Impact of FFR

From Data to The Practice

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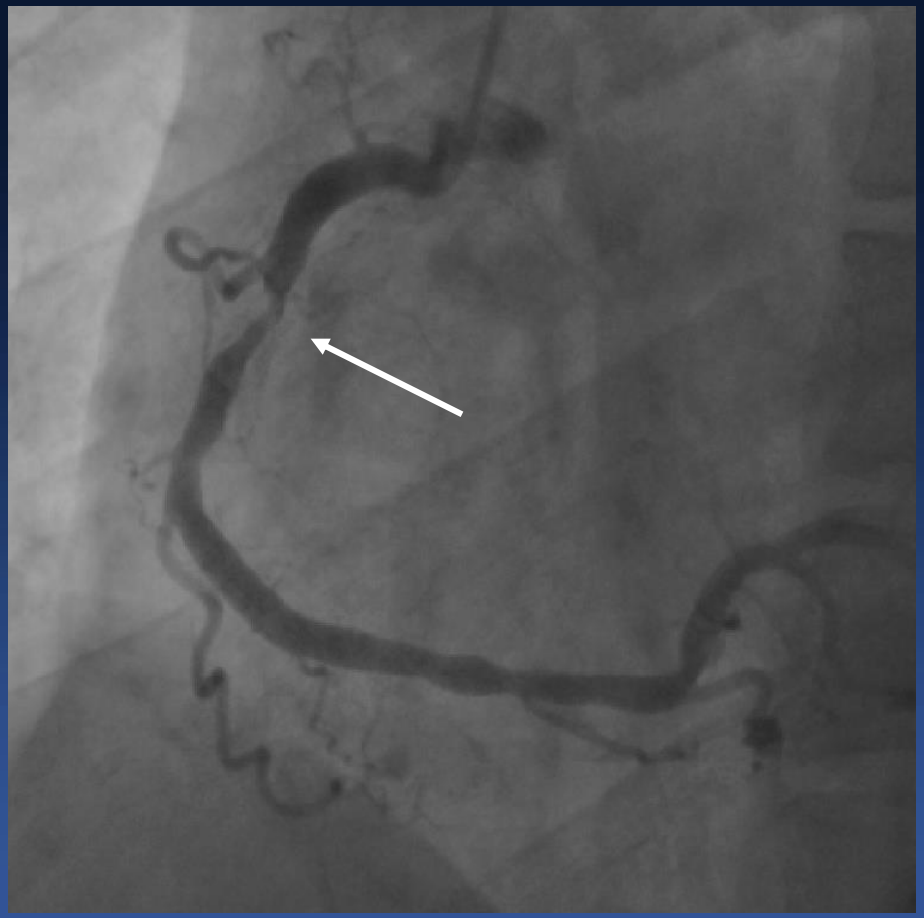
Angiography, Is It Enough for Objective Ischemia ?

M/72,

Recent developed Effort chest pain, Hyperlipidemia, Smoker

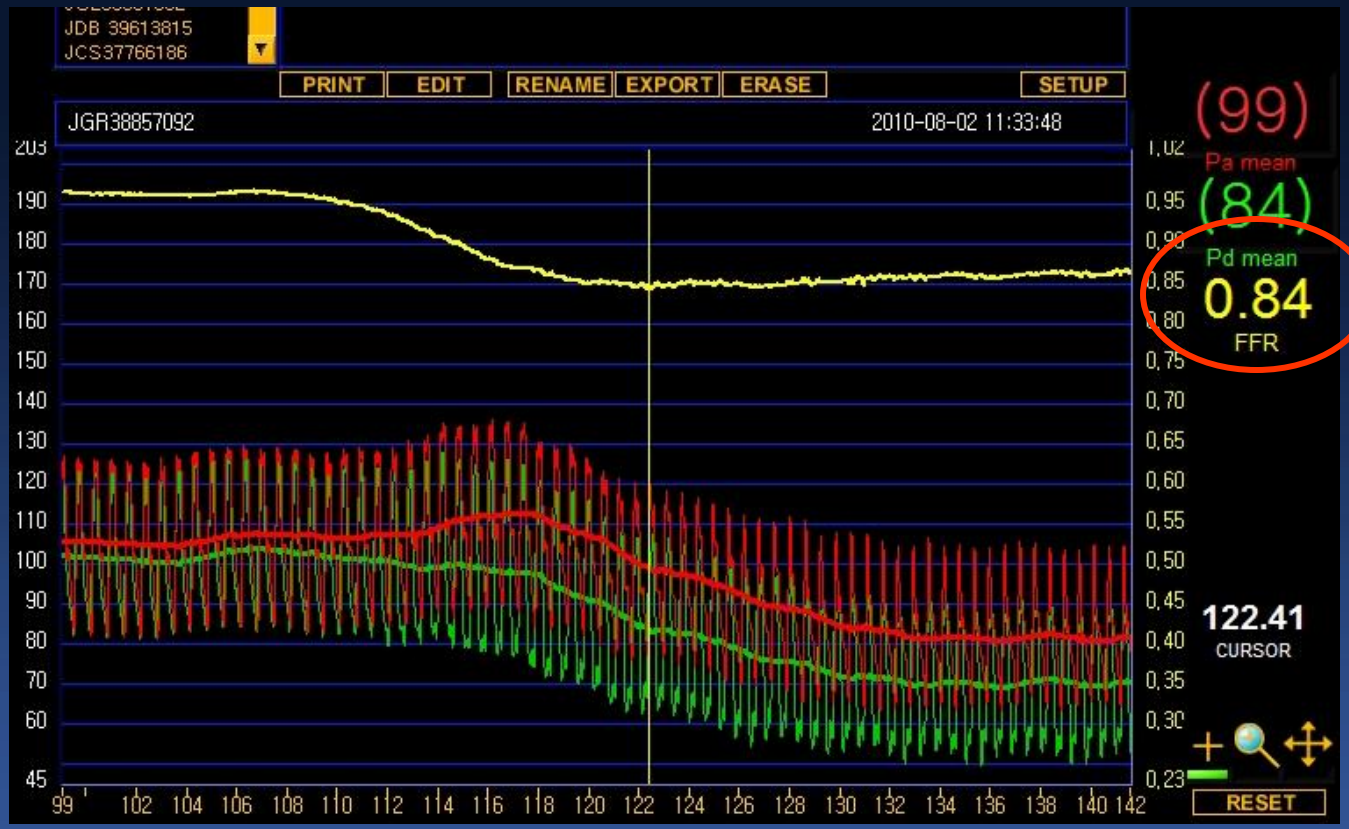
We took a coronary angiogram first,



Visual Estimation 85%

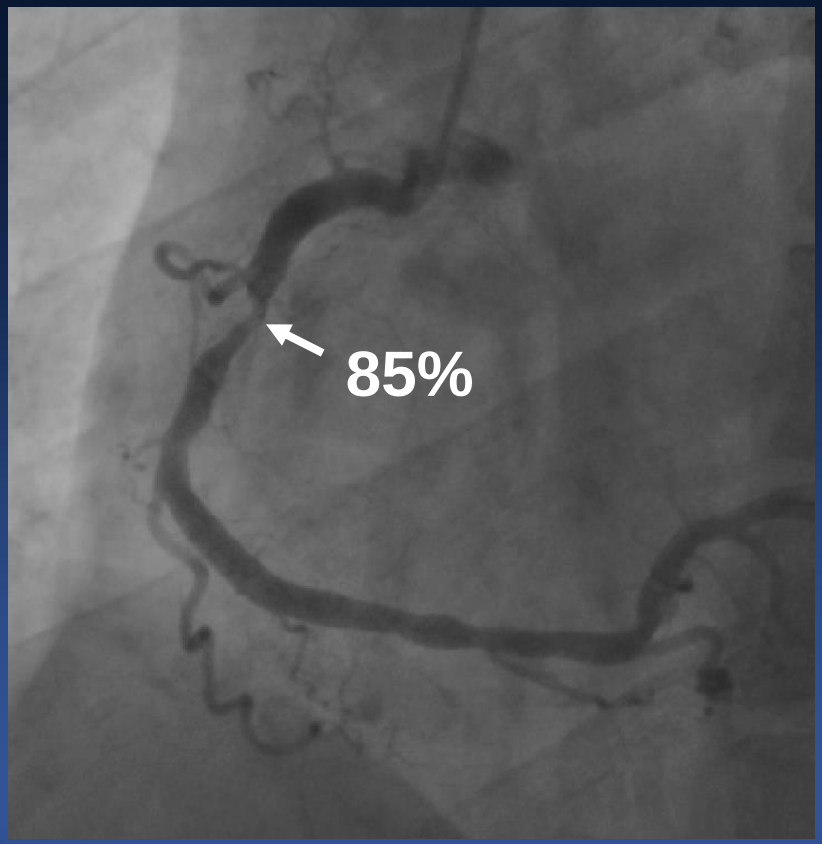
FFR

Intravenous adenosine, 160 µg/kg/min



To Treat or Not To Treat ?

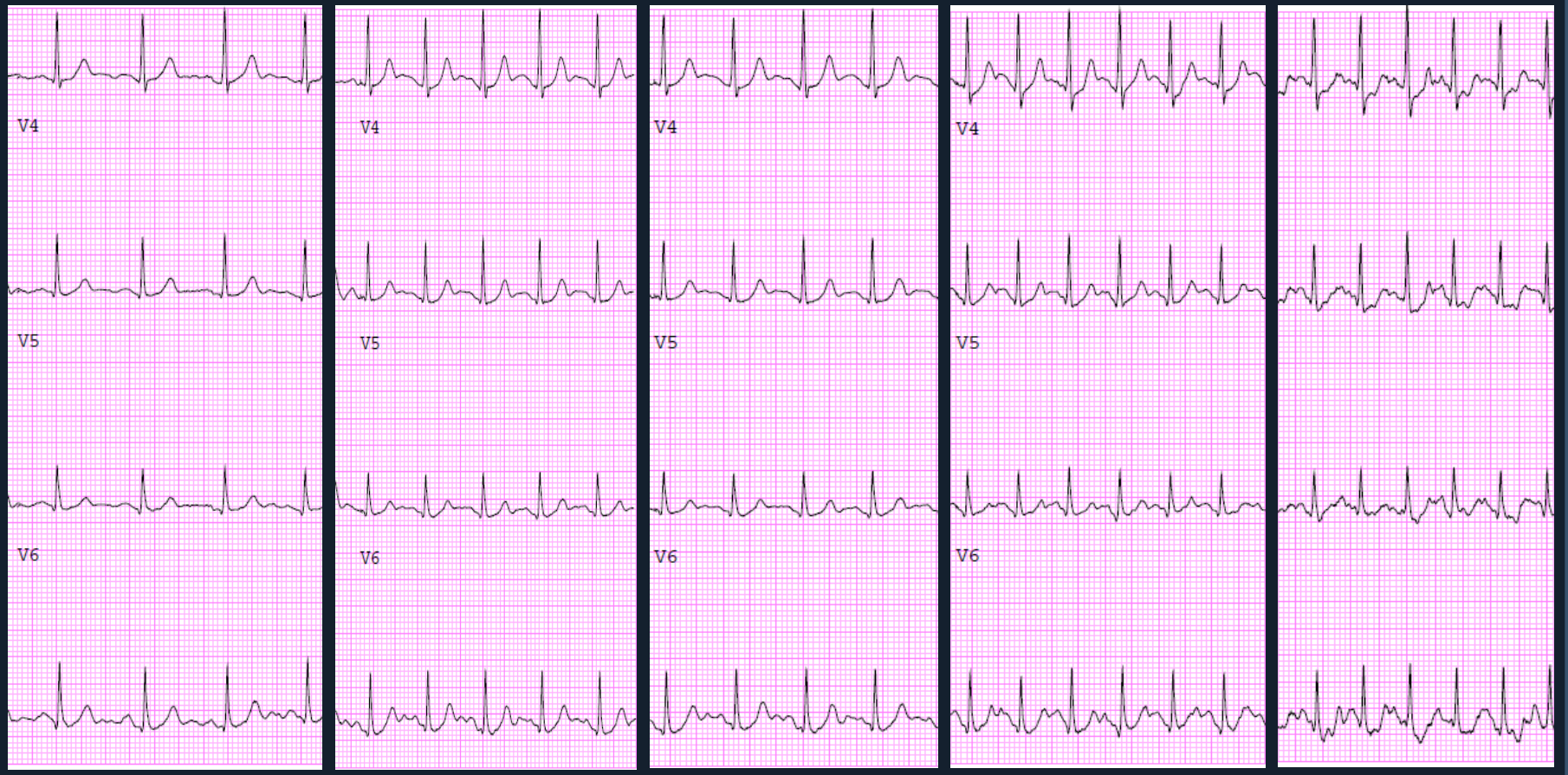
73/M, Atypical Chest Pain,



Finding Objective Ischemia ;

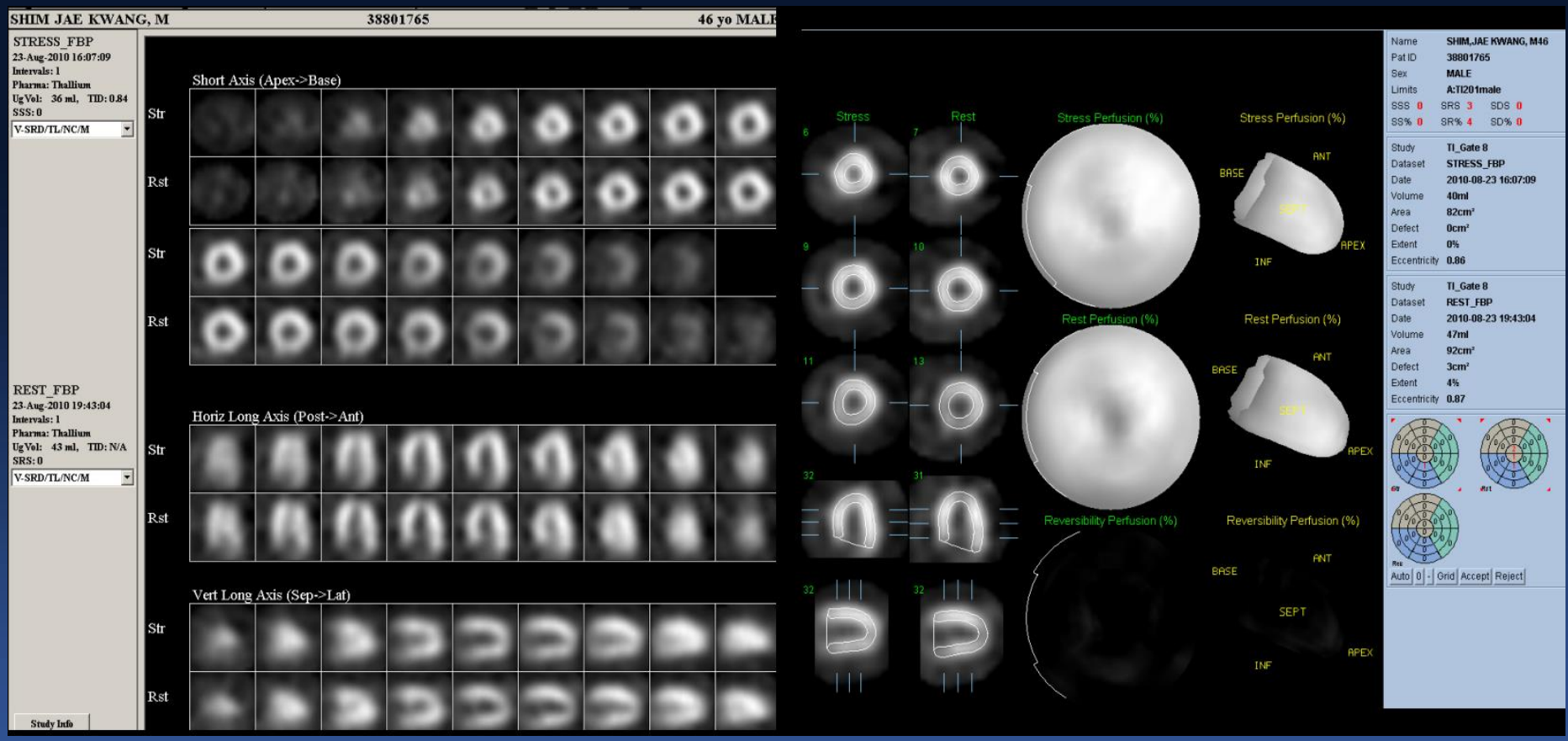
Results of
Non-invasive Stress Tests.

