

*High-Risk Plaques on Coronary CT Angiography  
Correlation With OCT  
Invasive vs. Non-Invasive Tools for Vulnerable Plaque*

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*On behalf of Daisuke Kinoshita, IK Jang (MGH)*

## *Disclosure*

- Speaking honoraria: Abbott Medical, Heartflow

## *Background*

- Noninvasive evaluation of rupture-prone coronary plaques has been done primarily by coronary computed tomography angiography (CTA).
- High risk plaque (HRP) on CTA is implicated as predictive of acute coronary events.
- Detailed plaque morphology of each HRP component has not been systematically validated against high-resolution imaging modalities.

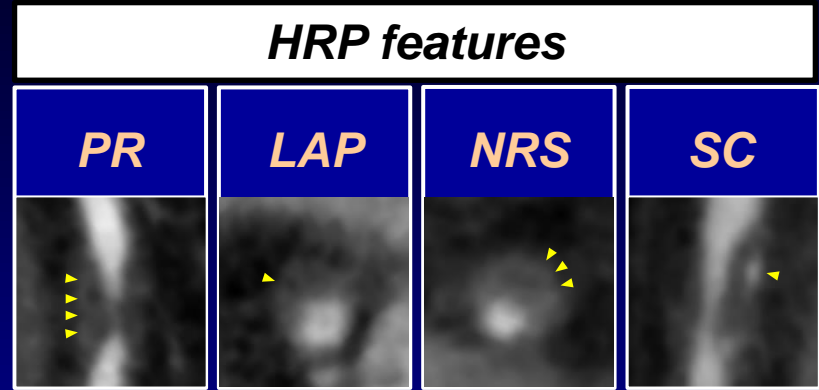
## *Aim*

To correlate HRP features on CTA with plaque characteristics on OCT

## Method

### CTA analysis

- Positive remodeling (PR)
- Low-attenuation plaque (LAP)
- Napkin-ring sign (NRS)
- Spotty calcification (SC)



### OCT analysis

Qualitative analysis: Lipid-rich plaque, thin-cap fibroatheroma (TCFA), macrophage, microvessels, cholesterol crystal, and layered plaque

Quantitative analysis: Maximum lipid arc, lipid-index, macrophage grade, and %AS

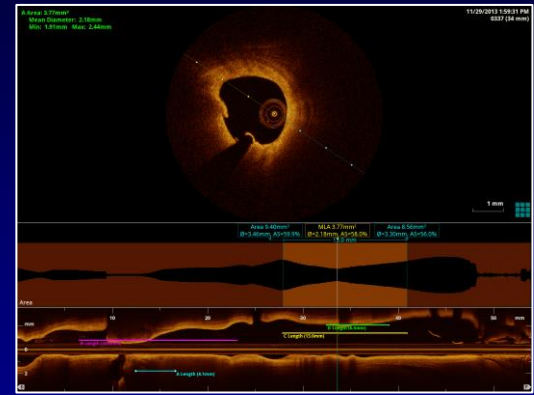
# Lesion Coregistration between CTA and OCT



