



6/7/8 JUIN 2018  
Palais des Congrès  
BIARRITZ



# Les Indices d'évaluation coronaire de repos

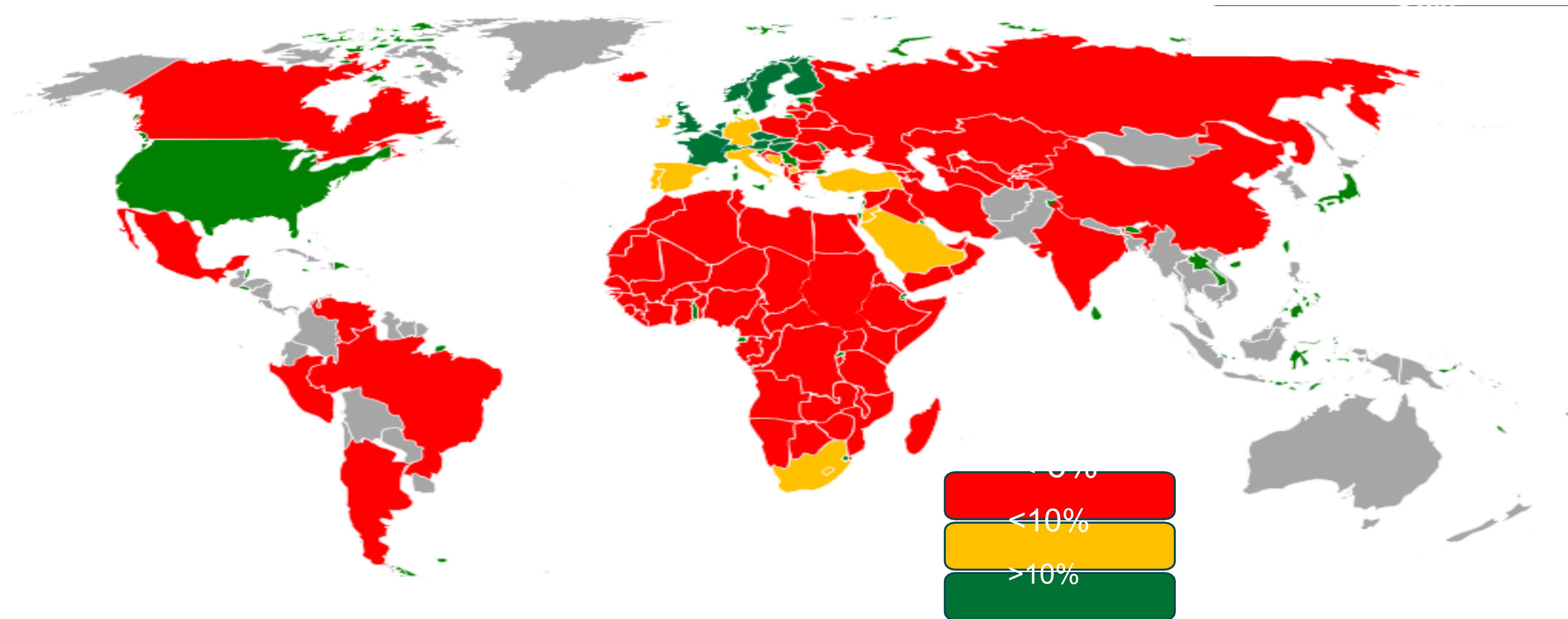
Patrick Dupouy

