

Clinical Insights Using NIR Spectroscopy Imaging

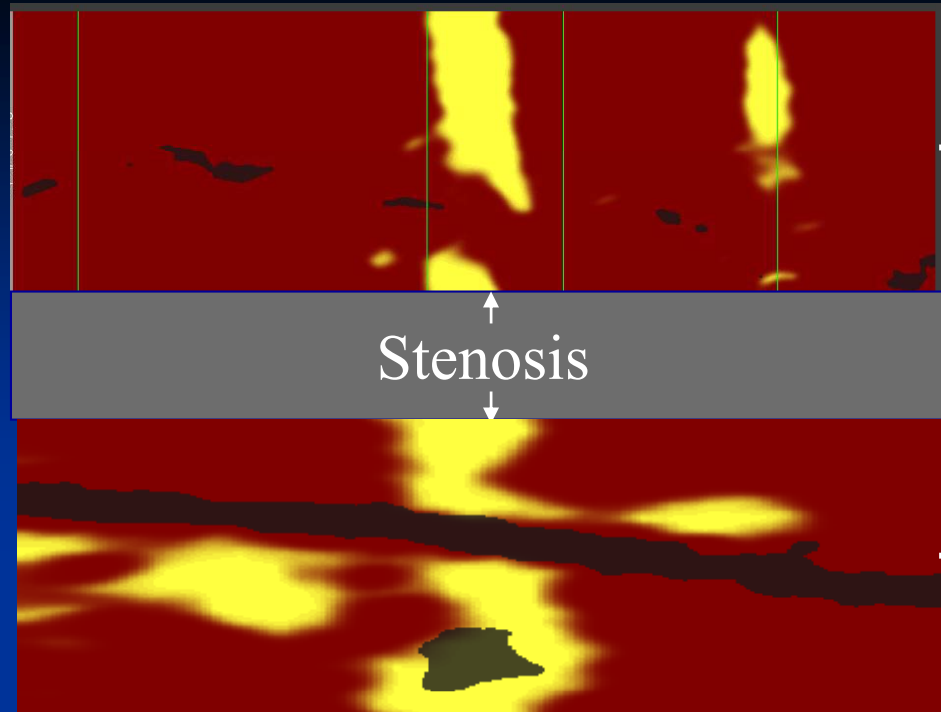
John McB. Hodgson, M.D.

ANGIOPLASTY SUMMIT
TCTAP 2012

John McB. Hodgson, M.D.

RCA with ring LCP at stenosis in 62 yo male

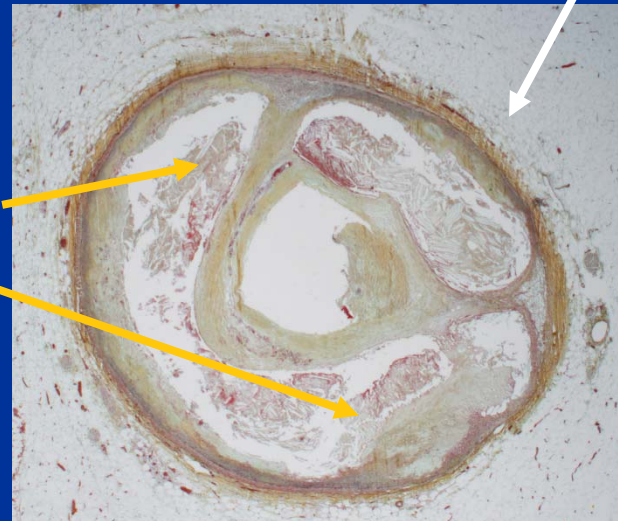
Similar finding with ring LCP from autopsy of 48 yo male