Treadmill Test



Stage 4, Negative

Thallium Spect

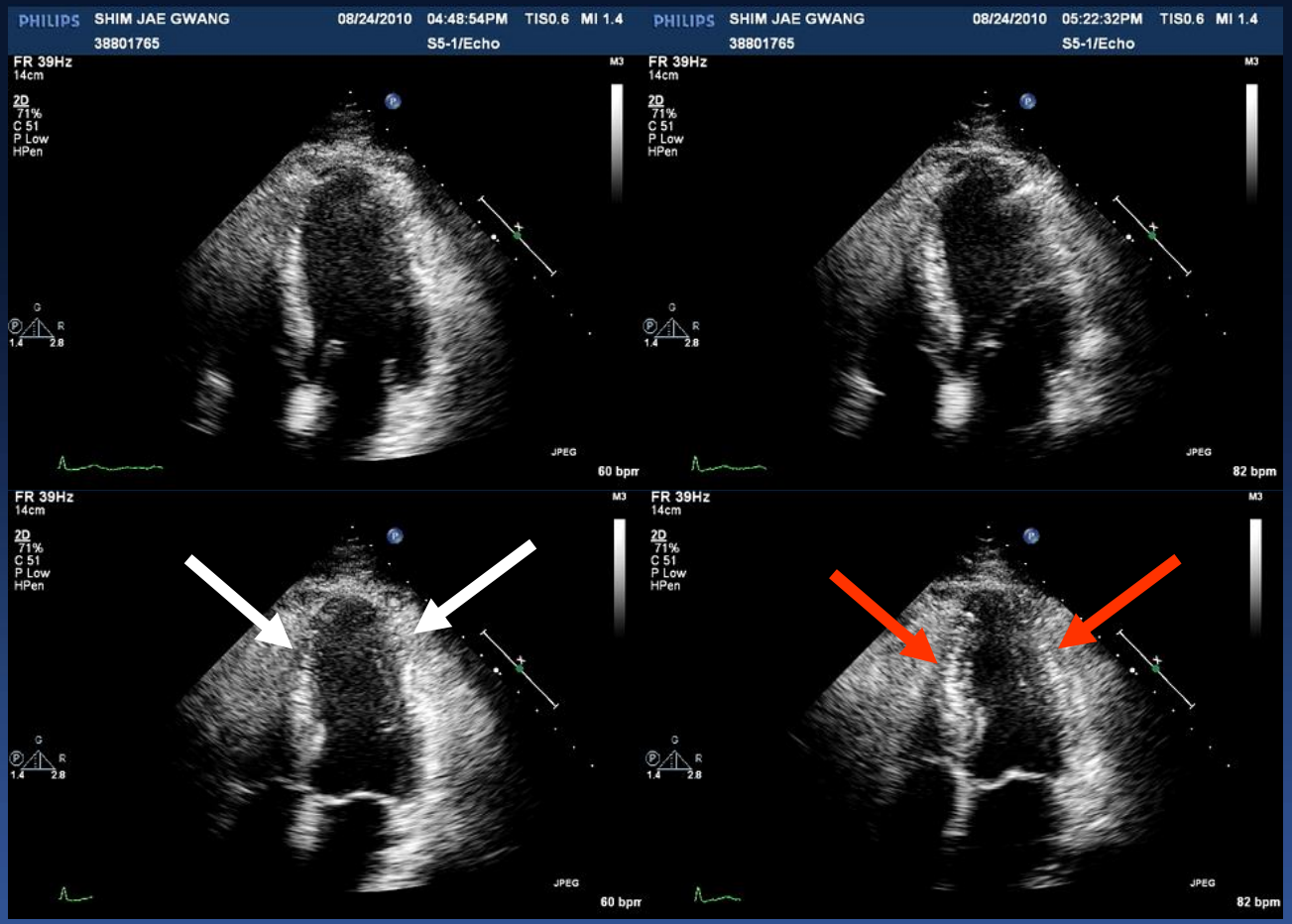


Normal

Dobutamine Stress EchoCG

Diastole

Systole

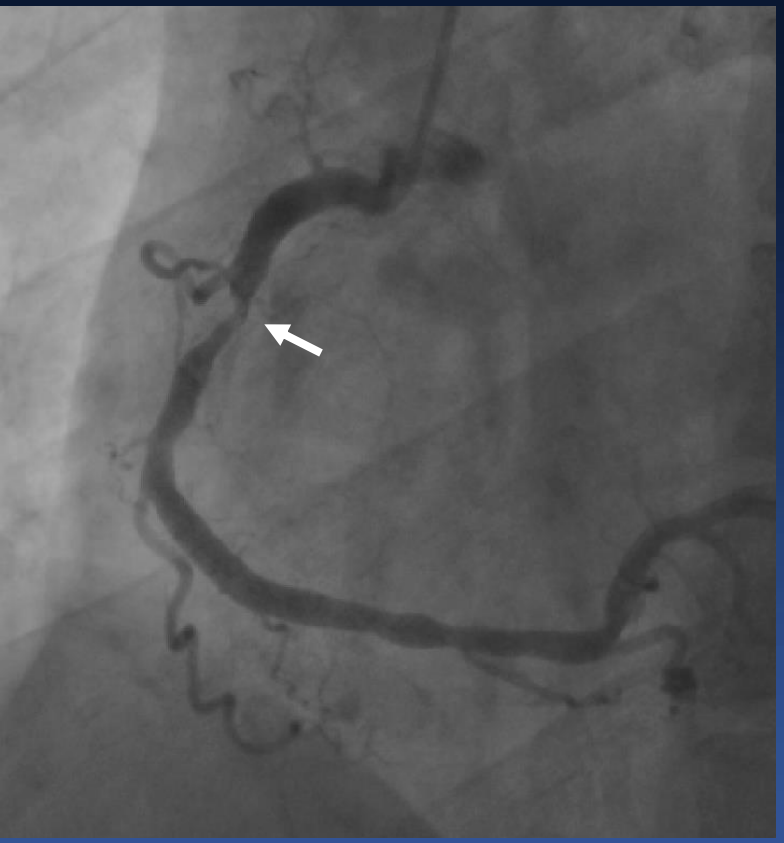


Baseline

Stimulation

Negative

Visual Functional Mismatches



Angiographic DS(%) : 85%

IVUS MLA : 2.8 mm^2

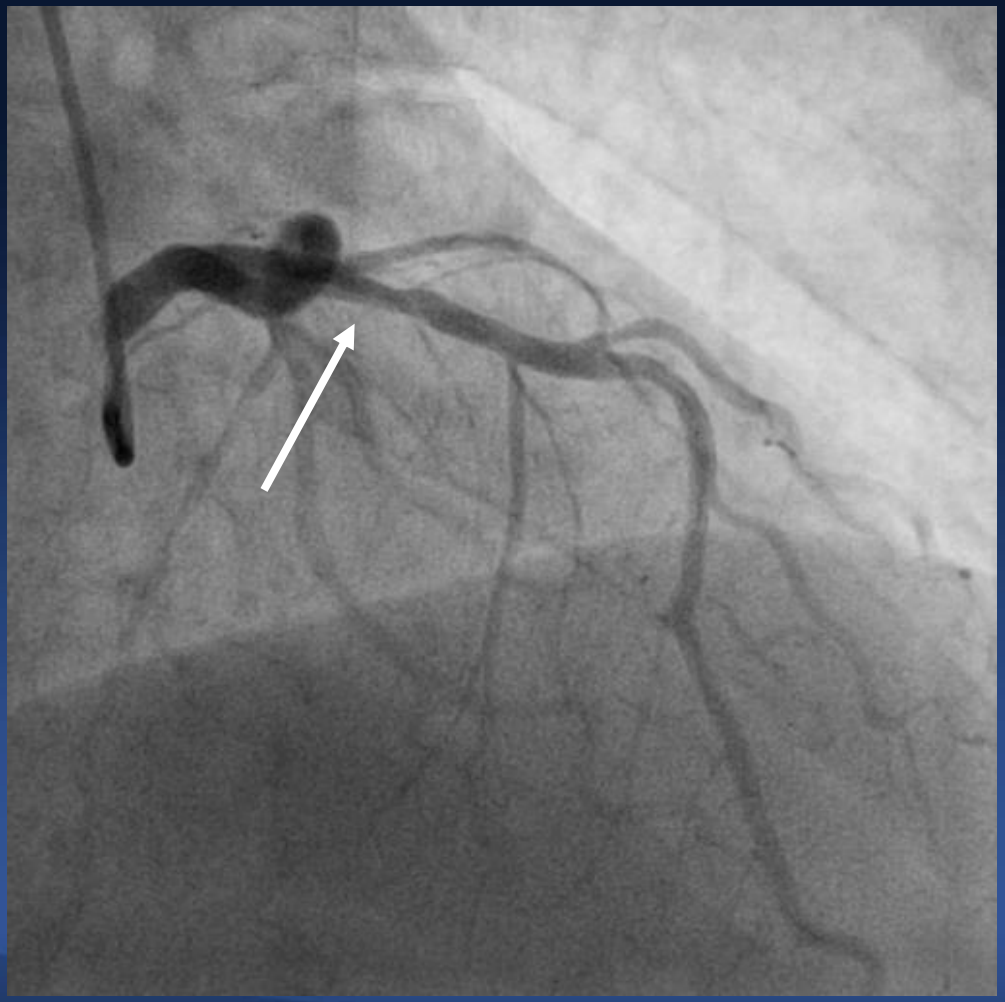
FFR : 0.84

Treadmill test : Negative

Thallium spect : Normal

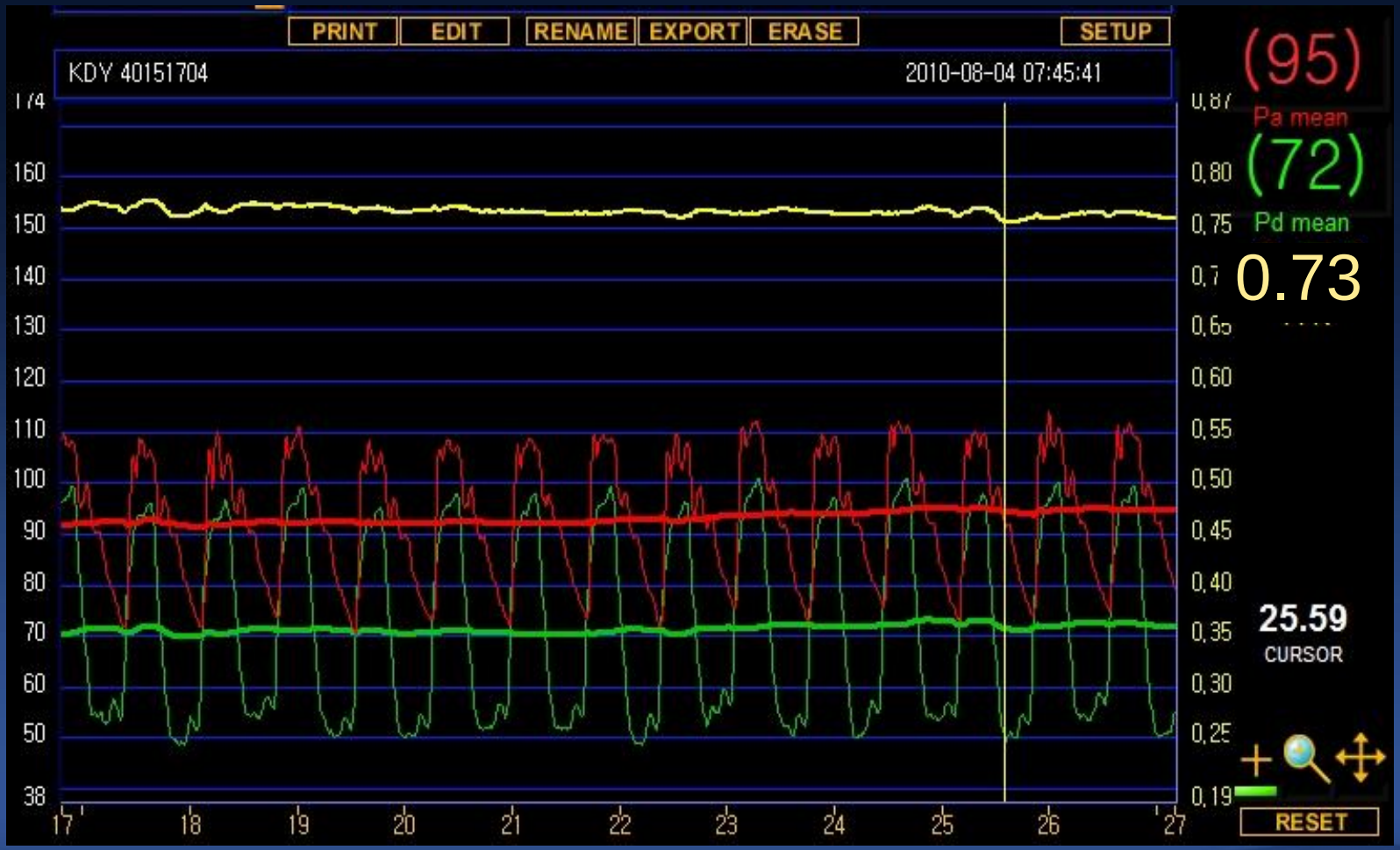
Stress Echo : Normal

M/44,
Intermittent resting chest pain, Hyperlipidemia, Smoker, Hypertension and Family history of CHD.