PCVI Antony-Melun

# Conflits d'intérêt

- AUCUN

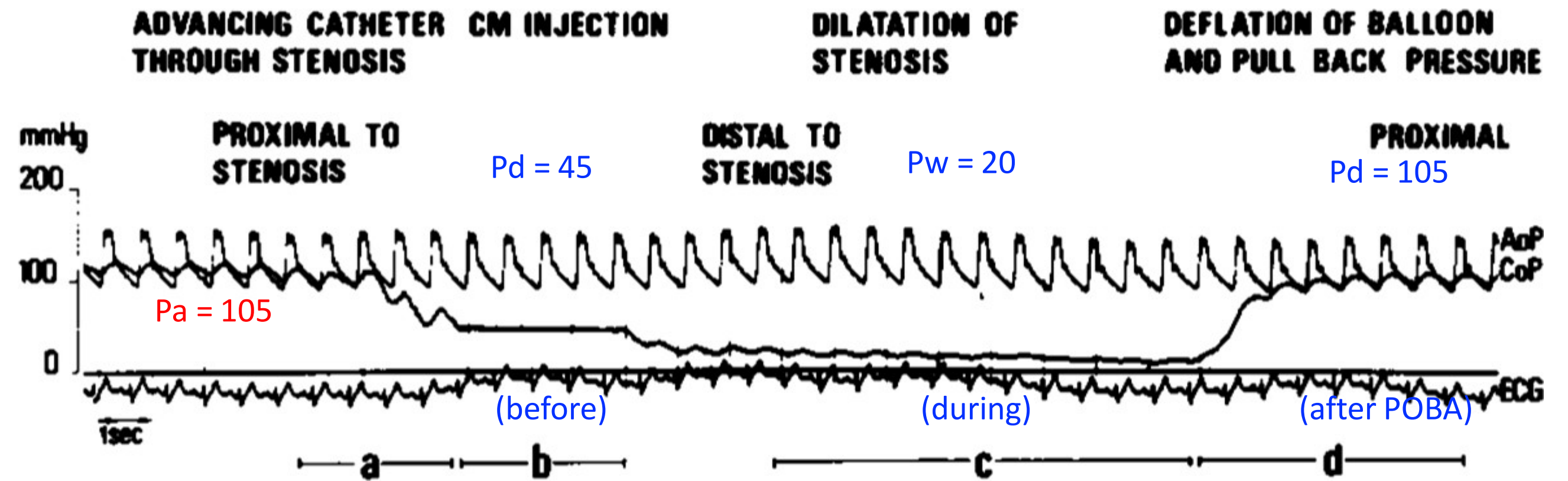
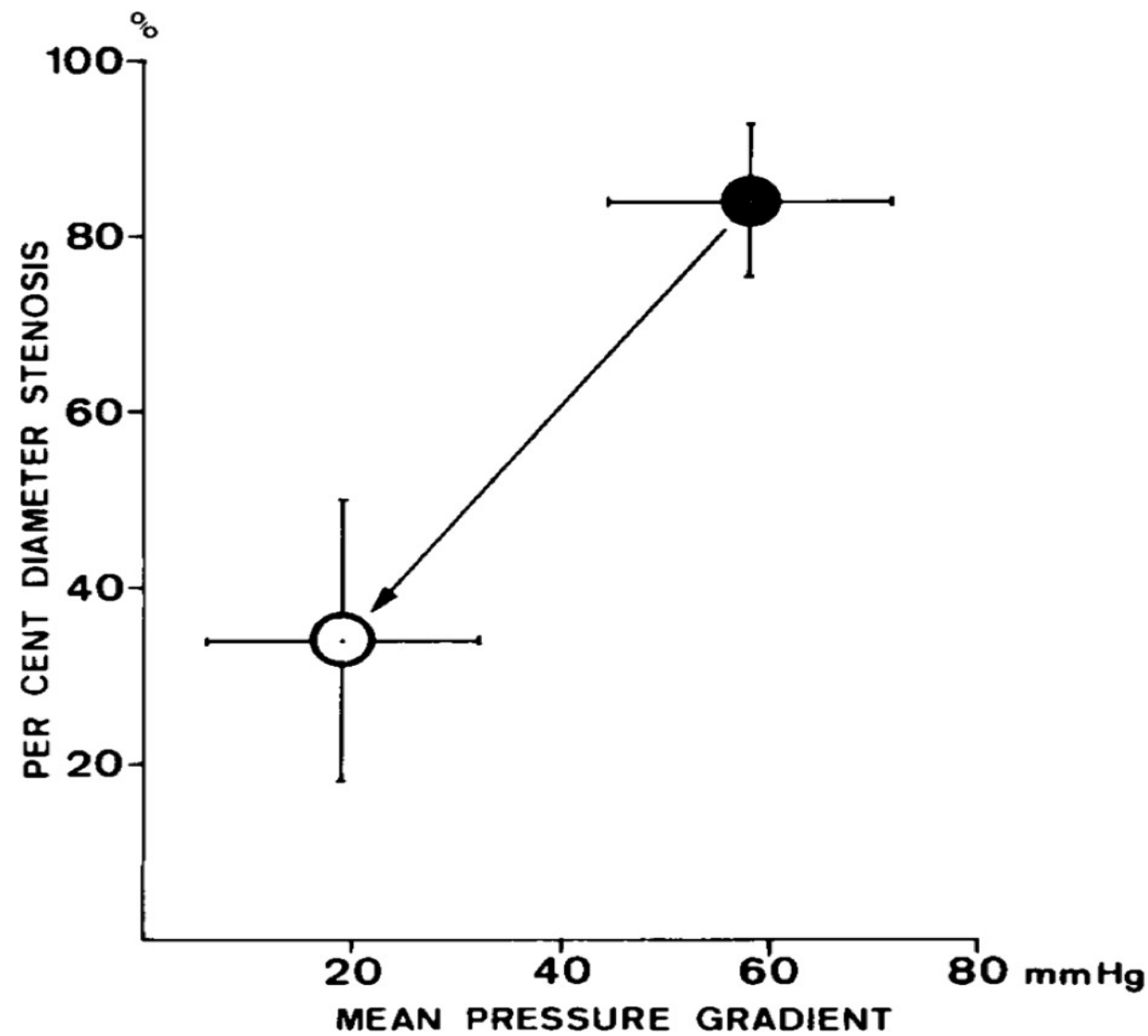
# FFR toujours sous utilisée



