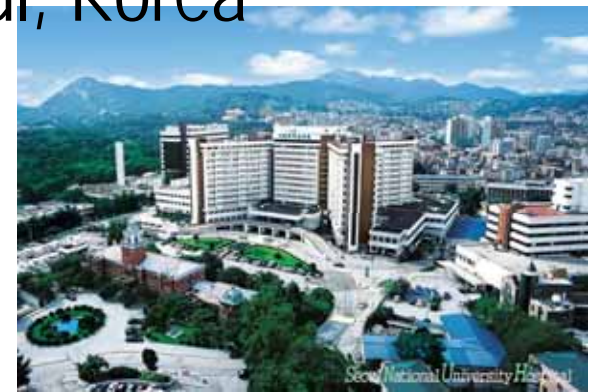


FFR at CathLab Today

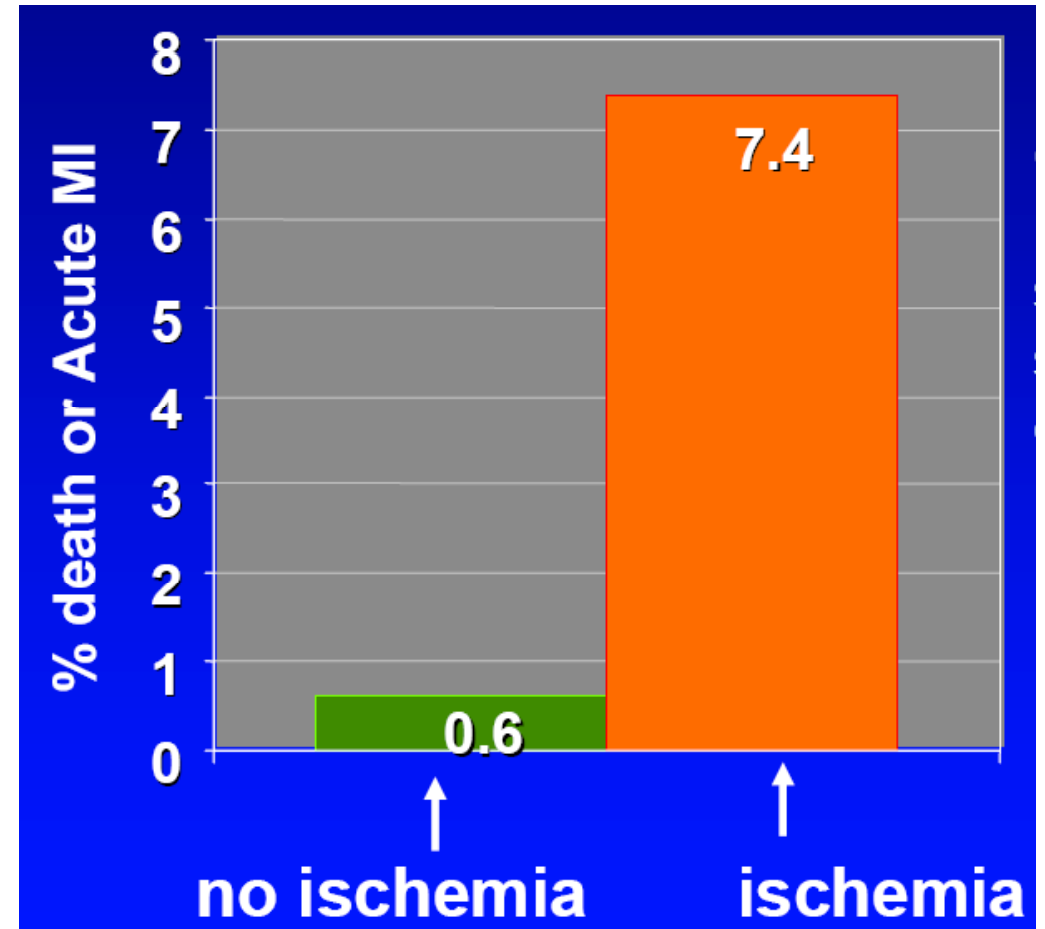
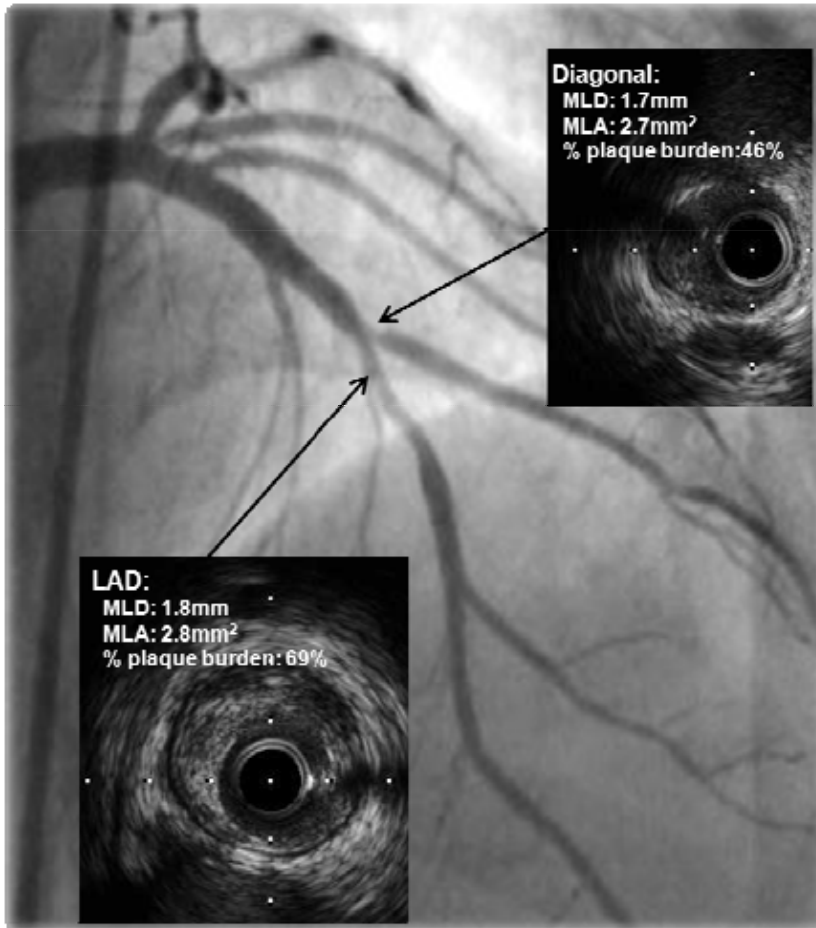
: Moving Closer, But Gaps Remain

Bon-Kwon Koo, MD, PhD

Seoul National University Hospital, Seoul, Korea



The most important prognostic factor is “Presence of Ischemia”!

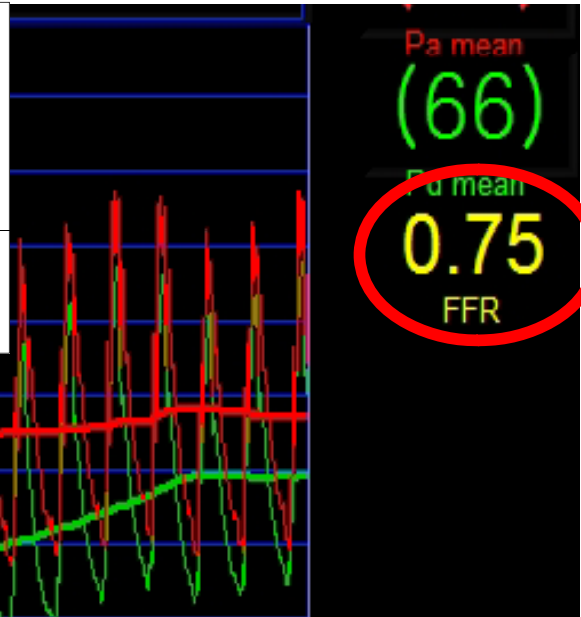
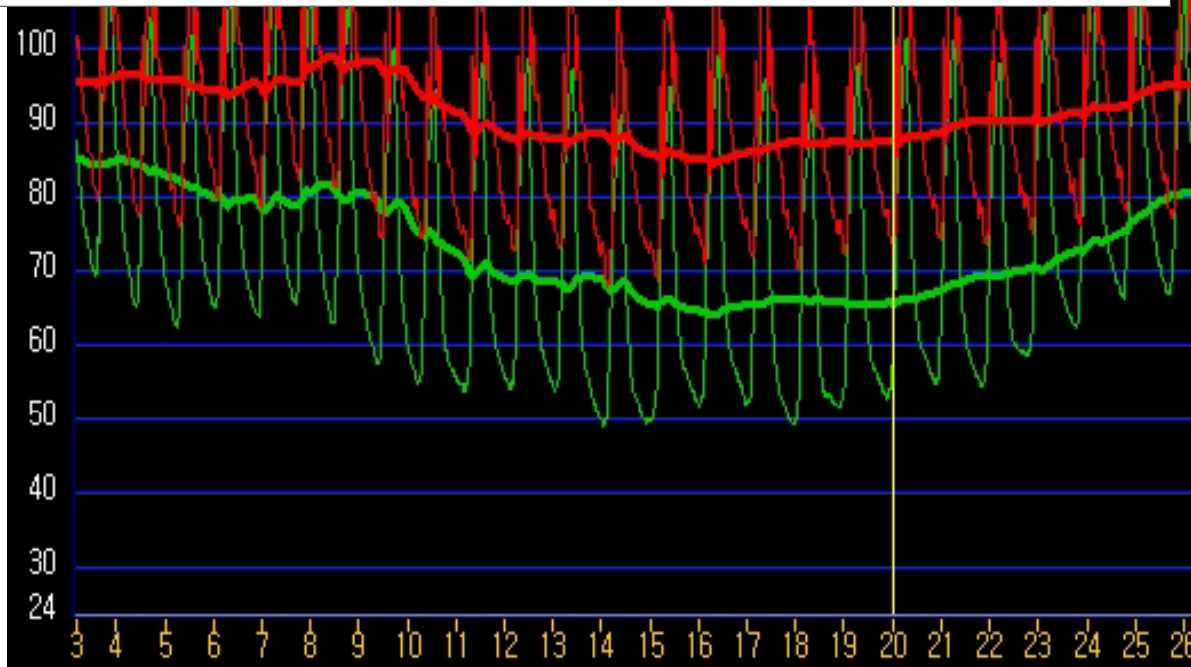


Iskander, et al. JACC 1998

Fractional Flow Reserve (FFR)

$$\text{FFR} = \frac{\text{Maximum flow in presence of stenosis}}{\text{Normal maximum flow}} = \frac{Q_{max}^S}{Q_{max}^N} = \frac{(P_d - P_v)/R}{(P_a - P_v)/R} = \frac{\text{Distal Pr (P}_d\text{)}}{\text{Proximal Pr (P}_a\text{)}}$$

Easily obtained, Stenosis specific
 Independent from the hemodynamic parameters
 Applicable in multi-vessel disease, multiple lesions
 Takes into account collateral flow



Evidences.....

