

Integration of FFR in Complex PCI of Daily Practice

John McB. Hodgson, M.D.

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Disclosure Information

John McB. Hodgson MD, FSCAI

The following relationships exist related to this presentation:

Grant support (GS), consultant (C), speakers bureau (SB), stock options (SO), equity interest (EI):

St. Jude/RADI, Boston Scientific, Volcano: GS

Volcano : SB

Technology Solutions Group: EI

Off label use of products will not be discussed in this presentation.

Angiography is inadequate in non-critical lesions in non-acute patients

- AUC recommends adjunctive techniques

TABLE 2. Patients Without Prior Bypass Surgery

Indication	Appropriateness Score (1-9)		
	CCS Angina Class		
	Asymptomatic	I or II	III or IV
<ul style="list-style-type: none"> • One- or 2-vessel CAD without involvement of proximal LAD • No noninvasive testing performed 	†	U ₍₅₎	A ₍₇₎
<ul style="list-style-type: none"> • One- or 2-vessel CAD with borderline stenosis “50% to 60%” • No noninvasive testing performed • No further invasive evaluation performed (i.e., FFR, IVUS) 	†	I ₍₂₎	I ₍₃₎
<ul style="list-style-type: none"> • One- or 2-vessel CAD with borderline stenosis “50% to 60%” • No noninvasive testing performed or equivocal test results present • FFR less than 0.75 and/or IVUS with significant reduction in cross-sectional area 	I ₍₃₎	U ₍₆₎	A ₍₇₎
<ul style="list-style-type: none"> • One- or 2-vessel CAD with borderline stenosis “50% to 60%” • No noninvasive testing performed or equivocal test results present • FFR or IVUS findings do not meet criteria for significant stenosis 	I ₍₁₎	I ₍₂₎	I ₍₂₎

Daniel Bernoulli



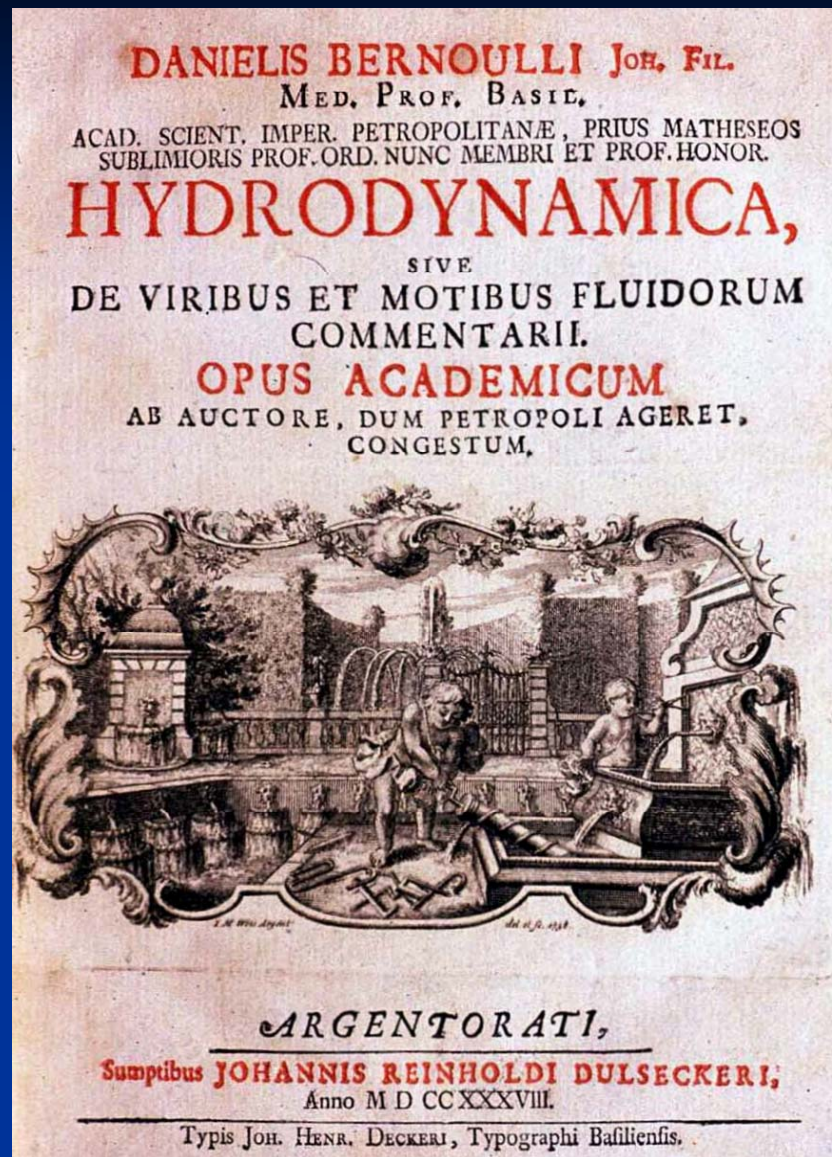
Daniel Bernoulli

8 February 1700

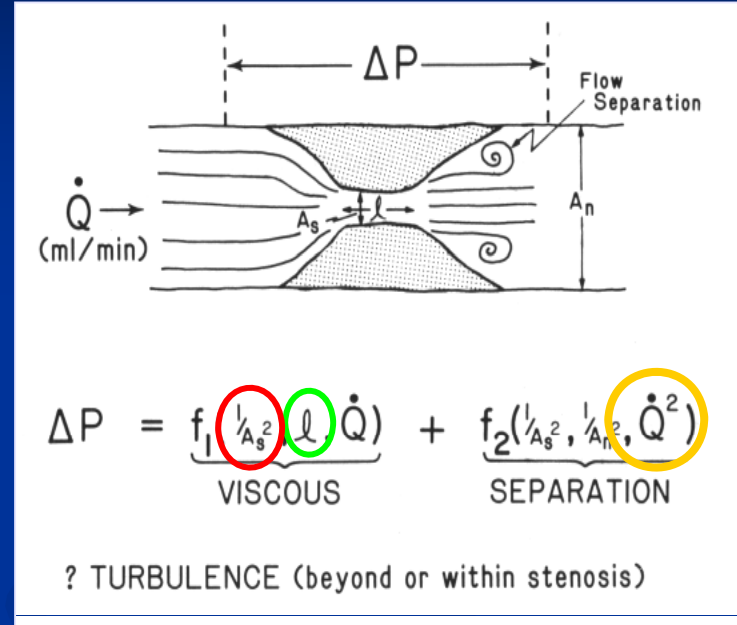
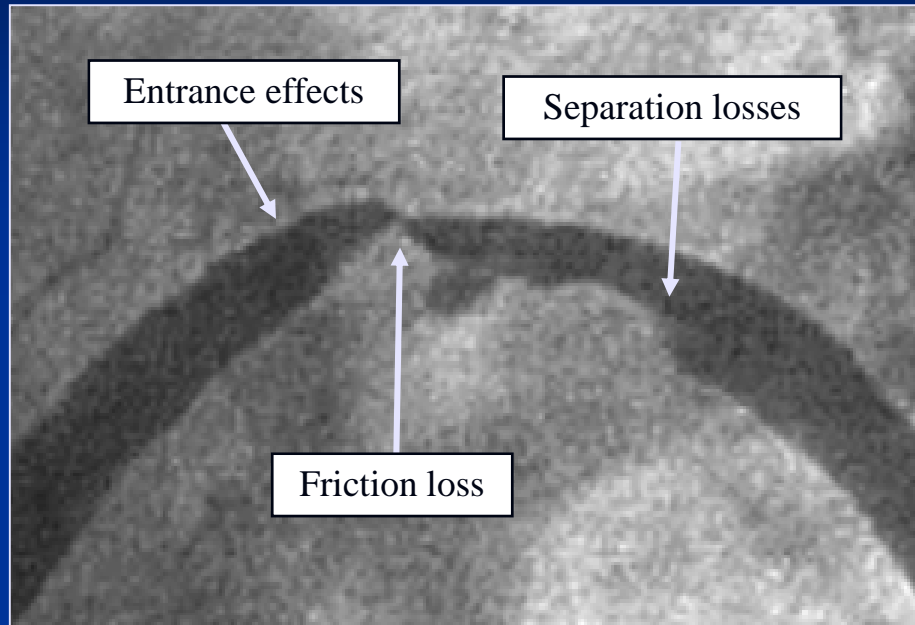
Groningen, Netherlands

8 March 1782 (aged 82)

Basel, Switzerland



Bernoulli equation



Pressure drop across stenosis:

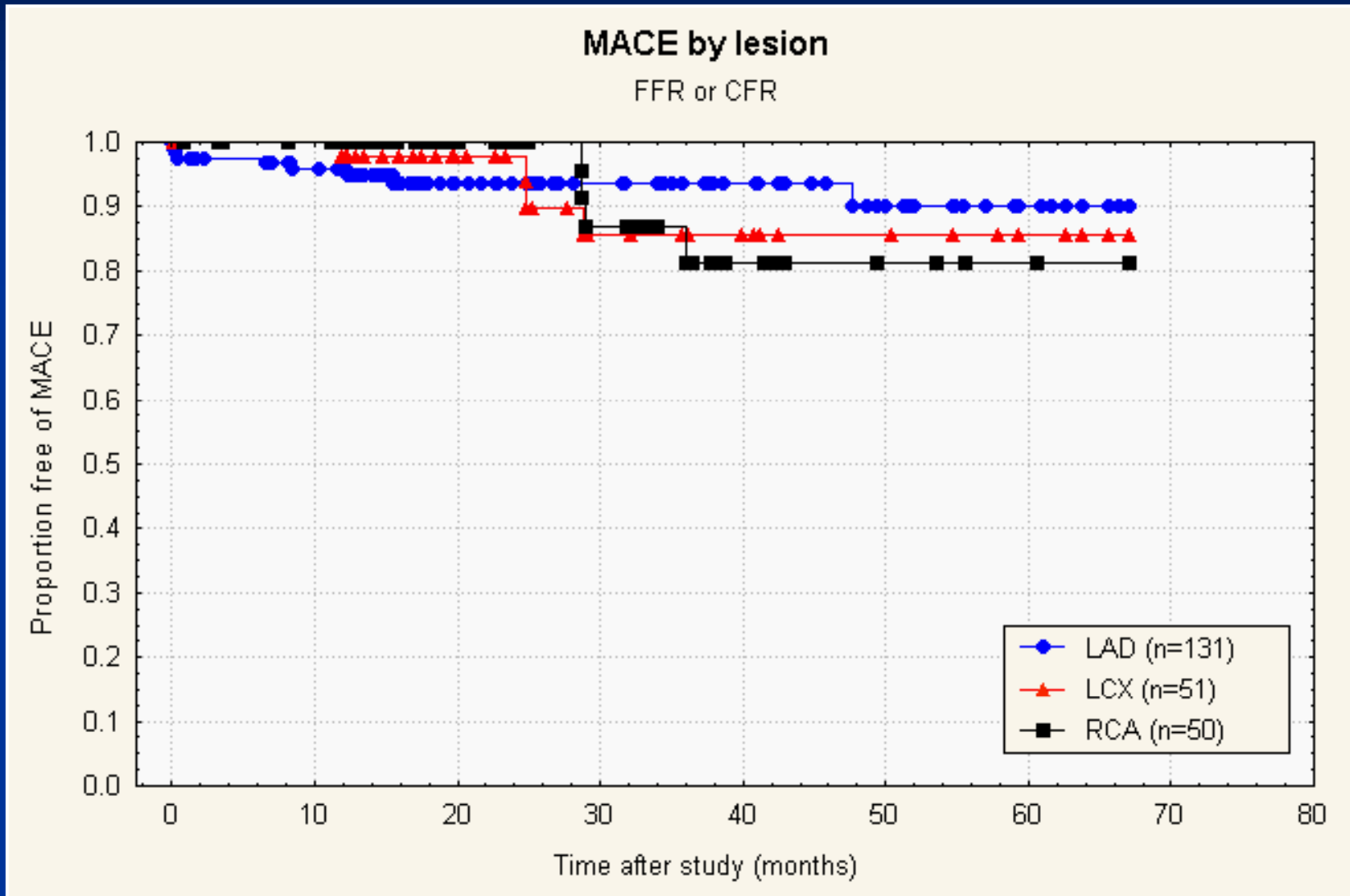
- increases with **flow** in a non-linear fashion
- increases with **lesion length**
- increases with smaller **lumen area**

When to use FFR

- All intermediate lesions in stable patients where there is not DEFINITIVE matching ischemia on a non-invasive study
- All side branch ostia when %DS >70
- Questionable non-culprit lesions in STEMI patients
- Multivessel disease to triage to CABG vs. PCI and guide PCI of only sig lesions

NOT in STEMI or ACS BM+ lesions

Deferral: effect of lesion location



Cleveland 1996-2001



Outcome of Deferred Lesions

513 Deferred Lesions in
509 FFR-Guided Patients

2 Years

53 Repeat Revascularizations

37
in a New Lesion or
in a Restenotic One

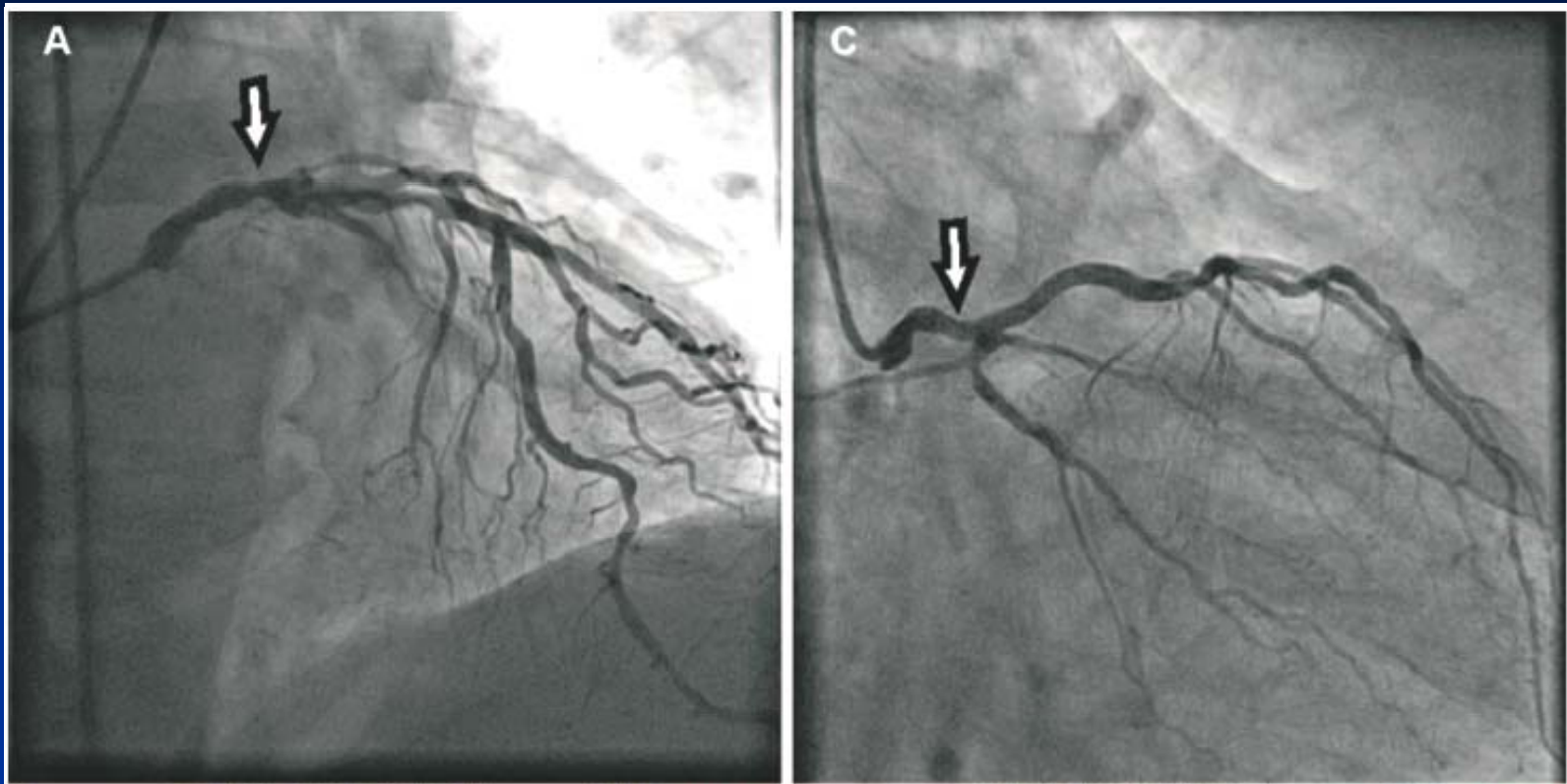
16
Originally Deferred Lesions

6
Without FFR or
Despite an FFR > 0.80

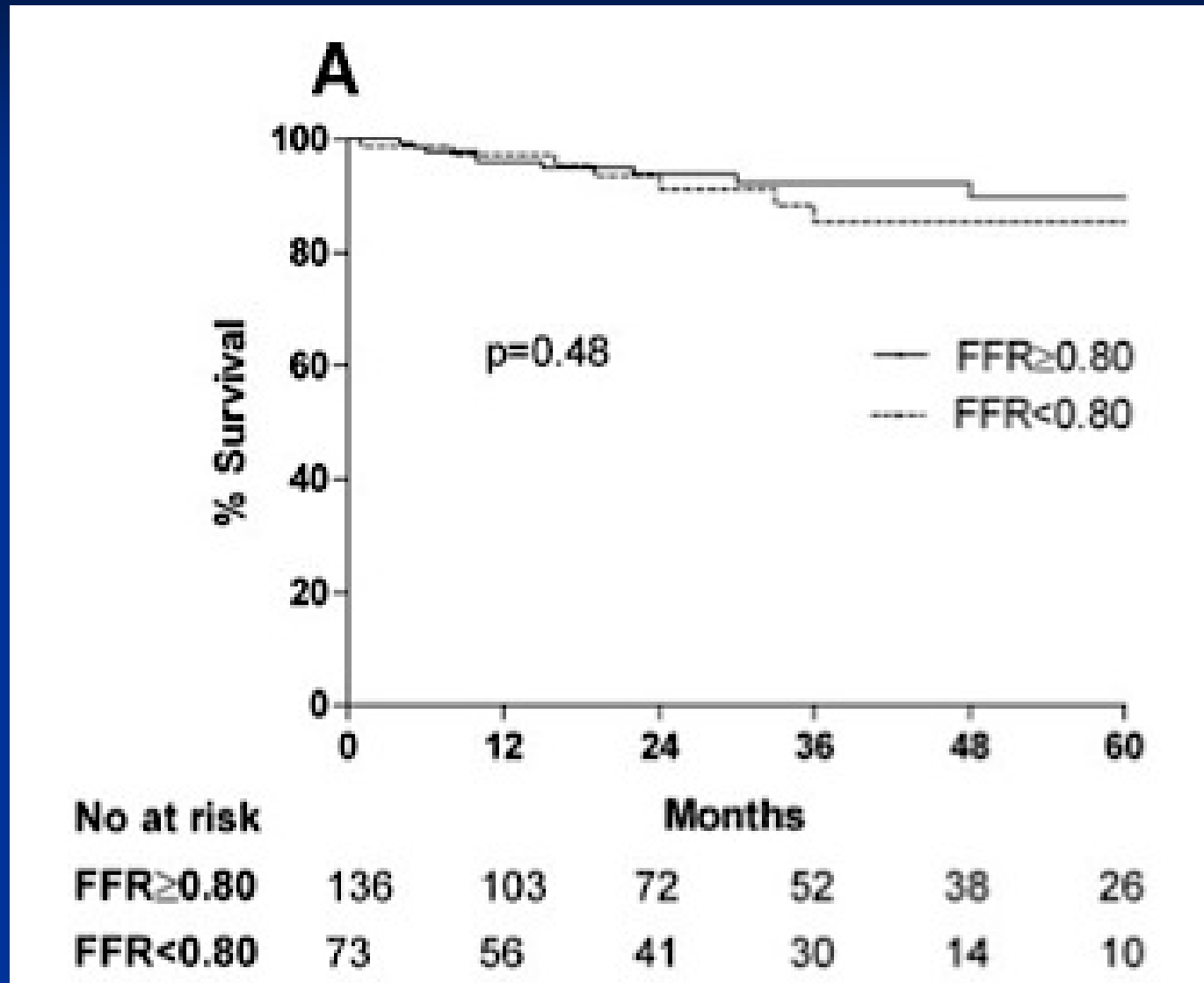
10
Originally Deferred Lesions
with Clear Progression