# INTERET DES INDICES DE REPOS

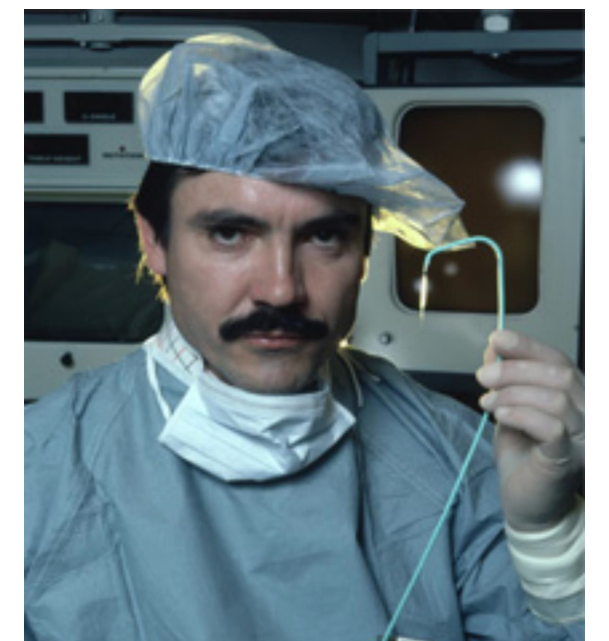
- PAS D'ADENOSINE
- REPONSE NON UNIFORME A L'ADENOSINE
- PLUS RAPIDE, PLUS SIMPLE (PATIENTS PLURITRONCULAIRES)
- MOINS CHER
- PAS D'EFFET SECONDAIRE