The NEW ENGLAND
JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 15, 2009 VOL. 366 NO. 3

Fractional Flow Reserve versus Angiography
for Guiding Percutaneous Coronary Intervention
doi:10.1016/j.jacc.2005

Interventional Cardiol

Journal of the American College of Cardiology
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Long-Term Clinical Outcome After Fractional Flow Reserve-Guided Percutaneous Coronary Intervention in Patients With Multivessel Disease

Alexandre Berger, MD,* Kees-Joost Botman, MD,* Philip A. MacCarthy, MD, PhD, MRCP,*
William Wijns, MD, PhD,* Jozef Bartunek, MD, PhD,* Guy R. Heyndrickx, MD, PhD,*
Nico H. J. Pijls, MD, PhD,† Bernard De Bruyne, MD, PhD*

Aalst, Belgium; and Eindhoven, the Netherlands

Clinical Significance of Fractional Flow Reserve for Evaluation of Functional Lesion Severity in Stent Restenosis and Native Coronary Arteries*

Stefan Krüger, MD; Karl-Christian Koch, MD; Ira Kaumanns, MD;
Marc W. Merx, MD; Peter Hanrath, MD; and Rainer Hoffmann, MD

Interventional Cardiology

Clinical outcome in patients with intermediate equivocal left main coronary artery disease a deferral of surgical revascularization on the basis of fractional flow reserve measurements

Michael Lindstaedt, MD,^a Aydan Yazar, MD,^a Alfried Germing, MD,^a Markus K. Fritz, MD,^b
Tim Holland-Letz, MSc,^c Andreas Mügge, MD,^a and Waldemar Bojara, MD^a *Bochum, Germany*

The NEW ENGLAND
JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 15, 2012 VOL. 367 NO. 11

Fractional Flow Reserve-Guided PCI versus Medical Therapy
in Stable Coronary Disease



Coronary Pressure Measurement After Stenting Predicts Adverse Events at Follow-Up A Multicenter Registry



Nico H.J. Pijls, MD, PhD; Volker Klauss, MD; Uwe Siebert, MPh, MSc; Eric Powers, MD;
Kenji Takazawa, MD; William F. Fearon, MD; Javier Escaned, MD; Yukio Tsurumi, MD;
Takashi Akasaka, MD; Habib Samady, MD; Bernard De Bruyne, MD, PhD;
for the Fractional Flow Reserve (FFR) Post-Stent Registry Investigators

Reliability of Pressure-Derived Myocardial Fractional Flow Reserve in Assessing Coronary Artery Stenosis in Patients With Previous Myocardial Infarction

Yasuhiro Usui, MD, Taishiro Chikamori, MD, Hidefumi Yanagisawa, MD,
Takayuki Morishima, MD, Satoshi Hida, MD, Nobuhiro Tanaka, MD,
Kenji Takazawa, MD, and Akira Yamashina, MD

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Vol. 46, No. 4, 2005
ISSN 0735-1097/05/\$30.00
doi:10.1016/j.jacc.2005.04.054

Physiologic Assessment of Jailed Side Branch Lesions Using Fractional Flow Reserve

Bon-Kwon Koo, MD, PhD,* Hyun-Jai Kang, MD, PhD,* Tae-Jin Youn, MD, PhD,†
In-Ho Chae, MD, PhD,† Dong-Joo Choi, MD, PhD,† Hyo-Soo Kim, MD, PhD,*
Dae-Won Sohn, MD, PhD,* Byung-Hee Oh, MD, PhD, FACC,*
Myoung-Mook Lee, MD, PhD, FACC,* Young-Bae Park, MD, PhD,*
Yun-Shik Choi, MD, PhD* *Seung-Tae Tahk MD PhD†*

Seoul, Seongnam, Gyeonggi-

Physiological evaluation of the provisional side-branch intervention strategy for bifurcation lesions using fractional flow reserve

Bon-Kwon Koo¹, Kyung-Woo Park¹, Hyun-Jae Kang¹, Young-Seok Cho²,
Woo-Young Chung², Tae-Jin Youn², In-Ho Chae², Dong-Ju Choi², Seung-Jae Tahk³,
Byung-Hee Oh¹, Young-Bae Park¹ and Hyo-Soo Kim^{1a}

¹Division of Cardiology, Department of Internal Medicine, Seoul National University College of Medicine, Cardiovascular Center and Cardiovascular Research Institute, Seoul National University Hospital, Yongsan-dong 28, Jongno-gu, Seoul 150-744, Republic of Korea; ²Heart Center, Bundang Seoul National University Hospital, Gyeonggi-do, Republic of Korea; and ³Ajou University School of Medicine, Gyeonggi-do, Republic of Korea

Received 26 March 2007; revised 8 January 2008; accepted 17 January 2008; online publish-ahead-of-print 28 February 2008

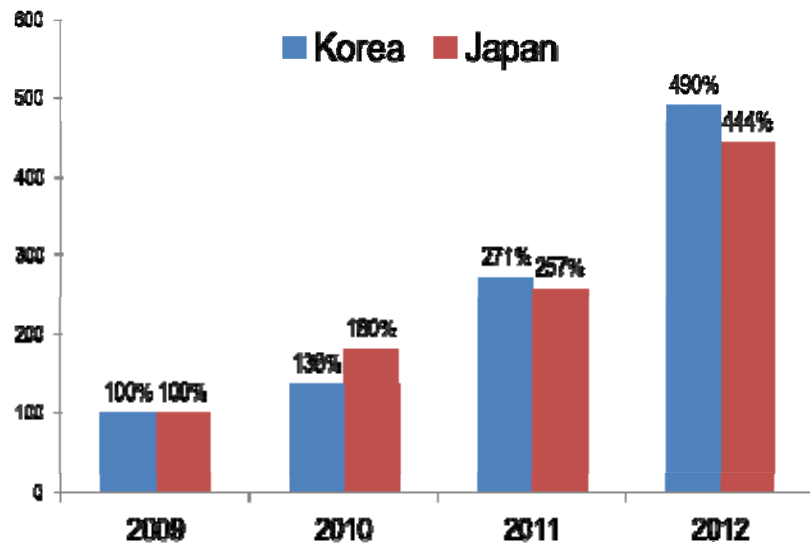
FFR has become the gold standard to detect the ischemia-related lesion and is good for the patients.....

Guidelines on myocardial revascularization

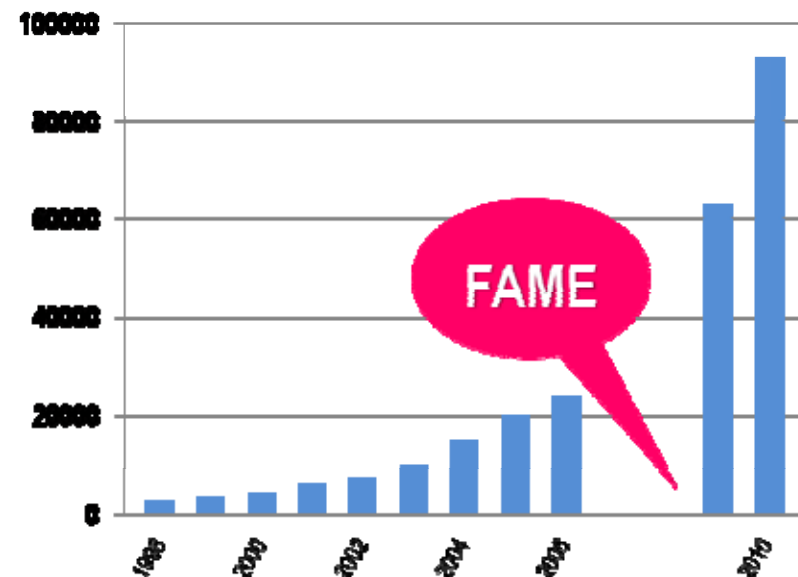
The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

	Class ^a	Level ^b
<u>FFR-guided PCI is recommended for detection of ischaemia-related lesion(s) when objective evidence of vessel-related ischaemia is not available.</u>	I	A
DES ^d are recommended for reduction of restenosis/re-occlusion, if no contraindication to extended DAPT.	I	A
Distal embolic protection is recommended during PCI of SVG disease to avoid distal embolization of debris and prevent MI	I	B

Use of FFR compared to year 2009



FFR market in EU



FFR has become the gold standard to detect the ischemia-related lesion and is good for the patients.....

Guidelines on myocardial revascularization

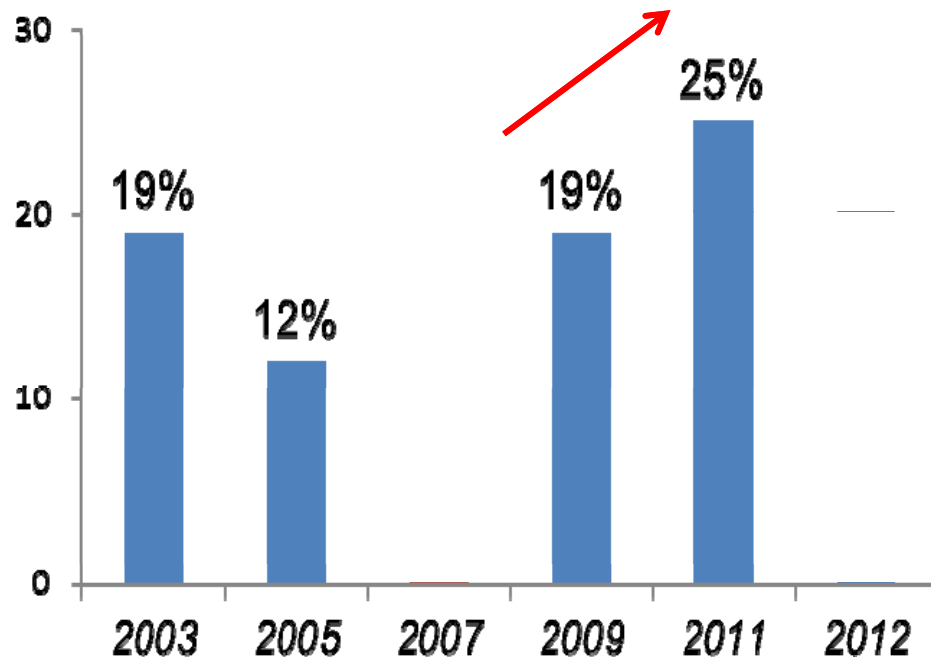
The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

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DES ^d are recommended for red		A
Distal embolic protection is rec		B