Only 10/513 or 1.9% of deferred lesions clearly progressed requiring repeat revascularization

Assessment of LM

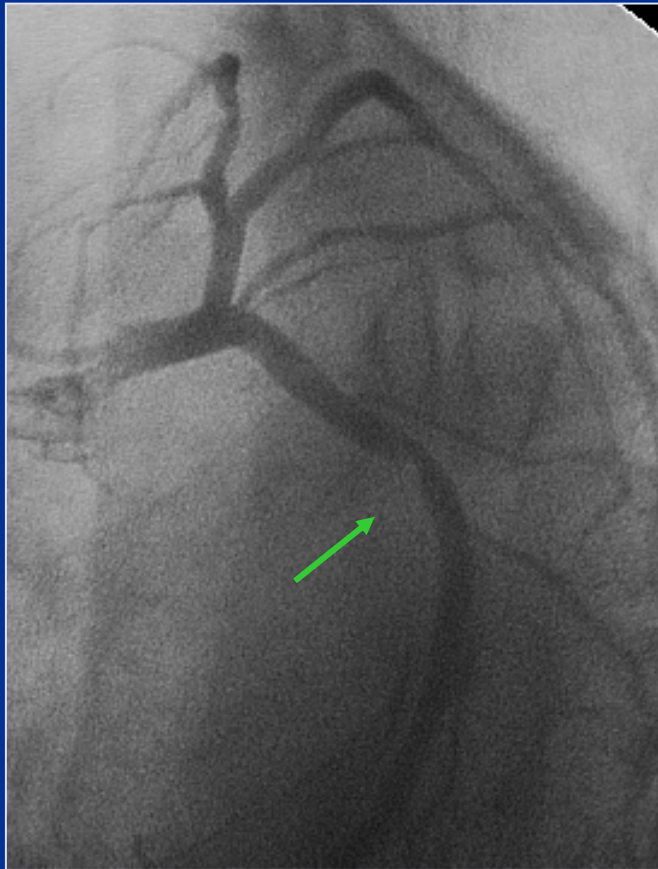


FFR in LM: safety of deferring Tx



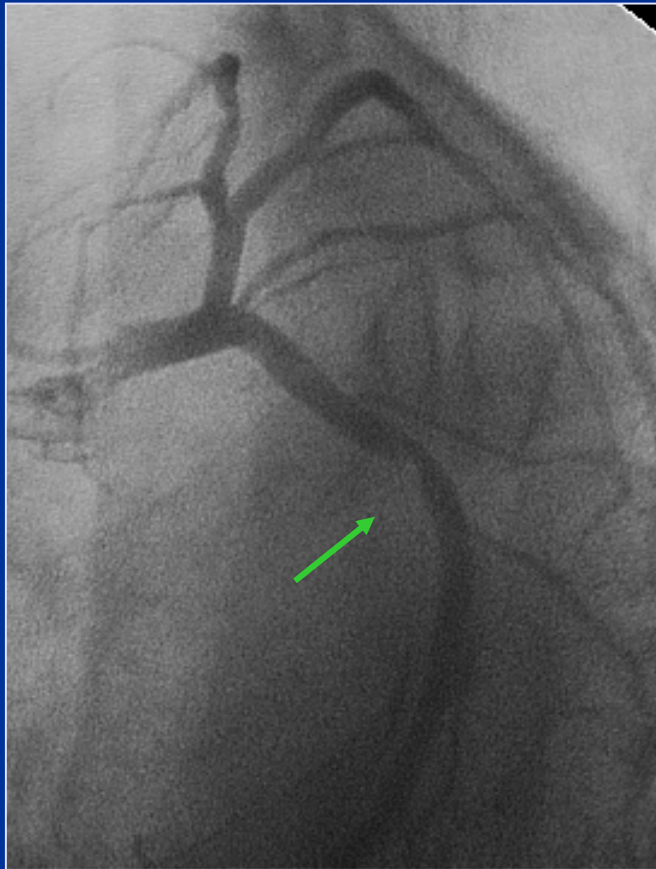
FFR in PCI: optimizing therapy

59 yo dialysis patient with flash pulmonary edema. Is PCI needed?



FFR in PCI: optimizing therapy

59 yo dialysis patient with flash pulmonary edema. Is PCI needed?



FFR= 0.92

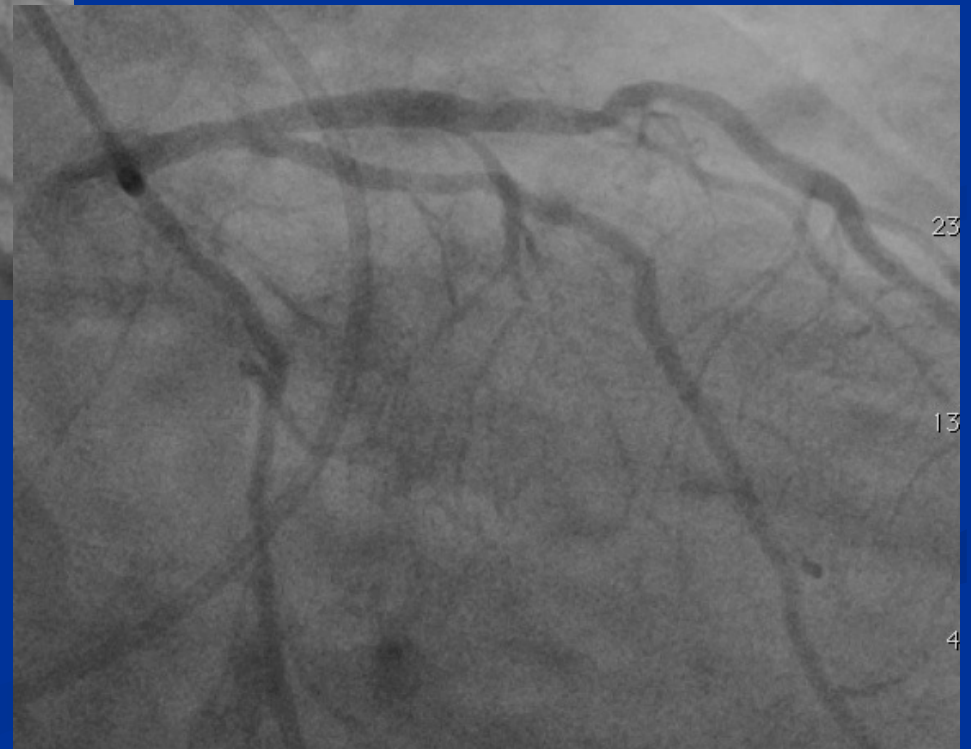


No PCI indicated

JB

- 65 yo man with atypical chest pains and DOE for many years
- Exercise MIBI: stopped for dyspnea; no ECG changes; possible anterior reversible defect; ischemic dilatation
- History of coronary angiogram 6 years prior: reportedly mild luminal irregularities

JB: angiography



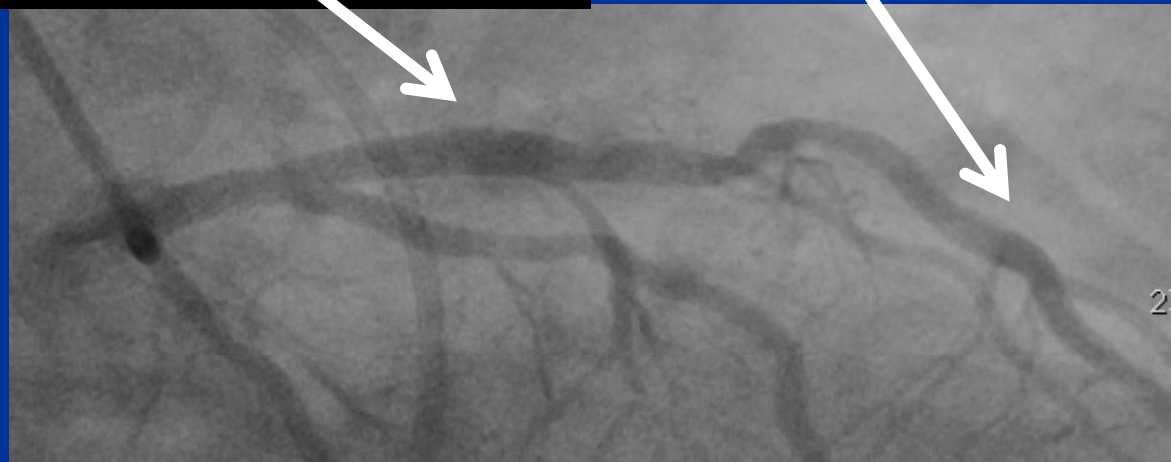
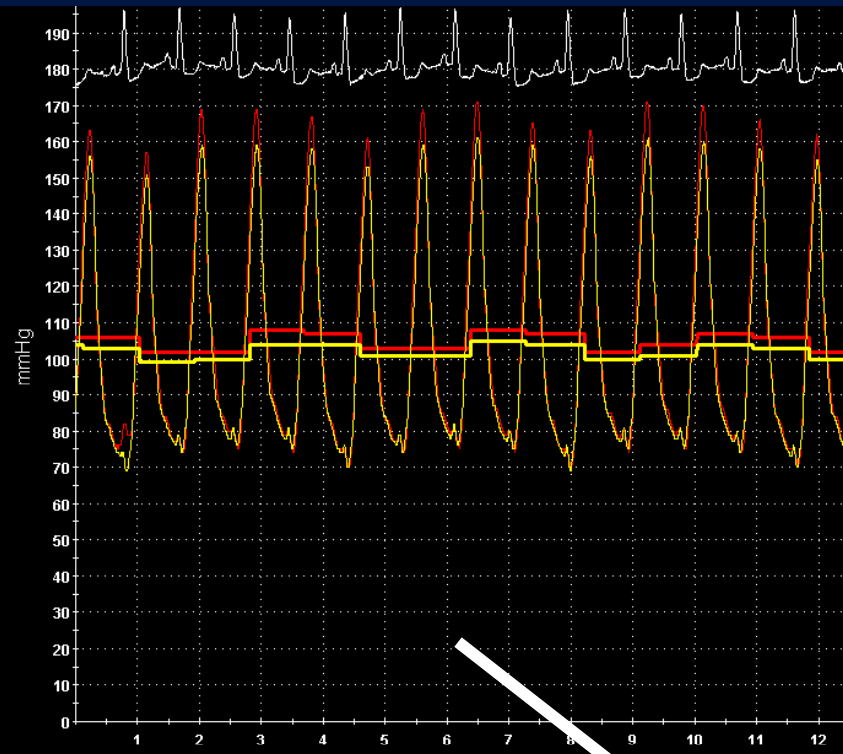
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JB: FFR of LAD

0:14

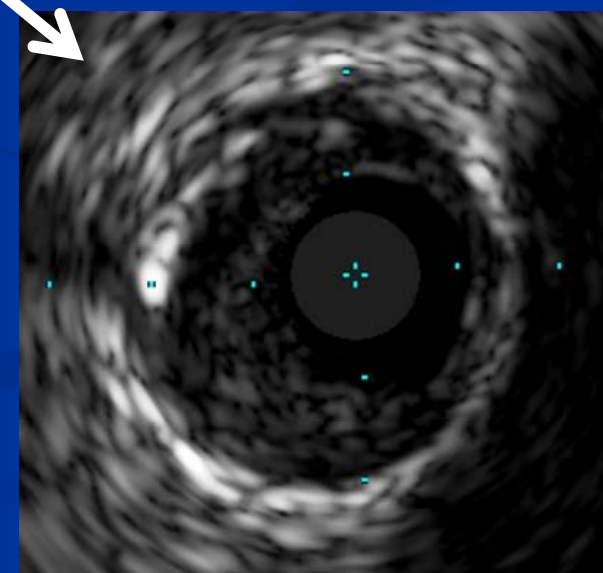
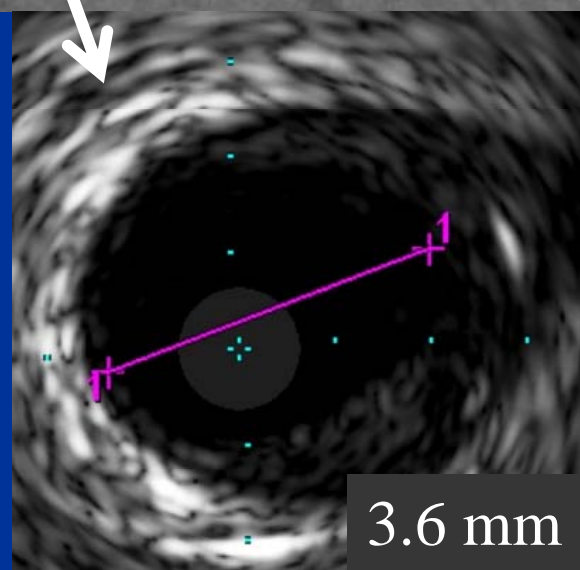
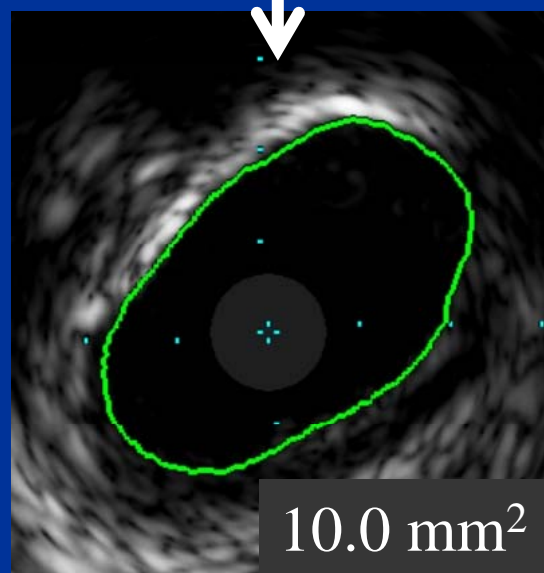
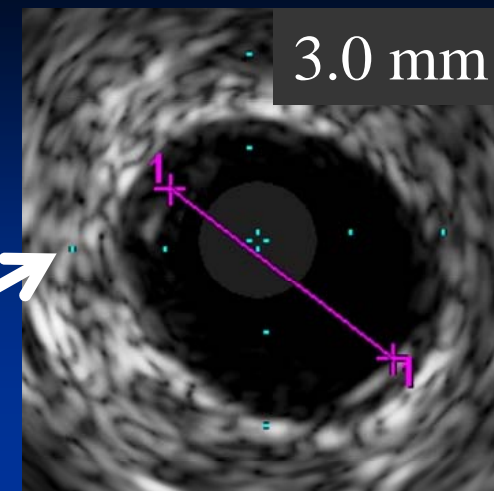
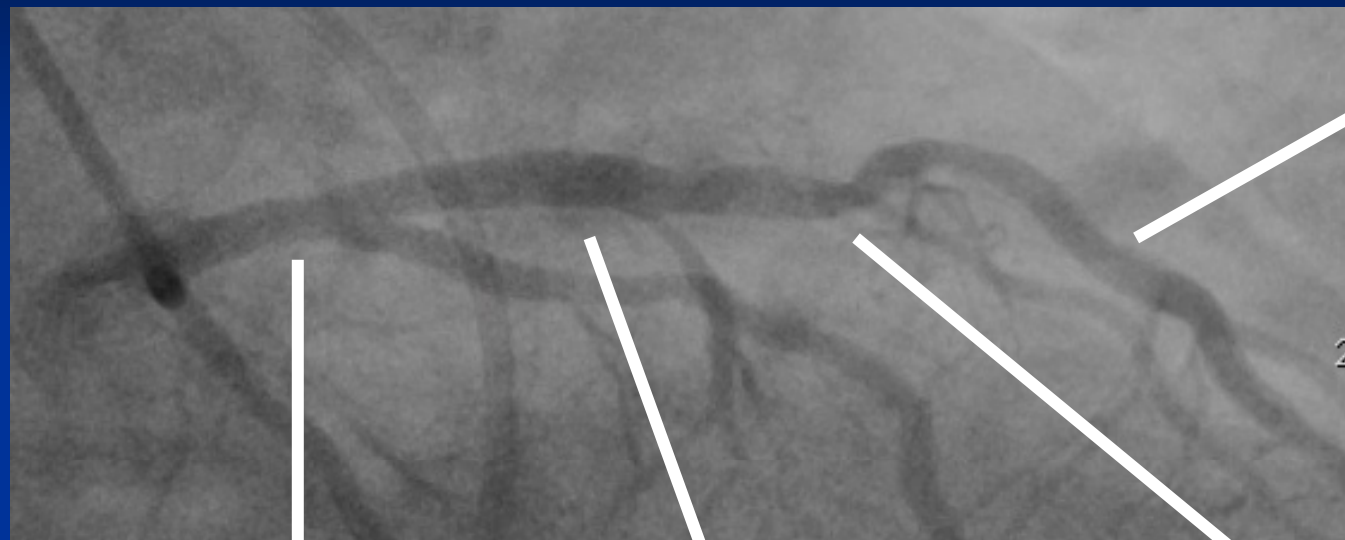
FFR	0.95
Pd/Pa	0.98
Pa:iPa	106:156
Pd:iPd	104:145
HR	66

