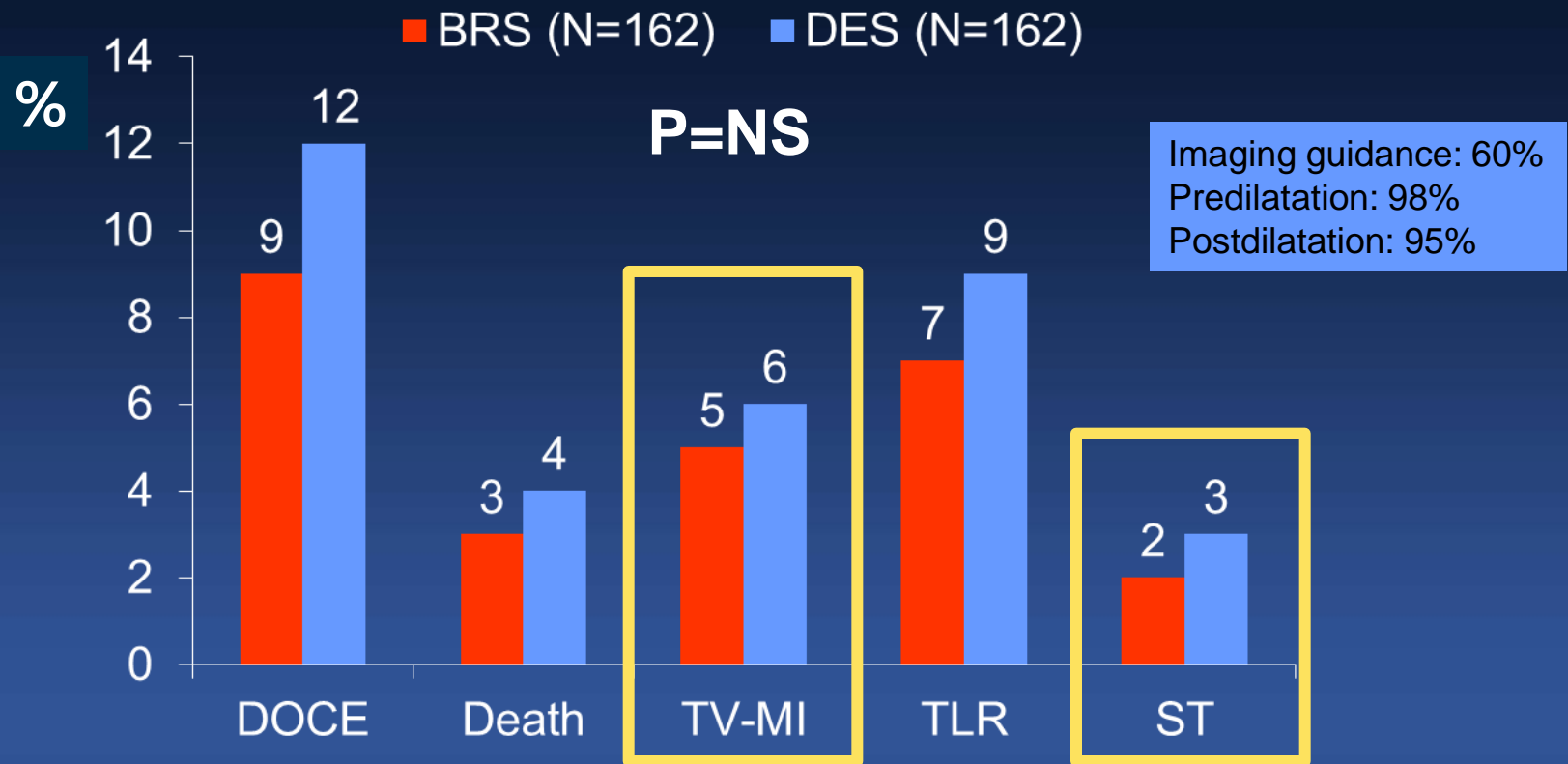
Buscagkua et al. Int J Cardiol. 2016 Apr 1;208:40-5

