

DEFINE-FLOW study

Do we need pressure and flow?

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Disclosure Statement of Financial Interest

Within the past 12+ months, Nils Johnson has had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship

- Grant/Research Support
(to *institution*)
- Educational organizations
(travel support for academic meetings
but *never honoraria*)

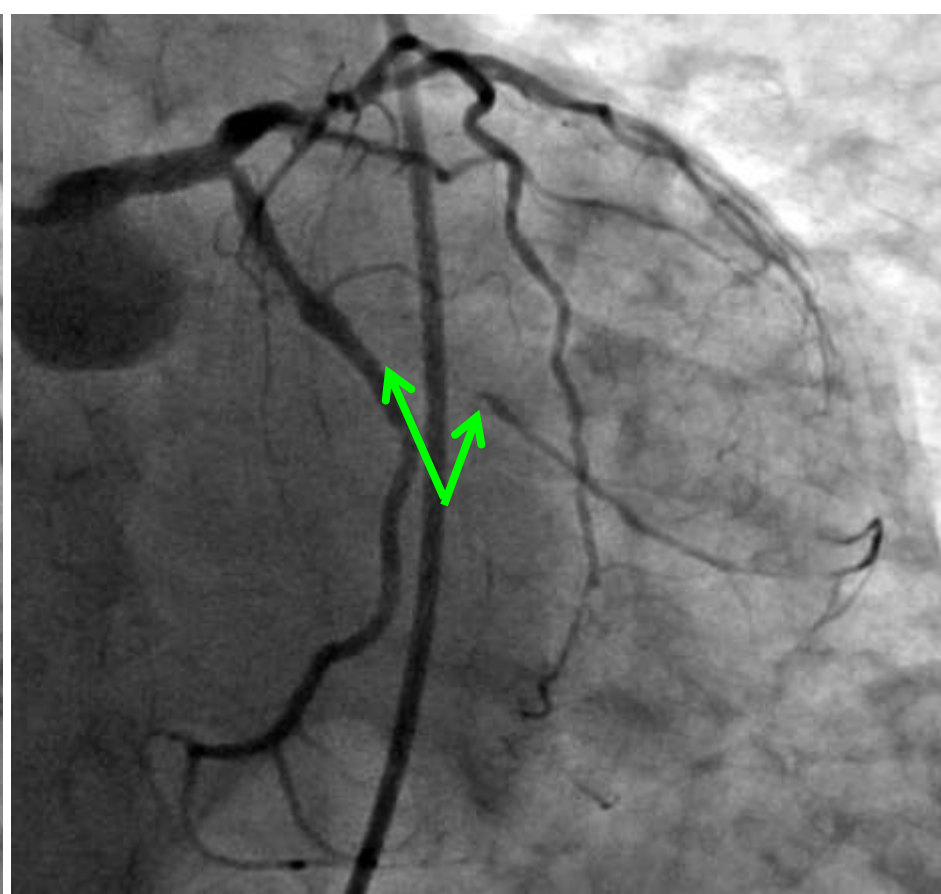
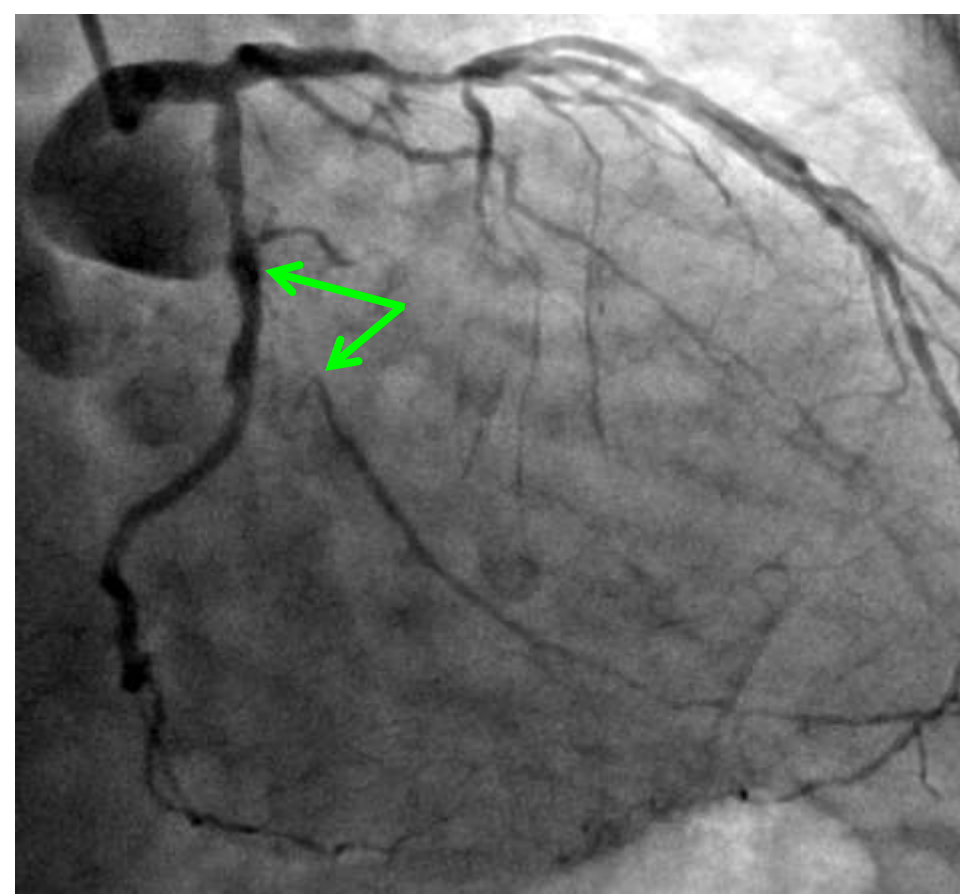
Organizations (alphabetical)

- St Jude Medical (for CONTRAST study)
- Volcano/Philips (for DEFINE-FLOW study)
- ASNC (travel award 2007)
- Canadian CPI (Montréal 2013-15)
- CRF (TCT 2012-15, CPIIS 2014)
- Emory (EPIC-SEC 2015)
- ESC (ETP physiology courses 2013-15)
- KSIC (annual meeting & IPOP 2015)
- PCR (EuroPCR 2015)
- SCAI (travel award 2010)

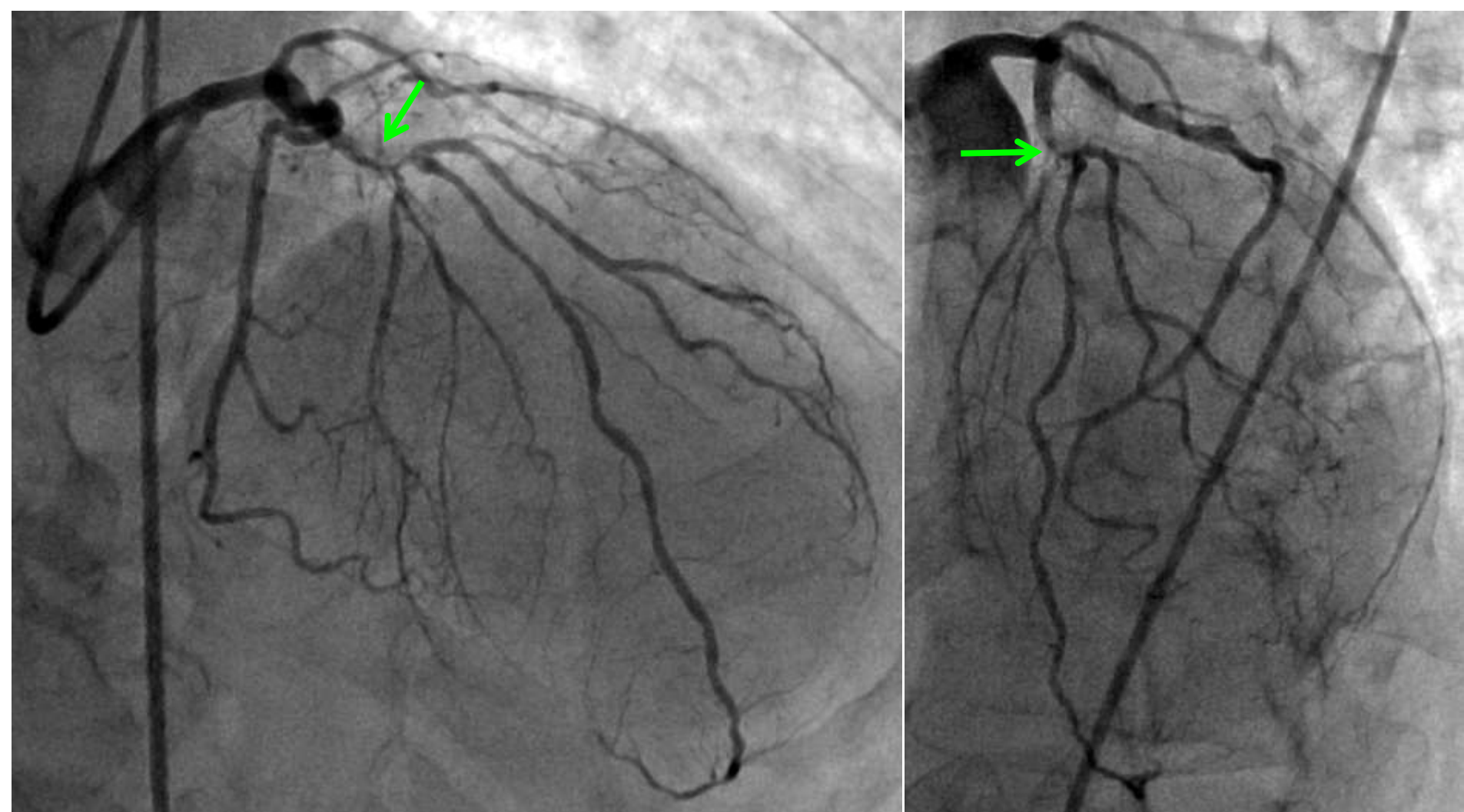
Nils Johnson has *never* personally received *any* money from *any* commercial company. Specifically, he does *not accept* commercial consulting, travel, entertainment, or speaking compensation *of any kind*.