# Les débuts de l'angioplastie



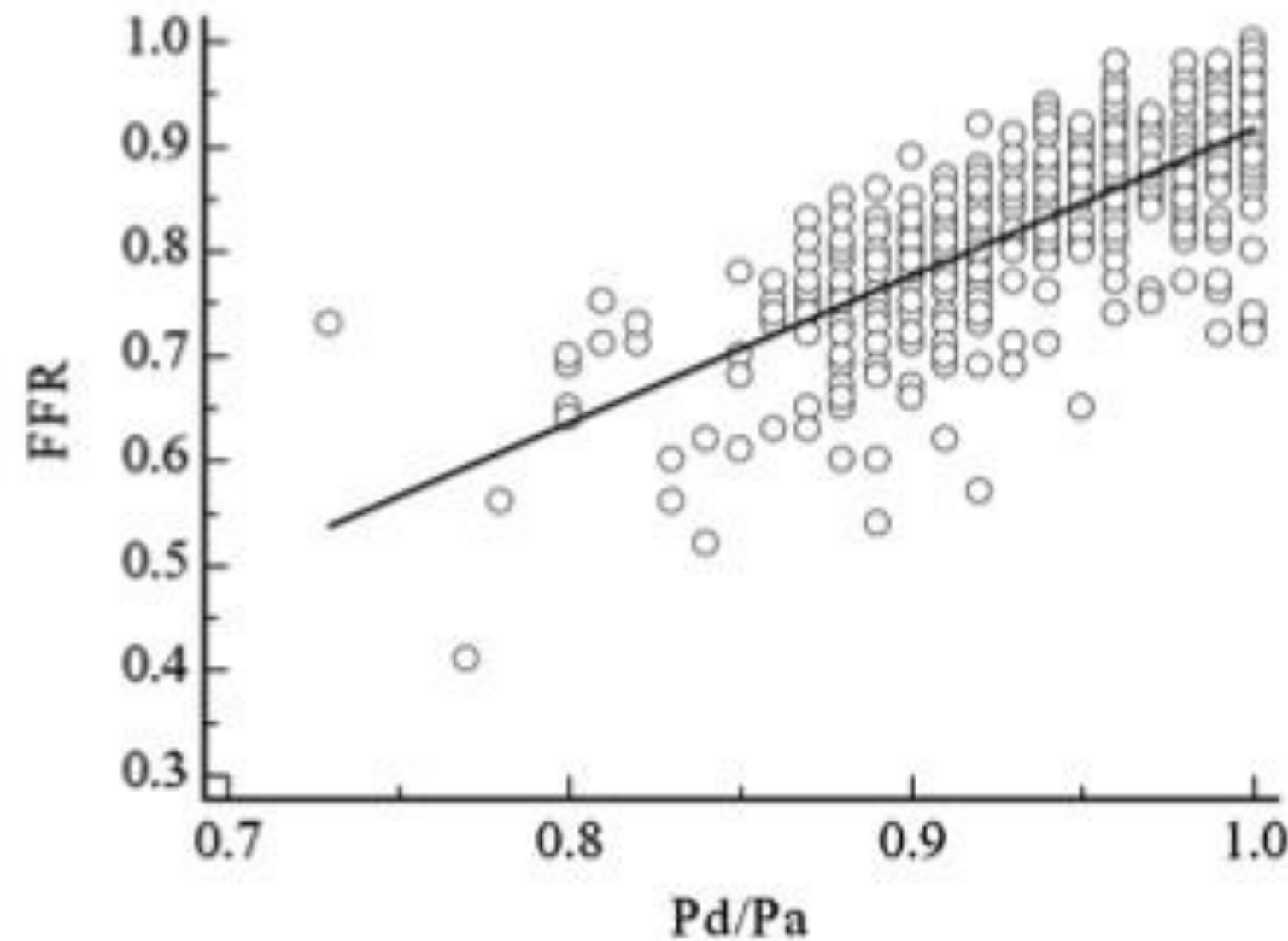
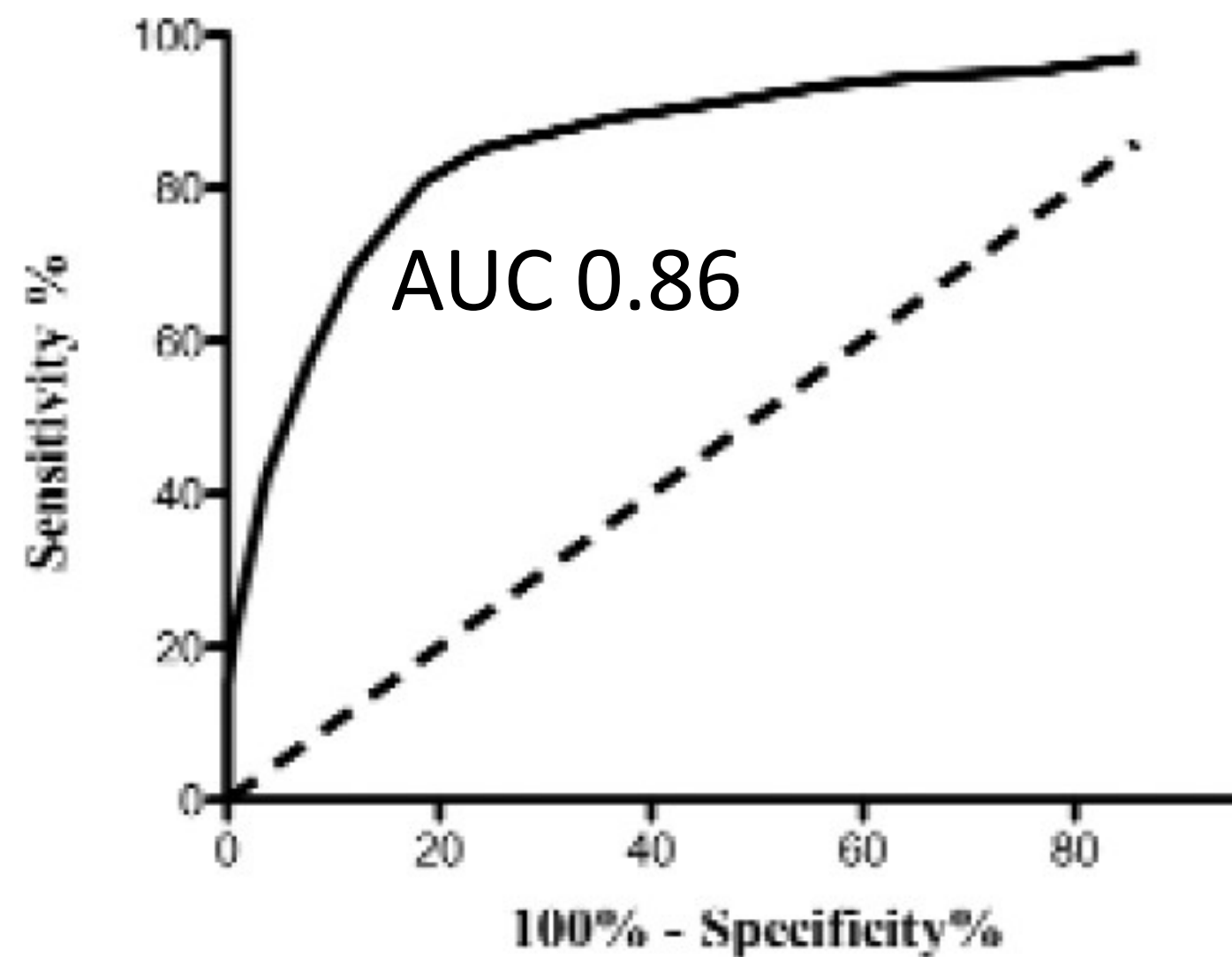
"... the pressure gradient across the stenosis provides only an index of the severity of the lesion"