Distal embolization following PCI leading to MI and CPR

Sudden Cardiac Death

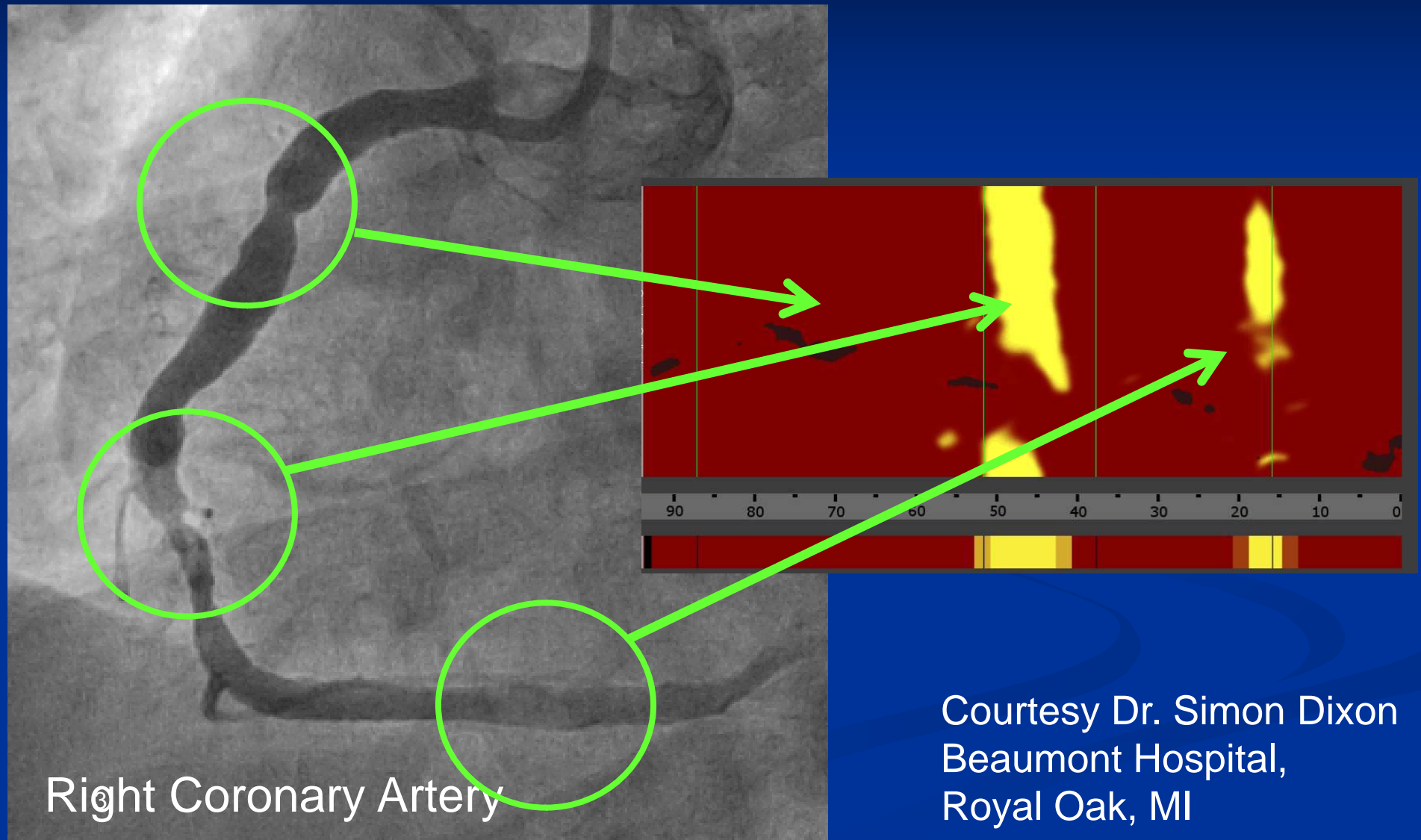
Massive LCP



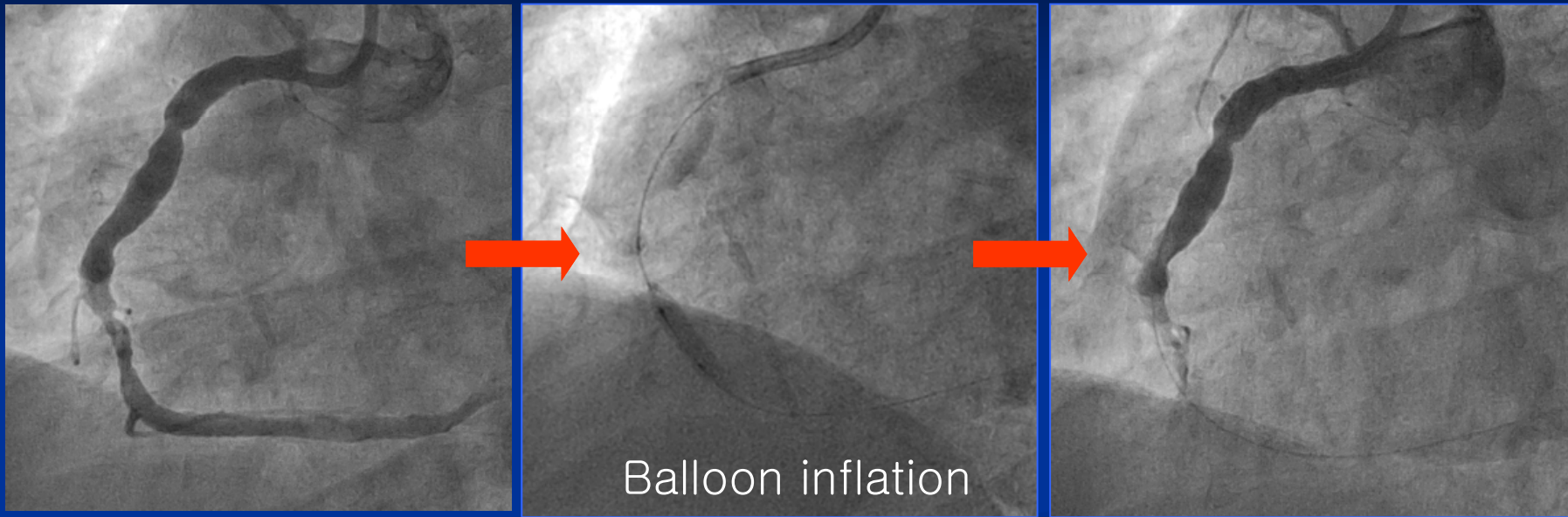
Thrombus remnant



Pre PCI imaging identifies lipid core plaque



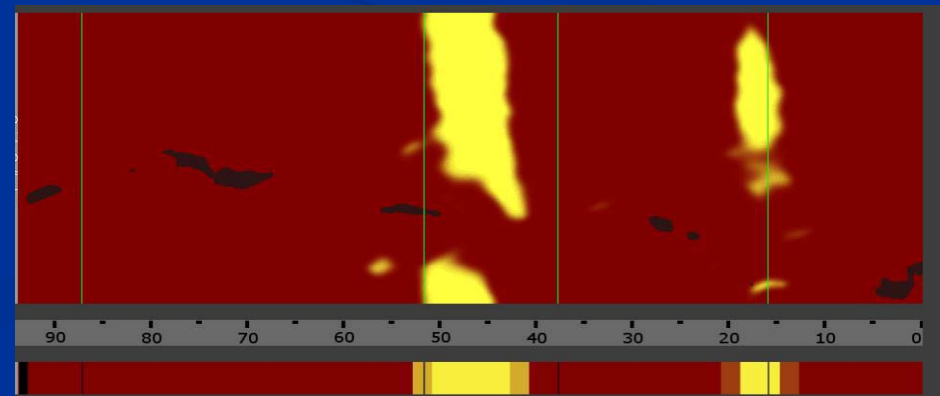
Dilation of circumferential lipid core plaque



Complete heart block
and hypotension

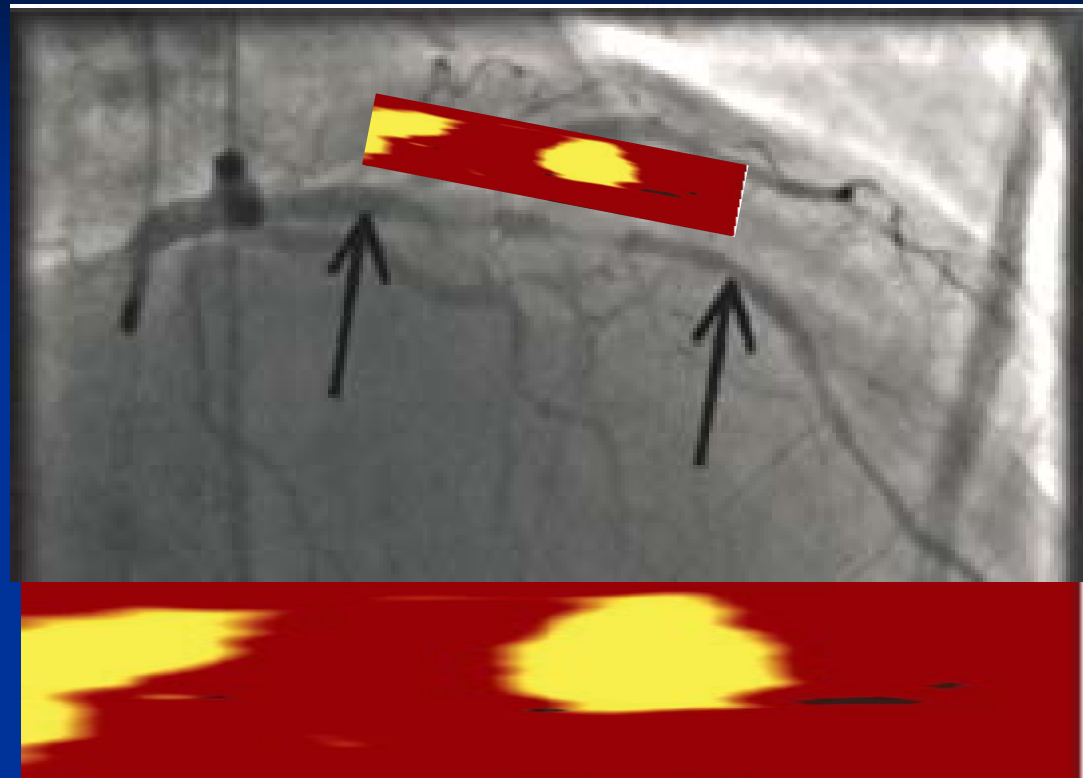


“No flow” occurs



LAD Pre-PCI

A large lipid core plaque is present in the lesion



The maximal lipid core burden index in any 4 mm segment $\{LCBI_{(4mm)}\}$ was 591.

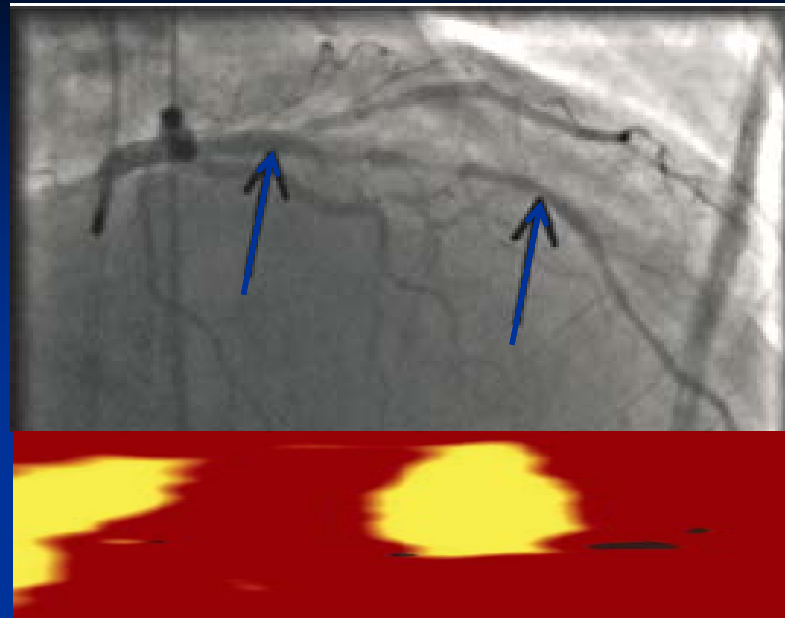
Stenting is performed with resolution of the stenosis.