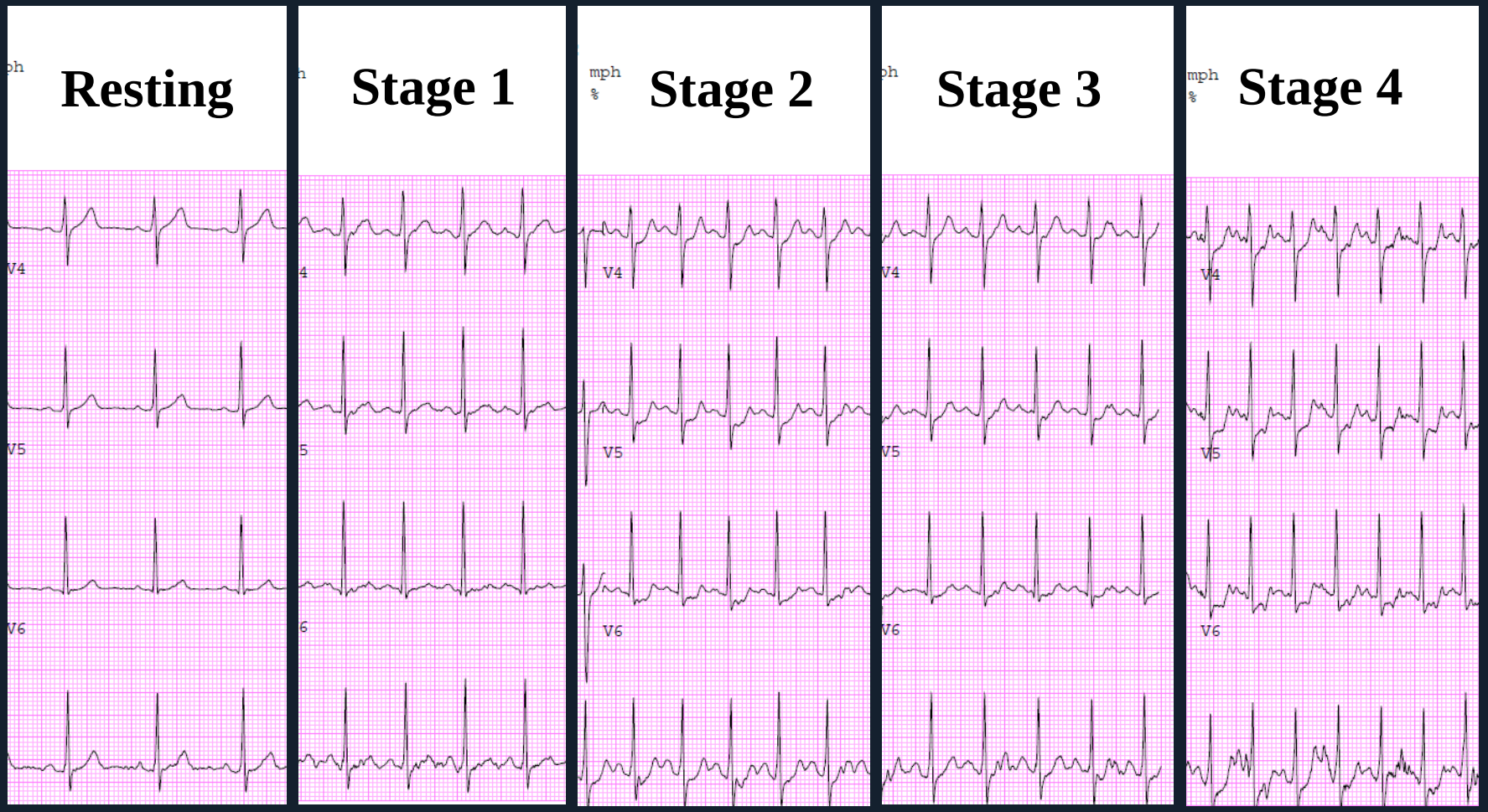


QCA
32%

FFR : 0.73

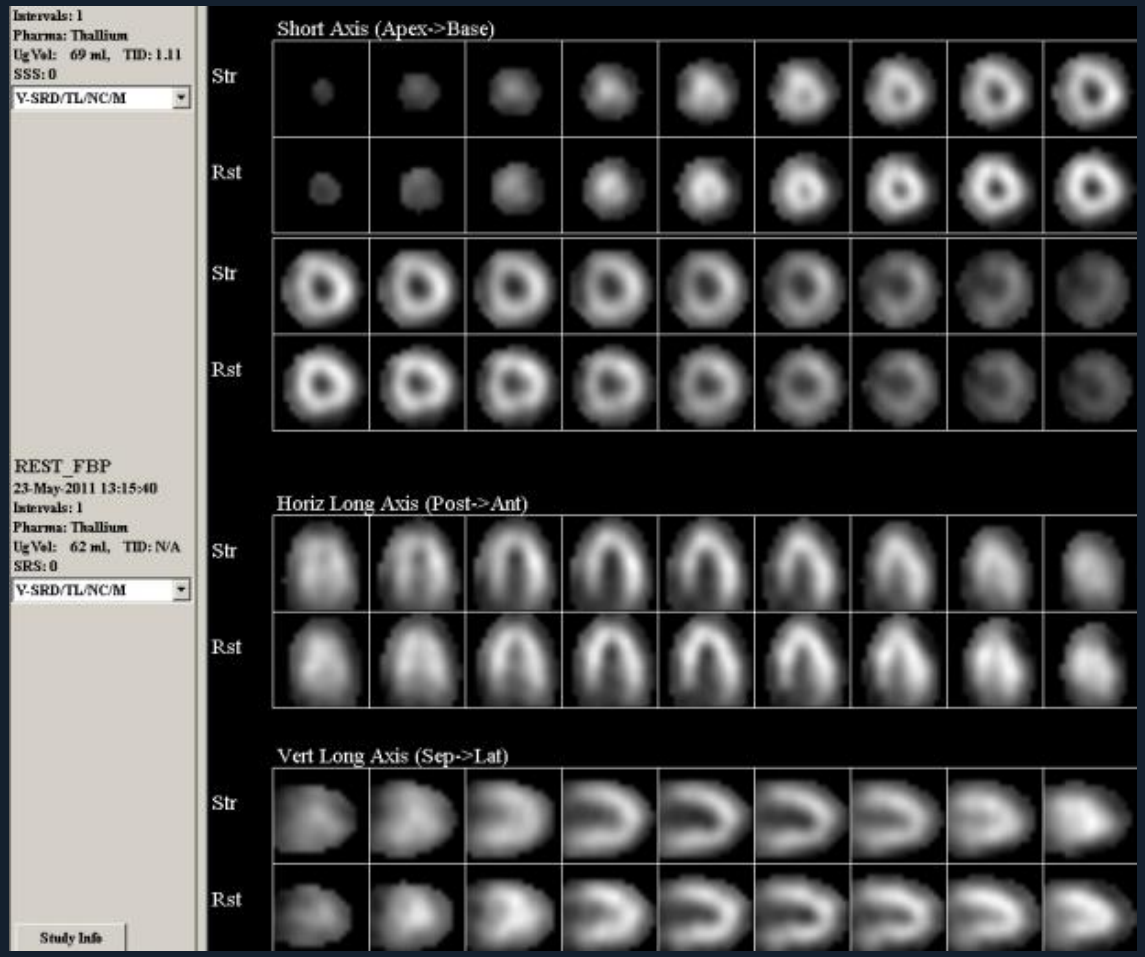

PRINT
EDIT
RENAME
EXPORT
ERASE
SETUP
KDY 40151704
2010-08-04 07:45:41
(95)
Pa mean
(72)
Pd mean
0.73
25.59
CURSOR
RESET

Treadmill Test



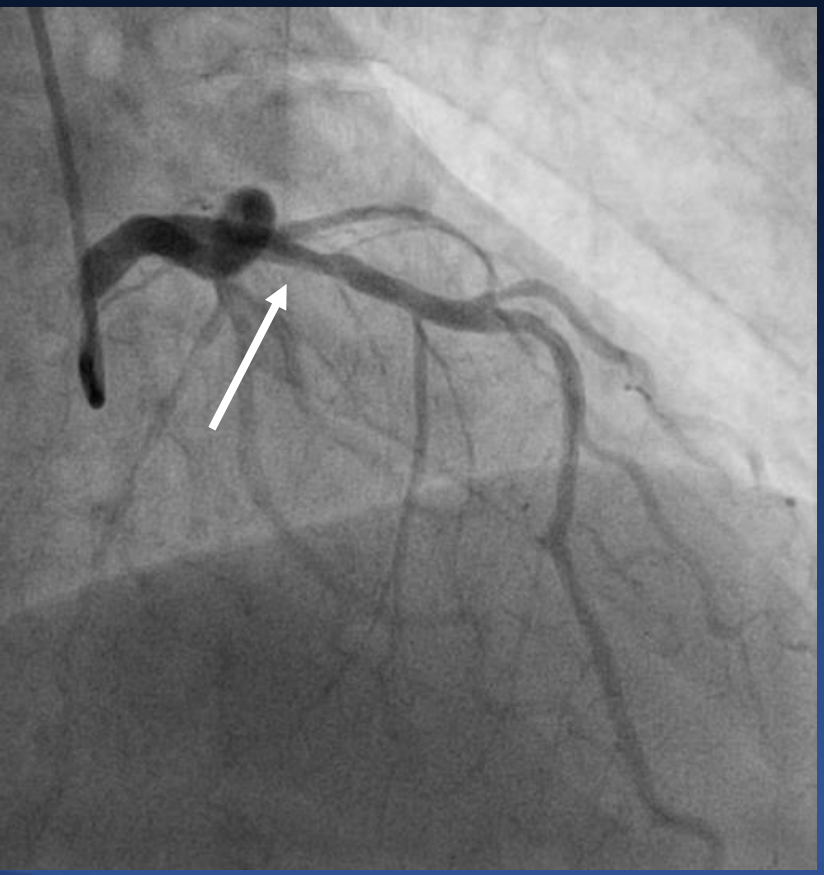
Positive Test

Thallium SPECT



Reversible large sized mildly decreased perfusion in apical septal, mid-basal anteroseptal and mid-basal inferolateral wall

Reverse Mismatch



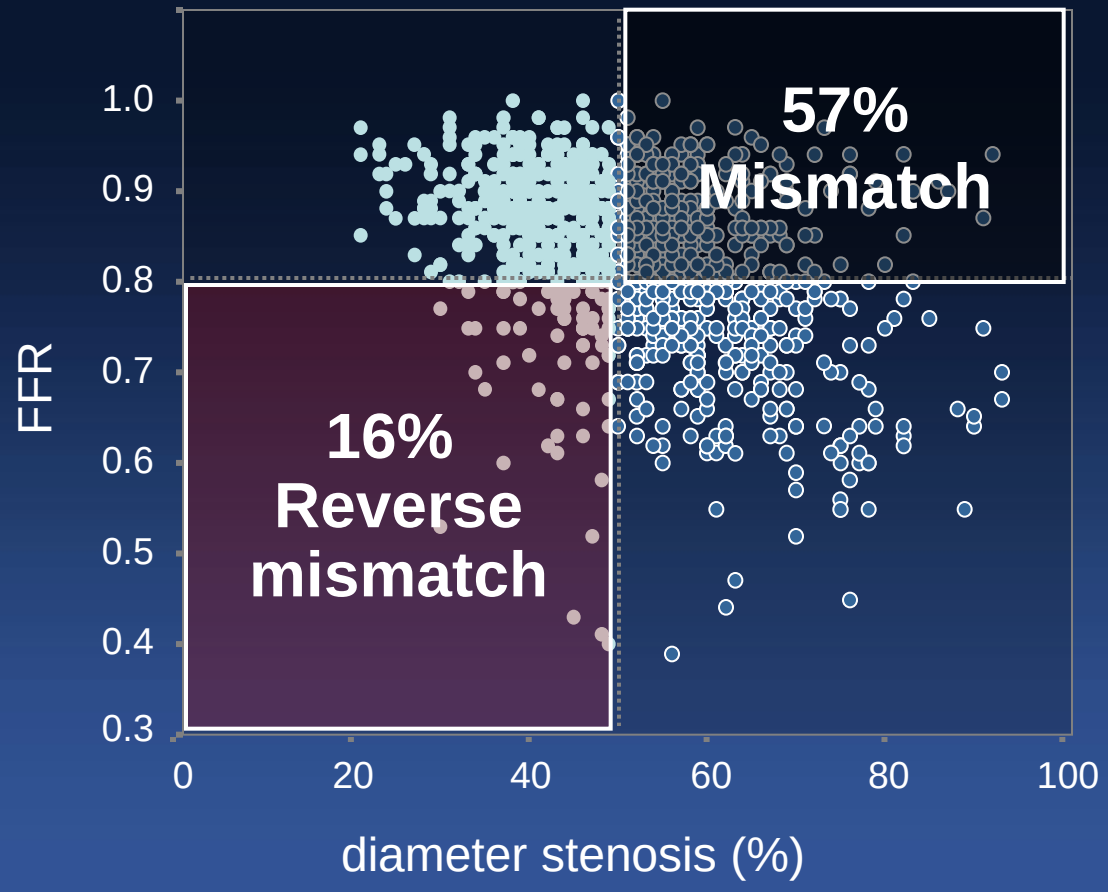
QCA DS(%) : 32%

FFR : 0.73

Treadmill test : stage 3 +

Thallium spect : + LAD

Many Mismatches,
1066 Non-LM lesions, AMC data



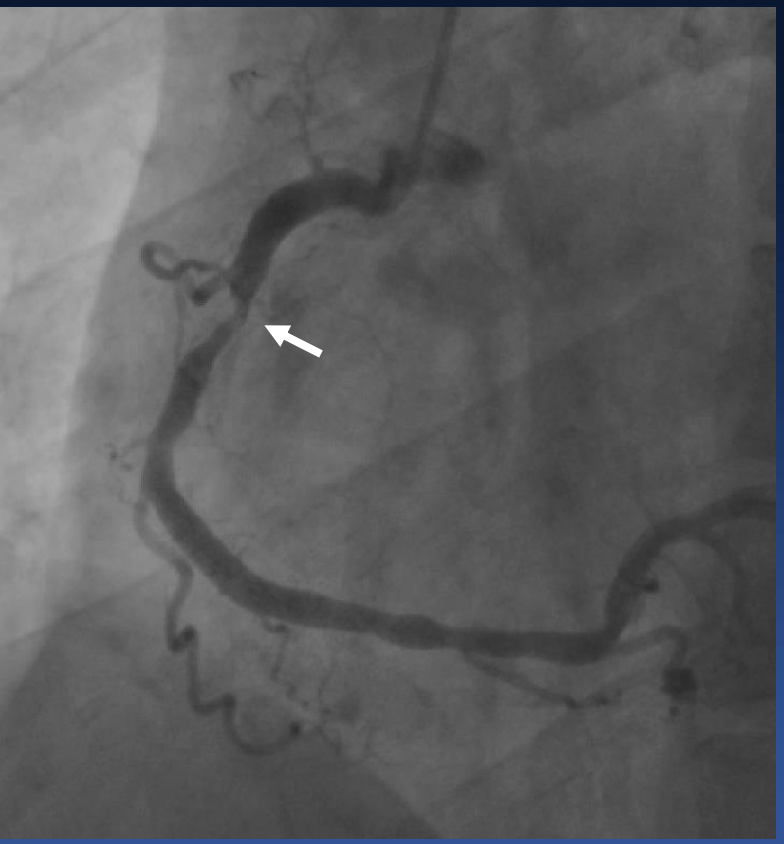
Tighter stenosis,
Negative FFR

Insignificant
stenosis,
Positive FFR

Why Mismatches ?
Multivariable Predictors, Non-LM (n=1,000)

Mismatch **Significant Stenosis (>50%)** **Negative FFR (>0.80)**	**Reverse Mismatch** **Insignificant Stenosis (<50%),** **Positive FFR (<0.80)**
Older Age	Younger Age
Non-LAD location	LAD location
Shorter lesion length	Plaque Rupture
Larger MLA by IVUS	Smaller MLA by IVUS
Larger MLD by QCA	
Smaller PB	Larger PB

To Treat or Deferred Treat ?



Angiographic DS(%) : 85%

IVUS MLA : 2.8 mm^2

FFR : 0.84

Treadmill test : Negative

Thallium spect : Normal

Stress Echo : Normal

Why

1. I am a FFR believer.
2. FFR is *well matched with non-invasive stress tests.*
3. Negative non-invasive stress tests means *just excellent prognosis (0.6%/year, Cardiac Death and MI),* even in the presence of angiographically proven coronary artery disease.

Shaw LJ, J Nucl Cardiol 2004;11:171-85 ,
Prognostic value of gated myocardial perfusion SPECT.
Very large meta-analysis. (n=39,173 patients)

Death and MI

1. Negative FFR (>0.80 or 0.75) and/or
   Normal Myocardial Perfusion Scan: < 1% / yr
   (NUCLEAR studies, DEFER, FAME)

2. Stented Segment : 2-3% / yr
   (DEFER, FAME, SYNTAX, and registries)

3. Untreated Positive FFR (<0.75 or 0.80) and/or Positive myocardial perfusion scan: 5-10% / yr
   (Registries, ACIP, etc)

FFR Guided Defer,
Is It Really Safe ?

Multicenter, Prospective Registry to Evaluate
The Natural History of FFR-Guided Deferred Coronary Lesions

IRIS FFR DEFER Registry

Patients with ≥1 Deferred Target Lesions
(DS>50% by visual estimation and FFR>0.80)

Deferred Patients
(N=10,000)

Imaging Sub-Study
(n=1,200)

2 year Clinical F/U

2-year CAG & Imaging FU
- IVUS
- VH-IVUS
- OCT

Primary Endpoint : *Target Vessel Related (TVF)*
Cardiac Death, MI, and Clinical driven TVR at 2 year

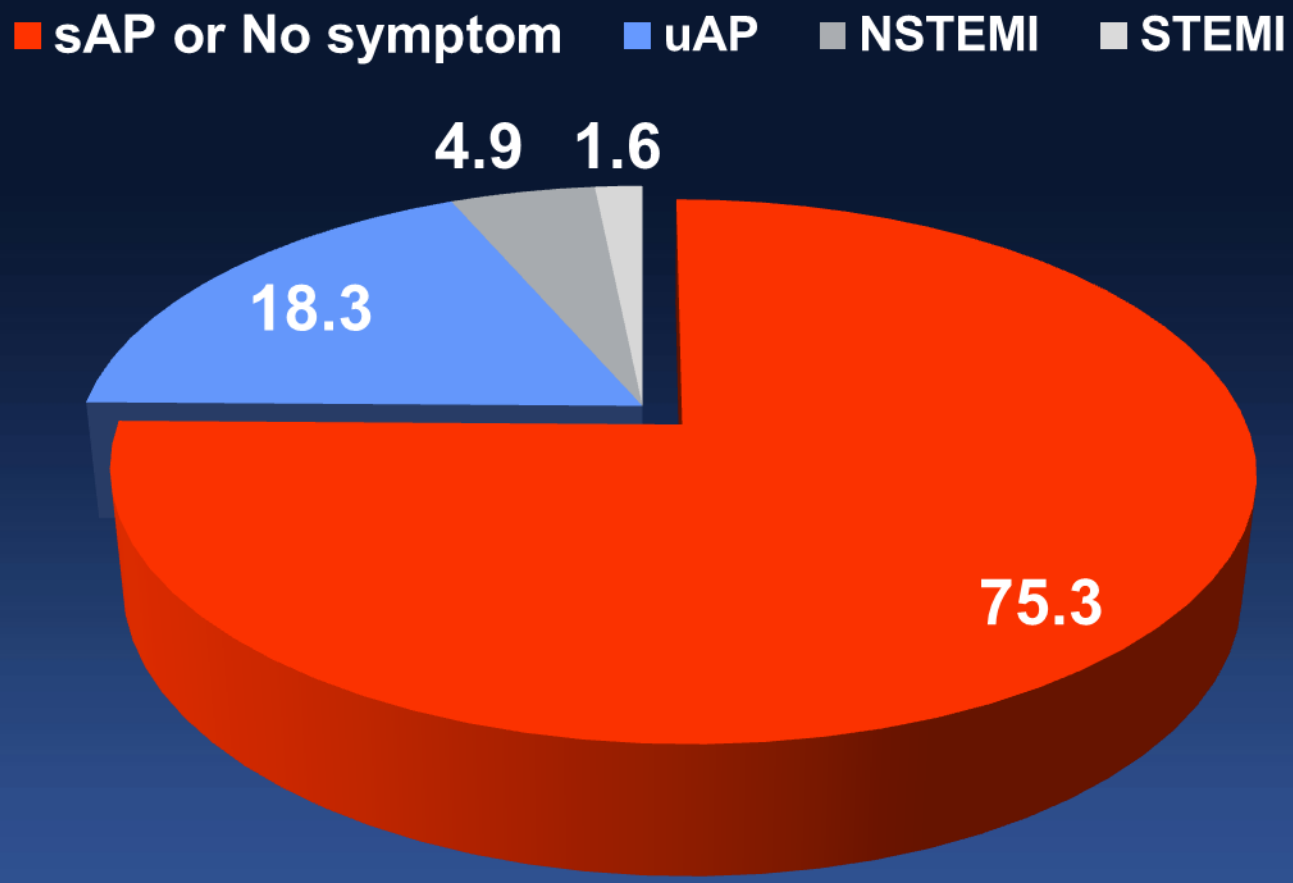
Patient Enrollment

Preliminary Analysis on 2060 Patients With at Least 6month Follow-Up.

