2014 TCTAP

Wrap-Up Interview

Invasive Imaging

Moderator

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Interviewees

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Issues in Brief

- VH-IVUS: PROSPECT/VIVA/ATHEROREMO Study
- OCT: OCT guided PCI
- NIRS: Current Status and Ongoing Studies
- IVUS: Attenuated Plaque

Definition of Vulnerable Plaque

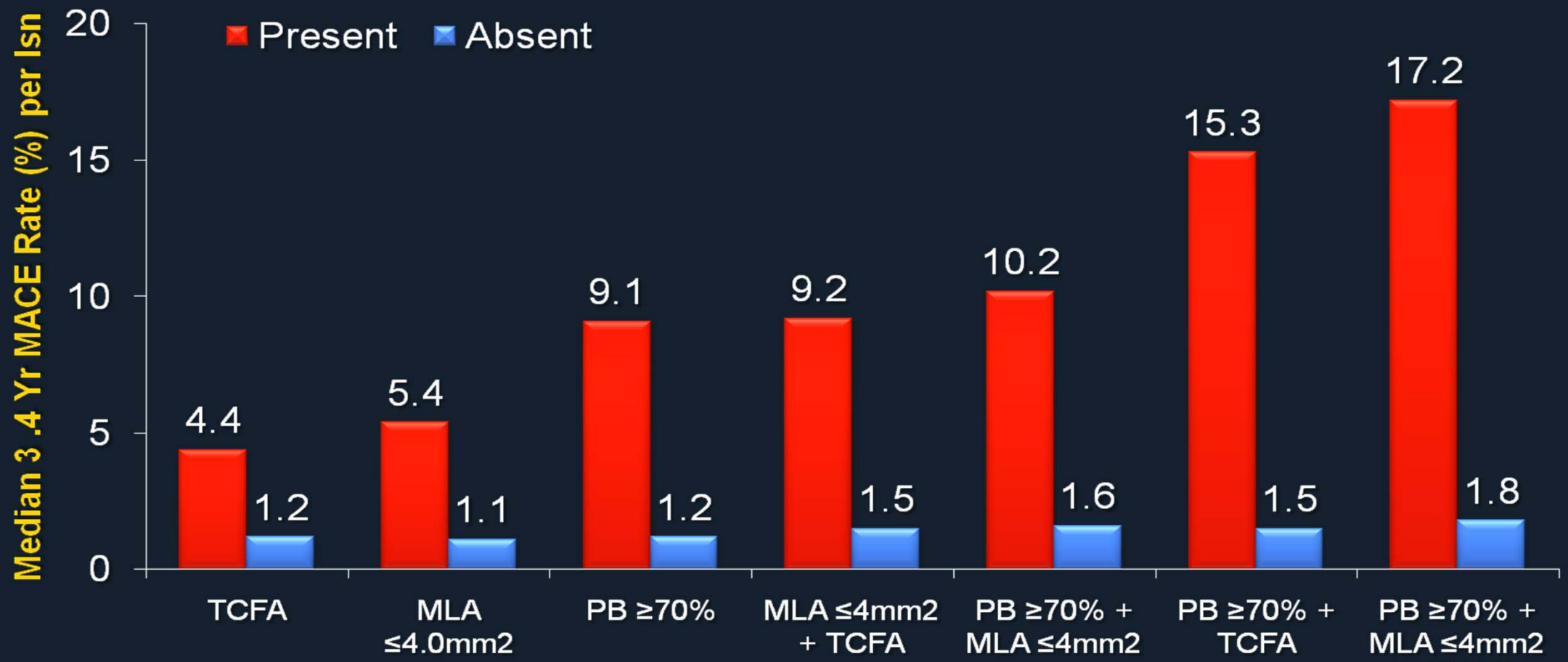
Major criteria

- **Active Inflammation**
- **Thin Cap with Large Lipid Core**
- **Endothelial Denudation with Superficial Platelet Aggregation**
- **Fissured Plaque**
- **Stenosis >90%**

Circulation, 2003; 14:1664-1672

PROSPECT

Correlates of Non Culprit Lesion Related Events



Lesion HR	3.8 (2.2, 6.6)	5.0 (2.9, 8.7)	7.9 (4.6, 13.8)	6.4 (3.4, 12.2)	6.7 (3.4, 13.0)	10.8 (5.5, 21.0)	10.8 (4.3, 27.2)
P value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Prevalence*	51.2%	49.1%	30.7%	17.4%	15.4%	11.0%	4.6%