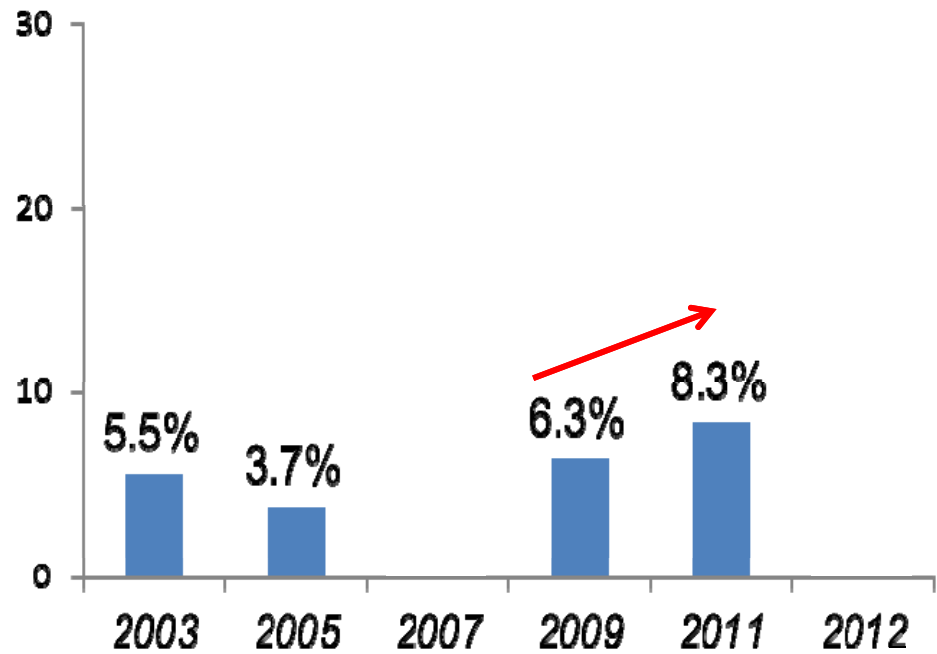


Gaps remain.....

FFR penetration (vs. all PCI)



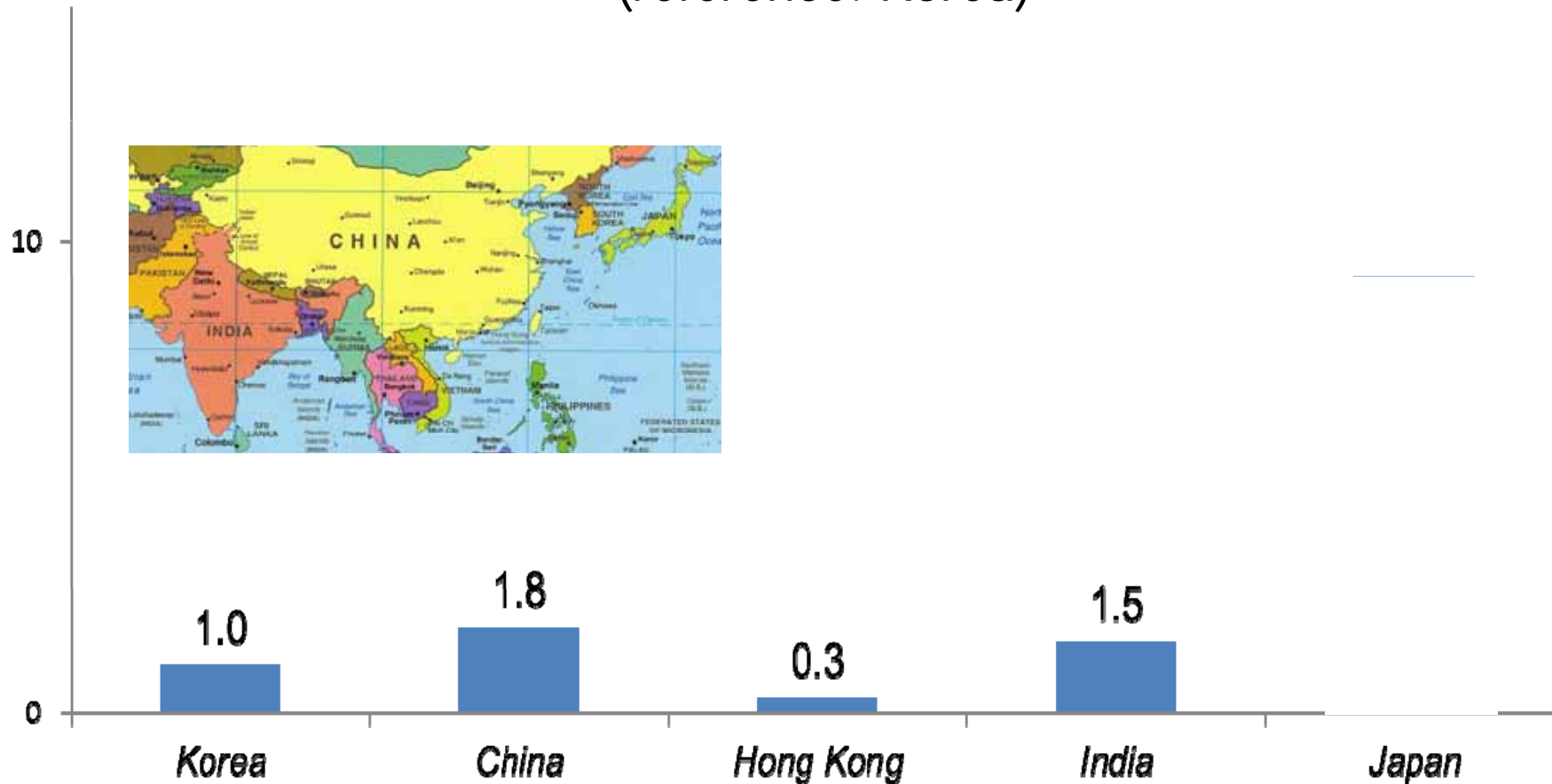
FFR penetration (vs. all CAG)



- Institutional use of FFR has been saturated.
- There's huge inter-individual variability in use of FFR.

Gaps remain.....

Number of pressure wires used in 2012
(reference: Korea)



- Reimbursement of pressure wire by medical insurance: Only in Japan

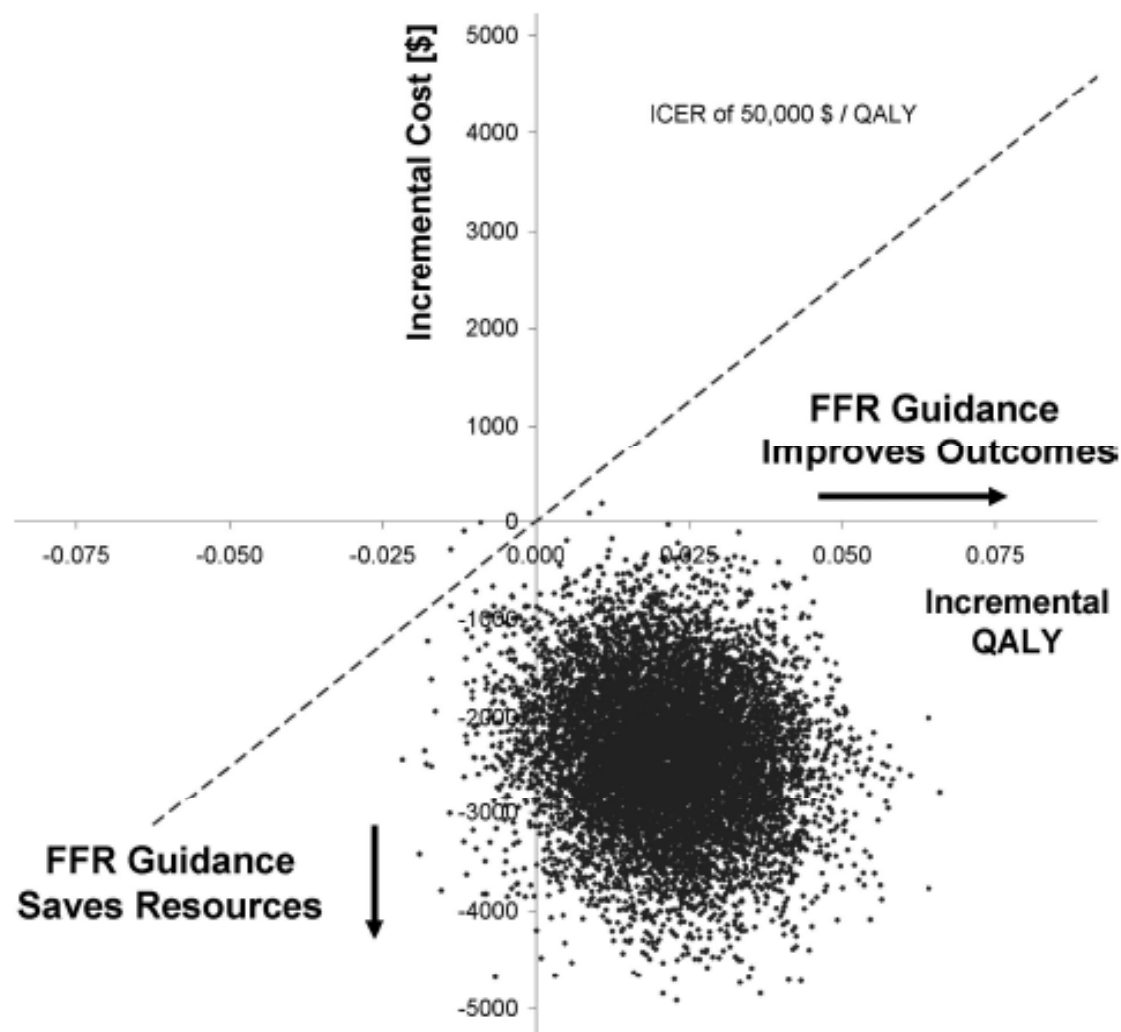
What are the barriers for routine use of FFR?

- Medical insurance reimbursement policy.
- **Some myths.....**
 - FFR requires expensive wire and may not be cost effective.
 - FFR/Hyperemia is inconvenient to doctors and patients and can be risky.
 - My clinical judgments (visual estimation) are better than simple numbers (FFR-guided).
 - IVUS &/or OCT can provide better information.
 - Only a few of my patients are proper candidates for FFR.