Hybrid Strategy (BRS+DCB+DES)
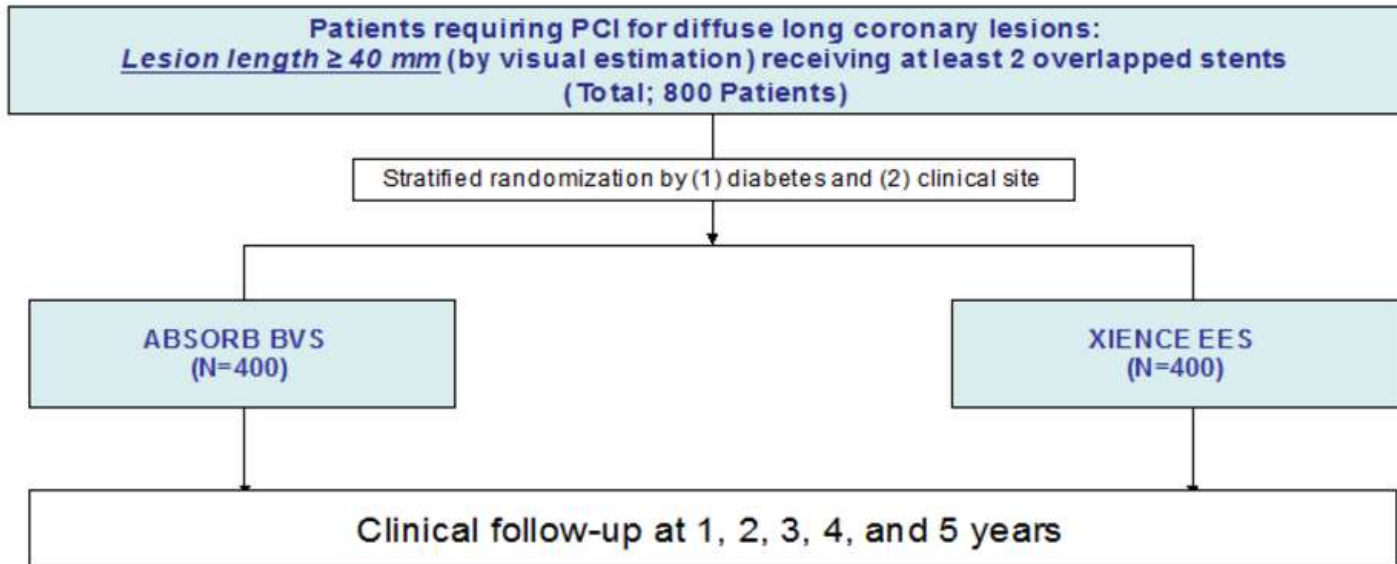

Big Vessel (LM): DES

BRS

Small Vessel: DCB (or DES)

Ielasi A et al. EuroIntervention. 2016 Apr 8;11(14):e1589-95

BVS for Long Lesion (>40mm)

Everolimus-Eluting Bioresorbable Scaffolds versus Everolimus-Eluting Metallic Stents for Diffuse Long Coronary Artery Disease

ABSORB-LONG Trial

Patients requiring PCI for diffuse long coronary lesions:
Lesion length ≥ 40 mm (by visual estimation) receiving at least 2 overlapped stents
(Total; 800 Patients)