Grüntzig AR. *NEJM* 1979 Jul 12;301(2):61-8.



# Pd/Pa repos vs FFR

Pd/Pa vs FFR  $\leq 0.80$  (n=528)



Pd/Pa  $> 0.96$

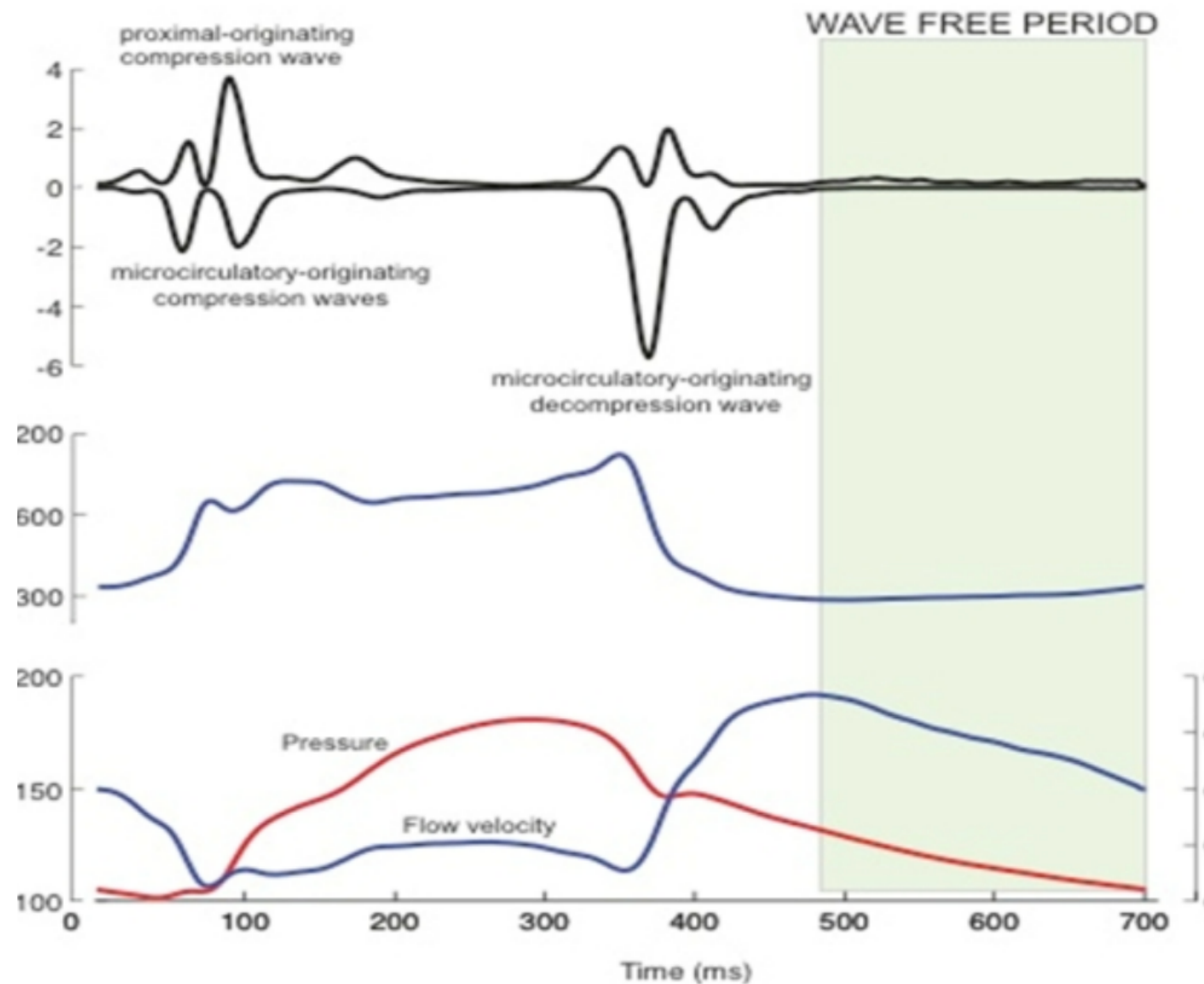
