Fractional Flow Reserve: *Practical Set-Up*

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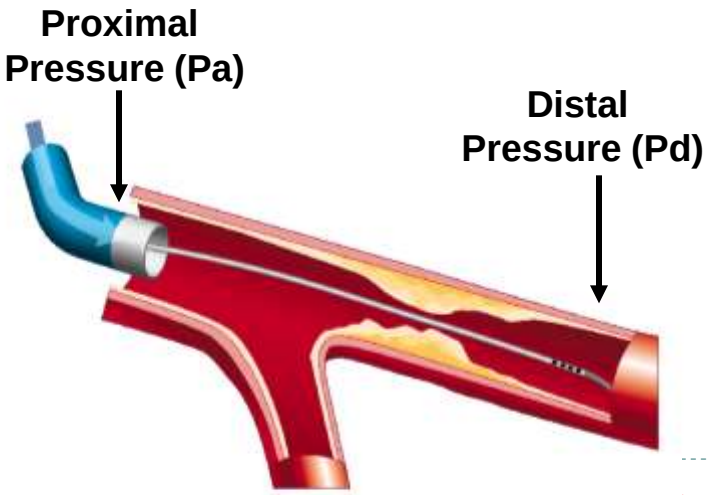
Disclosure Statement of Financial Interest

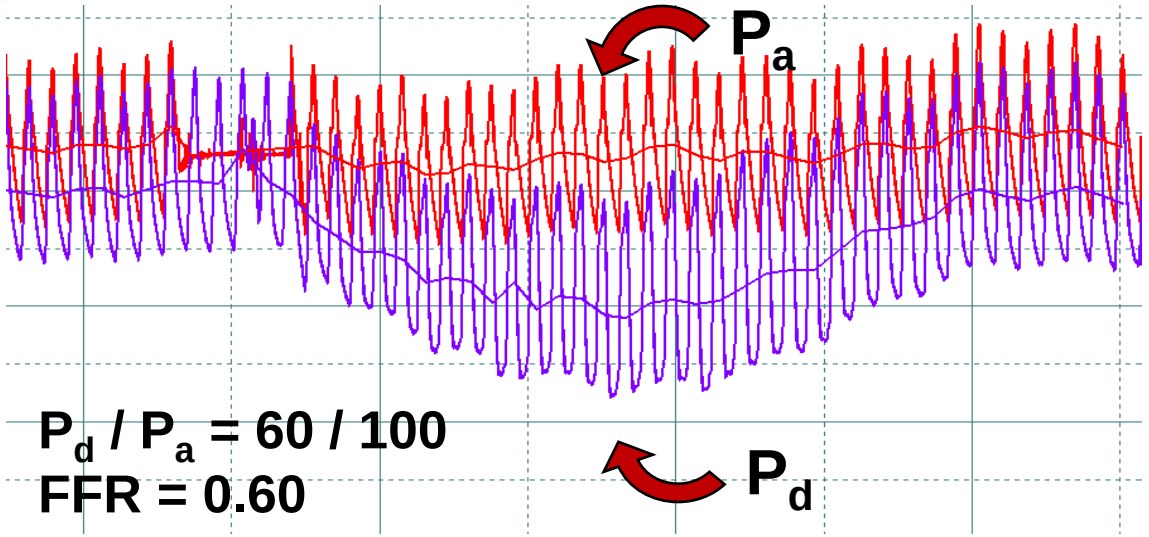
Within the past 12 months, I or my spouse/partner have had a financial interest /arrangement or affiliation with the organization(s) listed below

Affiliation/Financial Relationship	Company
Grant/ Research Support:	St. Jude Medical
Grant/ Research Support:	NIH-R01 HL093475 (PI)
Consulting Fees/Honoraria:	Medtronic
Major Stock Shareholder/Equity Interest:	
Royalty Income:	
Ownership/Founder:	
Salary:	NIH-R01 HL093475 (PI)
Intellectual Property Rights:	
Other Financial Benefit (minor stock options):	HeartFlow

FFR: *Gold Standard for Identifying Ischemia*



FFR = P_d / P_a
during maximal flow



P_d / P_a = 60 / 100
FFR = 0.60

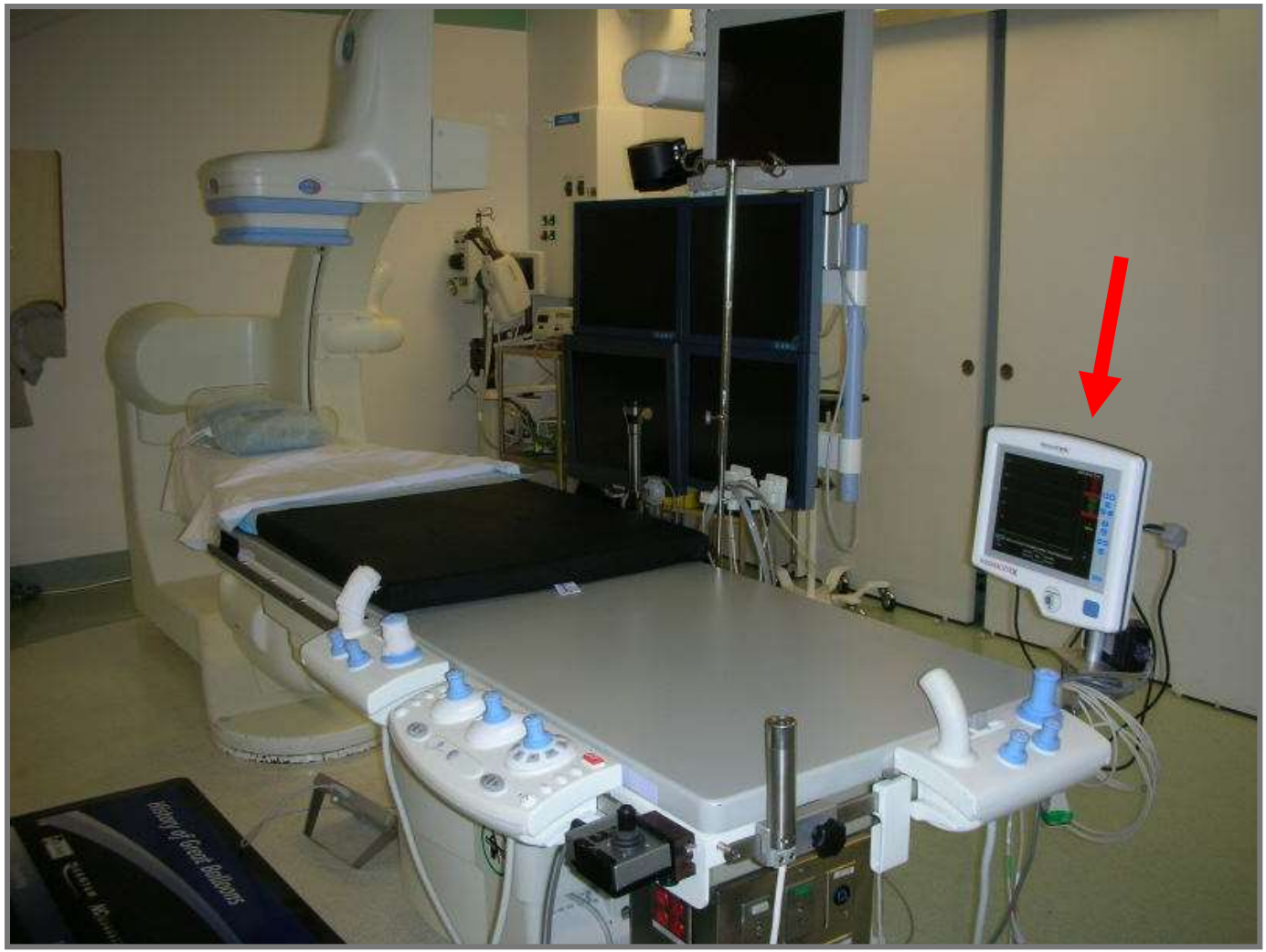
How to Measure FFR

Incorporating Physiology:

- Educating your assistants
  - Limitations of angiography
  - Benefits of physiology
  - Measure FFR in 10 consecutive cases
  - Obey FFR result

- Streamlining set-up
  - Identify point person
  - Post medication mixing and dosing instructions
  - Keep analyzer connected at all times or use “wireless” system