Stratified randomization by (1) diabetes and (2) clinical site

| ABSORB BVS (N=400) | XIENCE EES (N=400) |

Clinical follow-up at 1, 2, 3, 4, and 5 years

*Primary endpoint: target-lesion failure (composite of cardiac death, TV-MI, or ID-TLR) at 1 year
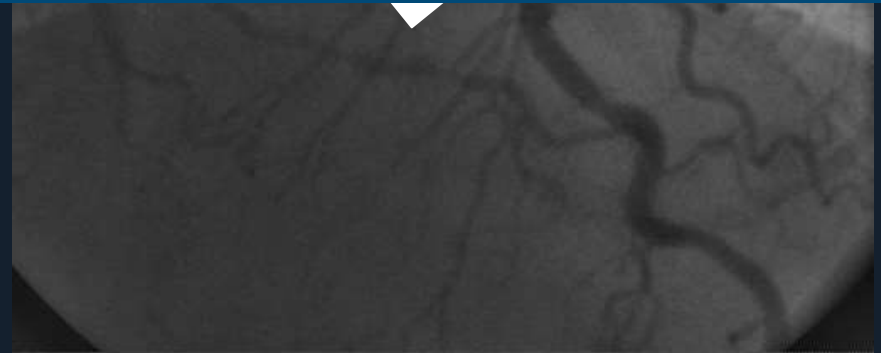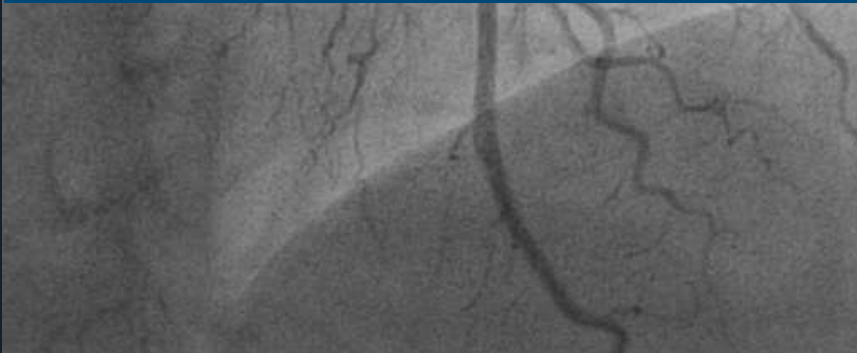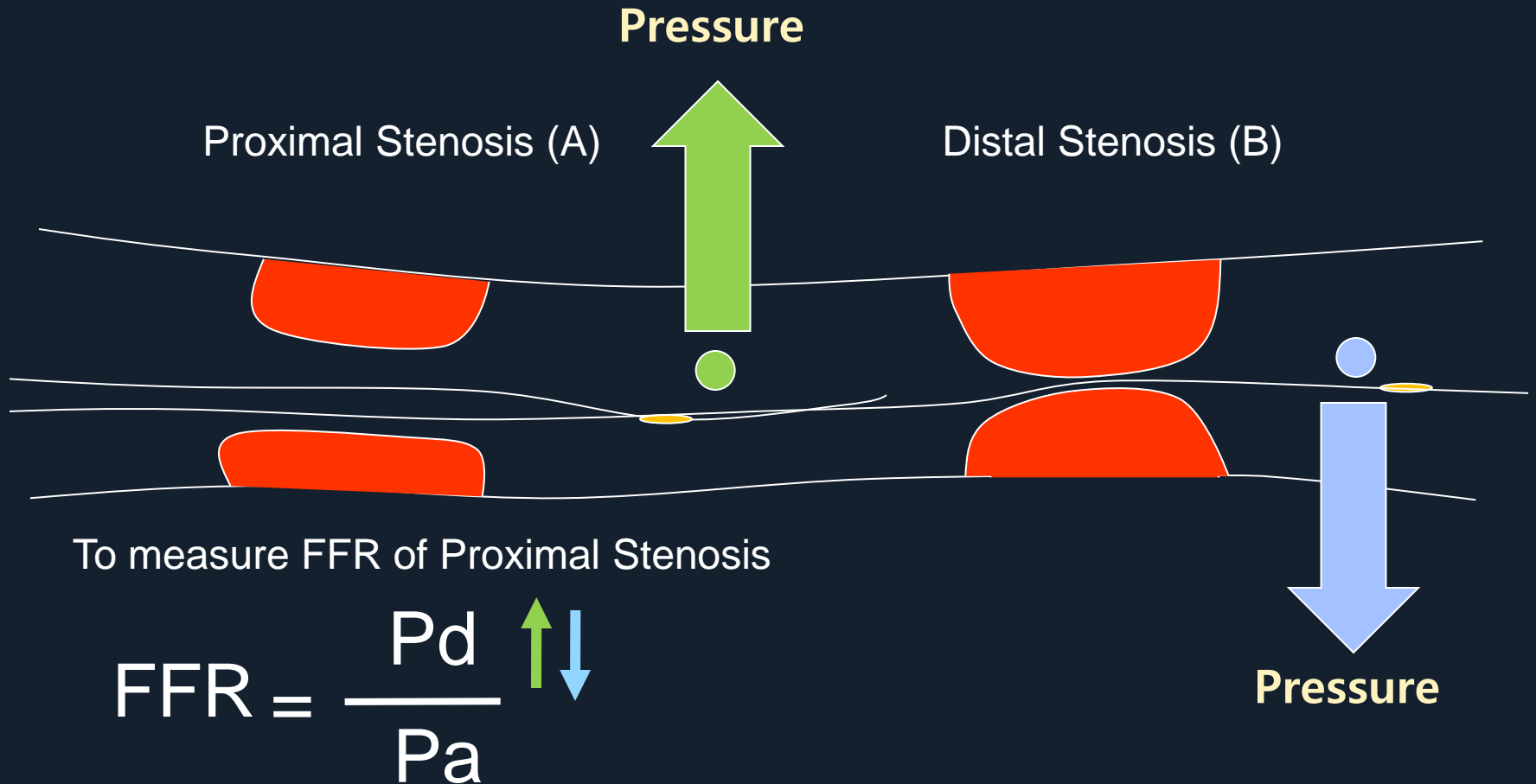