71 year-old man who presented with abnormal SPECT:

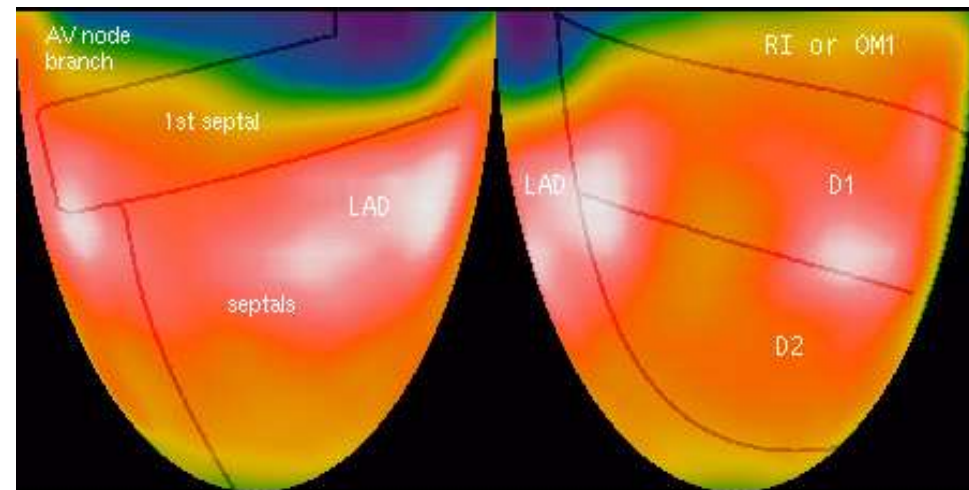
- Modifiable risk factor:
 - Hypertension (treated with beta blocker)
- Symptoms
 - None with typical daily activities
 - Occasional palpitations
 - Non-exertional chest discomfort, but mild and brief
 - Classic but **mild angina once** with heavy exertion
- Workup
 - Unremarkable echocardiogram and Holter
 - Treadmill showed **no angina but 2mm ST depression** after 6:30 minutes of Bruce protocol
 - SPECT showed partially reversible **inferolateral defect**



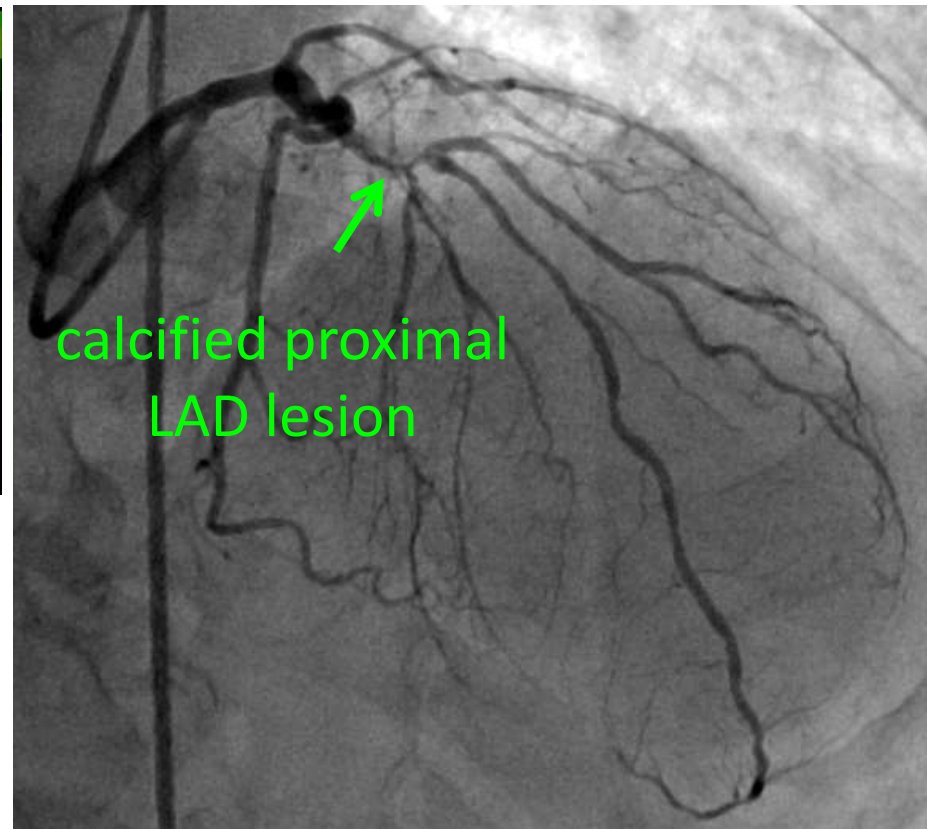
Total **occlusion** of large OM branch
supplied by collaterals
(explains inferolateral SPECT defect)