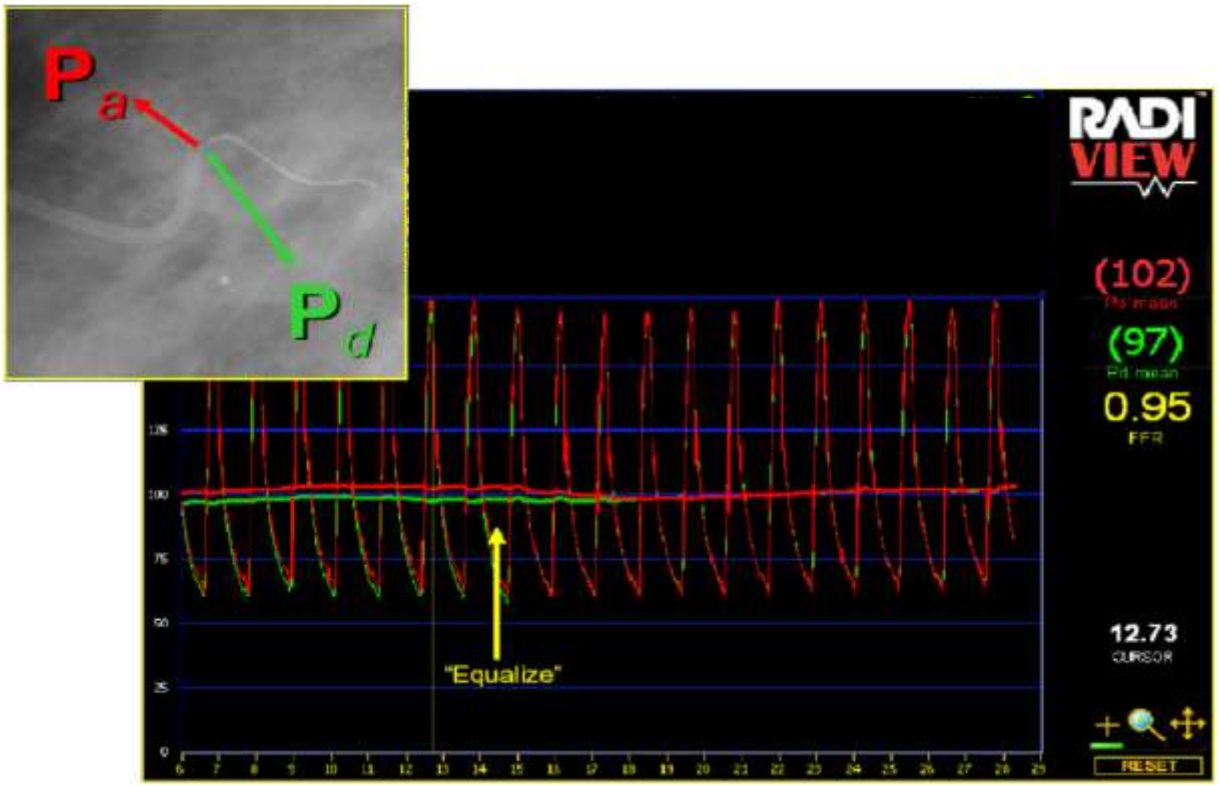
Incorporating Physiology



Performing FFR:

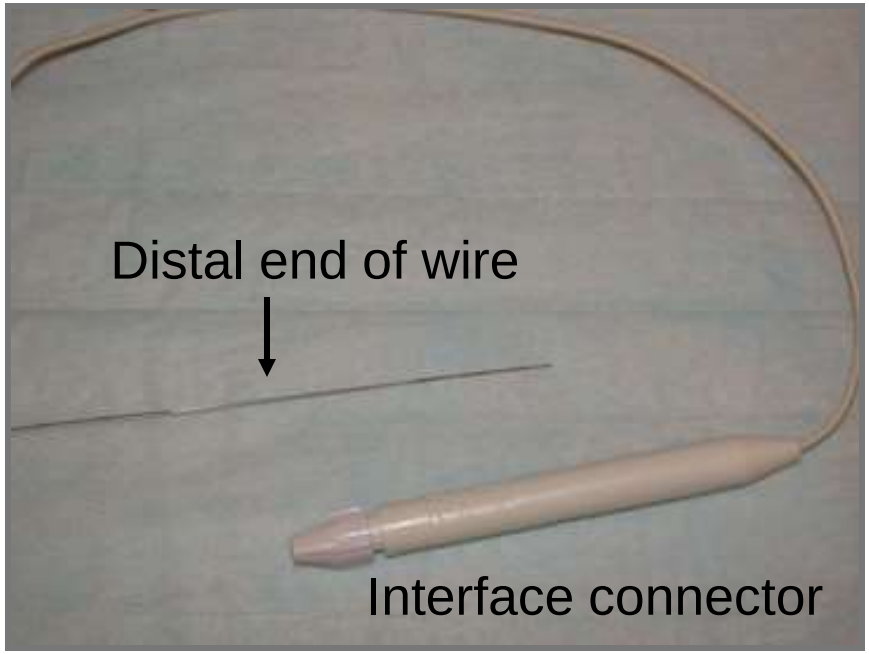
1. IC NTG and IV heparin/bivalirudin

2. Equalize Pressures



Performing FFR:

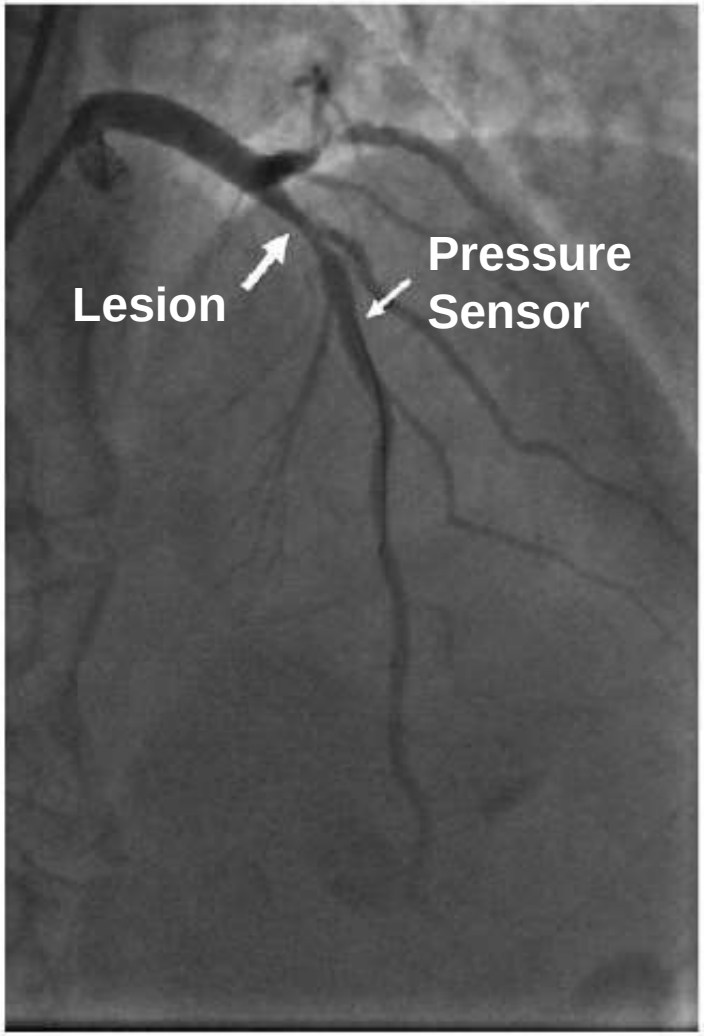
Wiring the Lesion



Consider disconnecting the wire from the interface connector

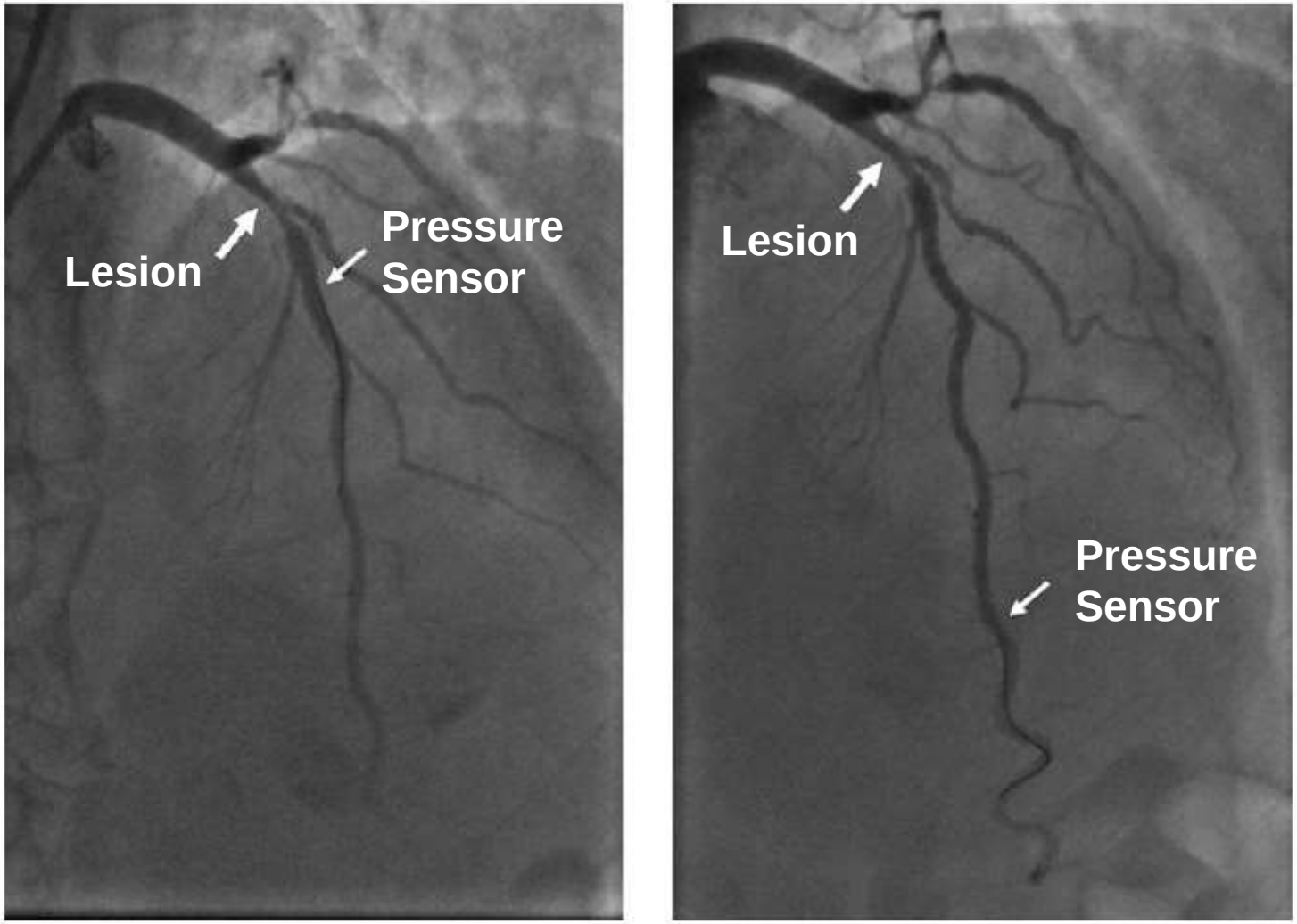
Can use exchange catheter to more safely position pressure wire

Performing FFR:



Rodes-Cabau, et al. Am J Cardiol 2011;108:483-90.

Performing FFR:



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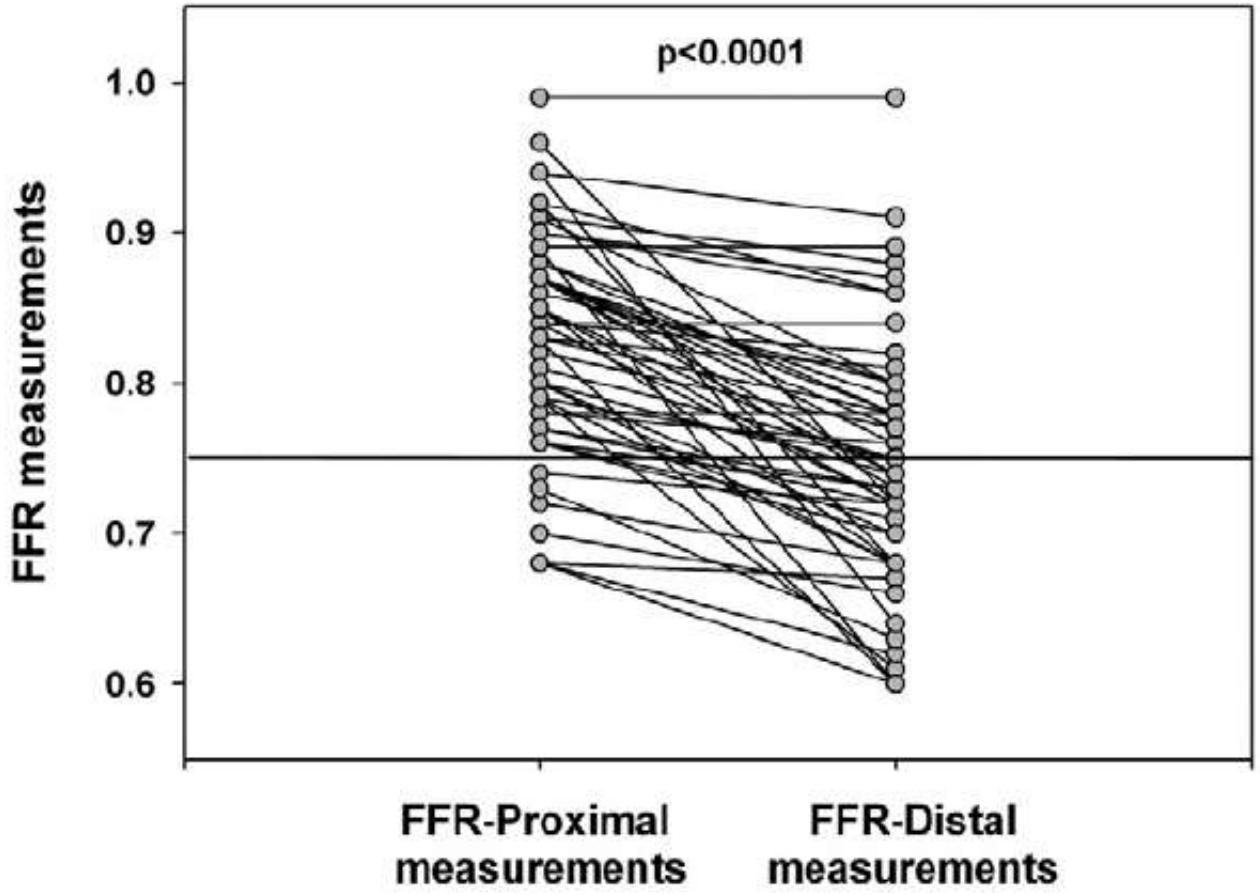
Performing FFR:

FFR measured in 100 patients with proximal-mid lesions with pressure sensor positioned just beyond the lesion and then in the distal vessel



