

# Beyond “Fractional Flow Reserve”

## Comprehensive antegrade and retrograde flow assessment using a pressure wire

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# Case Description

Female, 69 years old

CC> Aggravating exertional chest pain with dyspnea, 2 months ago  
Dyspnea on exertion, since 4 months ago

Past Medical History>

**Non-tuberculosis mycobacterial infection (NTM) and Bronchiectasis**  
**Massive Hemoptysis → Bronchial artery embolization, 1 month ago**

Social History> **Never smoker**    Family History> **None**

Current Medication before Admission>

**Aspirin 100mg qd, Clopidogrel 75mg → resume 1 week ago before admission**

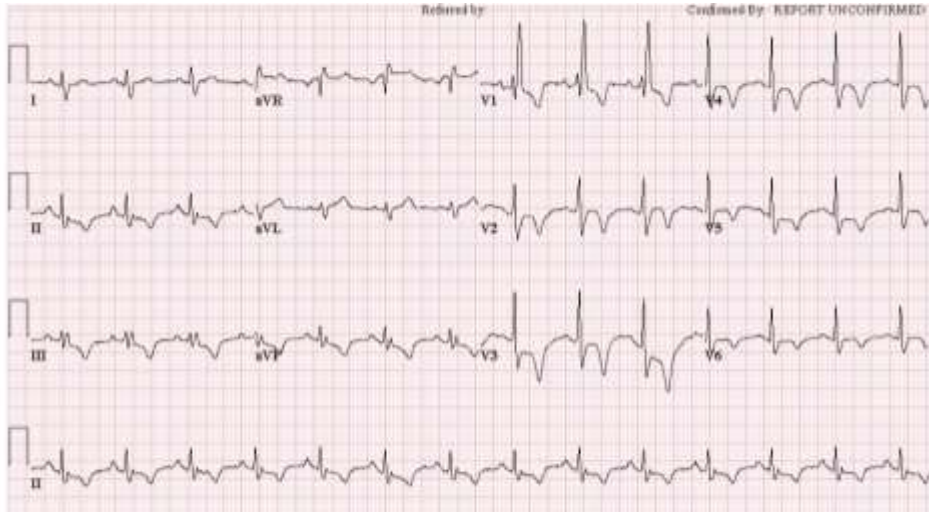
**Molsiton 5mg, Vastinan MR 35mg, Atorvastatin 40mg**

**B-blocker, CCB, RAAS blockade : could not be used due to marginal BP.**

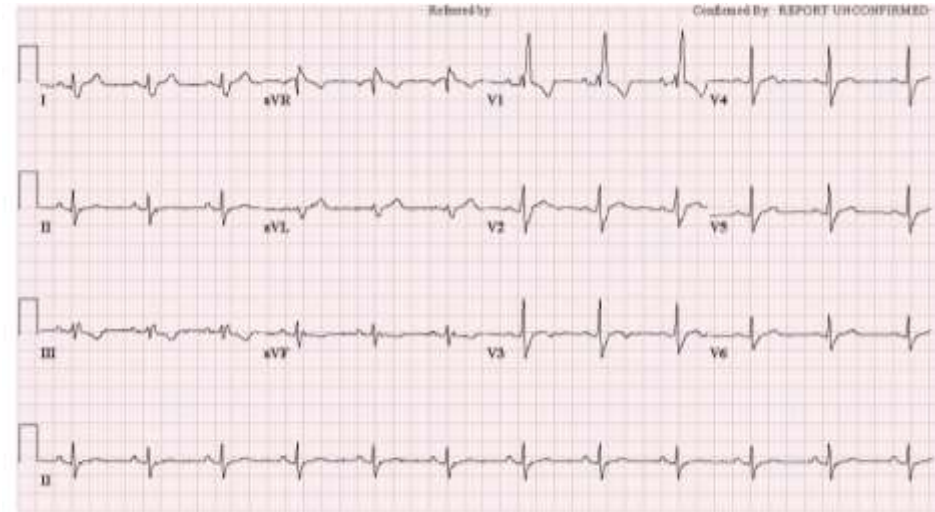
# ECG at Chest Pain

## - At ER -

### ECG During Chest Pain



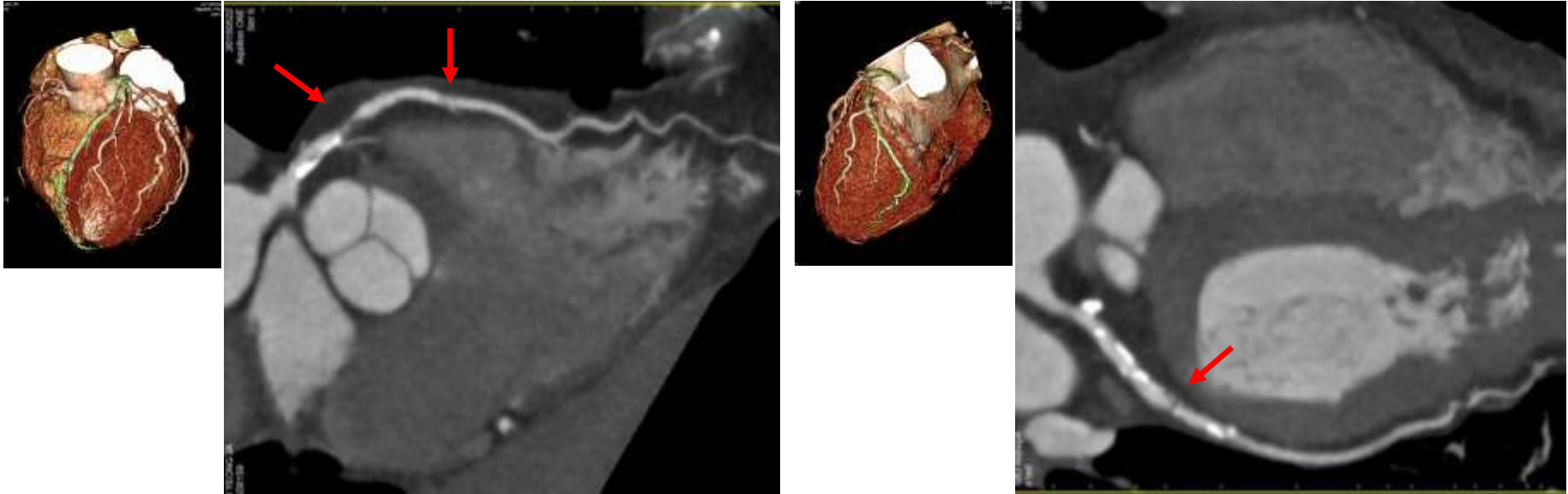
### ECG During "No" Chest Pain



Dynamic ECG change (precordial ST depression and T inversion)