List of Runs	FFR
12:12:01 PM	0.80
12:12:56 PM	0.78
12:14:09 PM	0.95
01:16:38 PM	0.90
01:17:34 PM	0.90

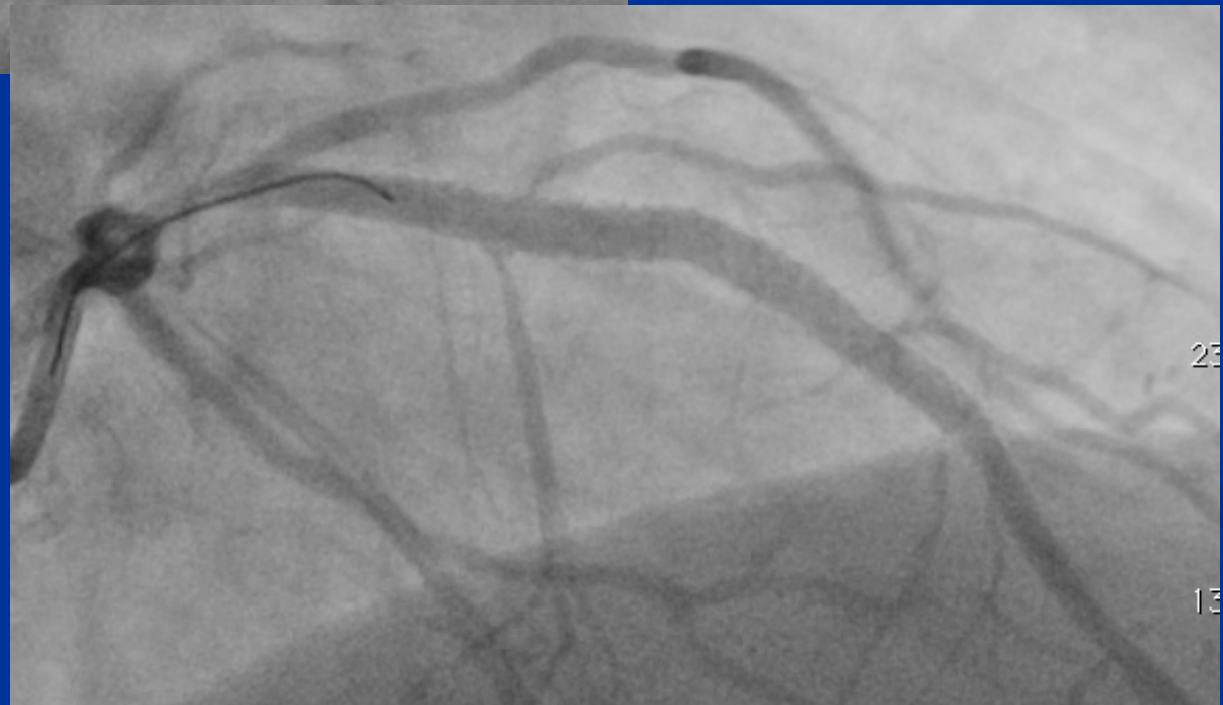
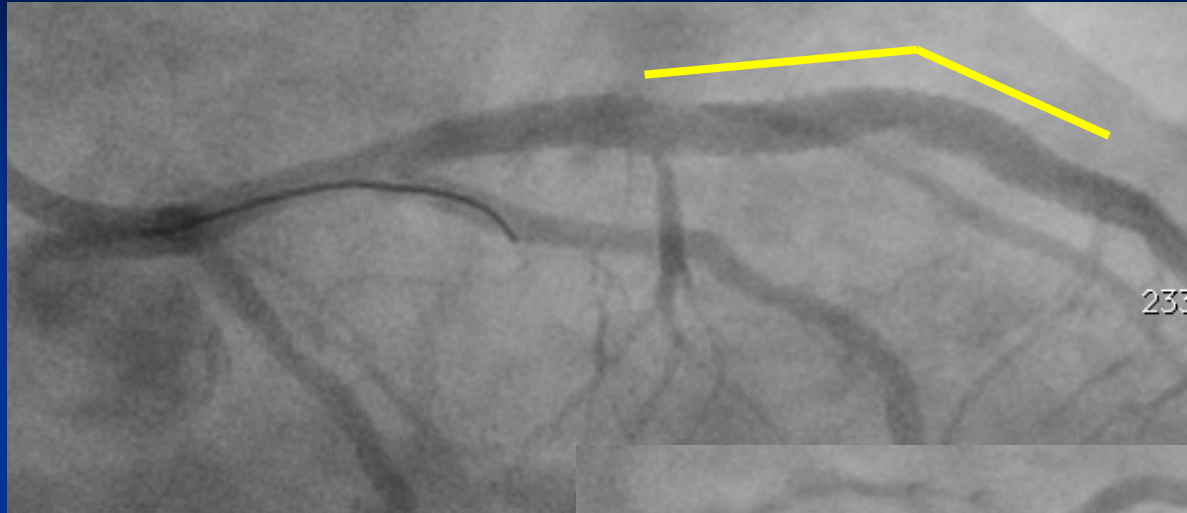


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JB: IVUS pre

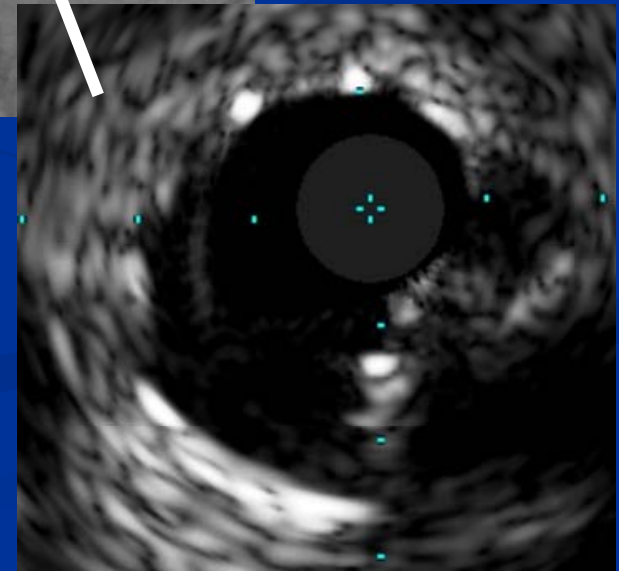
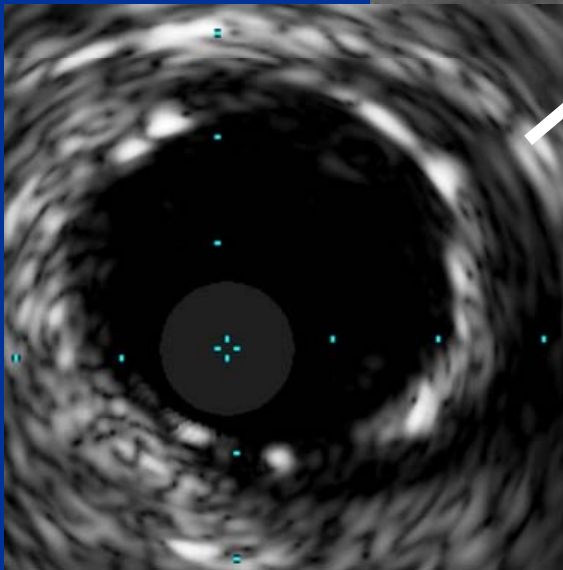
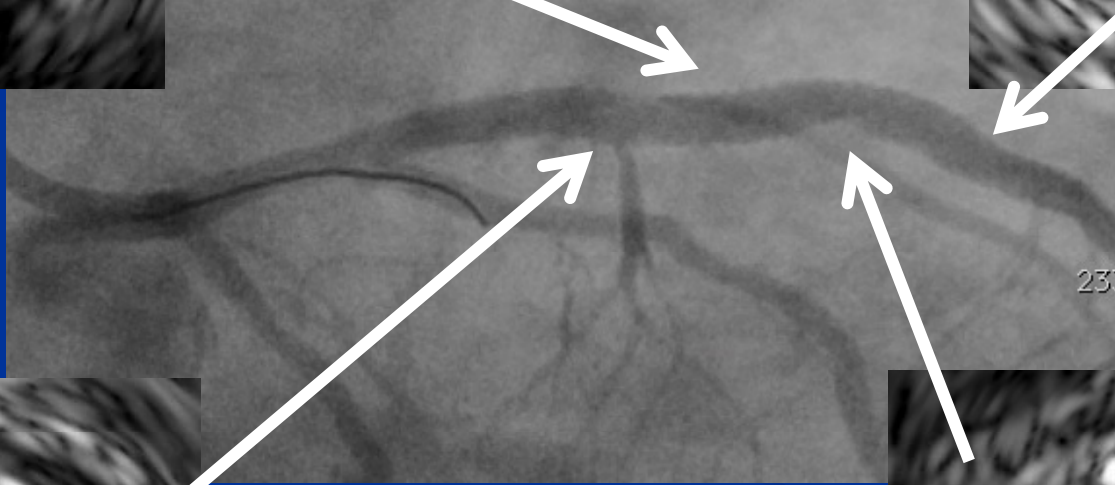
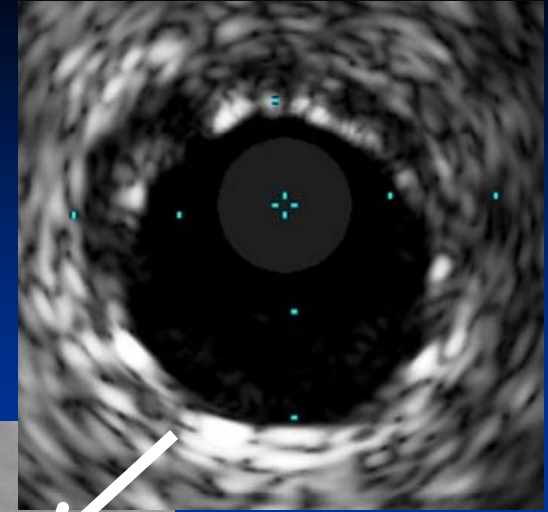
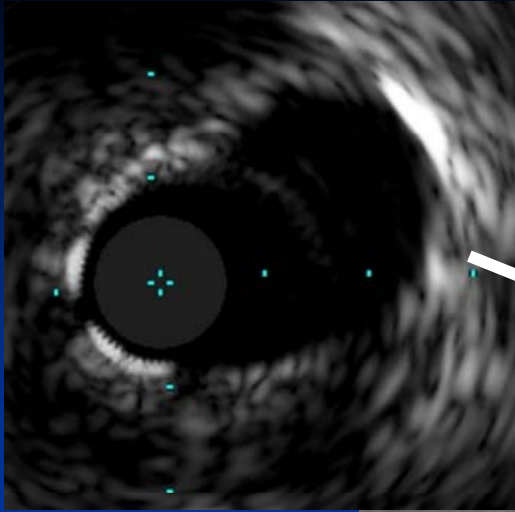