NPV 93%

Proportion  
52%

Pd/Pa  $\leq 0.87$

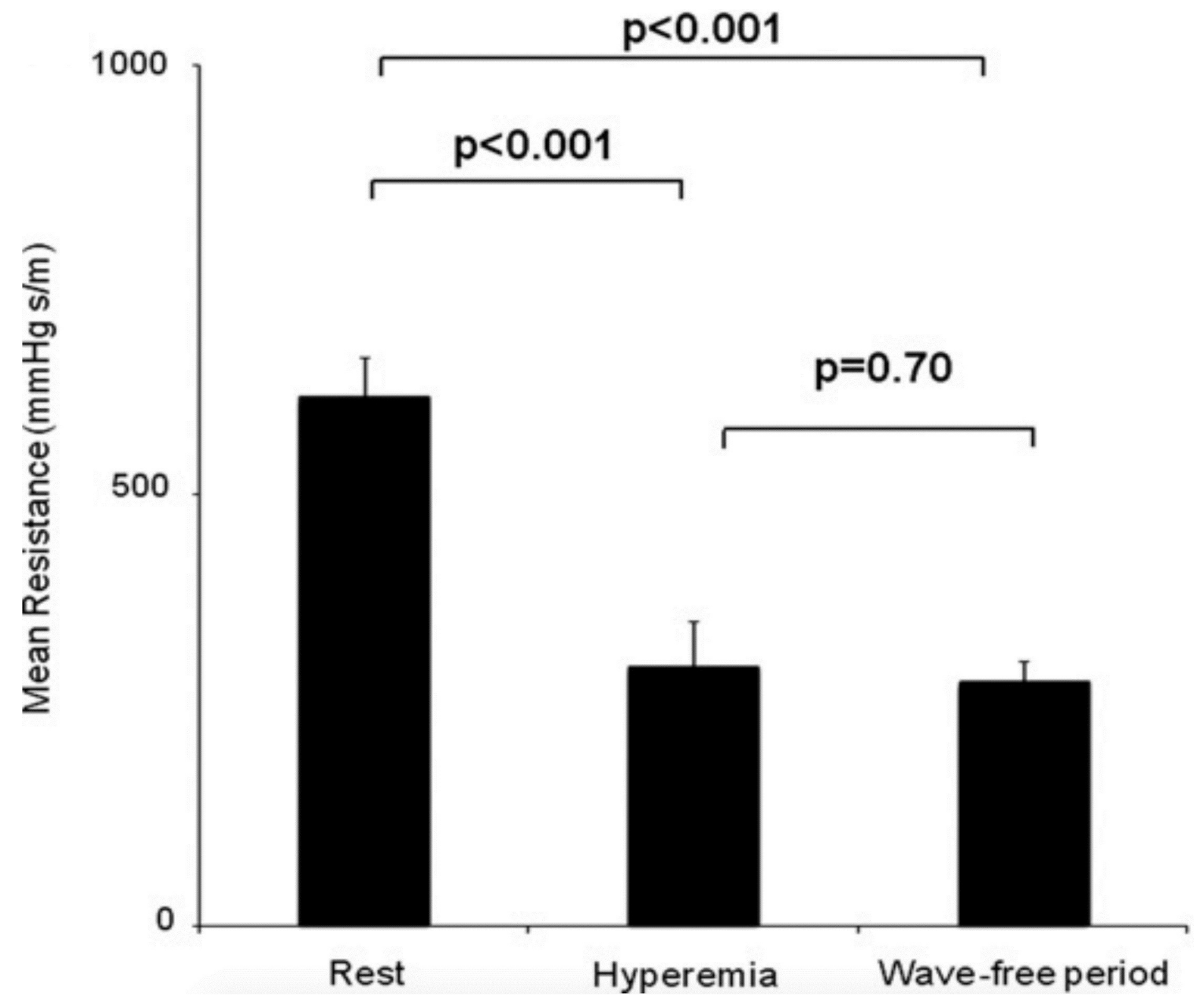
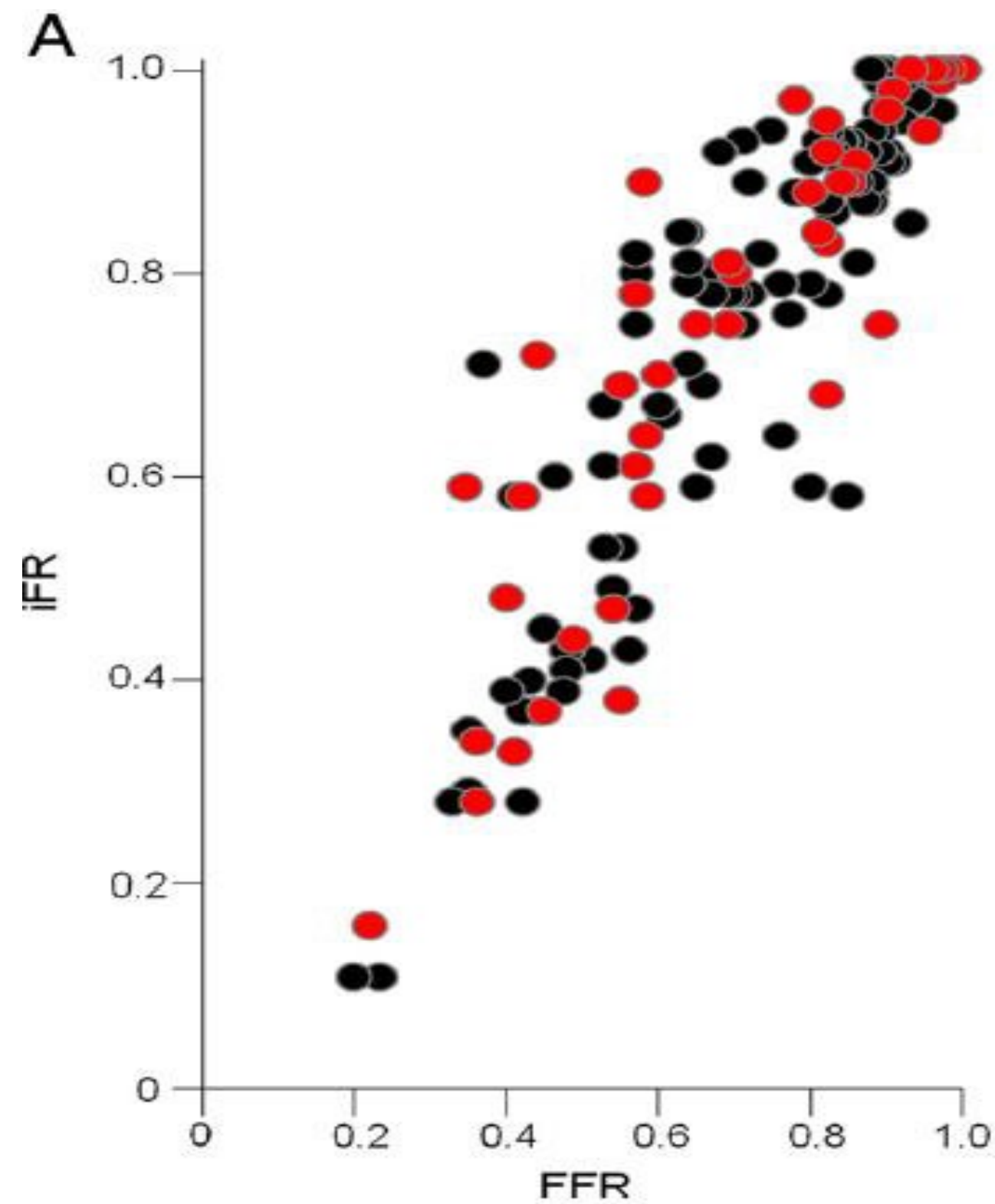
PPV 95%