# CT Coronary Angiography

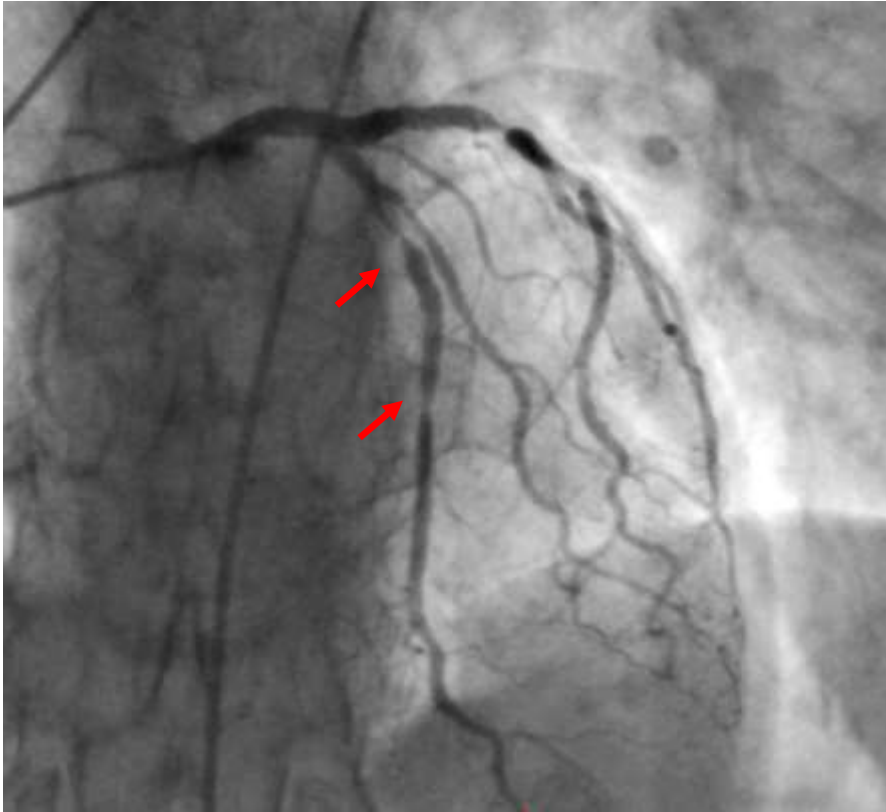
## - At ER -



### CT coronary Angiography:

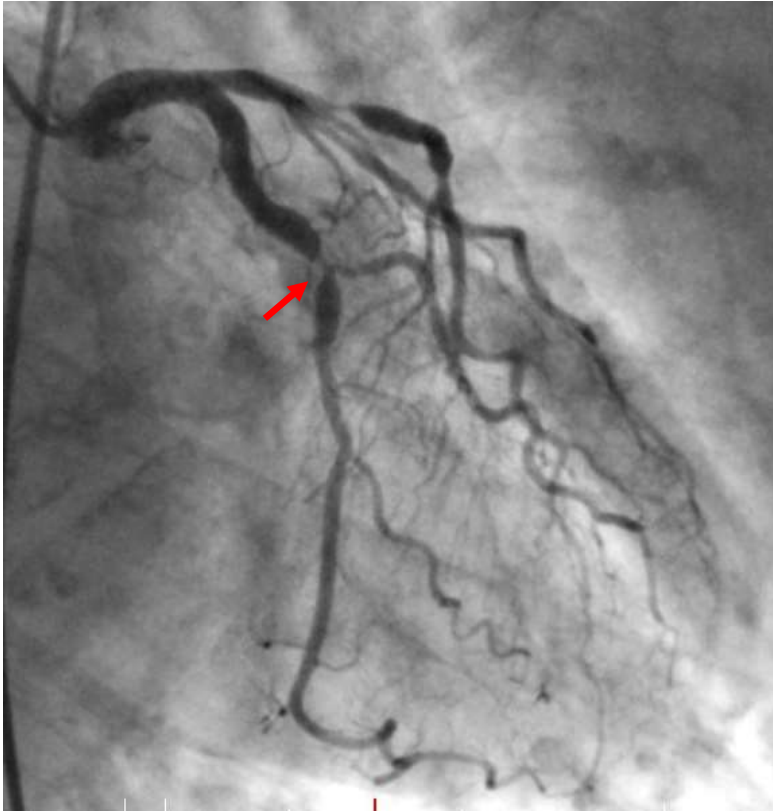
- LAD mid : 90% focal stenosis with mixed plaque.
- LAD distal : 80% focal tandem stenosis.
- LCX proximal : 90% focal stenosis with mixed plaque.

# Invasive Coronary Angiography



**LAD : mid LAD focal 90%  
distal LAD focal 80%**

# Invasive Coronary Angiography

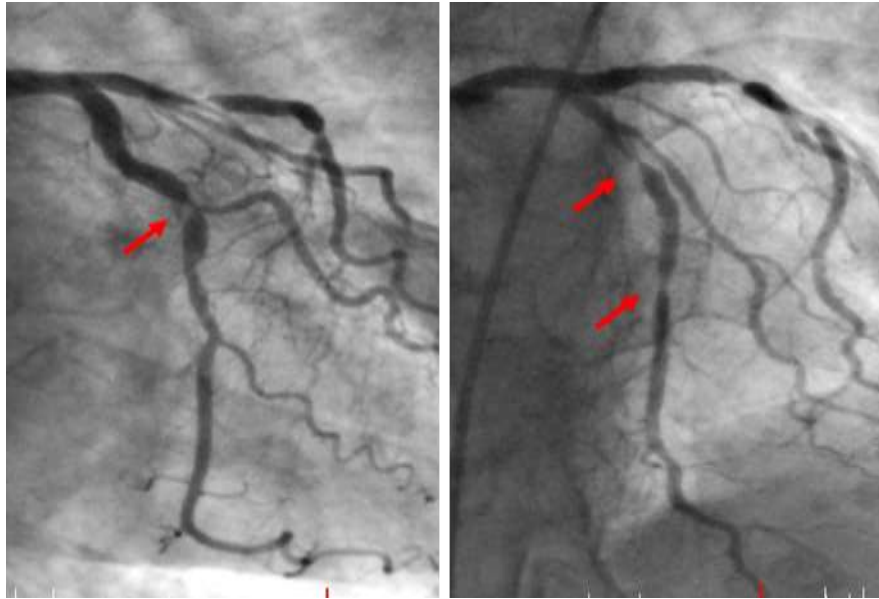


**LCX : proximal LCX focal 90% stenosis**

# Treatment Decision #1

## Anatomical Factor

**Significant LAD/LCX Lesions  
Angulated / Bending Portion Stenosis**



## Clinical Factor

- ① **Marginal Blood Pressure  
(Unable to use Beta-blocker, RAAS blockade)**
- ② **Accelerating Chest Pain Despite Medication**
- ③ **High Bleeding Risk after DAPT  
(Recent Massive Hemoptysis)**

