CARDIOVASCULAR DISEASE IT'S NOT JUST A PLUMBING PROBLEM!

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FAME

- Fractional Flow Reserve vs Angiography for Multivessel Evaluation

FFR – Pressure Wire

- Measures coronary artery flow before and after the stenosis
- Performed at time of angiography
- Uses a coronary pressure wire
- Identifies ischemic-producing coronary artery stenoses

Why?

Why is it important to know if the stenosis produces ischemia in the distal myocardium?

FACTS: WHAT DO WE KNOW

- Eliminating ischemia improves patient outcomes in the setting of:
  - Acute Myocardial Infarction
  - Acute Coronary Syndromes
  - Non-ST segment elevation myocardial infarctions

FACTS: WHAT DON'T WE KNOW

Are all moderate to
highgrade stenoses
seen on coronary angiogram
associated with ischemia?

FACTS: WHAT DON'T WE KNOW?

When is there a question of whether ischemia is present?

- No prior nuclear imaging stress test
- False positive nuclear imaging stress test
- Elective cardiac catheterization for pre-op clearance
- Atypically positive troponins

What Do the New 2009 ACC/AHA/SCAI/STS/AATS/ASNC Guidelines Recommend?

- "Recently published guidelines have underscored the importance of demonstration of ischemia when deciding between medical therapy and percutaneous revascularization"
- Patel MR et al. Circulation 2009; 119: 1330-1352
  - Appropriateness Criteria for Coronary Revascularization

Coronary Angiography Remains the Gold Standard for:

- Diagnosing critical coronary artery disease
- Guiding decisions about percutaneous coronary interventions

What are the Limitations of Coronary Angiography?

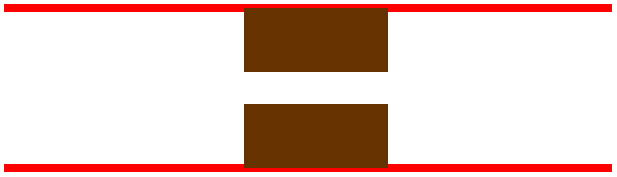
- It is 2-dimensional – this can result in both underestimation and overestimation of coronary stenosis

- Angiography does not take into account
  - The amount of myocardium at risk distally
  - The presence of collateral circulation
- In multivessel disease it may be difficult to accurately identify which stenosis is responsible for the ischemia and should be treated
- Provides morphological information only - No physiological information from the myocardial cells distally is provided

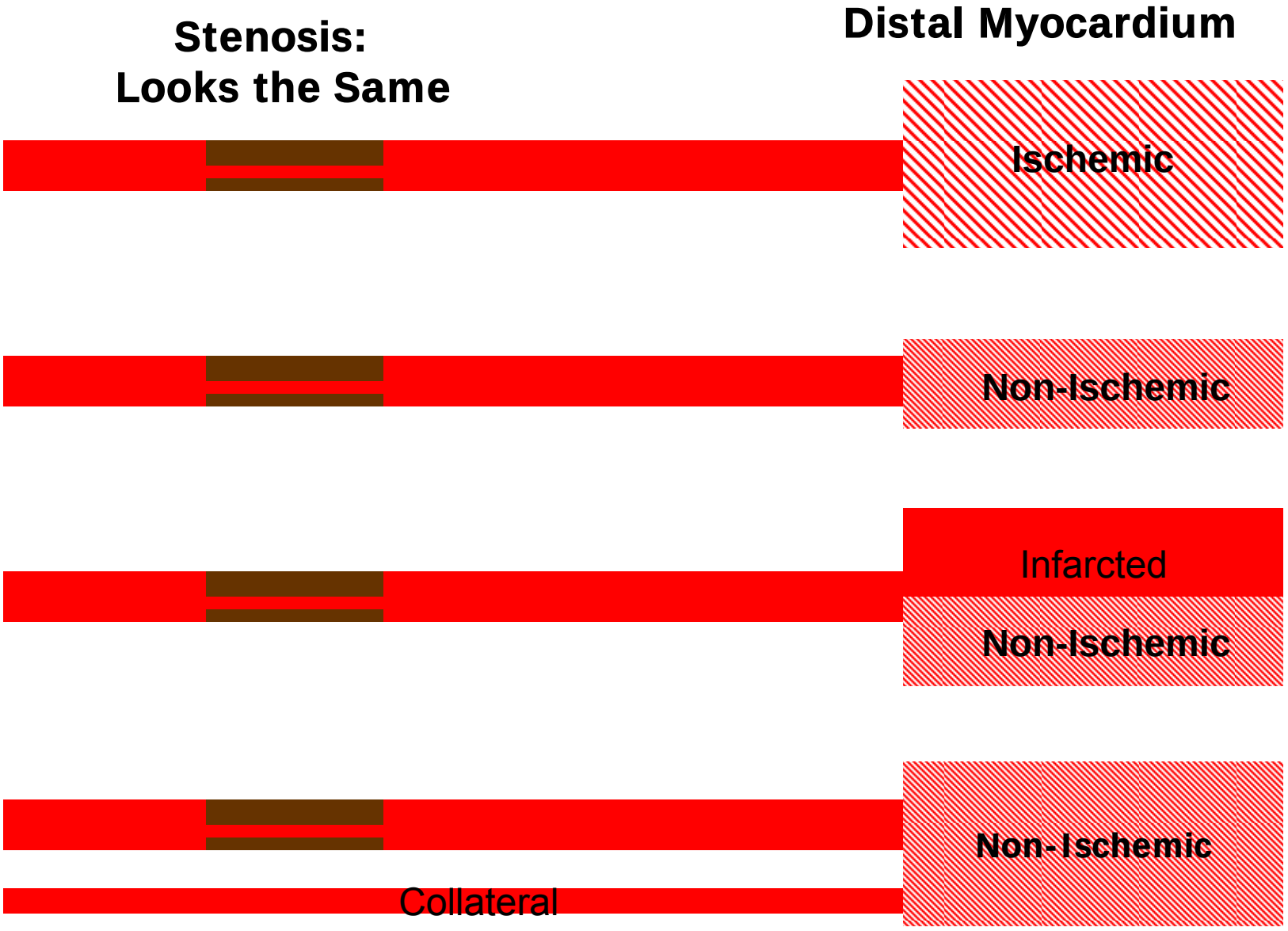
How can some stenoses look highgrade and not be associated with ischemia?