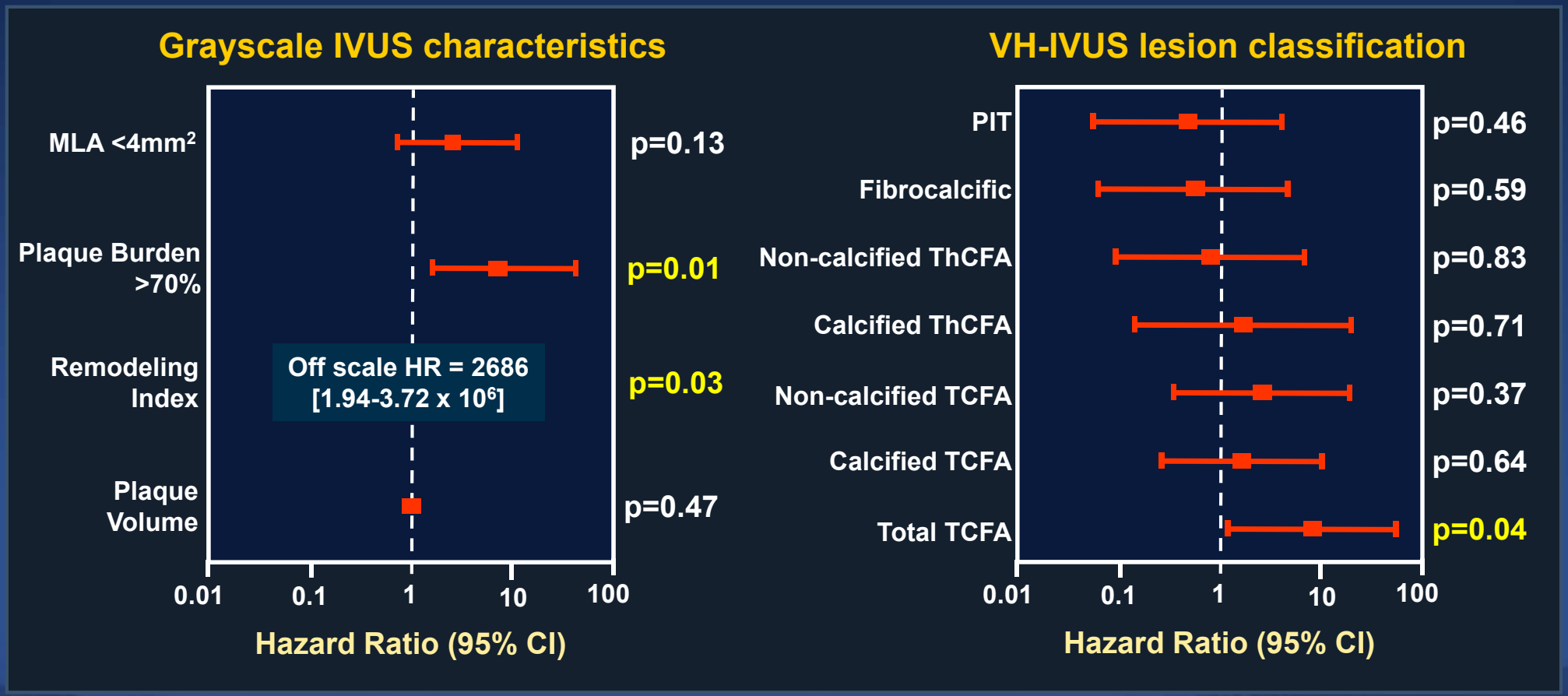
Stone G et al. N Engl J Med 2011;364:226-35

VIVA Study

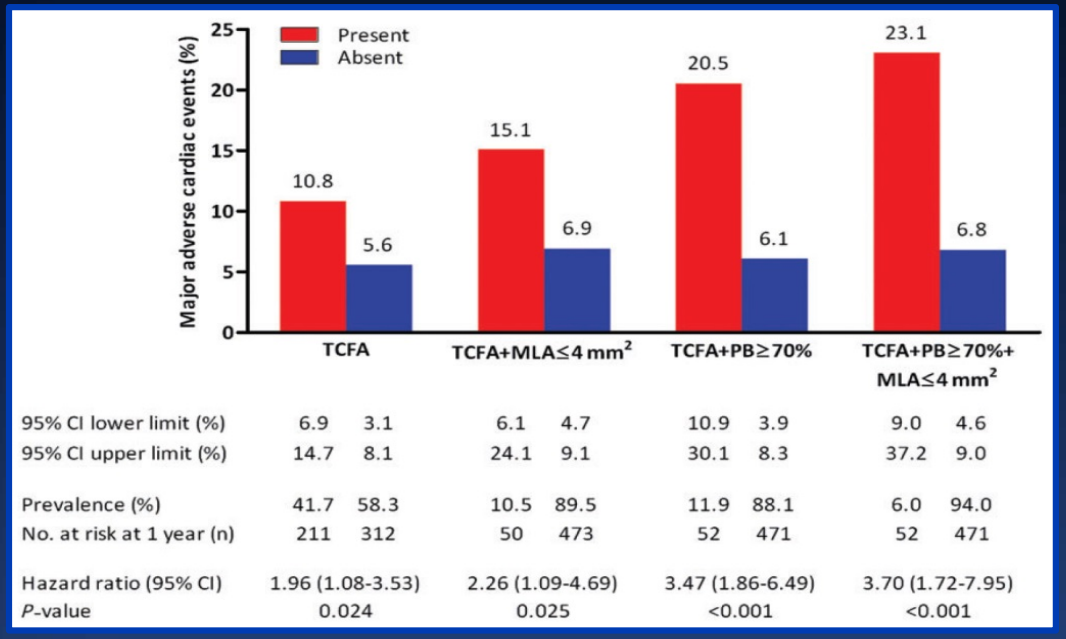
167 pts; 3-vessel VH-IVUS; 625 days

18 MACE (death [2], MI [2] or revasc [14]) in 16 pts
from 19 lesions (13 nonculprit lesions and 6 culprit lesions)

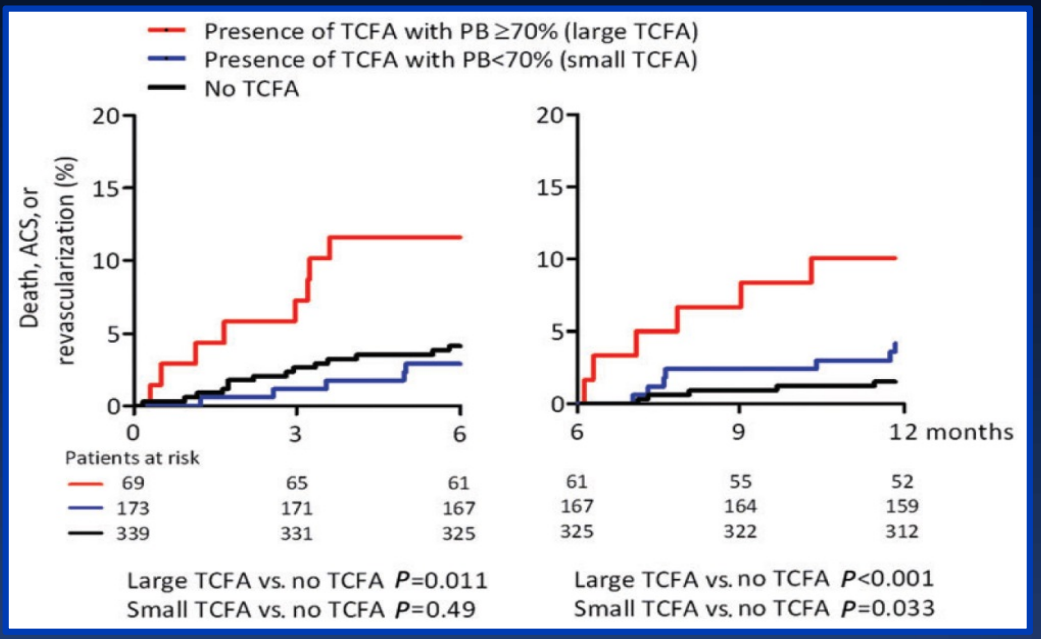
Univariate predictors of non-culprit MACE