Patient Characteristics

Variables	N=2060
Age	64.2±9.5
Sex (men)	1463 (71%)
Body mass index, kg/m^2	24.8±2.9
Diabetes	655 (32%)
Hypertension	1317 (64%)
Current smoker	528 (26%)
Hyperlipidemia	1294 (63%)
Previous myocardial infarction	131 (6%)
Previous stroke	125 (6%)
Chronic renal faliure	42 (2%)
Chronic lung disease	50 (2%)
Peripheral artery disease	52 (3%)
Family history	232 (11%)

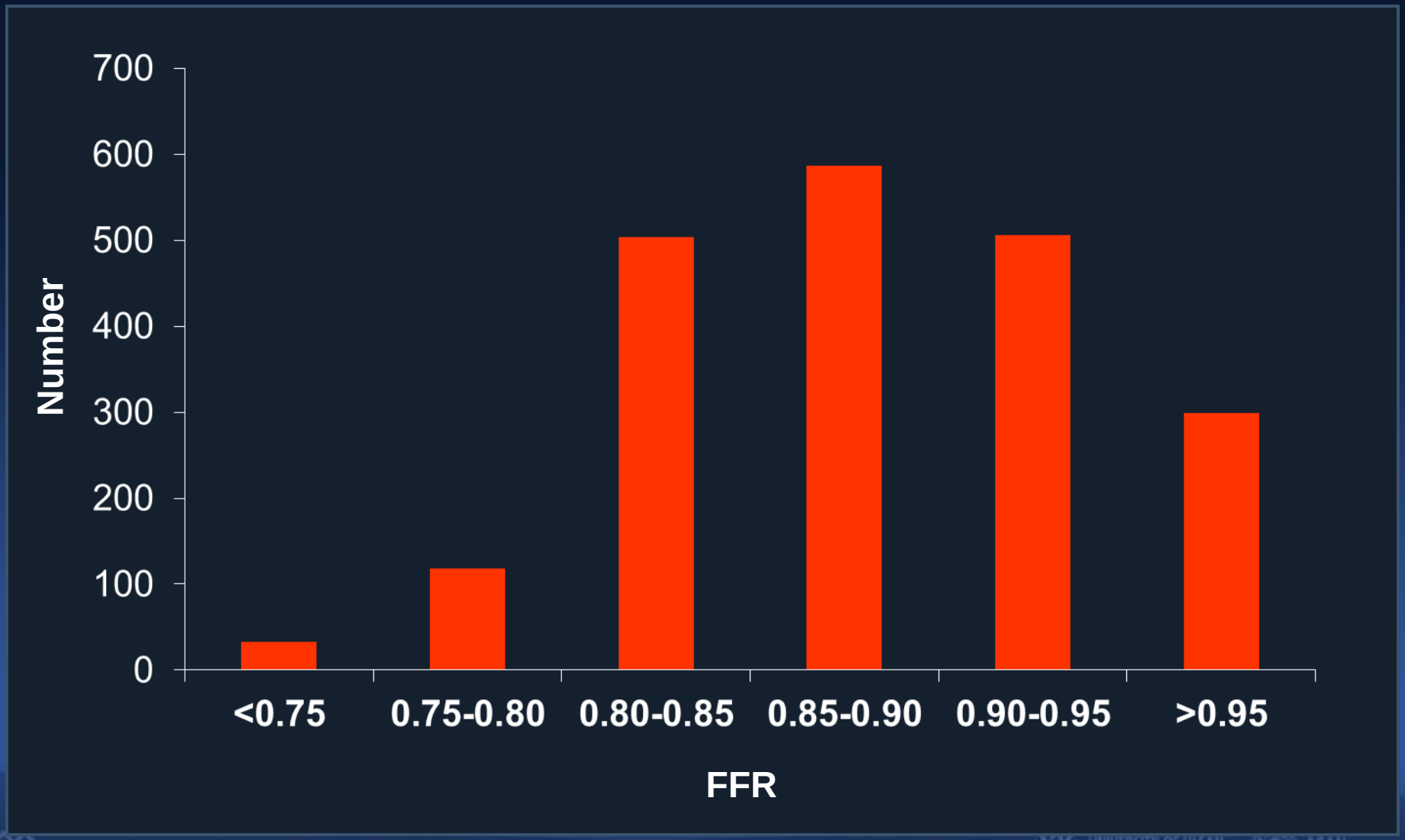
Clinical Presentation



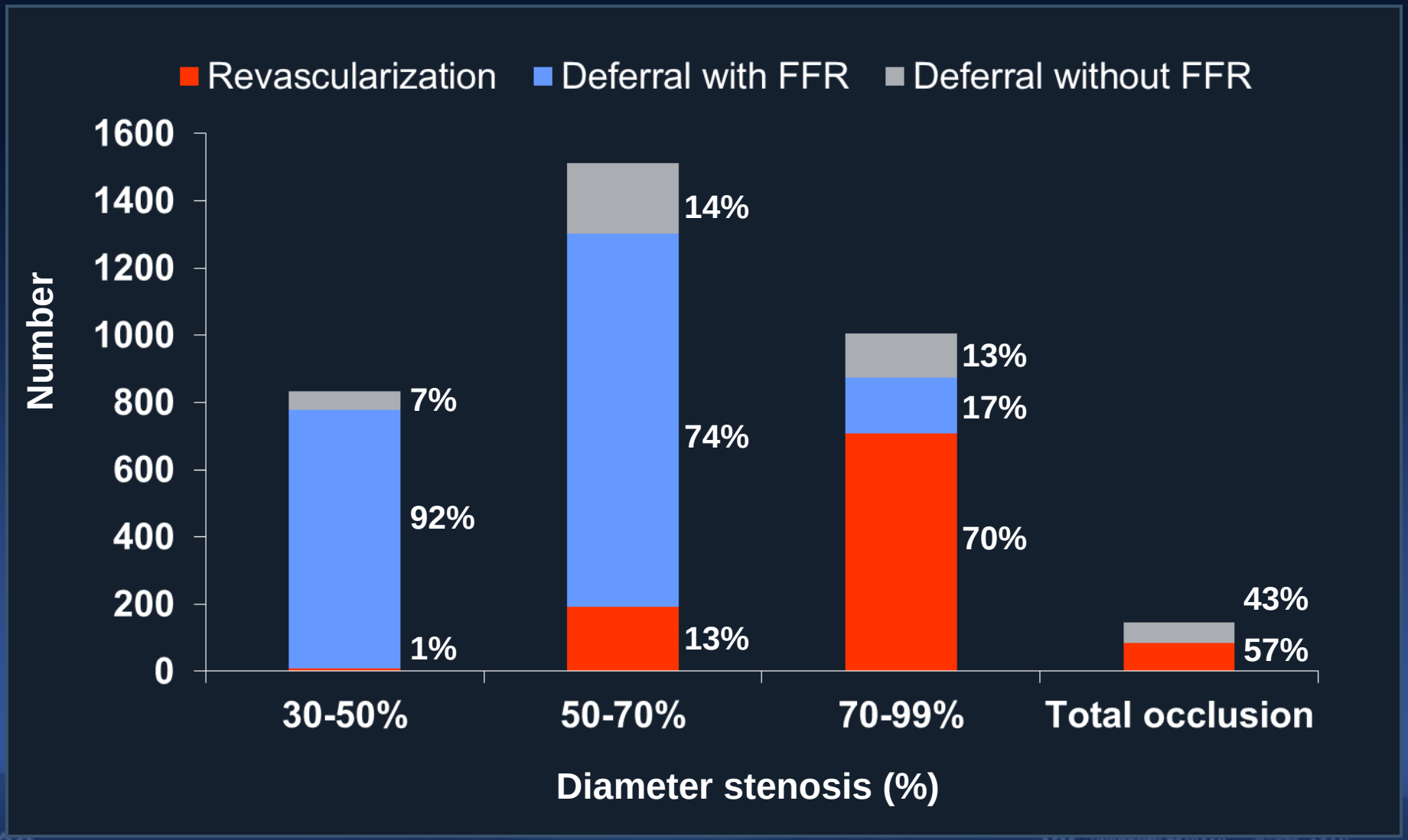
Lesion Characteristics: All lesion

Variables	N=3497
Lesion territory	
Left main	197 (5.6%)
Left anterior descending artery	2366 (68%)
Left circumflex artery	1464 (42%)
Right coronary artery	1889 (54%)
ACC/AHA B2C lesion	528 (26%)
Long lesion (>20mm)	1294 (63%)
Moderate to severe calcification	131 (6%)
Diameter stenosis	
50-70%	2345 (67%)
70-99%	1006 (29%)
Total occlusion	146 (4%)