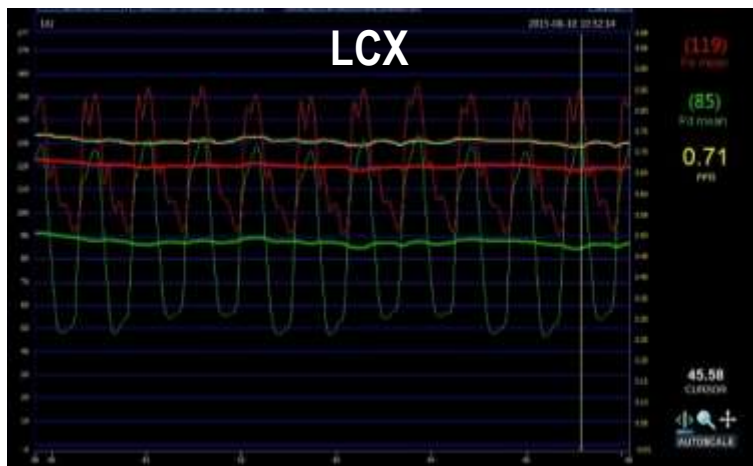
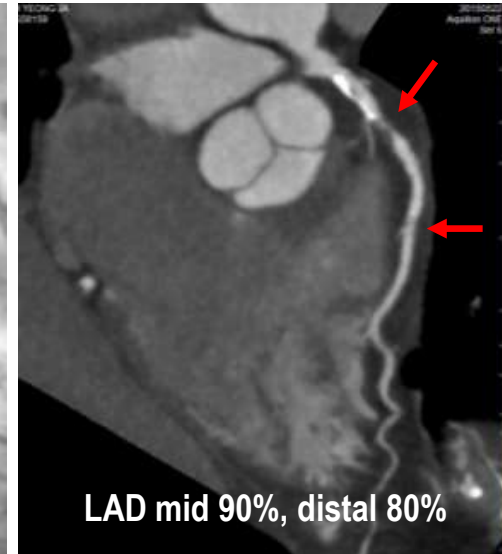
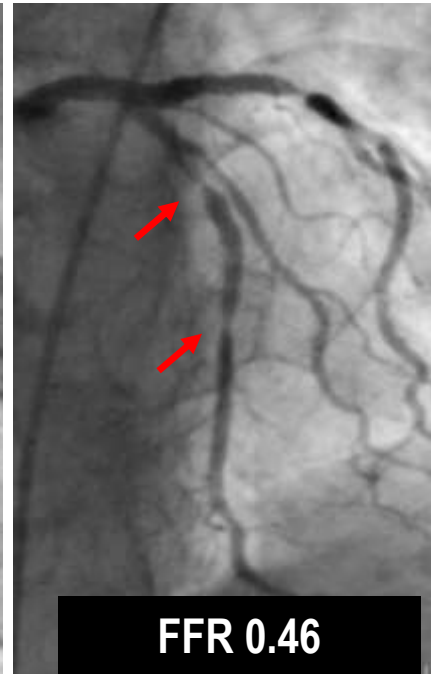
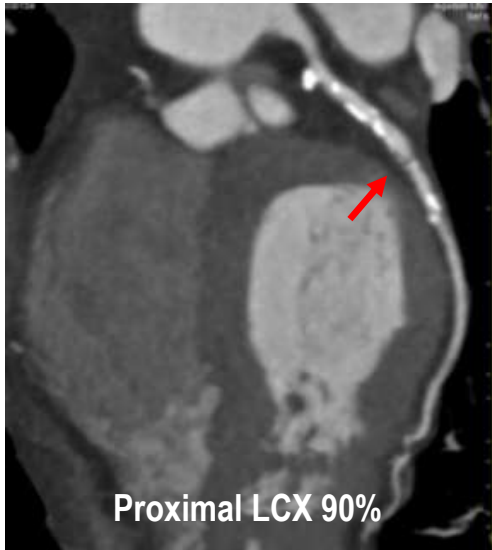


**Drug-eluting Balloon angioplasty**



# Question #1

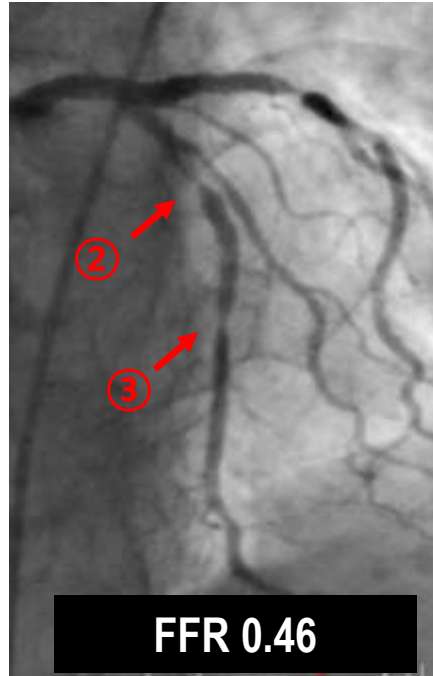
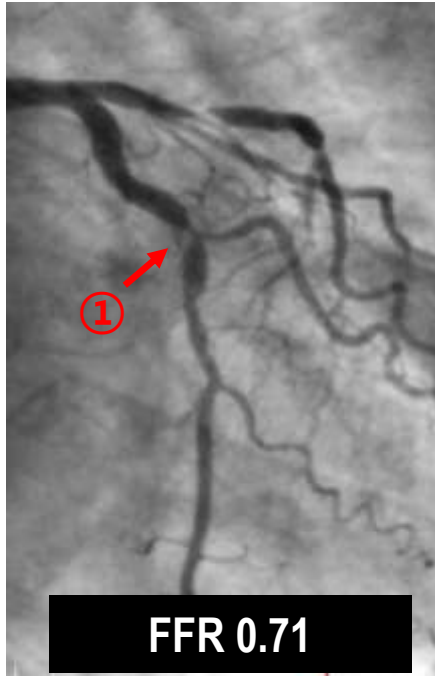
No Reason for Use of Pressure Wire?





# Question #2

## Drug-eluting Balloon angioplasty



Personal question to myself..

Among 3 Lesions,

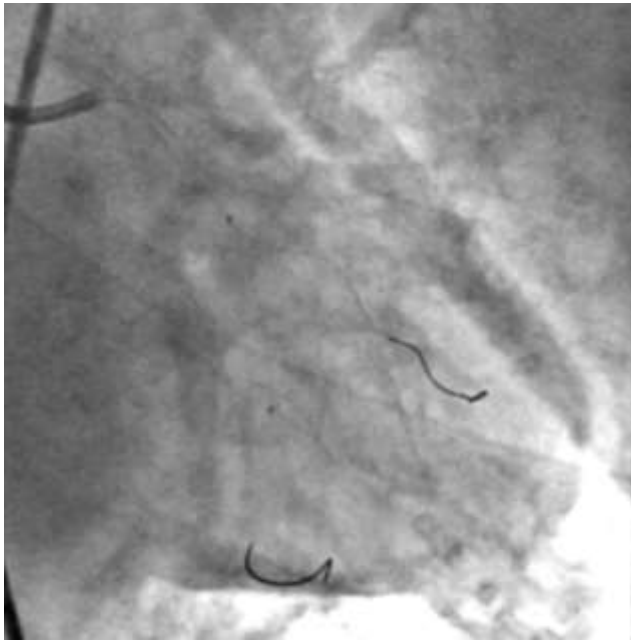
Total obstruction of these lesions will show same consequences?