No reflow occurs, associated with a CK-MB elevation.

The chemogram post stenting shows less yellow, suggesting possible embolization.

Goldstein et al., Circ Cardiovascular Interventions. 2011;4:429-437

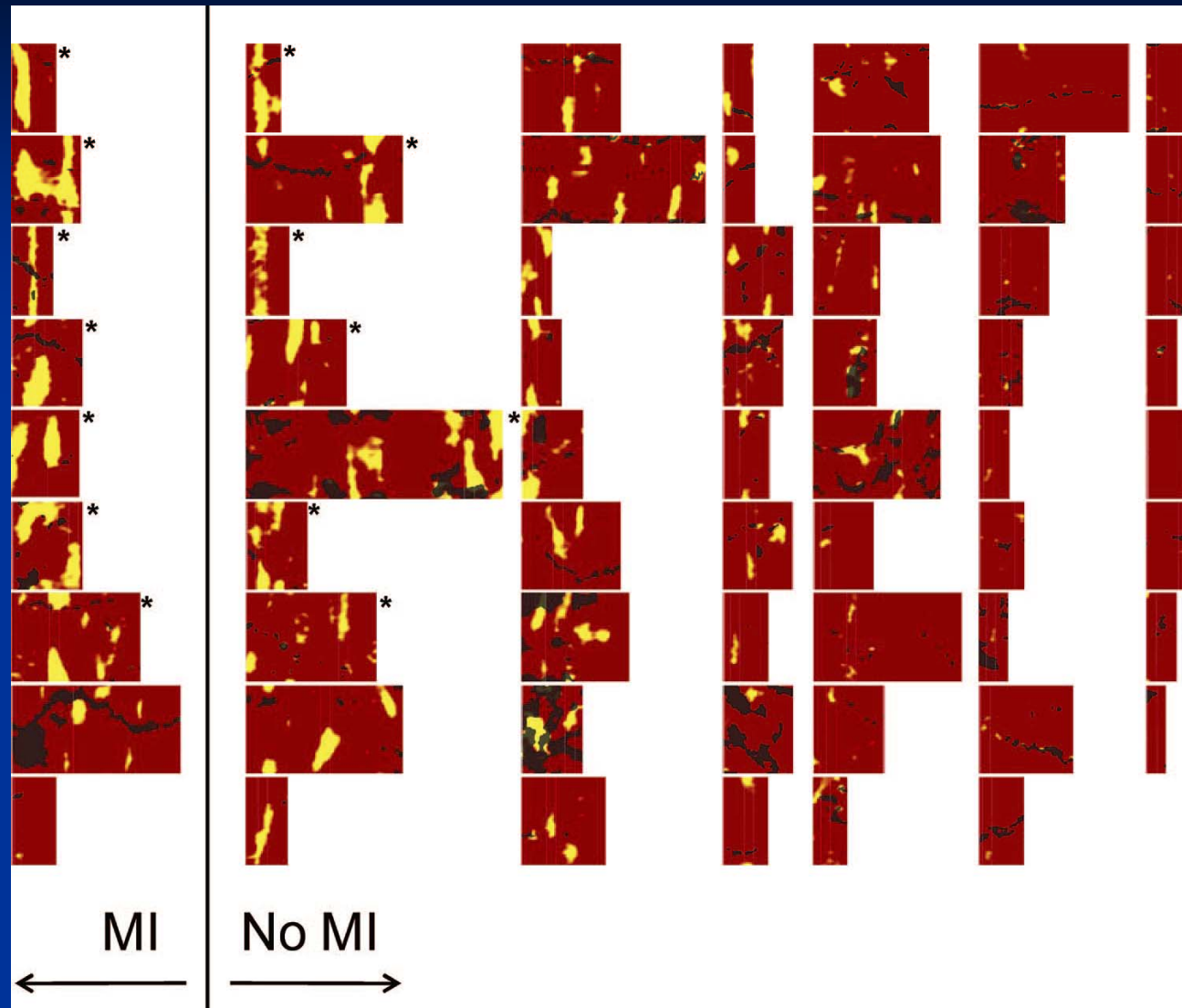
LAD Pre-PCI



LAD Post-PCI



Chemograms of 62 stable patients



Peri-procedural MI occurred in 50% of patients with max $LCBI_{(4mm)}$ of ≥ 500 compared to 4.2% patients with lower max $LCBI_{(4mm)}$

* Chemograms with max $LCBI_{4mm}$ of 500

Prognostic importance of “big yellow”

A max LCBI (4mm) > 500 was associated with a 12-fold increase in the risk of a peri-procedural MI

Parameter*	Threshold†	Relative risk of peri-procedural MI (95% CI)	<i>p</i> ‡
maxLCBI _{4mm}	≥500	12 (3.3 to 48)	0.0002
LDL – mg/dL	>100	5.4 (1.4 to 23)	0.03 [§]
Complex Plaque	Y	3.5 (0.91 to 14)	0.15
Degree Stenosis – %	>75	3.1 (0.92 to 11)	0.14 ^{**}

* Non-significant *p* value (*p*>0.1) for Age, Sex, BMI, Race, Prior CAD, Prior MI, DM, Smoking, HTN, HLD, HDL, HLD R_x, Lesion Length

† For continuous variables, a threshold was selected using a ROC analysis.