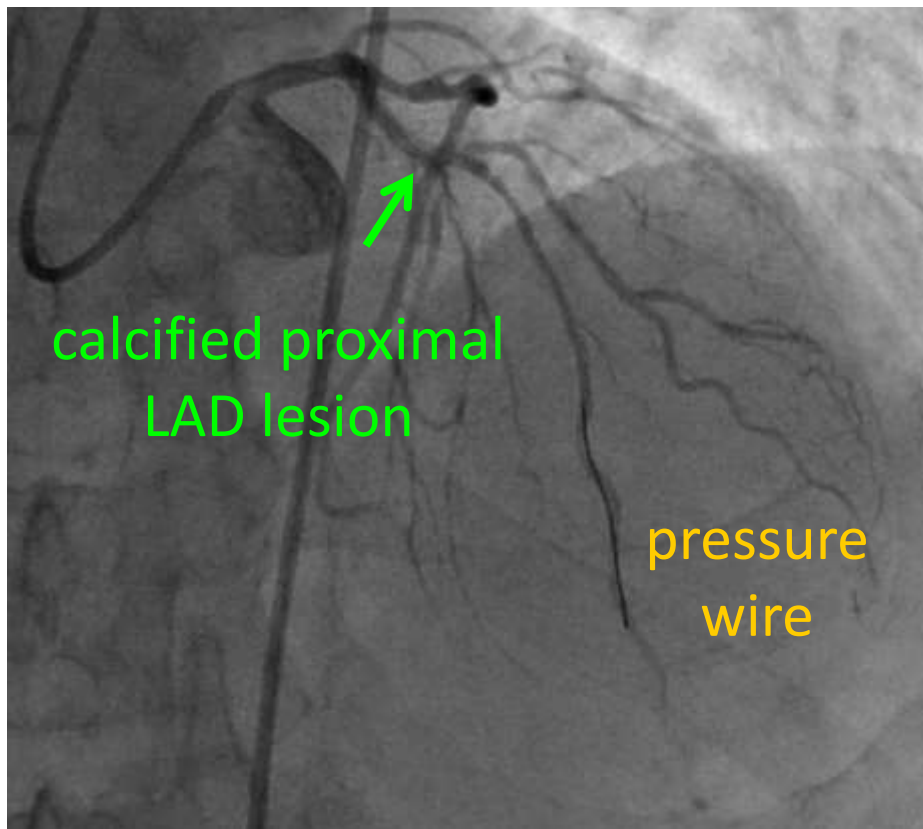
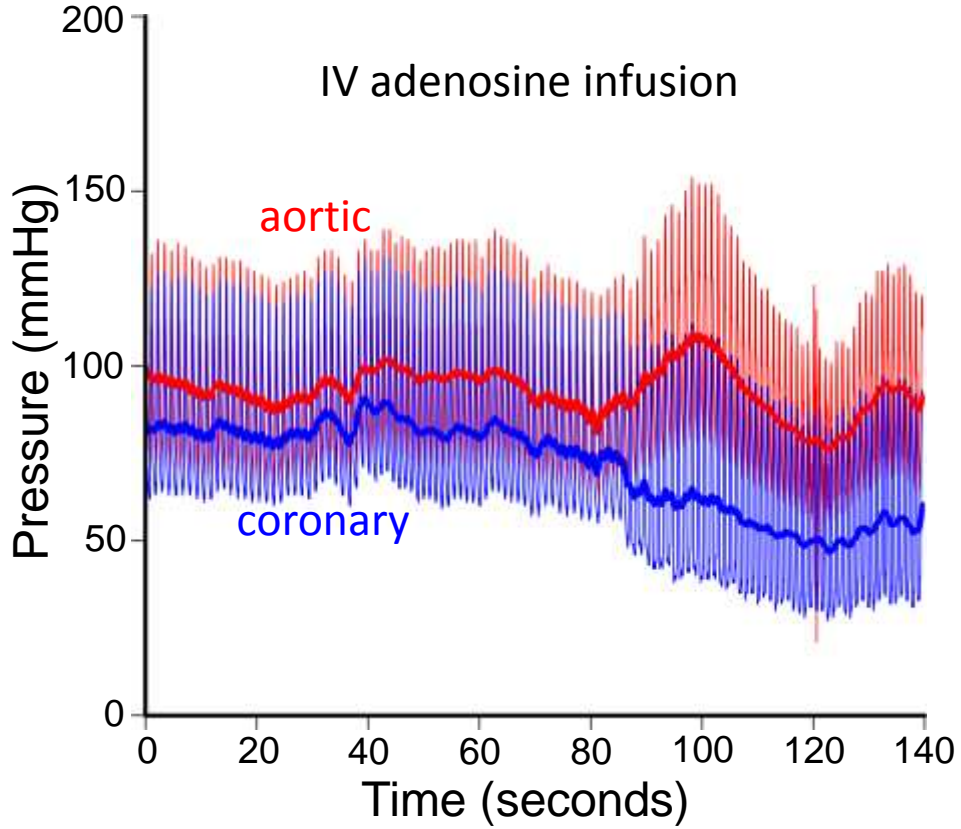


Calcified lesion in proximal LAD

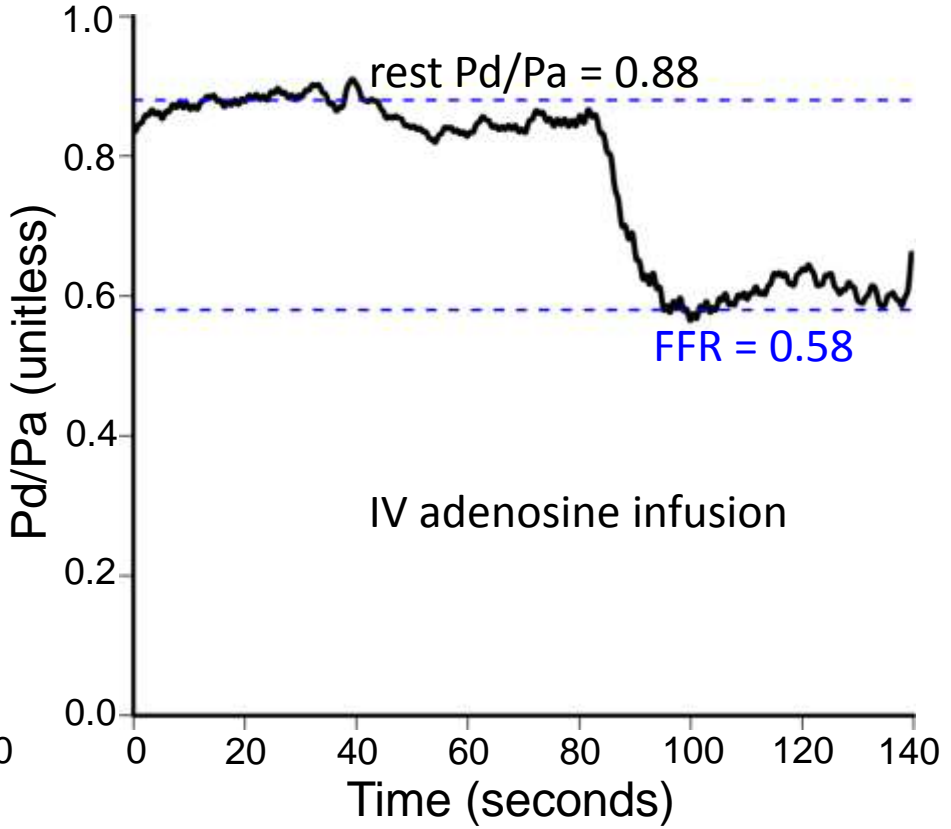
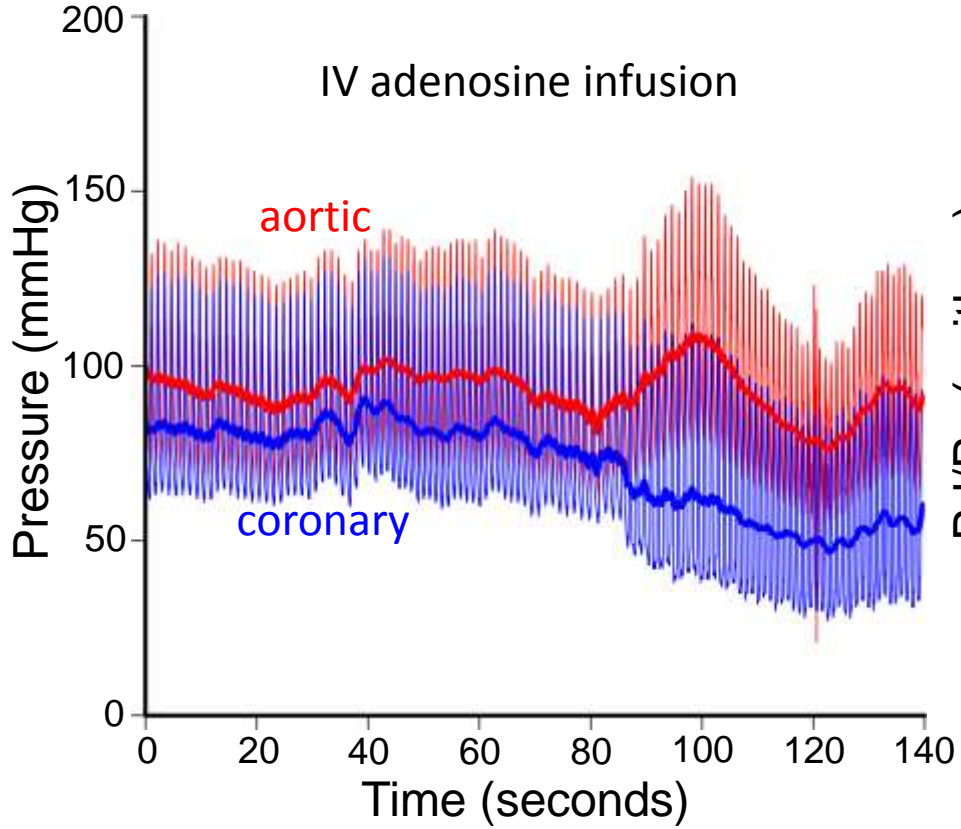


