

Virtual Histology Intravascular Ultrasound Analysis of Non-culprit Attenuated Plaques Detected by Grayscale Intravascular Ultrasound in Patients with Acute Coronary Syndromes

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Disclosure

Gary S. Mintz

A member of the speakers bureau, serves as a consultant, has received research/grant support, and a stockholder with Volcano Corporation

Takashi Kubo

Has received research-grant support from Volcano Corporation

Martin B. Leon and Gregg W. Stone

Serve as consultants for Volcano Corporation

Bernard De Bruyne

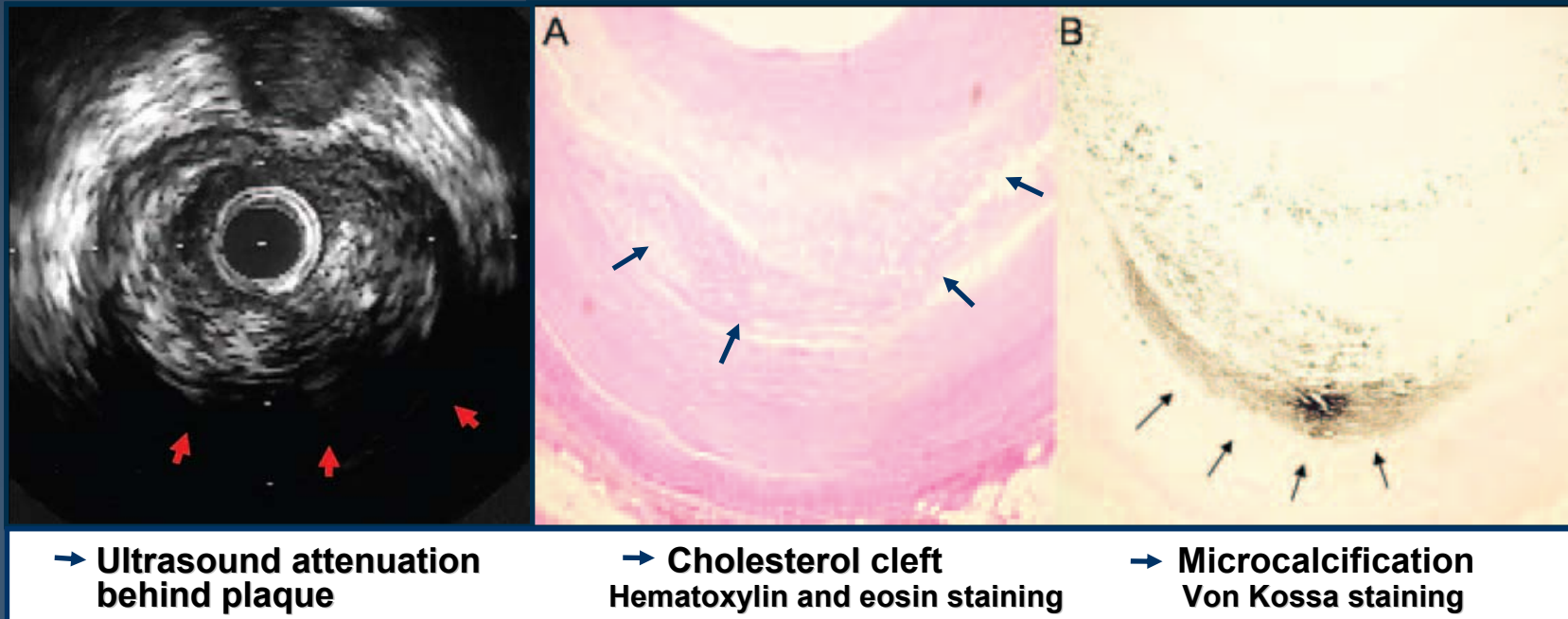
Patrick W. Serruys

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NO relationships to disclosure