My decision

- FFR-guided DEB angioplasty : ① → ③ → ②
- Assessing chest pain, ECG change during balloon occlusion
  - Measuring wedge pressure and CFI

# [1] DEB angioplasty to LCX



**Sequent Please 2.5\*15mm**  
(time to inflate 32 sec, for 70 sec)

**During Balloon Occlusion**

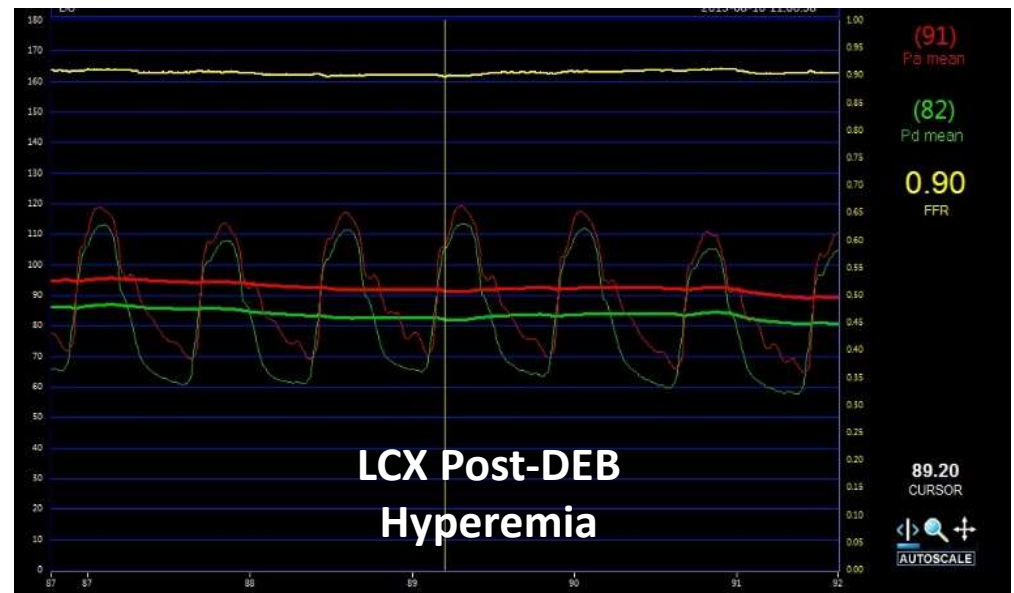
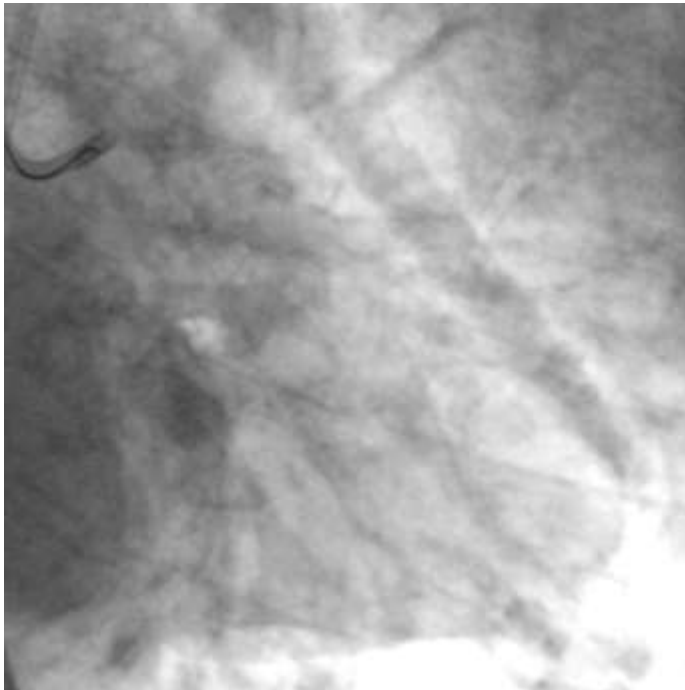
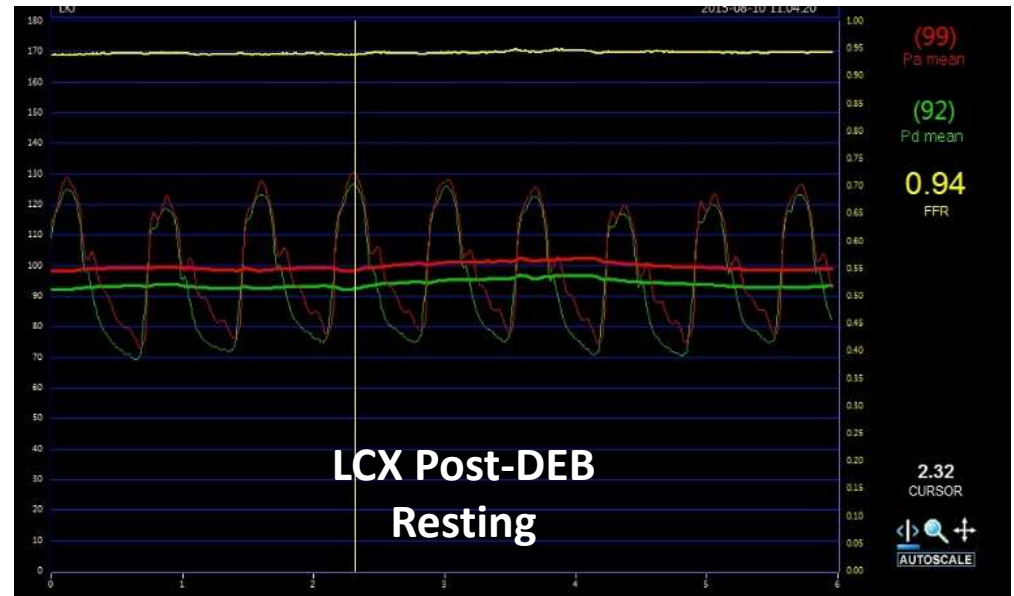
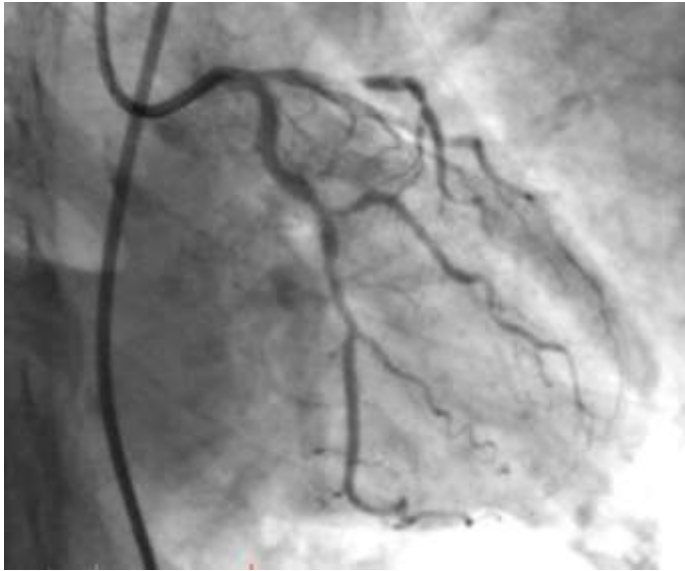