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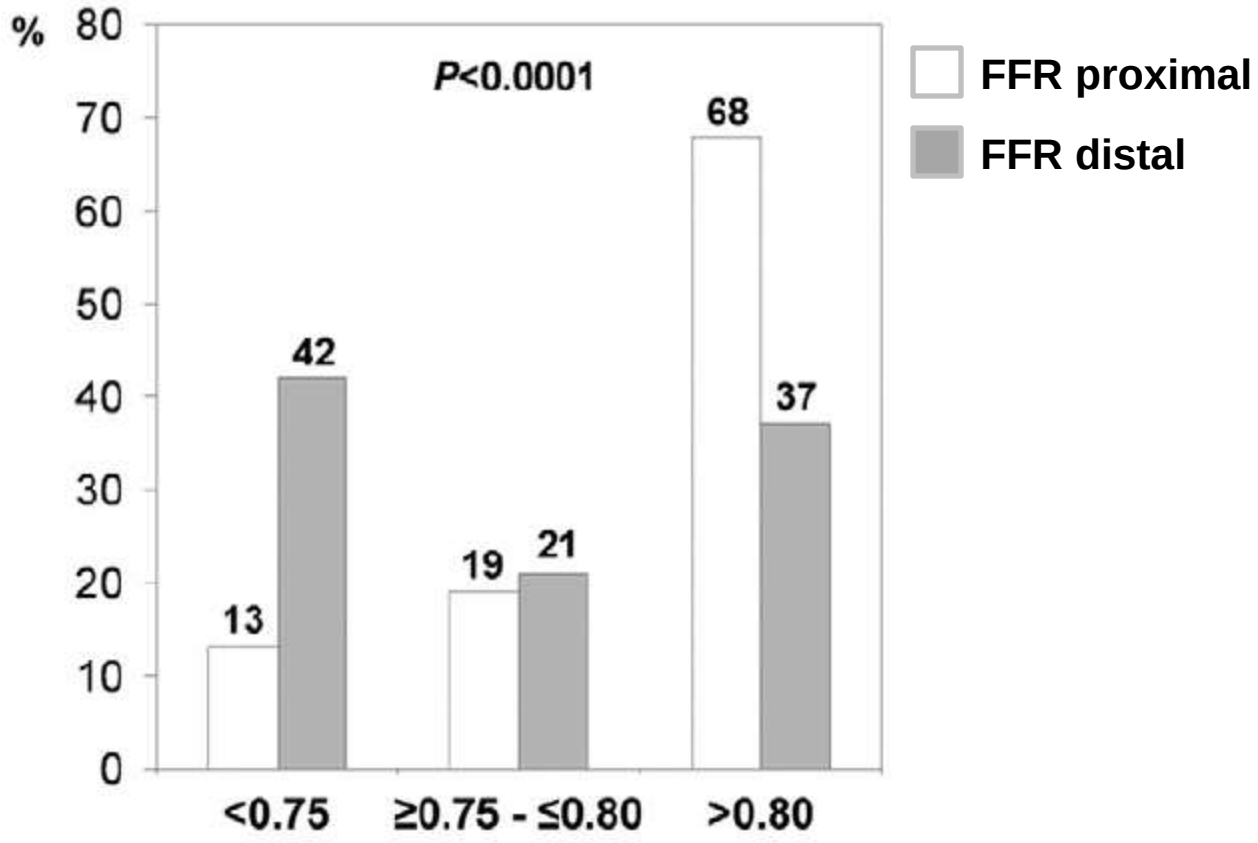
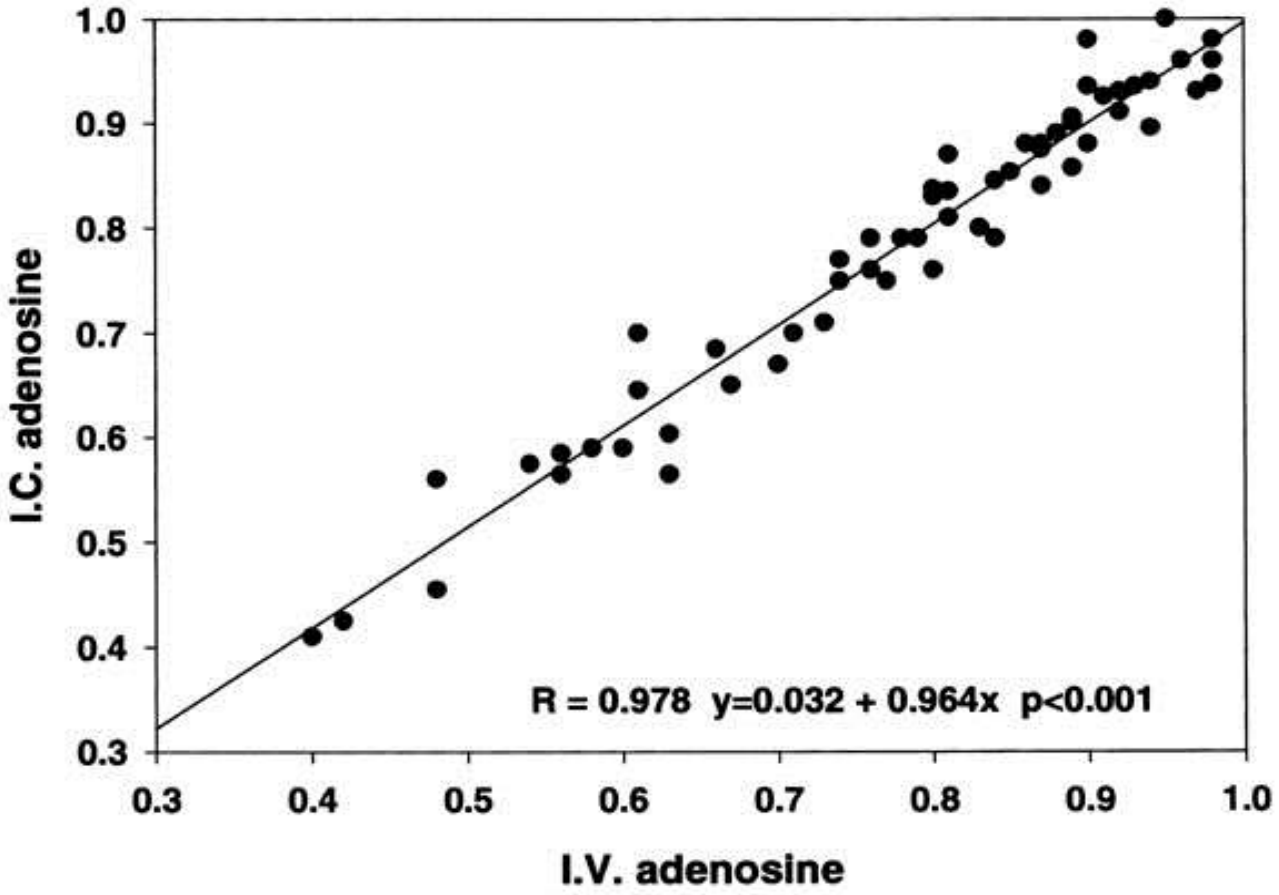


Rodes-Cabau, et al. Am J Cardiol 2011;108:483-90.

Inducing Hyperemia:

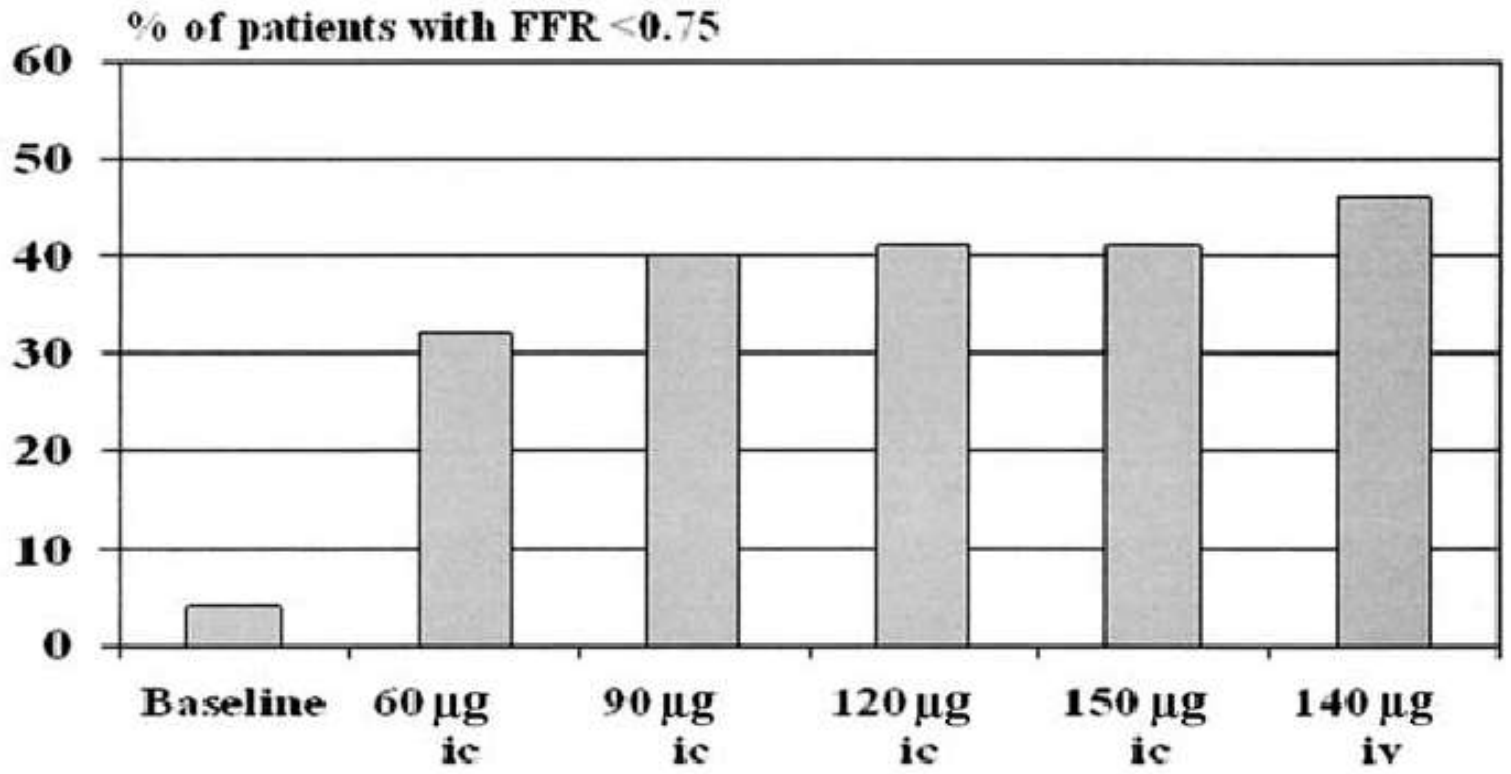
IC vs. IV Adenosine



Jeremias et al. Am Heart J 2000;140:651-657.

