

Physiological Assessment of CAD in the Cath Lab

- ▶ Coronary flow reserve (CFR)
- ▶ Fractional flow reserve (FFR)
- ▶ Hyperemic stenosis resistance (HSR)

Physiological Assessment of CAD in the Cath Lab

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Coronary flow reserve (CFR)

- ▶ Non-ischemic threshold range >2.0
- ▶ Affected by hemodynamic alterations (HR, BP, or contractility)
- ▶ In non-obstructed vessels assesses micro-vascular integrity

Hoffman JJ. *Ann Biomed Eng* 2000, 28: 884-896

Coronary flow reserve (CFR)

- ▶ Myocardial ischemia results from an imbalance between myocardial oxygen supply (MVO_2) & demand
- ▶ CBF normally increases automatically from a resting level to a maximum level in response to increases in (MVO_2) from exercise & hyperemia (neurohumoral or pharmacological)
- ▶ Coronary flow reserve (CFR) = The increase from baseline to maximal flow

Fractional Flow Reserve (FFR)

- ▶ During maximal hyperemia pressure can be used as a replacement of flow
- ▶ Pressure in a normal CA = aortic pressure (P_a)
- ▶ FFR is the ratio of mean pressure distal (P_d) to stenosis to P_a during maximal hyperemia

Kern MJ and Samady H. *J Am Coll Cardiol* 2010;55:173-85

Fractional Flow Reserve (FFR)

- ▶ FFR is the ratio of flow in the stenotic artery to the flow in the same artery in the theoretic absence of stenosis
- ▶ Flow (F) = $\frac{\text{Pressure gradient } (\Delta P)}{\text{Resistance } (R)}$
- ▶ If resistance is minimal and constant, flow is proportional to pressure

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Measurement of FFR

- ▶ The pressure wire is then advanced across the lesion
- ▶ Coronary hyperemia is induced with iv or i-coronary adenosine
- ▶ The Pd & Pa are continuously recorded
- ▶ FFR is then calculated as Pd/Pa at maximal hyperemia

Pijls NHJ, et al. N Engl J Med 1996;334:1703-8
Pijls NH, et al. Circulation 2002;105:2950-4

Measurement of FFR

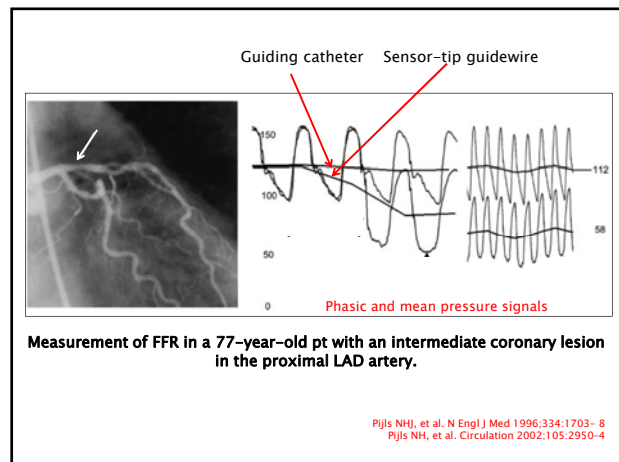
- ▶ Following diagnostic angio in the cath lab, a 0.014-inch pressure sensor angioplasty guidewire is inserted through a guiding catheter & into the target artery
- ▶ Before crossing the stenosis, the sensor wire's pressure signal is 1st matched to the aortic (guide catheter) pressure

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Pijls NH, et al. Circulation 2002;105:2950-4

Fractional Flow Reserve (FFR)

- ▶ Has a normal value of 1.0
- ▶ Nonischemic threshold range > (0.75-0.80)
- ▶ Independent of hemodynamic alterations

Kern MJ and Samady H. J Am Coll Cardiol 2010;55:173-85
Pijls NH, et al. Circulation 2002;105:2950-4
Samady H, et al. J Am CollCardiol Intv 2009;2:357- 63



Pijls NHJ, et al. N Engl J Med 1996;334:1703-8
Pijls NH, et al. Circulation 2002;105:2950-4

Fractional Flow Reserve (FFR)

- ▶ High reproducibility and low intra-individual variability
- ▶ Independent of gender and CAD risk factors
- ▶ Varies less with common doses of adenosine

Kern MJ and Samady H. J Am Coll Cardiol 2010;55:173-85
Pijls NH, et al. Circulation 2002;105:2950-4
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Validation and Threshold of Ischemia

- ▶ Values 0.75 are associated with ischemic stress testing in many comparative studies with high sensitivity (88%), specificity (100%), positive predictive value (100%), and overall accuracy (93%)
- ▶ Values 0.80 are associated with negative ischemic results with a predictive accuracy of 95%

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Pressure Pullback Recording

- ▶ To assess diffuse CAD, the pressure wire can be pulled back gradually from the distal to proximal vessel segments during continuous hyperemia induced by iv adenosine
- ▶ The pressure pullback curve can demonstrate either a sudden change in distal pressure across a focal narrowing or the gradual pressure recovery of diffuse disease without focal obstructions

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Fractional flow reserve (FFR)

- ▶ Specific to epicardial lesions
- ▶ Value accounts for total myocardial BF including collaterals
- ▶ High spatial resolution (pressure pullback recording)

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Samady H, et al. J Am CollCardiol Intv 2009;2:357- 63

Hyperemic Stenosis Resistance (HSR)

- ▶ Combined pressure and flow velocity measures
- ▶ Normal value = zero
- ▶ Non-ischemic threshold value <0.8 mmHg/cm/sec
- ▶ Lesion specific
- ▶ High reproducibility and sensitivity
- ▶ Useful in cases of disagree between CFR & FFR

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