Review in 2015
Imaging

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Disclosure Statement of Financial Interest

I, Soo-Jin Kang DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation

Papers in 2015
Intravascular Imaging

- Hong MK et al. JAMA
- Wijns W et al. Eur Heart J
- Meahara A et al. JACC Intv
- Soeda T et al. Circulation
- Niccoli G et al. Eur Heart J
- Taruya A et al. J Am Coll Cardiol
- Puri R et al. J Am Coll Cardiol

Original Investigation

Effect of Intravascular Ultrasound–Guided vs Angiography-Guided Everolimus-Eluting Stent Implantation

The IVUS-XPL Randomized Clinical Trial

Sung-Jin Hong, MD; Byeong-Keuk Kim, MD; Dong-Ho Shin, MD, MPH; Chung-Mo Nam, PhD; Jung-Sun Kim, MD; Young-Guk Ko, MD; Donghoon Choi, MD; Tae-Soo Kang, MD; Woong-Chol Kang, MD; Ae-Young Her, MD; Yonghoon Kim, MD; Seung-Ho Hur, MD; Bum-Kee Hong, MD; Hyuckmoon Kwon, MD; Yangsoo Jang, MD; Myeong-Ki Hong, MD, PhD; for the IVUS-XPL Investigators

- between Oct 2010-July 2014 at 20 centers in Korea
- 1400 pts with long lesions (>28mm stent length)
- randomly assigned to receive IVUS-guided (n=700) or angiography-guided (n=700) EES implantation
- primary end point: 1-year MACE (cardiac death, target lesion-related MI, or ischemia-driven TLR)
- follow-up rate 94.5%

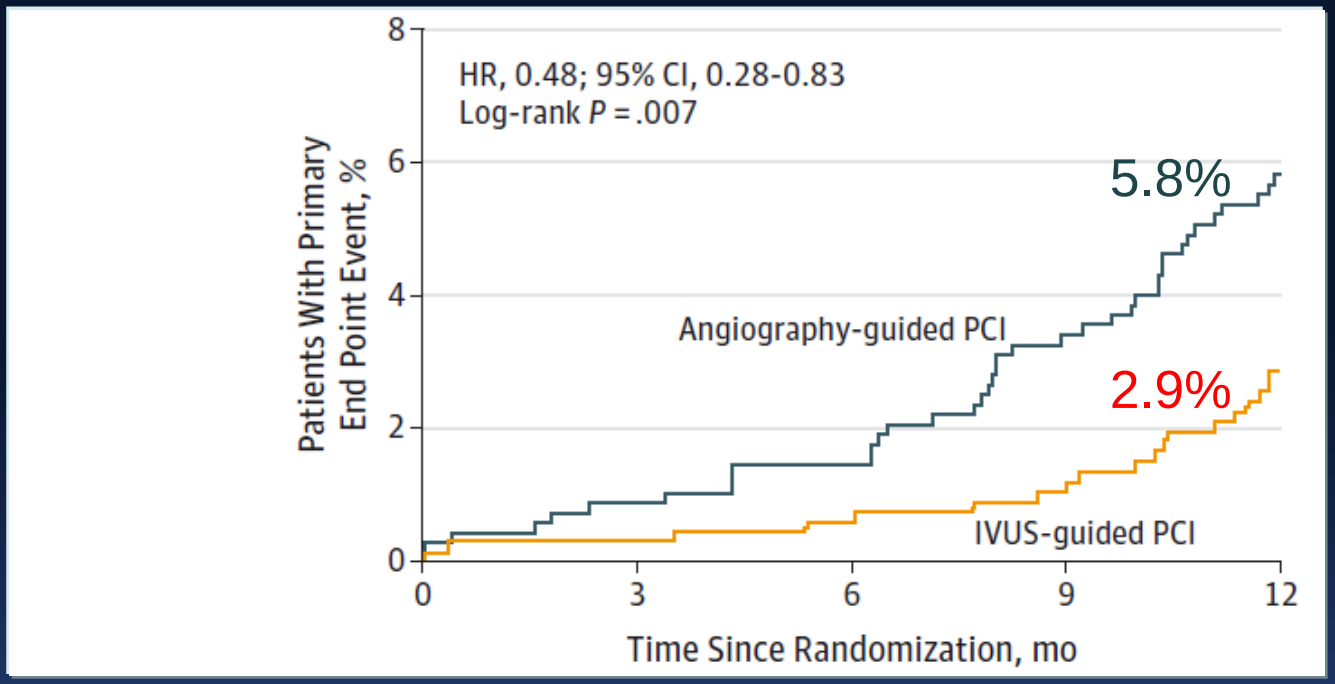
Hong SJ, Hong MK et al. JAMA 2015;10:1-9

Angiographic and Procedural Characteristics

	IVUS-guided	Angio-guided	p
Pre-PCI QCA-MLD, mm	0.83±0.42	0.82±0.43	0.56
Pre-PCI QCA-RVD, mm	2.89±0.45	2.85±0.45	0.13
Pre-PCI lesion length, mm	34.7±10.8	35.2±10.5	0.41
Post-dilatation, N (%)	534 (76%)	402 (57%)	<0.001
Final balloon size, mm	3.14 ±0.43	3.04 ±0.42	<0.001
Maximal inflation pressure, atm	16.5±4.1	15.9±4.1	0.05
Post-stenting QCA-MLD, mm	2.64±0.42	2.56±0.39	<0.001
Post-stenting QCA-RVD,mm	3.03±0.44	2.97±0.43	0.01
Total stent length, mm	39.3±13.1	39.2±12.3	0.90

Hong SJ, Hong MK et al. JAMA 2015;10:1-9

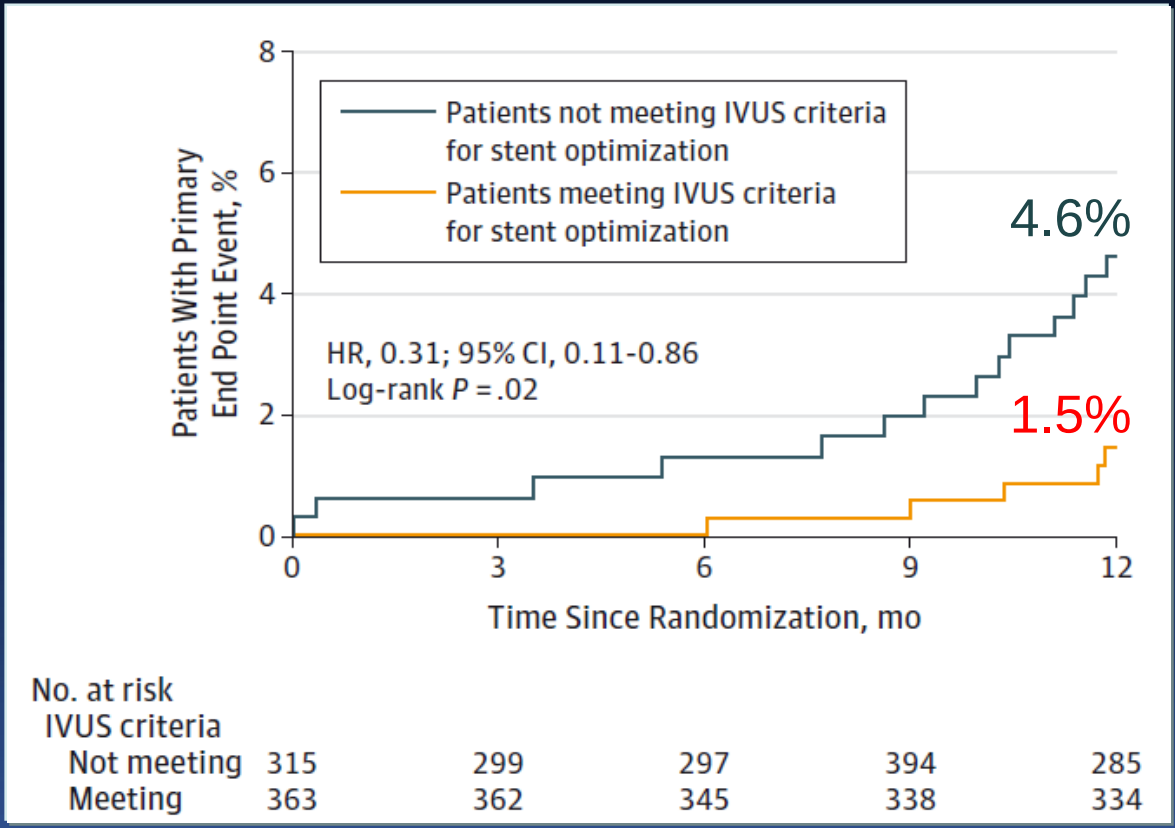
Kaplan-Meier Estimates of 1-year MACE



	IVUS-guided	Angio-guided	HR	p
Cardiac death	3 (0.4%)	5 (0.7%)	0.60 (0.14-2.52)	0.48
Target lesion-related MI	0 (0%)	1 (0.1%)		0.32
Ischemia-driven TLR	17 (2.5%)	33 (5.0%)	0.51 (0.28-0.91)	0.02
Stent thrombosis	2 (0.3%)	2 (0.3%)	1.00 (0.14-7.10)	1.0