**Severe Excruciating Chest Pain (+)**

**ECG : Antero-Lateral lead ST elevation**

**Aortic Pressure decreased < 90mmHg during 1 min**

# Final Results after LCX DEB

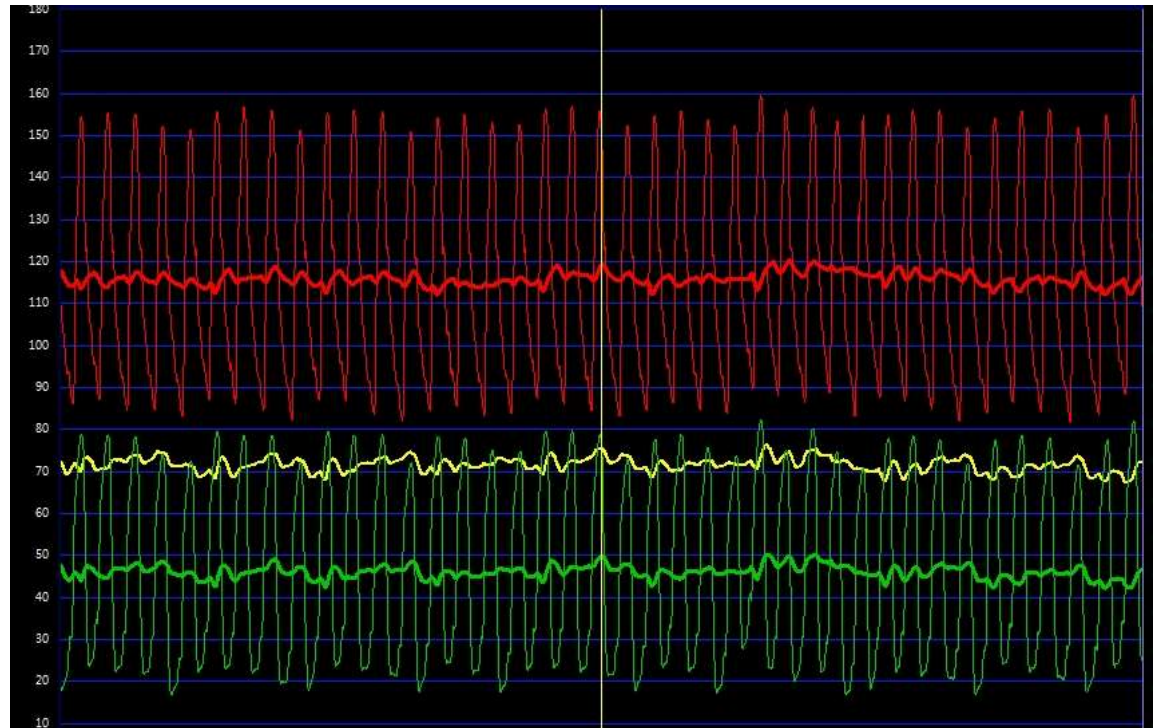


## [2] DEB angioplasty to distal-LAD



Sequent Please 2.75\*20mm  
(time to inflate 16 sec, for 180 sec)

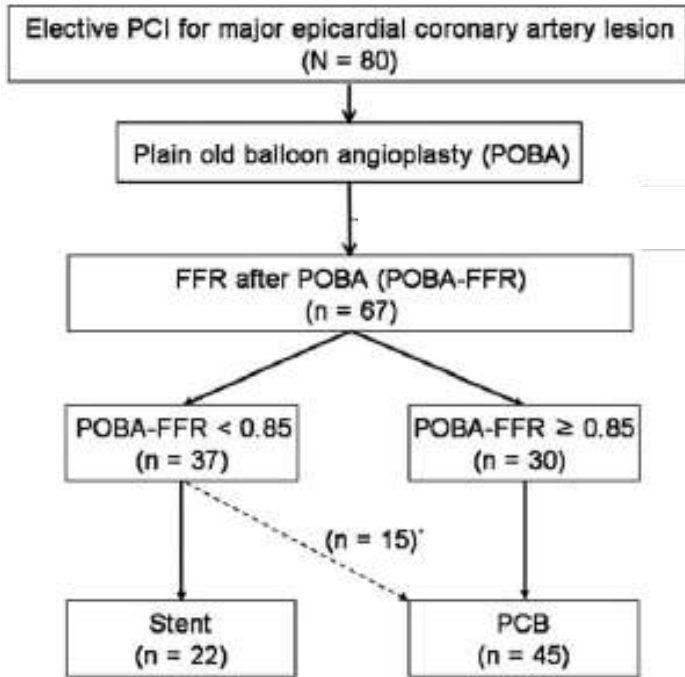
### During Balloon Occlusion



**No Chest Pain during 3-min of balloon occlusion**  
**ECG : No ECG changes during balloon occlusion**  
**No Change in “Aortic Pressure” during 3 minutes**



# FFR after distal-LAD DEB



## Fractional Flow Reserve-guided Paclitaxel-coated Balloon Treatment for De Novo Coronary Lesions

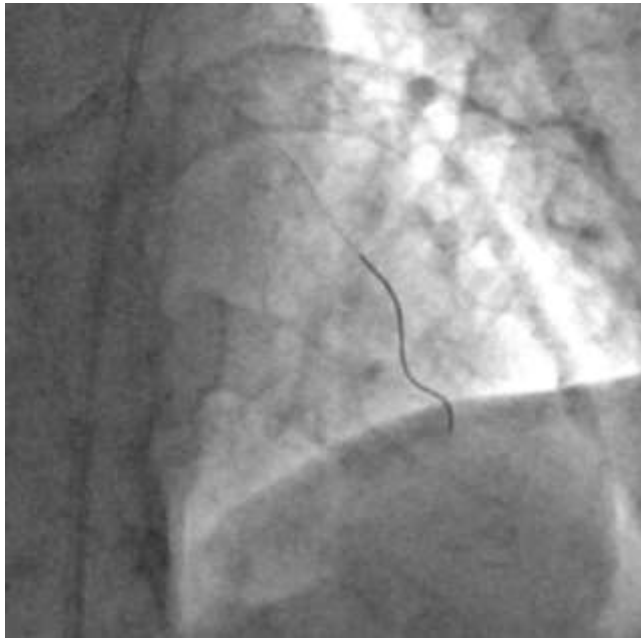
Eun-Seok Shin,<sup>1\*</sup> MD, PhD, Soe Hee Ann,<sup>1</sup> MD, Gillian Balbir Singh,<sup>1</sup> MBChB, FRACP, Kyung Hun Lim,<sup>1</sup> MD, Franz X. Kleber,<sup>2</sup> MD, and Bon-Kwon Koo,<sup>3</sup> MD, PhD