Calvert PA et al. JACC Img 2011;4:894–901



95% CI lower limit (%)	6.9	3.1	6.1	4.7	10.9	3.9	9.0	4.6
95% CI upper limit (%)	14.7	8.1	24.1	9.1	30.1	8.3	37.2	9.0
Prevalence (%)	41.7	58.3	10.5	89.5	11.9	88.1	6.0	94.0
No. at risk at 1 year (n)	211	312	50	473	52	471	52	471
Hazard ratio (95% CI)	1.96 (1.08-3.53)		2.26 (1.09-4.69)		3.47 (1.86-6.49)		3.70 (1.72-7.95)	
P-value	0.024		0.025		<0.001		<0.001	



- **A VH-TCFA (present 10.8% vs. absent 5.6%; adjusted HR: 1.98, P=0.026) and a plaque burden ≥70% (present 16.2% vs. absent 5.5%; adjusted HR: 2.90, P<0.001), but not the presence of lesions with an MLA ≤4.0mm², were independently associated with MACE.**
- **Risk for MACE was further increased if the VH-TCFA lesions had a MLA ≤4.0mm², plaque burden ≥70%, or a combination of these three characteristics**
- **VH-TCFAs with a plaque burden ≥70% were associated with a higher MACE rate both in the first 6 months (P=0.011) and after 6 months (P<0.001), while smaller TCFA lesions were only associated with a higher MACE rate after 6 months (P=0.033)**

Cheng et al. Eur Heart J, in press

Which One is Better?

IVUS guided PCI

ADAPT DES

Witzenbichler et al. Circulation 2014;129:463-70

4 Meta-Analysis

Zhang et al. Eurointervention 2012;8:855-65
Kersy C et al. Int J Cardiol 2013;170:54-63
Jang et al. JACC Cardiovasc Interv 2014;7:233-43
Ahn et al. Am J Cardiol 2014;113:1338-47

OCT guided PCI

CLI-OPCI

Prati F et al. EuroIntervention 2012;8:823-9

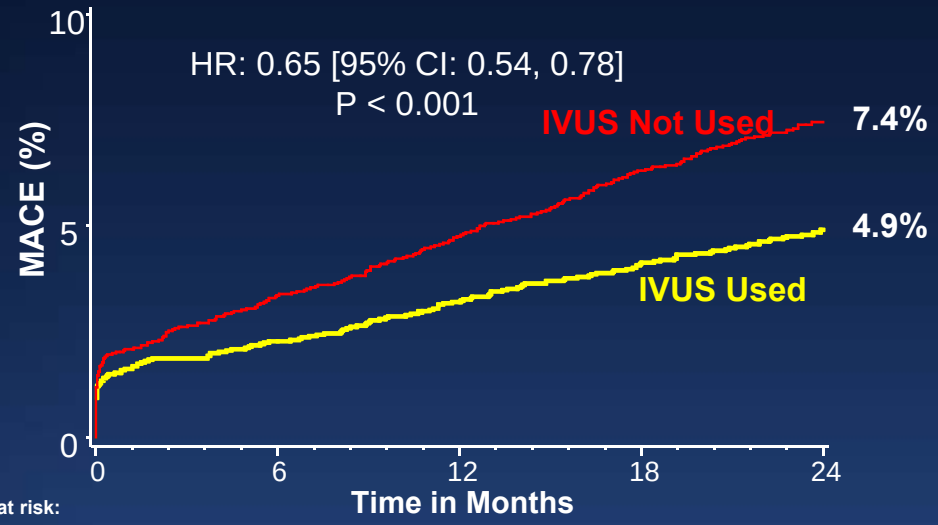
OCT vs IVUS guided PCI

Habara et al.
Circ Cardiovasc Interv. 2012;5:193-201

Four meta-analyses have assessed IVUS vs angiography-guided DES implantation

					HR (p-values)					
Reference	**Yr**	**RCT**	**Non-RCT**	**Pts**	**MACE**	**Death**	**MI**	**ST**	**TLR**	**TVR**
Zhang et al Euroin tervention	2012	1	10	19,619	0.87 (p=0.008)	0.59 (p<0.001)	0.82 (p=0.13)	0.58 (p<0.001)	0.90 (p=0.3)	0.90 (p=0.2)
Propensity score m atched sub-analysis			6	5,300	0.86 (p=0.06)	0.73 (p=0.04)	0.63 (p=0.01)	0.57 (p=0.004)	0.85 (p=0.3)	0.94 (p=0.6)
Klersy et al Int J Cardiol	2013	3	9	18,707	0.80 (p<0.001)	0.60 (p<0.001)	0.59 (p=0.001)	0.58 (p=0.007)	0.95 (p=0.8)	
Jang et al. JACC Cardiovasc Interv	On-line	3	12	24,869	0.79 (p=0.001)	0.64 (p<0.001)	0.57 (p<0.001)	0.59 (p=0.002)	0.76 (p=0.01)	0.81 (p=0.01)
Propensity score ma tched sub-analysis			9	13,545	0.79 (p=0.01)	0.58 (p=0.01)	0.56 (p=0.04)	0.52 (p=0.004)	0.85 (p=0.3)	0.93 (p=0.3)
Ahn et al. Am J Ca rdiol	In press	3	14	26,503	0.74 (p<0.001)	0.61 (p<0.001)	0.57 (p<0.001)	0.59 (p<0.001)	0.81 (p=0.046)	0.82 (p=0.022)