Hong SJ, Hong MK et al. JAMA 2015;10:1-9

Kaplan-Meier Estimates of 1-year MACE for Patients With IVUS-Guided PCI



Conclusion Among patients with long lesions, IVUS- (vs. angio-) guided EES implantation resulted in a lower rate of 1-year MACE, which was primarily due to the lower risk of TLR

Hong SJ, Hong MK et al. JAMA 2015;10:1-9

Optical coherence tomography imaging during percutaneous coronary intervention impacts physician decision-making: ILUMIEN I study

William Wijns[1*], Junya Shite[2], Michael R. Jones[3], Stephen W.-L. Lee[4], Matthew J. Price[5], Franco Fabbiocchi[6], Emanuele Barbato[1], Takashi Akasaka[7], Hiram Bezerra[8], and David Holmes[9]

A prospective, non-randomized study to see the impact of OCT on physician decision-making, post-PCI residual ischemia, and clinical outcomes

418 patients with 467 lesions

Mandatory use of FFR and plan PCI strategy

Pre-PCI OCT (411 pts, 459 lesions)

Plan changed in 230 (55%) pts, 264 (57%) lesions

Perform PCI

FFR and OCT

With unsatisfactory post-PCI OCT results
Optimization in 25% of pts, 27% of lesions

14.5% malapposition
7.6% under-expansion
2.7% edge dissection

Follow-up at discharge and at 30 days (401 pts)

Eur Heart J 2015 in press

FFR and Clinical Outcomes

	PCI optimiz, without change	PCI optimiz based on pre-PCI OCT	PCI optimiz, based on post-PCI OCT	PCI optimiz, based on pre- and post-PCI OCT	p
Pre-PCI FFR	0.72±0.14	0.73±0.14	0.72±0.14	0.72±0.14	0.93
Post-PCI FFR	0.89±0.07	0.89±0.07	0.89±0.08	0.86±0.09	0.003
Final FFR			0.90±0.10	0.90±0.10	0.24
In-hos MACE	8.8%	6.7%	12.2%	1.5%	0.118
1-mo MACE	8.8%	8%	12.5%	1.5%	0.127
Peri-procedural MI	9.5%	8.6%	10.0%	0%	0.029

- Following OCT-guided PCI, the rates of MACEs at 30 days were very low (death 0.25%, MI 7.7%, TLR 1.7%, ST 0.25%)

Wijns et al. Eur Heart J 2015 in press

Implications

- Physician decision-making was affected by OCT imaging pre-PCI in 57% and post-PCI in 27%
- Changes in PCI procedure based on OCT were associated with a low rate of peri-procedural MI
- Use of OCT can have substantial impact on how operators treat patients with stable angina

Comparison of Stent Expansion Guided by Optical Coherence Tomography Versus Intravascular Ultrasound

The ILUMIEN II Study (Observational Study of Optical Coherence Tomography [OCT] in Patients Undergoing Fractional Flow Reserve [FFR] and Percutaneous Coronary Intervention)

Akiko Maehara, MD,*† Ori Ben-Yehuda, MD,*† Ziad Ali, MD,*† William Wijns, MD, PhD,‡ Hiram G. Bezerra, MD,§ Junya Shite, MD,‖ Philippe Généreux, MD,*†¶ Melissa Nichols, MS,† Paul Jenkins, PhD,† Bernhard Witzenbichler, MD,# Gary S. Mintz, MD,† Gregg W. Stone, MD*†

Design: A post-hoc analysis of the outcome of OCT- vs. IVUS-guided PCI from the prospective ILUMIEN I and ADAPT-DES

Primary endpoint: Final post-PCI stent expansion (defined as the MSA divided by the mean of the proximal and distal RLA)

Meahara A. J Am Coll Cardiol Intv 2015;8:1704–14

ILUMIEN II

Retrospective comparison of OCT-guidance in ILUMIEN I and IVUS-guidance in ADAPT-DES

ILUMIEN I

418 pts enrolled

Lesions excluded:

- Poor quality (n=45)
- Not received by core lab (n=12)
- BRS (n=5)
- Inconsistent data (n=2)

ADAPT-DES

2,179 pts enrolled in IVUS substudy

Lesions excluded:

- No QCA available (n=1043)
- STEMI (n=378)
- In-stent restenosis (n=191)
- No reference available (n=179)
- Left main (n=99)
- Poor image quality or media issue (n=77)
- Chronic total occlusion (n=75)
- Saphenous vein graft (n=66)
- Unreliable pullback (n=66)
- Not received by core lab (n=12)

Randomly chosen 1 lesion per patient

Overall study population (n=940)

354 patients, 354 lesions | 586 patients, 586 lesions

1:1 Propensity matching

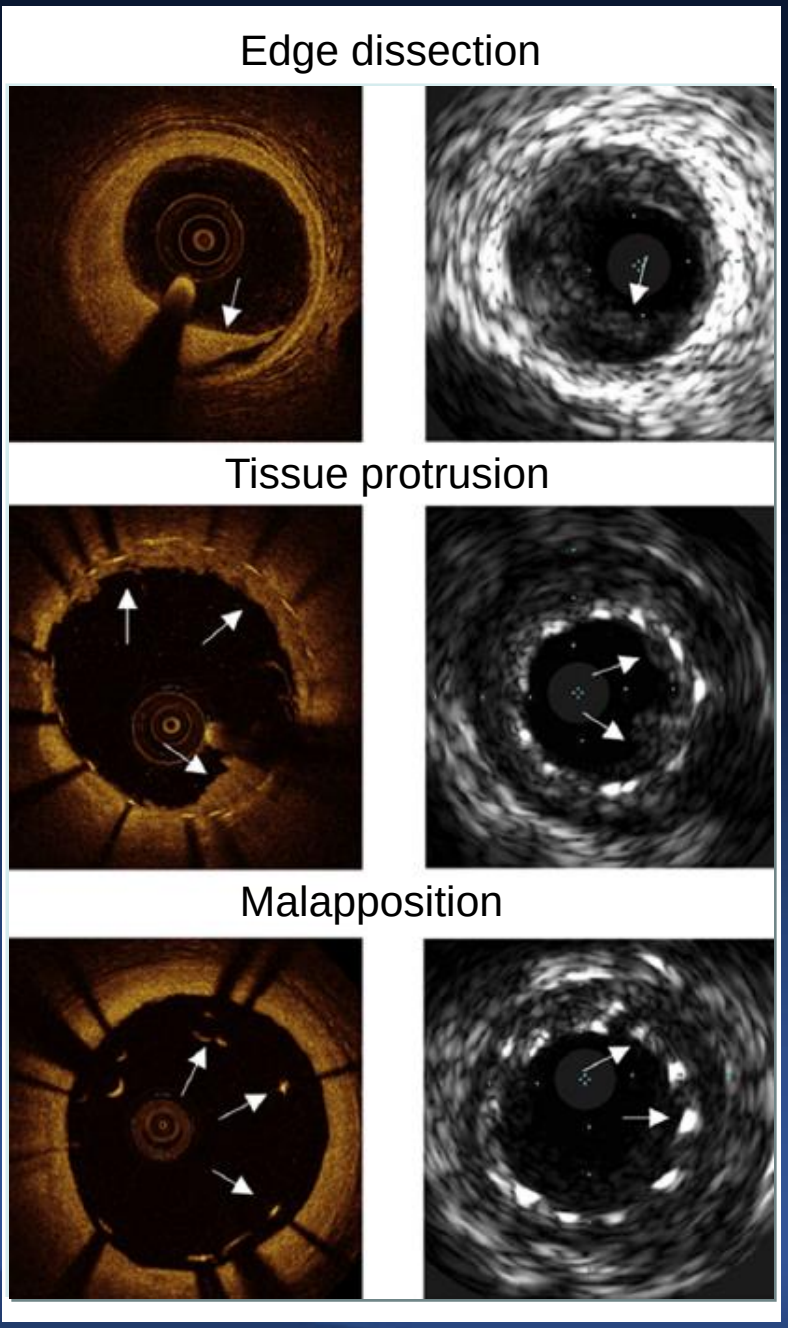
RVD, lesion length, calcification
reference segment availability