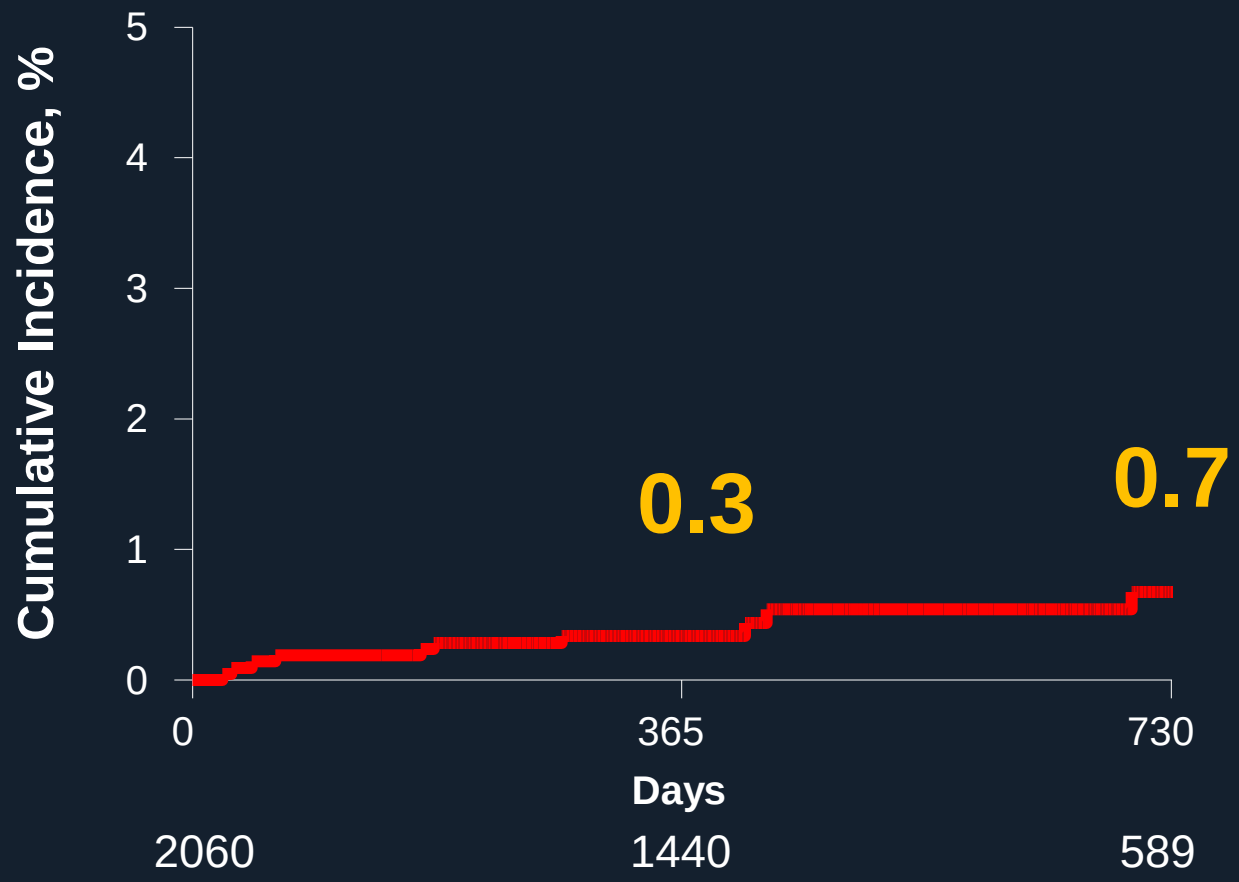
FFR Distribution of Deferred Lesions



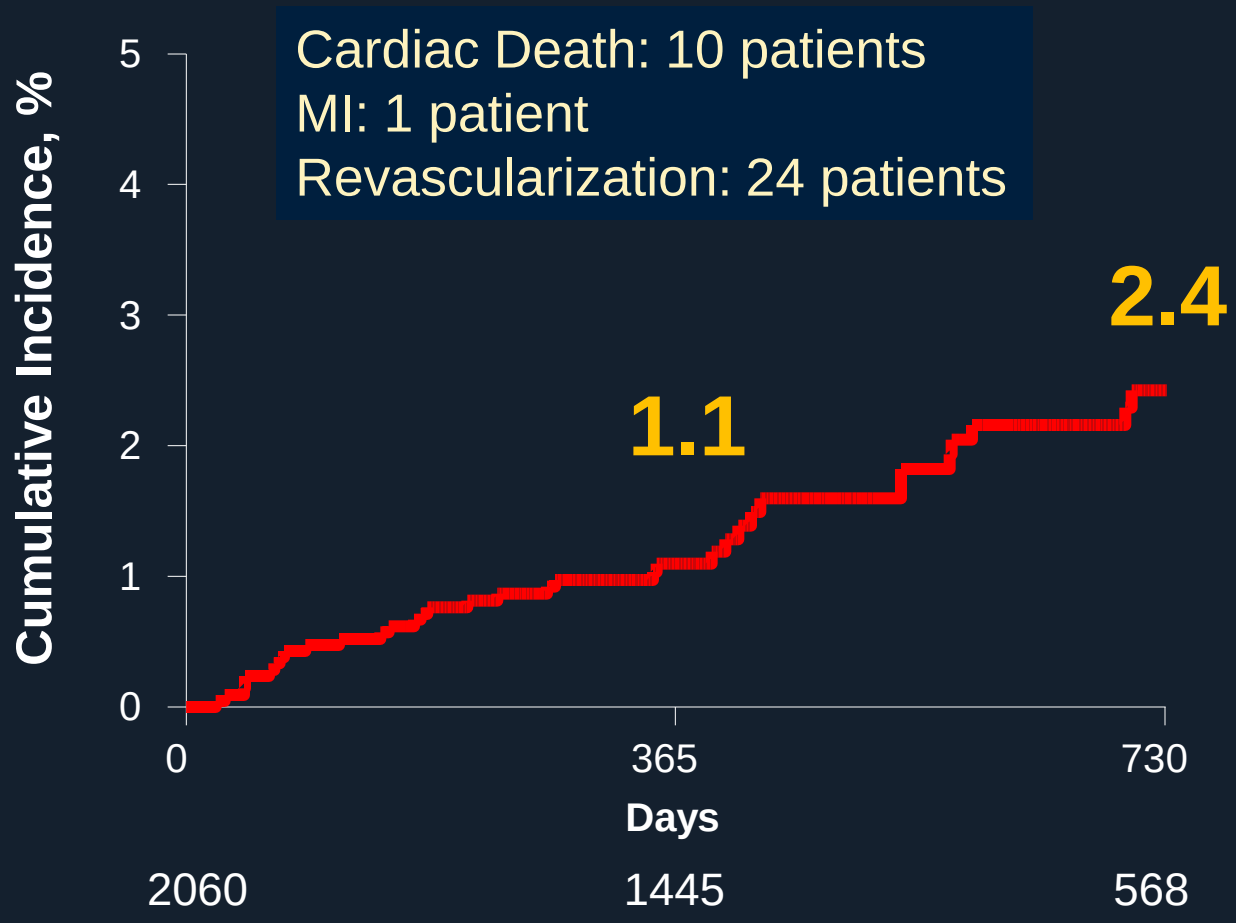
Lesion Treatment



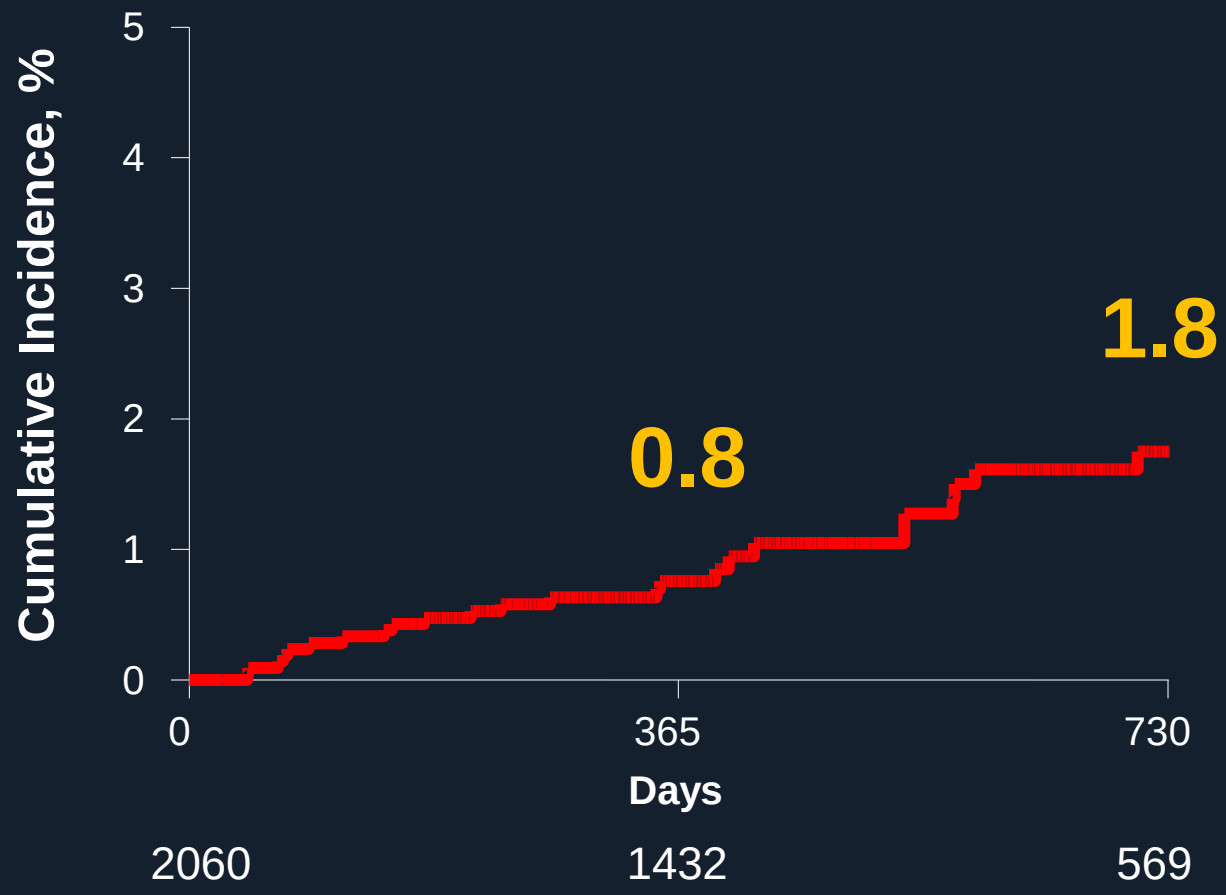
Death and MI at 2 Year (per patient, n=2,060)



Death / MI Revascularization at 2 Year (per patient, n=2,060)

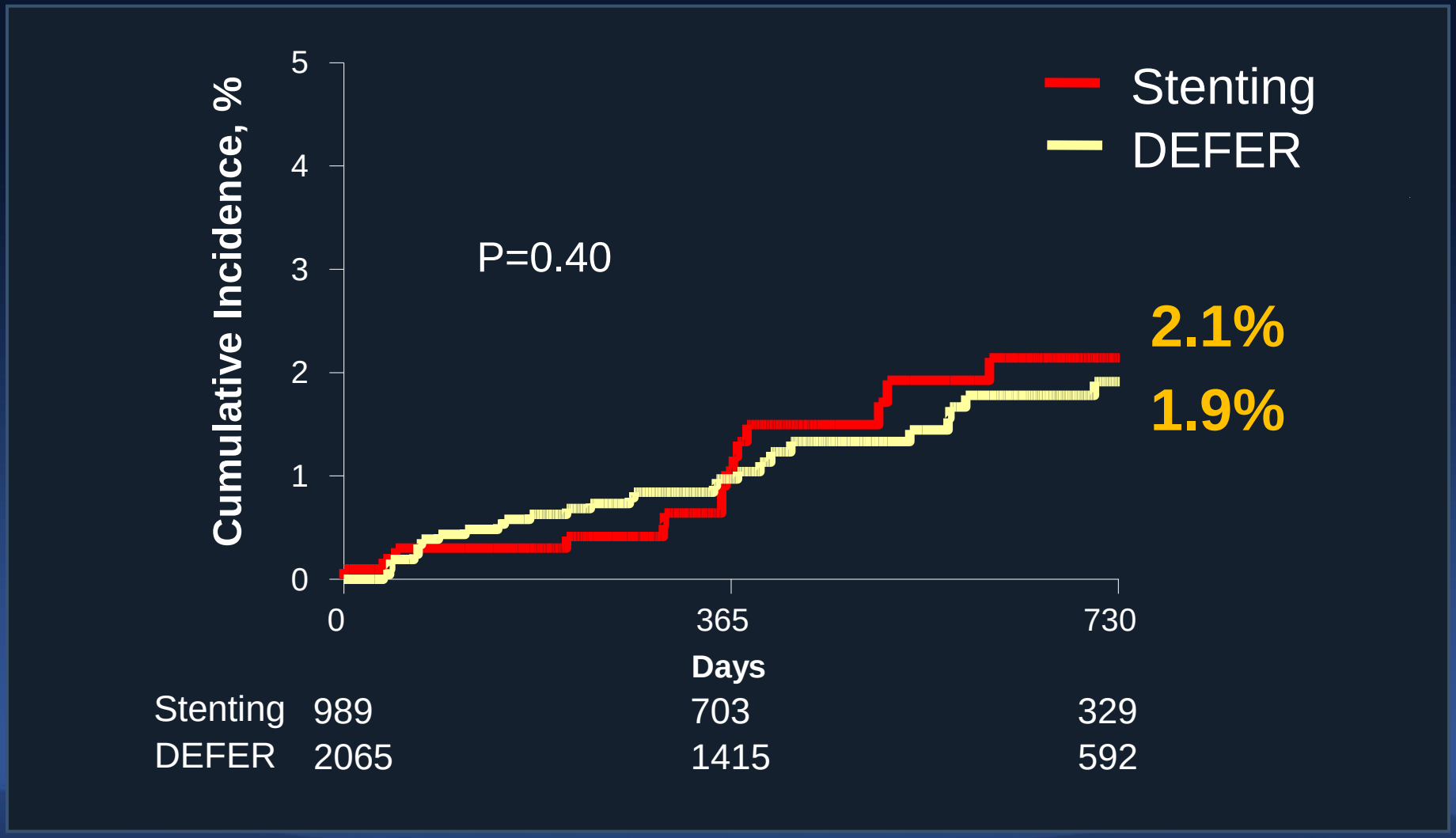


Revascularization at 2 Year (per patient, n=2,060)

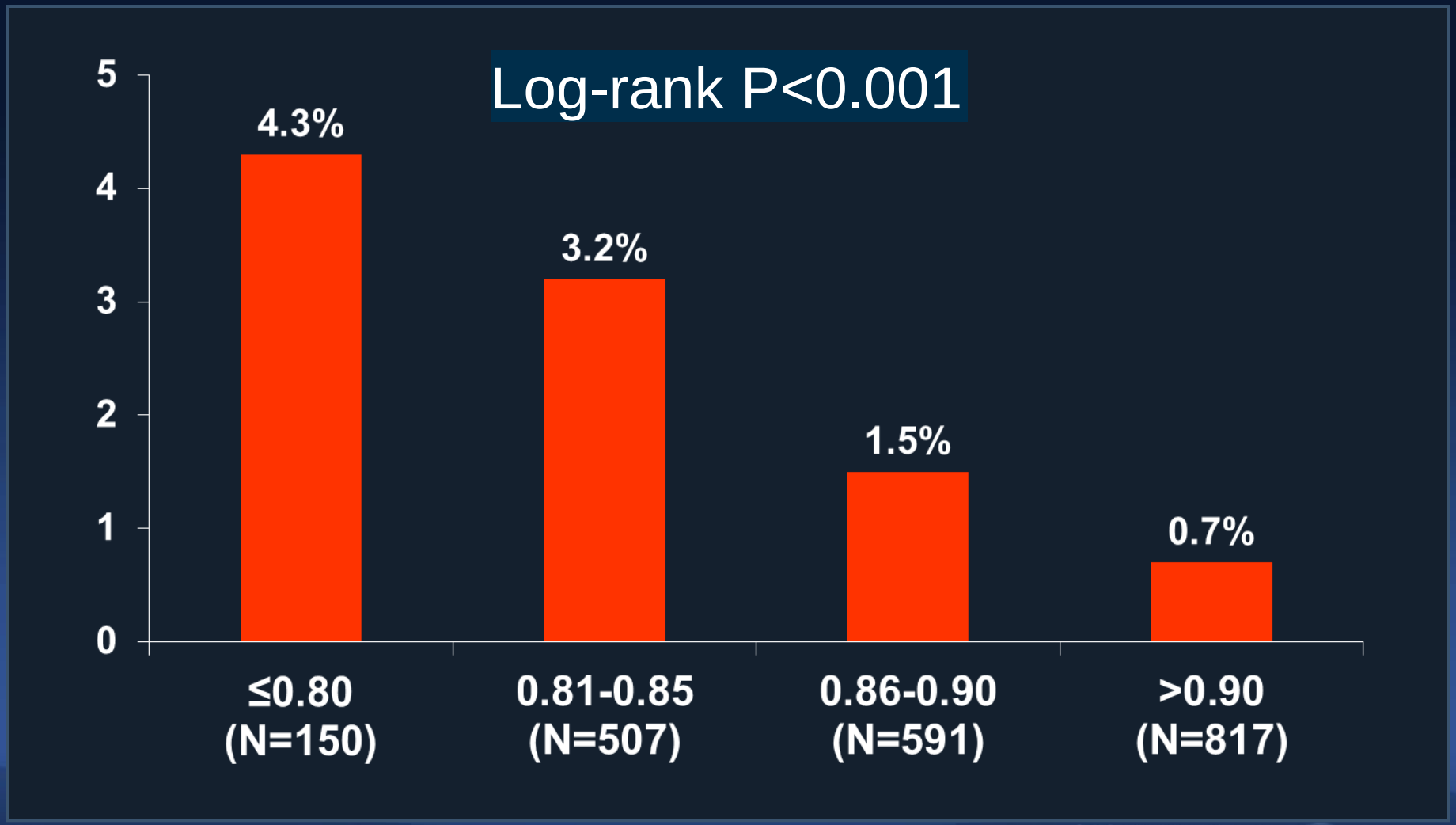


Preliminary Data, 2014 from IRIS FFR DEFER Registry

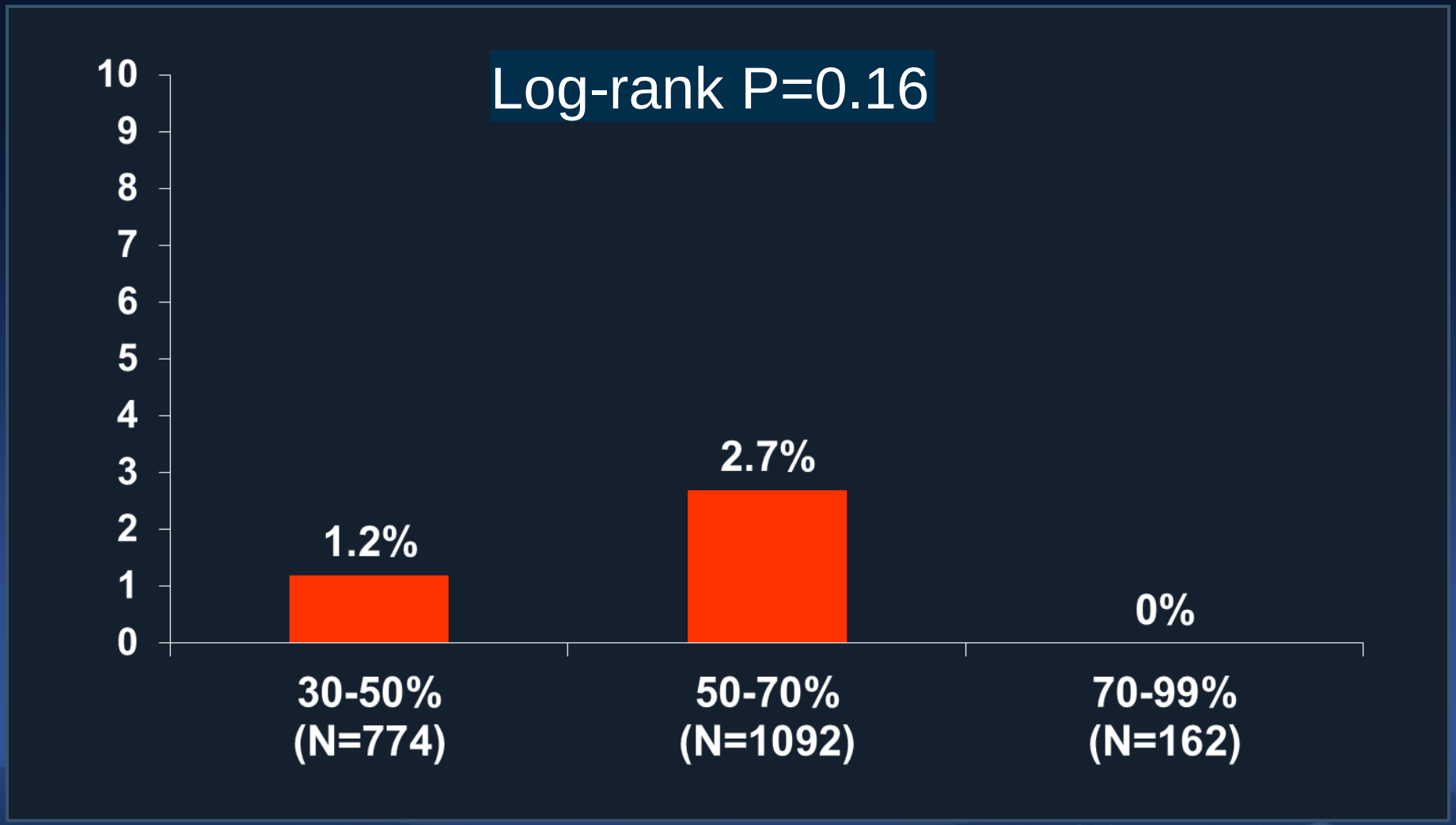
Revascularization at 2 Year (per lesion, n=2,506)



Revascularization at 2 Year
According to FFR (per lesion)



Revascularization at 2 Year
According to % DS (per lesion)



FFR Guided Defer
Is Safe and Good !