All Stenoses Are Not Equal

- Same diameter stenosis



- Different distal myocardium by
  - Size
  - Prior myocardial infarction
  - Collateral blood flow


Stenosis:
Looks the Same
Distal Myocardium
Ischemic
Non-Ischemic
Infarcted
Non-Ischemic
Non-Ischemic
Collateral

FAME: FFR vs Angiography

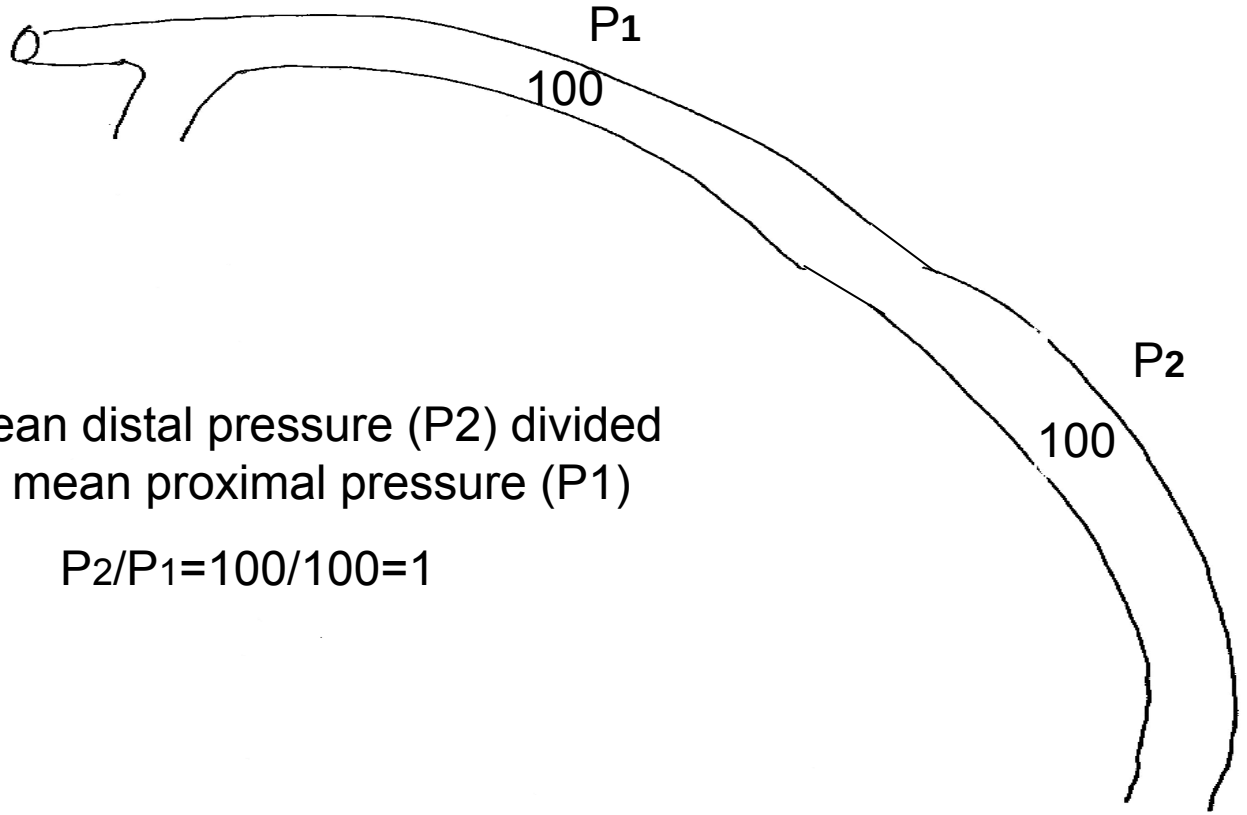
- Study: Prospective randomized comparison of FFR-guided strategy to an angiographic-guided strategy in patients with multivessel coronary artery disease undergoing PCI