MACE (Definite/Probable ST, Cardiac Death, MI)

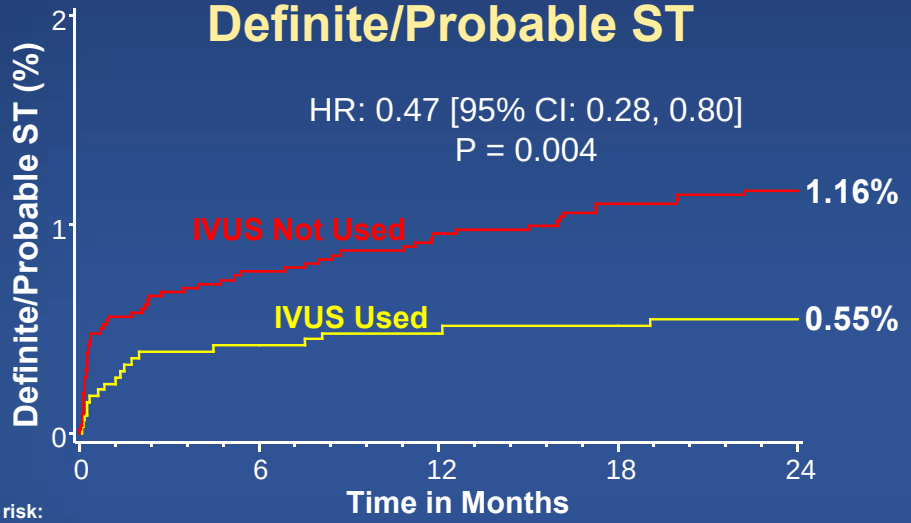


Number at risk:

IVUS Used	3361	3206	3117	2988	1739
IVUS Not Used	5221	4912	4740	4537	2177

Two year follow-up data from ADAPT-DES (3361 pts treated with IVUS-guidance vs 5221 pts treated with angiographic guidance)

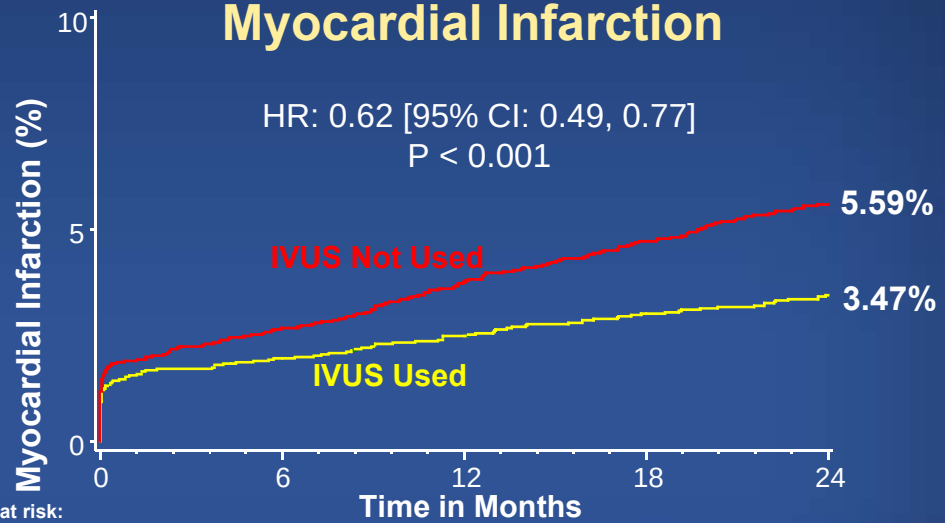
Definite/Probable ST



Number at risk:

IVUS Used	3361	3260	3182	3065	1791
IVUS Not Used	5221	5019	4886	4713	2279

Myocardial Infarction



Number at risk:

IVUS Used	3361	3209	3120	2991	1739
IVUS Not Used	5221	4916	4744	4541	2179

Maehara et al. J Am Coll Cardiol 2013;62:B21-B22

Comparison of pts undergoing PCI with "OCT guidance" vs angiographic guidance at three high-OCT-volume Italian centers: CLI-OPCI Study

One year outcomes	OCT	Angiography	p
#	335	335	
Death	3.3%	6.9%	0.035
Cardiac death	1.2%	4.5%	0.010
MI	5.4%	8.7%	0.096
TLR	3.3%	3.3%	1
Definite ST	0.3%	0.6%	0.6
Cardiac death/MI	6.6%	13.0%	0.006
Cardiac death/MI or repeat revascularization*	9.6%	15.1%	0.034

***Even after accounting for baseline and procedural differences (OR=0.49, p=0.037)**

Prati et al. Eurointervention 2012;8:823-9

Randomized comparison of IVUS vs OCT-guided stenting with blinded cross-over imaging (n=70) showed that IVUS was superior and indicating that there is a need for a new paradigm for OCT-guided stenting