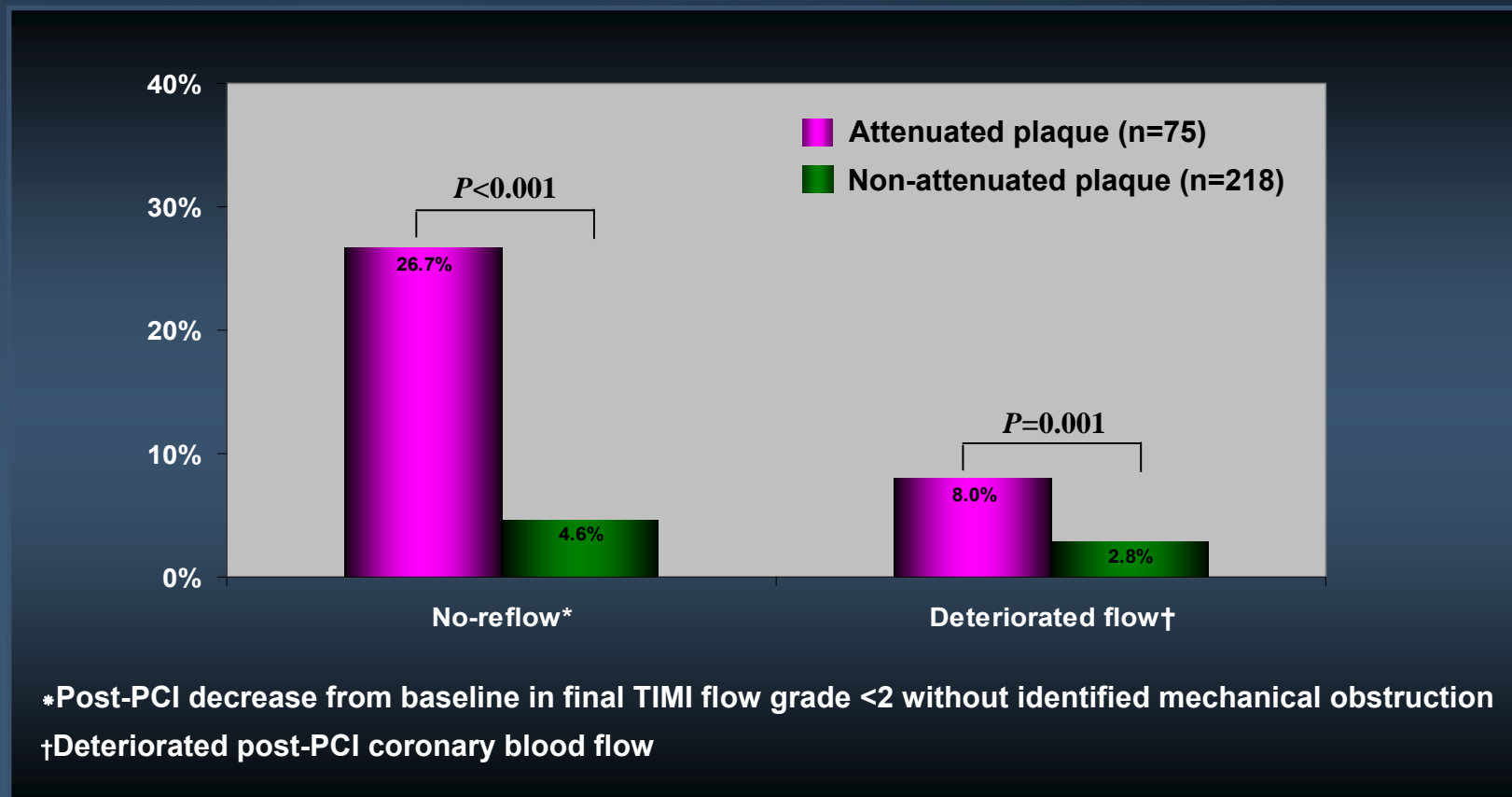
Attenuated plaque & Histopathology

- Attenuated plaque is defined as hypoechoic or mixed atheroma with ultrasound attenuation without evidence of calcification in grayscale IVUS
- Histopathologically, attenuated plaque contains microcalcifications and cholesterol crystals



Attenuated plaque & No-reflow

- Attenuated plaques are often seen in ACS
- Attenuated plaques are associated with no-reflow and CK-MB elevation after PCI



VH-IVUS

- **The overall predictive accuracies of VH were 93.5% for Fibrous, 94.1% for fibro-fatty, 95.8% for necrotic core and 96.7% for dense-calcium when used to identify different atherosclerotic plaque elements***
- **Reproducibility of VH-IVUS analyses†**
- **The presence and size of the VH-IVUS necrotic core are related to liberation of small embolic particles during coronary stenting in ACS‡**

*Nair A et al Euro Intervention 2007;3:113-20

†Rodriguea-Granillo GA et al Int J Cardiovasc Imaging 2006; 22: 621-31

‡Kawamoto T et al J Am Coll Cardiol 2007;50:1635-40

‡Kawaguchi R et al J Am Coll Cardiol 2007;50:1641-6

Hypothesis

Attenuated plaques contain large amounts of necrotic core that would also explain the unstable nature of such lesions



The PROSPECT Trial

700 pts with ACS

UA (with ECGΔ) or NSTEMI or STEMI >24hrs

1-2 vessel CAD undergoing PCI
at up to 40 sites in U.S., Europe

Metabolic S.

- Waist circum
- Fast lipids
- Fast glu
- HgbA1C
- Fast insulin
- Creatinine

Biomarkers

- Hs CRP
- IL-6
- sCD40L
- MPO
- TNF α
- MMP9
- Lp-PLA2
- others

PCI of culprit lesion(s)

Successful and uncomplicated

Formally enrolled

PI: Gregg W. Stone

Sponsor: Abbott Vascular; Partner: Volcano

3-vessel imaging post PCI

Culprit artery, followed by non-culprit arteries

Angiography (QCA of entire coronary tree)

IVUS

Virtual histology

Palpography (n= \sim 350)

*Proximal 6-8
cm of each
coronary
artery*

Meds rec

Aspirin

Plavix 1yr

Statin

Repeat biomarkers

@ 30 days, 6 months

**F/U: 1 mo, 6 mo,
1 yr, 2 yr,
 \pm 3-5 yrs**

MSCT

Substudy

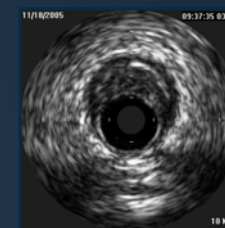
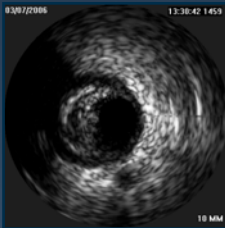
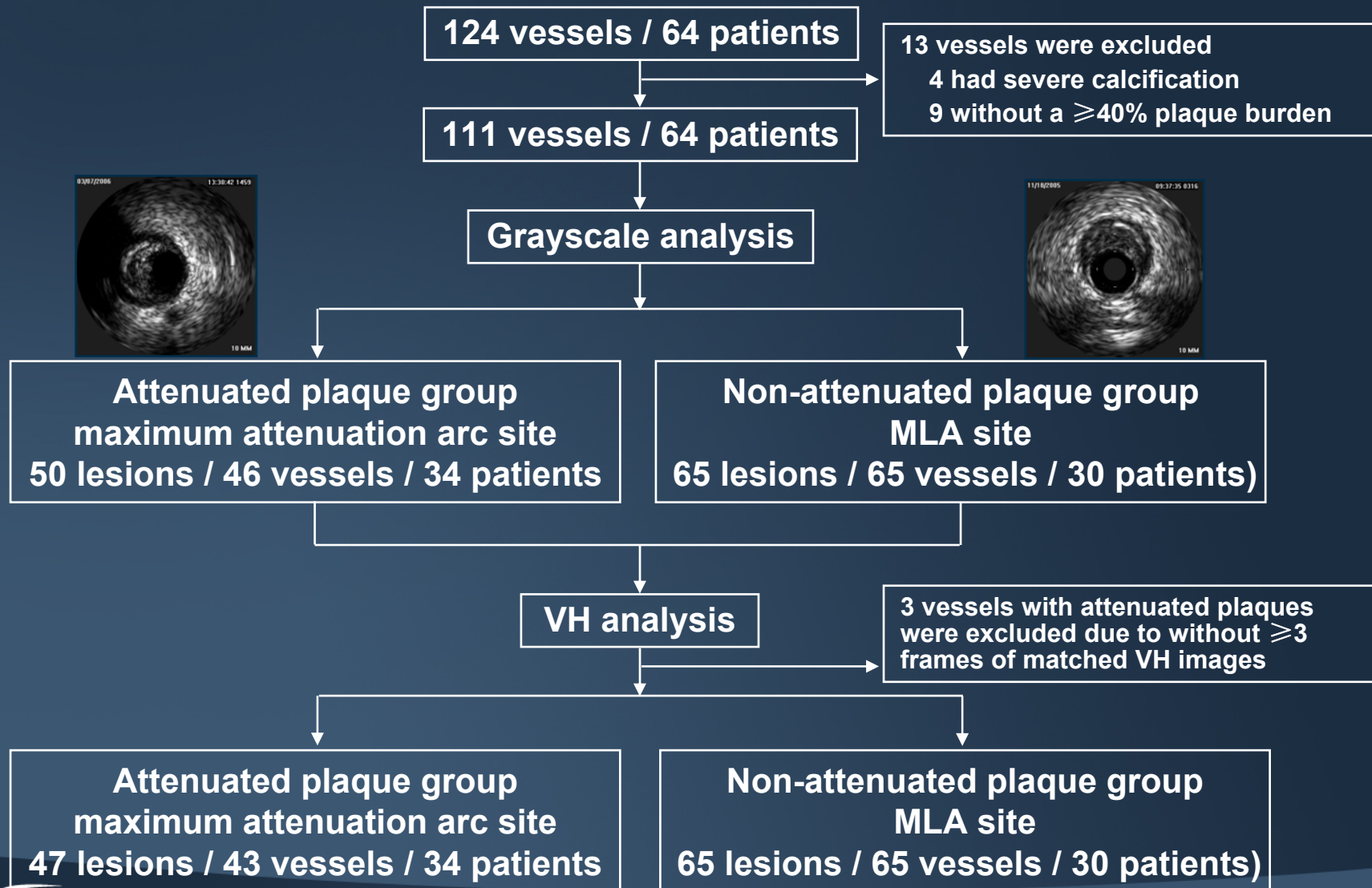
N=50-100