2013, ESC Guidelines

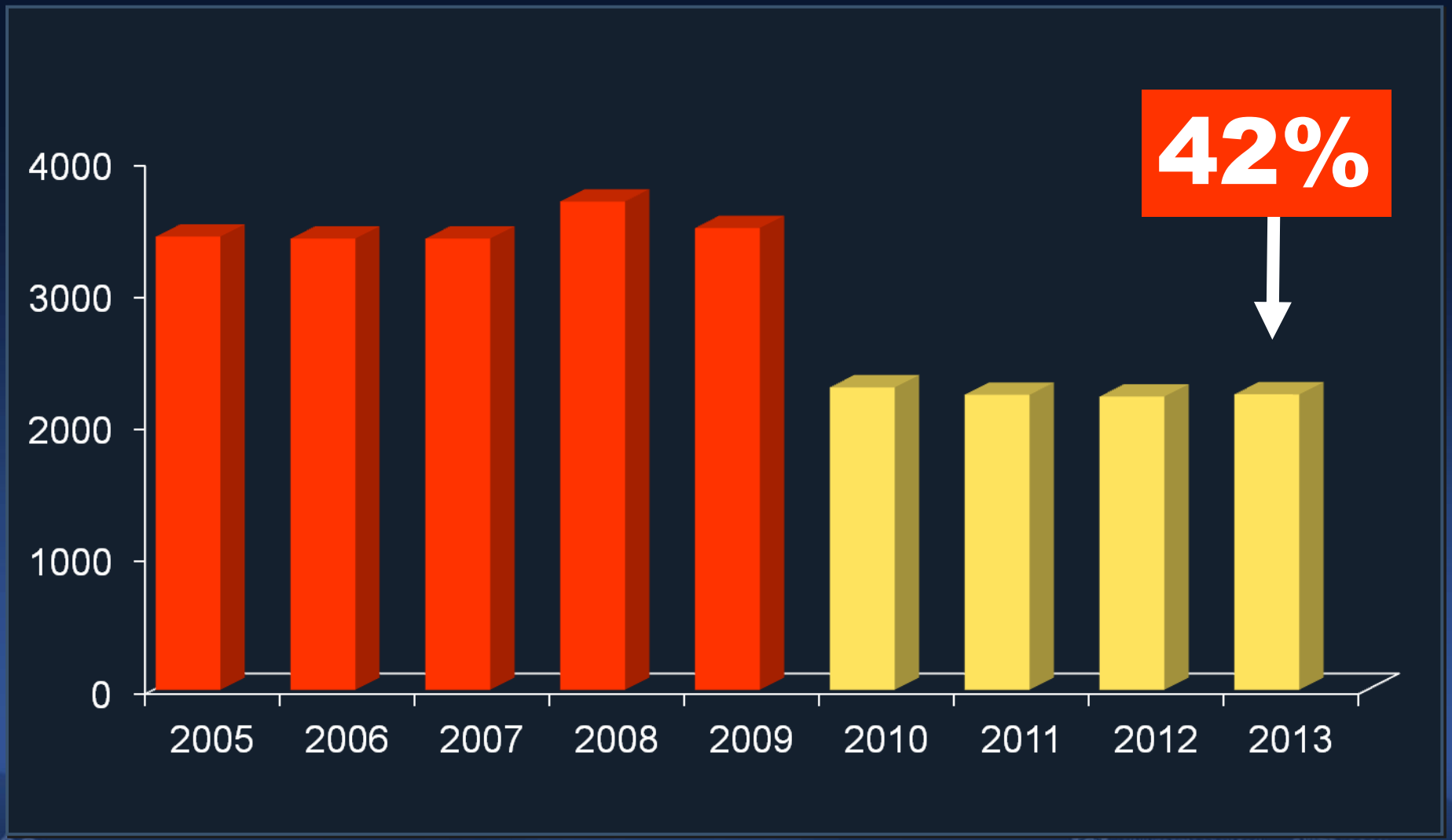
Recommendations	Class	Level
FFR is recommended to identify hemodynamically relevant coronary lesion(s) when evidence of ischemia is not available.	I	A
Revascularization of stenosis with FFR <0.80 is recommended in patients with angina symptoms or a positive stress test.	I	B
Revascularization of an angiographically intermediate stenosis without related ischemia or without FFR <0.80 is not recommended.	III	B

When FFR Should Be Considered ?

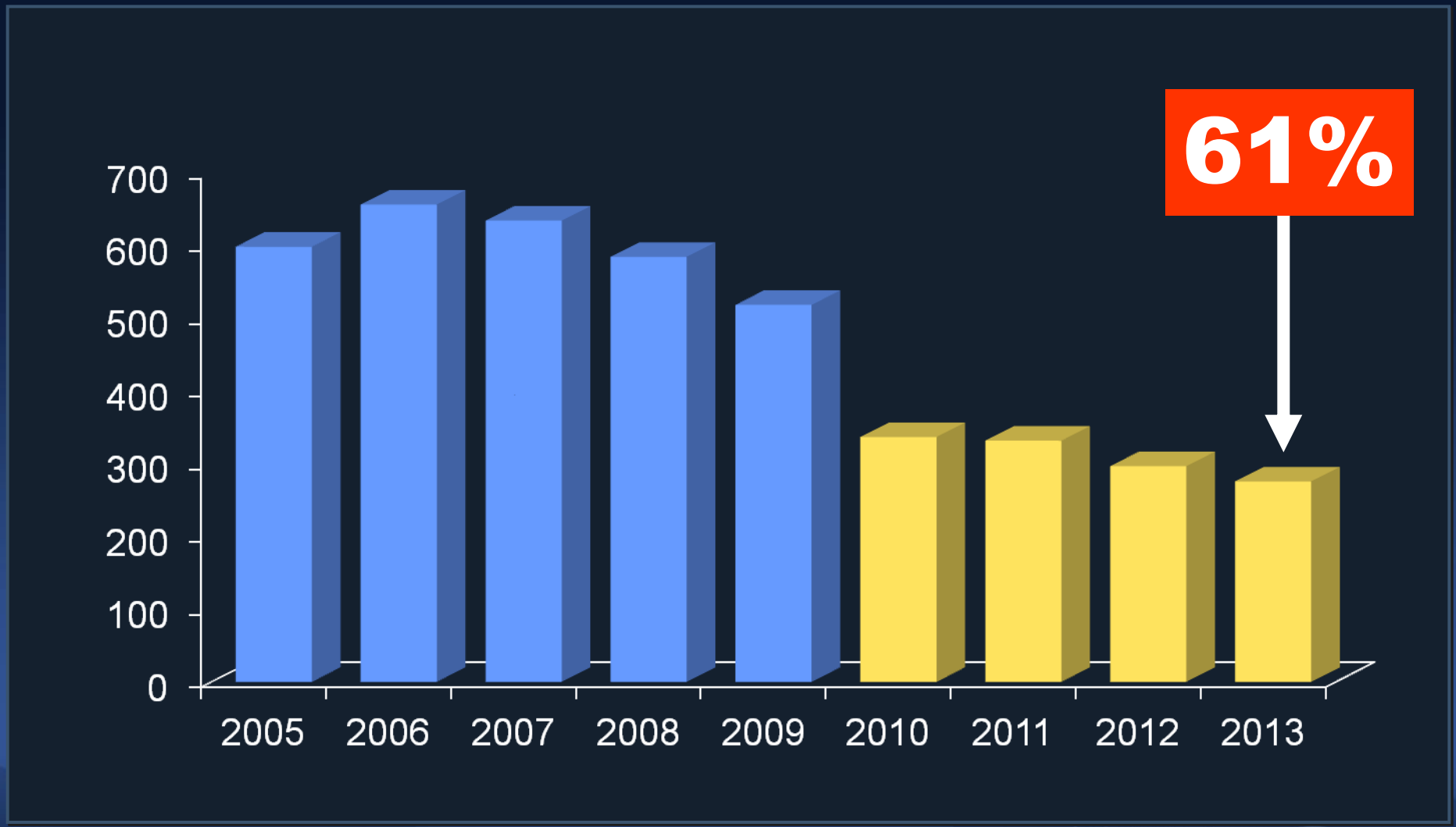
1. Visual Estimation, 40-90 % of diameter stenosis Without Evidence of Non-Invasive Stress Test in the Cath Lab.
2. Multi-Vessel Disease Evaluation.

Impact of FFR
In Real Practice *At AMC*

Number of Stent Decreased



Number of CABG Decreased

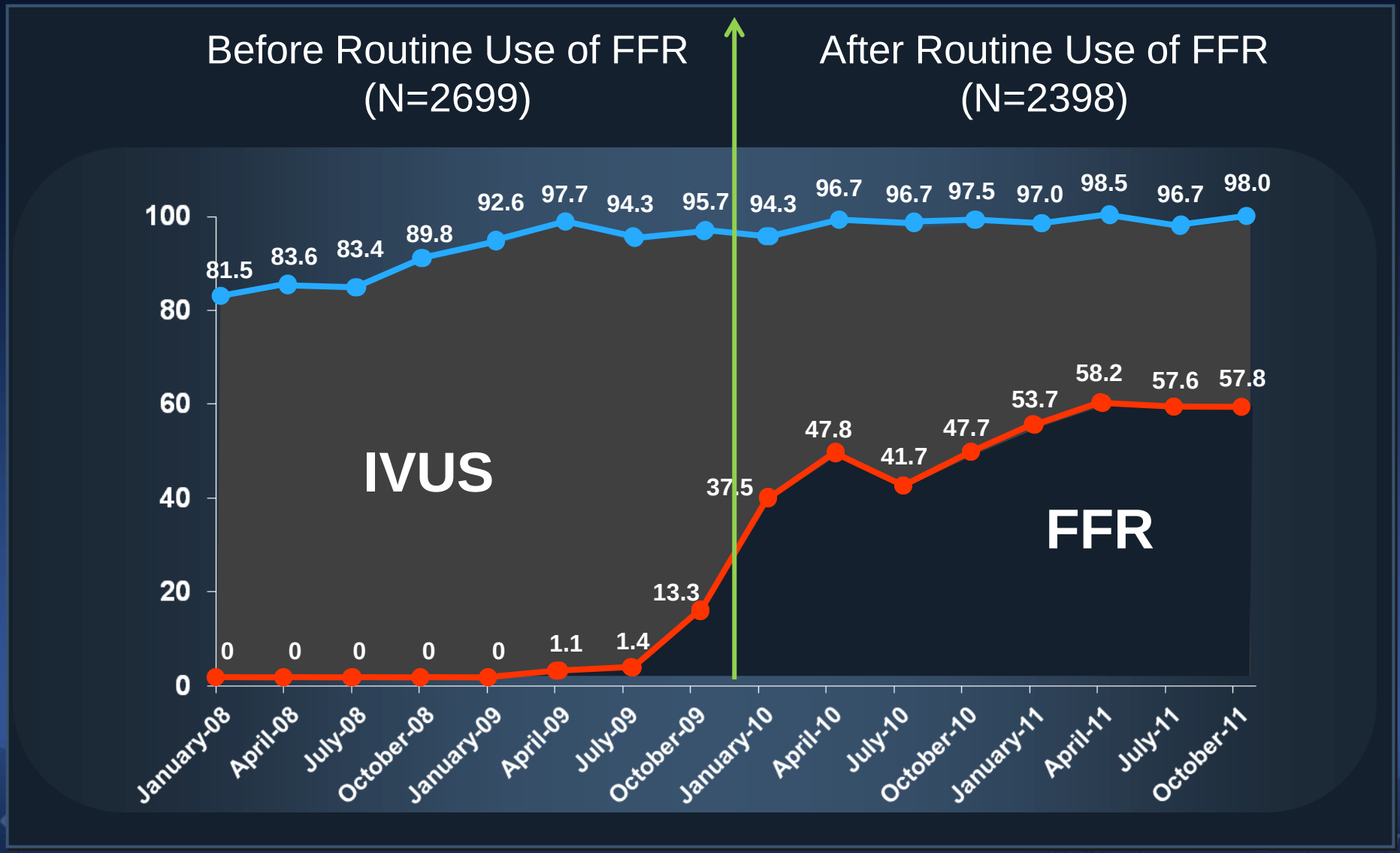


Impact of FFR
On PCI Outcomes

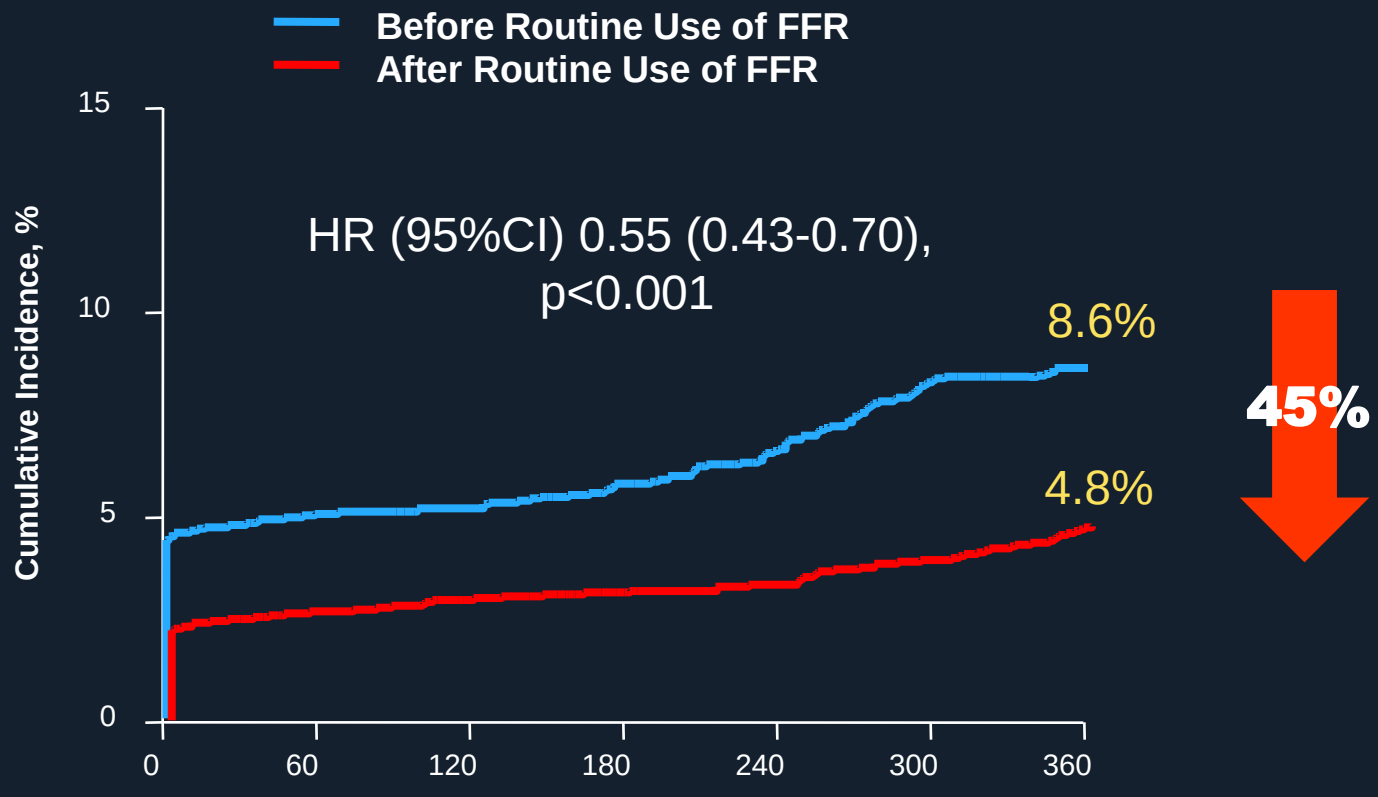
Park SJ, European Heart Journal. 2013 Nov;34(43):3353-61.

Integrated Use of FFR and IVUS

(AMC data, n=5097)



Primary End Point
(Death, MI, or Repeat Revascularization)



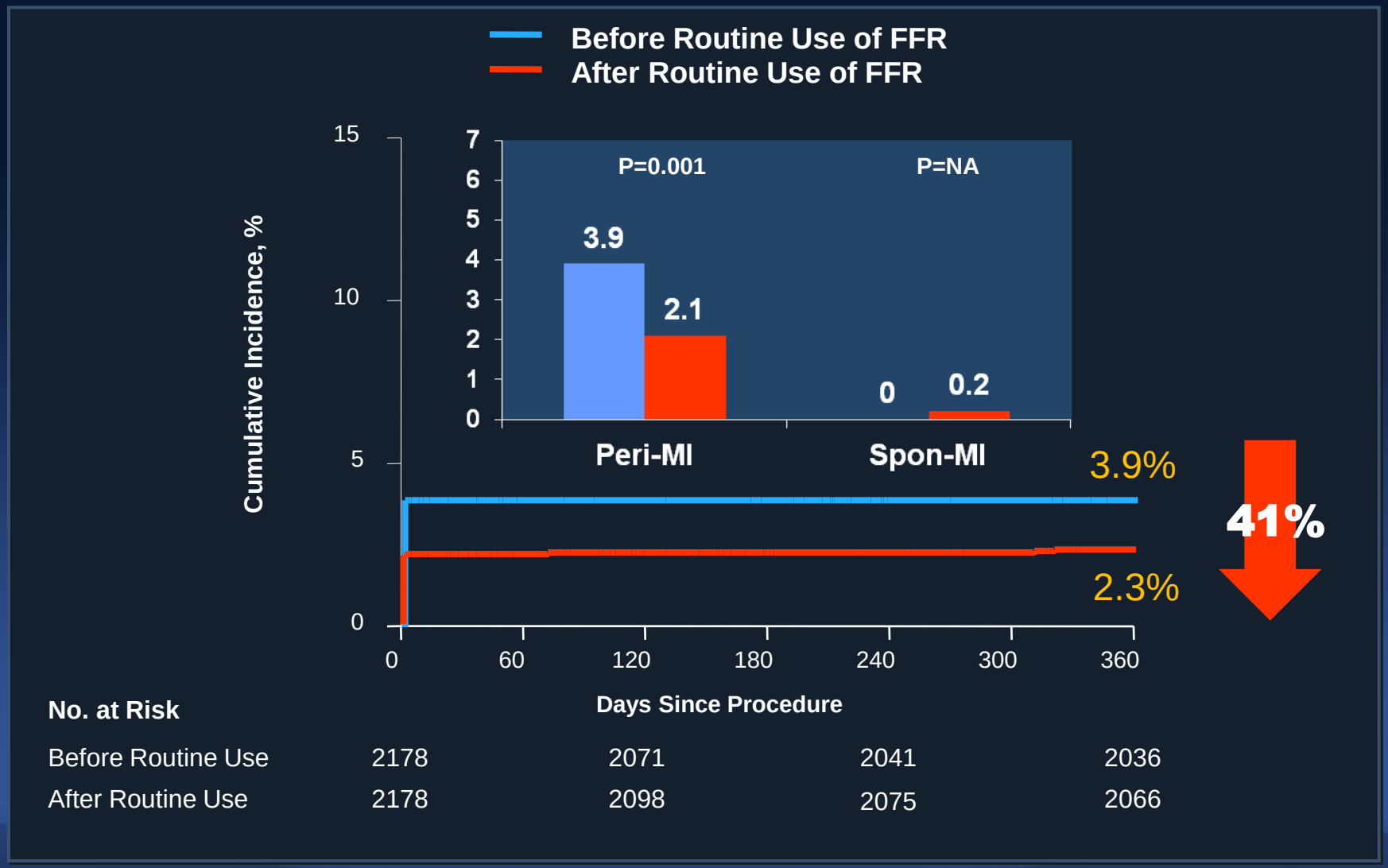
No. at Risk

Before Routine Use	2178	2066	2011	1960
After Routine Use	2178	2092	2067	2037

Propensity Score Matched Population

Park SJ, European Heart Journal. 2013 Nov;34(43):3353-61.