PET: LAD
CFR = 2.6

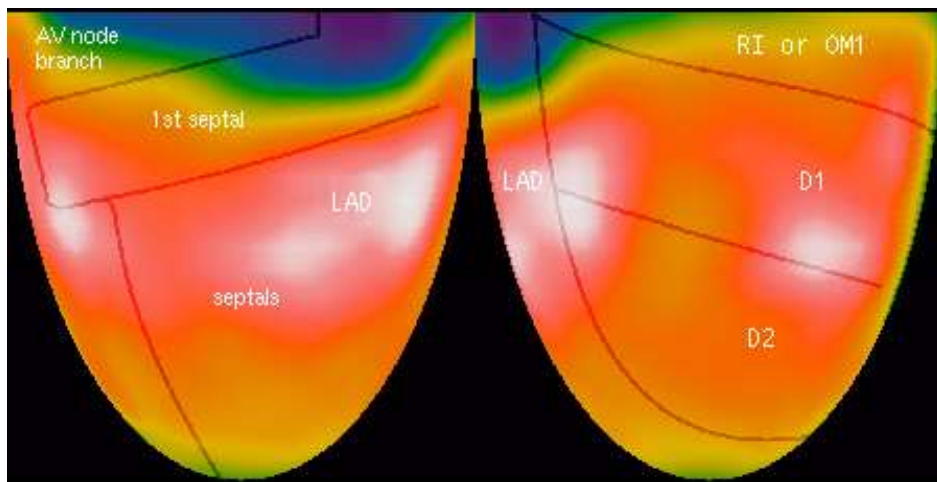




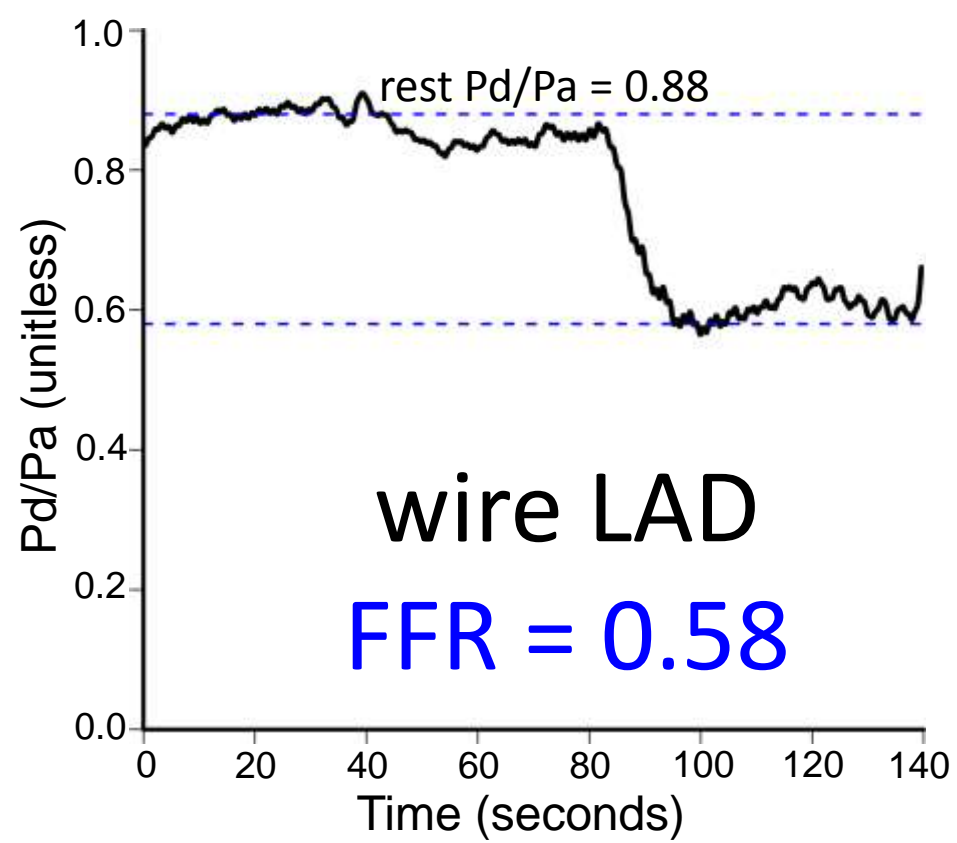
FFR of LAD lesion

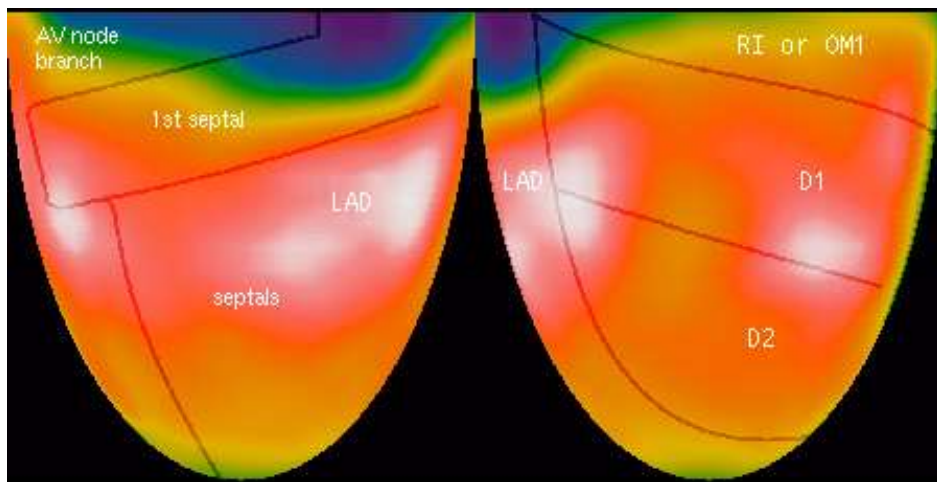


FFR of LAD lesion

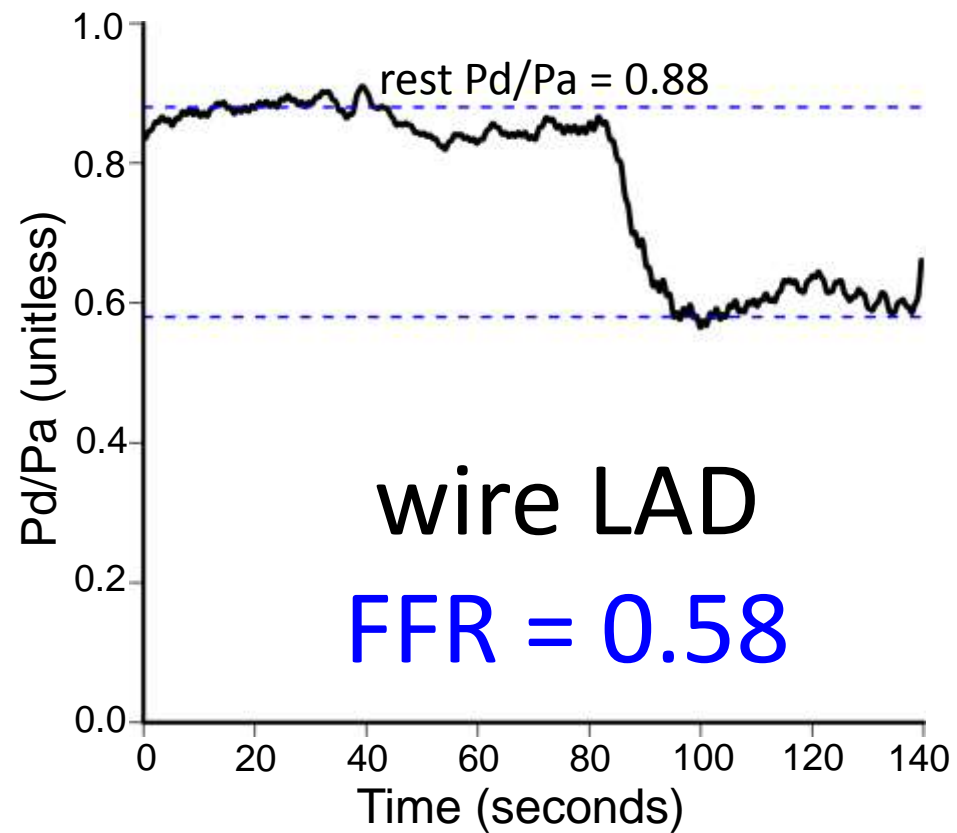


PET: LAD
CFR = 2.6





PET: LAD
 CFR = 2.6



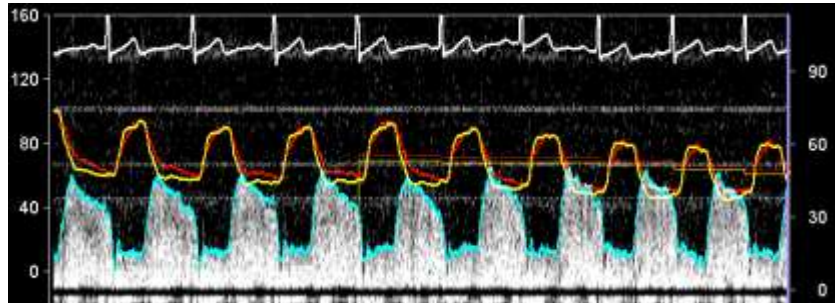
discordance

CFR > 2.0