**Repeat imaging
in pts with events**



Methods - I

- Study Population -



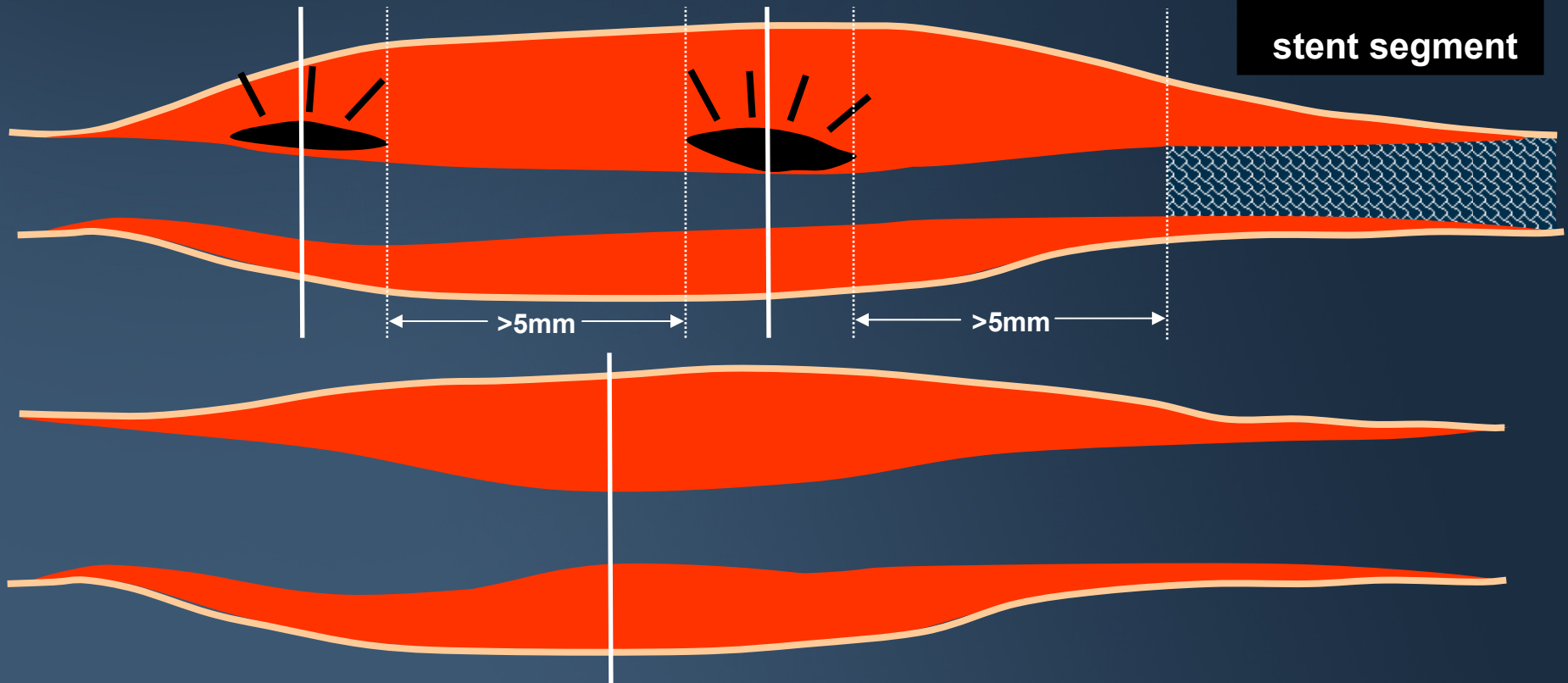
Methods - II

- Lesion site -

Attenuated plaque

Maximum attenuation arc site, >40% plaque burden,
Separate if >5mm far each other

Exclusion
stent segment



Control

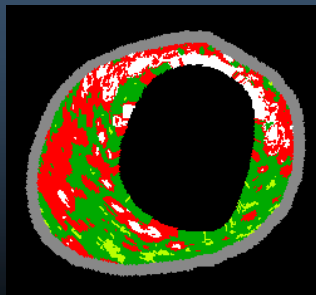
MLA site, >40% plaque, burden

Methods - III

- IVUS-VH Imaging -

- IVUS system: phased-array, 20 MHz, catheters (Volcano)
- Automatic pullback at 0.5mm/sec
- Gray scale image=10 frame/second
- VH data=1 frame/beat at R-wave