PI: Seung-Jung Park

Tandem Lesions

Multiple stenoses in series along one coronary artery

**Long Stent Implantation (Full Metal Jacket or Full Polymer Jacket)
But, If you use FFR wire, more selective stenting would be possible**
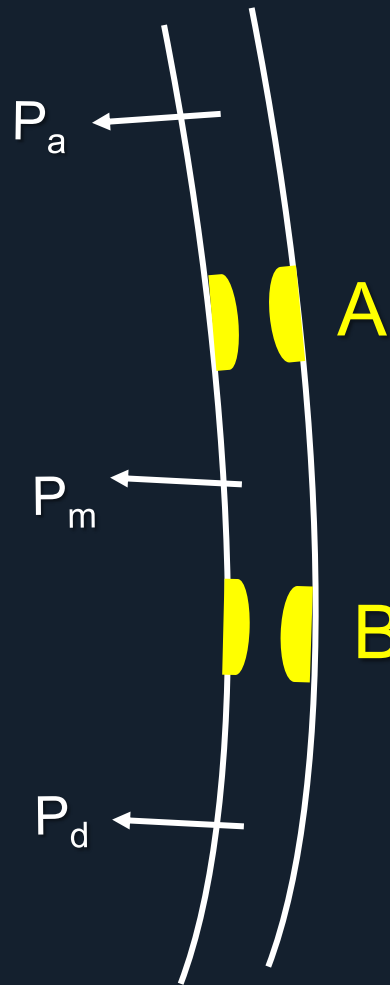
Hemodynamic Interaction in Tandem Lesion