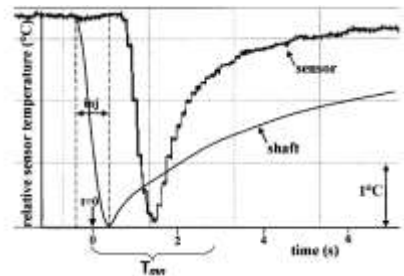
FFR ≤ 0.8

Invasive tools to estimate flow

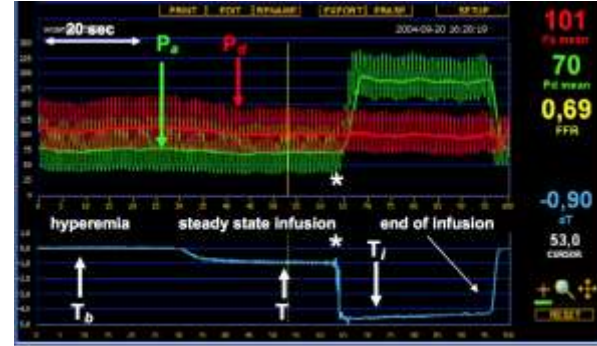
- *Doppler velocity*



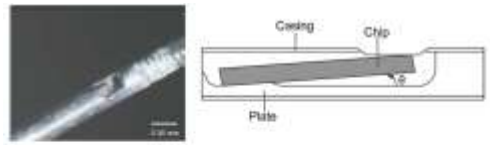
- *Bolus thermodilution*



- Continuous thermodilution

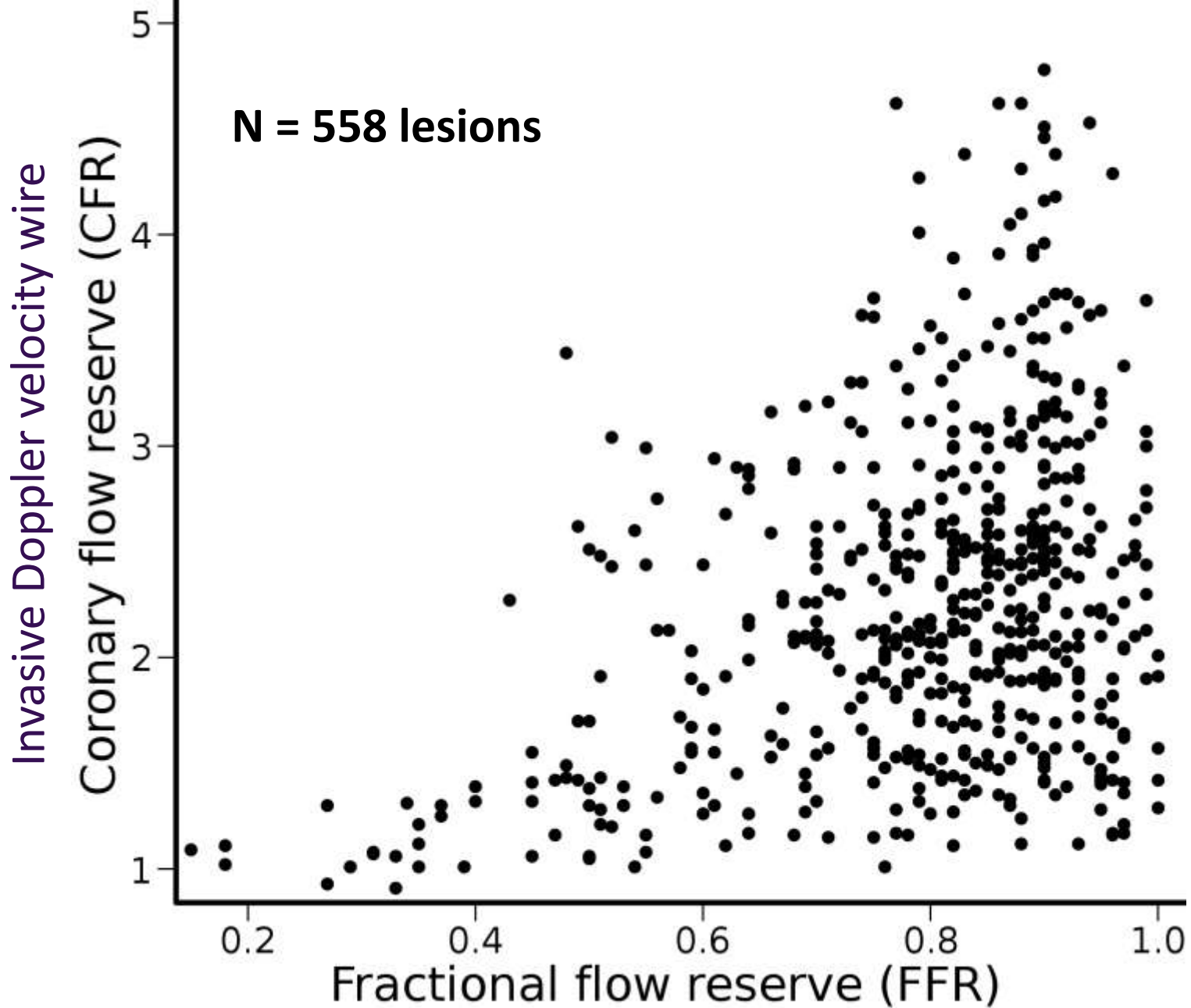


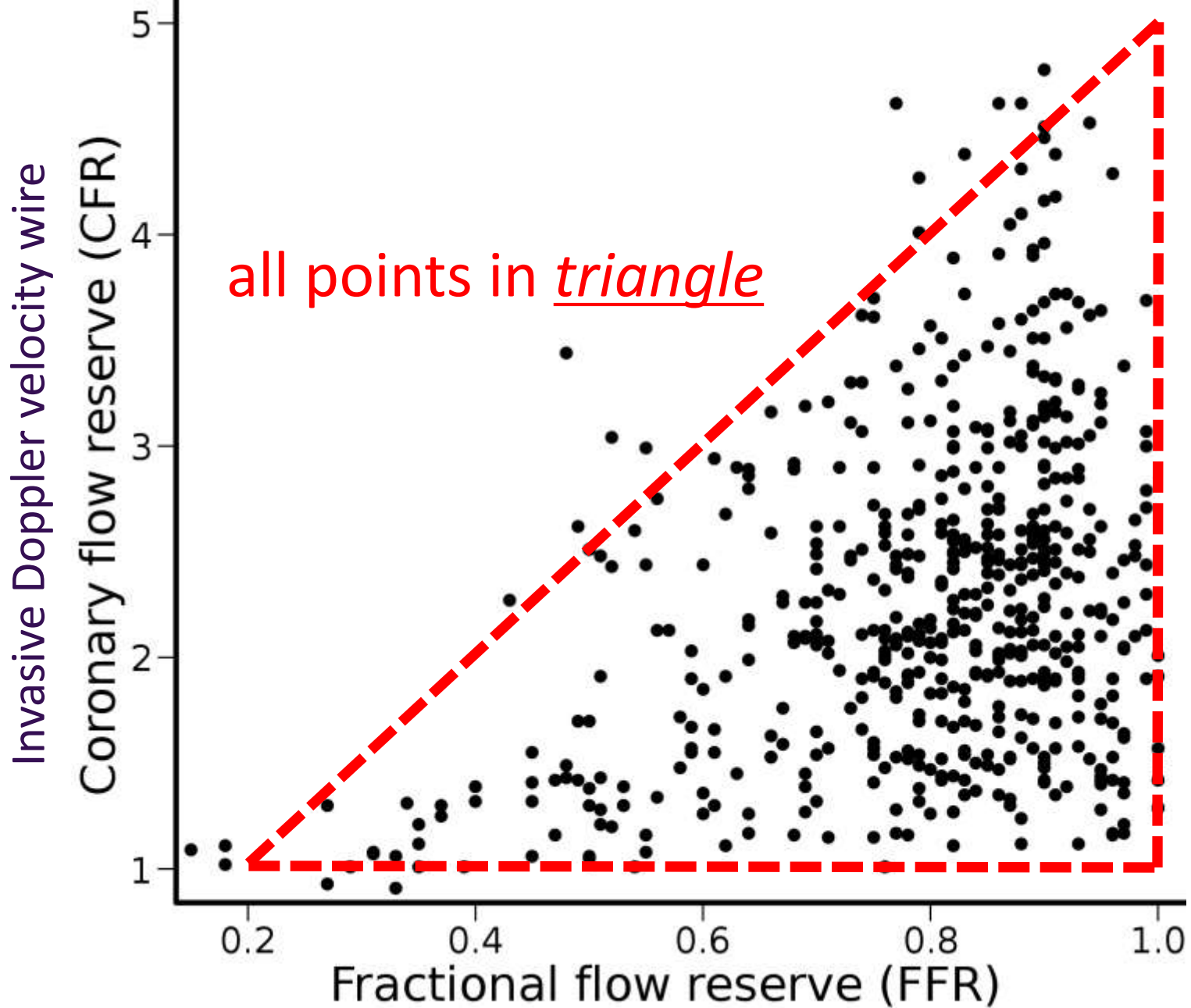
- Thermal anemometry