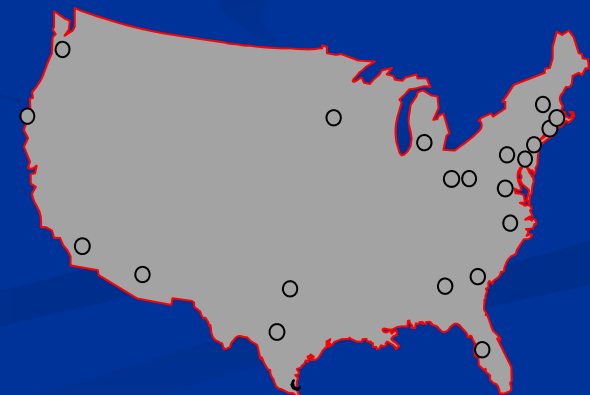
‡ Fisher's Exact Test two-sided *p*

§ N = 44 due to missing data

** N=61 due to missing data

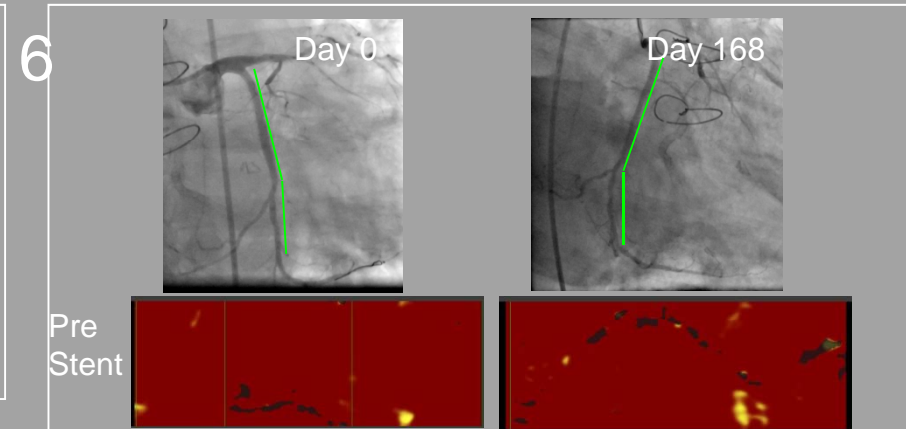
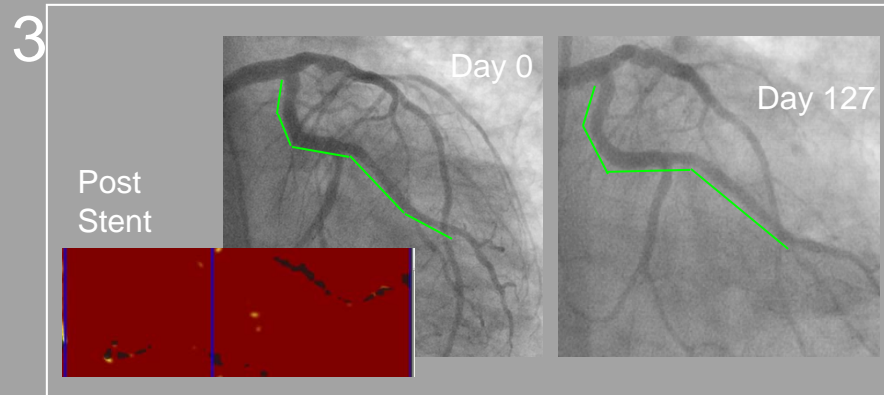
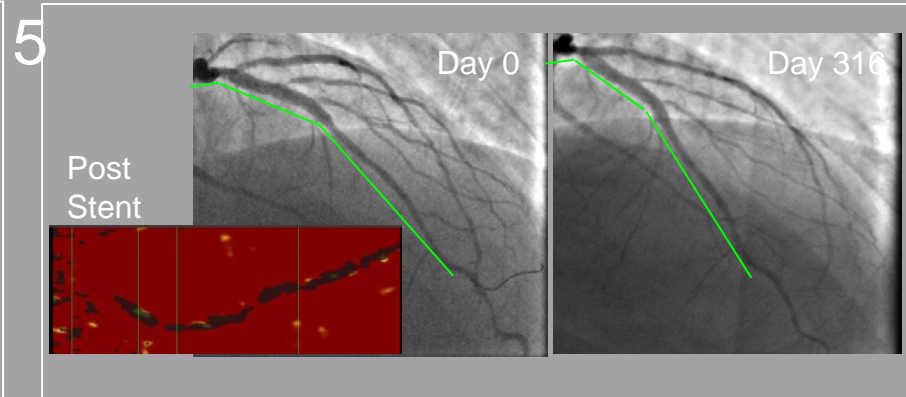
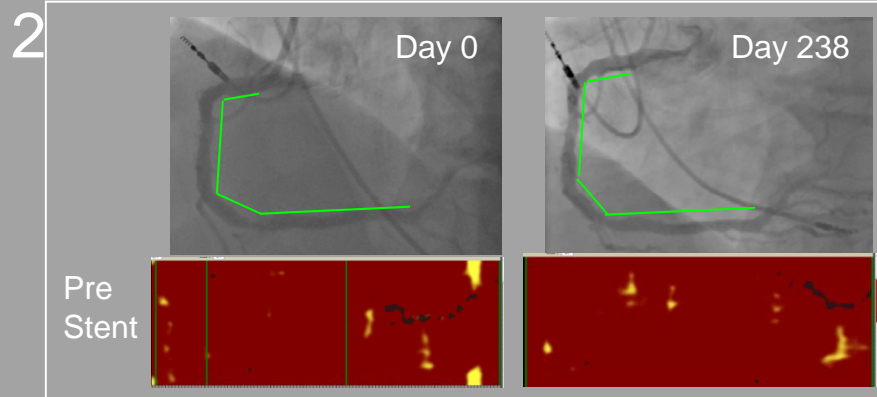
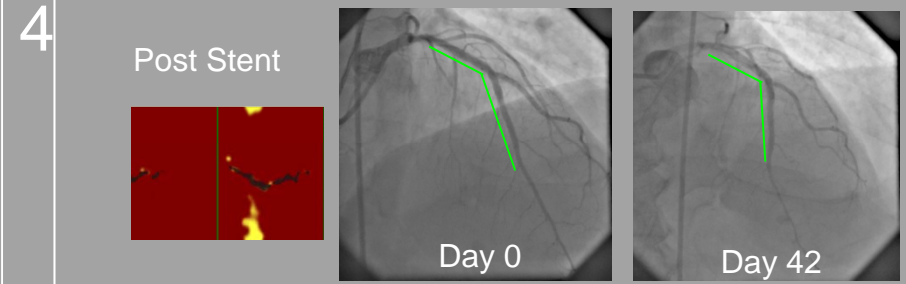
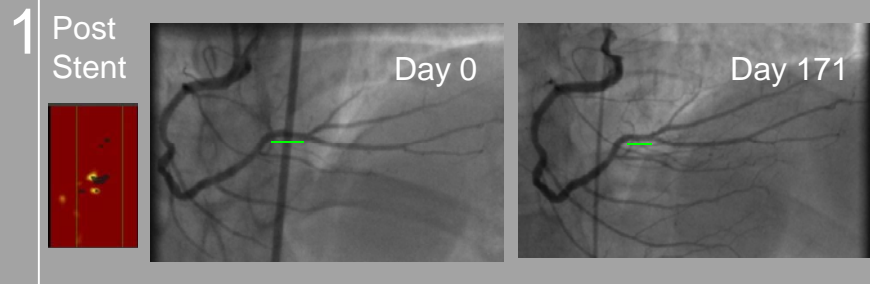
COLOR Registry

- 1000 patients – PCI and NIR at baseline
- Patients followed for 2 years to identify stenting complications and new coronary events
- Launched Jan 2009
- ~20 sites, over 1,000 patients
- Patients now reaching 2yr FU