JB: post stent

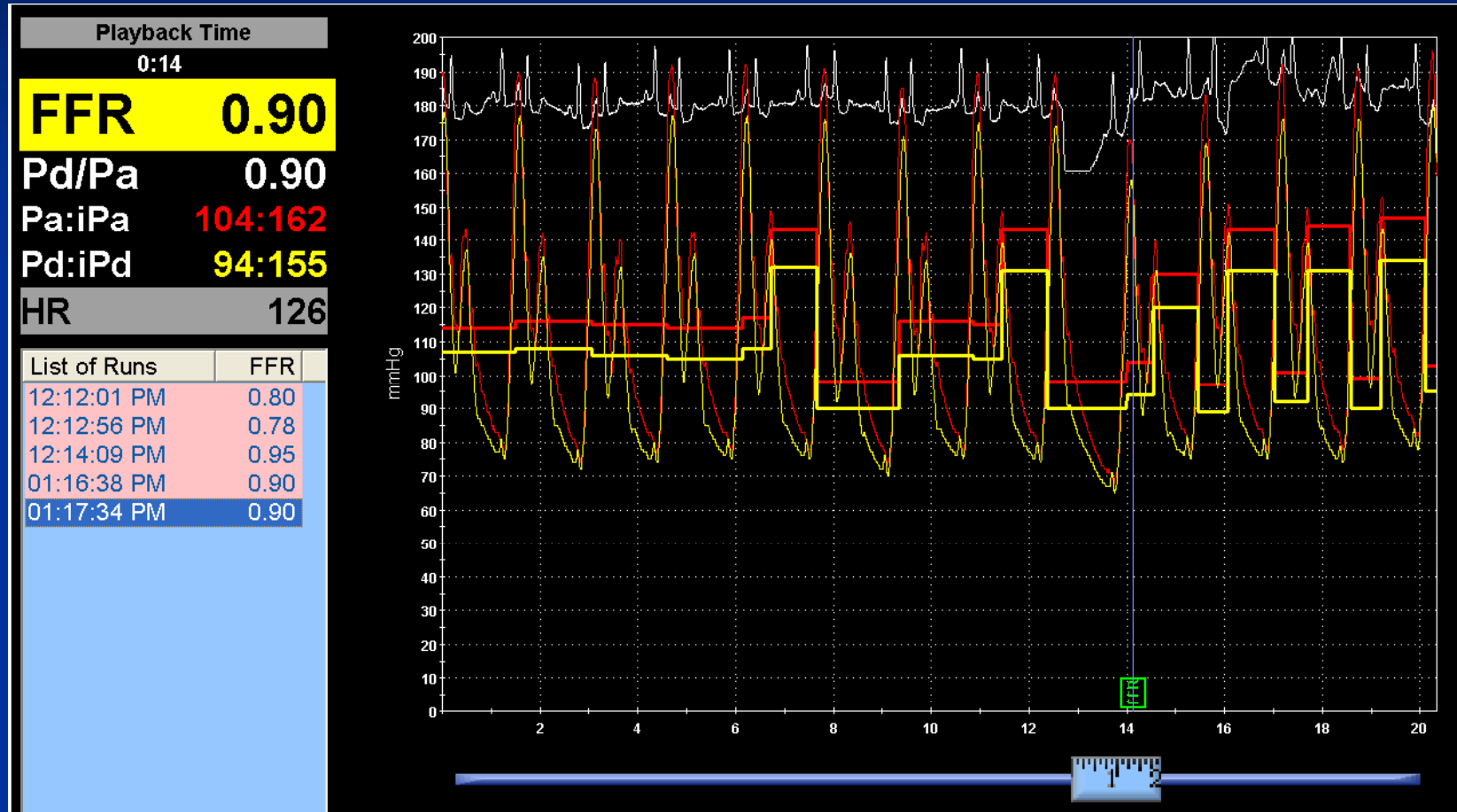


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JB: post IVUS



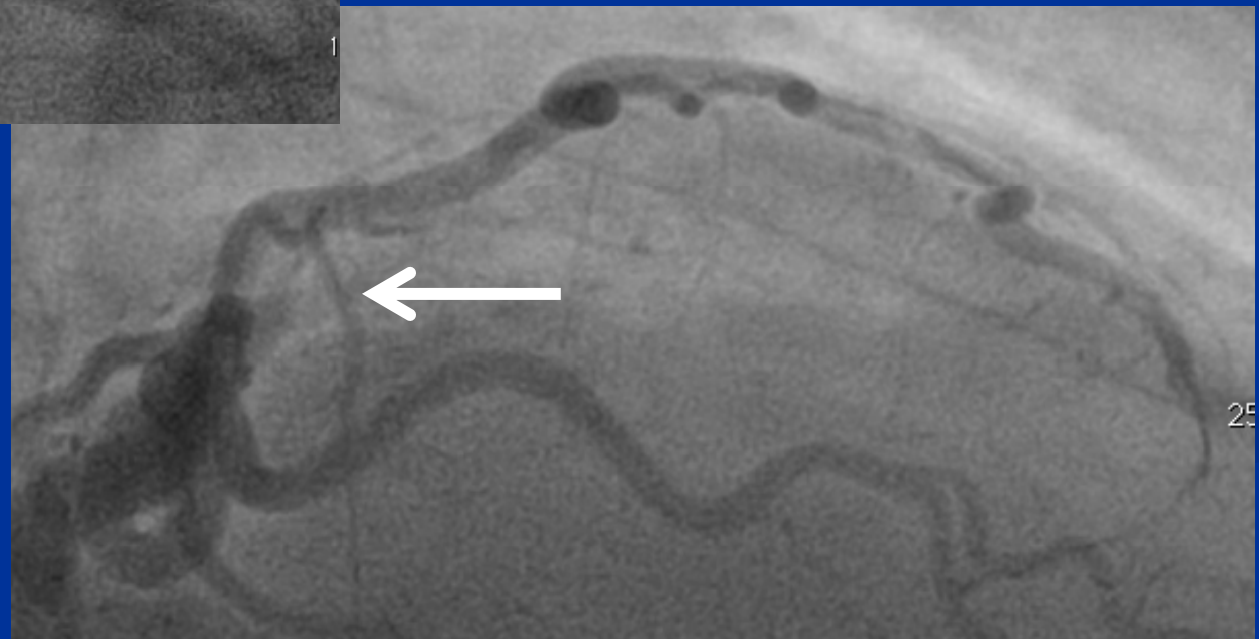
JB: FFR post



Determination of involved vessels in ACS

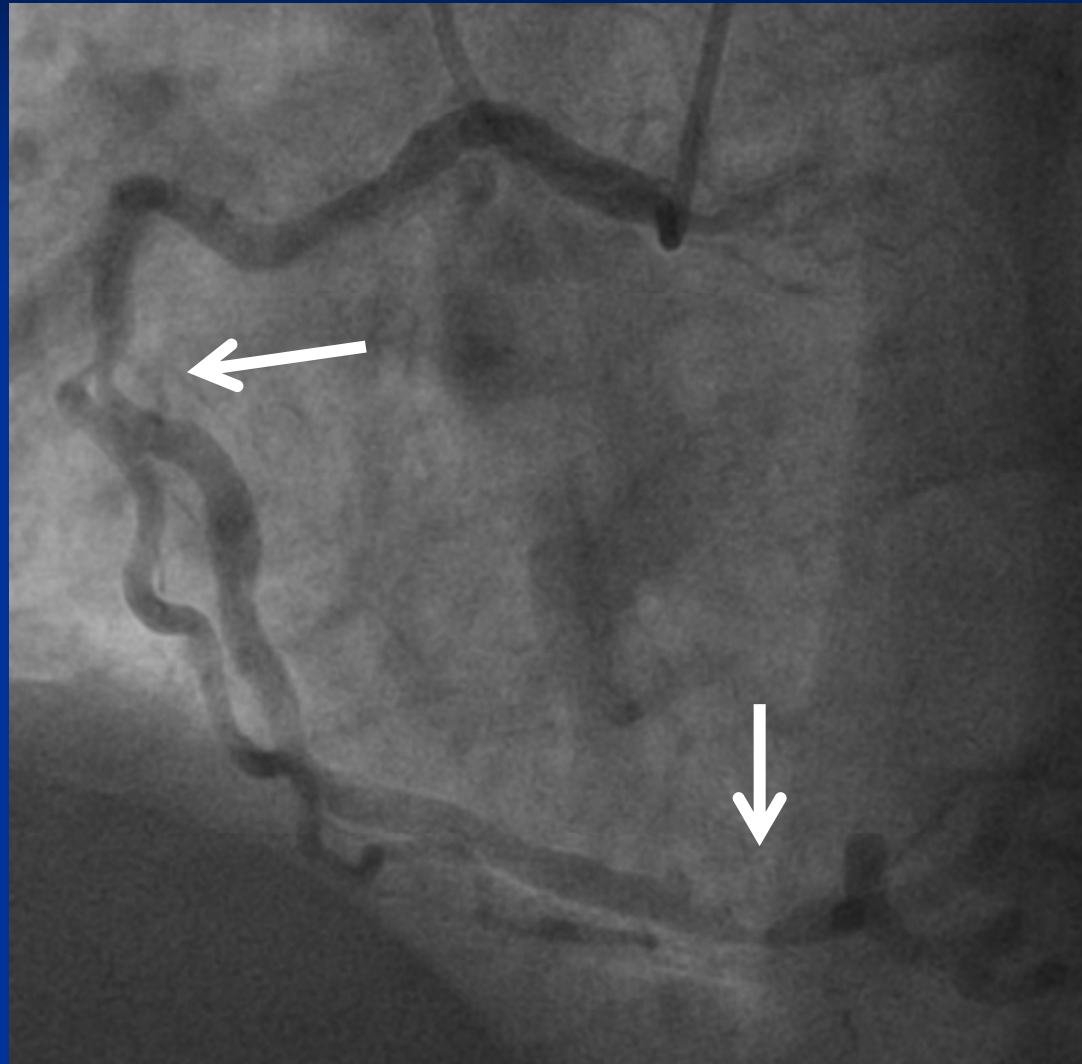
- RZ: 60 yo man with acute MI
- Presented 2 days post event

RZ: angiography



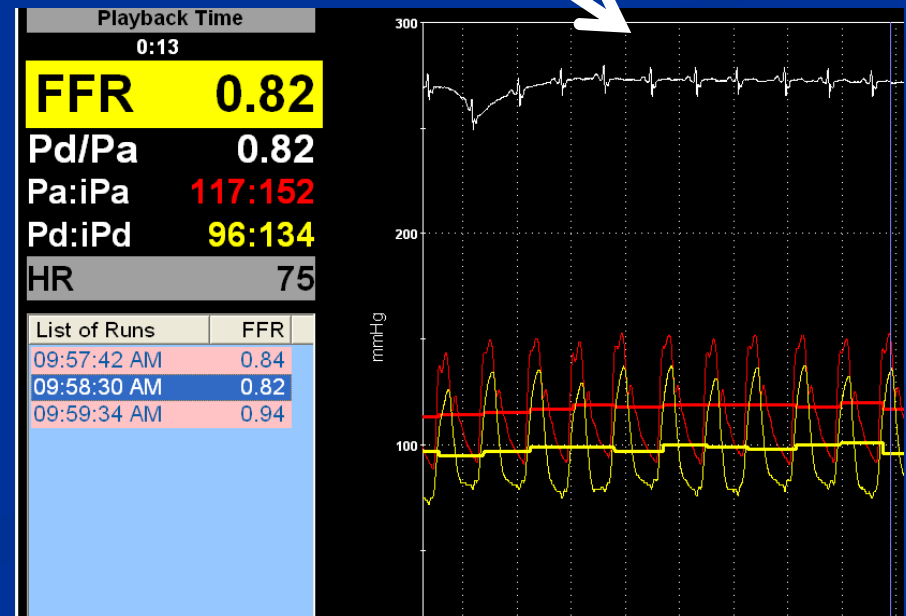
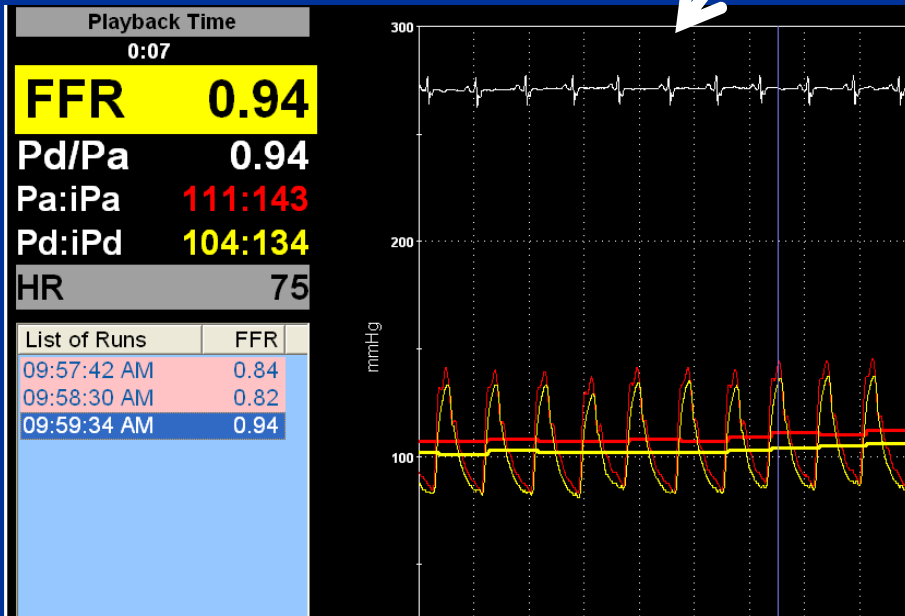
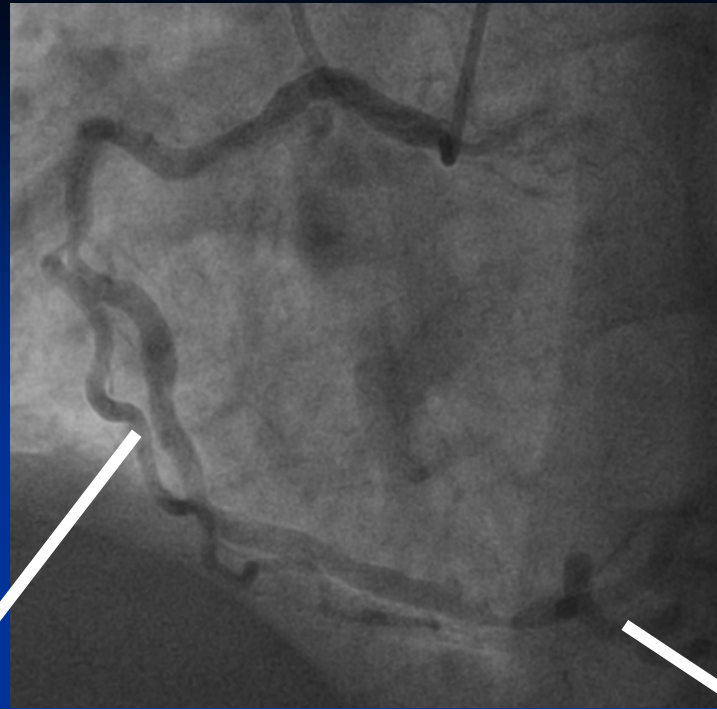
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RZ: angiography

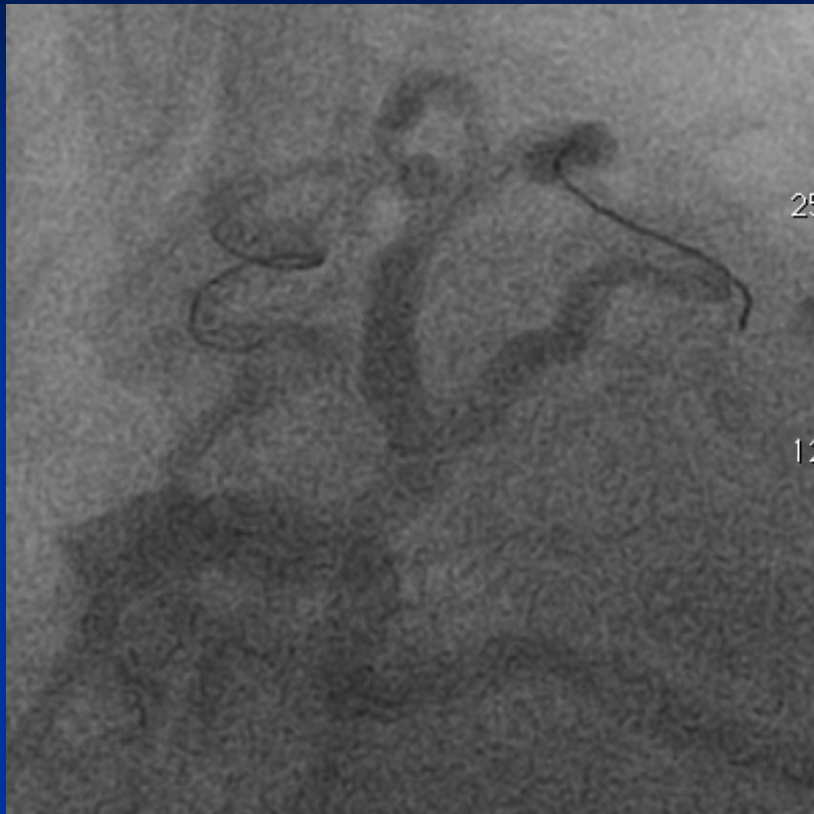


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RZ: RCA FFR before LAD PCI



RZ: post stent



25

12



256

128

C

Ostial lesion evaluation

55 ostial lesions evaluated with QCA and FFR

TABLE 2 Ostial Lesions: Angiography Versus Fractional Flow Reserve

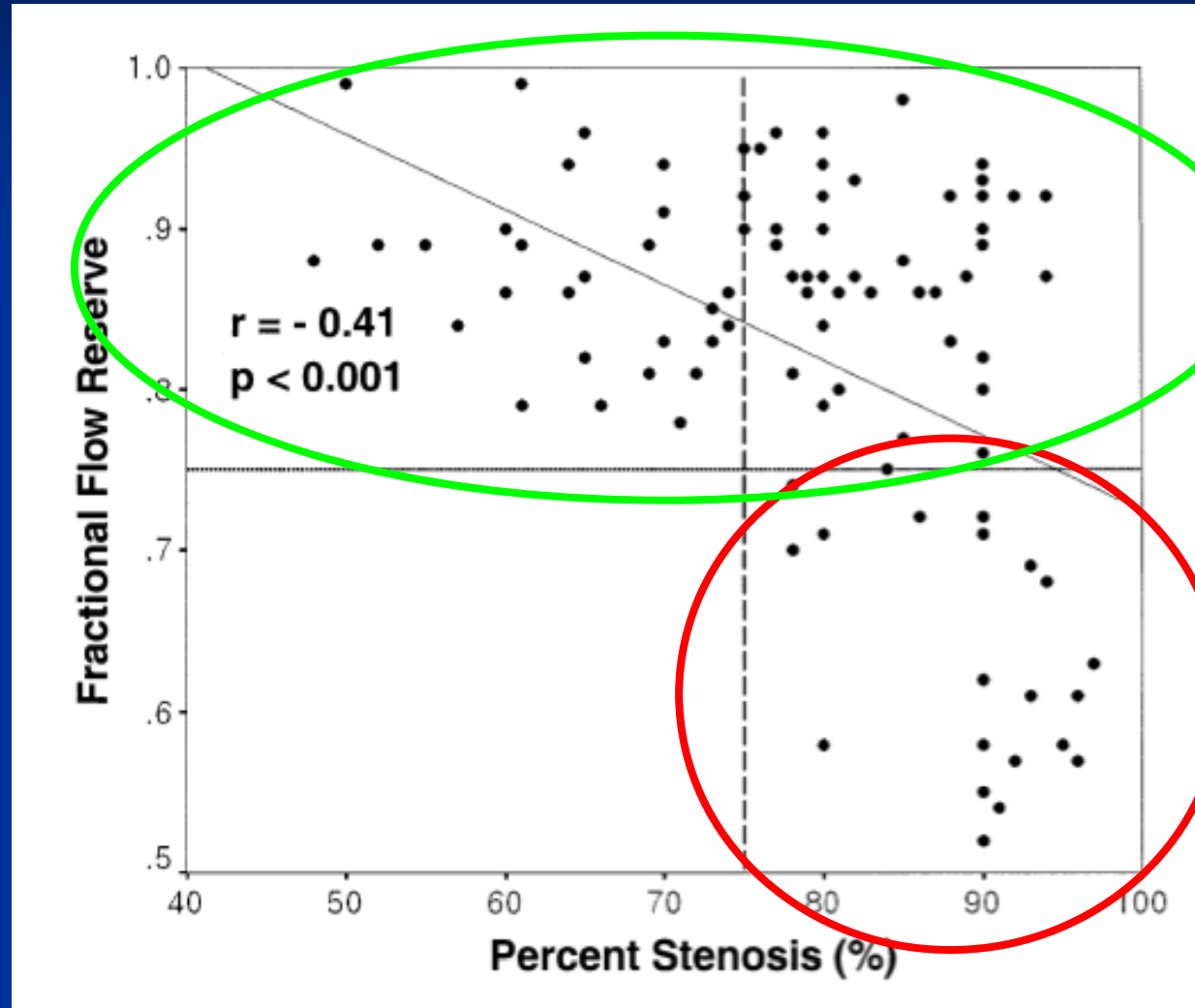
FFR	$\geq 70\%$ Angiographic Stenosis	50%–70% Angiographic Stenosis
≥ 0.75	20	30
< 0.75	5	0

< 10% were significant

Sensitivity 100%, specificity 55%, and test accuracy 60%.

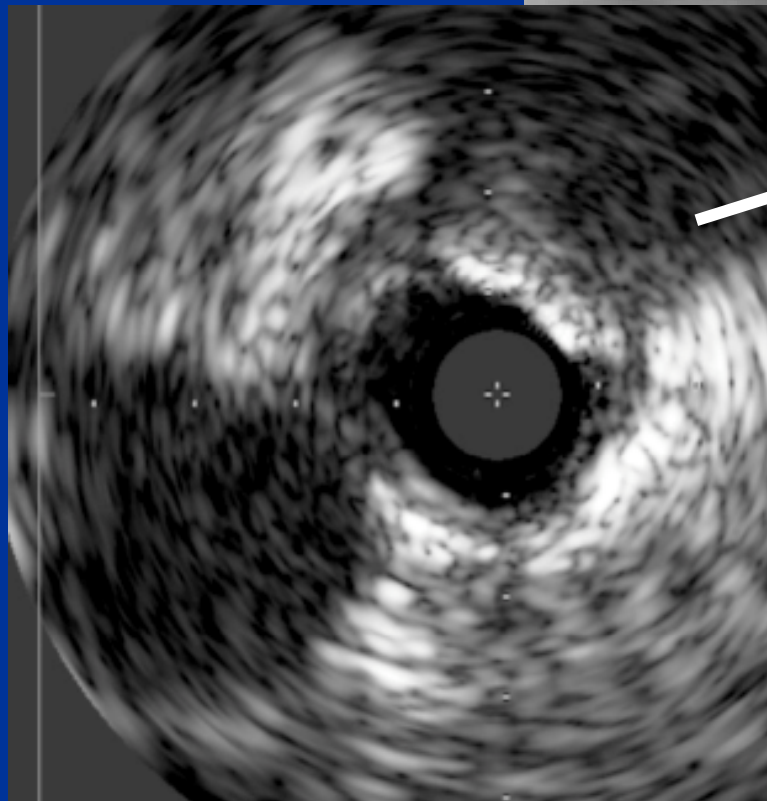
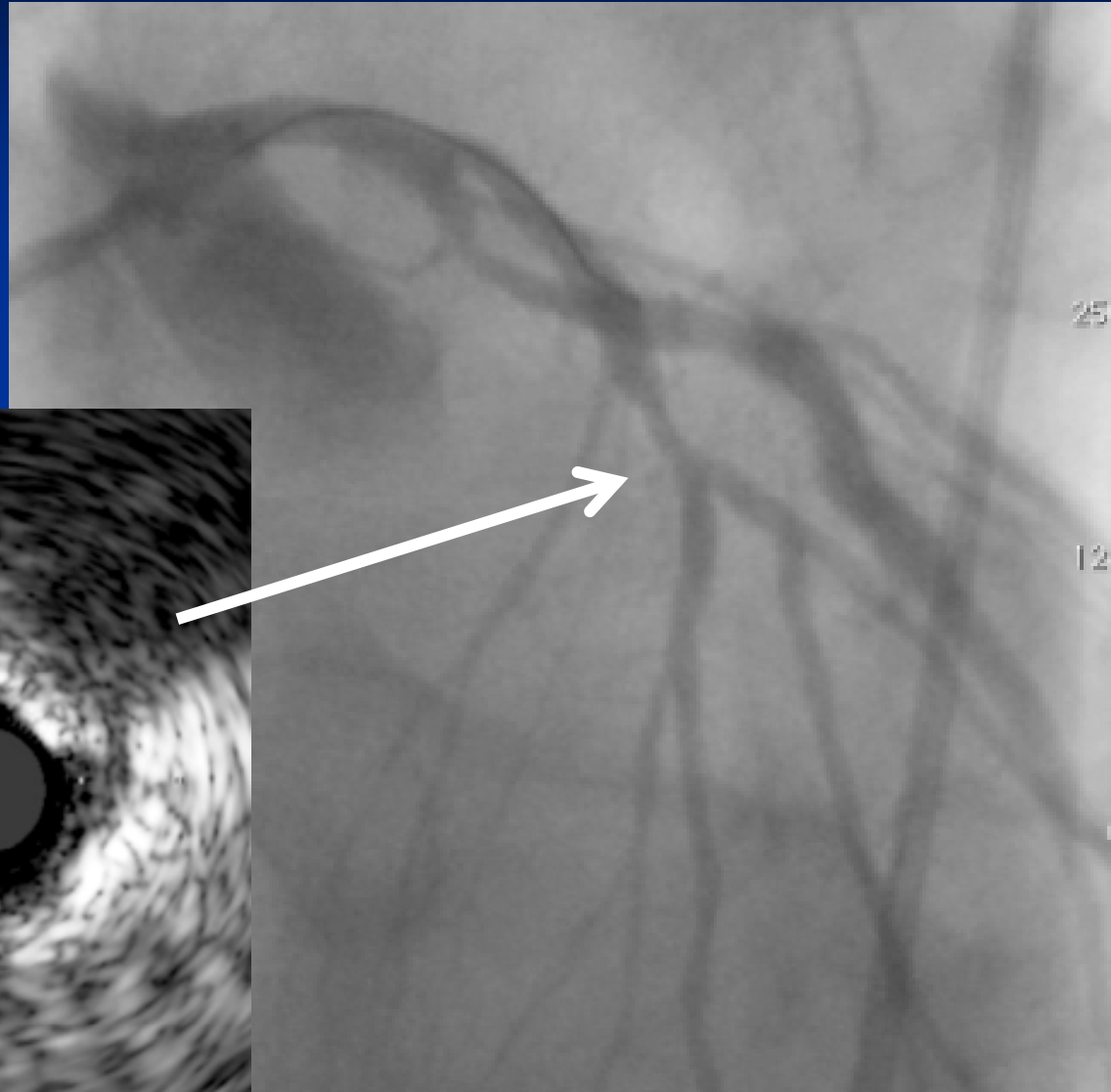
FFR vs Angio evaluation of SB