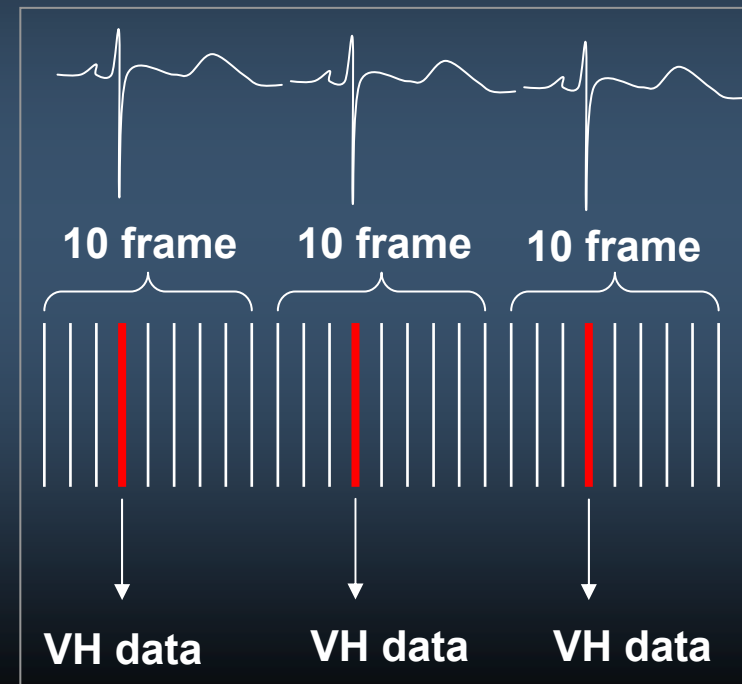
- 4 color code  Necrotic Core



-  Fibrofatty

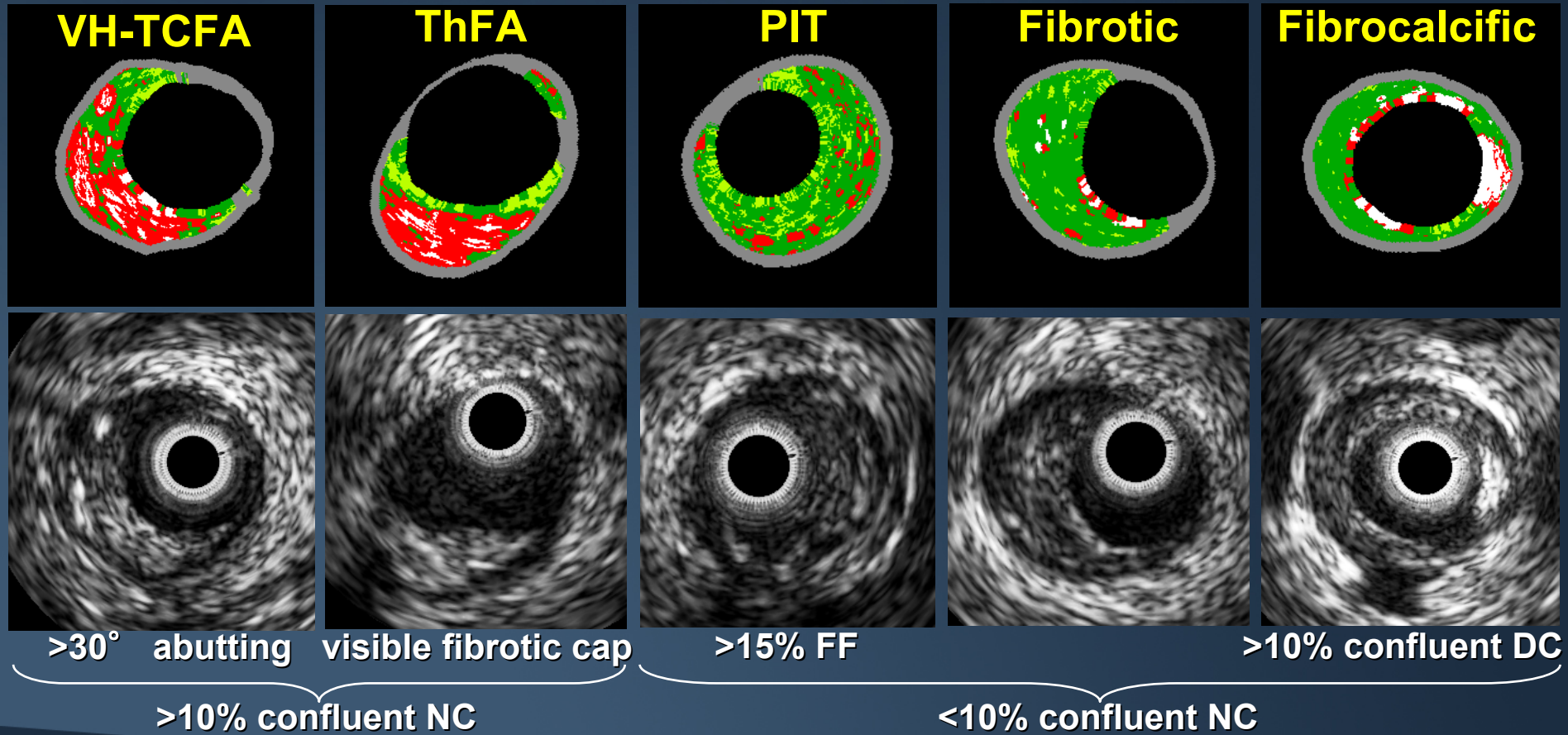
-  Fibrous tissue

-  Dense Calcium



VH-IVUS Classification

- Fibroatheroma: >10% confluent necrotic core
- VH-TCFA: 30° NC abutting to lumen