1:1 Propensity matched groups (n=572)

286 patients, 286 lesions | 286 patients, 286 lesions

Meahara A. J Am Coll Cardiol Intv 2015;8:1704–14

Qualitative Data in the Propensity-Matched Groups



	OCT (ILUMIEN I)	IVUS (ADAPT-DES)	p
Any malapposition	27%	14%	0.002
distance/MLD>20%	1%	1%	0.69
Any tissue protrusion	64%	27%	<0.001
protrusion CSA>10%	12%	8%	0.17
Any edge dissection	23%	5%	<0.001
dissec length ≥3mm	2%	1%	0.29

Meahara A. J Am Coll Cardiol Intv 2015;8:1704–14

TABLE 5 Multivariable Analysis in the Entire Study Population (N = 940)

	Endpoints			
	Stent Expansion, %	Mean Stent Expansion, %	Diameter Stenosis In-Stent, %	Diameter Stenosis In-Segment, %
Measurement by OCT (N = 354)	72.6 (63.5, 81.4)	89.6 (79.2, 98.5)	6.4 (2.7, 9.9)	13.3 (8.9, 20.2)
Measurement by IVUS (n = 586)	70.5 (62.1, 79.5)	86.8 (77.1, 96.8)	6.4 (3.0, 10.7)	11.2 (7.6, 17.2)
	Adjusted p Values			
OCT vs. IVUS	0.84	0.30	0.19	0.009

Conclusion

- OCT-guidance was related to comparable expansion, and similar rates of major edge dissection, protrusion, and malapposition as compared to IVUS-guidance
- OCT was as good as IVUS to guide stent expansion

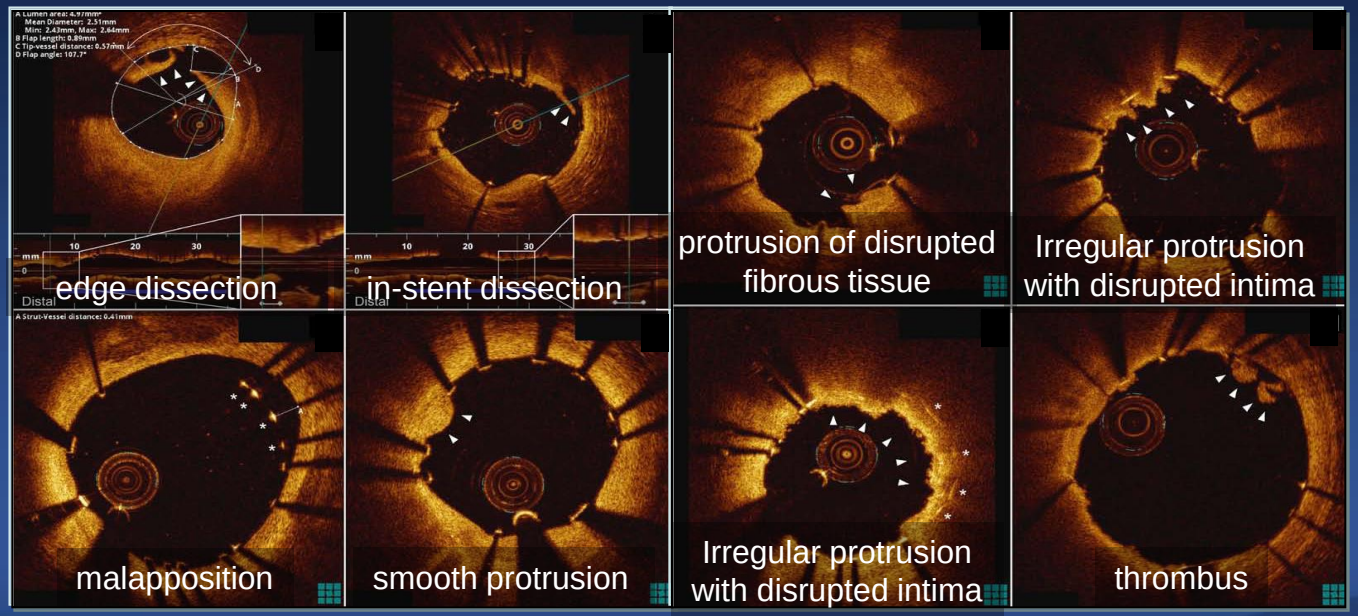
Meahara et al. J Am Coll Cardiol Intv 2015;8:1704-14

Incidence and Clinical Significance of Poststent Optical Coherence Tomography Findings

One-Year Follow-Up Study From a Multicenter Registry

Tsunenari Soeda, MD, PhD; Shiro Uemura, MD, PhD; Seung-Jung Park, MD, PhD; Yangsoo Jang, MD, PhD; Stephen Lee, MD; Jin-Man Cho, MD, PhD; Soo-Joong Kim, MD, PhD; Rocco Vergallo, MD; Yoshiyasu Minami, MD, PhD; Daniel S. Ong, MD; Lei Gao, MD, PhD; Hang Lee, PhD; Shaosong Zhang, MD, PhD; Bo Yu, MD, PhD; Yoshihiko Saito, MD; PhD; Ik-Kyung Jang, MD, PhD

From MGH OCT registry, 900 lesions in 786 patients were analyzed to identify the post-stenting OCT predictors for device-oriented clinical end points (cardiac death, target vessel-related MI, TLR and stent thrombosis)



Soeda T, Jang IK et al. Circulation 2015;132:1020-9

Incidence of Post-stent OCT Findings
(Lesion-Level)