Pressure

Proximal Stenosis (A)

Distal Stenosis (B)

Pressure

To measure FFR of Proximal Stenosis

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

FFR value of proximal stenosis should be underestimated
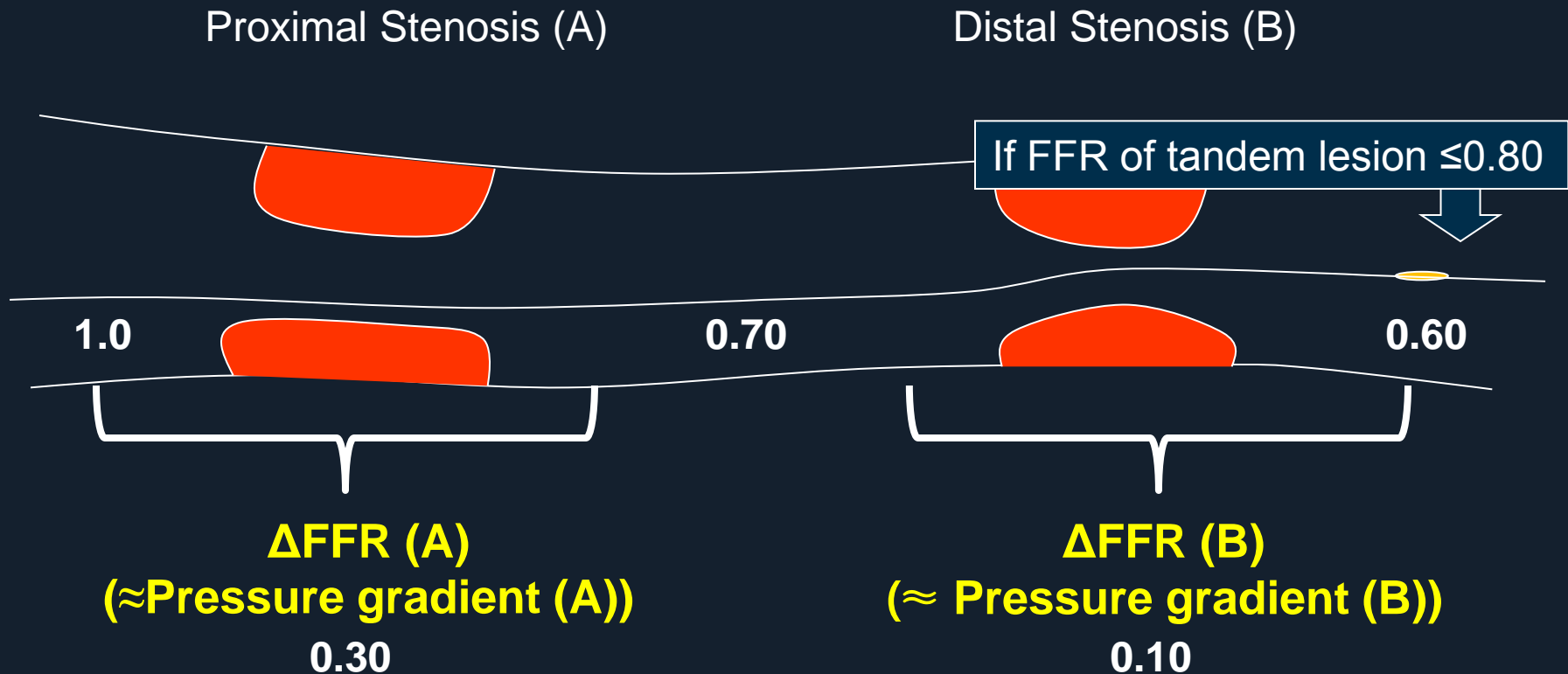
The Separate Functional Significance of Tandem Stenoses