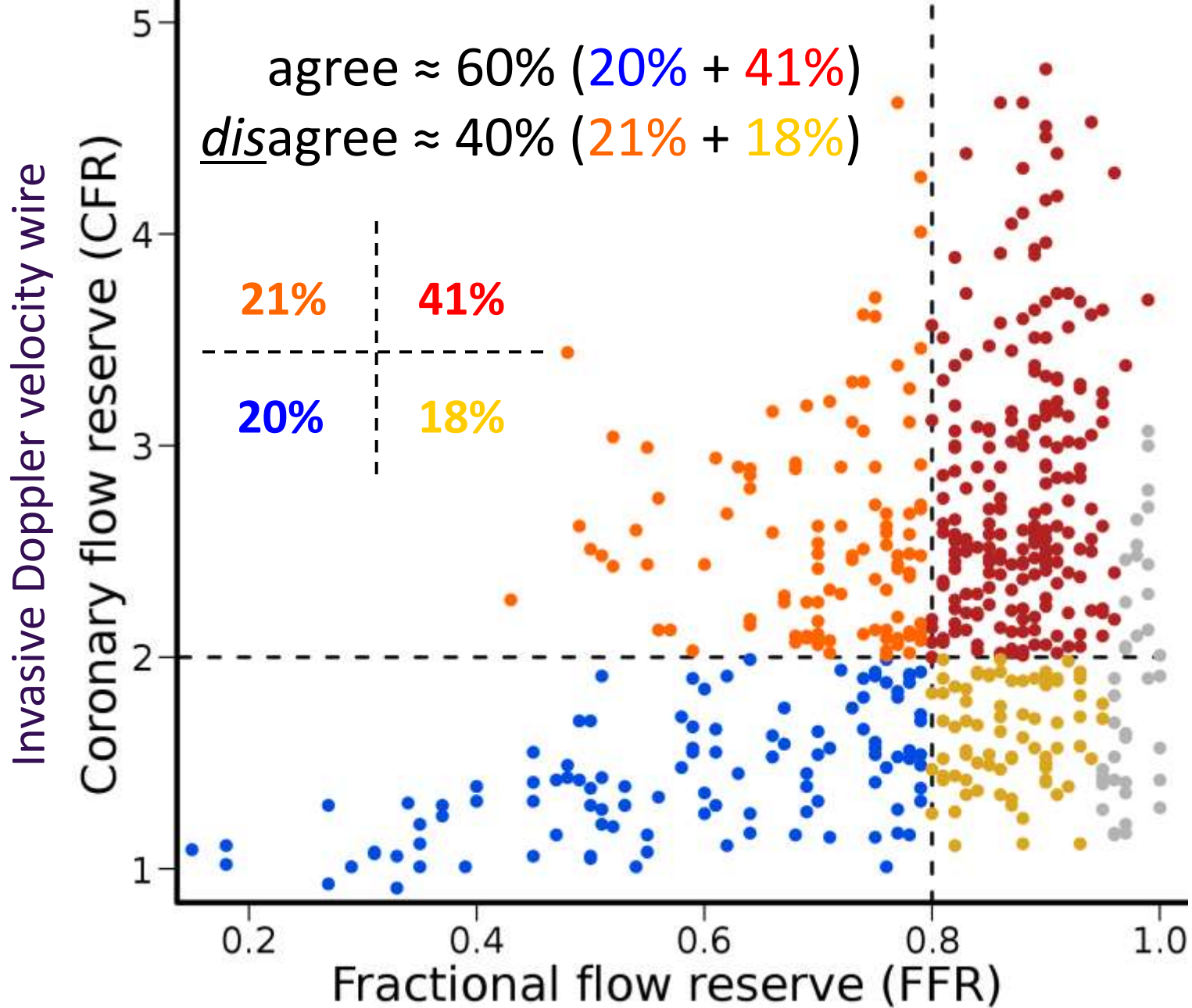


$$Q_b = 15 \times (-4.5 / -0.9) \times 1.08 = 81 \text{ ml/min}$$

Pijls NH, *Circulation*. 105(21):2482, 2002, Figure 2
 Aarnoudse W, *JACC*. 50(24):2294, 2007, Figure 7
 van der Horst A, *Med Eng Phys*. 33(6):684, 2011, Figures 1 and 2







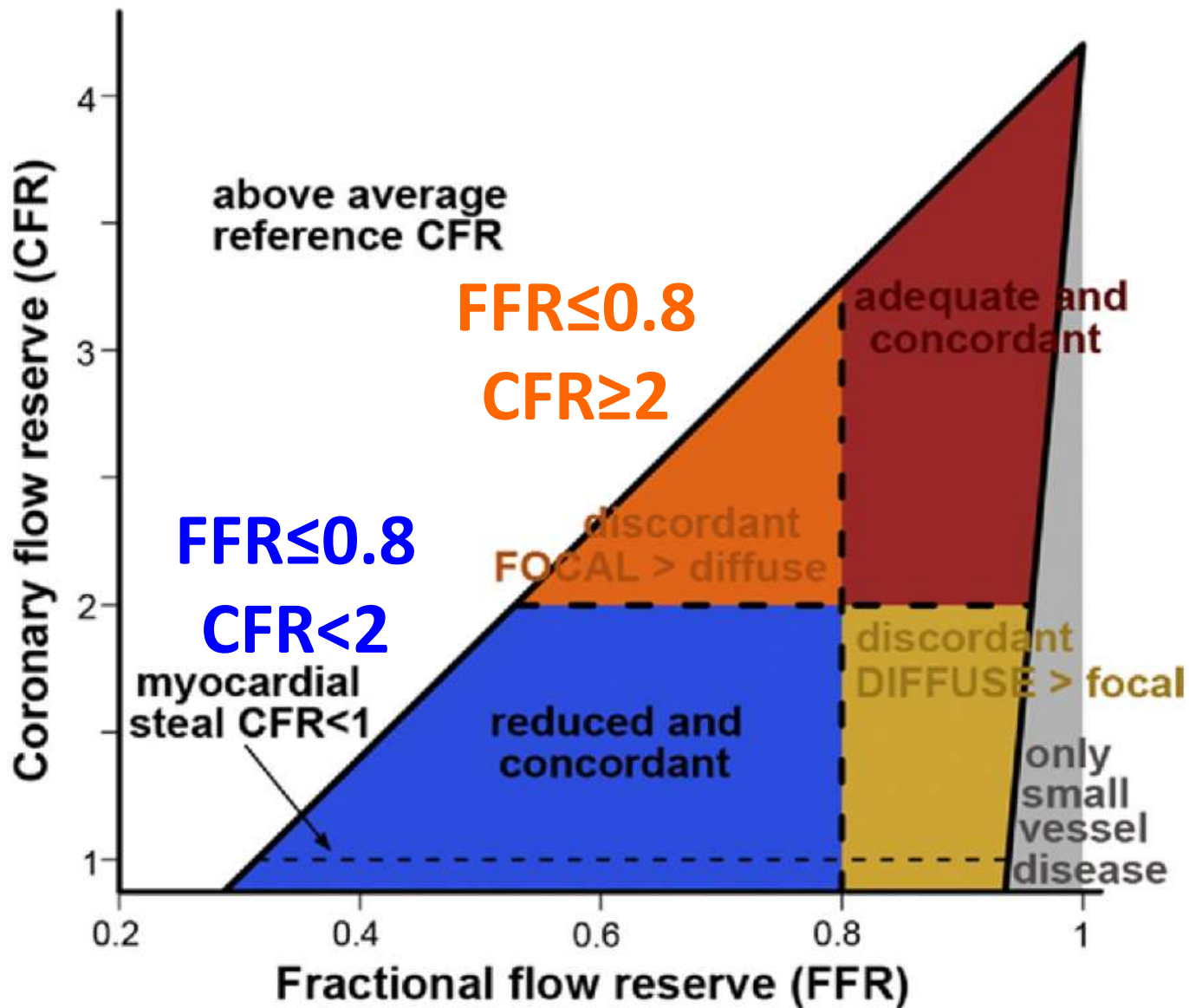
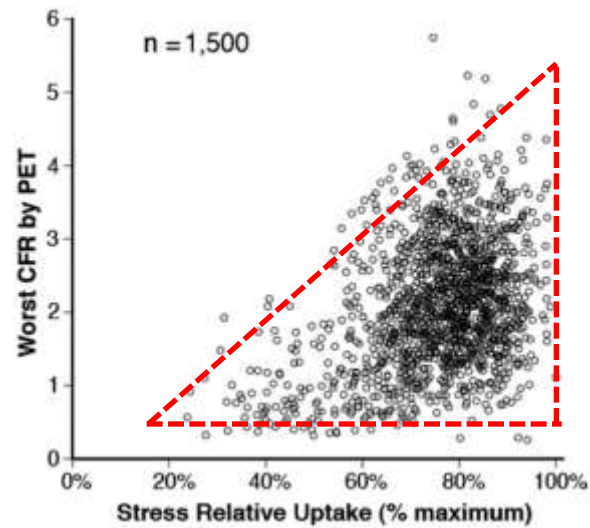