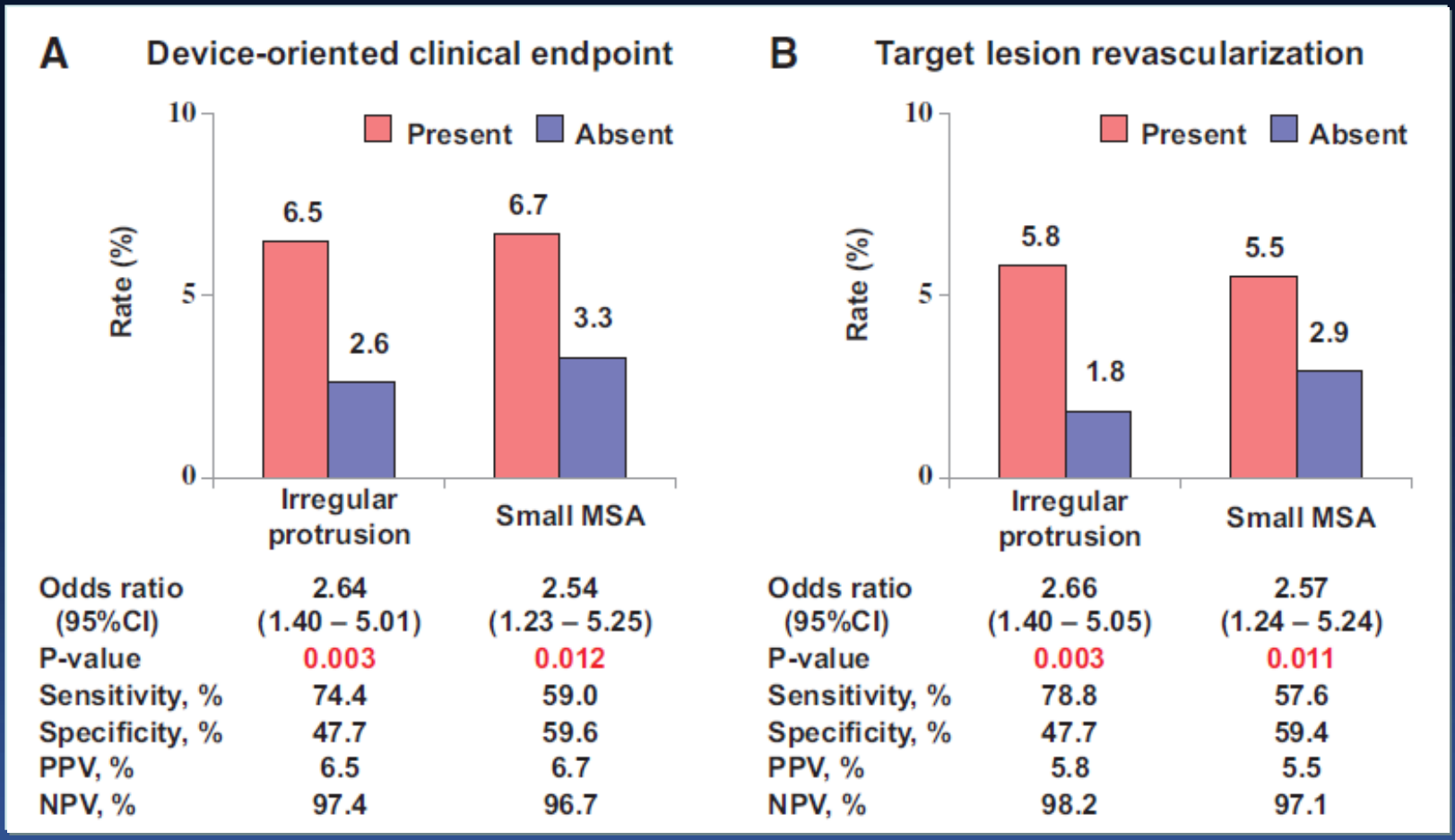
	No MACE	MACE	p
N	795	39	
Edge dissection	29%	31%	0.78
Malapposition	38%	36%	0.76
Tissue protrusion	97%	100%	0.63
Irregular protrusion	52%	74%	0.003
Thrombus	38%	51%	0.13
Small MSA*	40%	59%	0.039

*Small MSA : <5.0 mm^2 for DES and <5.6 mm^2 for BMS

Soeda T, Jang IK et al. Circulation 2015;132:1020-9

Device-oriented MACE and TLR

from multivariable models



	Irregular protrusion	Small MSA
Odds ratio (95%CI)	2.64 (1.40 – 5.01)	2.54 (1.23 – 5.25)
P-value	0.003	0.012
Sensitivity, %	74.4	59.0
Specificity, %	47.7	59.6
PPV, %	6.5	6.7
NPV, %	97.4	96.7

	Irregular protrusion	Small MSA
Odds ratio (95%CI)	2.66 (1.40 – 5.05)	2.57 (1.24 – 5.24)
P-value	0.003	0.011
Sensitivity, %	78.8	57.6
Specificity, %	47.7	59.4
PPV, %	5.8	5.5
NPV, %	98.2	97.1

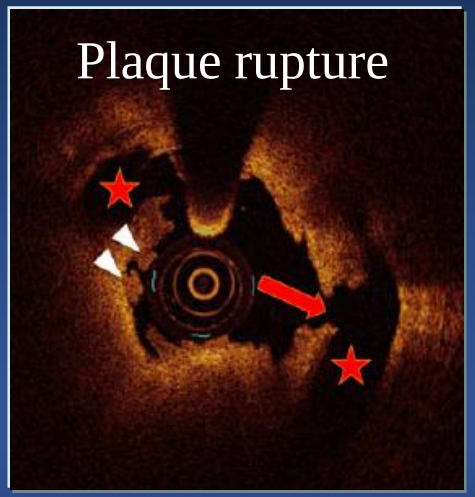
Irregular protrusion and underexpansion were the independent OCT predictors of MACE, which were primarily driven by TLR

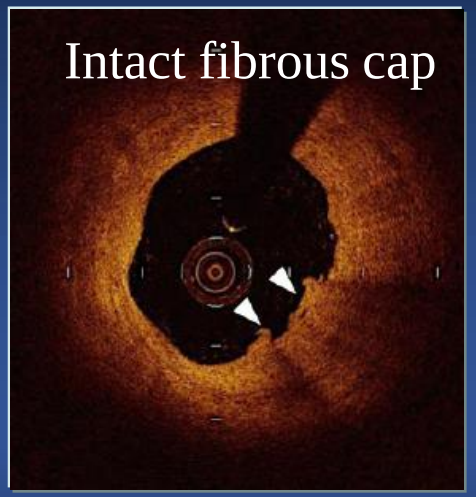
Soeda T, Jang IK et al. Circulation 2015;132:1020-9

Plaque rupture and intact fibrous cap assessed by optical coherence tomography portend different outcomes in patients with acute coronary syndrome

Giampaolo Niccoli[1]*, Rocco A. Montone[1], Luca Di Vito[2,3], Mario Gramegna[1], Hesham Refaat[1,4], Giancarla Scalone[1], Antonio M. Leone[1], Carlo Trani[1], Francesco Burzotta[1], Italo Porto[1], Cristina Aurigemma[1], Francesco Prati[2,3], and Filippo Crea[1]

- To evaluate the prognostic impact of plaque rupture vs. intact fibrous cap in 139 ACS patients undergoing PCI
- No differences in clinical, angiographic, or procedural data