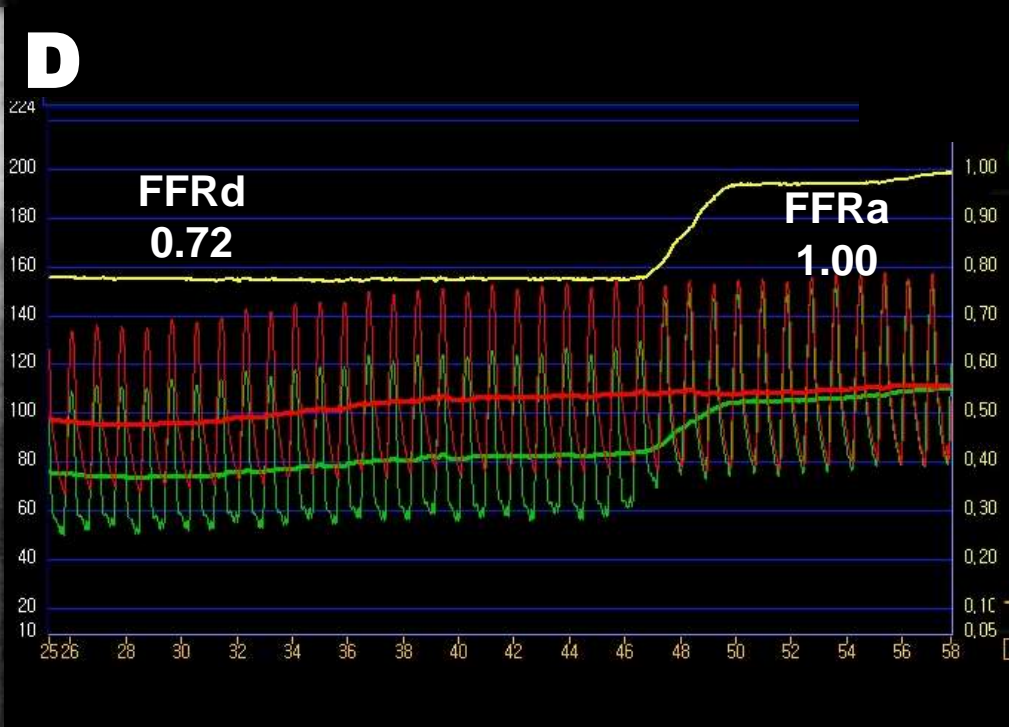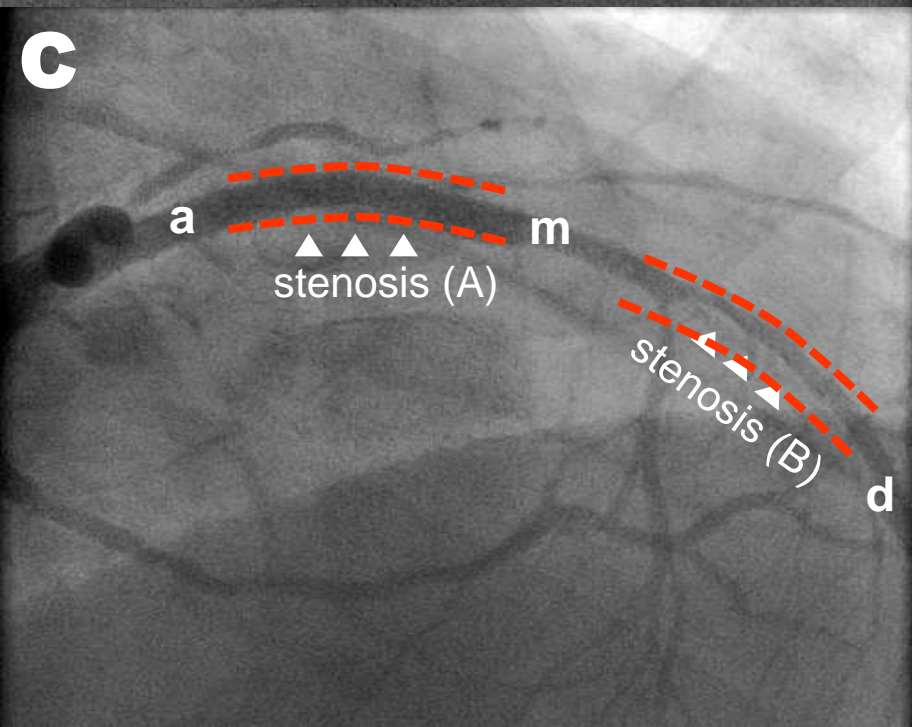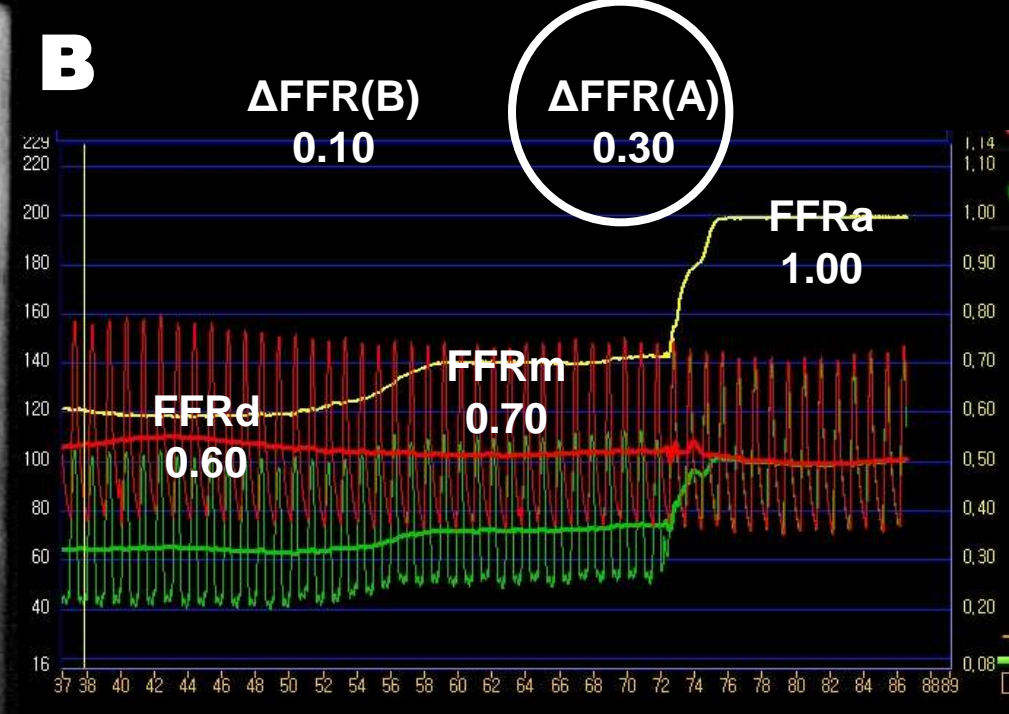$$FFR(A)_{pred} = \frac{P_d - (P_m/P_a) P_w}{P_a - P_m + P_d - P_w}$$