n = 97
%sten > 50%
ref > 2 mm

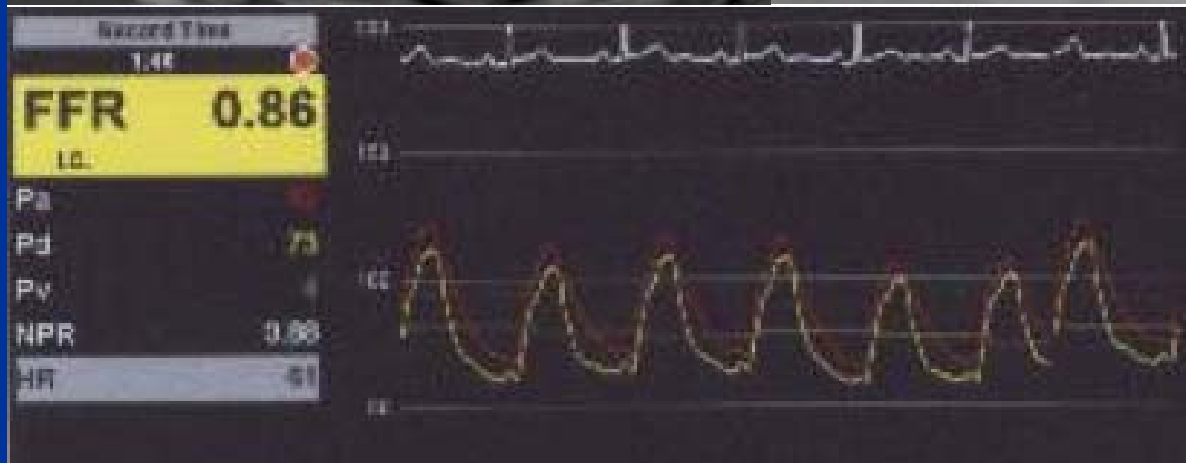
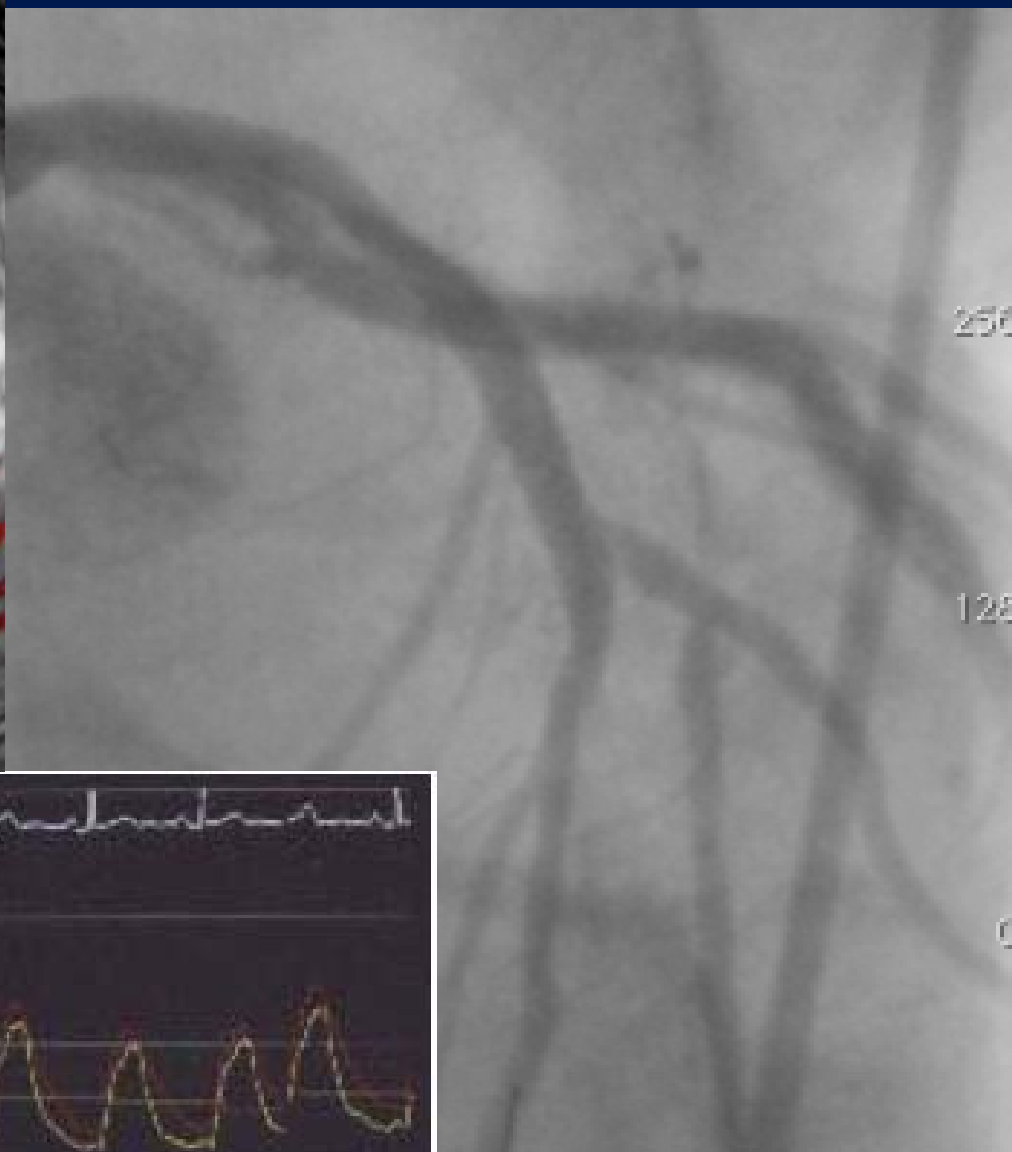
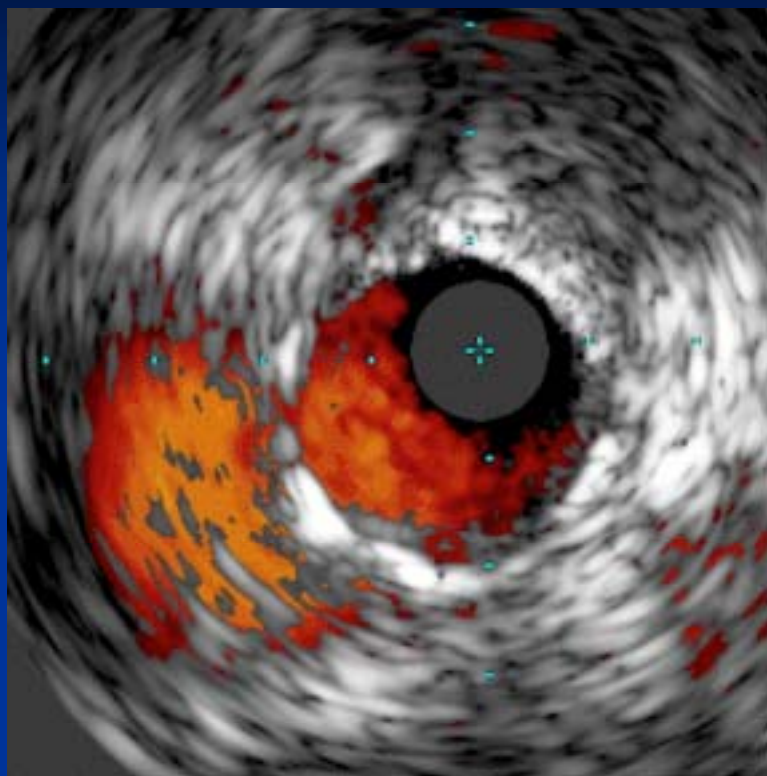


BB: LAD Branch

LAD FFR 0.72
at time of RCA
STEMI
5 weeks earlier

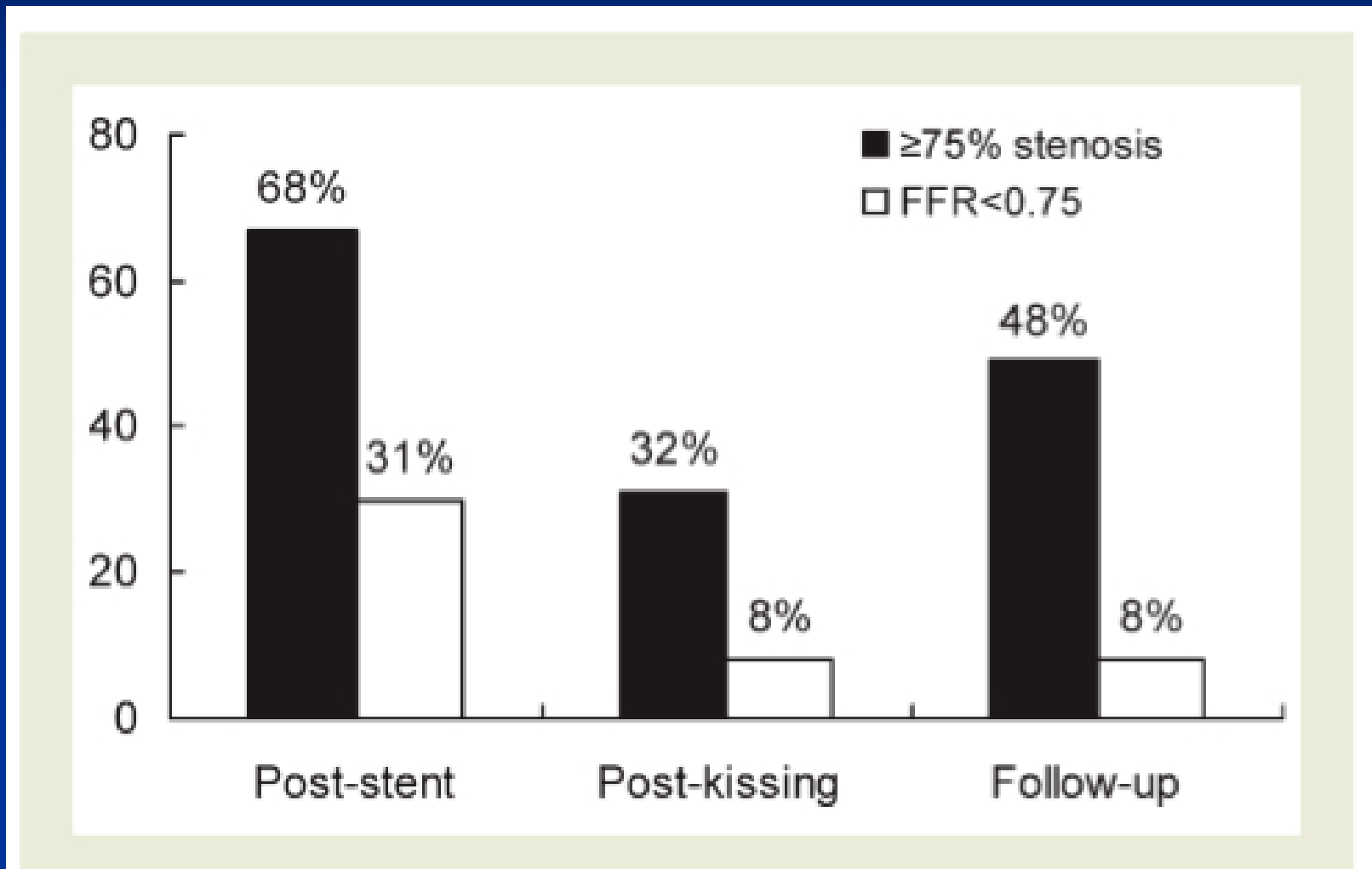


BB: LAD post Stent

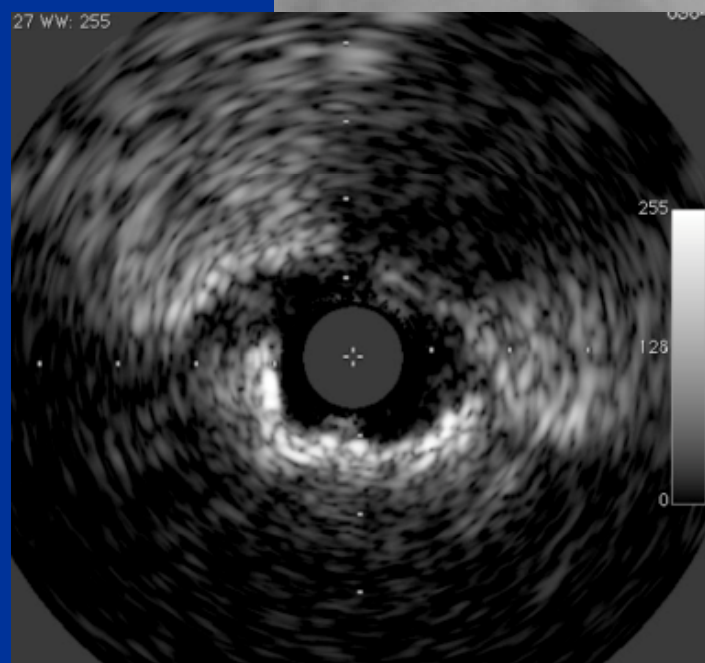
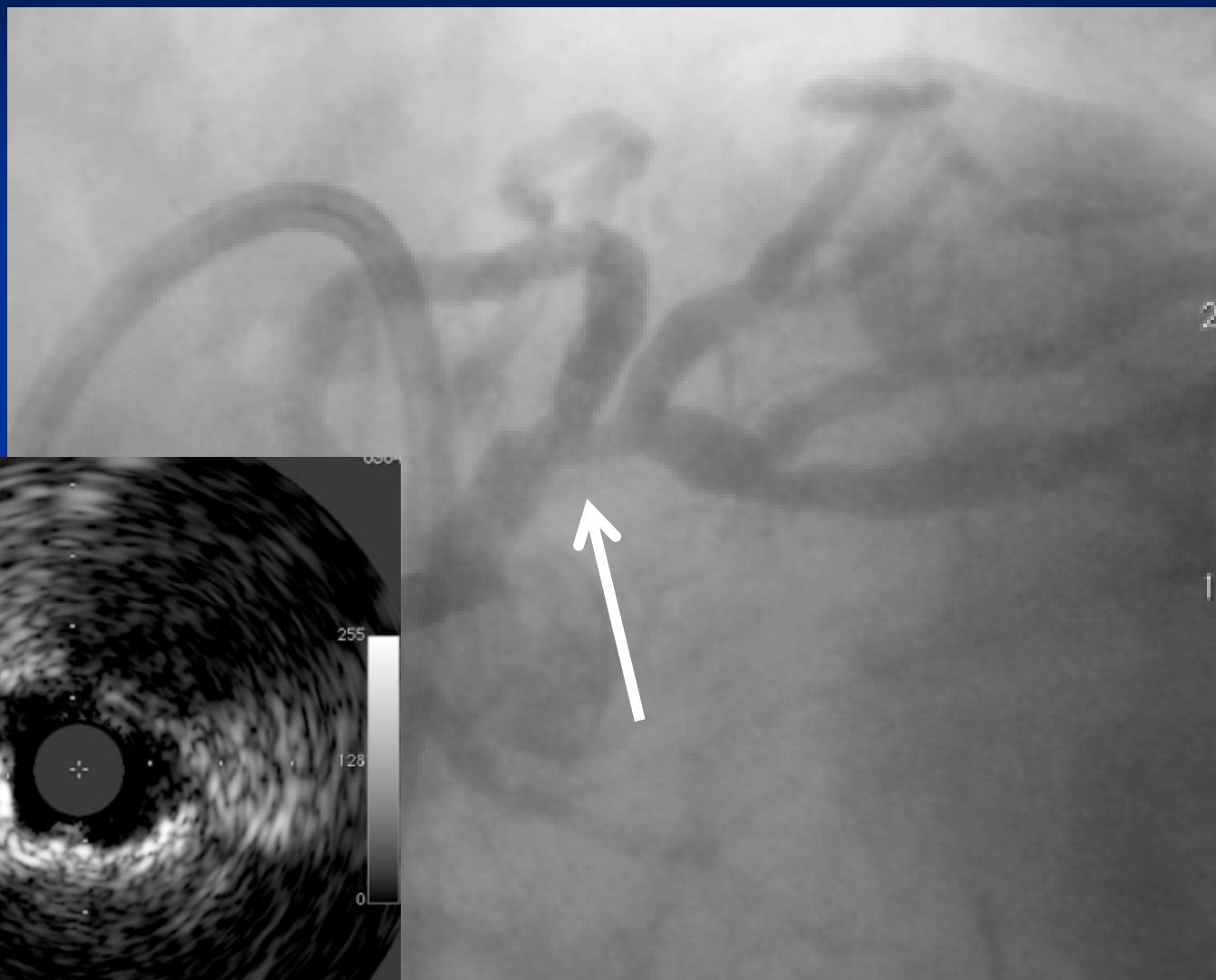