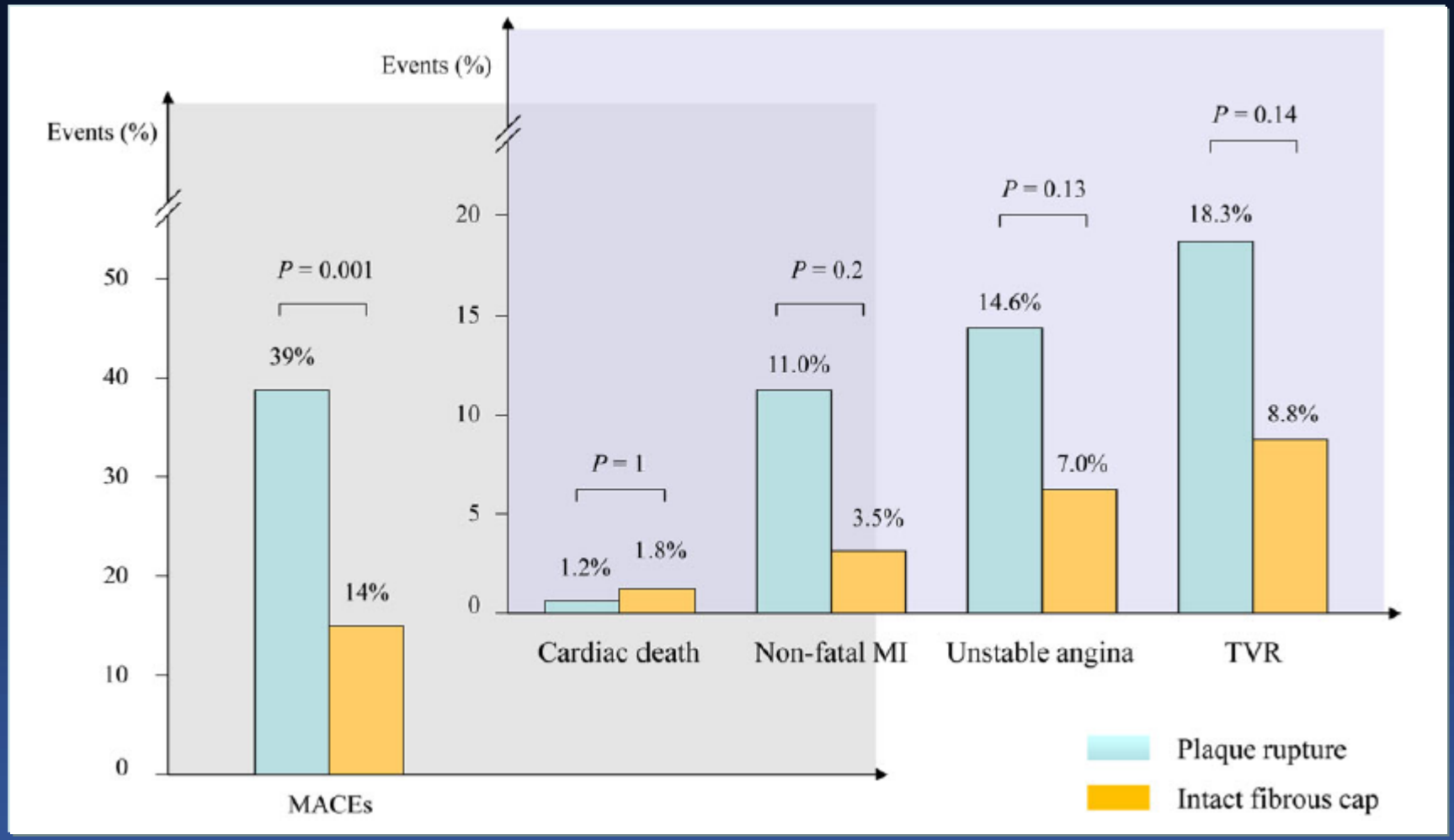




Niccoli et al. Eur Heart J 2015;36:1377-84

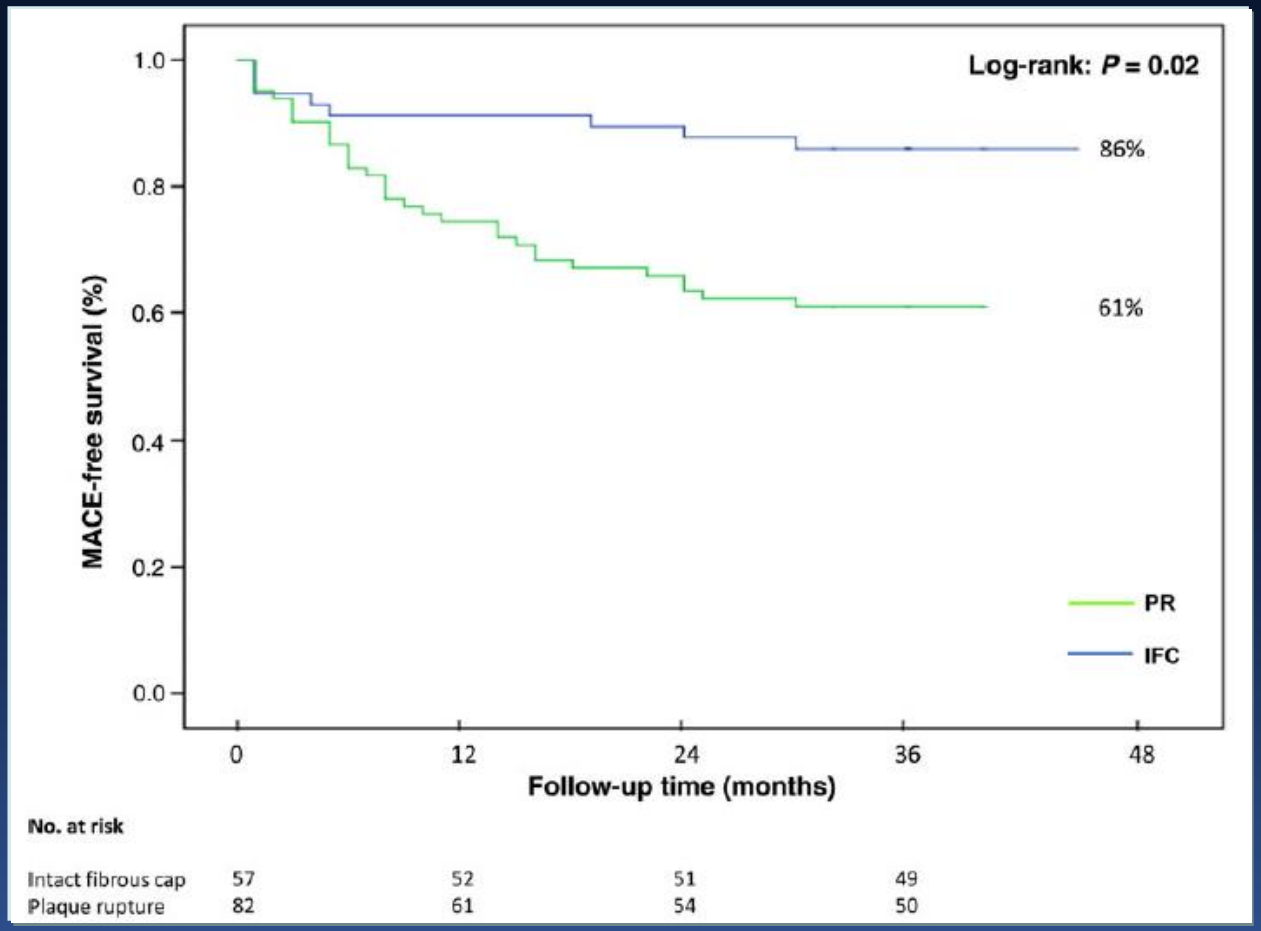
MACE rates

Patients with plaque rupture vs. with intact fibrous cap



Niccoli et al. Eur Heart J 2015;36:1377-84

Kaplan–Meier Analysis



Conclusion

Patients with plaque rupture had a worse MACE-free survival (61% vs. 86%) compared with those having an intact fibrous cap

Niccoli et al. Eur Heart J 2015;36:1377-84

Predictor of 3-year MACE

Multivariable Cox regression analysis

	HR	95% CI	p
Obesity (BMI >35)	1.688	0.822-3.845	0.15
Plaque rupture	3.735	1.358-9.735	0.010
Previous PCI	1.449	0.610-4.146	0.34
Stent length	1.028	0.980-1.081	0.26
Age	1.005	0.977-1.034	0.73
Male	1.36	0.335-1.591	0.76

Conclusion

ACS patients with plaque rupture in culprit lesion have a worse prognosis compared to those with IFC, which should be taken into account in risk stratification and management of ACS