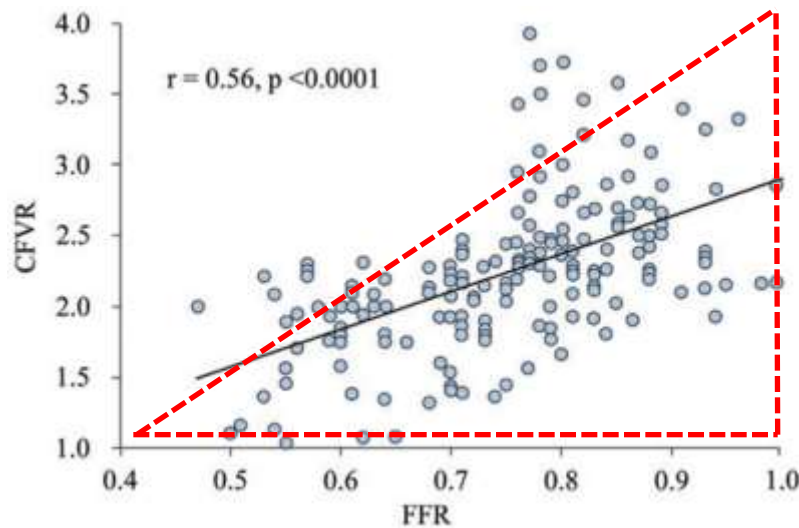
Figure 3. Conceptual Plot of CFR and Fractional Flow Reserve Regions

Universal CFR/FFR **triangle**



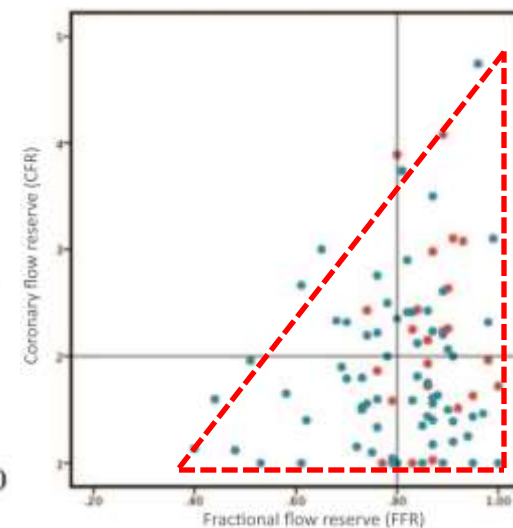
CFR by **PET**
Texas (2012)

43% discordance



CFR by **thoracic echo**
Japan (2014)

35% discordance



CFR by **thermo**
Madrid (2013)

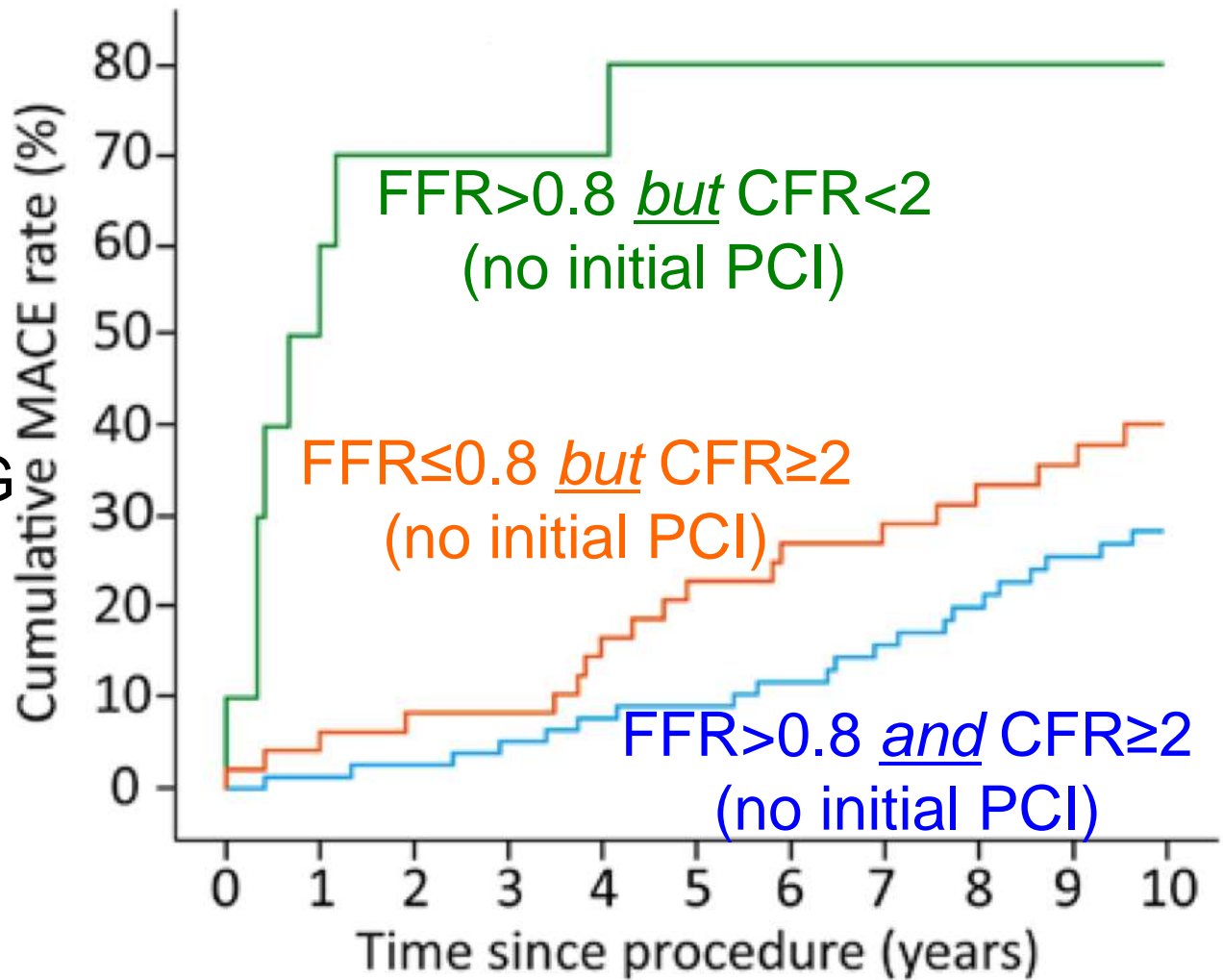
44% discordance

PET = Johnson NP, *JACC Cardiovasc Imaging*. 5(2):193, 2012, Figure 1B

Thoracic echo = Wada T, *Eur Heart J Cardiovasc Imaging*. 15(4):399, 2014, Figure 6