Inducing Hyperemia:

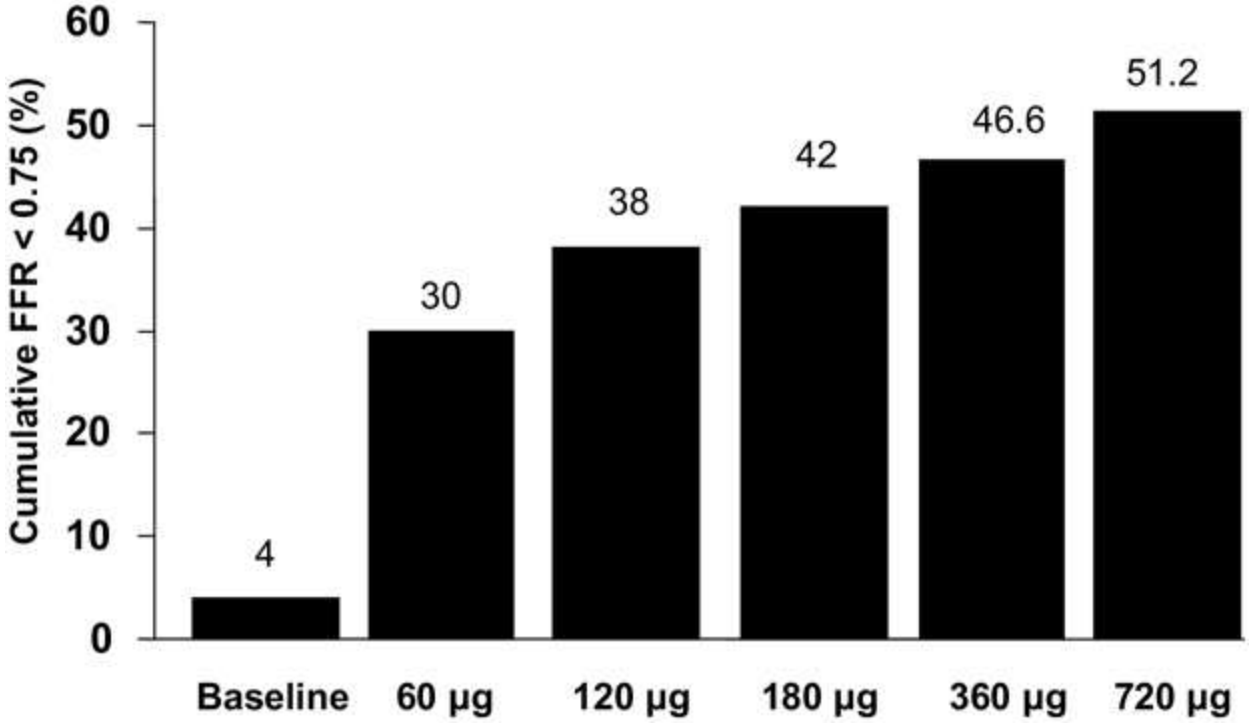
FFR measured in 50 patients with intermediate lesions



Casella et al. Am Heart J 2004;148:590-5.

Inducing Hyperemia:

FFR measured in 46 patients with intermediate lesions and increasing doses of IC Adenosine were administered



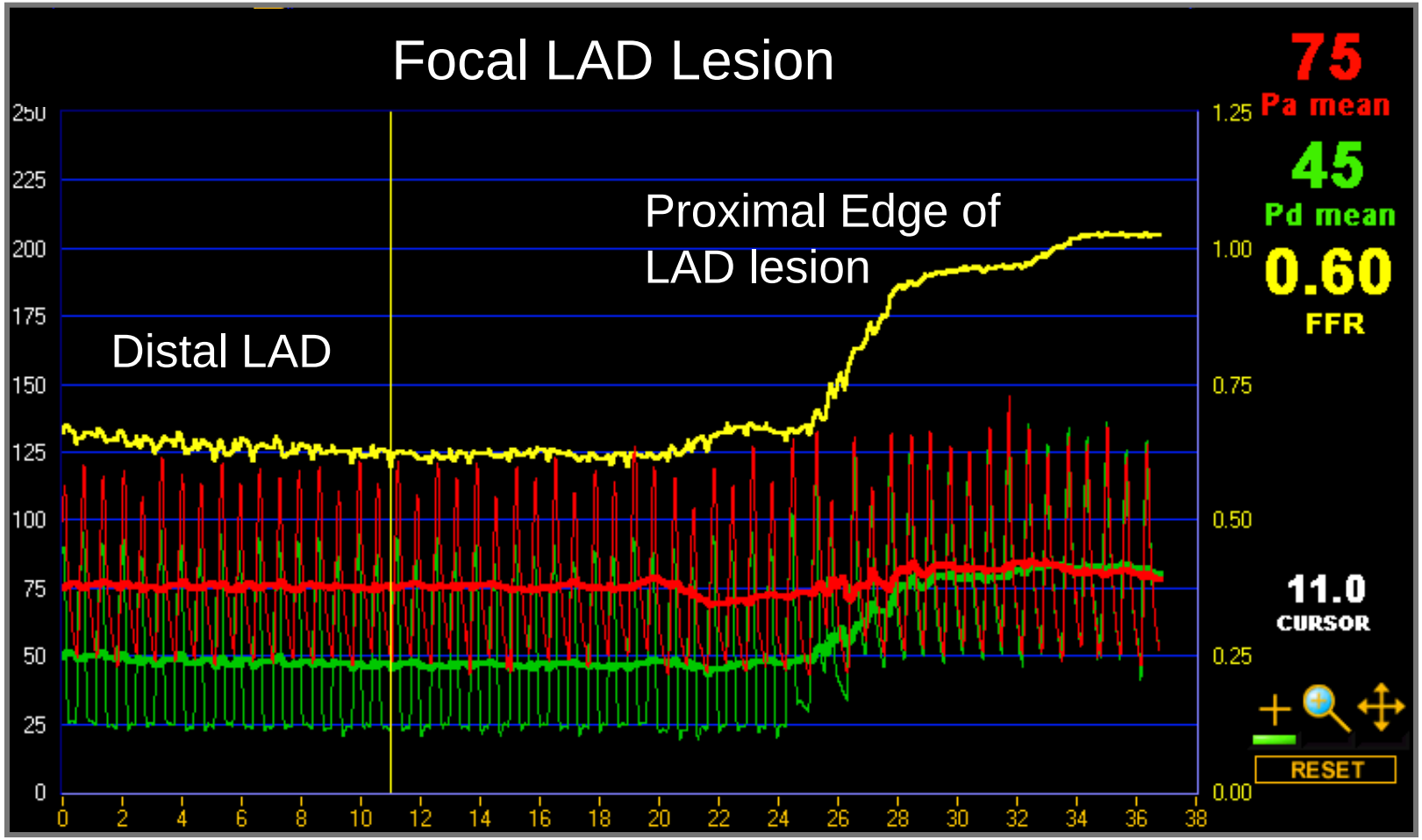
De Luca, et al. J Am Coll Cardiol Intv 2011;4:1079-84

Inducing Hyperemia:

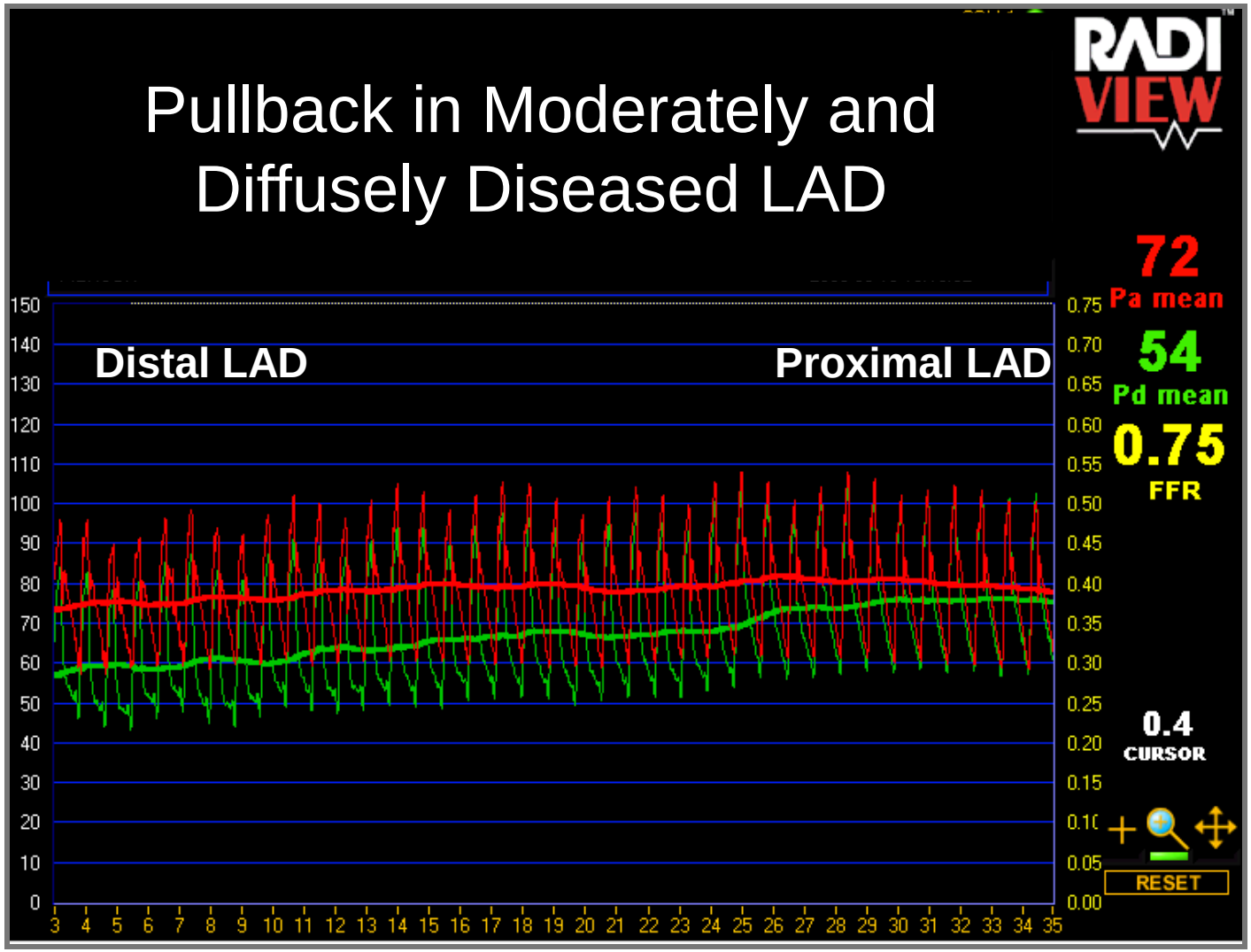
- Intracoronary adenosine
  - Short-lasting peak effect (~5-15 seconds)
  - Don’t use a guiding catheter with sideholes
  - If one suspects inadequate hyperemia, then increase dose (>200 µg) or use intravenous adenosine
- Intravenous adenosine
  - Ideally administered via central vein
  - Can consider higher doses (>140 ug/kg/min) if given peripherally and uncertain about hyperemia
  - If the patient doesn’t develop symptoms and/or hemodynamic changes, the patient is likely not receiving IV adenosine

Performing FFR:

Pressure Pullback



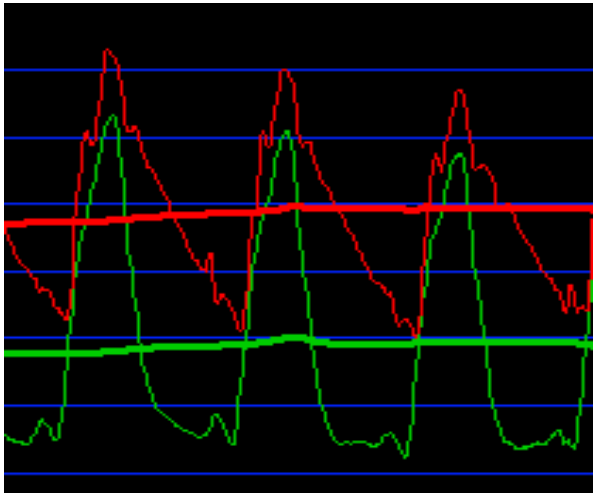
Performing FFR:



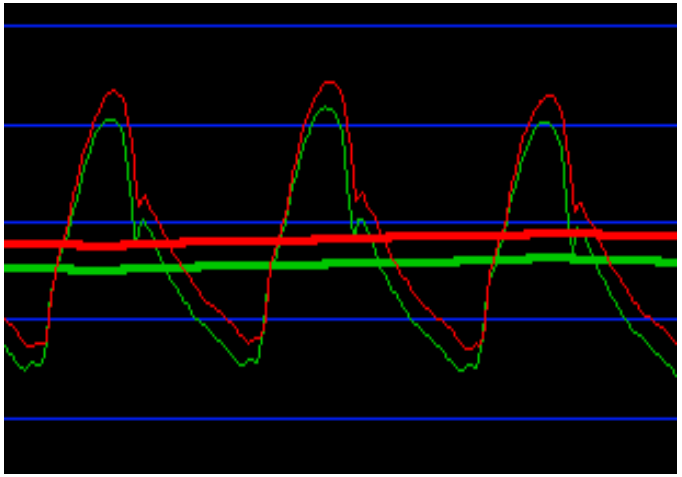
Pressure Drift:

Recognizing Drift

True Gradient



Drift



After pressure wire pullback, if there is a >0.05 difference between pressure wire and guide catheter, re-equalize and re-measure FFR, particularly if FFR is in "grey zone".

Catheter Issues:

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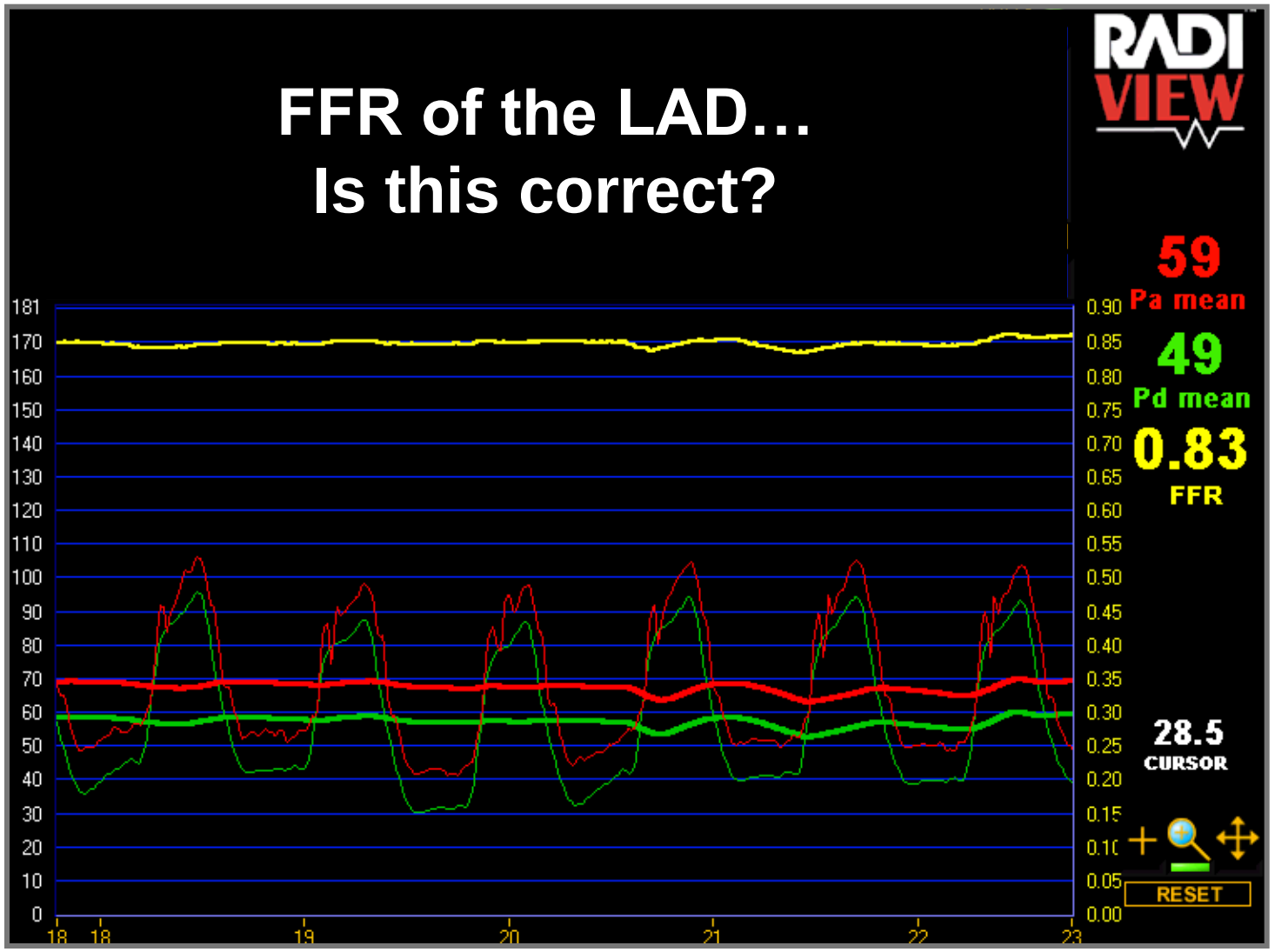