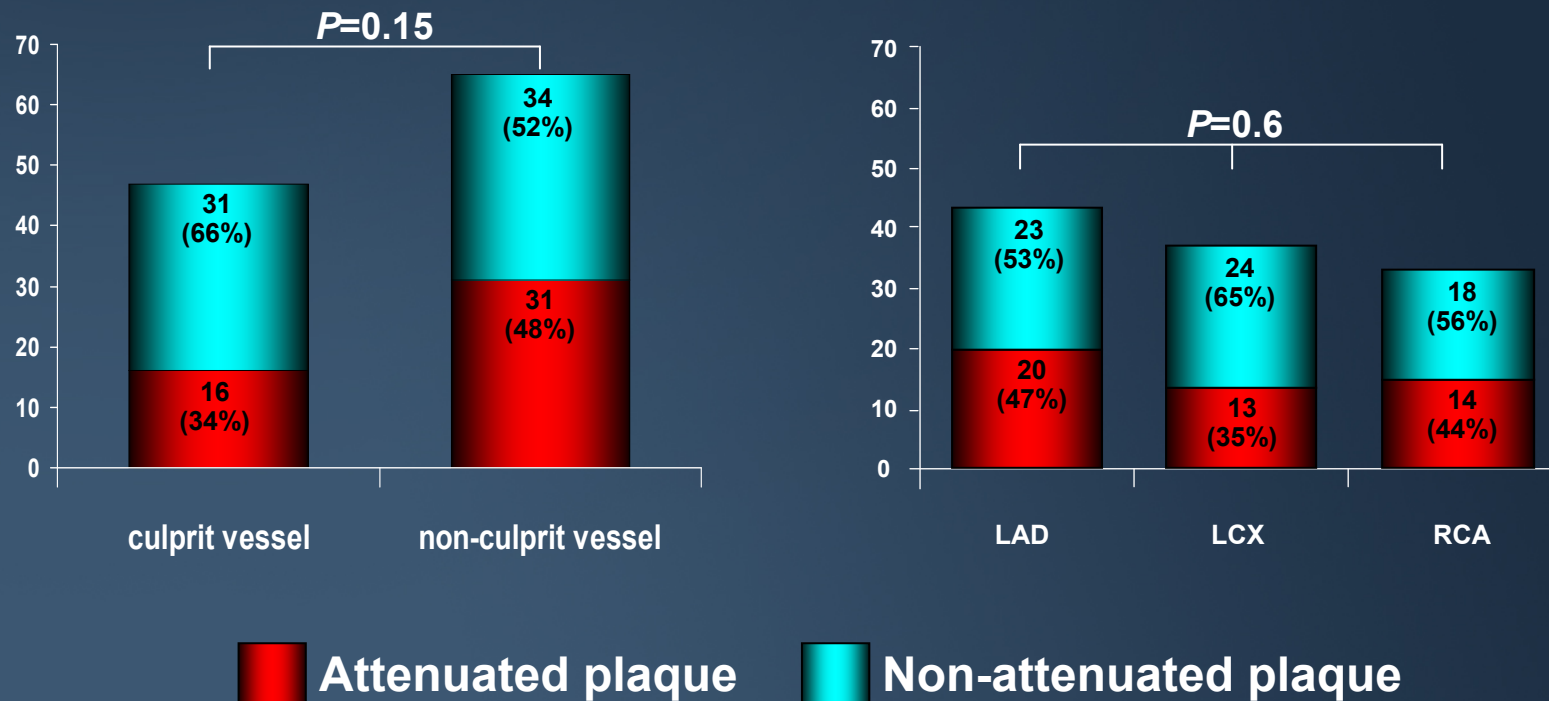
Baseline Patients Characteristics

Male gender	52 (81%)
Age, yrs	59 ± 12
ACS, n (%)	
unstable angina	42 (39%)
NSTEMI	36 (23%)
STEMI (>24hrs)	30 (28%)
Hypertension	42 (66%)
Hypercholesterolemia	43 (67%)
Diabetes mellitus	11 (17%)
Current smoker	29 (45%)
Previous myocardial infarction (MI)	3 (5%)
Culprit lesion	
Left anterior descending	205 (46%)
Left circumflex	107 (24%)
Right	132 (30%)

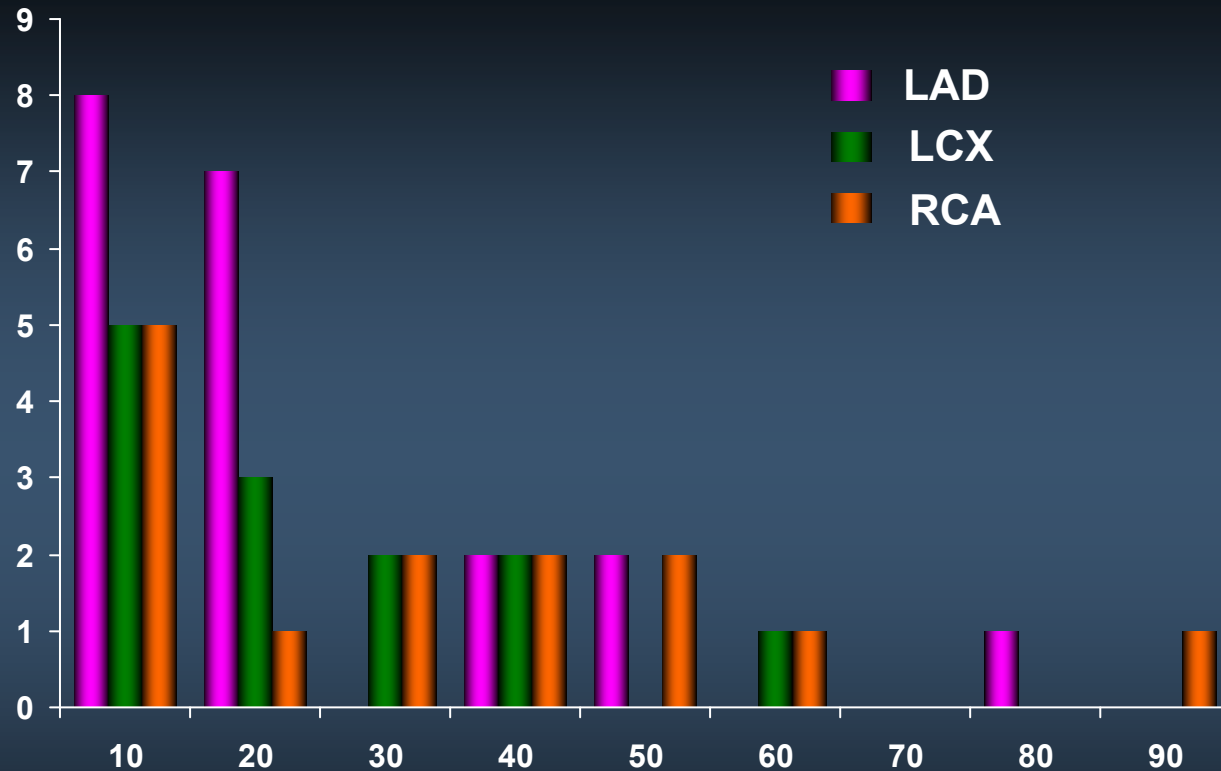
Mean + SD or Number (percent)