FAME: FFR vs Angiography

Questions:

- Is angiographic assessment only adequate in assessing requirements for PCI?
- Does FFR – measurement have a role in assessing requirements for PCI?
- Could invasive physiologic guidance (FFR) improve decision making for stent implantation and affect outcomes?

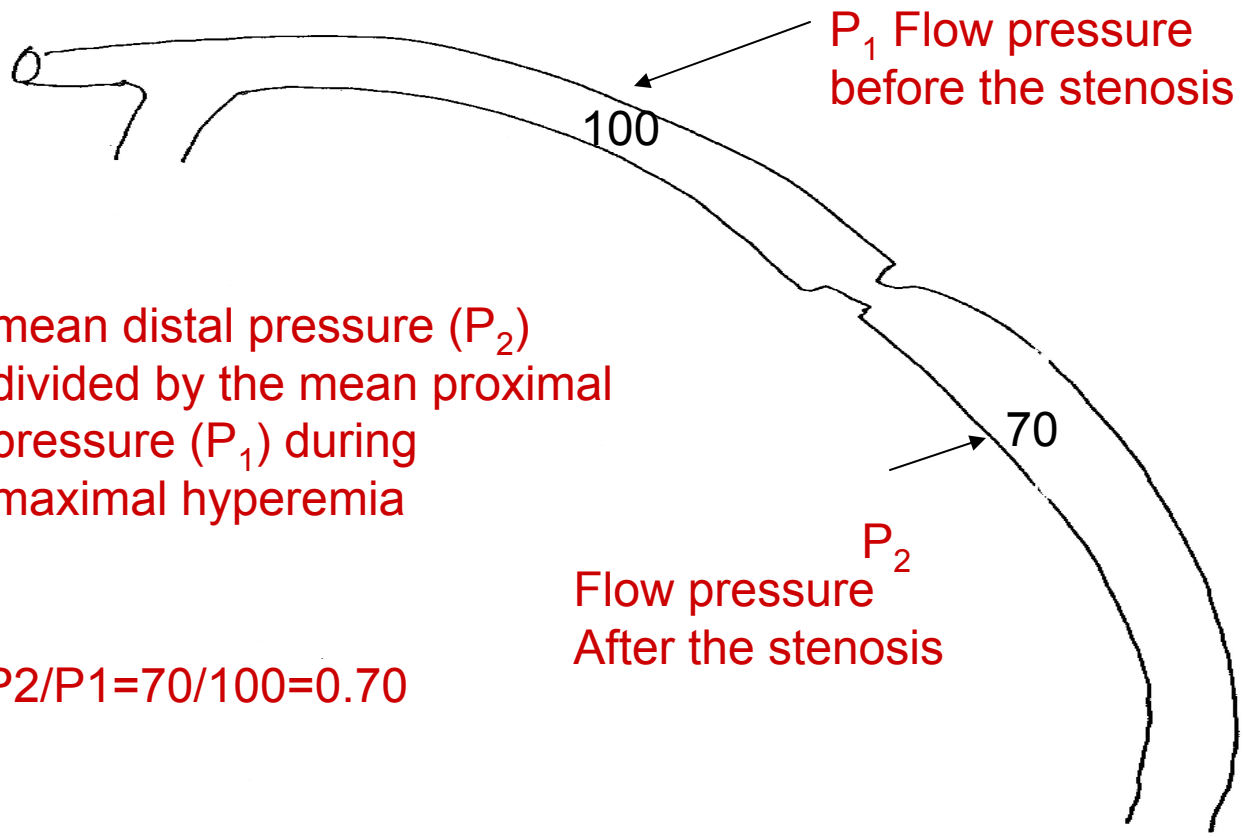
FFR: No Stenosis



FFR = mean distal pressure (P2) divided by mean proximal pressure (P1)