**Objectives:** To assess the safety and efficacy of fractional flow reserve (FFR) guided paclitaxel-coated balloon (PCB) treatment for de novo coronary artery lesions. **Background:** There is limited data on PCB treatment for de novo lesions especially of major epicardial coronary arteries. **Methods:** Sixty-six patients with 67 de novo lesions who underwent successful plain old balloon angioplasty (POBA) were included. If POBA-FFR was favorable ( $\geq 0.85$ ), PCB was applied and if POBA-FFR was  $< 0.85$ , stent implantation was preferred over PCB. **Results:** Forty-five lesions were treated with PCB (67.2%) and 22 lesions with stents (32.8%). Dual antiplatelet therapy duration was 6 weeks. Late luminal loss with PCB was significantly less than stent ( $0.05 \pm 0.27$  mm vs.  $0.40 \pm 0.54$  mm,  $P = 0.022$ ). The baseline FFR of target lesions was  $0.69 \pm 0.16$  in PCB and  $0.60 \pm 0.11$  in stent group ( $P = 0.015$ ), however, the FFR at 9 months was not different between groups ( $0.85 \pm 0.08$  in PCB vs.  $0.85 \pm 0.05$  in stent group,  $P = 0.973$ ). At 1 year, one myocardial infarction and one target lesion revascularization related to in-stent restenosis were detected, both in the stent group. **Conclusion:** POBA-FFR-guided PCB treatment is safe and effective for de novo coronary lesions with good anatomical and physiological patency at mid-term follow-up. © 2015 Wiley Periodicals, Inc.

**Key words:** paclitaxel-coated balloon; fractional flow reserve; plain old balloon angioplasty; de novo lesion; late luminal loss

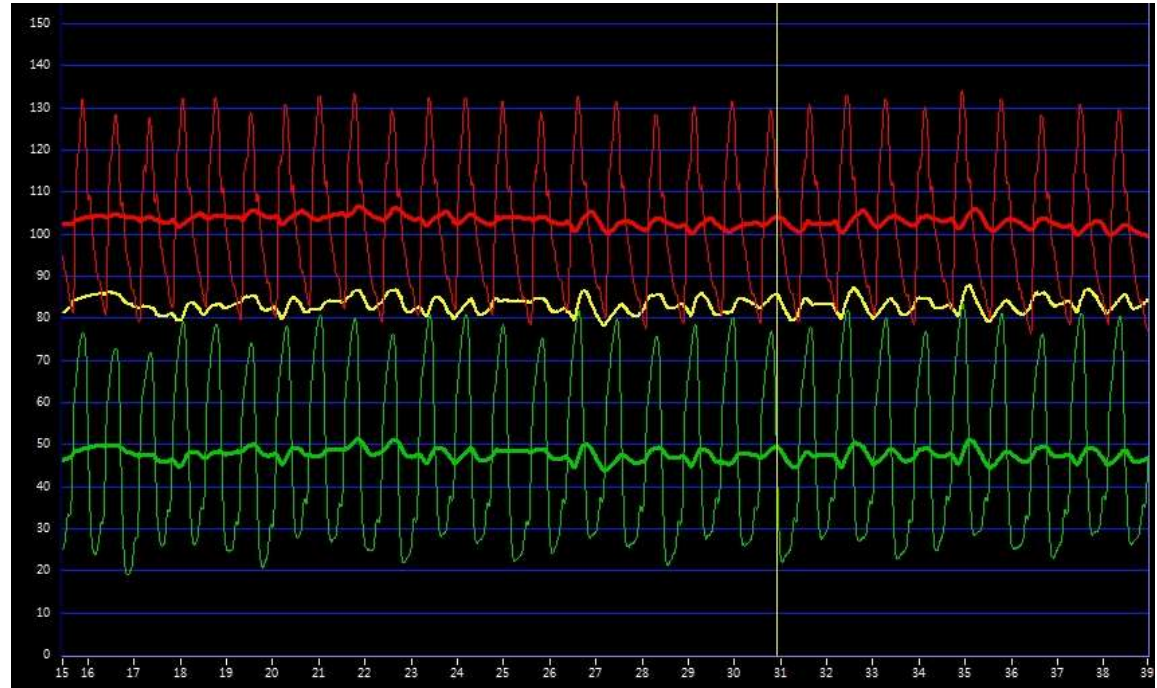
**Further Angioplasty is considered to achieve post-FFR  $\geq 0.85$**

# [3] DEB angioplasty to mid-LAD



Sequent Please 3.0\*20mm  
(time to inflate 18 sec, for 180 sec)

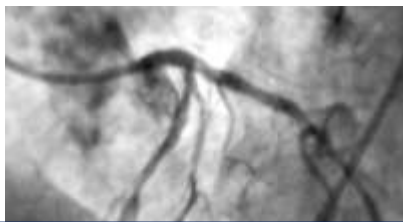
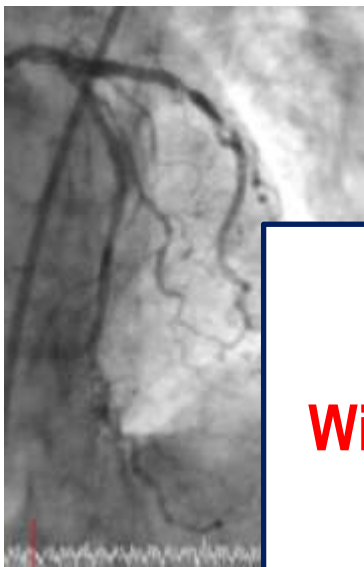
During Balloon Occlusion



**No Chest Pain during 3-min of balloon occlusion**  
**ECG : No ECG changes during balloon occlusion**  
**No Change in “Aortic Pressure” during 3 minutes**