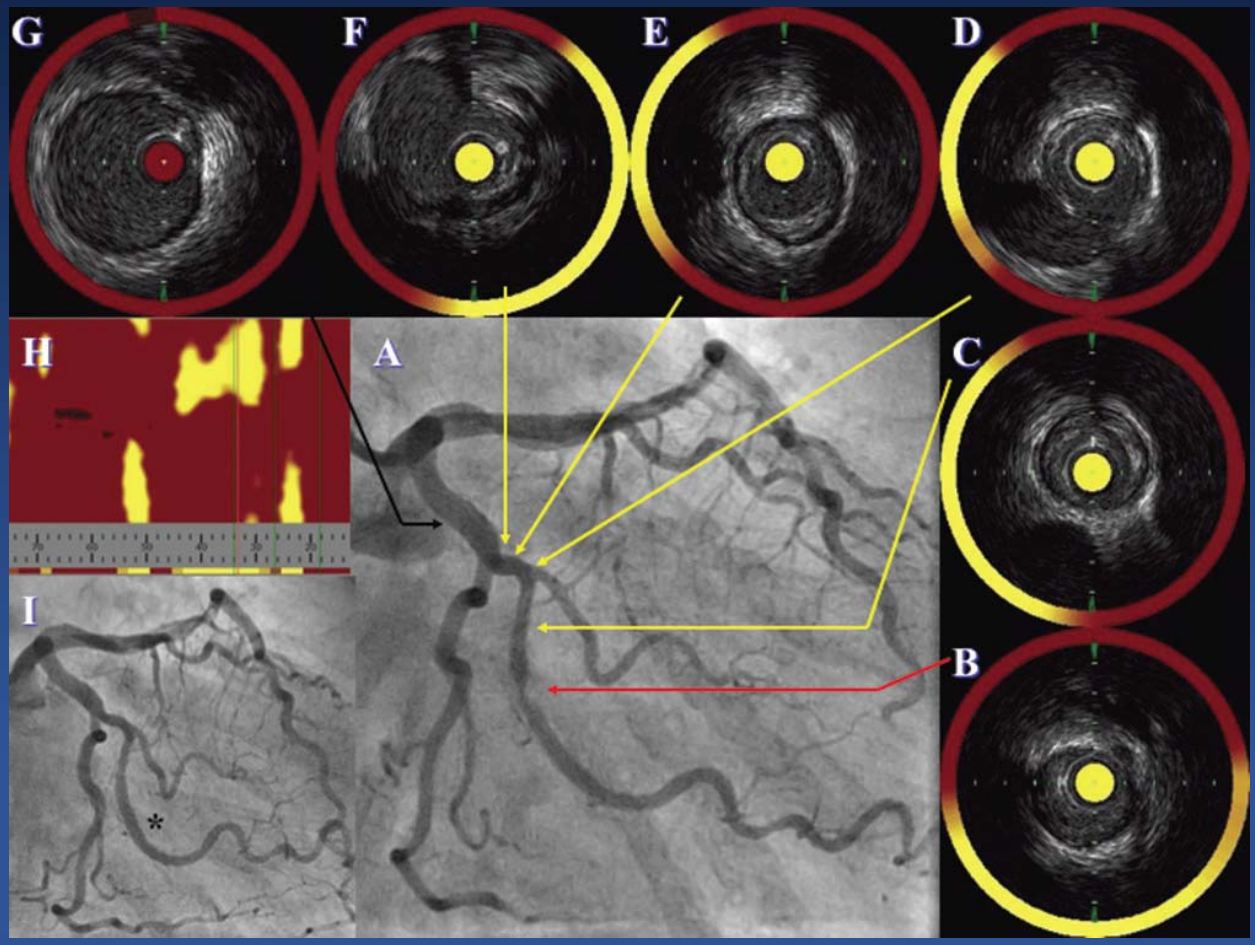
	IVUS	OCT	P-value
Final inflation pressure, atm	16.1±4.7	13.5±3.4	0.03
Final balloon diameter, mm	3.2±0.4	3.4±0.6	0.3
Proximal edge			
Plaque burden, %	37.1±10.1	45.7±10.9	0.001
Plaque burden >50%	8.6%	31.4%	0.04
MSA, mm^2	7.1±2.1	6.1±2.2	0.04
Focal expansion	80±13%	65±14%	0.001
Distal edge			
Plaque burden, %	33.3±6.4	40.3±8.8	<0.001
Plaque burden >50%	2.9%	11.4%	0.4

All OCT findings including the frequency of stent malapposition and the percentage of cross sections with malapposed strute were not significantly different between the groups.