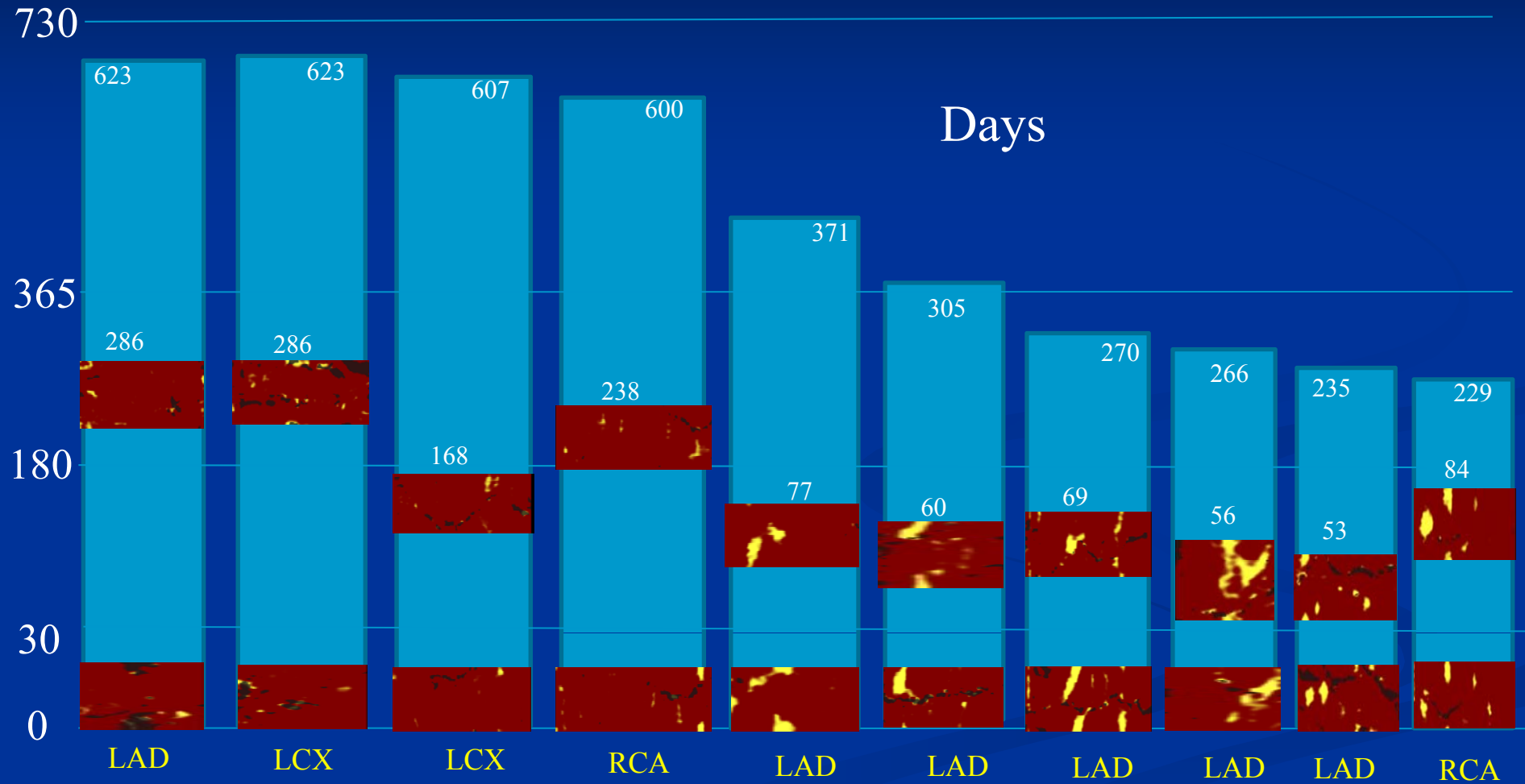
Red Chemogram: Angiographic follow-up

Remains stable



Stability of lipid core plaque

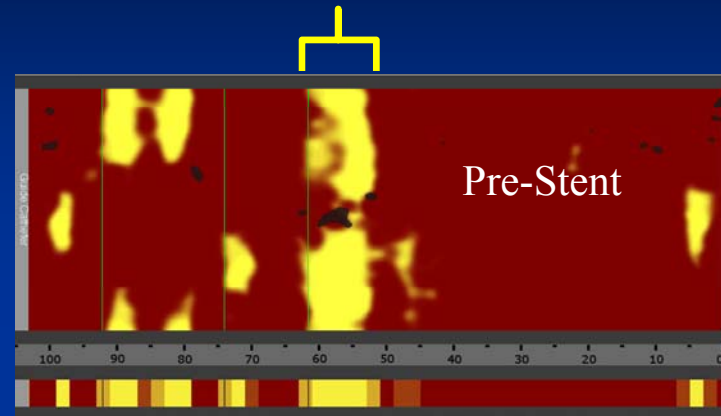
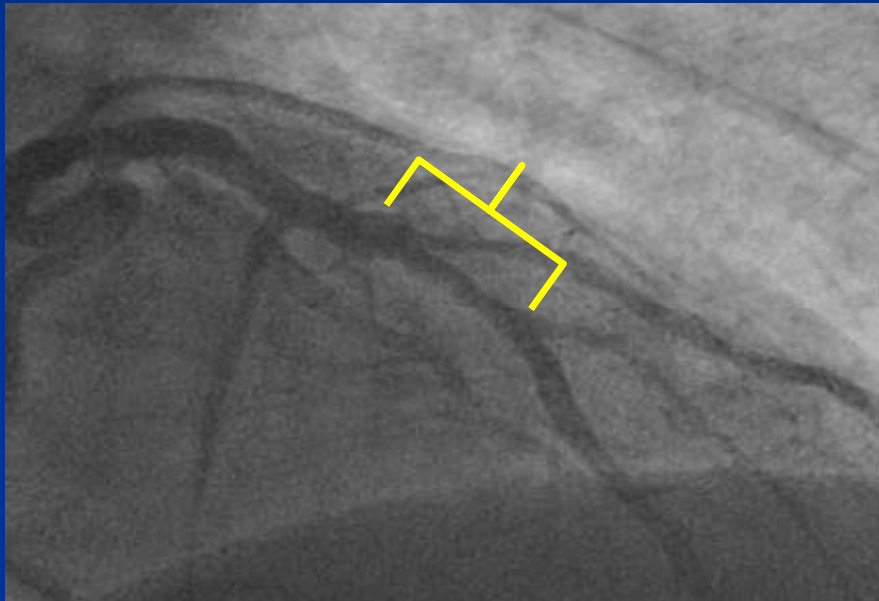
Each column represents a single vessel with 2 chemograms acquired at least 1 month apart