$P_2/P_1=100/100=1$

Fractional Flow Reserve



FFR: mean distal pressure (P_2)
divided by the mean proximal
pressure (P_1) during
maximal hyperemia

P2/P1=70/100=0.70

Fractional Flow Reserve = FFR

Normal FFR = 0.94 – 1.0

P_2/P_1

Abnormal FFR = < 0.75 - 0.80

P_2/P_1

Interpretation of Results

Normal FFR: $P_2/P_1 = 0.94 – 1.0$

- Normal blood flow to distal myocardium
- Stenosis does not compromise flow to the distal myocardium
- Significant ischemia has been Ruled Out
- Correlates with no evidence of ischemia on non-invasive imaging studies

Interpretation of Results

Abnormal FFR: $P_2/P_1 = < 0.75 - 0.8$

- Abnormal – inadequate blood flow to distal myocardium
- Stenosis does compromise flow to the distal myocardium
- Significant ischemic has been Ruled In
- Correlates with Ischemia on non-invasive imaging studies

Trial Design

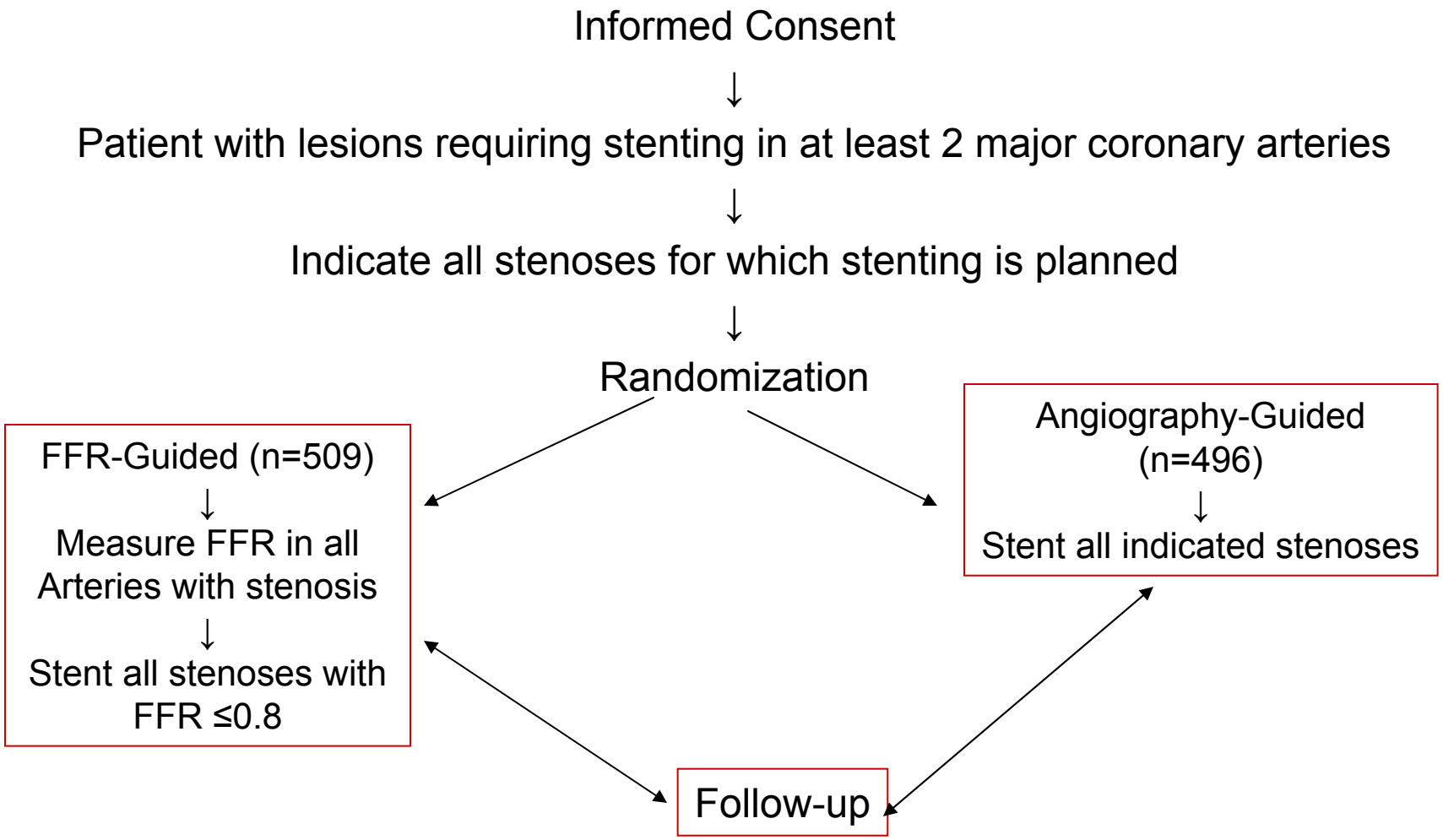
- To compare the efficacy of 2 strategies
  - Angiographic guidance
  - Physiologic guidance/FFR