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

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

Proximal Stenosis (A)   Distal Stenosis (B)

If FFR of tandem lesion ≤0.80

1.0   0.70   0.60

ΔFFR (A)
(≈Pressure gradient (A))

0.30

ΔFFR (B)
(≈ Pressure gradient (B))

0.10

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

▲ ▲ ▲
stenosis (A)

m

▲ ▲ ▲ ▲
stenosis (B)

d

B

ΔFFR(B)
0.10

ΔFFR(A)
0.30

FFRa
1.00

FFRd
0.60

FFRm
0.70

C

a

stenosis (A)
▲ ▲ ▲

m

stenosis (B)
▲ ▲ ▲

d

D

FFRd
0.72

FFRa
1.00

A

stenosis (A)

stenosis (B)

B

ΔFFR (B)   ΔFFR (A)

0.15   0.11

0.89   1.00

0.74

C

stenosis (A)

stenosis (B)

D

0.82
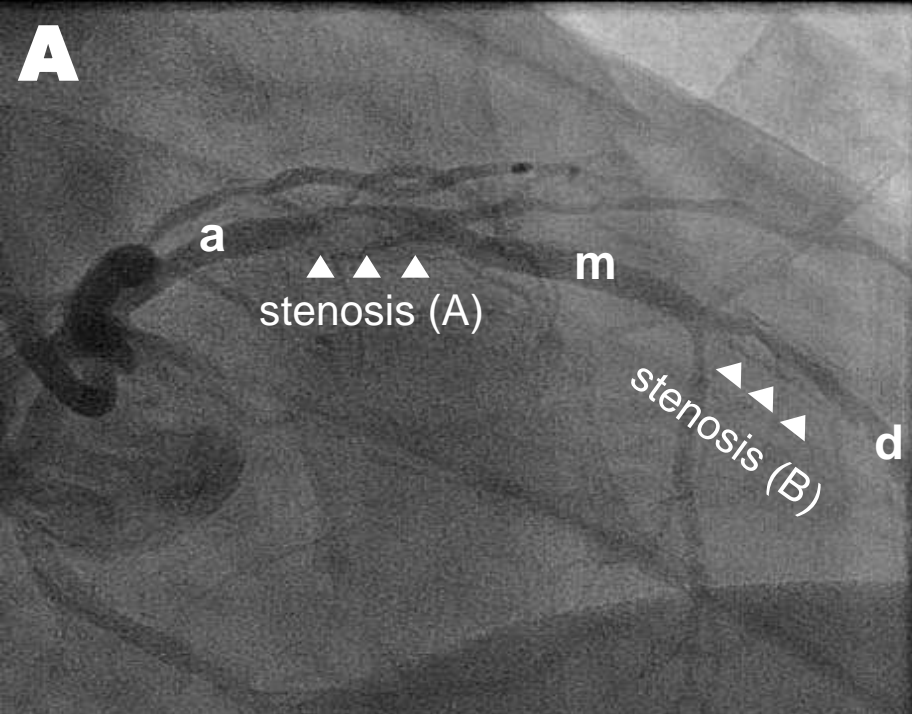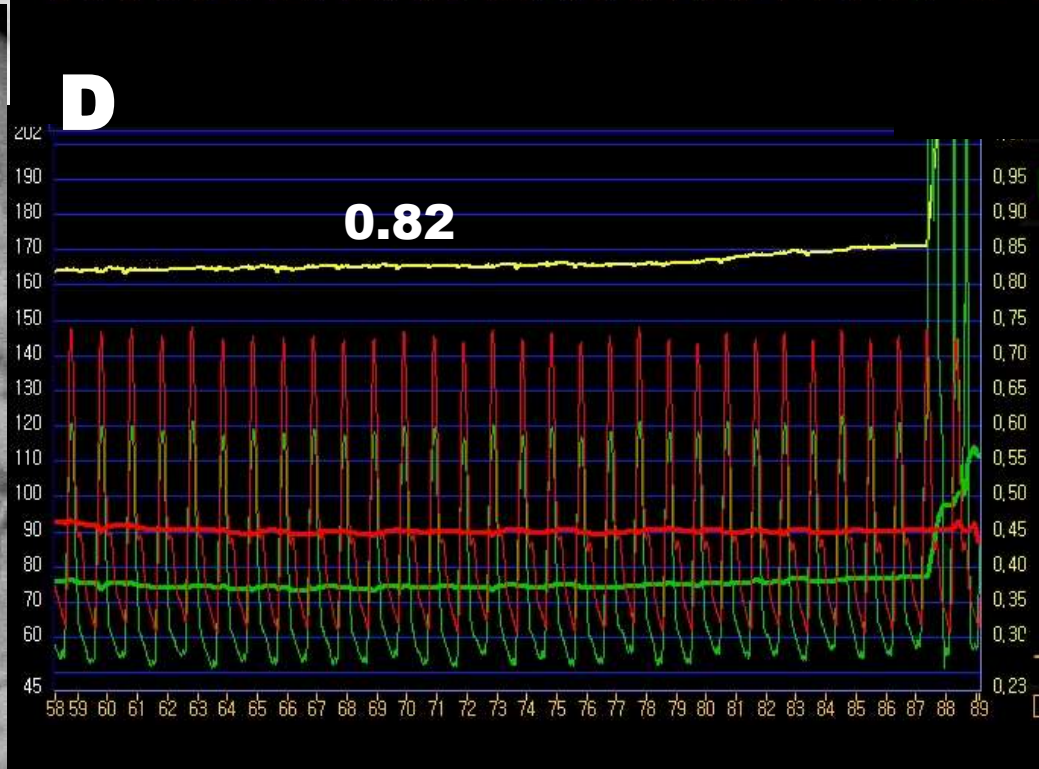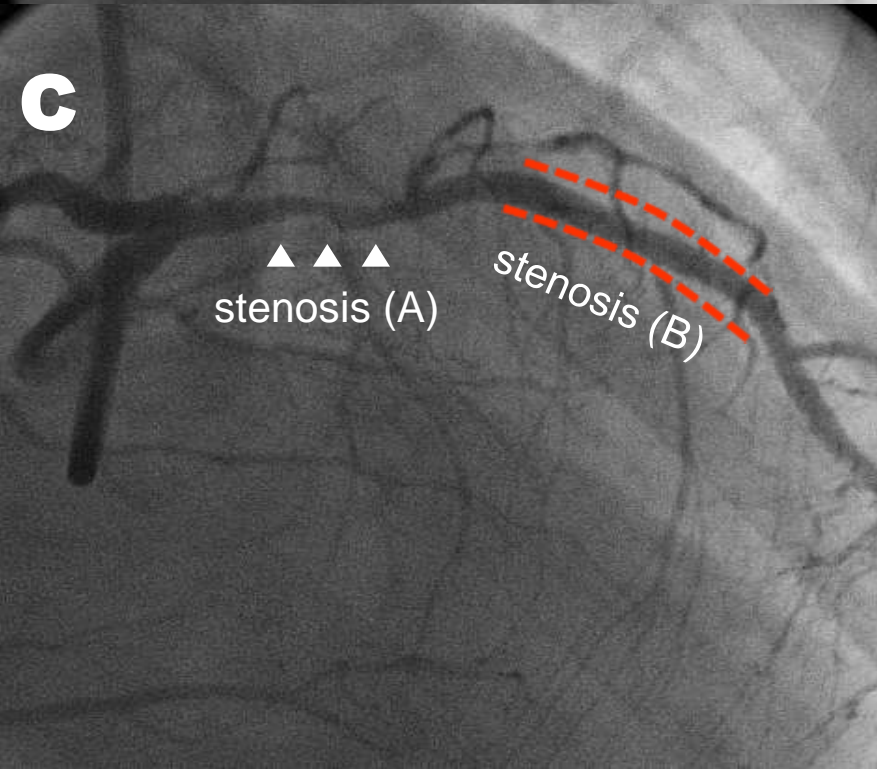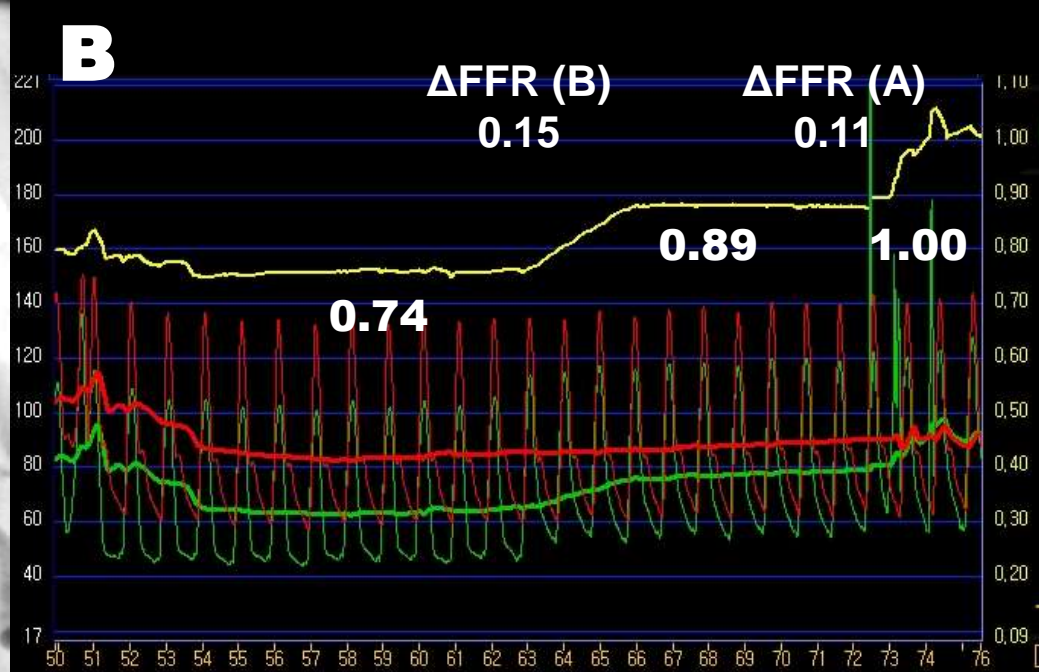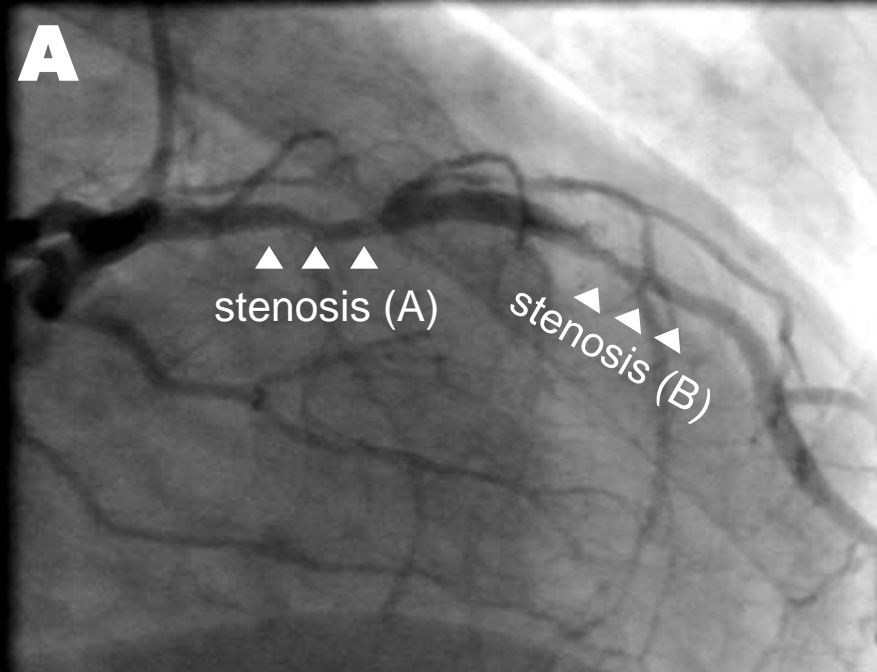
According to the Rule of "Big Delta"

52 patients with coronary tandem lesion with FFR ≤0.80

↓

Prioritizing the treatment according to △FFR ("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

Long-Term Outcomes

DATA from IRIS FFR registry

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. BRS appeared to be feasible in these common lesions.

- IVUS use may attenuate the detrimental effect of the increase of implanted stent length, 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.