Attenuated plaques identified by grayscale IVUS

47 attenuated plaque was present at 43 vessels in 34 patients



Distribution of attenuated plaques



39 (83%) attenuated plaques were located within 40mm proximal to the ostium of coronary arteries: 17 (85%), 12 (92%) and 10 (71%) in LAD, LCX and RCA, respectively

Gray-Scale IVUS Findings

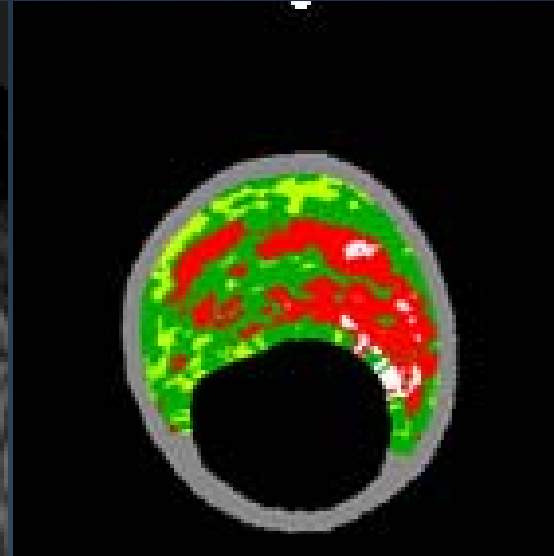
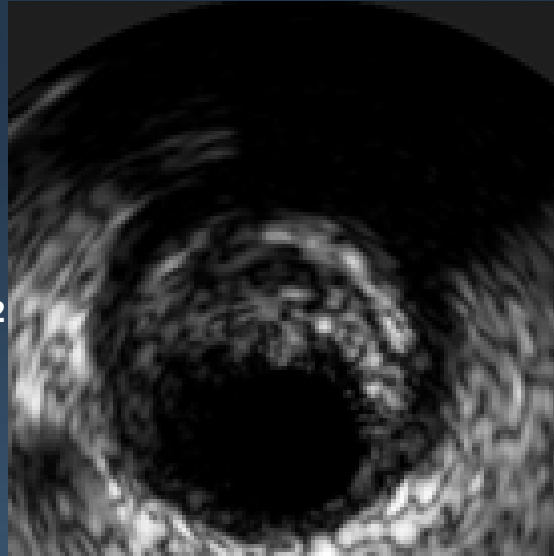
	Attenuated plaque N=47	Non-attenuated plaque N=65	P value
Lesion site			
EEM CSA, mm ²	16.5±5.7	14.6±4.6	0.12
Lumen CSA, mm ²	7.0±3.9	5.6±1.8	0.07
P&M CSA, mm ²	9.5±3.1	9.0±3.5	0.53
Plaque burden, %	59.0±11.4	60.8±8.1	0.41
Eccentricity index	9.0±8.7	5.9±3.4	0.02
Positive remodeling, %	50.0	17.1	<0.005
Proximal reference segment			
EEM CSA, mm ²	16.5±5.8	15.2±5.1	0.33
Lumen CSA, mm ²	8.8±4.8	8.1±2.4	0.46
P&M CSA, mm ²	7.7±2.9	7.1±3.7	0.50
Plaque burden, %	47.9±13.8	45.2±11.8	0.39
Distal Reference Segment			
EEM CSA, mm ²	16.3±5.7	14.4±4.5	0.12
Lumen CSA, mm ²	8.1±3.7	7.5±2.1	0.39
P&M CSA, mm ²	8.2±2.7	6.9±3.6	0.13
Plaque burden, %	50.1±12.1	46.2±13.4	0.21

VH-IVUS imaging characteristics

Attenuated plaque

P&M : 9.44 mm²

PB: 67.3%



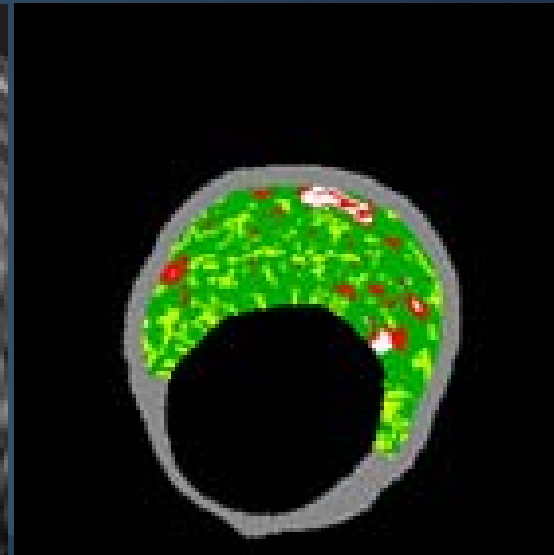
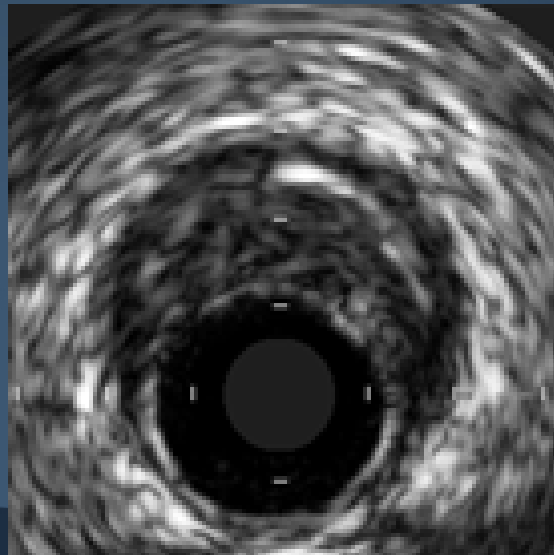
NC area: 1.96 mm²