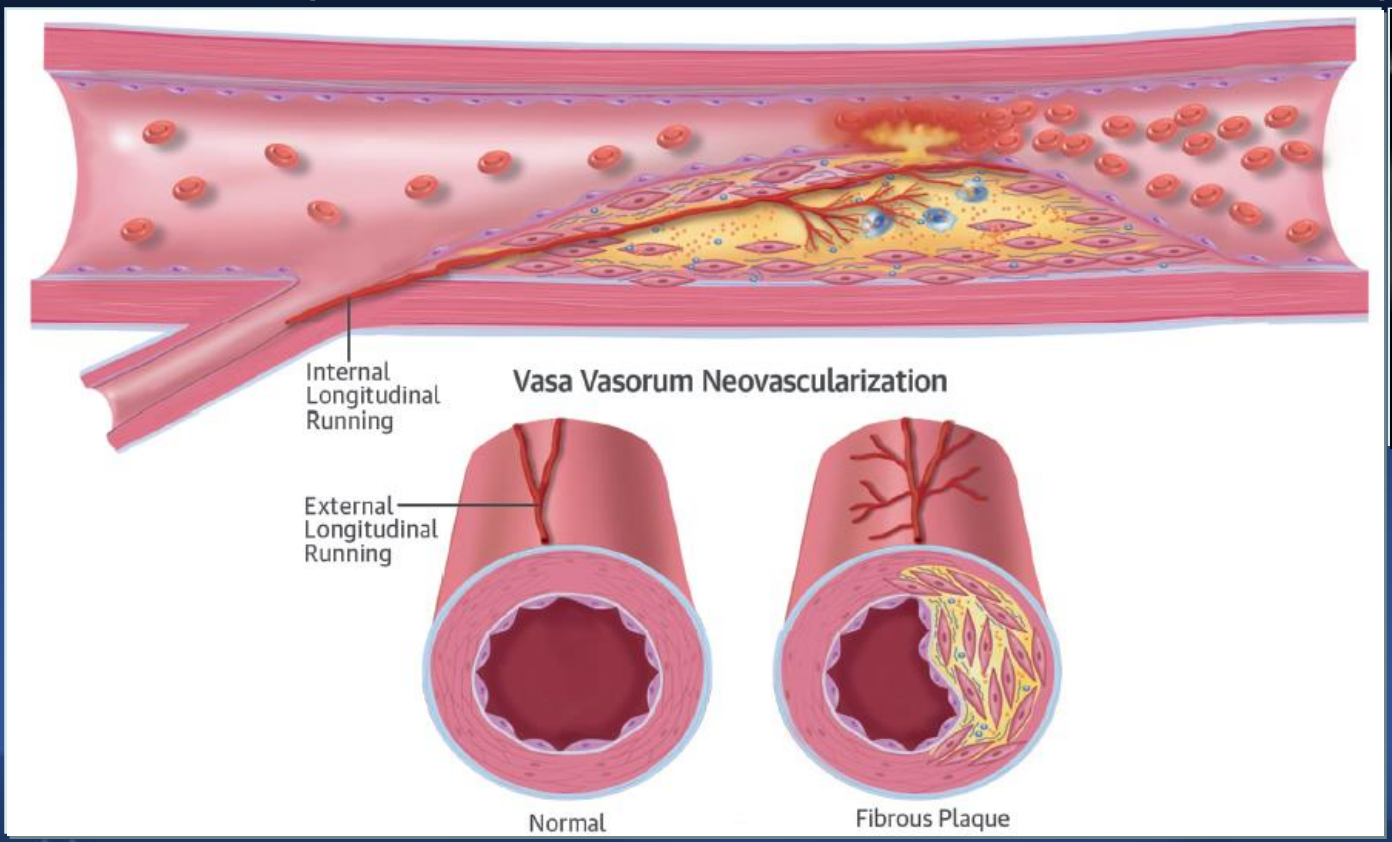
Niccoli et al. Eur Heart J 2015;36:1377-84

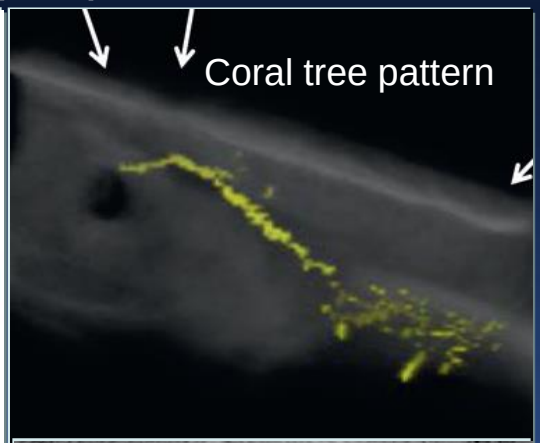
Vasa Vasorum Restructuring in Human Atherosclerotic Plaque Vulnerability

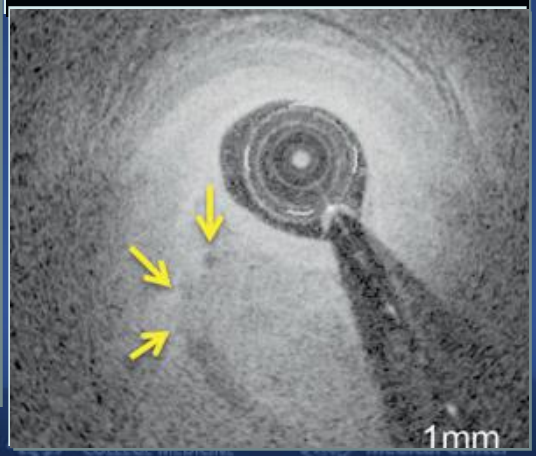
A Clinical Optical Coherence Tomography Study

Akira Taruya, MD, Atsushi Tanaka, MD, PhD, Tsuyoshi Nishiguchi, MD, Yoshiki Matsuo, MD, PhD, Yuichi Ozaki, MD, PhD, Manabu Kashiwagi, MD, PhD, Yasutsugu Shiono, MD, Makoto Orii, MD, Takashi Yamano, MD, Yasushi Ino, MD, Kumiko Hirata, MD, PhD, Takashi Kubo, MD, PhD, Takashi Akasaka, MD, PhD

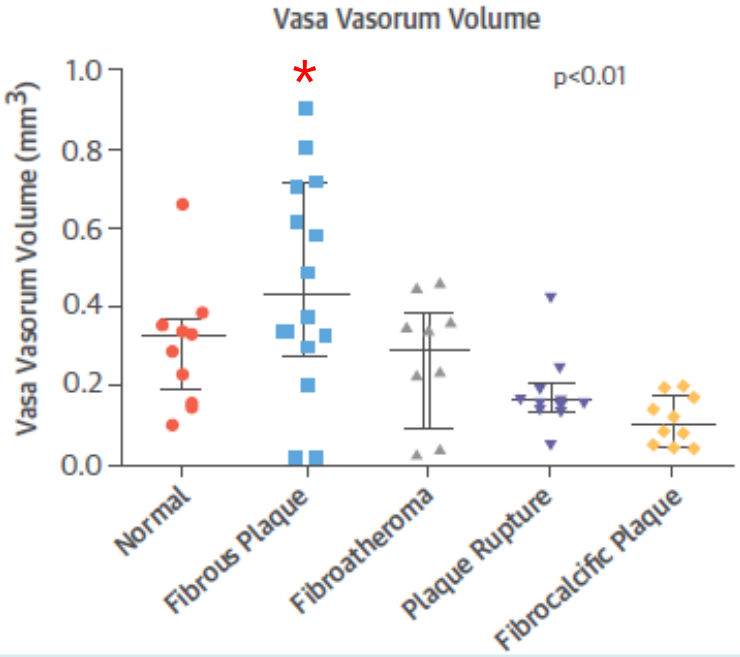
Relationship between neovascularization structures and plaque characteristics