*CTA detected lesions*



*Lesion locations were recorded on angiography images*

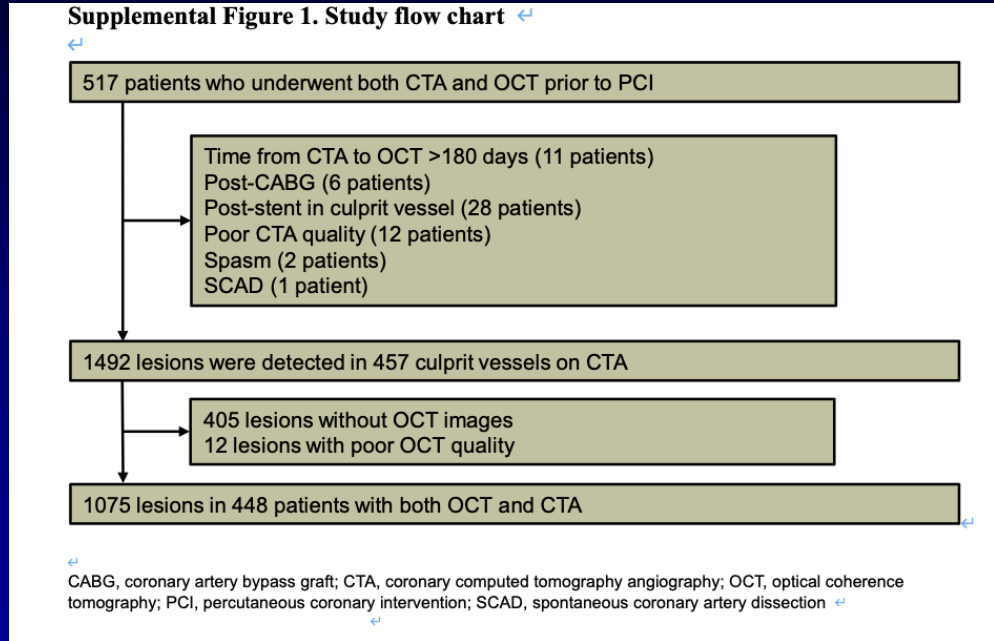


*OCT readers were given the exact location of each lesion using anatomical landmarks (branch and ostium).*

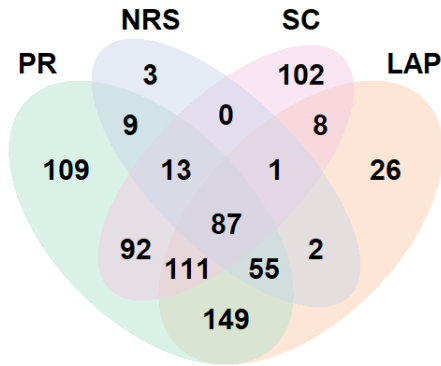
# Patient background

**TABLE 1** Baseline Characteristics (N = 448)

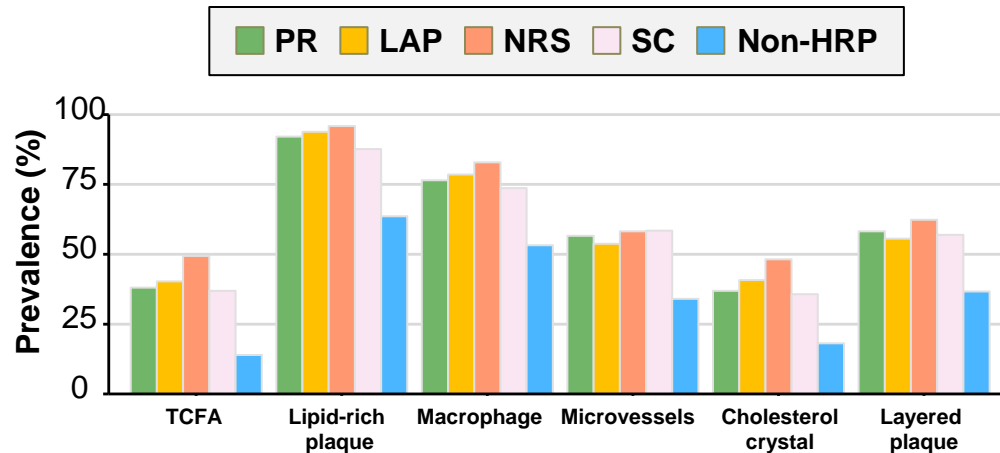
Age, y	67 (59-74)
Male	357 (79.7)
Body mass index, kg/m <sup>2</sup>	24.7 (22.5-26.6)
Clinical presentation	
CCS	245 (54.7)
UAP	48 (10.7)
NSTEMI	155 (34.6)
Risk factors	
Hypertension	265 (59.2)
Hyperlipidemia	259 (57.8)
Diabetes mellitus	182 (40.6)
Chronic kidney disease	131 (29.2)
Current smoker	131 (29.2)
Previous PCI	78 (17.4)
History of MI	59 (13.2)
Laboratory data	
LDL-C, mg/dL	103 (83-129)
HDL-C, mg/dL	46 (40-56)
Triglyceride, mg/dL	123 (85-182)
HbA <sub>1c</sub> , %	5.9 (5.6-6.6)
eGFR, mL/min/1.73 m <sup>2</sup>	72 (62-83)
Time from CTA to OCT, d	8 (0-40)
Medication before PCI	
P2Y12 inhibitor	144 (32.1)
Aspirin	181 (40.4)
ARB/ACE inhibitor	276 (61.6)
Beta-blocker	159 (35.5)
Statin	227 (50.7)