NC%: 20.8%

Non attenuated plaque

P&M : 8.8 mm²

PB: 61.7%

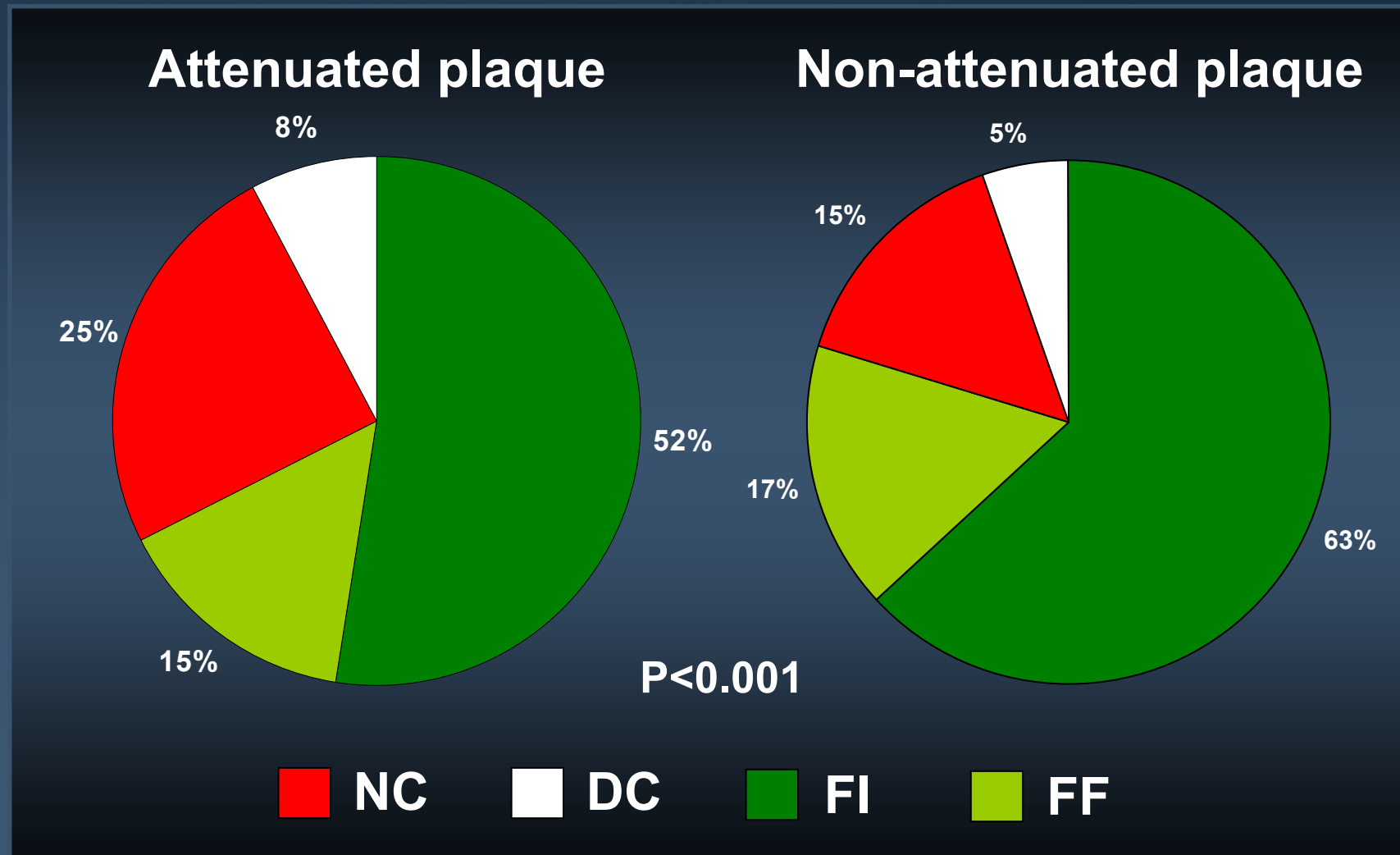


NC area: 0.54 mm²

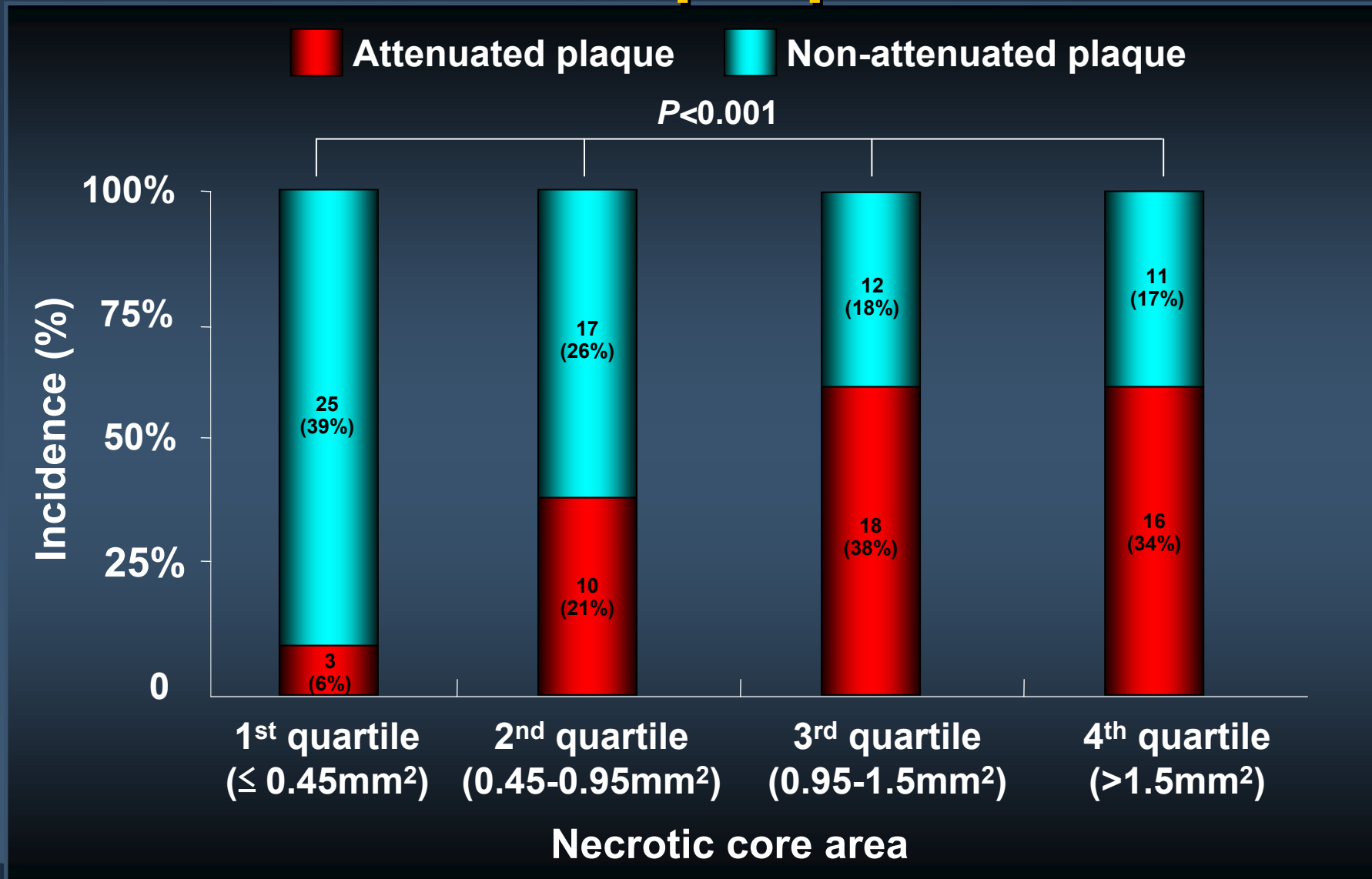
NC%: 6.1%



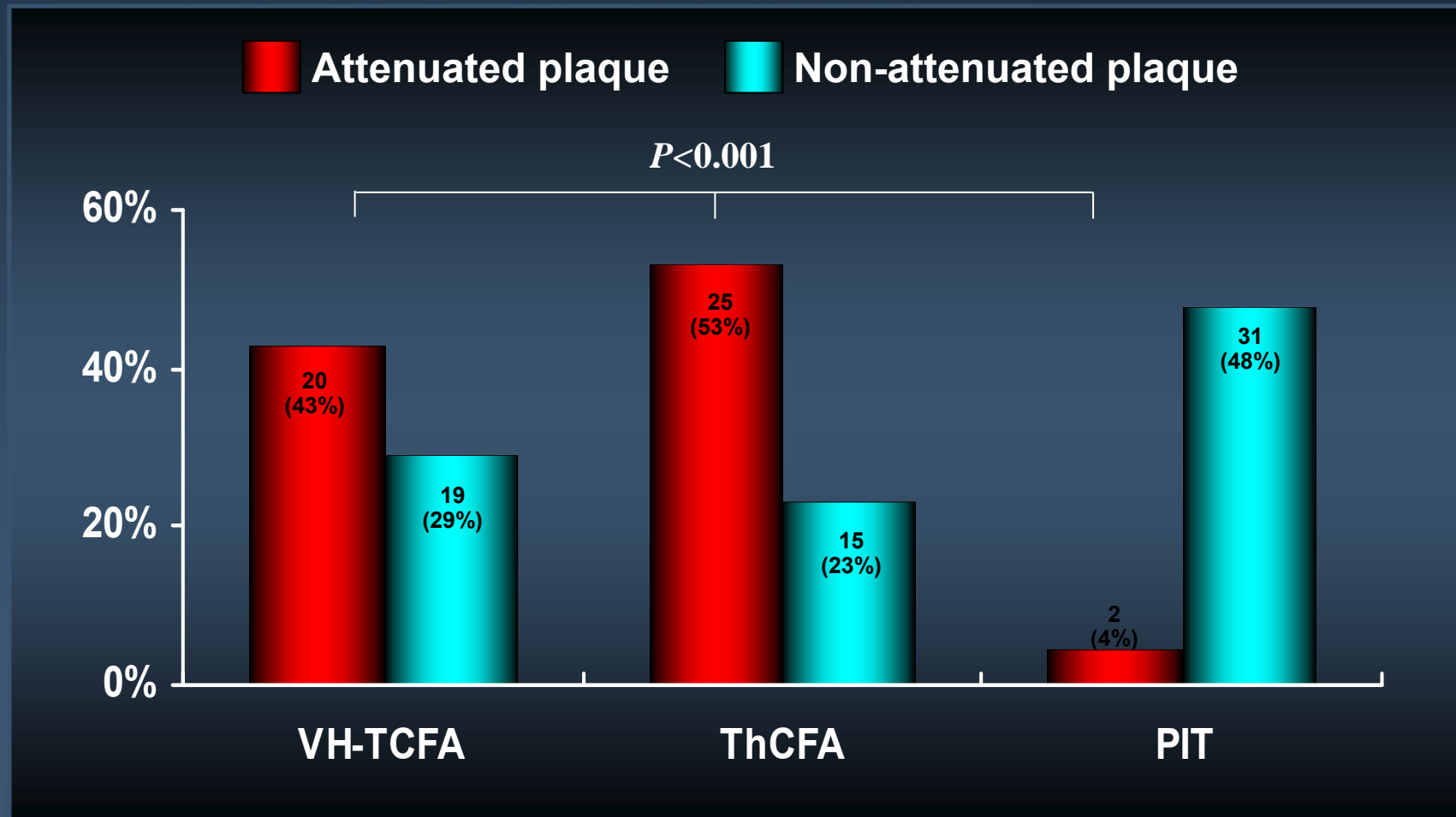
VH-IVUS imaging characteristics



Attenuated plaque & NC



VH-IVUS phenotype



Conclusions

Grayscale IVUS attenuated plaques are associated with a large amount of VH-IVUS necrotic core and are marker of the presence of a fibroatheroma (VH-TCFA or ThCFA). This may explain the reported biologic instability of these lesions