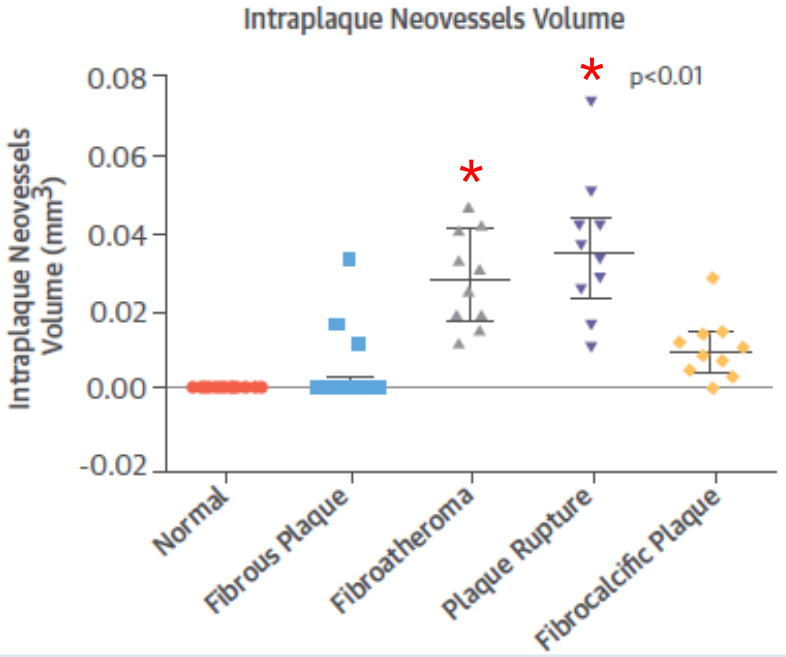


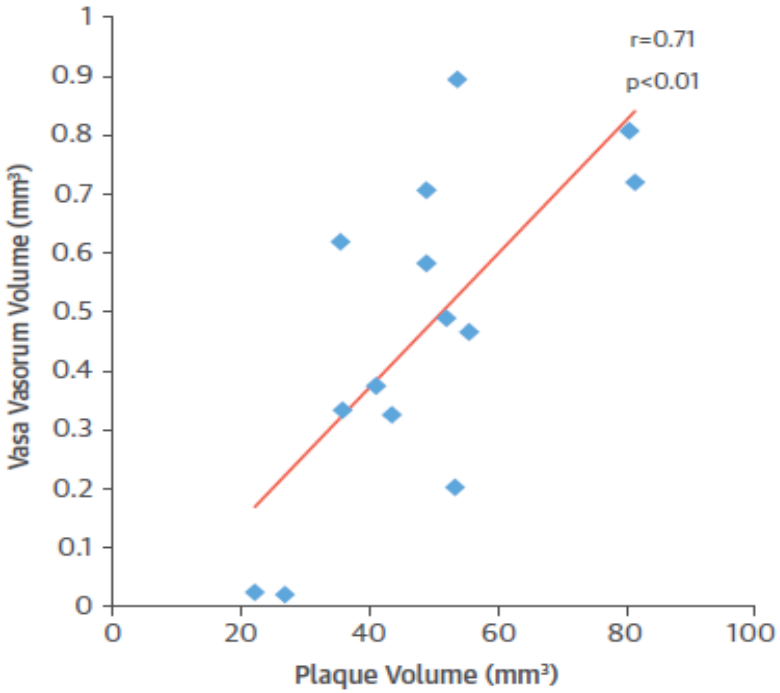


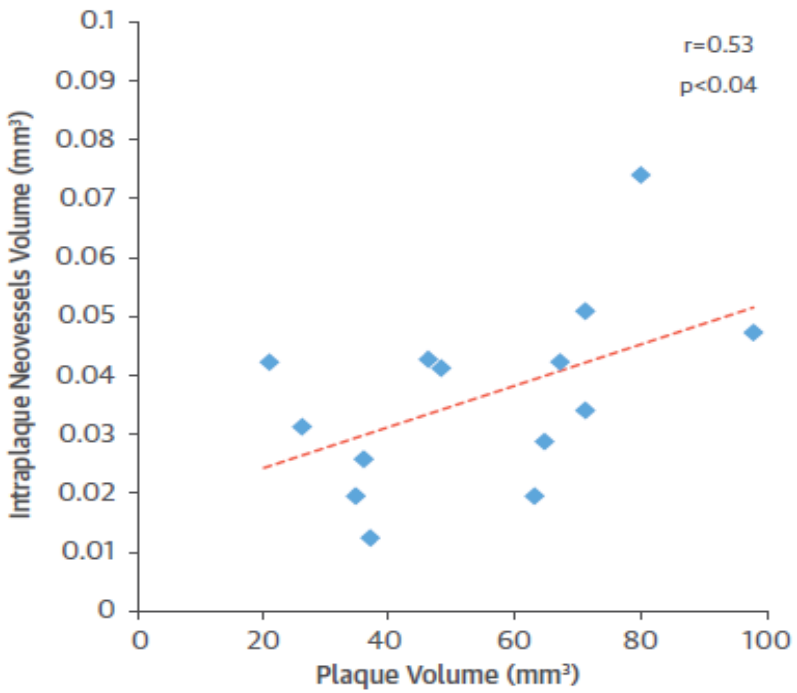


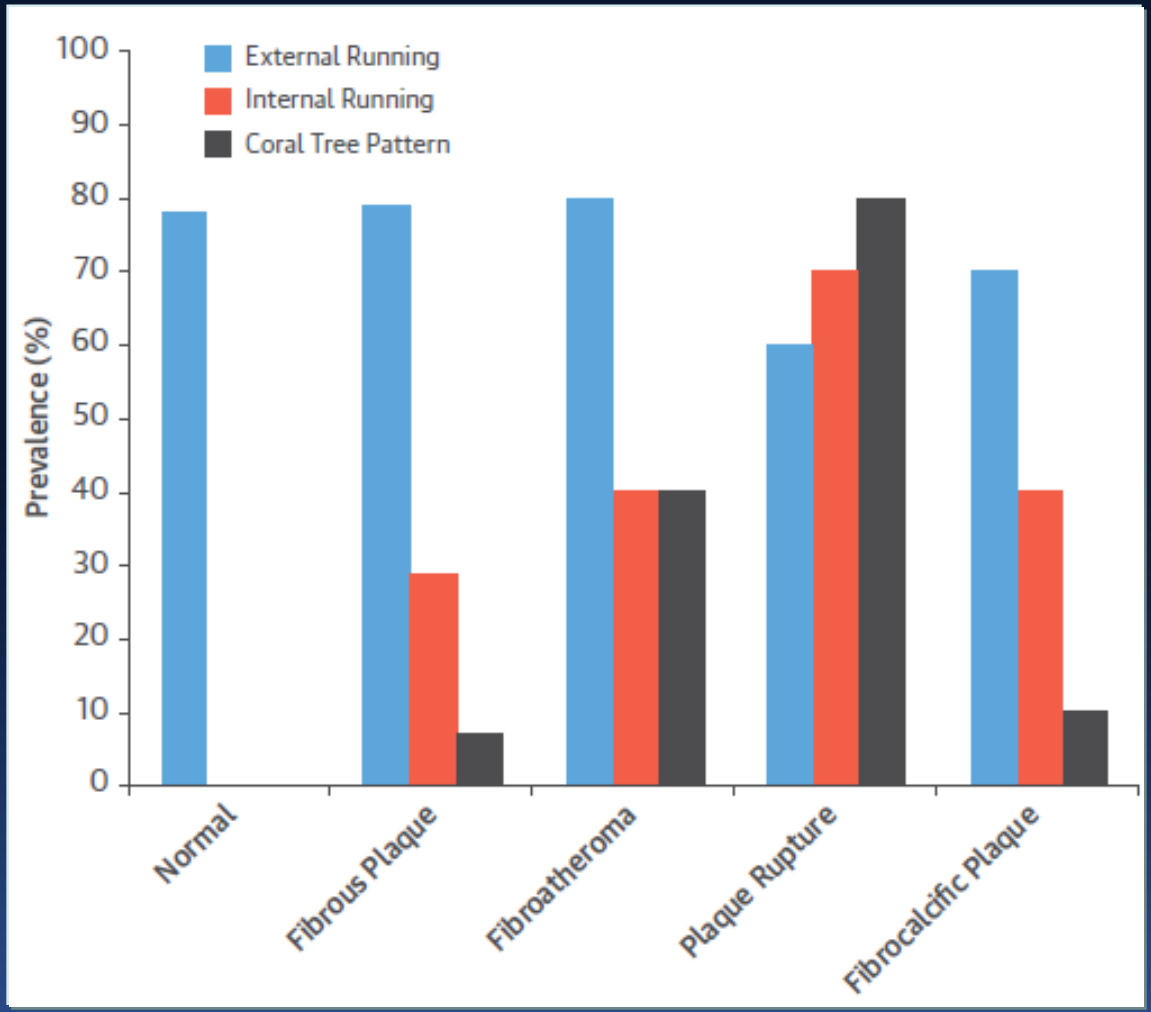
Taruya and Tanaka et al. J Am Coll Cardiol 2015;65:2469 - 77


Vasa Vasorum Volume
Vasa Vasorum Volume (mm3)
1.0
0.8
0.6
0.4
0.2
0.0
*
p<0.01
Normal
Fibrous Plaque
Fibroatheroma
Plaque Rupture
Fibrocalcific Plaque


Intraplaque Neovessels Volume
Intraplaque Neovessels Volume (mm3)
0.08
0.06
0.04
0.02
0.00
-0.02
*
*
p<0.01
Normal
Fibrous Plaque
Fibroatheroma
Plaque Rupture
Fibrocalcific Plaque