# Final Results after mid and distal-LAD DEB

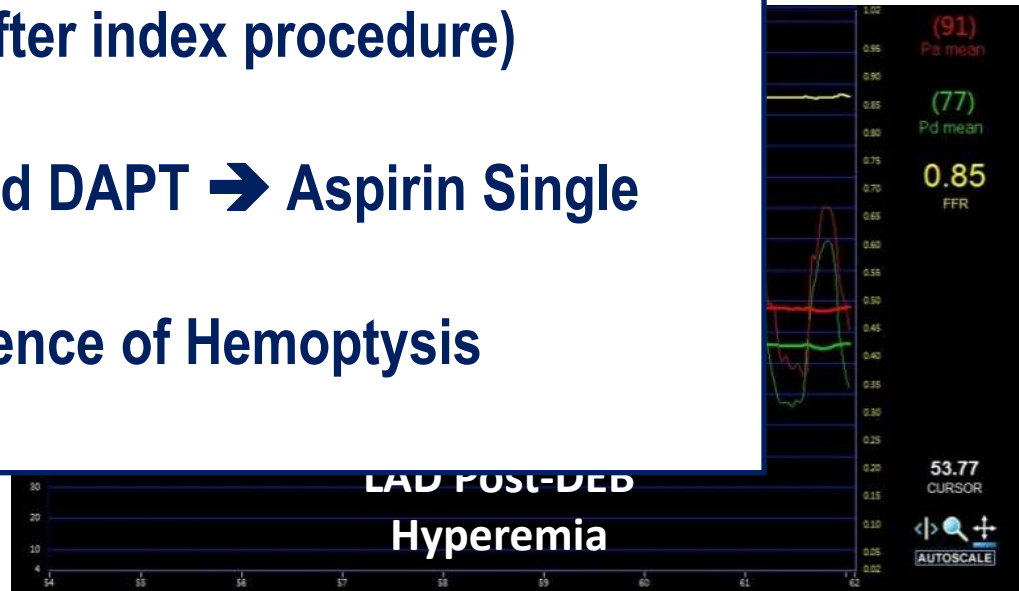
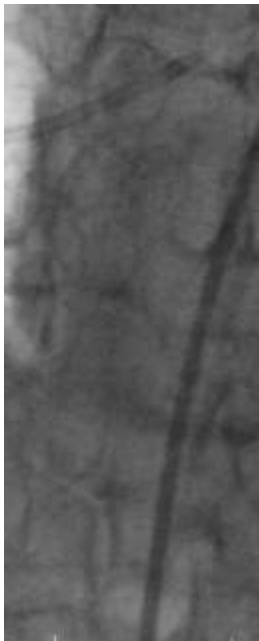


**Successful “FFR-guided DEB angioplasty”  
With Physiologically Complete Revascularization**

**Patients is now symptom free  
(3 months after index procedure)**

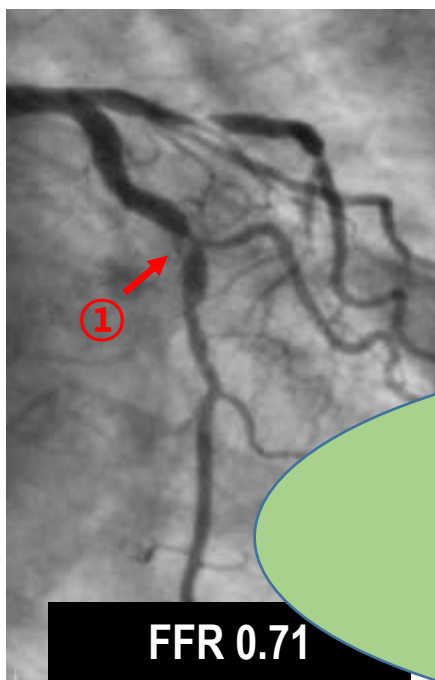
**Recently Changed DAPT → Aspirin Single**

**No Recurrence of Hemoptysis**

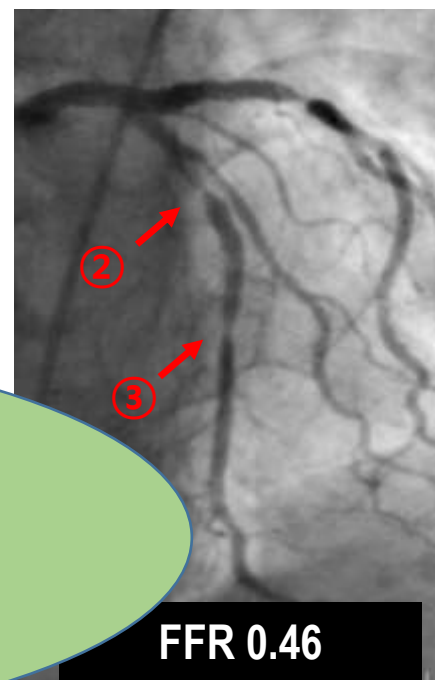


# Back to the Question..... No. 1

## Drug-eluting Balloon angioplasty



Were total obstruction of these lesions show same consequences?

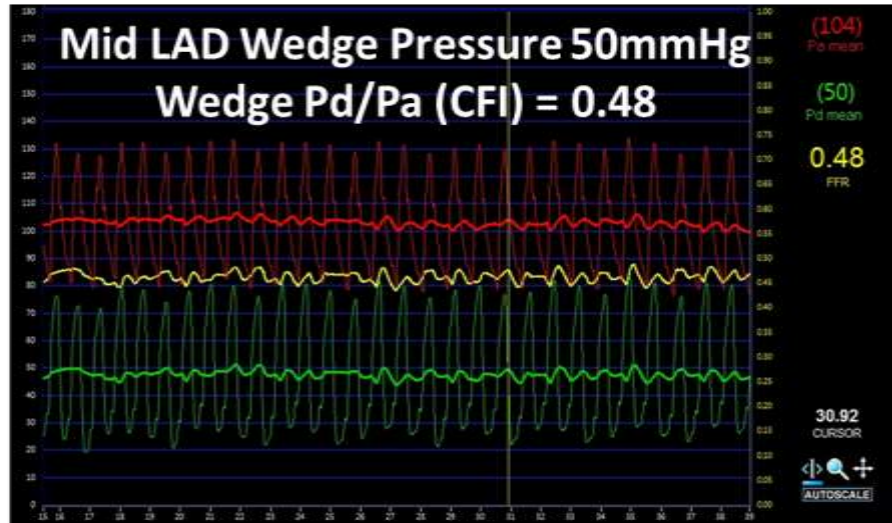
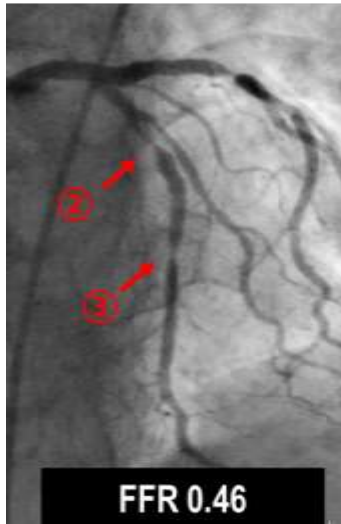


Why These Lesions are Different???