Barriers for routine use of FFR

- Medical insurance reimbursement policy
- **FFR requires expensive wire and may not be cost effective.**
- FFR and hyperemia is inconvenient to doctors and patients and can be risky
- My clinical judgments (visual estimation) are better than simple numbers (FFR-guided)
- IVUS &/or OCT can provide better information
- Only a few of my patients are candidates for FFR measurement

FAME study: Cost-effectiveness

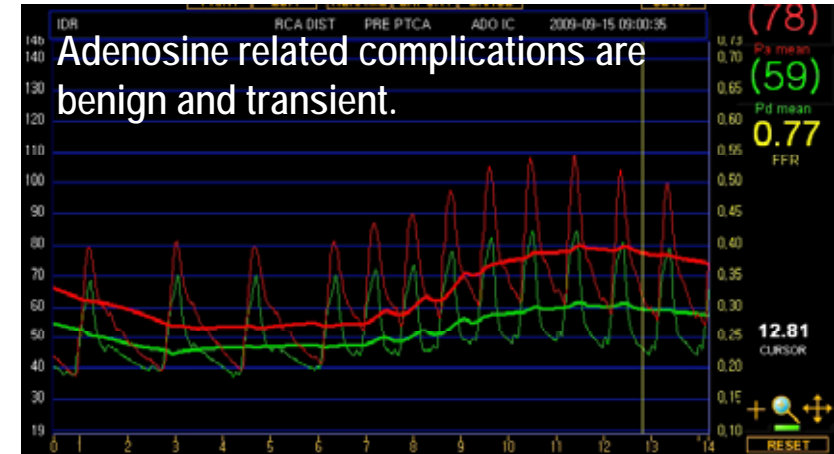


Barriers for routine use of FFR

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- Pressure wire induced complications (dissection, stenting): < 0.5%
- In jailed side branches, pressure wire induced complications → 0.1%

* IVUS associated complications in PROSPECT study: 1.6% :



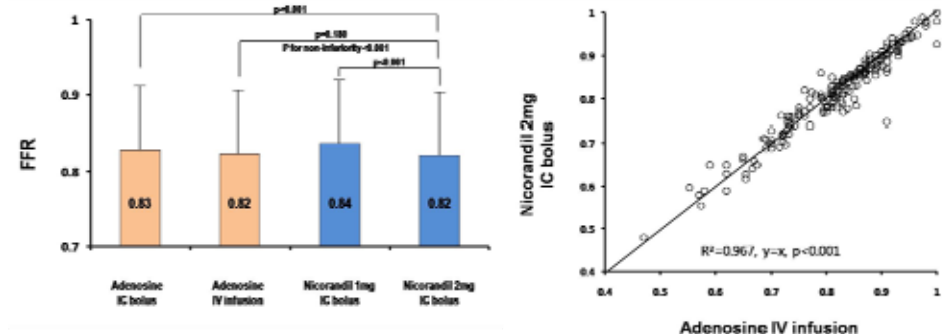
More convenient/safer hyperemia

Clinical Utility of Regadenoson for Assessing Fractional Flow Reserve

Pradeep K. Nair, MD,* Oscar C. Marroquin, MD,*† Suresh R. Mulukutla, MD,*† Sameer Khandhar, MD,* Vijay Gulati, MD,* John T. Schindler, MD,* Joon S. Lee, MD*†

Pittsburgh, Pennsylvania

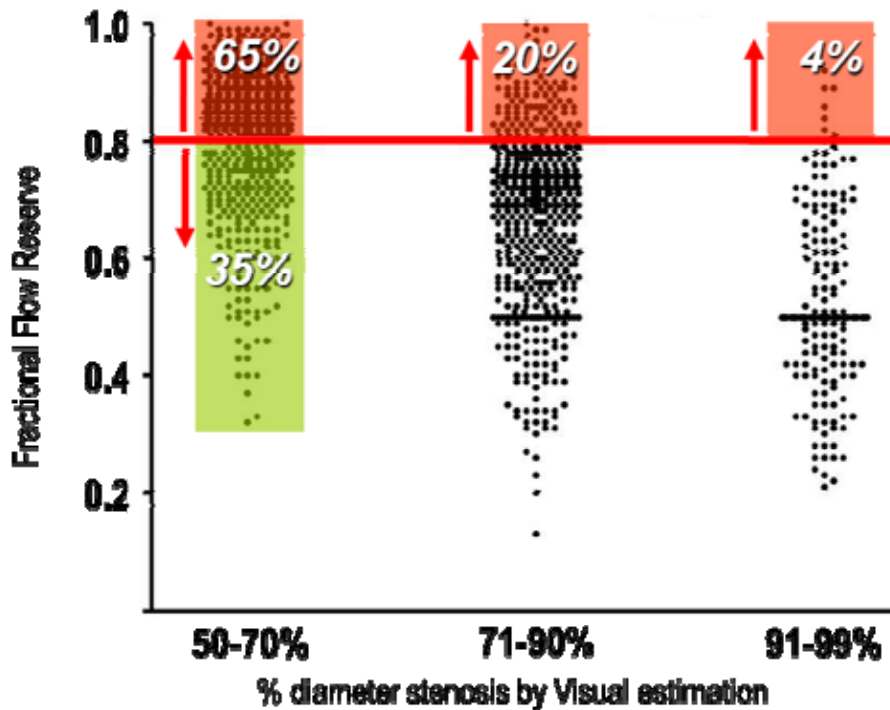
Single bolus administration of Nicorandil



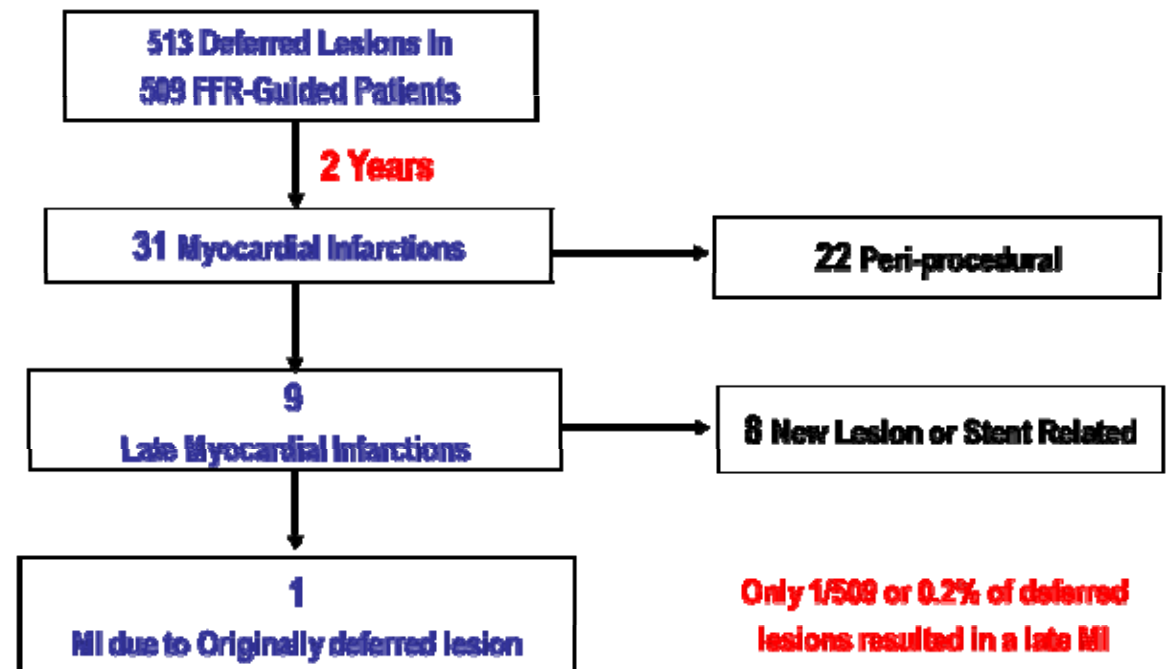
Barriers for routine use of FFR

- Medical insurance reimbursement policy
- FFR requires expensive wire and may not be cost effective.
- FFR and hyperemia is inconvenient to doctors and patients and can be risky
- **My clinical judgments (visual estimation) and 2nd generation stents are better than simple number (FFR)-guided treatment**
- IVUS &/or OCT can provide better information
- Only a few of my patients are candidates for FFR measurement

FFR versus Angiography



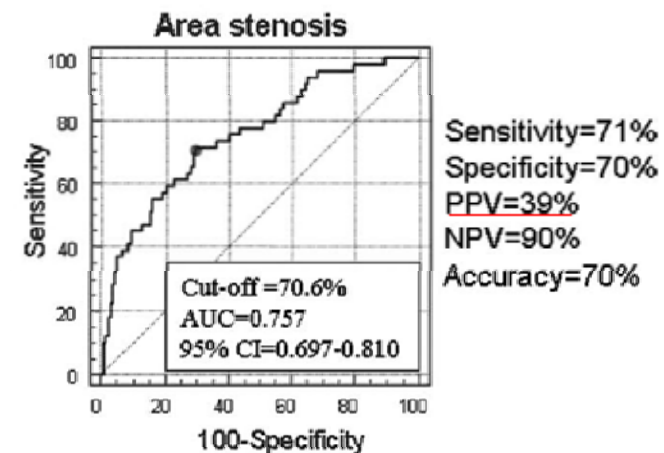
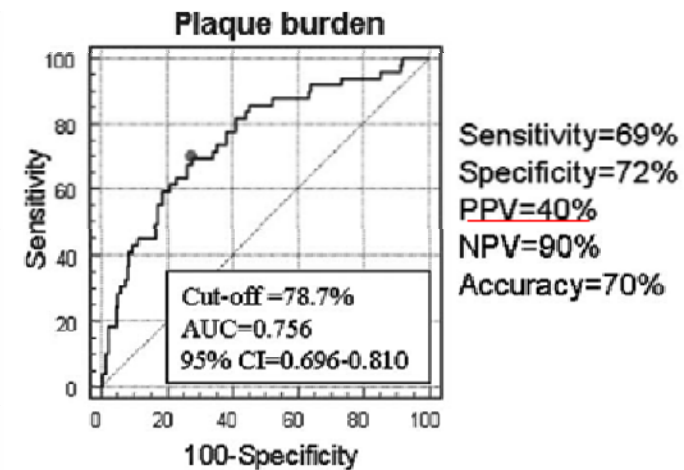
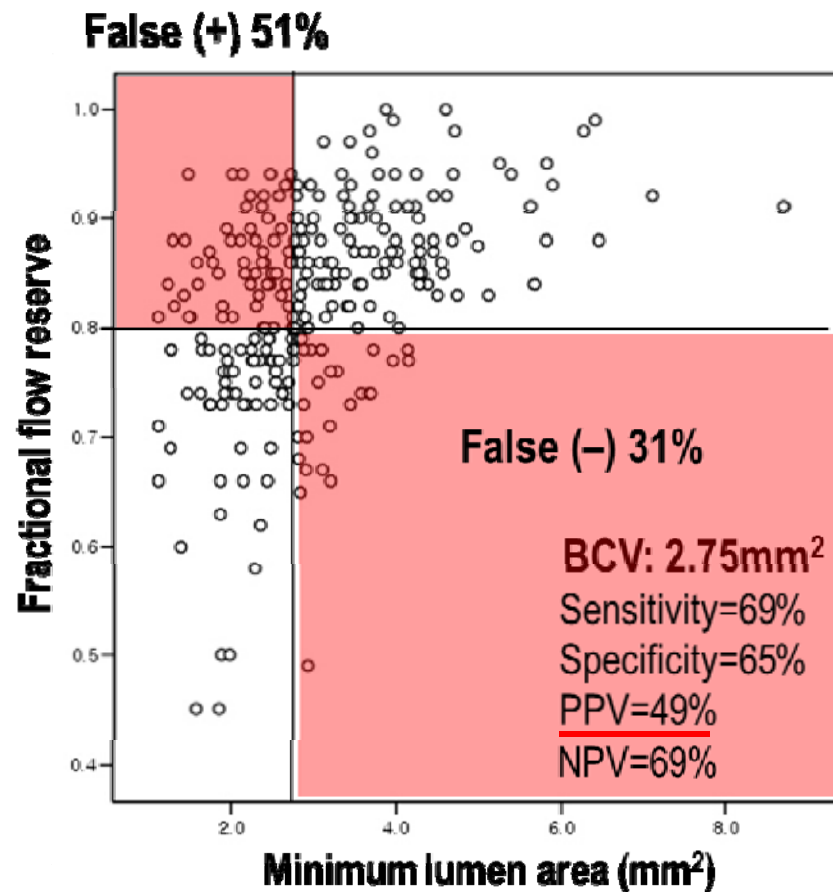
Outcome of Deferred Lesions