# Prevalence of OCT features of plaque vulnerability according to CTA-defined HRP features.



	PR	LAP	NRS	SC	Non-HRP
<b>TCFA</b>	38.1%*	40.3%*	49.4%*	37.0%*	14.0%
<b>Lipid-rich plaque</b>	92.2%*	93.8%*	95.9%*	87.7%*	63.6%
<b>Macrophage</b>	76.5%*	78.6%*	82.9%*	73.7%*	53.2%
<b>Microvessels</b>	56.6%*	53.8%*	58.2%*	58.5%*	34.1%
<b>Cholesterol crystal</b>	37.0%*	40.8%*	48.2%*	35.7%*	18.2%
<b>Layered plaque</b>	58.2%*	55.6%*	62.4%*	57.0%*	36.7%



HRP, high-risk plaque; LAP, low-attenuation plaque; NRS, napkin ring sign; OCT, optical coherence tomography; PR, positive remodeling; SC, spotty calcification; TCFA, thin-cap fibroatheroma. \* indicates  $P < .001$  vs. Non-HRP.



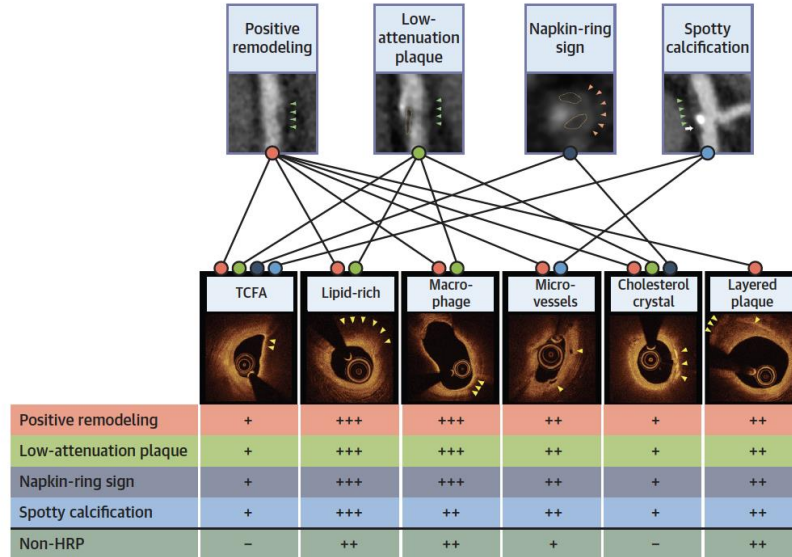
**TABLE 2** Generalized Estimating Equation Log-Binomial Regression of Each Optical Coherence Tomography Feature

	Univariable		Multivariable	
	OR (95% CI)	P Value	OR (95% CI)	P Value
<b>Thin-cap fibroatheroma</b>				
PR	3.23 (2.38-4.38)	<0.001	2.14 (1.47-3.10)	<0.001 <sup>a</sup>
LAP	2.56 (1.94-3.36)	<0.001	1.41 (1.00-1.99)	0.049 <sup>a</sup>
NRS	2.94 (2.10-4.09)	<0.001	1.70 (1.18-2.45)	0.005 <sup>a</sup>
SC	1.88 (1.44-2.46)	<0.001	1.43 (1.07-1.91)	0.015 <sup>a</sup>
<b>Lipid-rich plaque</b>				
PR	5.76 (4.11-8.07)	<0.001	3.20 (2.17-4.73)	<0.001 <sup>a</sup>
LAP	5.57 (3.71-8.35)	<0.001	2.37 (1.49-3.76)	<0.001 <sup>a</sup>
NRS	6.19 (2.88-13.30)	<0.001	1.93 (0.87-4.31)	0.108
SC	2.02 (1.43-2.85)	<0.001	1.34 (0.92-1.97)	0.126
<b>Macrophage</b>				
PR	2.46 (1.89-3.21)	<0.001	1.75 (1.28-2.38)	<0.001 <sup>a</sup>
LAP	2.33 (1.76-3.09)	<0.001	1.48 (1.08-2.04)	0.016 <sup>a</sup>
NRS	2.56 (1.64-3.98)	<0.001	1.52 (0.94-2.45)	0.085
SC	1.51 (1.13-2.02)	0.005	1.20 (0.88-1.63)	0.253
<b>Microvessels</b>				
PR	2.07 (1.63-2.64)	<0.001	2.01 (1.47-2.74)	<0.001 <sup>a</sup>
LAP	1.37 (1.07-1.76)	0.012	0.84 (0.60-1.18)	0.312
NRS	1.55 (1.12-2.14)	0.008	1.11 (0.76-1.62)	0.599
SC	1.86 (1.42-2.40)	<0.001	1.59 (1.21-2.10)	0.001 <sup>a</sup>
<b>Cholesterol crystal</b>				
PR	2.45 (1.82-3.30)	<0.001	1.54 (1.07-2.20)	0.020 <sup>a</sup>
LAP	2.46 (1.85-3.27)	<0.001	1.64 (1.15-2.33)	0.006 <sup>a</sup>
NRS	2.64 (1.89-3.69)	<0.001	1.64 (1.12-2.41)	0.012 <sup>a</sup>
SC	1.61 (1.23-2.10)	0.001	1.28 (0.96-1.69)	0.093
<b>Layered plaque</b>				
PR	2.11 (1.63-2.74)	<0.001	2.06 (1.50-2.83)	<0.001 <sup>a</sup>
LAP	1.41 (1.10-1.81)	0.007	0.84 (0.61-1.15)	0.274
NRS	1.77 (1.26-2.50)	0.001	1.33 (0.91-1.94)	0.142
SC	1.53 (1.18-1.97)	0.001	1.28 (0.98-1.67)	0.072