Habara et al. Circ Cardiovasc Interv 2012;5:193-201

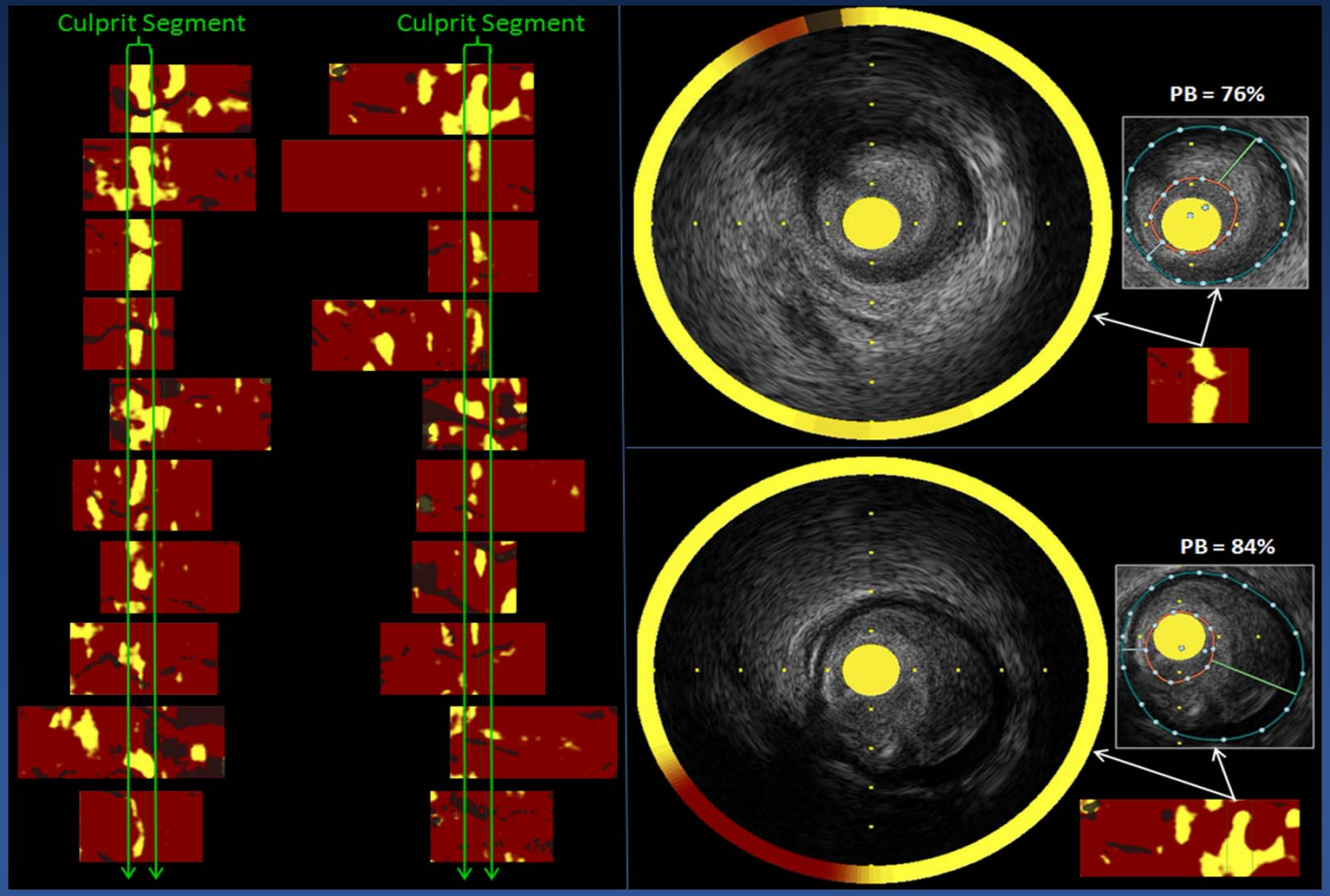
Near Infrared Spectroscopy

Interventional Role and Emerging Data



Rizik et al JIC Supplement 2013

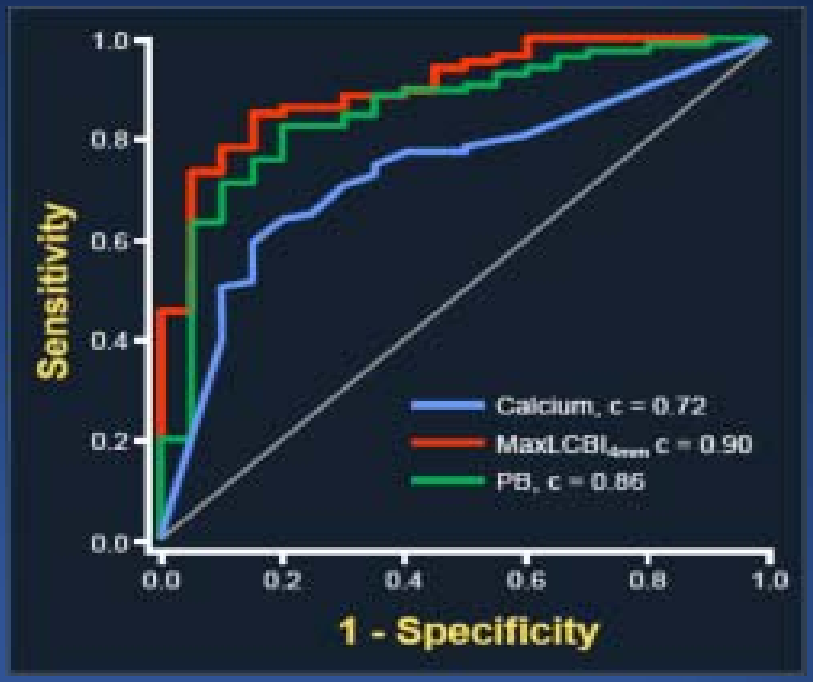
The culprit segments contained lipid rich plaque in 19 of 20 STEMI cases (95%), all with a large plaque burden.



Madder et al, JACC Cardiovasc Interv 2013;6:838-46

IVUS and NIRS were performed pre-PCI in 20 STEMI pts. Culprit lesions were compared to nonculprit segments in the same artery and to autopsy control segments.

	STEMI Culprit	STEMI Non-culprit	Histology
#	20	87	279
MaxLCBI$_{4mm}$	524 (445, 821)	90 (6, 265)	6 (0, 88)
Plaque burden (%)	64±14	44±15	44±14
Calcification (%)	89	38	0