Vasa Vasorum Volume (mm³)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
r=0.71
p<0.01
0
20
40
60
80
100
Plaque Volume (mm³)


Intraplaque Neovessels Volume (mm³)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
r=0.53
p<0.04
0
20
40
60
80
100
Plaque Volume (mm³)



Conclusion

VV increased with FP volume and intra-plaque neovessels with coral tree pattern were associated with plaque vulnerability

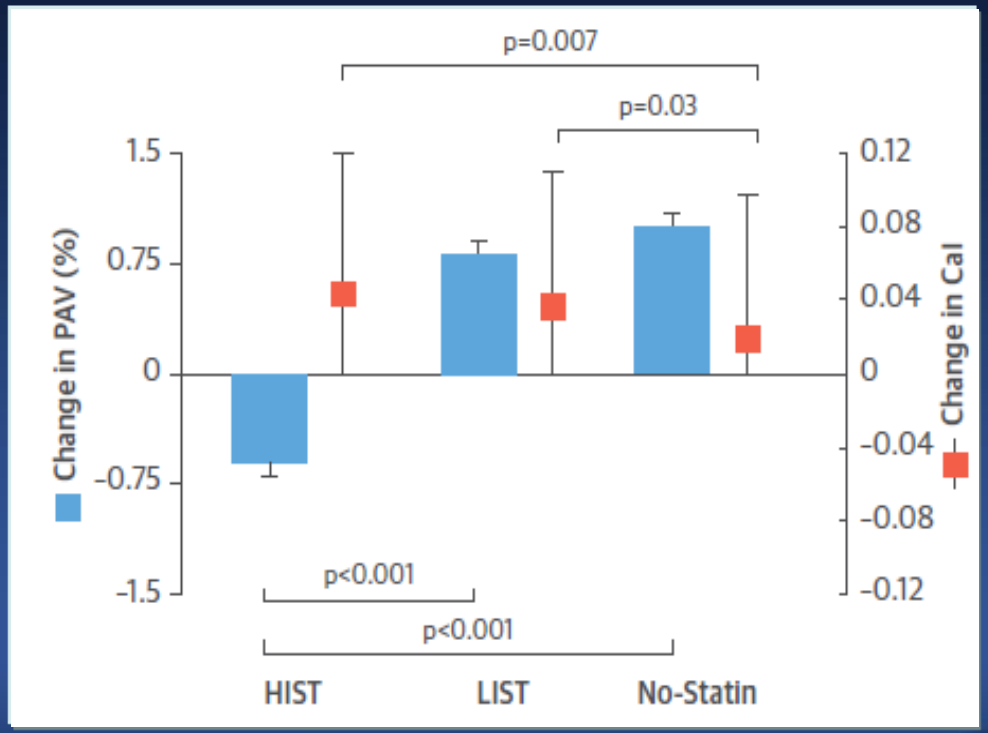
Taruya and Tanaka et al. J Am Coll Cardiol 2015;65:2469 - 77

Impact of Statins on Serial Coronary Calcification During Atheroma Progression and Regression

Rishi Puri, MBBS, PhD,*† Stephen J. Nicholls, MBBS, PhD,‡ Mingyuan Shao, MS,* Yu Kataoka, MD,‡
Kiyoko Uno, MD, PhD,* Samir R. Kapadia, MD,† E. Murat Tuzcu, MD,† Steven E. Nissen, MD*†

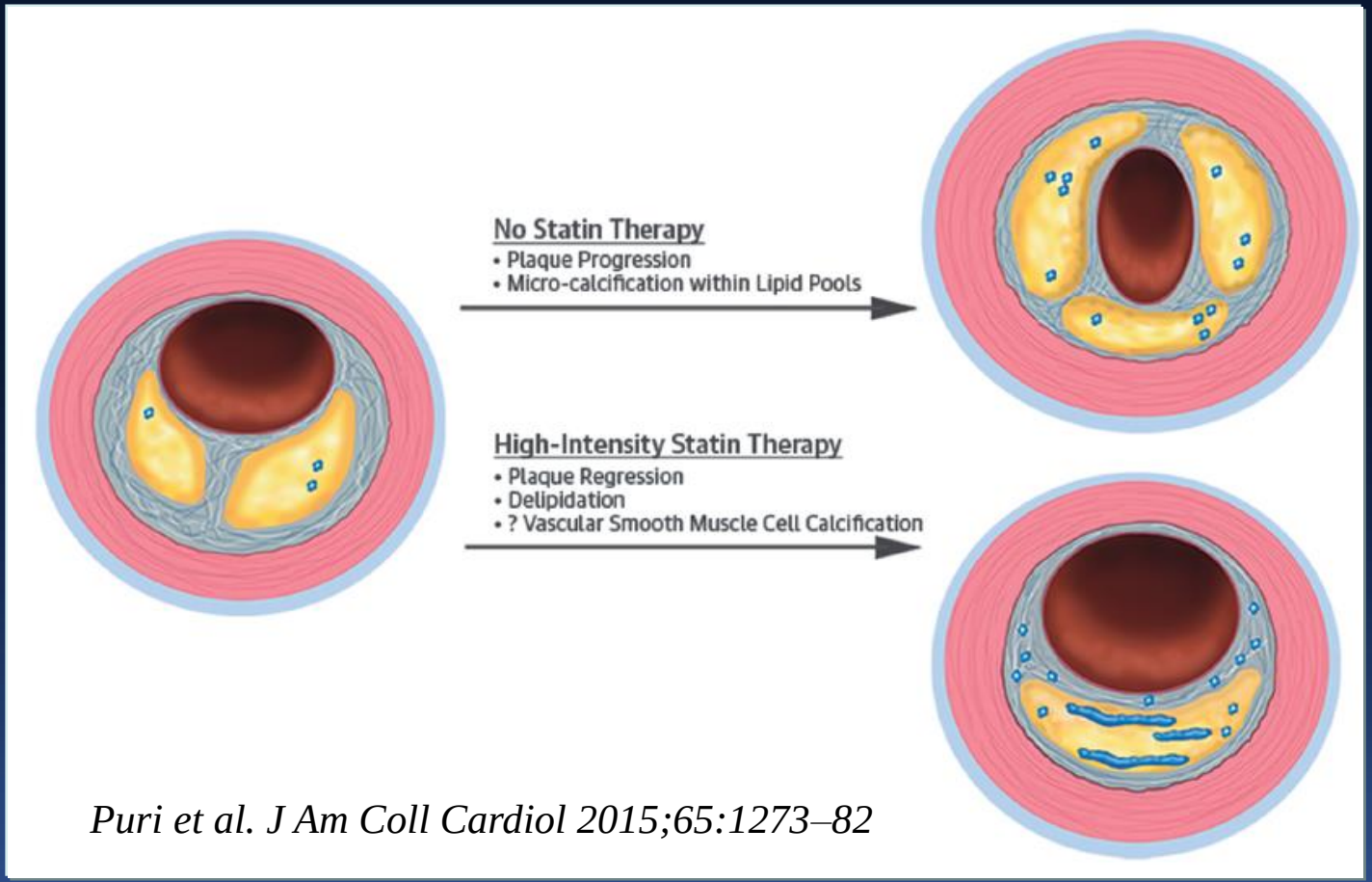
Post-hoc patient-level analysis of 8 RCT using serial IVUS

Changes in PAV and Calcium



Puri et al. J Am Coll Cardiol 2015;65:1273–82

Plaque Calcification



Puri et al. J Am Coll Cardiol 2015;65:1273–82

Plaque progression involves lipid pool expansion with microcalcification. After high-intensity statin therapy, plaque regression manifests as de-lipidation and probable vascular SMC calcification, promoting plaque stability

Implications

- The serial IVUS study provides unique insights into procalcific effects of prolonged statin therapy on coronary atheroma in vivo
- Despite the association with plaque regression, statin has procalcific effect related to the intensity of therapy

Papers in 2015
Intravascular Imaging

- Hong MK et al. JAMA
- Wijns W et al. Eur Heart J
- Meahara A et al. JACC Intv
- Soeda T et al. Circulation
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