Side branch decisions

Classification of need for PCI: angiographic vs FFR criteria



RA: LCA pre

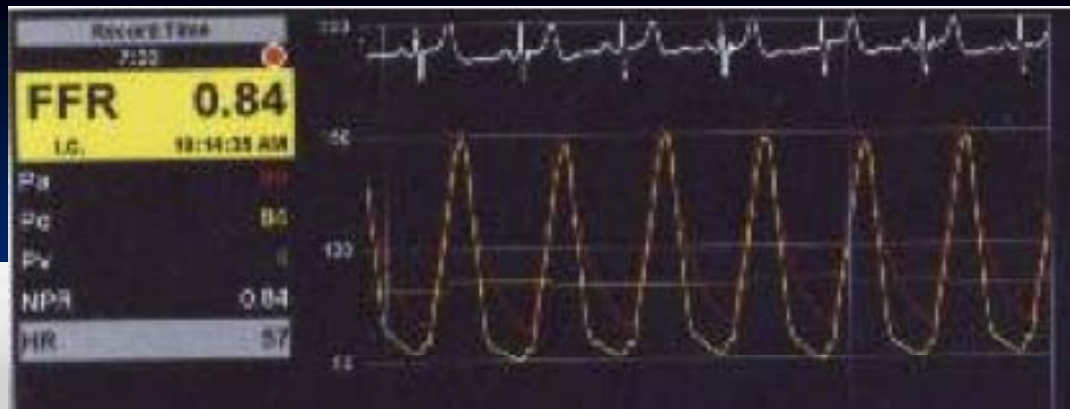


RA: LCA post RB and stent

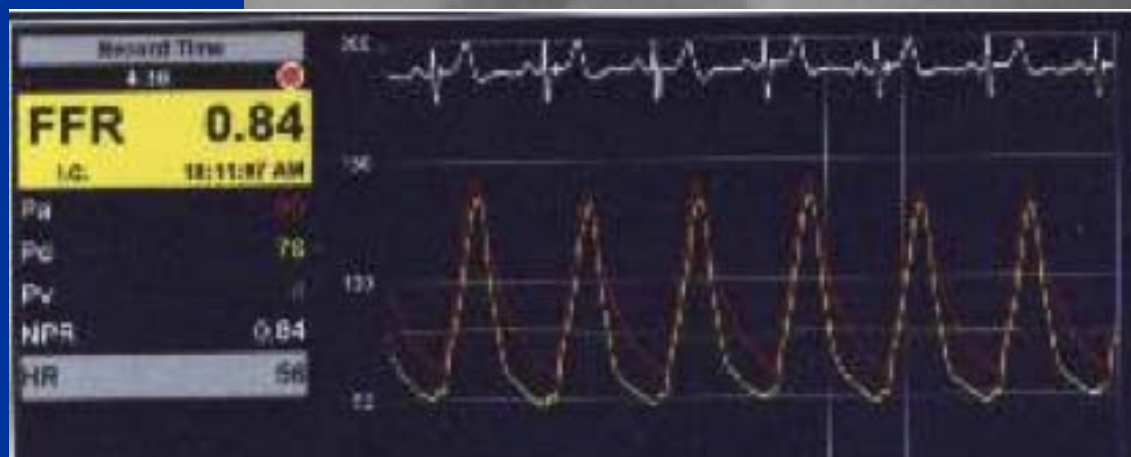


LAD FFR

RA: post KISS



RAMUS FFR



LAD FFR

Balloon treated ostial lesions

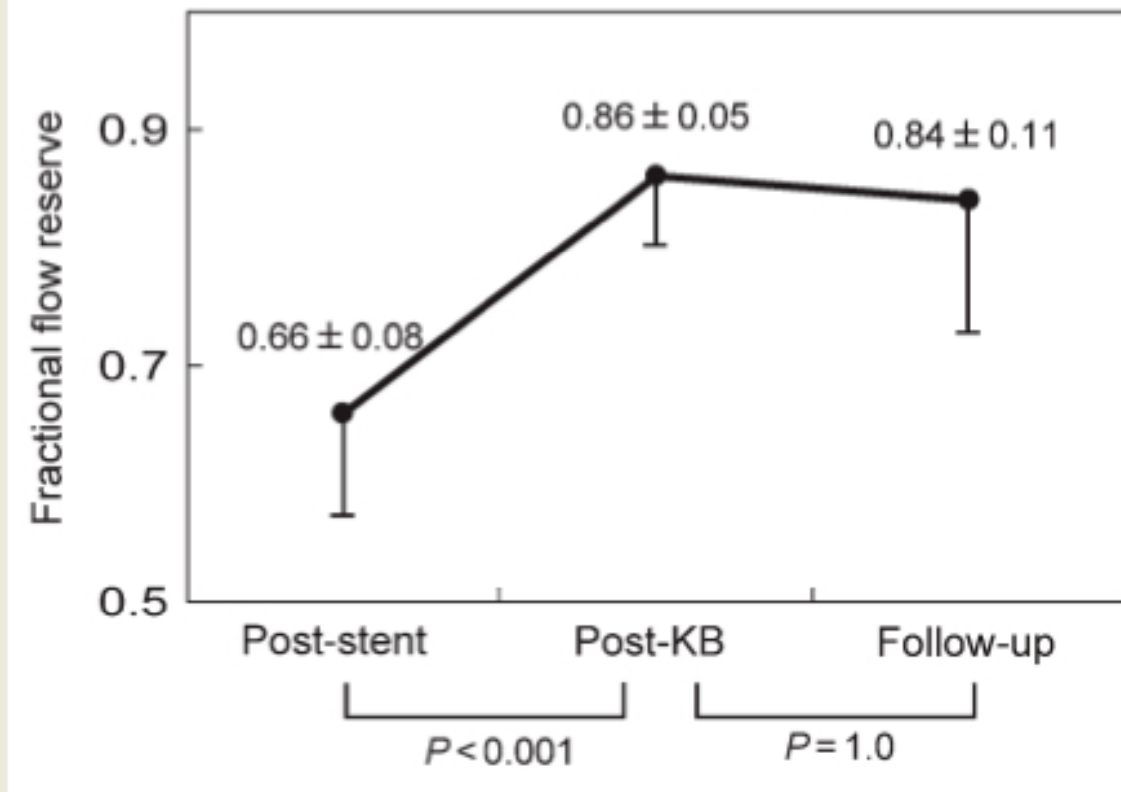
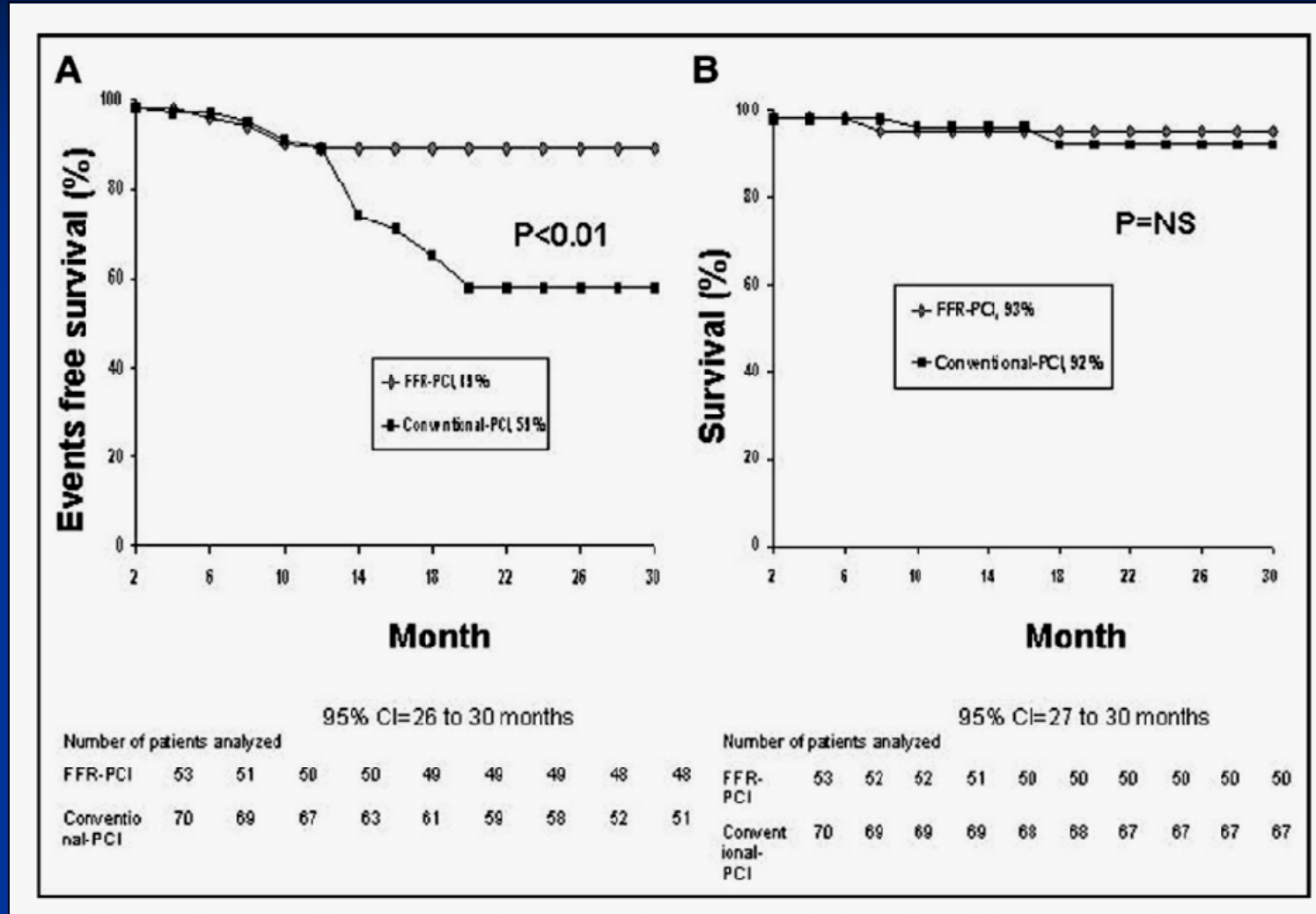


Figure 3 Serial changes of fractional flow reserve in 22 lesions with kissing balloon inflation (KB, kissing balloon inflation).

FFR-guided PCI

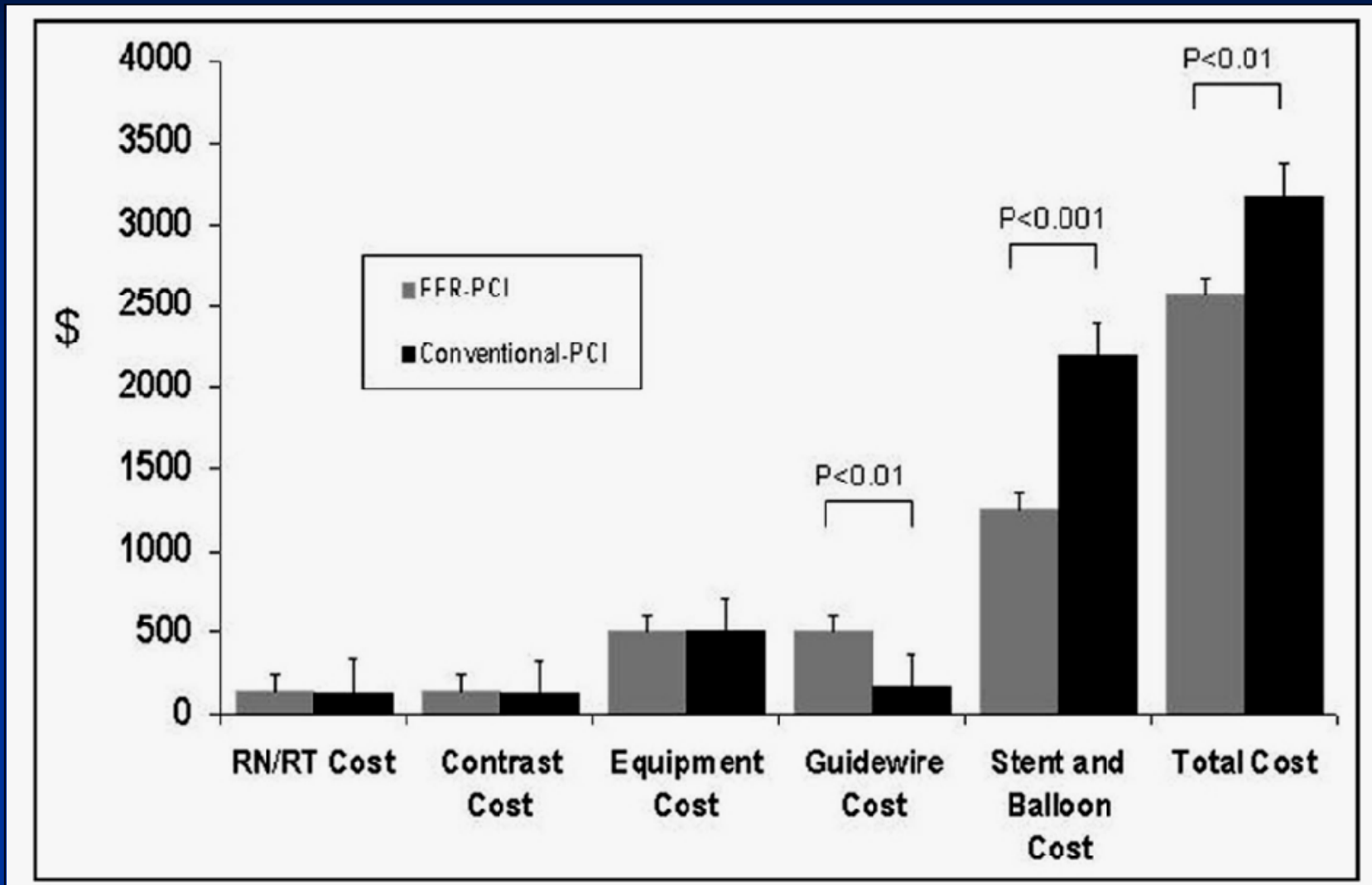
Concurrent but NOT randomized:
57 FFR-guided, 80 conventional



58% lesions deferred

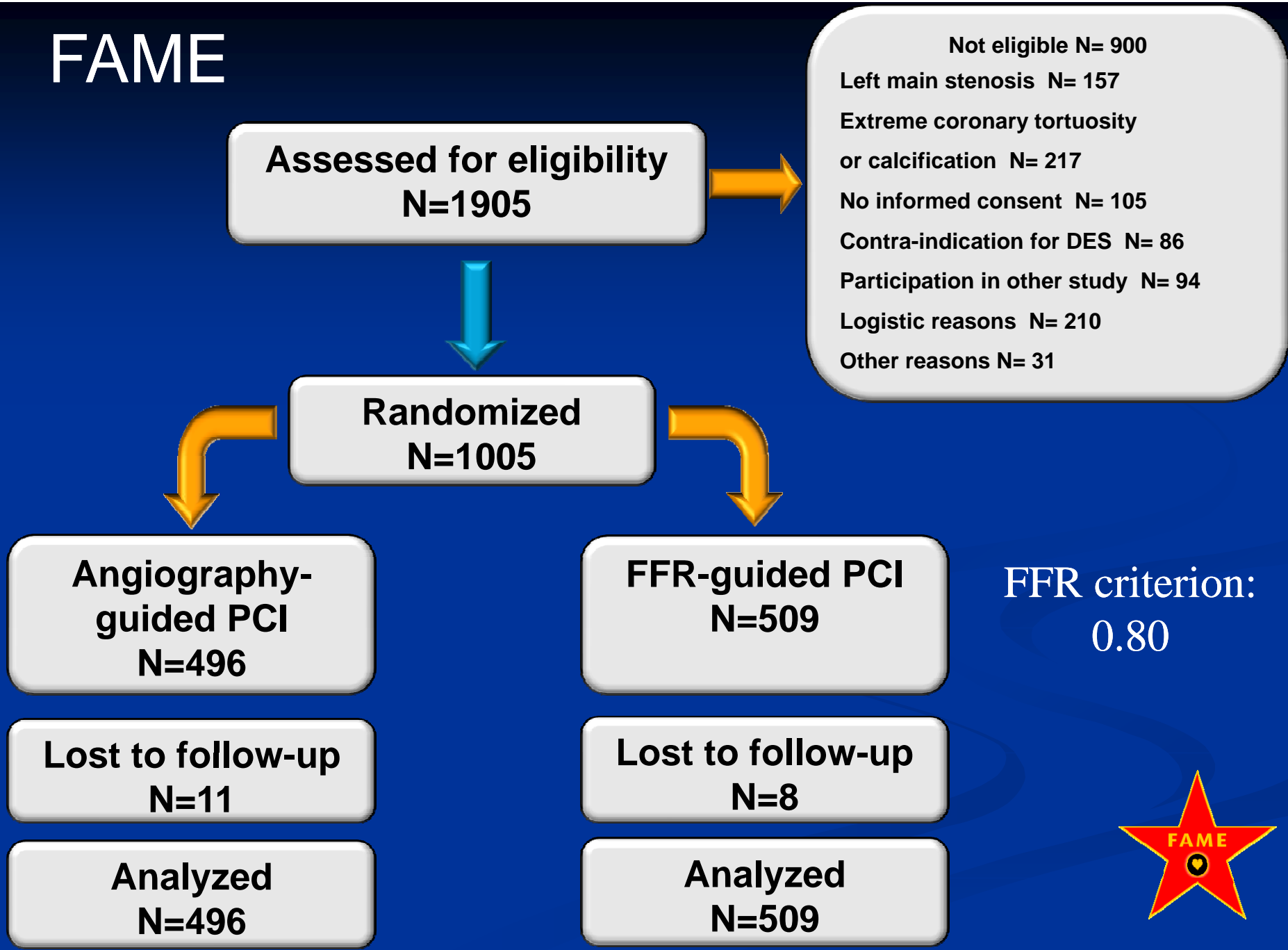
Wongpraparut et al Am J Cardiol 2005;96:877