Barriers for routine use of FFR

- Medical insurance reimbursement policy
- FFR requires expensive wire and may not be cost effective.
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- **IVUS &/or OCT can provide better information**
- Only a few of my patients are candidates for FFR measurement

Diagnostic performance of IVUS parameters



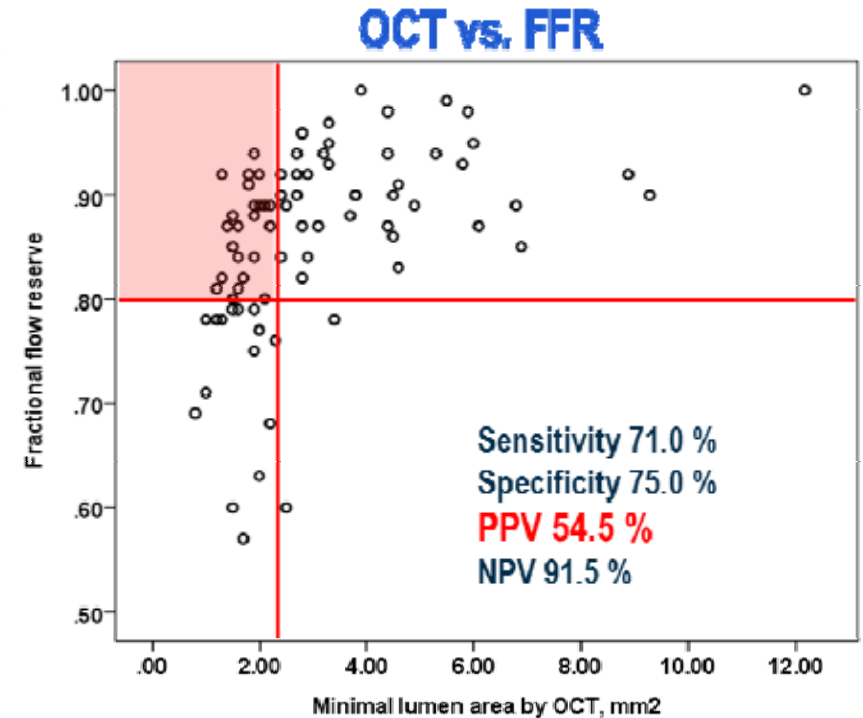
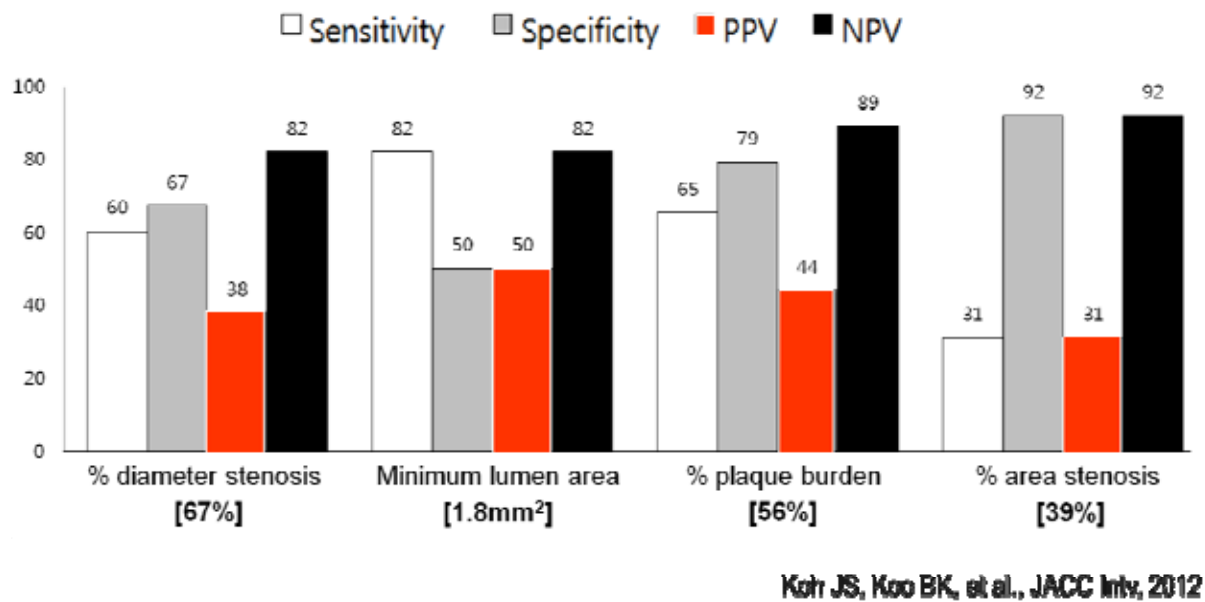
Koo BK, et al., JACC intv, 2011

Kang SJ, et al., Circ CVI, 2011

Barriers for routine use of FFR

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- Only a few of my patients are candidates for FFR measurement

Diagnostic accuracy of anatomic parameters in SB ostial lesions



Ha J, Kim JS, et al. JACC Img 2013, in press

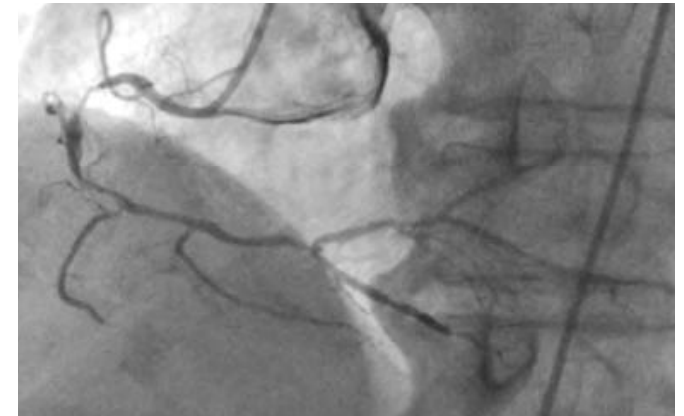
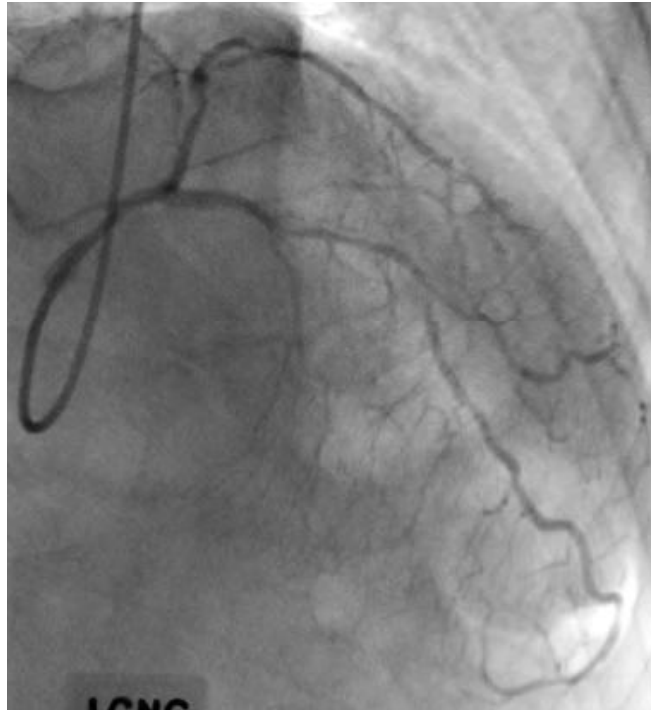
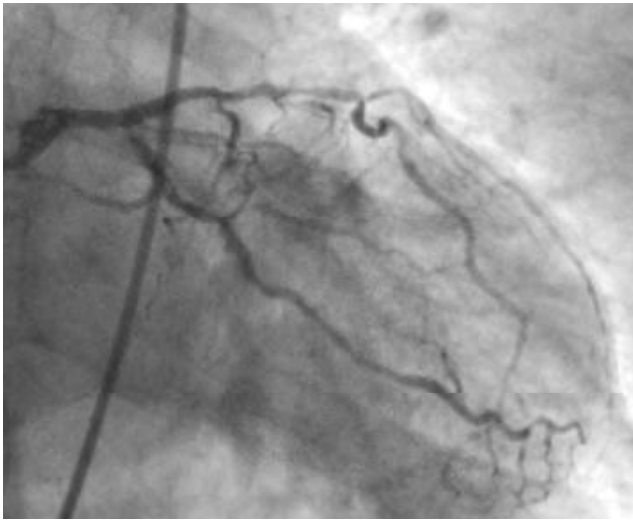
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- **Only a few of my patients are candidates for FFR measurement**

One busy Friday.....