All high-risk plaque features were included in univariable generalized estimating equation log-binomial regression analysis to identify each optical coherence tomography feature of plaque vulnerability. Variables with P values <0.10 in the univariable test were entered into the multivariable modeling. \*P < 0.05 in the multivariable analysis.

LAP = low-attenuation plaque; NRS = napkin-ring sign; PR = positive remodeling; SC = spotty calcification.

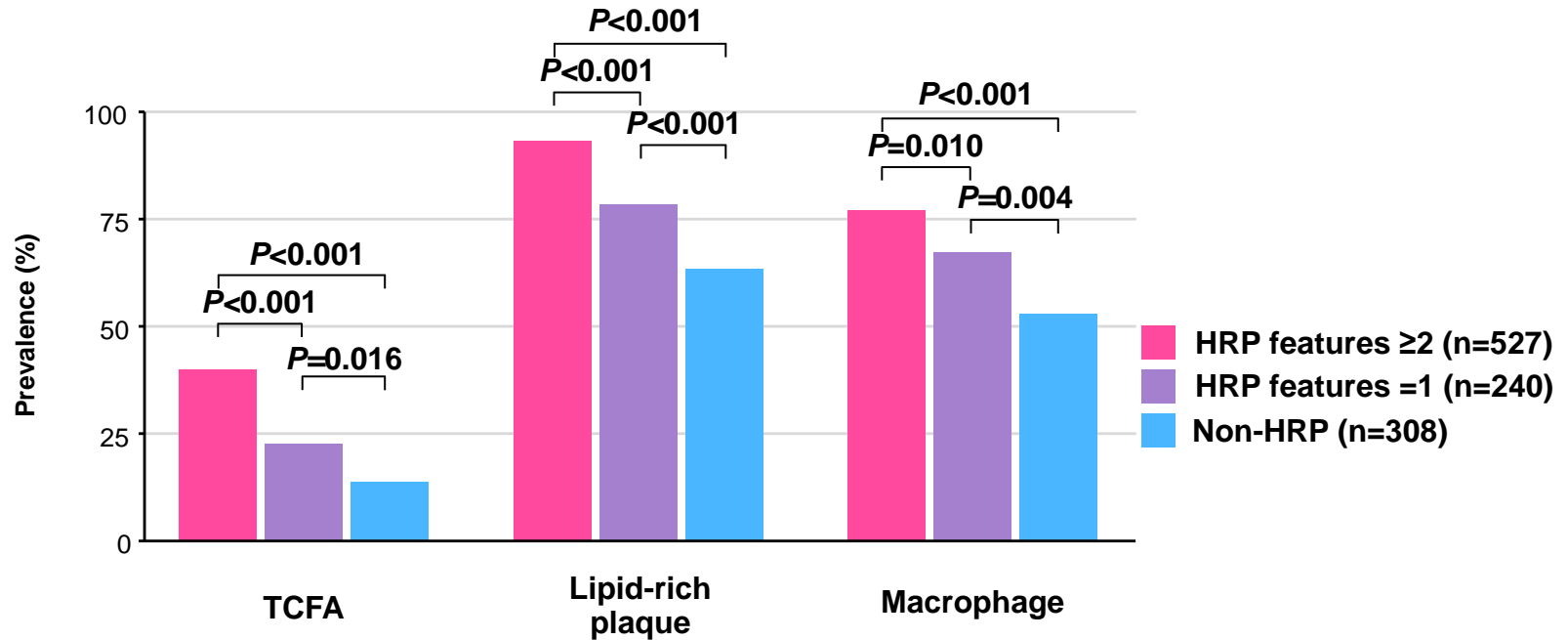
**CENTRAL ILLUSTRATION** ■■■



Kinoshita D, et al. J Am Coll Cardiol Img. 2023;■■■:■■■.