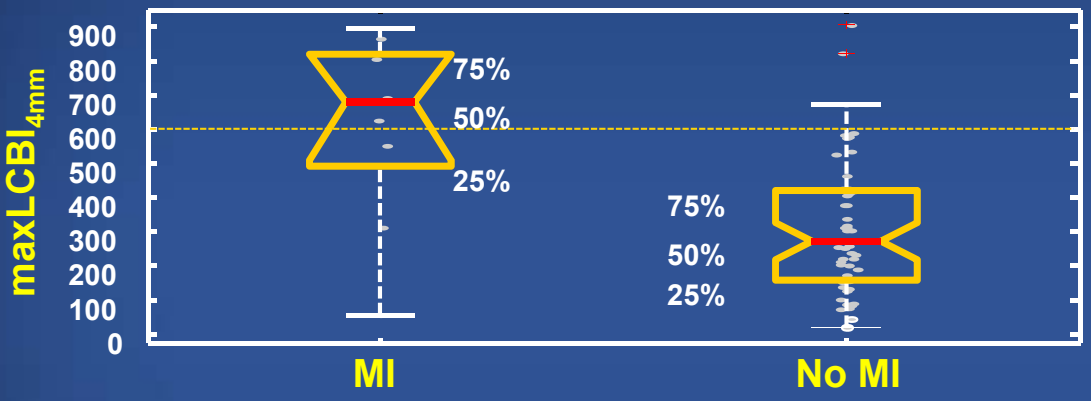


Madder et al, JACC Cardiovasc Interv 2013;6:838-46

COLOR Registry

62 pts were studied pre-PCI using NIRS. Peri-procedure MI (cTnI >3x normal) occurred in 9 pts.

Predictors	RR	p
$maxLCBI_{4mm}$ >500	12.0	0.0002
LDL >100mg/dL	5.4	0.03
Angiographic complex lesion	3.5	0.15
Angiographic DS >75%	3.1	0.14



Peri-procedural MI - defined as an elevation >5× the ULN for either CPK-MB or Troponin I occurred in 21.6% of 88 pts with normal baseline biomarkers

- **No differences in clinical or angiographic variables**
- **The best cut-off of $maxLCBI_{4mm}$ for detecting peri-procedural MI was 524 (AUC=0.672) with a specificity of 63% and a sensitivity of 78%.**
- **Peri-procedural MI occurred in 17 of 69 pts (24.6%) with $maxLCBI_{4mm}$ <500 compared with 12 of 19 pts (63.2%) with $maxLCBI_{4mm}$ ≥500 (p=0.002). The relative risk of peri-procedural MI for pts with $maxLCBI_{4mm}$ ≥500 was 5.2 (95% CI 1.8 to 16.2, p=0.002).**

Goldstein et al. Circ Cardiovasc Interv 2011;4:429-437

Dohi et al. ACC2014

Near Infrared Spectroscopy

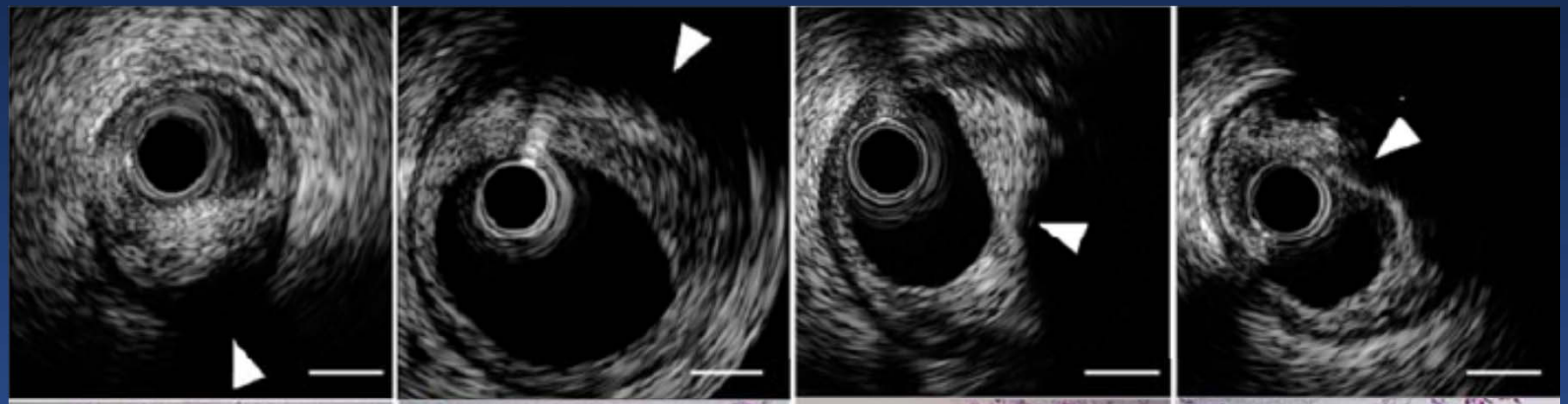
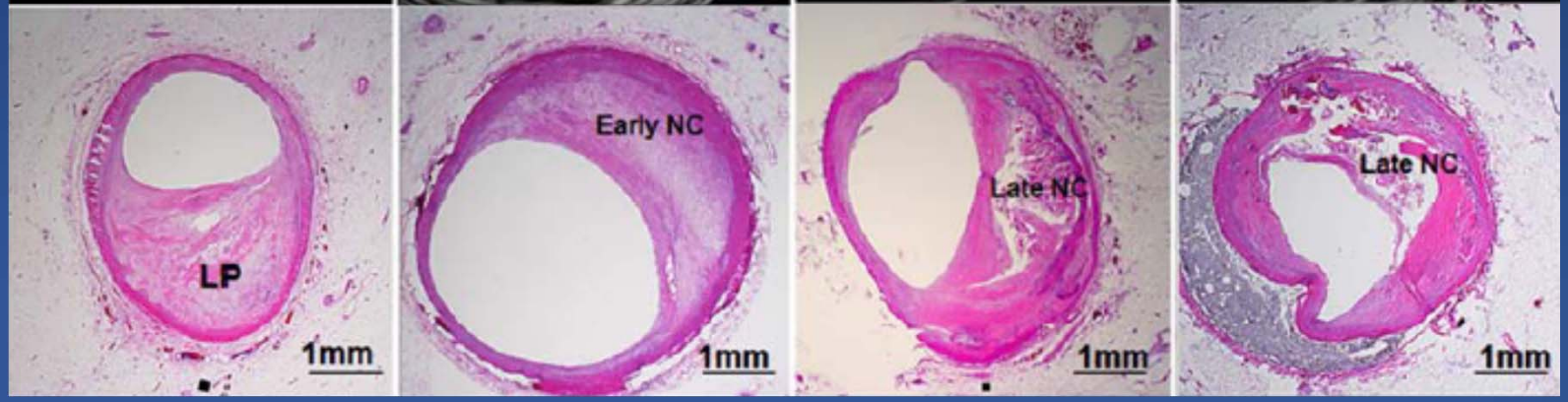
Interventional Role and Emerging Data