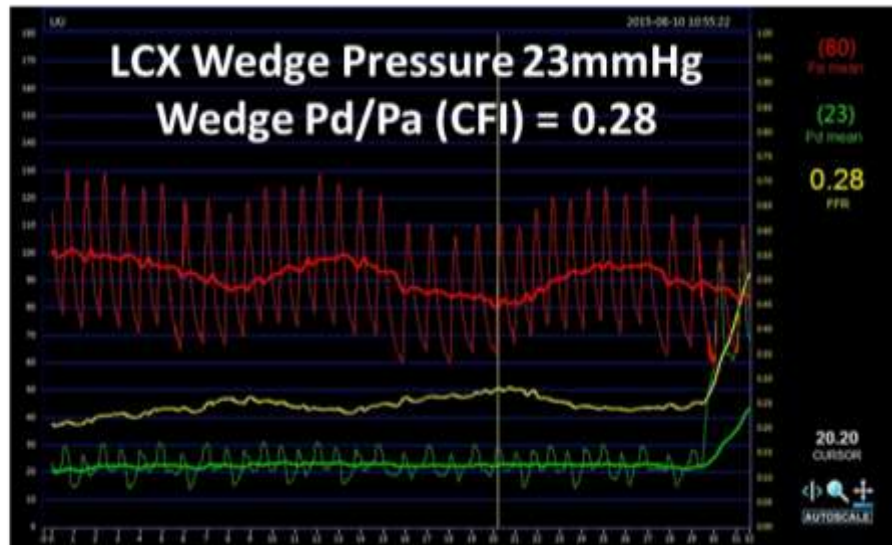
LCX		LAD
+++	Chest Pain	-
+++	Ischemic ECG change	-
+++	▼ Systemic Pressure	-

# Different “Collateral Recruitability”

→ Different “Protection Reserve” for Ischemia



Well  
“Protected”  
Lesion to  
Ischemia



More  
“Vulnerable”  
Lesion to  
Ischemia

# Beneficial Effect of Recrutable Collaterals

## A 10-Year Follow-Up Study in Patients With Stable Coronary Artery Disease Undergoing Quantitative Collateral Measurements

Pascal Meier, MD\*; Steffen Gloekler, MD\*; Rainer Zbinden, MD\*; Sarah Beckh, BS;  
 Stefano F. de Marchi, MD; Stephan Zbinden, MD; Kerstin Wustmann, MD; Michael Billinger, MD;  
 Rolf Vogel, MD, PhD; Stéphane Cook, MD; Peter Wenaweser, MD; Mario Togni, MD;  
 Stephan Windecker, MD; Bernhard Meier, MD; Christian Seiler, MD

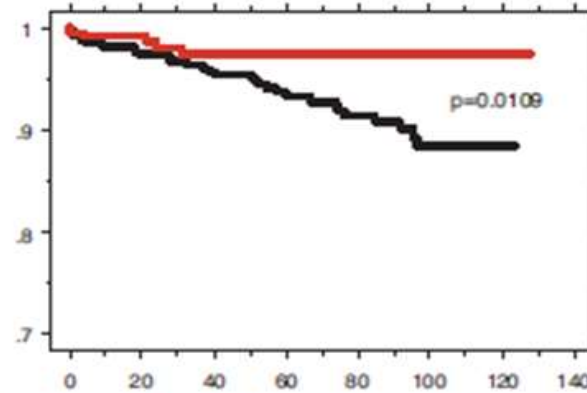
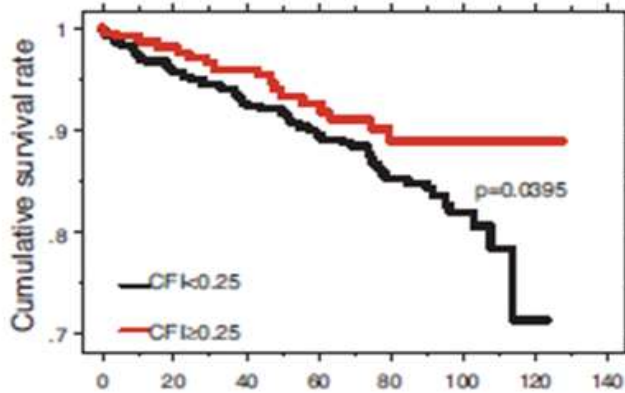
No!

No!"

of Ischemia"

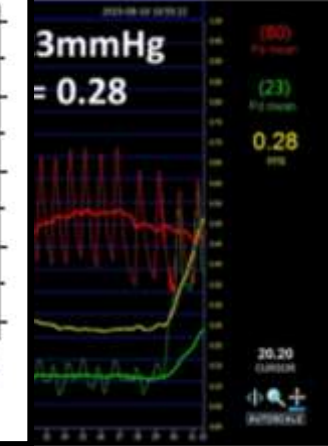
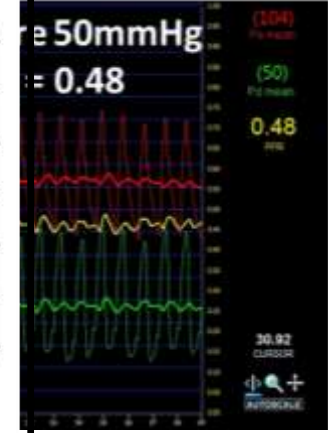
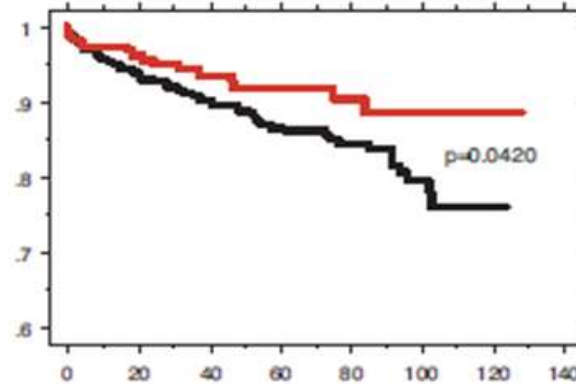
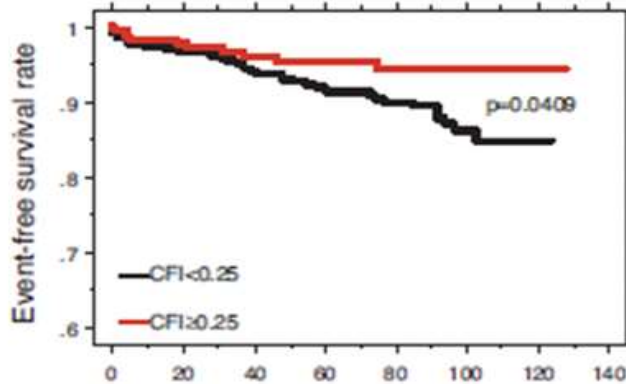
All-cause deaths (n=83)

Cardiac deaths (n=42)



Cardiac death or myocardial infarction

Cardiac death, myocardial infarction or unstable angina pectoris





# Lessons From the Case

- FFR-guided DEB angioplasty is suitable treatment option for patients who cannot tolerate prolonged duration of DAPT.
- Despite similar functional significance measured by FFR, these lesions were completely different regarding “consequences of ischemic insult”.
- This differential “consequences of ischemic insult” can be predicted by measuring wedge pressure and collateral flow index (or wedge index).
- Comprehensive use of pressure wire beyond current clinical indication or beyond simply measuring FFR only would provide further information regarding consequences of ischemic insult, further treatment plan, and long-term prognosis, beyond the information about presence of ischemia only.

# Conclusion

My mentor always says that “We should be more physiologic than FFR..”



Even though we are not able to see the whole forest for the trees...  
If we are keep trying to see as many trees as possible...

We will be able to know more things about the forest...



# Thank you for your attention

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If you have any question, don't hesitate to e-mail me.

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