FFR-guided PCI

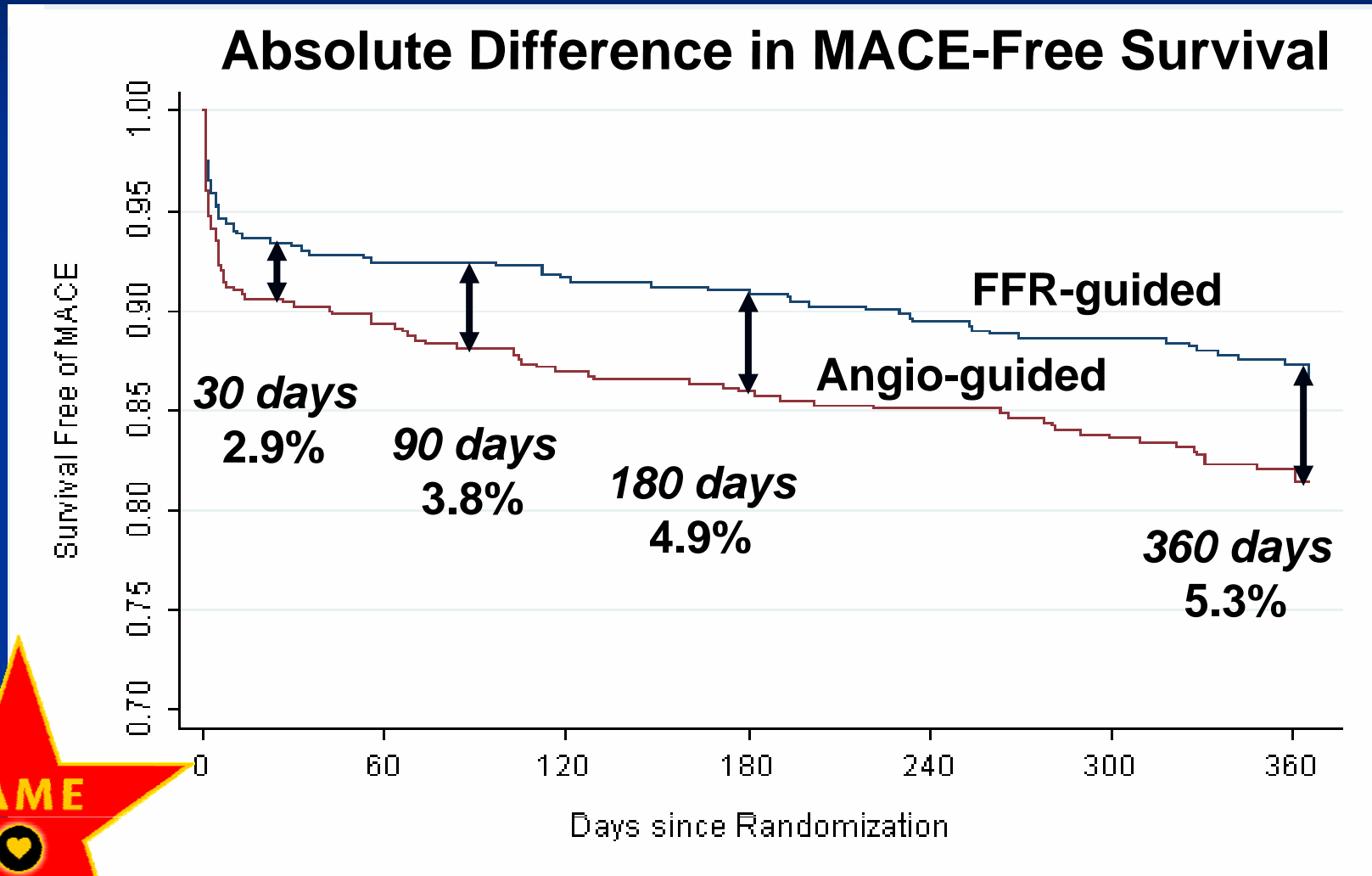


Wongpraparut et al Am J Cardiol 2005;96:877

FAME



FAME: FFR guided multivessel PCI improves outcome



FFR in PCI: optimizing therapy

45 yo man with typical angina and positive MIBI anterior

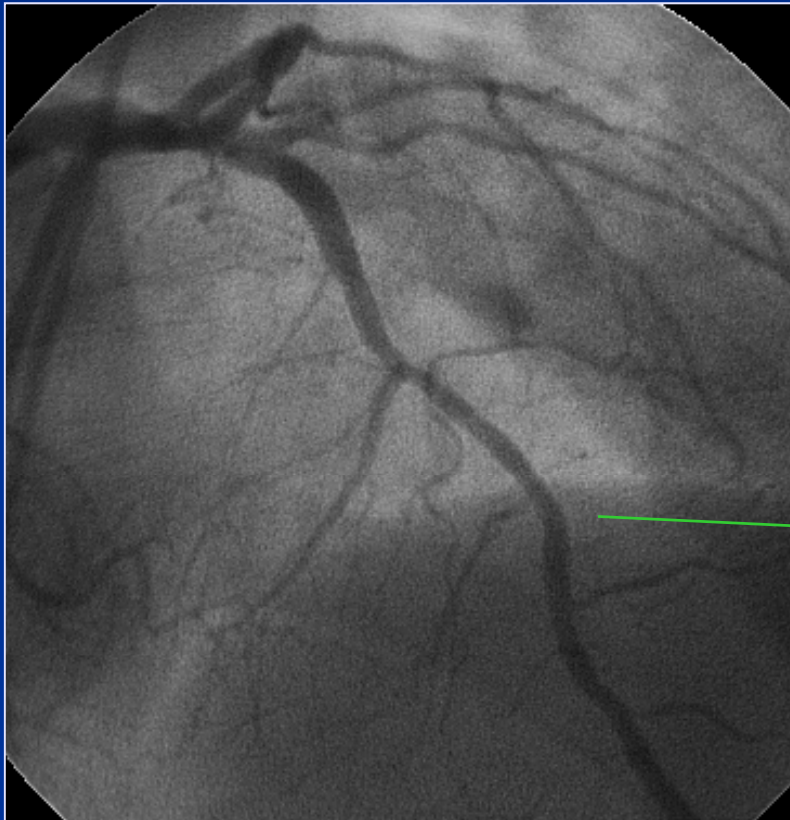


How would you approach this patient?

FFR in PCI: optimizing therapy

Evaluate the LAD serial lesions

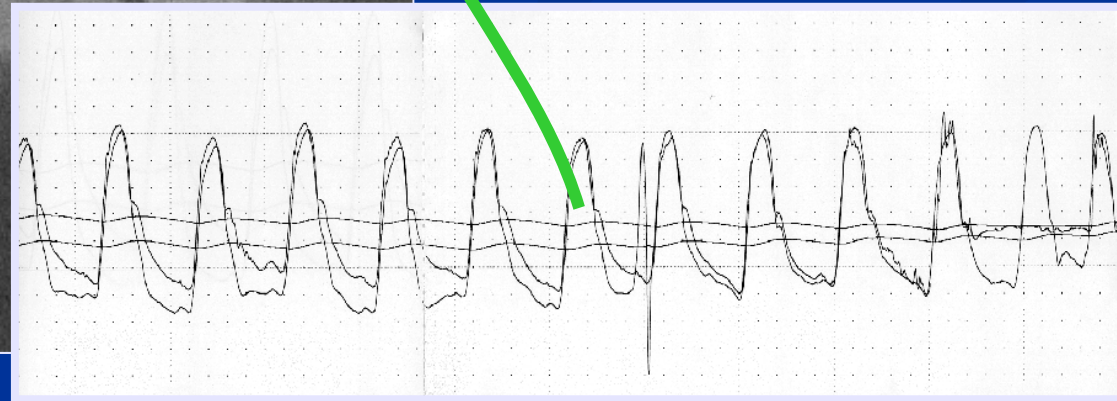
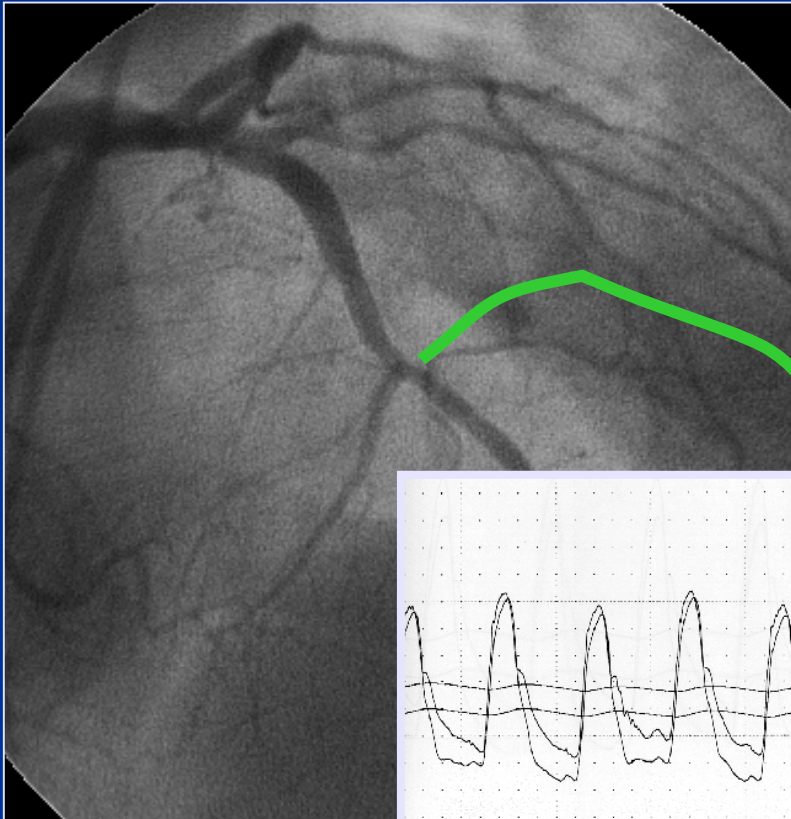
Distal to both:
FFR – 0.75



FFR in PCI: optimizing therapy

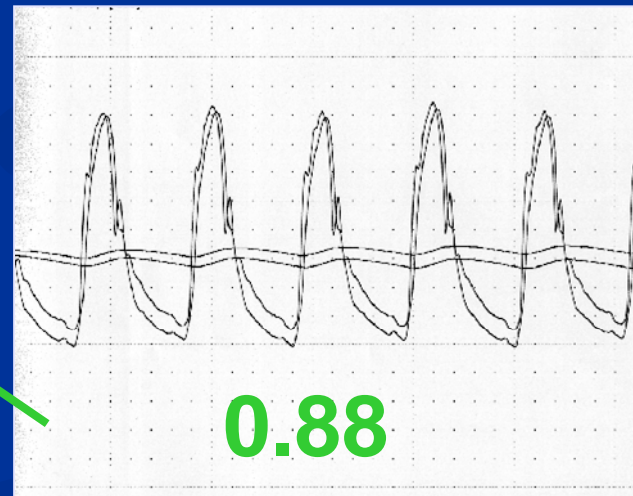
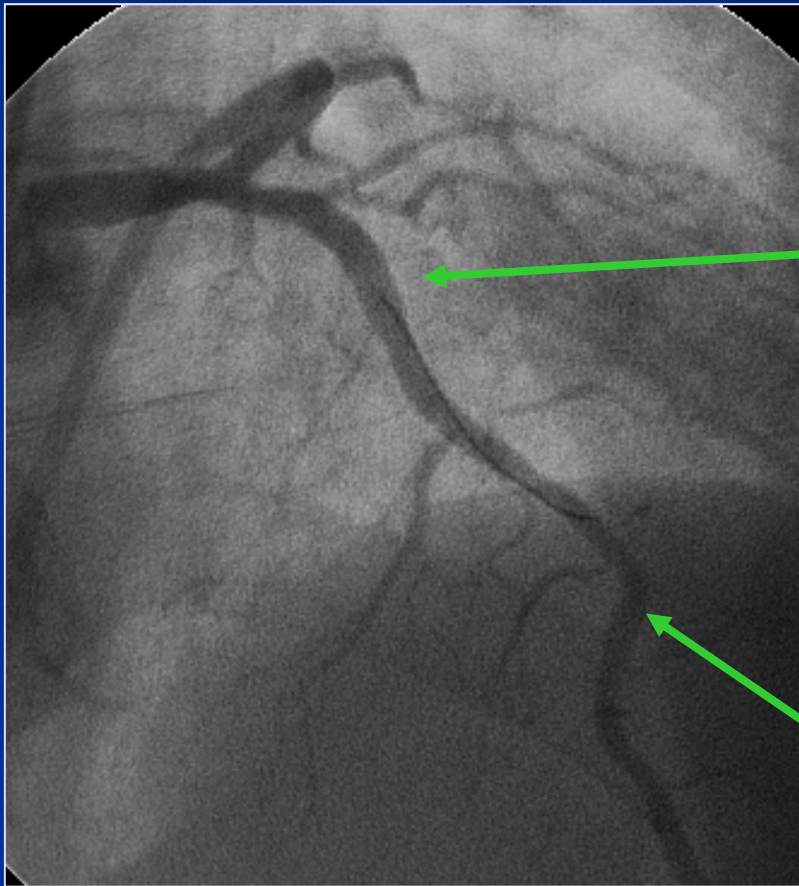
Find the worst lesion