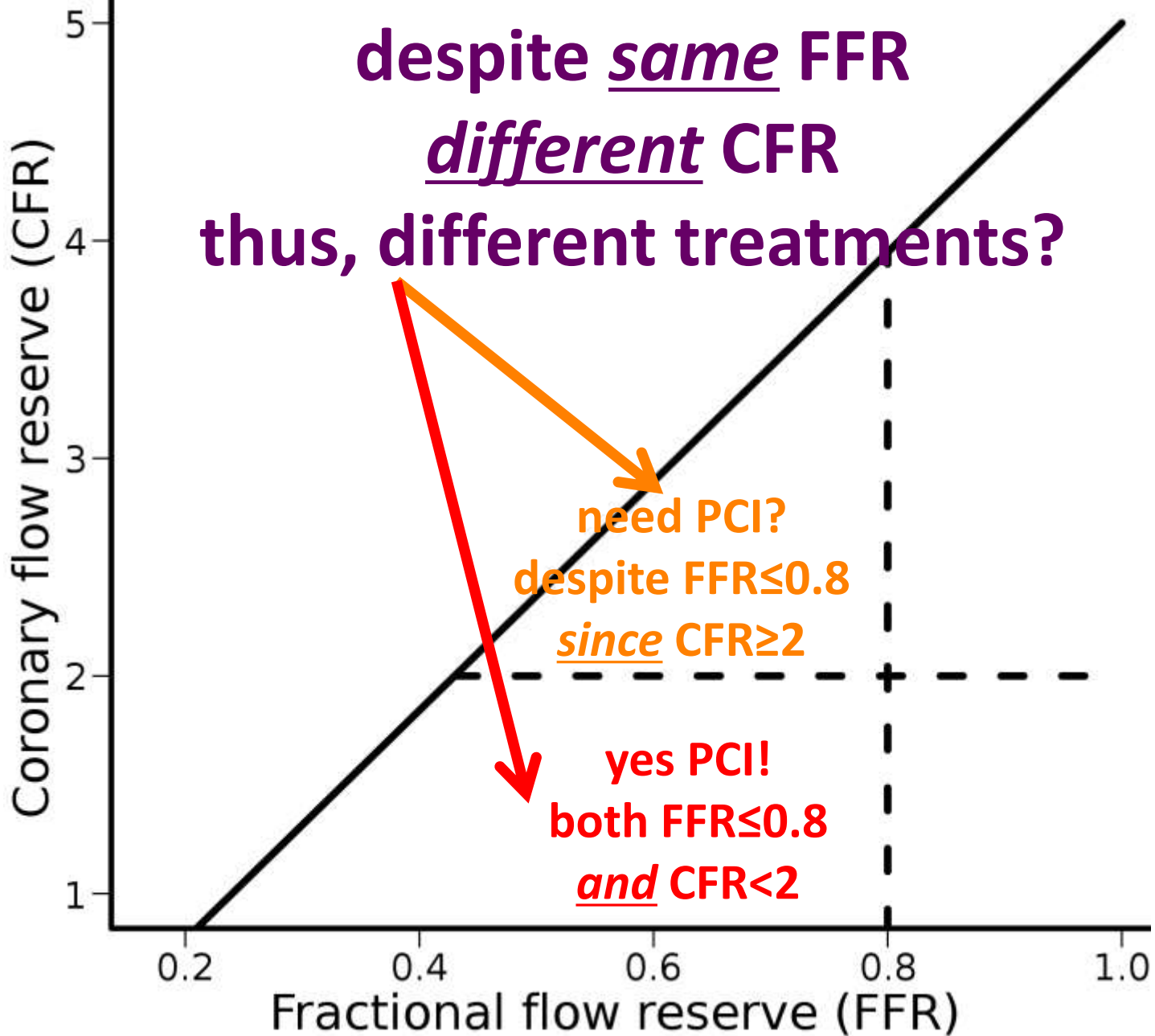
Thermodilution = Echavarría-Pinto M, *Circulation*. 128(24):2557, 2013, Figure 1B

MACE =
death, MI,
or PCI/CABG

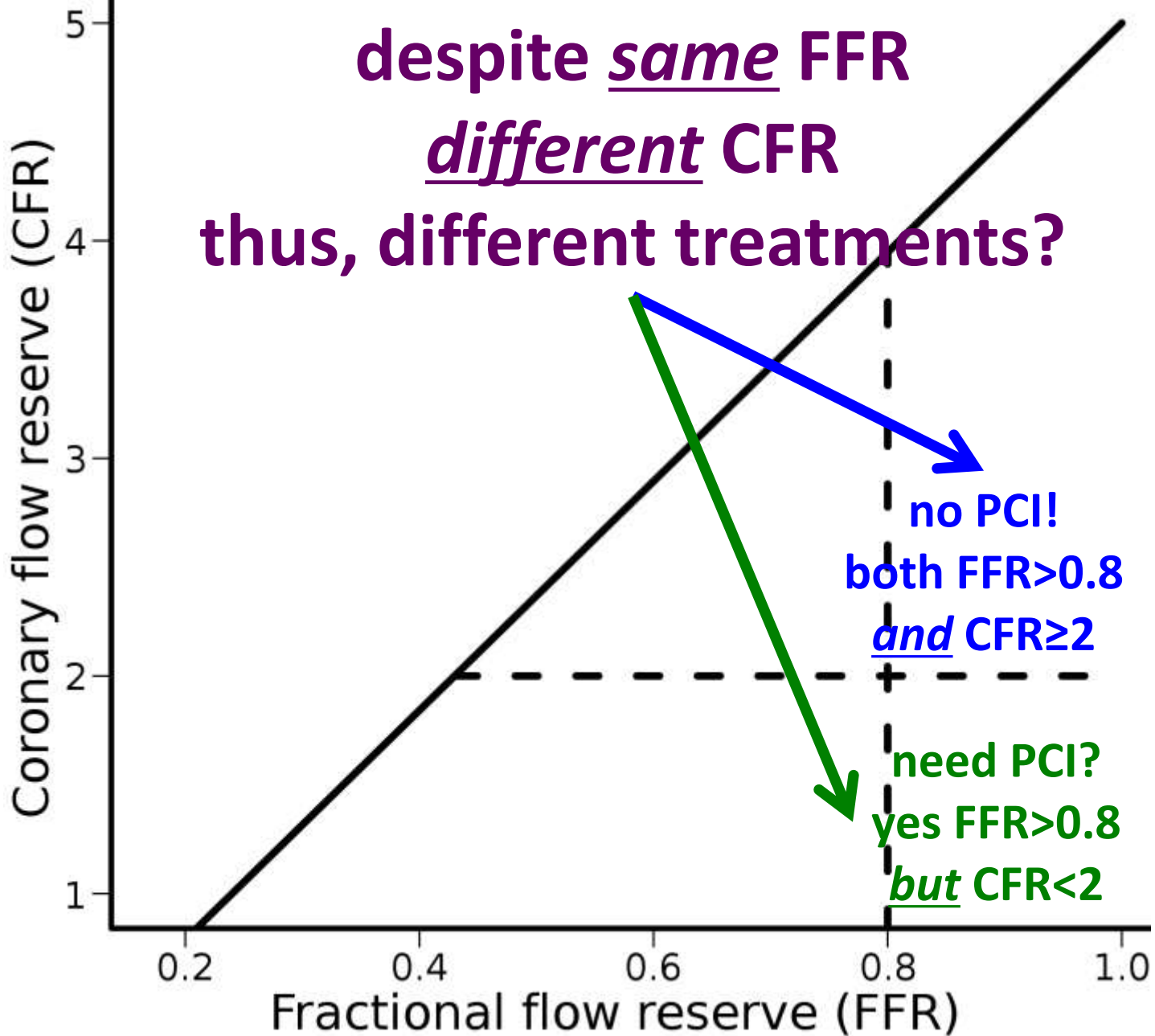


No. at risk:

FFR > 0.80 / CFVR ≥ 2.0	78	75	71	66	57	48
FFR > 0.80 / CFVR < 2.0	10	3	3	2	2	2
FFR ≤ 0.80 / CFVR ≥ 2.0	48	44	40	35	31	24



despite same FFR
different CFR
thus, different treatments?



DEFINE-FLOW study (NCT02328820)

- PI: Nils Johnson (UT), Jan Piek (AMC)
- Sponsors: Volcano/Philips, UT
- Size: 450 patients
- Sites: approximately 10 (international)
- Enrollment: started October 2014
- Tool: ComboWire Doppler (Volcano)
- Endpoint: 2-year MACE
- Design: pilot, *not* randomized

$FFR \leq 0.8, CFR < 2 =$ undergo PCI

$FFR \leq 0.8, CFR \geq 2 =$ defer PCI

$FFR > 0.8 =$ defer PCI



“... **pressure and flow** represent
the **two sides of the same coin**
... from the physiologic point of
view, both techniques are highly
complementary.”

-Kern MJ, De Bruyne B, Pijls NH.
JACC. 30(3):613, 1997. (my **color** and *emphasis* added)