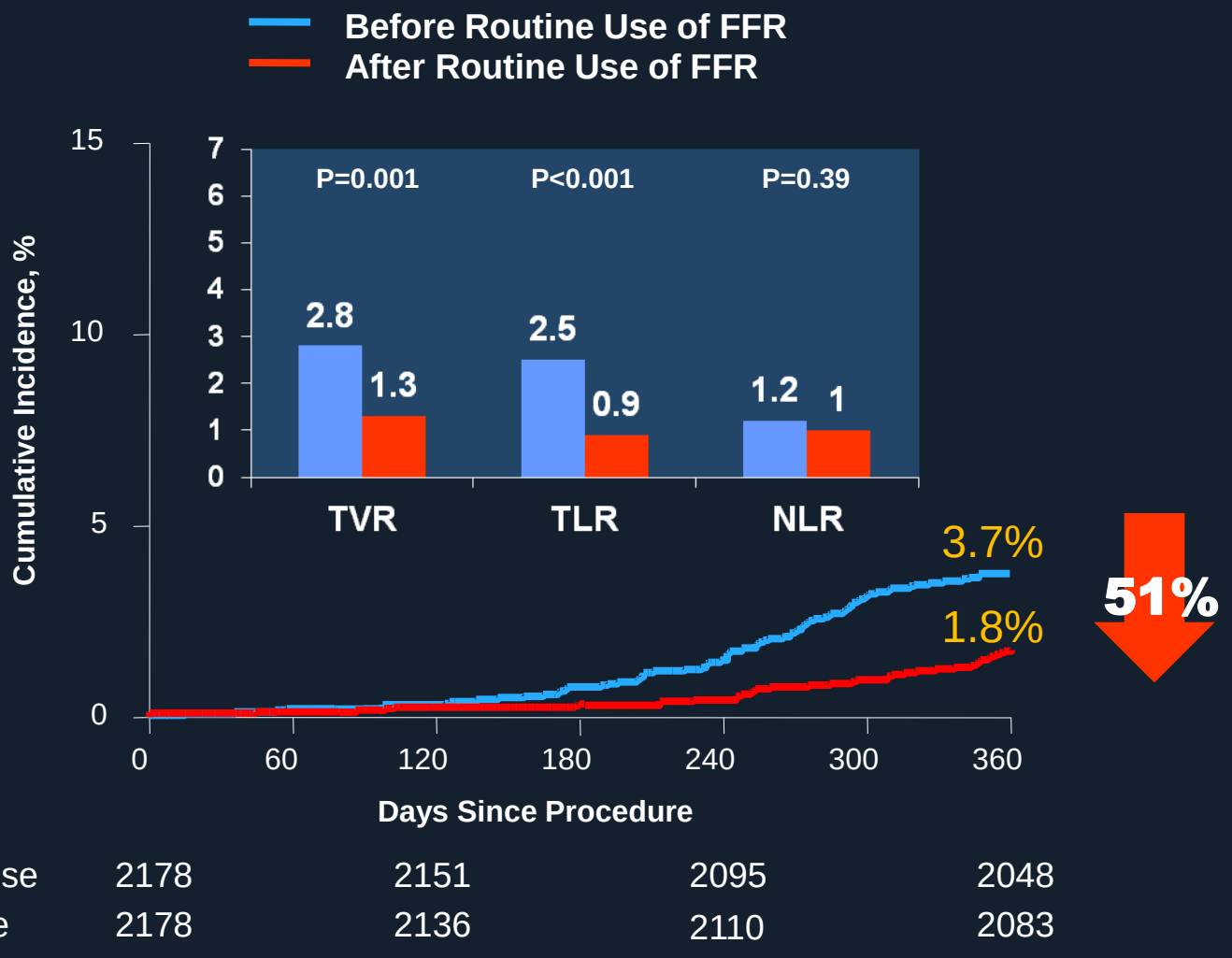
Myocardial Infarction



No. at Risk

Before Routine Use	2178	2071	2041	2036
After Routine Use	2178	2098	2075	2066

Repeat Revascularization



No. at Risk

Before Routine Use	2178	2151	2095	2048
After Routine Use	2178	2136	2110	2083

Impact of FFR
On Multi-Vessel Disease

Impact of FFR on 3 Vessel Disease

Functionally,
...nt

Different World,
Different Concept
We Need Totally Different Data !

Tonino et al, JACC 2010;55:2816-2821

Outcome Changes,
After Routine Use of IVUS (98%) and FFR (52%) For LM and 3 VD Treatment ,

AMC Data 2014

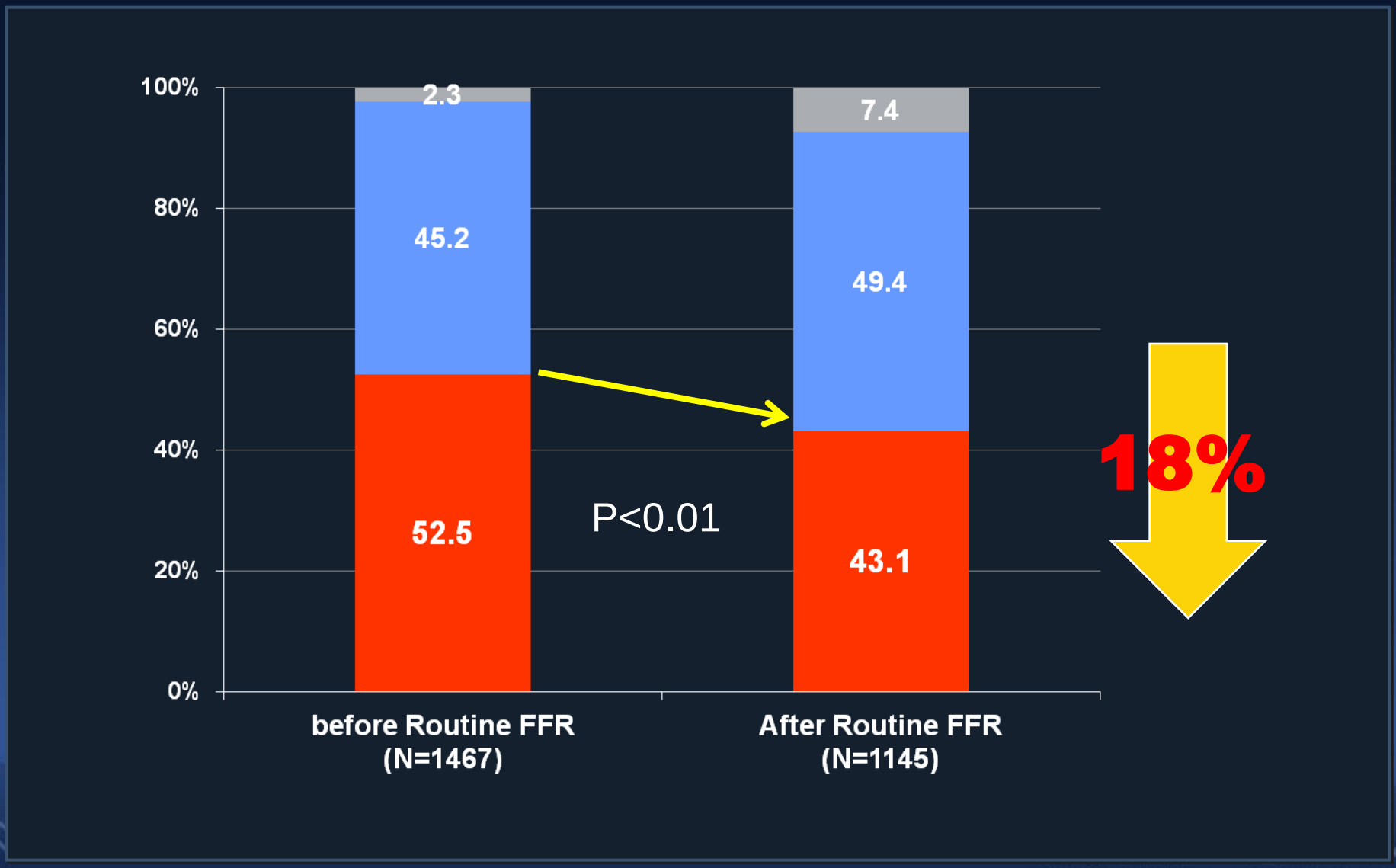
Procedural Characteristics of PCI

	Before Routine FFR (N=663)	After Routine FFR (N=566)	P value
Fractional flow reserve	13 (2.0)	237 (41.9)	<0.001
Mean	0.87±0.08	0.77±0.12	
>0.80	13 (86.7)	133 (39.8)	
0.75-0.80	0	77 (23.1)	
<0.75	2 (13.3)	124 (37.1)	
N. of Deferred lesions	13 (86.7)	145 (43.4)	
No. of stents	3.04±1.52	2.51±1.39	<0.001
Total stent length, mm	77.7±40.9	65.6±39.0	<0.001
Average stent diameter, mm	3.32±0.28	3.33±0.32	0.63

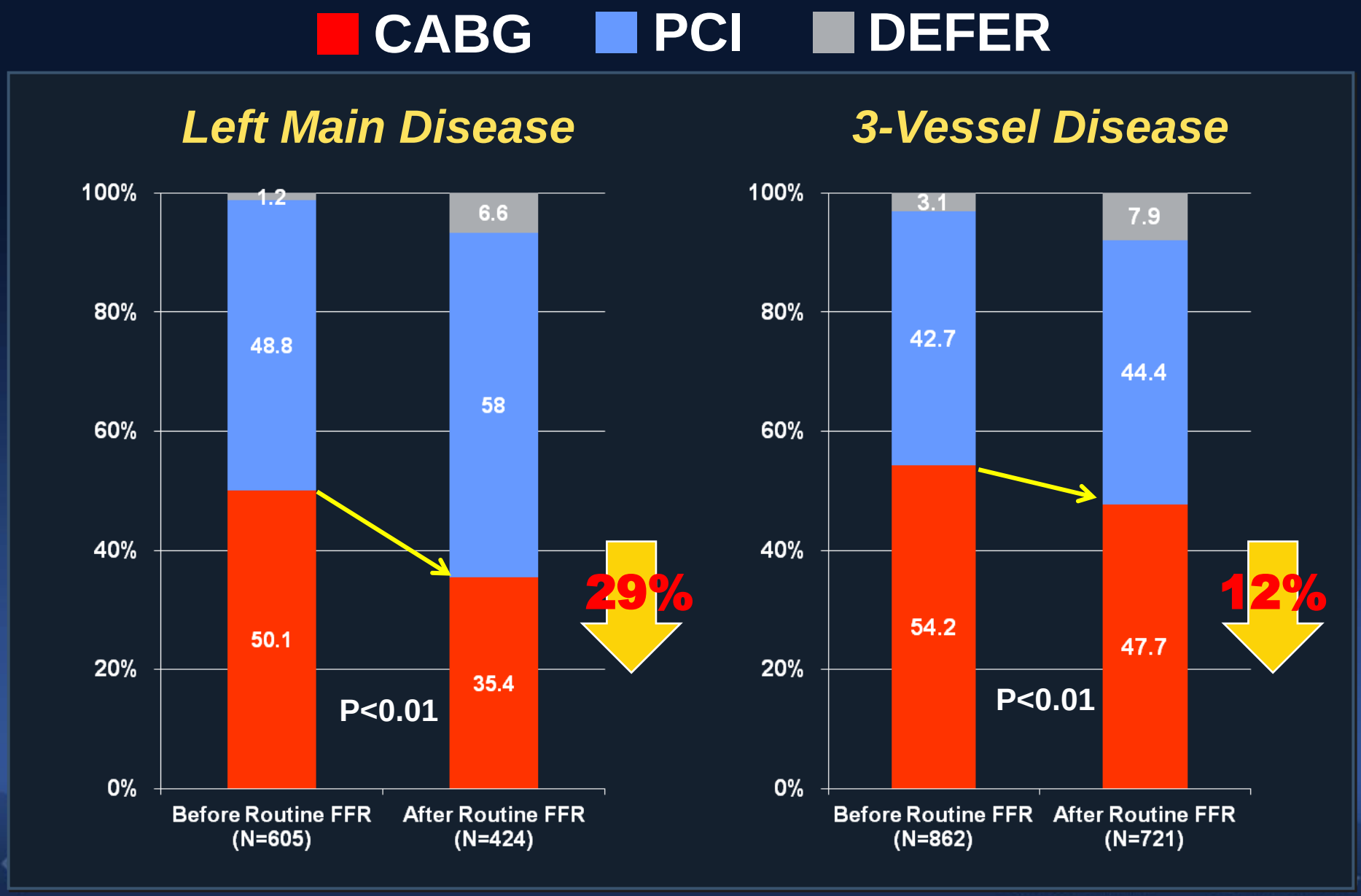
Procedural Characteristics of CABG

	Before Routine FFR (N=770)	After Routine FFR (N=494)	P value
Number of conduit	2.97±0.94	3.08±0.94	0.038
Number of vein conduit	1.17±0.90	1.30±0.85	0.009
Number of arterial conduit	1.80±0.87	1.78±0.90	0.69
Internal thoracic artery	757 (98.3)	481 (97.4)	0.25
Off-pump	499 (64.8)	433 (87.7)	<0.001