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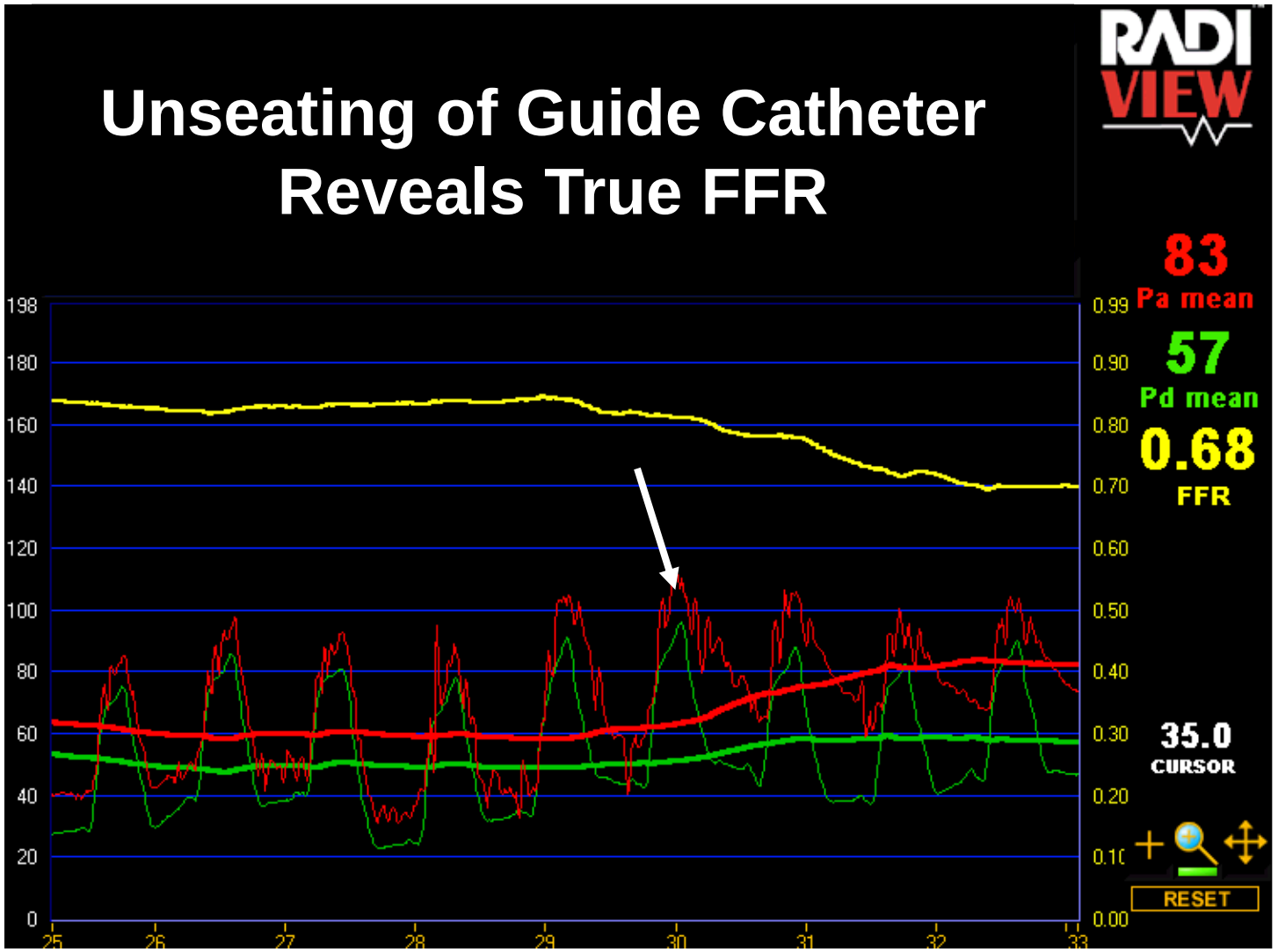
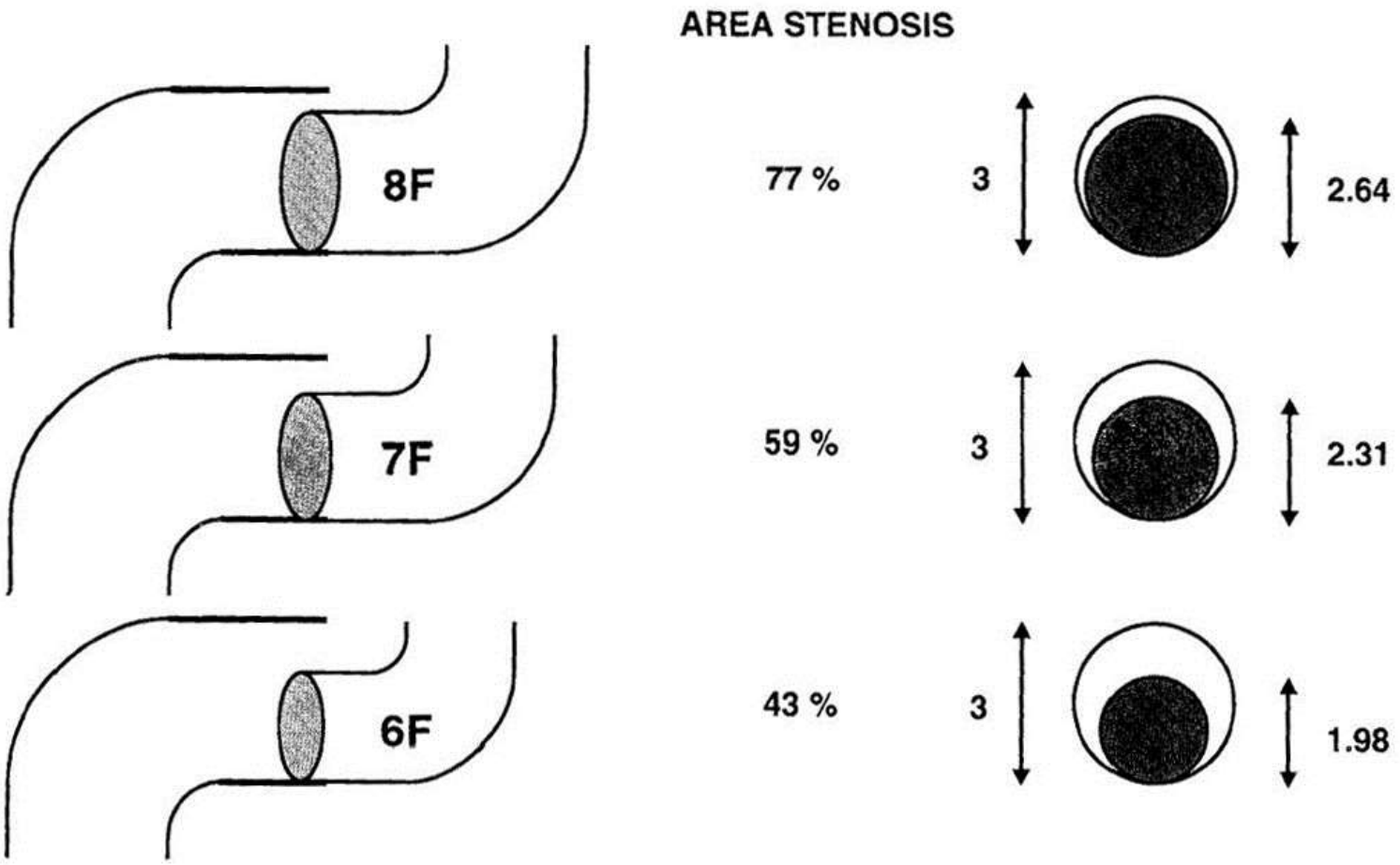
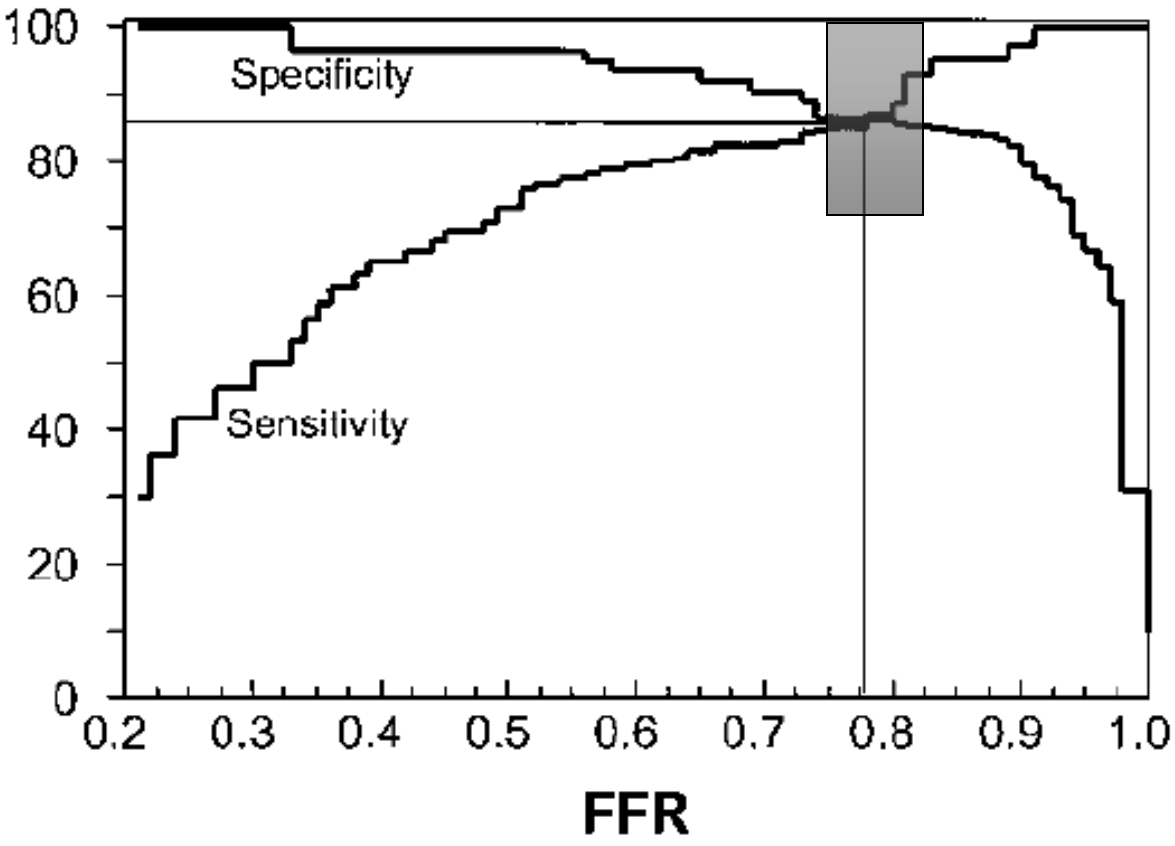