1st CASE

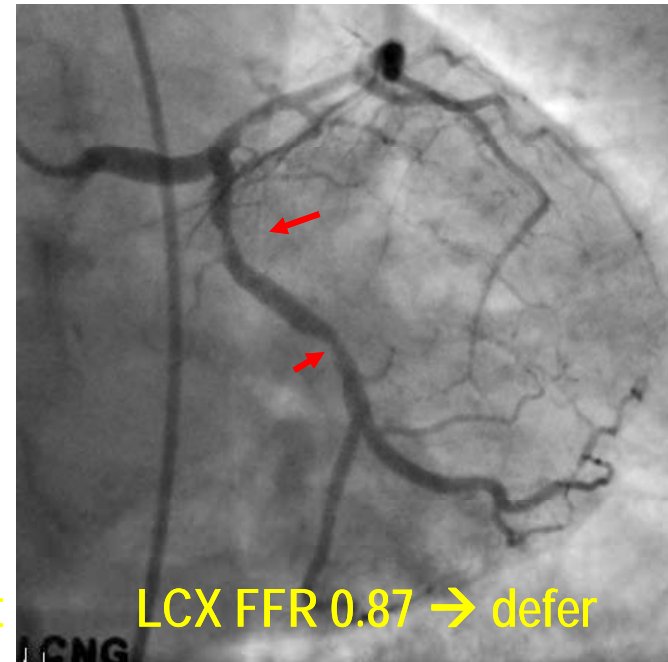
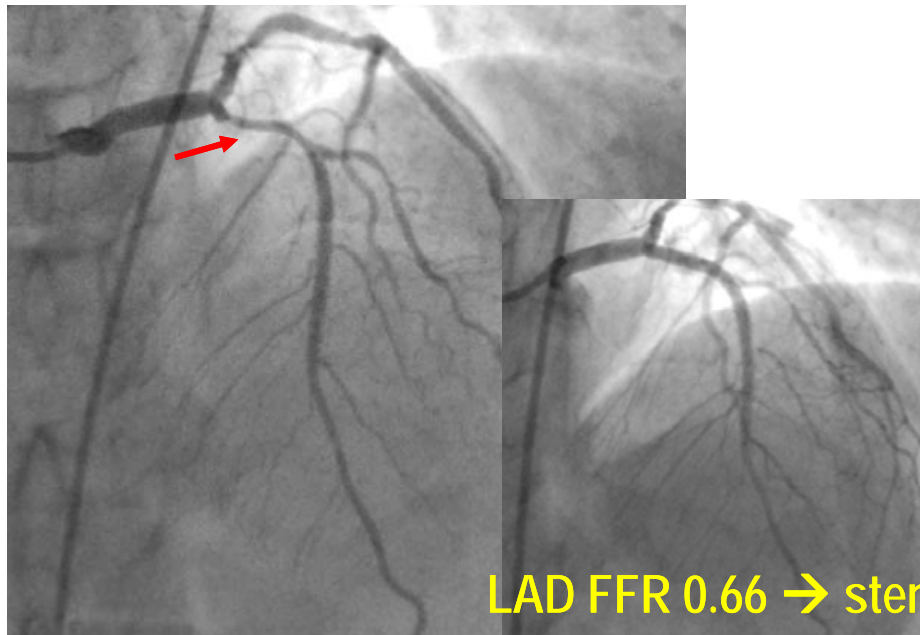
- M/72, Stable angina



Multiple diffuse 3VD → CABG

2nd CASE

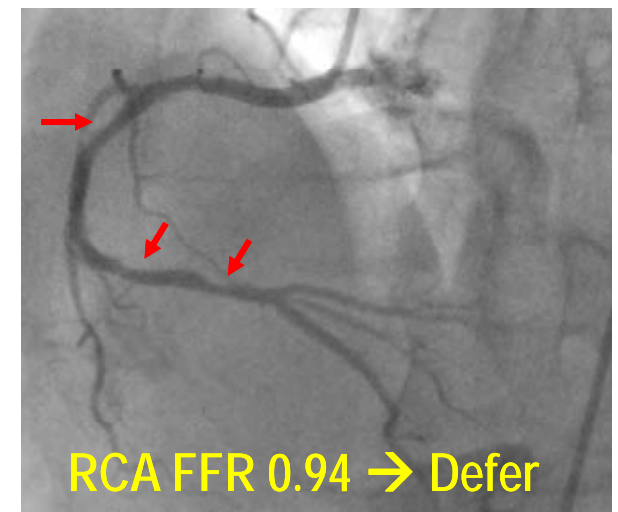
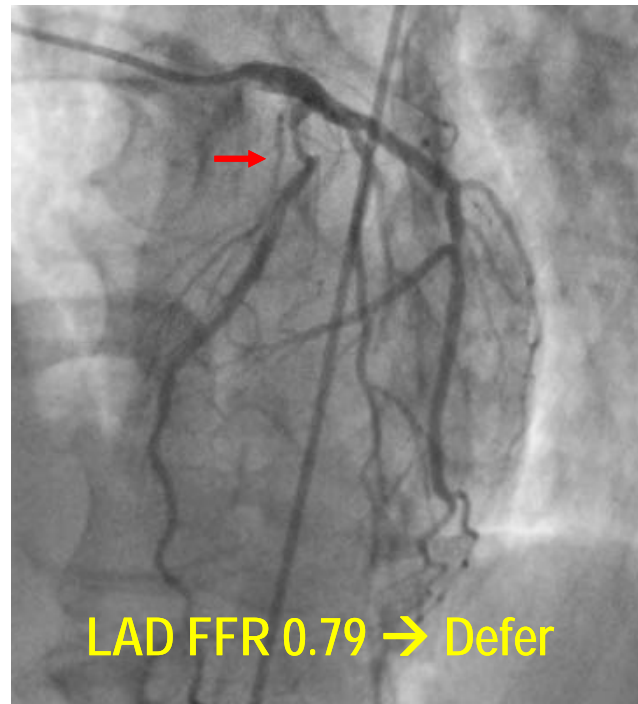
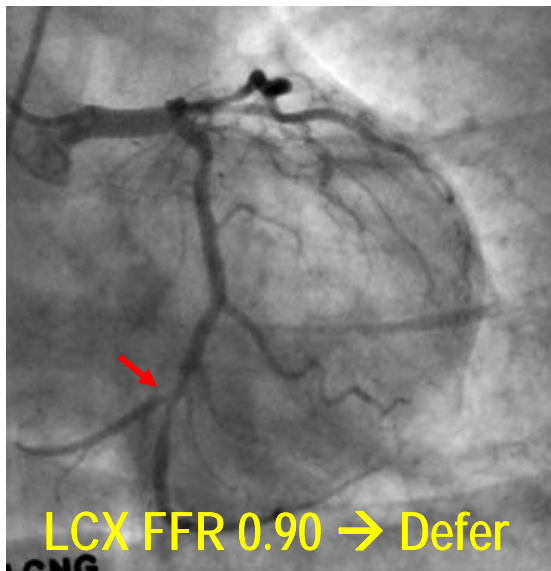
- F/63 Stable angina



LAD, LCX intermediate stenosis

3rd CASE

- M/62, Asymptomatic, CCTA+



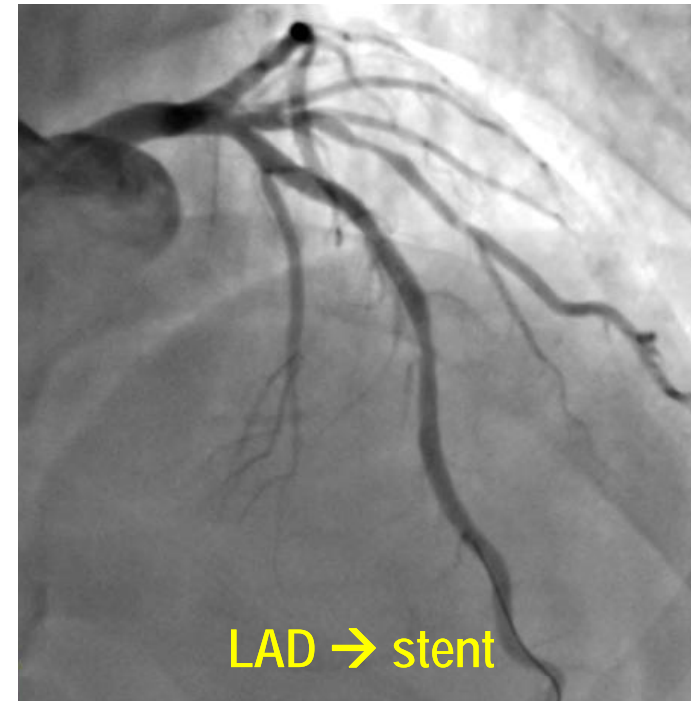
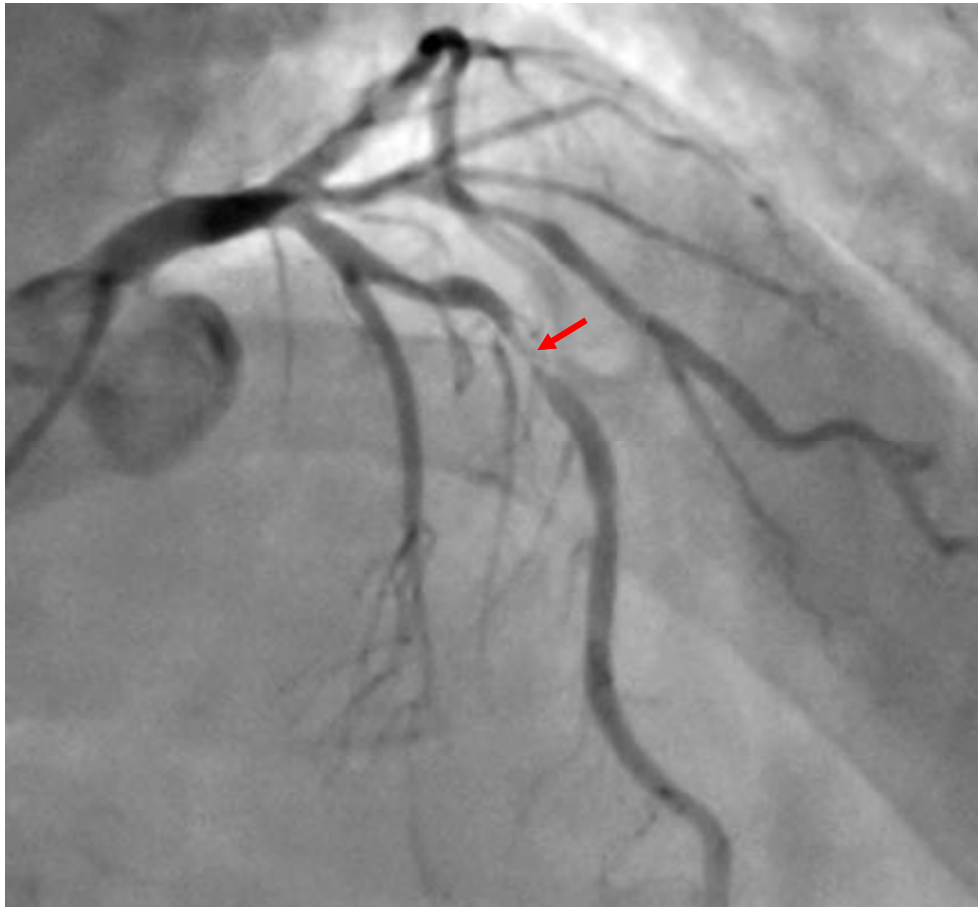
pLAD angulated intermediate stenosis