Treatment Strategy

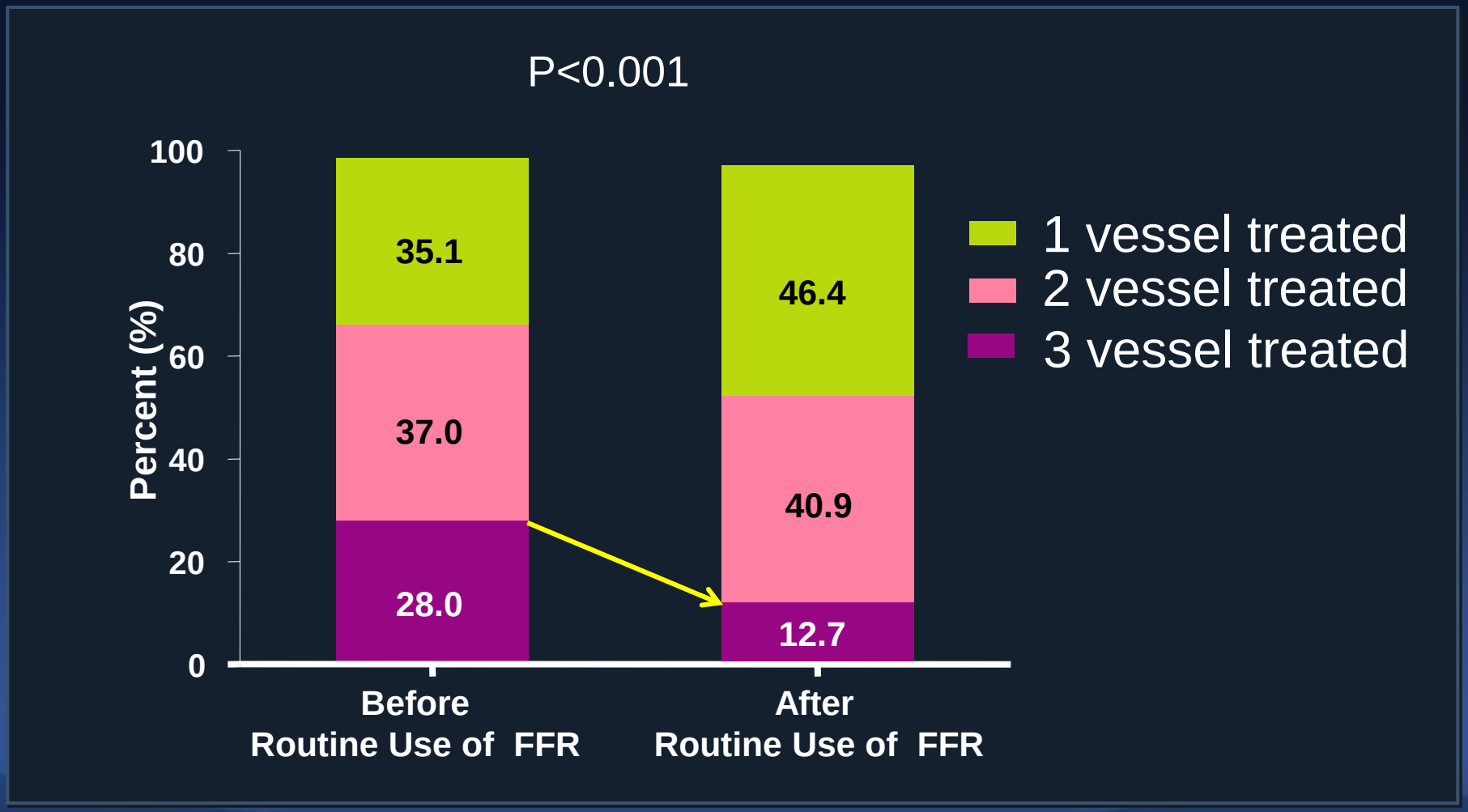


Treatment Strategy



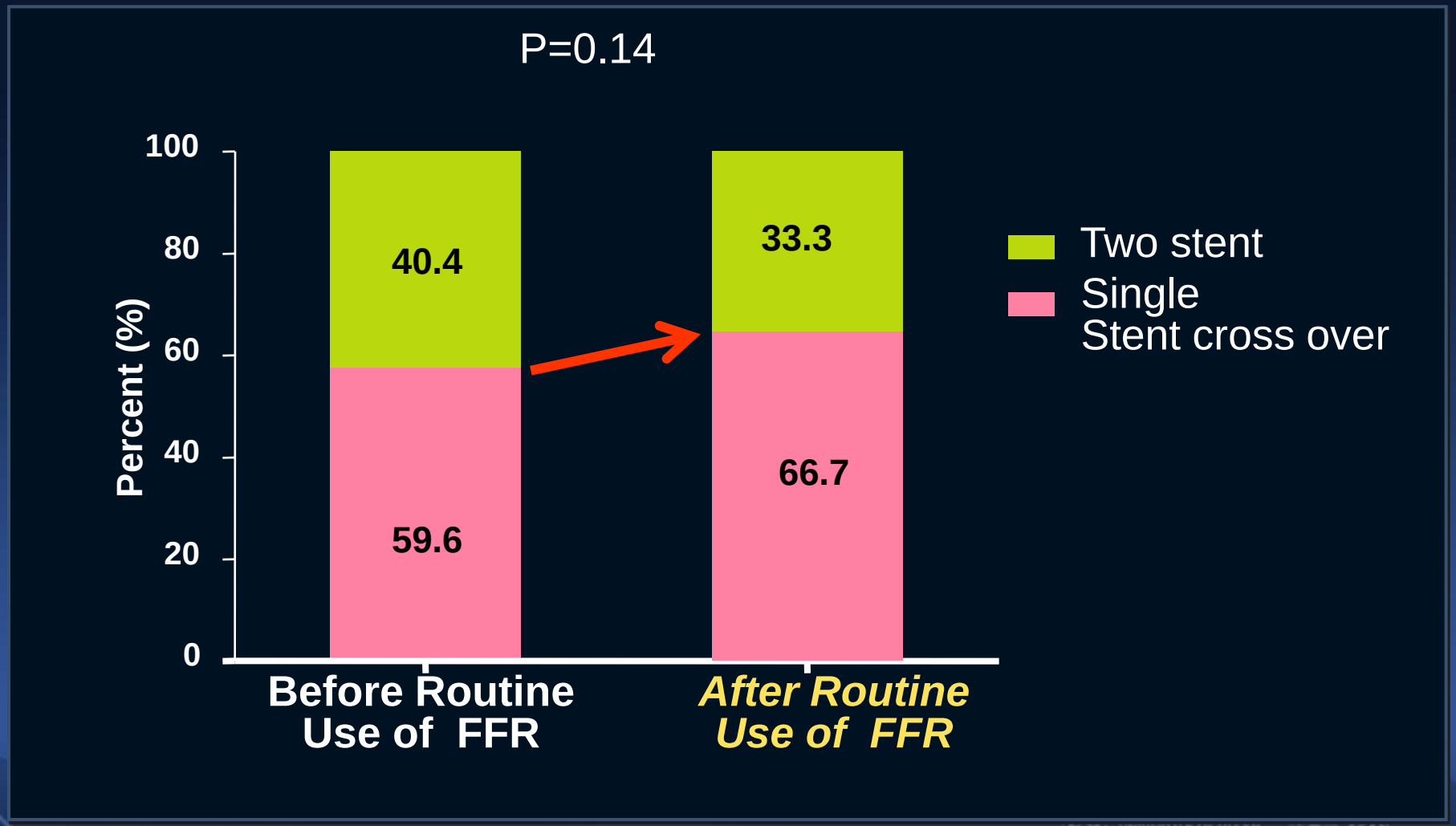
3 Vessel Disease Treatment

Multi-Vessel Stenting Decreased !



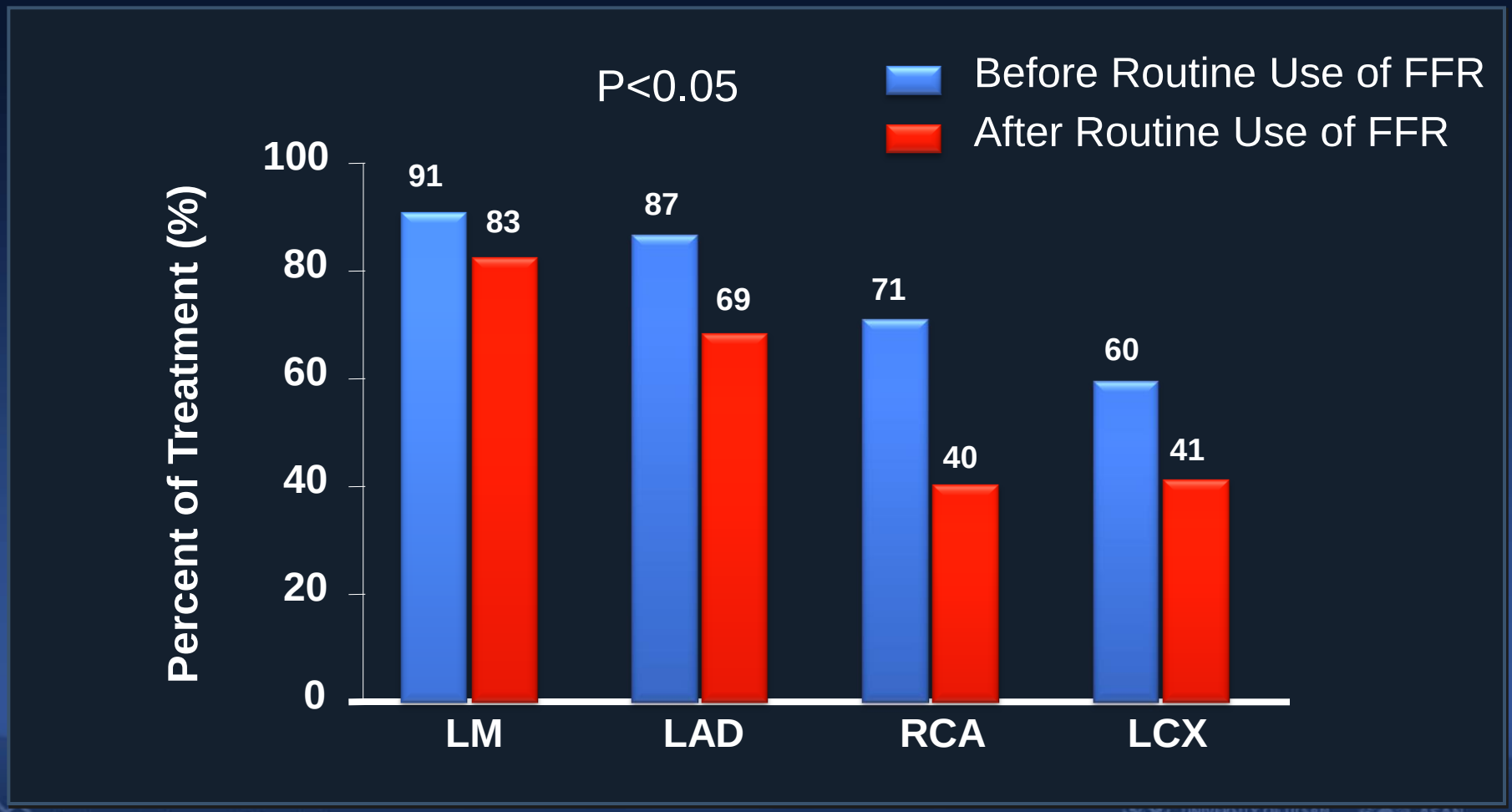
Distal LM Stent Technique

Simple Procedure Increased !

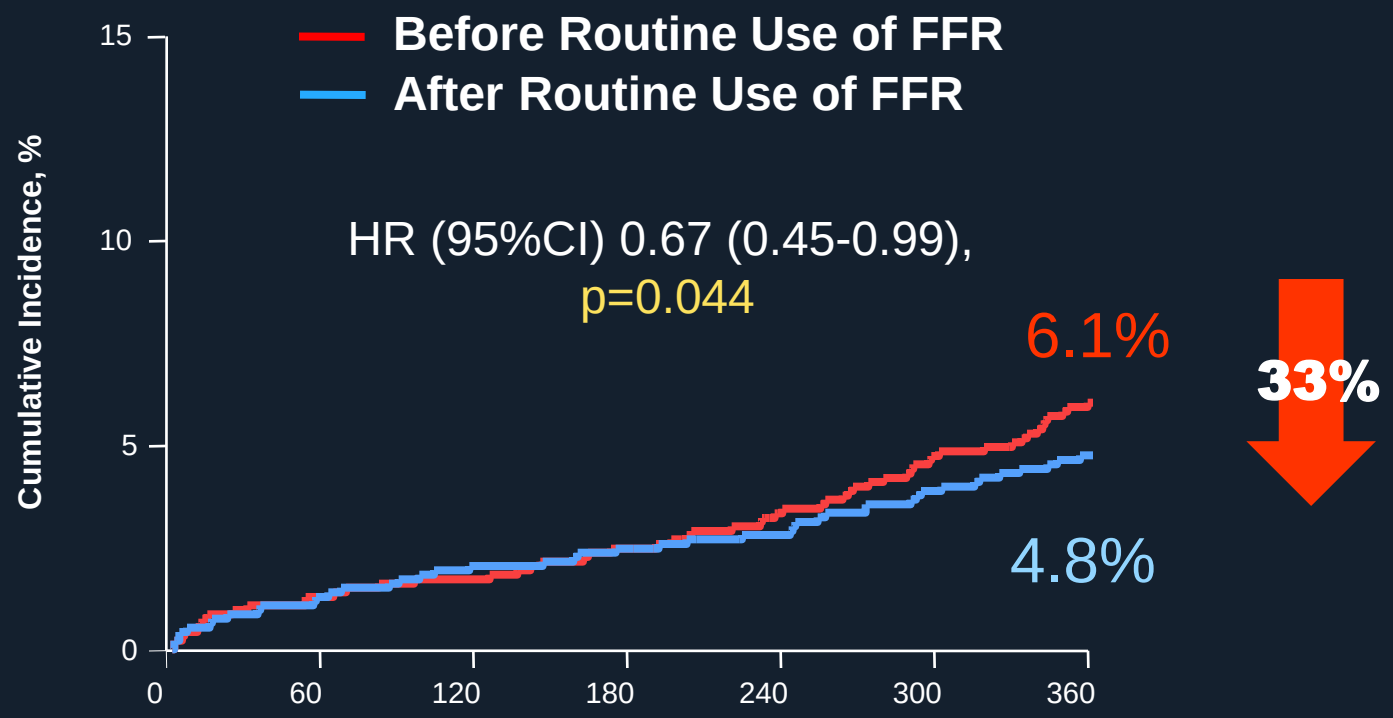


Treated Vessel Territory,

Don't Touch on RCA and LCX, Reasonable Incomplete Revascularization !



Primary End Point
Death, MI, Stroke or Repeat Revascularization

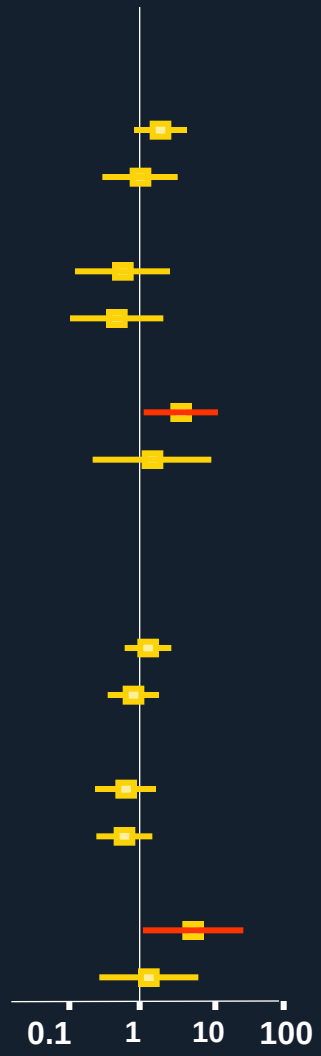


No. at Risk

Before Routine Use	917	901	883	857
After Routine Use	917	898	886	869

PCI vs. CABG

	1 Year Event Rate (%) CABG	PCI	Adjusted Hazard Ratio (95% CI)	P value
Left Main Disease	N=231	N=231		
MACCE				
Before Routine FFR	15 (5.0)	25 (8.5)	1.89 (0.84-4.25)	0.12
After Routine FFR	7 (4.6)	15 (6.2)	1.02 (0.32-3.21)	0.97
Death, MI, or stroke				
Before Routine FFR	10 (3.3)	4 (1.4)	0.60 (0.14-2.54)	0.49
After Routine FFR	6 (4.0)	6 (2.5)	0.50 (0.12-2.06)	0.34
Any Repeat Revascularization				
Before Routine FFR	5 (1.7)	21 (7.2)	3.53 (1.14-11.0)	0.029
After Routine FFR	2 (1.3)	10 (4.2)	1.48 (0.24-8.98)	0.67
3 Vessel Disease	N=529	N=529		
MACCE				
Before Routine FFR	21 (4.5)	24 (6.5)	1.30 (0.63-2.65)	0.48
After Routine FFR	18 (5.3)	15 (4.7)	0.83 (0.38-1.81)	0.65
Death, MI, or stroke				
Before Routine FFR	18 (3.9)	9 (2.5)	0.67 (0.27-1.65)	0.38
After Routine FFR	17 (5.0)	9 (2.8)	0.63 (0.27-1.48)	0.29
Any Repeat Revascularization				
Before Routine FFR	3 (0.7)	15 (4.2)	5.12 (1.11-23.7)	0.036
After Routine FFR	3 (0.9)	8 (2.5)	1.33 (0.30-5.97)	0.71



PCI Better **CABG Better**

Independent Predictors for Death, MI, Stroke or Repeat Revascularization

	Hazard Ratio (95% CI)	P value
Chronic renal failure	2.41 (1.61-3.59)	<0.001
Multivessel disease	1.89 (1.45-2.46)	<0.001
Peripheral vascular disease	1.84 (1.07-3.17)	0.027
Bifurcation lesion	1.37 (1.09-1.71)	0.006
Acute coronary syndrome	1.37 (1.10-1.69)	0.004
Total stent length per patient	1.01 (1.00-1.01)	<0.001
Fractional flow reserve	0.72 (0.53-0.98)	0.036
Intravascular ultrasound	0.57 (0.40-0.81)	0.002

Impact Of FFR
For LM and 3VD Treatment

1. *Overall Clinical Outcomes Were Improved* Mainly Due to Reduced Rate of Any Repeat Revascularization of PCI.
2. *FFR guided PCI Showed Similar Clinical Outcomes With Concurrent CABG* at 1 Year and It Had Reduced Role of CABG As The Primary Treatment Strategy.

Impact Of FFR in Real Practice

- Less DES,
- More Less Surgery,
- More Optimal Medical Treatment,
- Minimize MACE and Maximize Clinical Outcomes,
- Save Money and Save Lives.