Continuous infusion with pullback shows a clear focal lesion

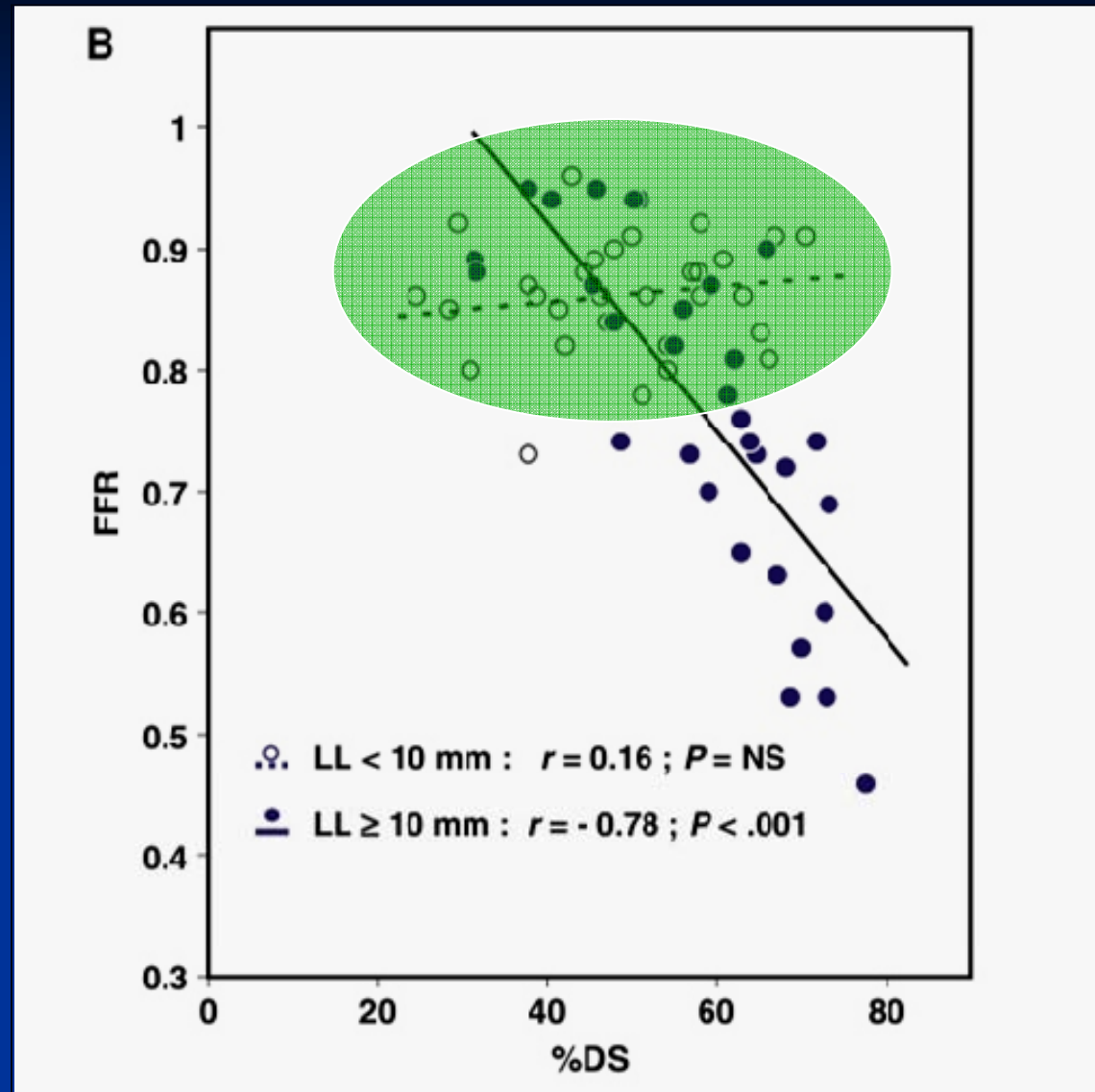


FFR in PCI: optimizing therapy

After an 8 mm stent

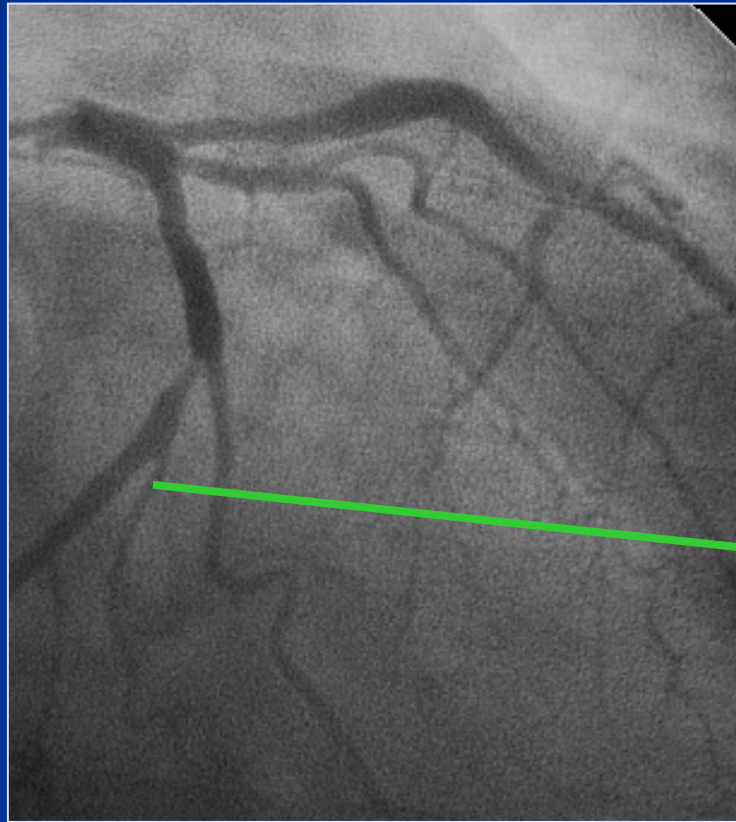


Lesion length:
short lesions in
big vessels are
usually NOT
significant

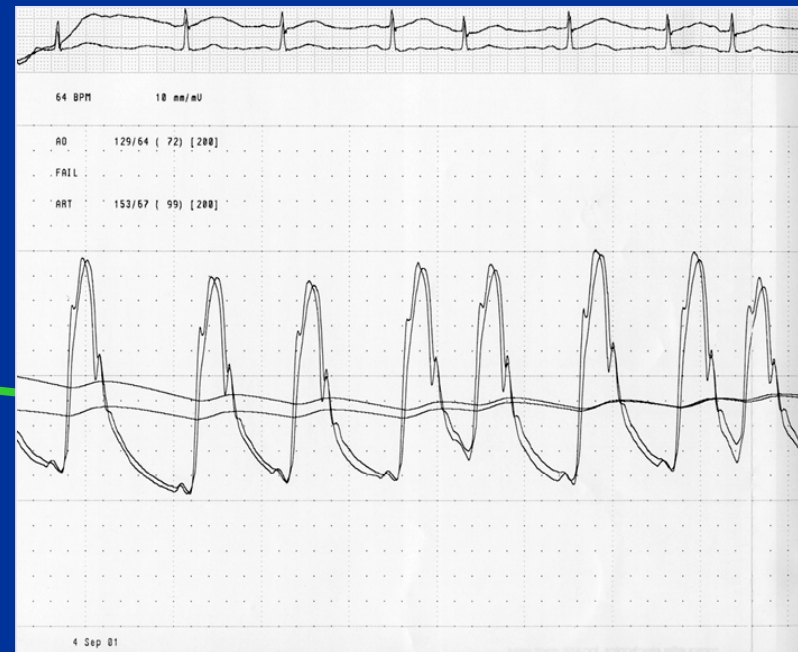


FFR in PCI: optimizing therapy

Evaluate the LCx lesion



FFR – 0.92

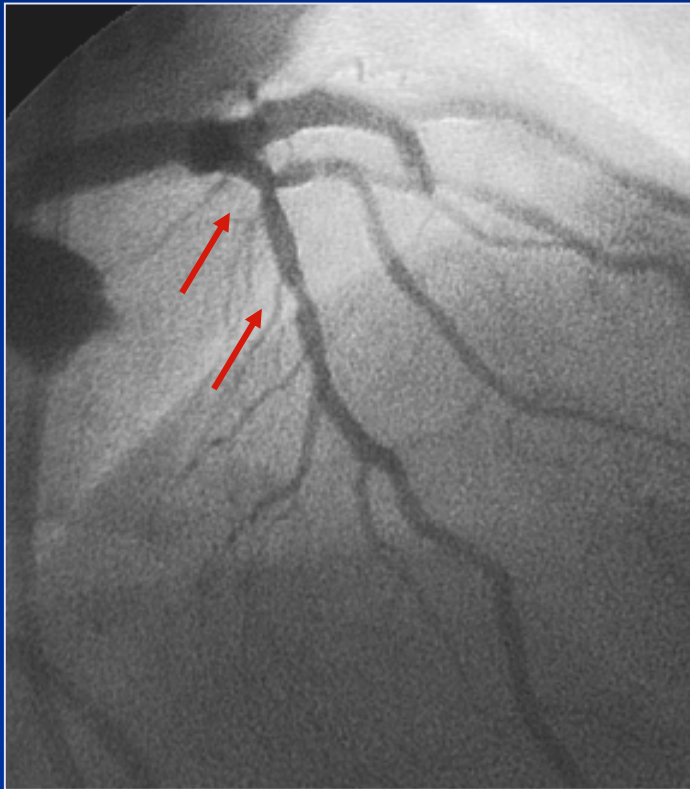


FFR in PCI: optimizing therapy

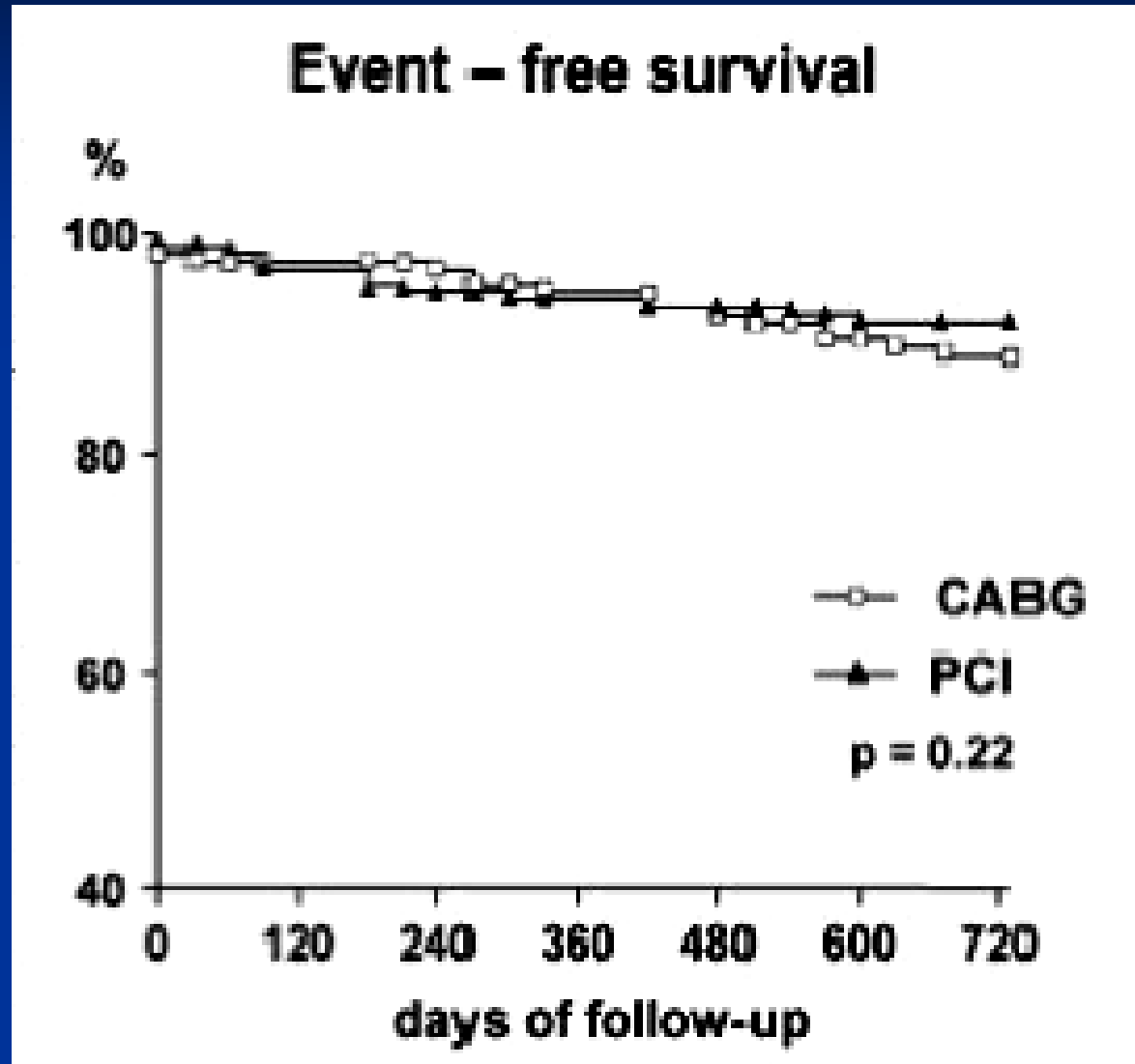
- 72 year old woman with insulin–dependent diabetes and angina
- 125 kg, 152 cm, morbid obesity
- EF: 60%
- Angiography: three vessel disease including proximal LAD
- CABG or PCI?

FFR in PCI: optimizing therapy (1999)

LAD/D1 bifurcation lesion

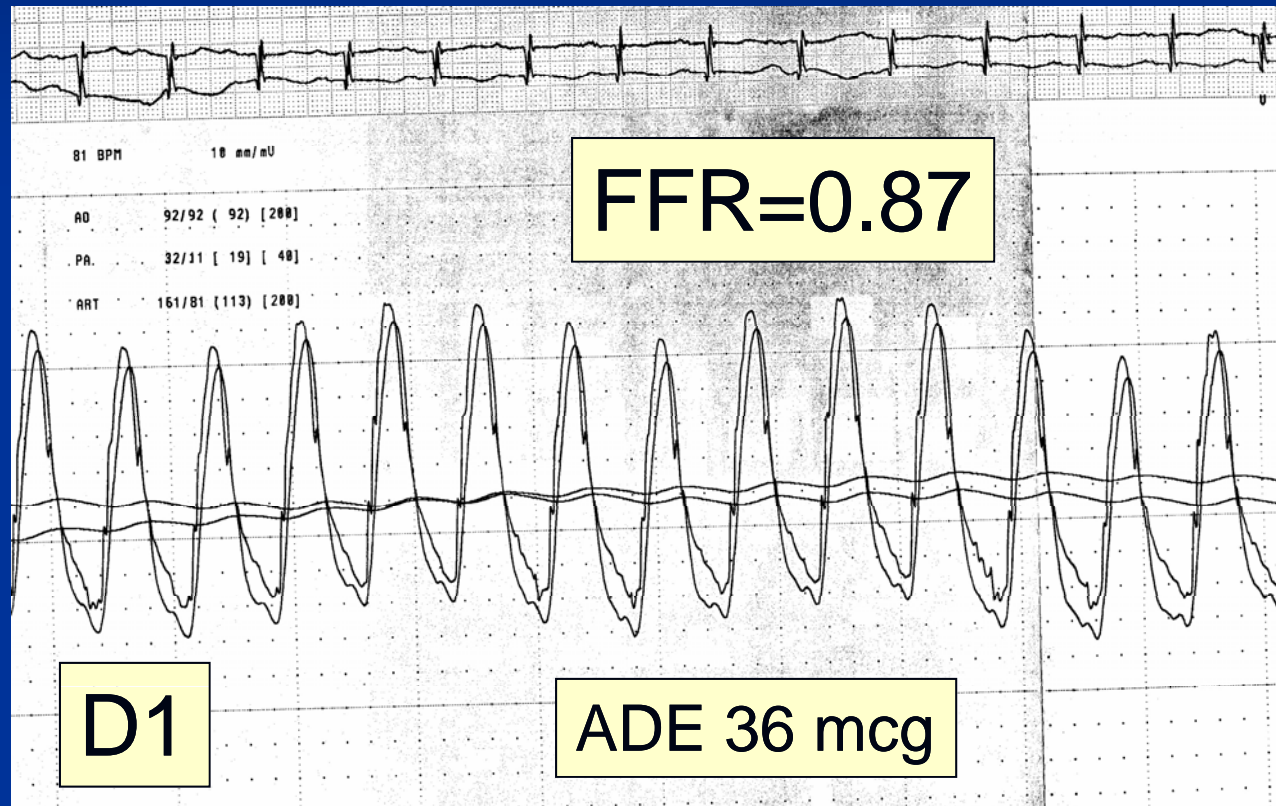


Tailored Approach



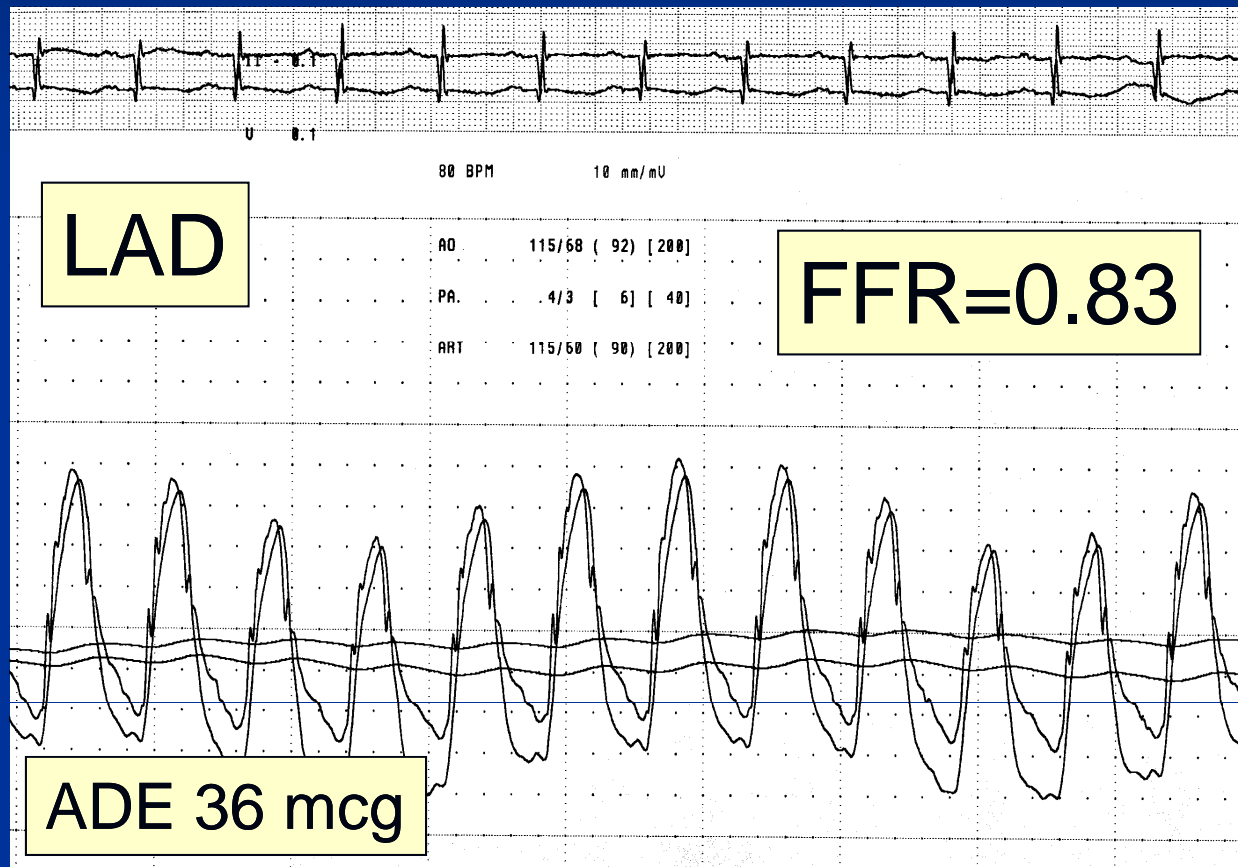
FFR in PCI: optimizing therapy

Evaluate LAD/D1 lesion with FFR



FFR in PCI: optimizing therapy

Evaluate LAD/D1 lesion with FFR

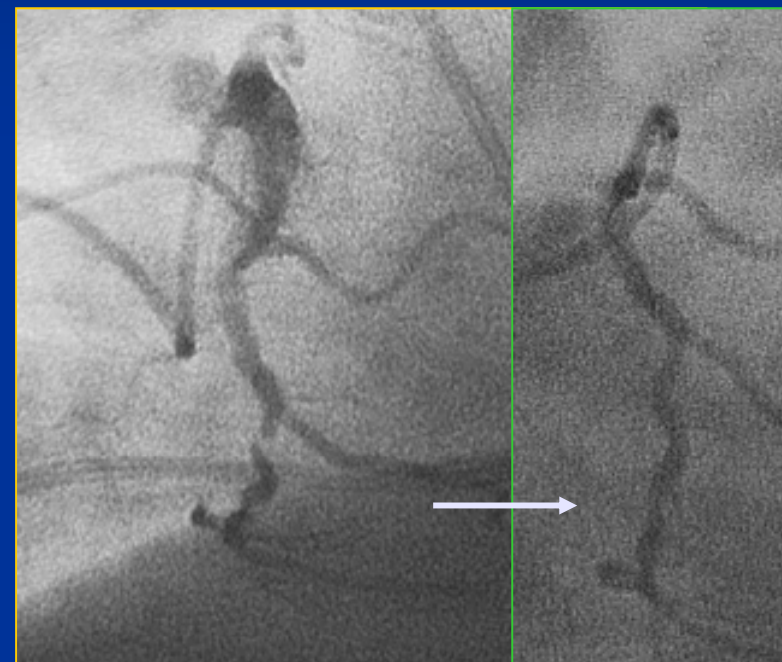


FFR in PCI: optimizing therapy

Treat LCx, RCA with PCI



LCX: stent



RCA: CB

When to use FFR

- All intermediate lesions in stable patients where there is not DEFINITIVE matching ischemia on a non-invasive study
- All side branch ostia when %DS >70
- Questionable non-culprit lesions in STEMI patients
- Multivessel disease to triage to CABG vs. PCI and guide PCI of only sig lesions

NOT in STEMI or ACS BM+ lesions