LCPs do not arise and disappear rapidly

Rapid plaque progression

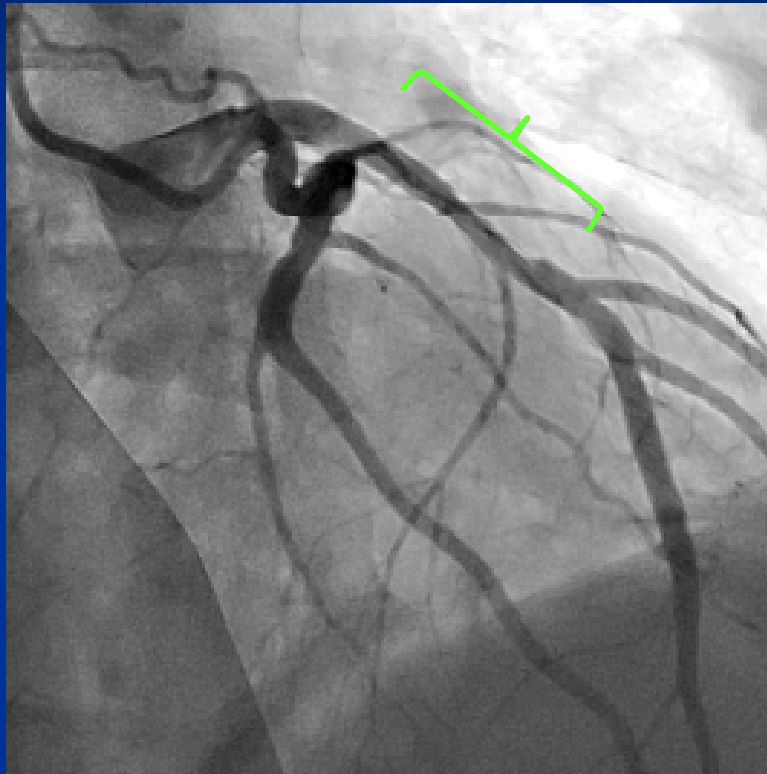
59 yo m



171 days later
develops
unstable angina

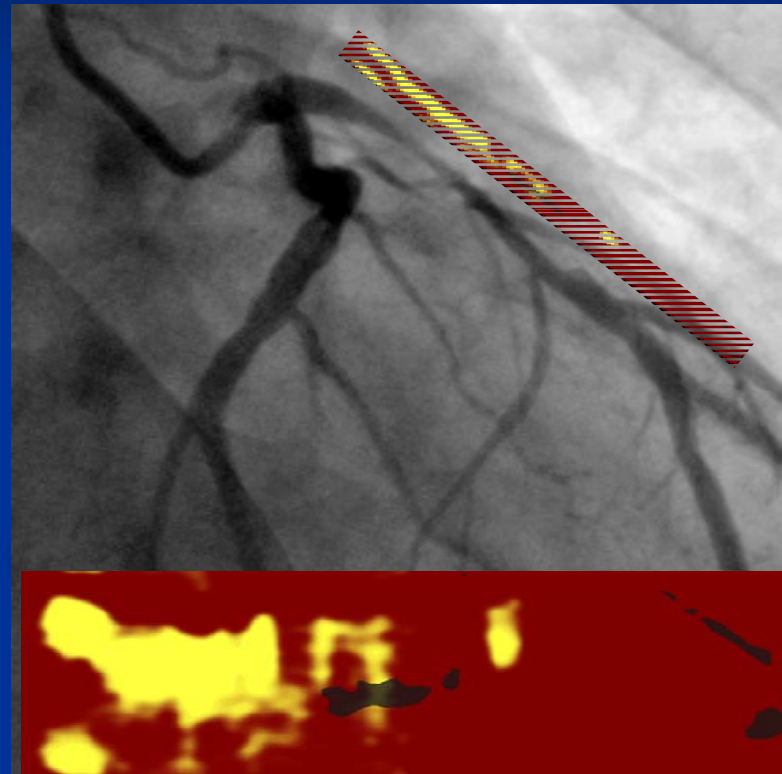


Rapid plaque progression



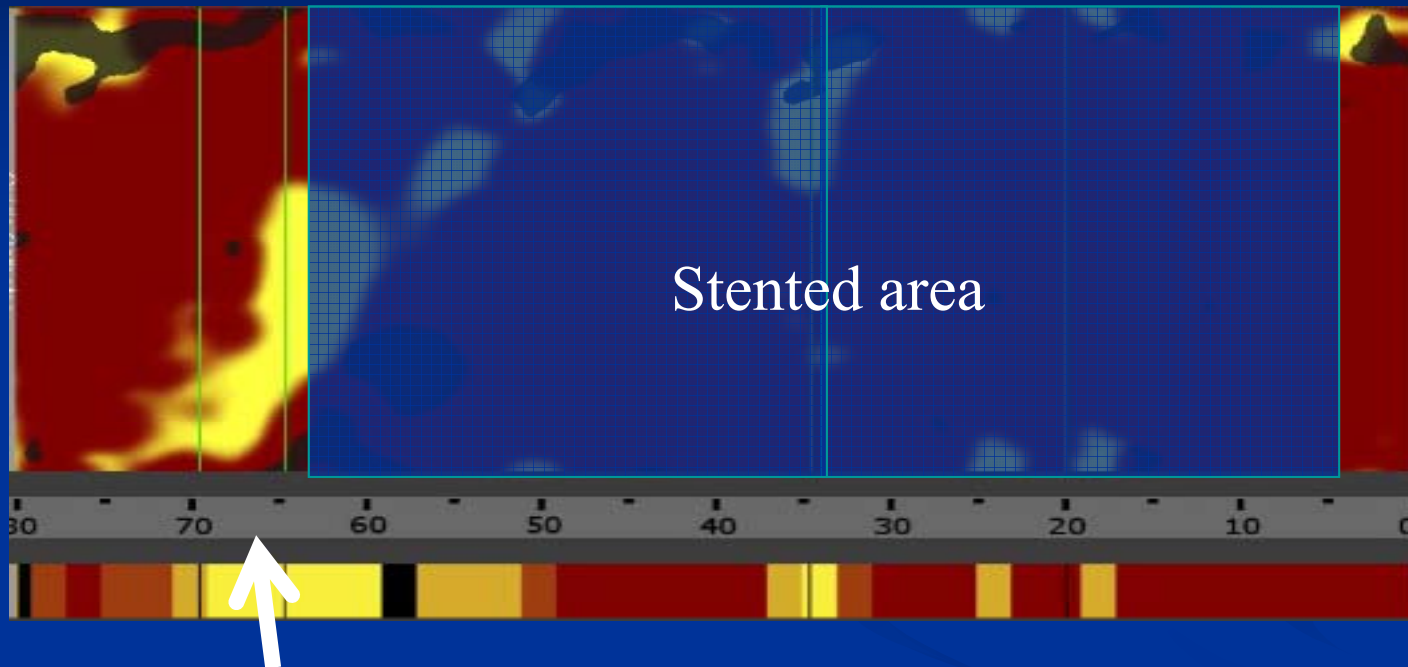
At time of RCA stent

4 mo
→



No reflow during PCI

Lipid core plaque and stent placement



Day 241:

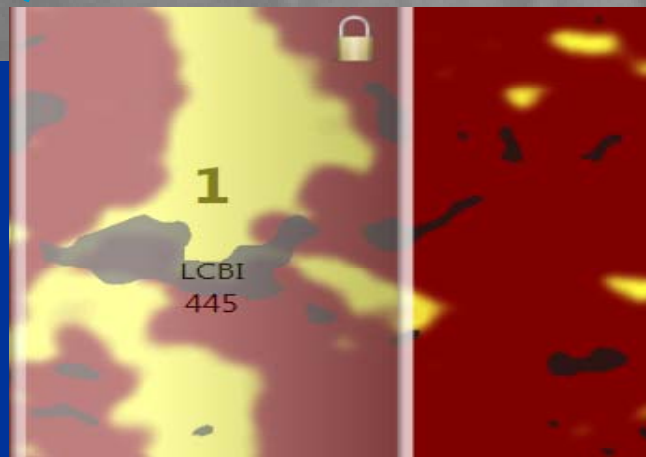
--Stenosis at proximal edge of proximal stent

10 cases of restenosis in COLOR Registry.
In 9 of those, the stent ended in a lipid core.

Ulcerated Lesion



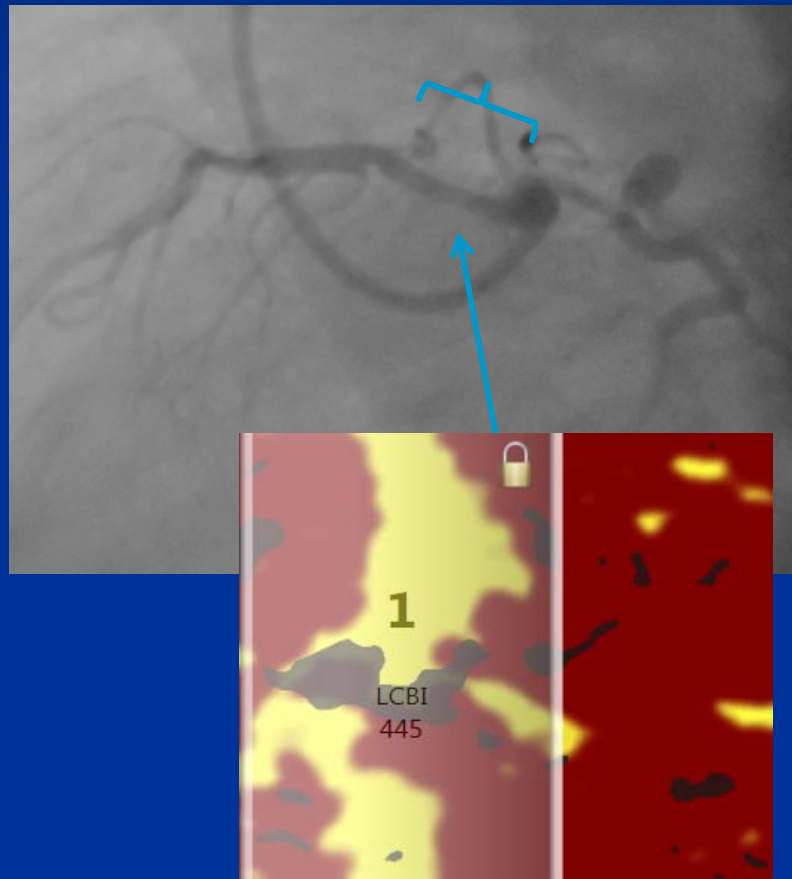
Chemogram demonstrates a circumferential LCP at site of ulceration.