dLCX intermediate stenosis

RCA multiple intermediate stenoses

4th CASE

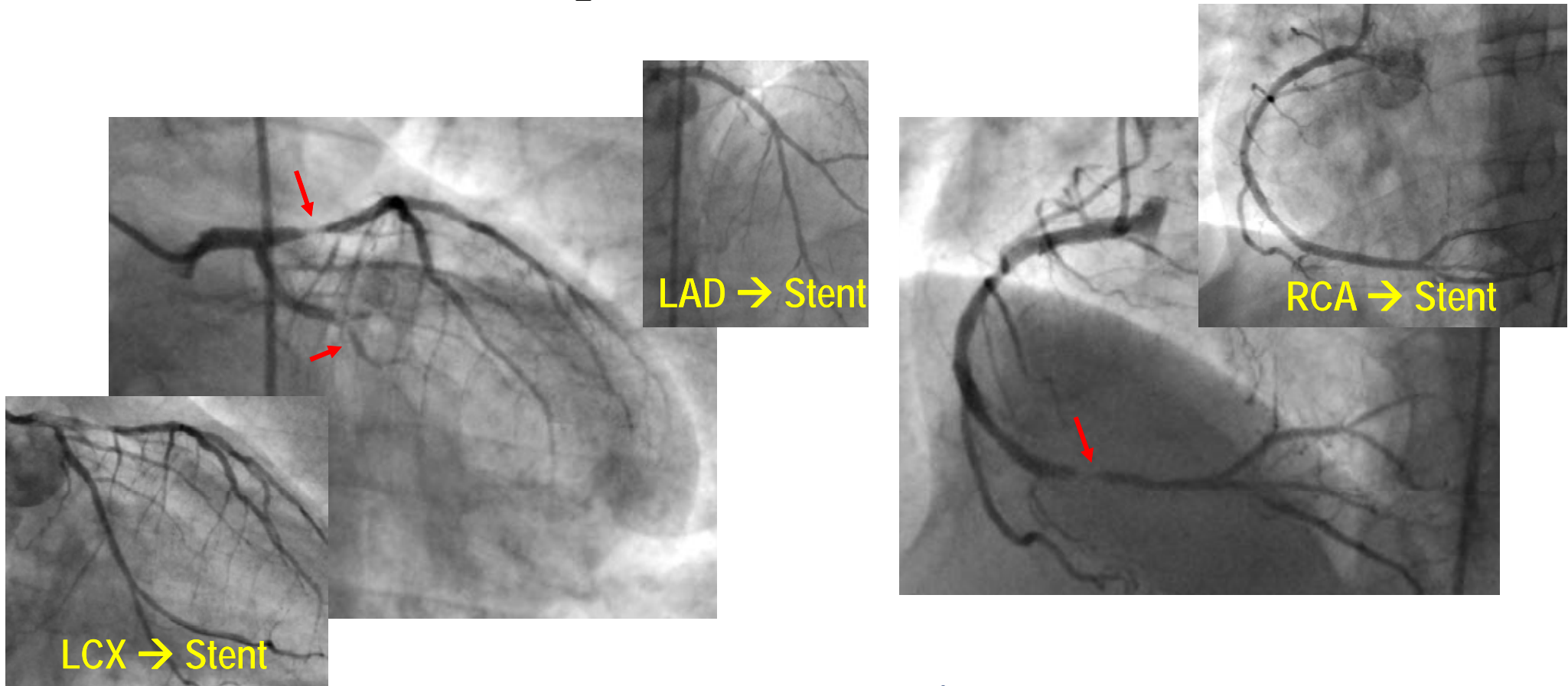
- M/65, Unstable angina



LAD severe stenosis

5th CASE

- M/73 Unstable angina



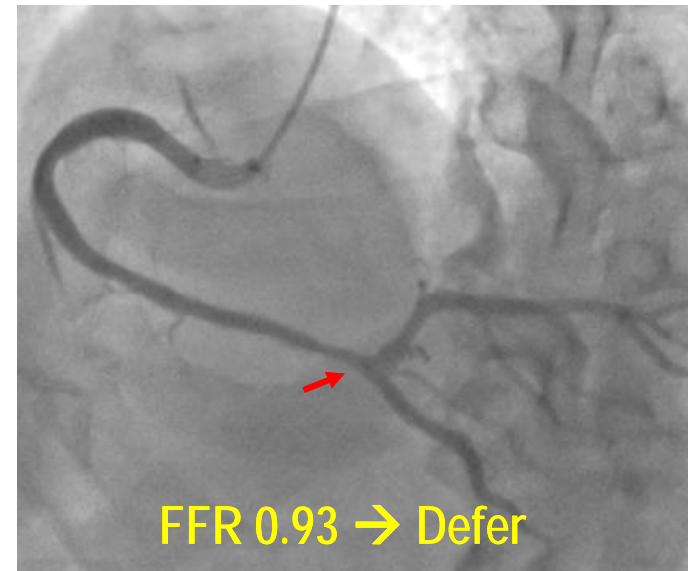
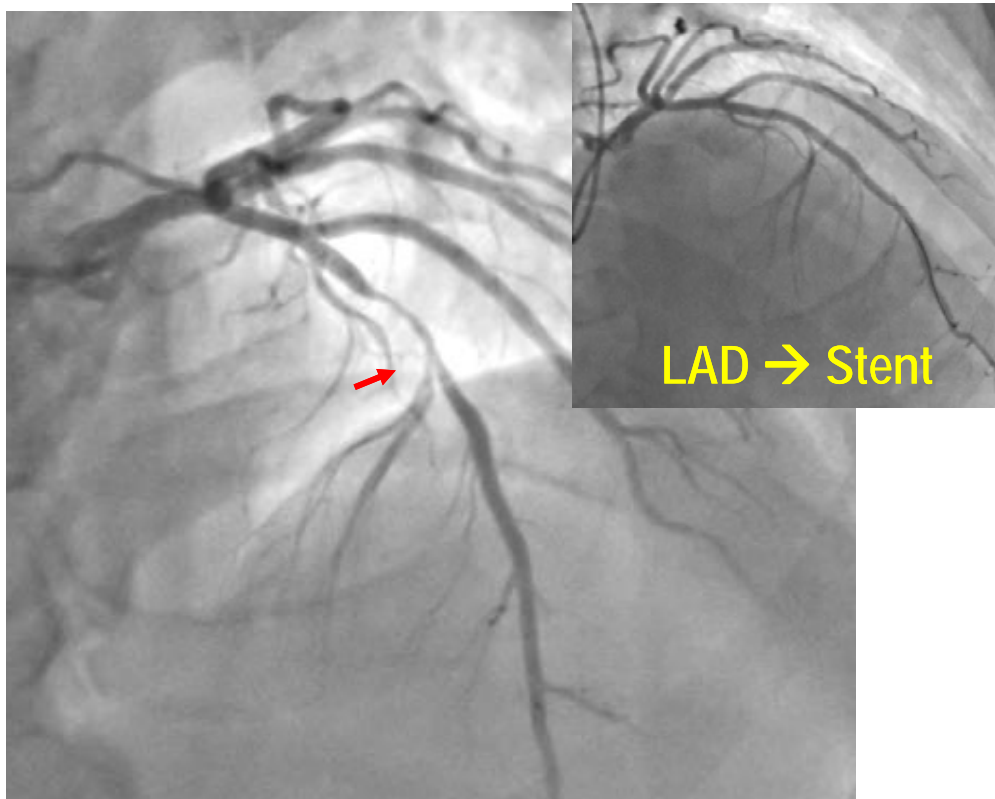
LAD severe stenosis