  for deciding which coronary lesion to stent in patients with mutivessel CAD

Trial Design

- Coronary Angiogram
  - Stenoses identified in ≥ 2 major coronary arteries
  - Investigator/Cath Physician recommends DES stents
- Randomization
  - Angiographic guidance arm → Stenting/PCI
  - FFR Guidance arm → FFR measure in each vessel
    - Only undergo stent if FFR < 0.8
    - Central line of IV Adenosine 140 mcg/kg/min for maximum hyperemia

FAME STUDY SCHEMA



Jan 2006 – Sept 2007

Trial Design

- Primary End Point (at one year)
  - Death
  - Myocardial Infarction
  - Repeat coronary revascularization

- Secondary Ends Points
  - Individual Adverse Events
  - Cost Effectiveness
  - Quality of Life
  - Mace
  - Functional Class
  - # Anti-Anginal Medications
  - Procedural Time
  - Contrast Used

Results

FFR Measurements	Angio group (N=496)	FFR group (N=509)	P-value
FFR			
<0.80	n/a	63%	
>0.80	n/a	37%	

Primary End Points at 1 year

End points Events at 1 year	Angio-group N=509	FFR group N=509	P-value
Composite death, MI, repeat vascularization	N=91 18.3%	N=67 13.2%	0.02
Death	N=15 3%	N=9 1.3%	0.19
Myocardial Infarction	N=43 8.7%	N=29 5.7%	0.07
Repeat vascularization	N=47 9.5%	N=33 6.5%	0.08
Death or MI	N=55 11.1%	N=37 7.3%	0.04

Functional Status at 1 year

Functional Status at 1 year	Angio-group N=509	FFR group N=509	P-value
No Events/Angina Free #/total #	326/482 67.6%	360/493 73%	0.07
Angina Free #/total #	374/480 77.9%	399/491 81.3%	0.20
Anti-Anginal Meds # meds taking BB, CCB, Nitrates	1.23 +/- 0.74	1.20 +/- 0.76	0.48
Quality of llfe Scale 0 – 100 0=low 100=high (quality)	73.7	74.5	0.65

Results

	Angio group (N=496)	FFR group (N=509)	P-value
Procedure Time (min)	70	71	
Volume of contrast (MI)	302	272	<0.001
DES #/pt	2.7	1.9	<0.001
Cost	$6007	$5332	<0.001
Hospital stay (days)	3.7	3.4	0.05

FFR Strategy

- Reduced the number of stents used
- Decreased amount of contrast used
- Did not prolong the procedure
- Reduced cost
- Resulted in a similar if not improved functional status

Summary

In patients with ACS or SAP and multi-vessel disease

- Routine measurement of FFR prior to PCI

Compared with

- Standard strategy of PCI guided by angiography

★ At one year, significantly reduced the rate of primary end points of:

- Death
- Myocardial Infarction
- Repeat Vascularization

My Summary

- It has been known for decades that the most important prognostic factor among patients with CAD is the presence and extent of inducible ischemia.[1]

- 2009 Guidelines underscore the importance of demonstrating ischemia when deciding on therapy modality with percutaneous revasculaization.[2]

1. Beller, G.A. etal Circ 2000
2. Patel, M.R. etal Circ 2009

Take Home Message

- Revascularize the ischemic lesions
  (PTCA/Stent)
- Medical therapy for the non-ischemic lesions
- Optimal medical therapy for all patients with CAD