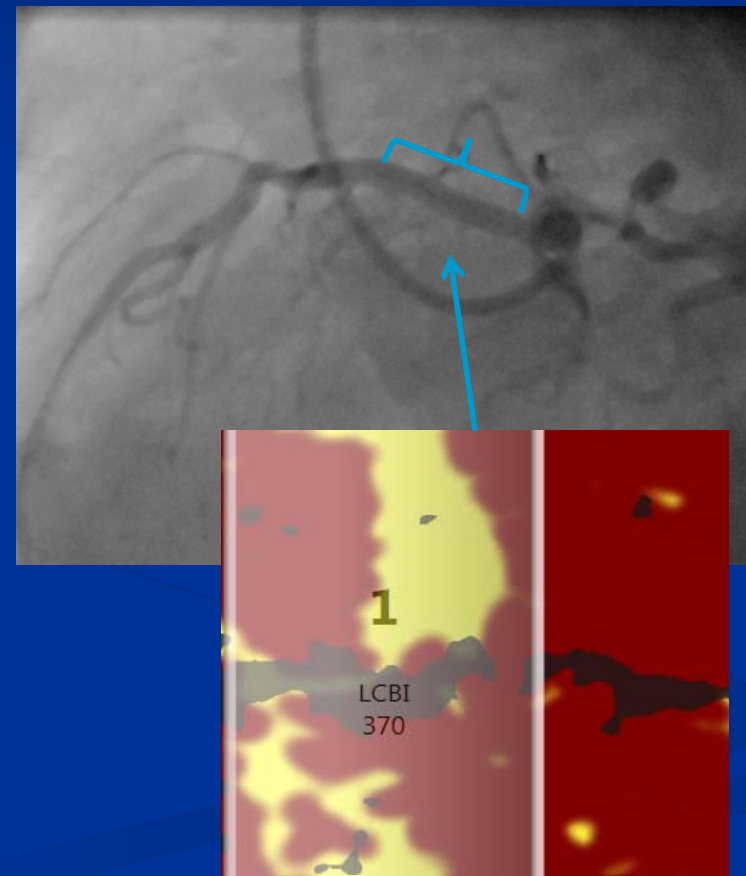
Courtesy Dr. David Rizik

Containment of LCP behind Stent

Pre Stent



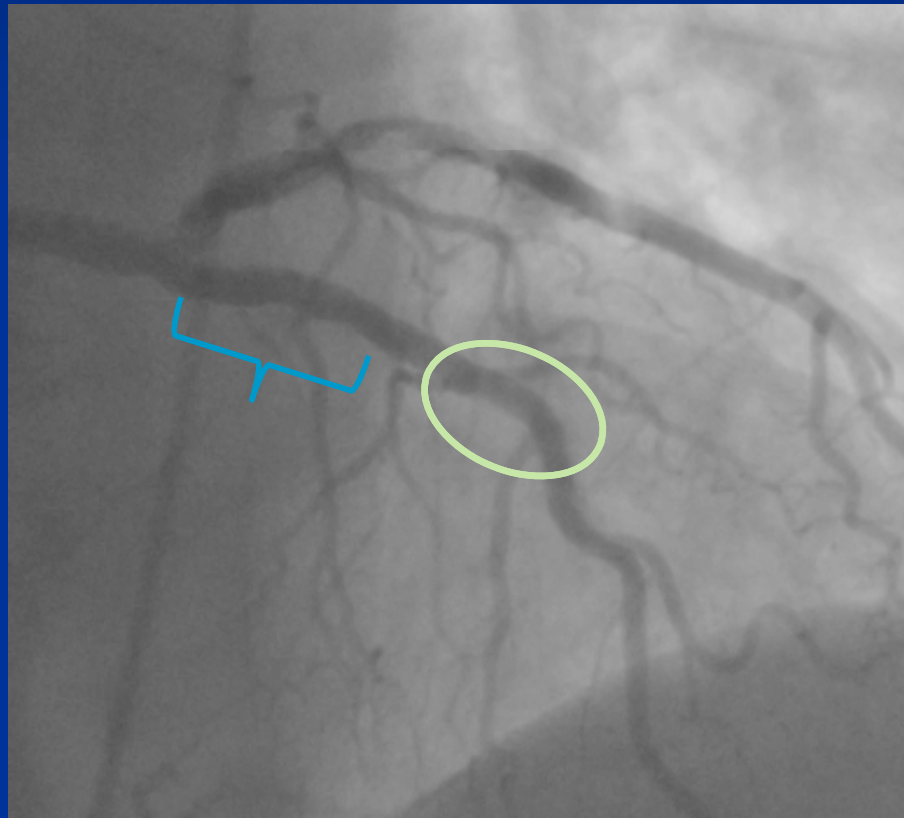
Post Stent



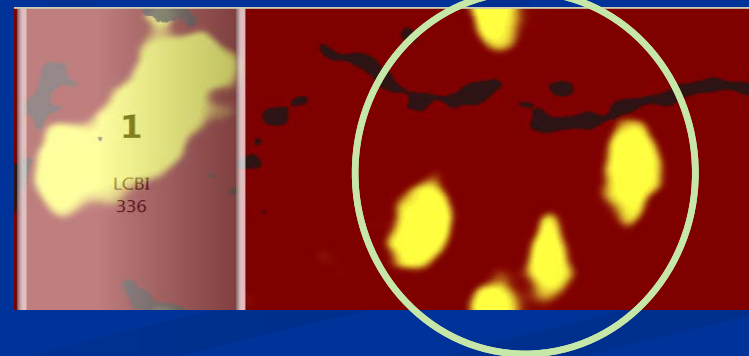
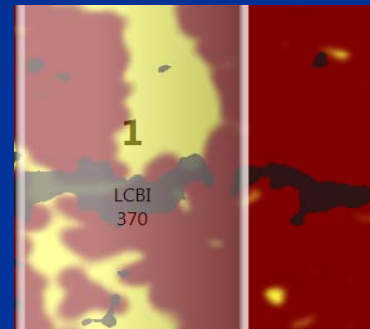
Lipid Core contained
behind stent struts

Courtesy Dr. David Rizik

Very late follow-up after LAD stent



Day 0 – post stent



Day 580

Courtesy Dr. David Rizik

Does Aggressive Statin Therapy Reduce Coronary
Atherosclerotic Plaque Lipid Content?
Results From: Reduction in YELlow Plaque by
Aggressive Lipid LOWering Therapy (**YELLOW**) Trial

Annapoorna S Kini, PR Moreno, J Kovacic, A Limaye,
ZA Ali, J Sweeny, U Baber, R Mehran, G Dangas, SK
Sharma

Cardiac Catheterization Laboratory
Mount Sinai Heart
Mount Sinai Hospital, NY, NY

High-Dose statin therapy will **reduce lipid core** content in *severely obstructive* coronary lesions in the short term (6–8 weeks), as evaluated by near-infrared spectroscopy

Primary outcome

Change in coronary **lipid core burden index (LCBI)** after short-term high-dose statin therapy, as determined by near-infrared spectroscopy (NIRS).

Two/Three Vessel CAD

(n= 87)

**After stenting the target vessel
The non-target lesion underwent FFR**

FFR \leq 0.8 \rightarrow IVUS, NIRS

Randomized

Standard

n = 43

**Continue statin the patient was taking
DAPT for 1 year**

Aggressive

n = 44

**Rosuvastatin 40 mg
DAPT for 1 year**

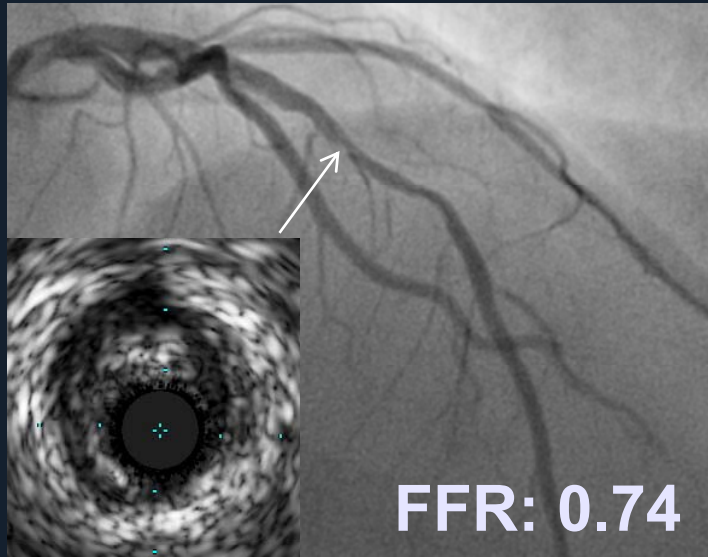
**Follow up Cath (6-8 weeks)
FFR, IVUS and NIRS repeated.
If FFR \leq 0.8, lesion stented and imaging repeated.
If FFR > 0.8 the patient was treated medically.**