Impact of Catheter Size on Hyperemic Flow



De Bruyne et al. Cathet Cardiovasc Diagn 1994;33:145-152.

FFR and the “Grey Zone”



De Bruyne, et al. Circulation 2001;104:157-62

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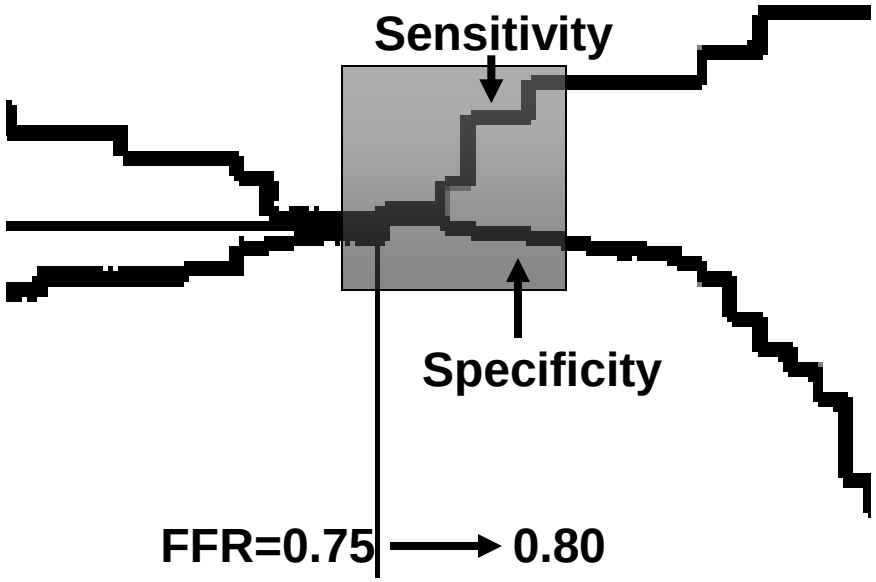
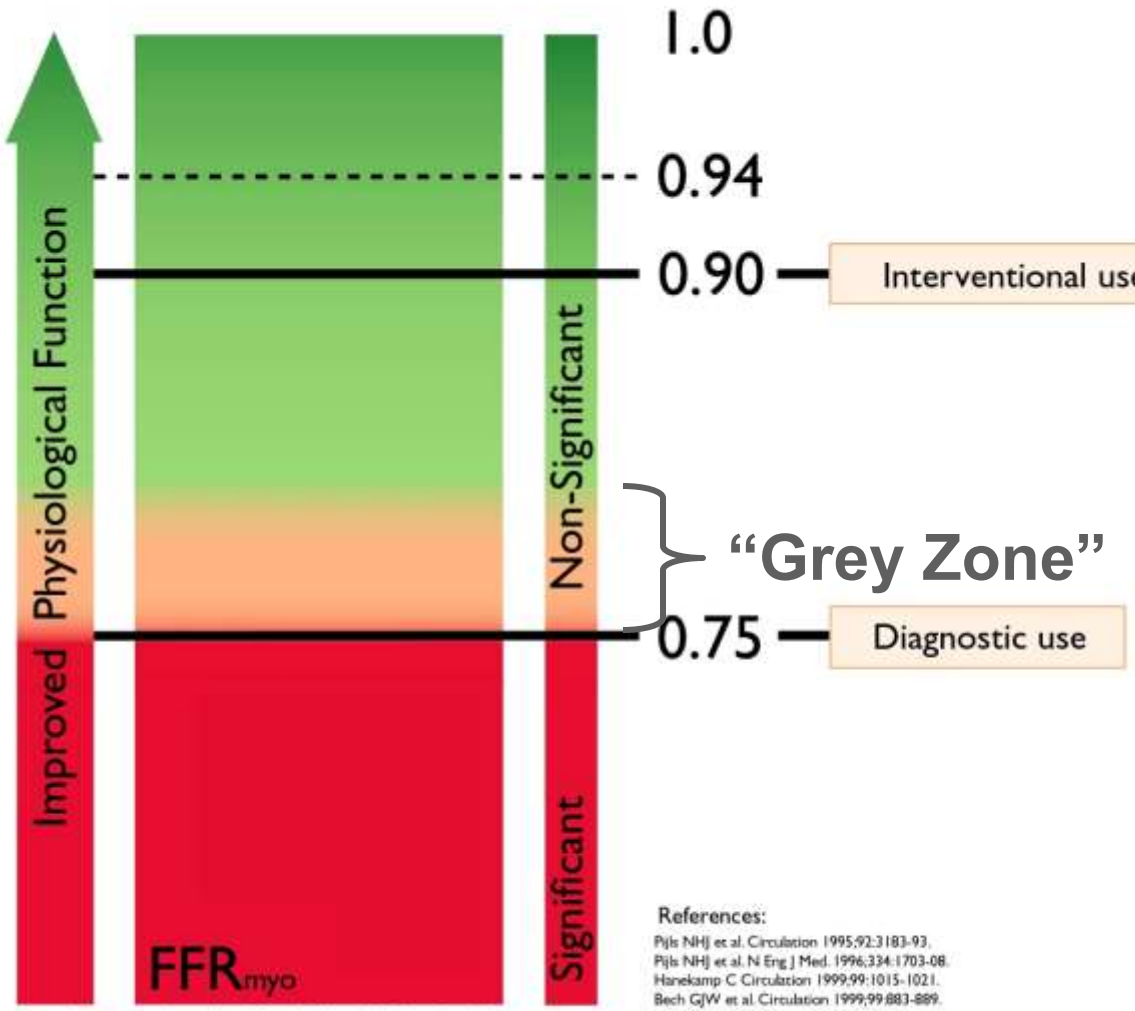


De Bruyne, et al. Circulation 2001;104:157-62

FFR for decision-making in the cath lab



Based on the teaching file of Paul G. Yock MD, Stanford University.

Note: The specificity of this cut-off value is 100% and the sensitivity is 88%.

References:
Pijls NHJ et al. Circulation 1995;92:3183-93.
Pijls NHJ et al. N Eng J Med. 1996;334:1703-08.
Hanekamp C Circulation 1999;99:1015-1021.
Bech GJW et al. Circulation 1999;99:883-889.
Pijls NHJ and De Bruyne B. 2000.
Coronary Pressure 2nd Edition. Kluwer Academic Publishers

Conclusion:

- Measuring FFR can be easy.
- Measuring FFR can be quick.
- Measuring FFR regularly is the best way to make it easy and quick, and it will improve your patients' outcomes!