**All 4 HRP features were associated with TCFA, PR was associated with all OCT features of plaque vulnerability, LAP was associated with lipid-rich plaque, macrophage, and cholesterol crystals, NRS was associated with cholesterol crystals, and SC was associated with microvessels.**

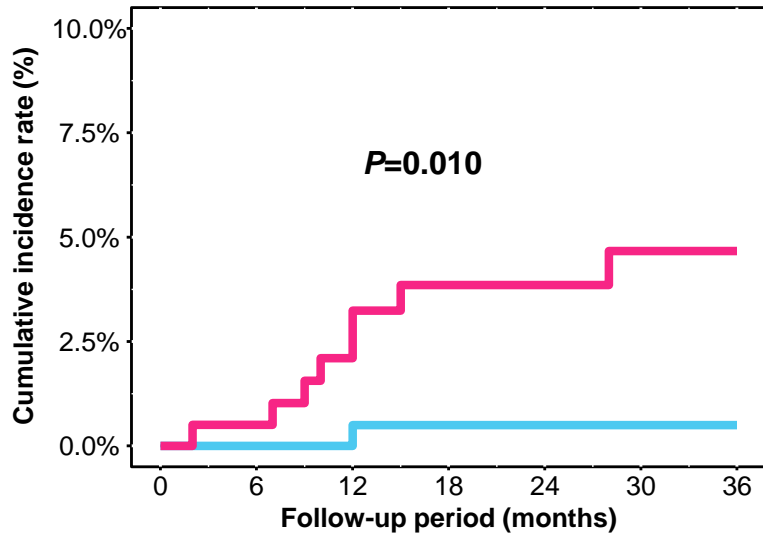
## OCT findings based on the number of HRP features



# Cumulative incidence rate of adverse clinical events between patients with untreated HRP and those without

Untreated HRP present ■ Yes ■ No

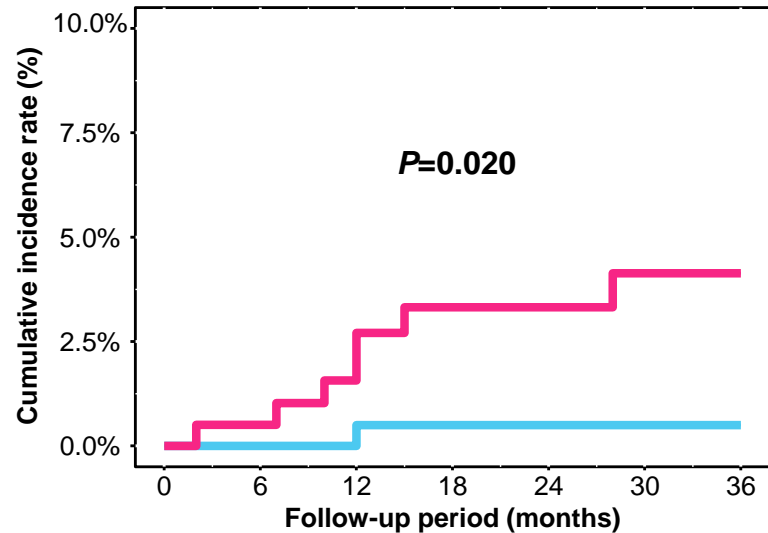
**TVR + Cardiac death**



**No. at risk**

Yes	201	190	170	145	130	109	96
No	244	233	201	166	140	125	108

**TVR**



**No. at risk**

Yes	201	190	170	145	130	109	96
No	244	233	201	166	140	125	108

## *Summary of results*

- All HRP features, including PR, LAP, NRS, and SC, were associated with a higher prevalence of OCT features of plaque vulnerability.
- Although the prevalence of OCT features was similar among the 4 HRP features, TCFA, lipid-rich plaque and macrophage became more prevalent as lesions exhibited more HRP features.
- HRP in a culprit vessel was associated with a higher incidence of repeat revascularization and cardiac death at a 3-year follow-up.

## *Coronary CT Angiography Correlation With OCT*

- *HRP features on CTA were associated with OCT features of plaque vulnerability.*
- *Patients with HRP have a higher incidence of major cardiac events (TVR + cardiac death).*

*Acknowledgment: Daisuke Kinoshita, IK Jang, Pts of Tsuchiura Kyodo, MGH*