**Imaging data analyzed by CRF Core Lab
Data analysis for primary outcome analyzed by MSH independent Core Lab**

Case Example

Yellow

Baseline



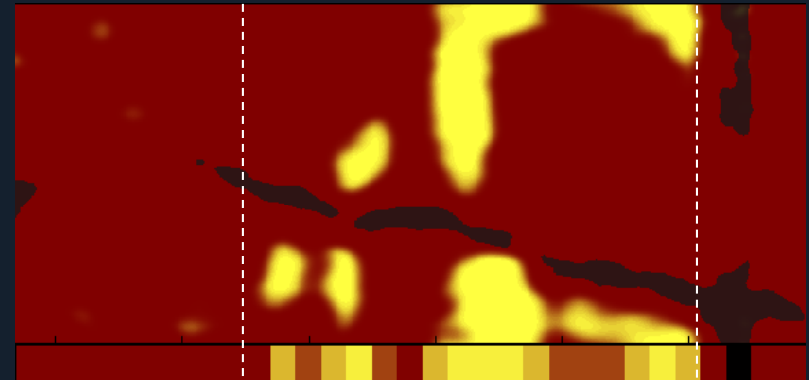
Plaque Area
5.6mm²

FFR: 0.74

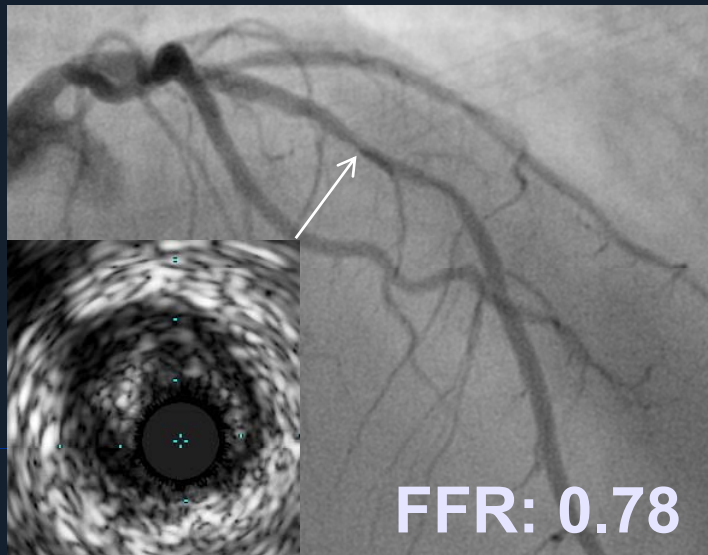
Lesion LCBI: 259

Max10mm LCBI: 511

Max4mm LCBI: 802



Follow-up



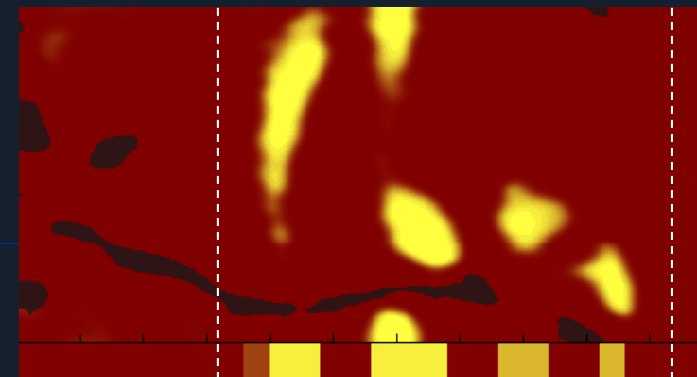
Plaque Area
5.5mm²

FFR: 0.78

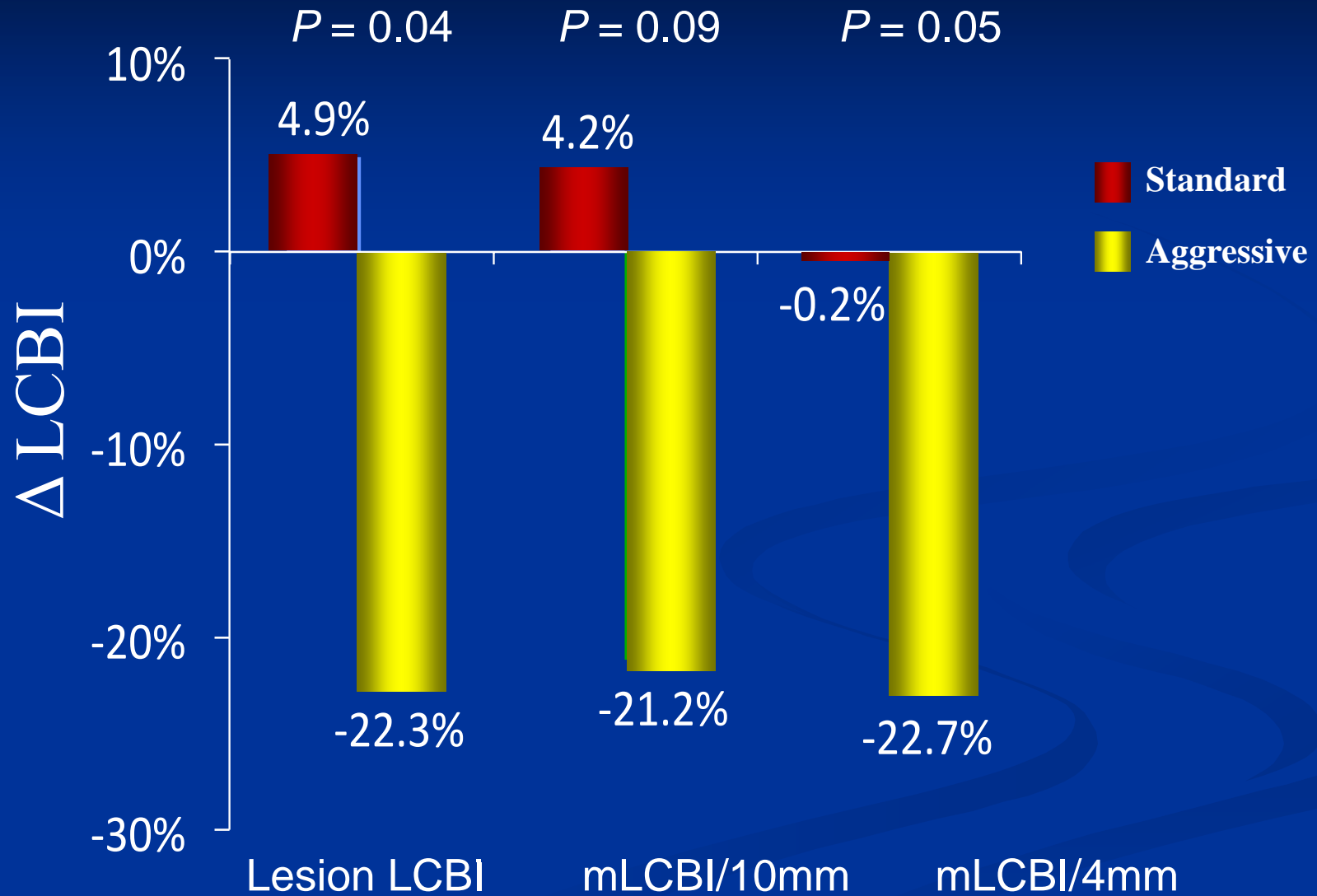
Lesion LCBI: 177

Max10mm LCBI: 289

Max4mm LCBI: 474



Percent Change in LCBI



Summary: early clinical use of NIR

- Large lipid core plaque, especially when circumferential, associated with PCI complications
- Rapid plaque progression is possible, but not typical
- Stents ending in a lipid core plaque may be prone to restenosis
- Aggressive statin therapy can reduce lipid content over a time frame of < 2 months
 - Could justify intensification of therapy
 - Allows testing of new treatments in manageable patient sample