LCX total occlusion

RCA subtotal occlusion

6th CASE

- M/52, Angina, CCTA+

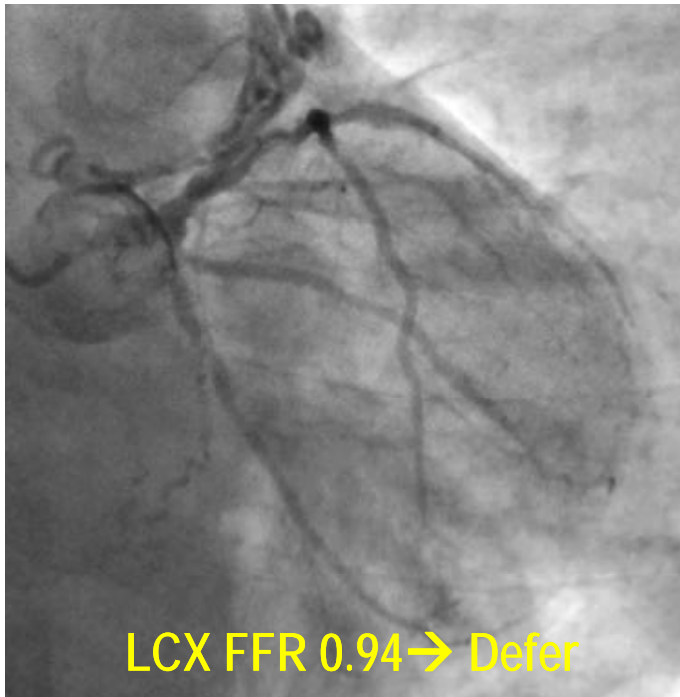


LAD severe stenosis

dRCA intermediate stenosis

7th CASE

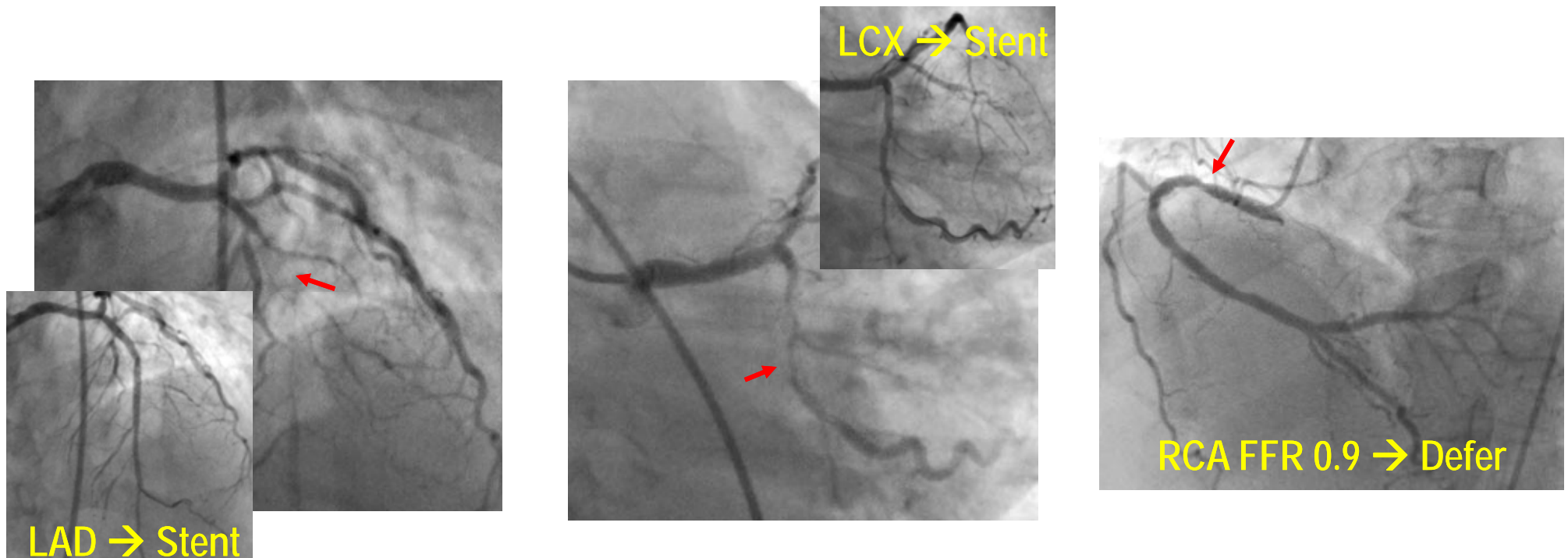
- M/64, CCTA+



Ambiguous and intermediate pLAD, LCX stenosis

8th CASE

F/64, Stable angina, CCTA+



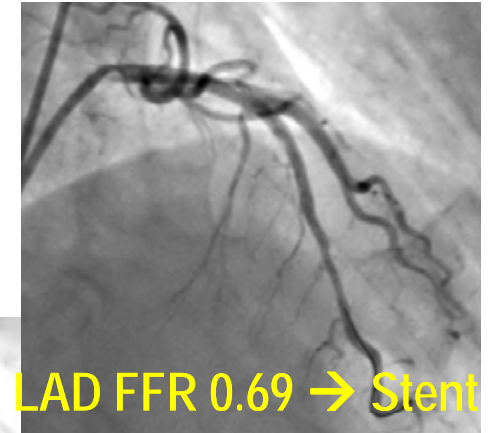
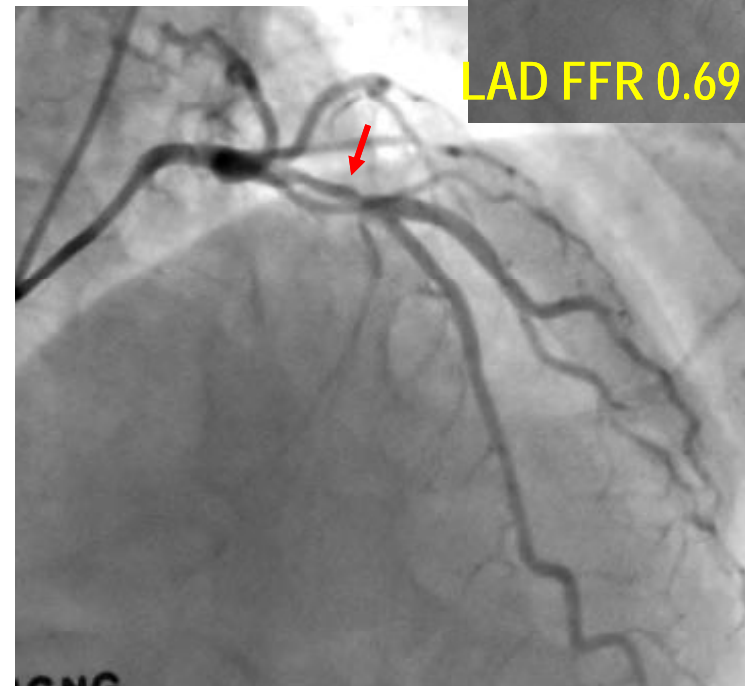
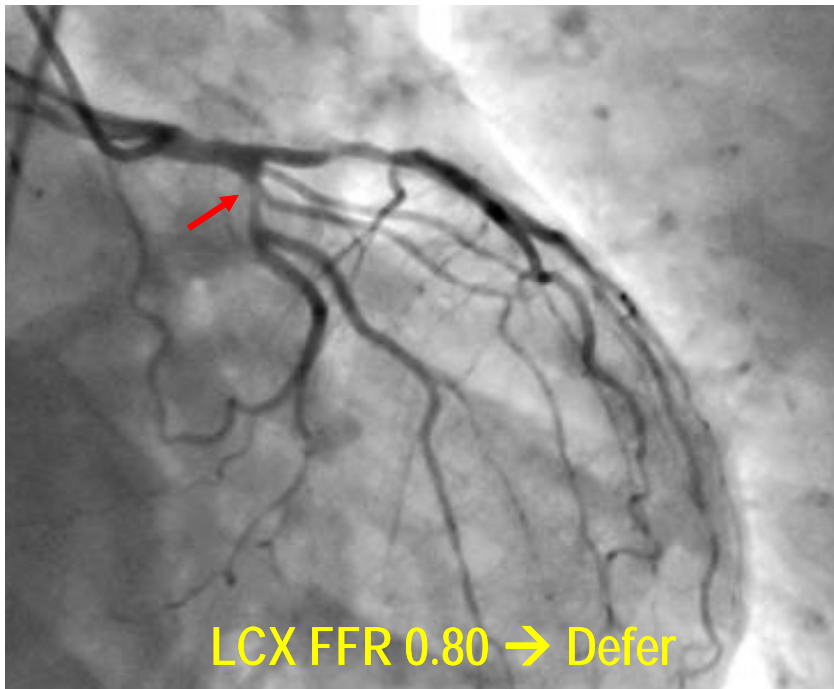
LAD CTO

LCX diffuse severe stenosis

RCA focal intermediate stenosis

9th CASE

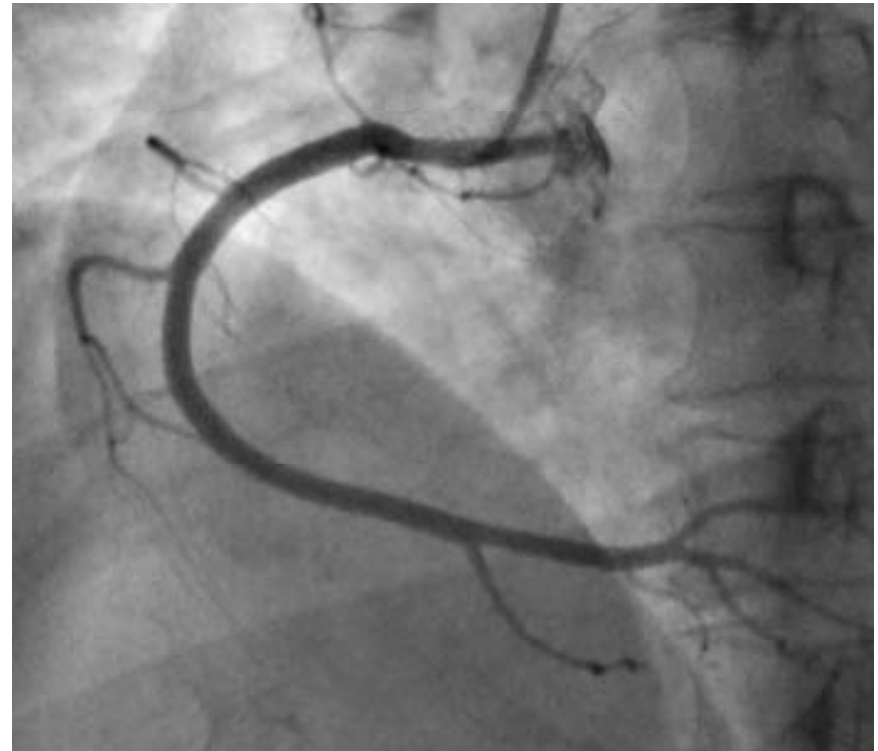
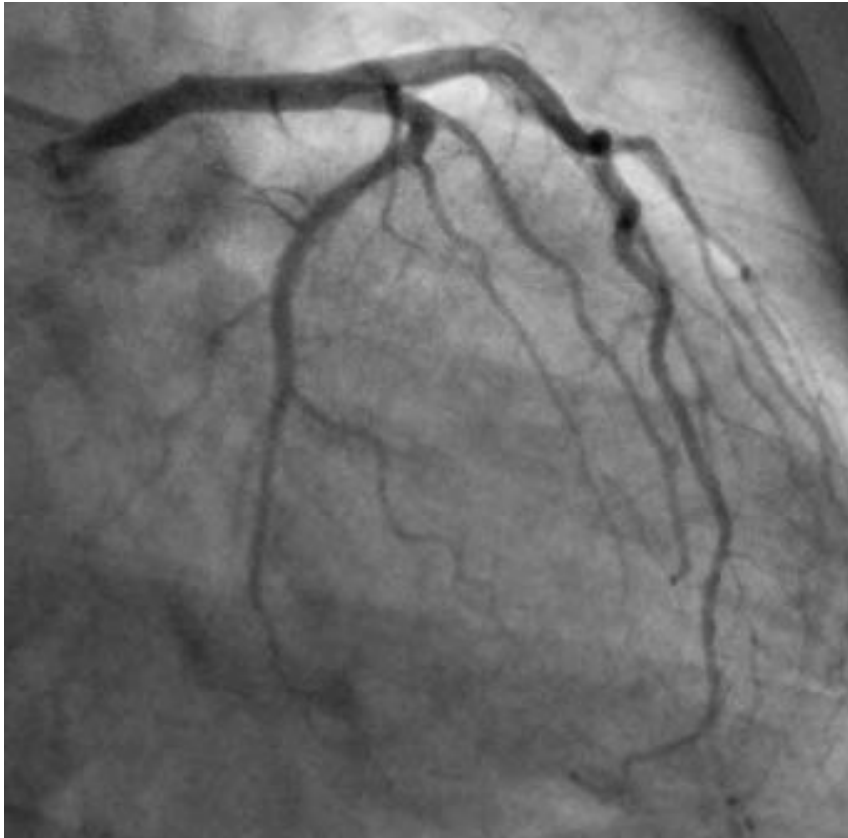
M/72, Stable angina



Intermediate pLAD, pLCX stenoses

10th CASE

- F/48, Atypical discomfort, CCTA+, TMT: equivocal



No significant stenosis

Barriers for routine use of FFR

- Medical insurance reimbursement policy
- FFR requires expensive wire and may not be cost effective.
- FFR and hyperemia is inconvenient to doctors and patients and can be risky
- My clinical judgments (visual estimation) and 2nd generation stents are better than simple number (FFR)-guided treatment
- IVUS &/or OCT can provide better information
- **Only a few of my patients are candidates for FFR measurement**

One busy Friday.....

- Procedure: 9:00 ~ 19:30
- 10 patients
 - No significant stenosis: 1 patient
 - 1VD: 1 patient → Stent
 - Multivessel disease: 8 patients
 - **FFR in 6 patients (60%), 11 vessels (55%)**
 - PCI 2, Defer 9 vessels
 - Critical stenosis and PCI in 8 vessels
 - CABG 1 patient

Barriers for routine use of FFR

- Medical insurance reimbursement policy
- FFR requires expensive wire and may not be cost effective.
- FFR and hyperemia is inconvenient to doctors and patients and can be risky
- My clinical judgments (visual estimation) are better than simple numbers (FFR-guided)
- IVUS &/or OCT can provide better information
- Only a few of my patients are candidates for FFR measurement

Conclusion

- Use of FFR is getting more popular. However, there still are gaps between the ideal and the reality.
- Medical insurance reimbursement policy may be the key barrier for routine use of FFR.
- Most other barriers are based on myths, not on scientific evidences.
- Removing these barriers will reduce unnecessary invasive procedures and improve the patients' outcomes.