1. Vulnerable Plaque: ACS/STEMI
2. Distal Embolization: COLOR registry, CANARY Study
3. Stent Thrombosis
4. Drug Evaluation: YELLOW trial

Madder RD et al. JACC Cardiovascular Interv 2013;6:838-46
Madder RD et al. Circ Cardivasc Interv 2012;5:55-61
Goldstein JA et al. Circ Cardiovasc Interv. 2011:4:429-437
Sakhuja R et al. Circulation 2010;122:2349-2350
Kini A et al. JACC 2013; 62: 21-9

Echo Attenuated Plaque

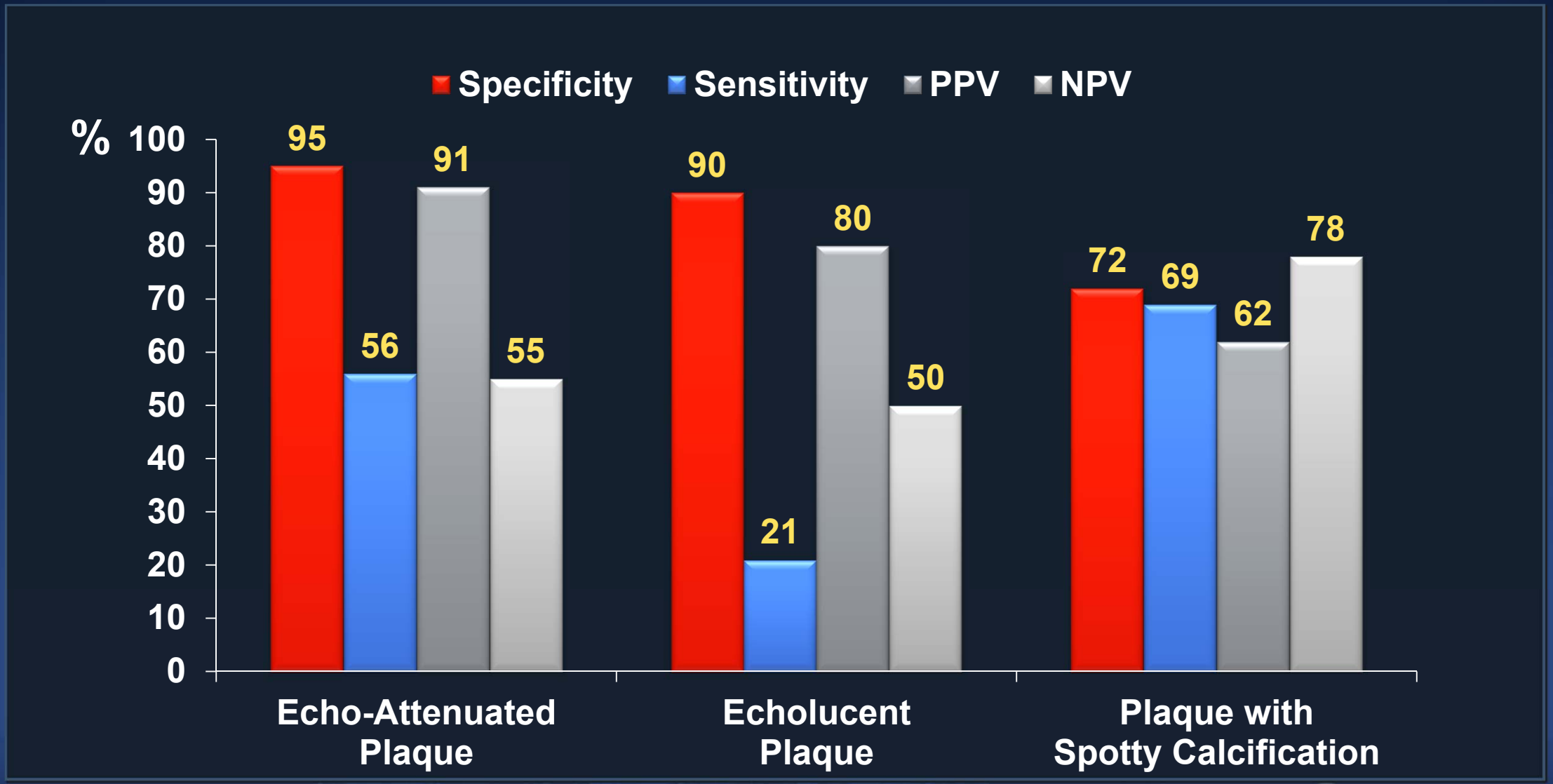
New Signals About Plaque Instability

IVUS	**Attenuated Plaque (Deep)**	**Attenuated Plaque (Deep)**	**Attenuated Plaque (Superficial)**	**Attenuated Plaque (Superficial)**
				
				
Pathology	**PIT (Lipid pool)**	**Early FA (Early NC)**	**Late FA (Late NC)**	**TCFA (Late NC)**

Jun Pu et al. JACC, 2014 In Press

Echo Attenuated Plaque

IVUS findings and Pathological Lipid/Necrotic Core



Jun Pu et al. JACC, 2014 In Press

Discussion

- Risk Prediction Based on Intracoronary Imaging
- OCT Guided PCI
- Clinical Roles of NIRS
- Echo-Attenuated Plaque
- Future Perspective of Intracoronary Imaging