# Concept de wave free period



- - « Bruit » des ondes de compression et succion myocardique minimal
- Résistances constantes donc  $\Delta P$  est proportionnel au débit
- puisque résistances minimales dans le cycle les Vitesses sont plus élevées donc meilleure discrimination

# iFR: description initiale

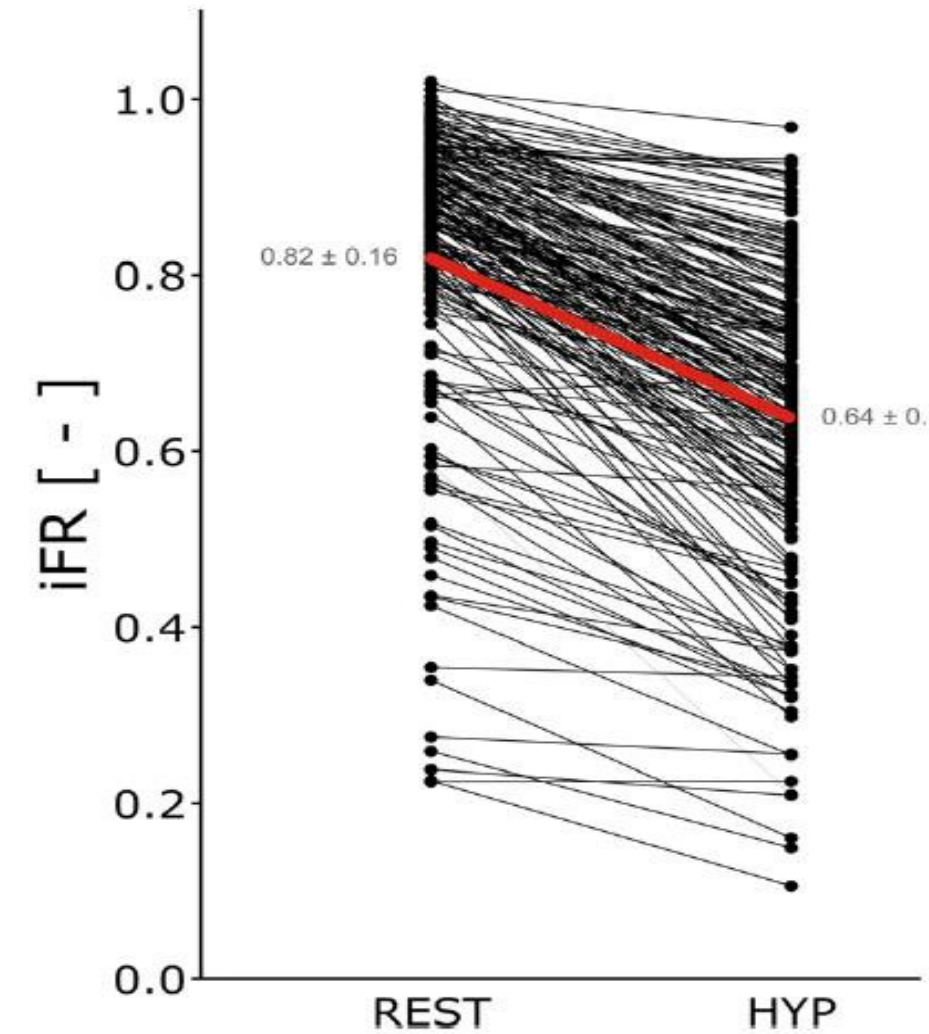
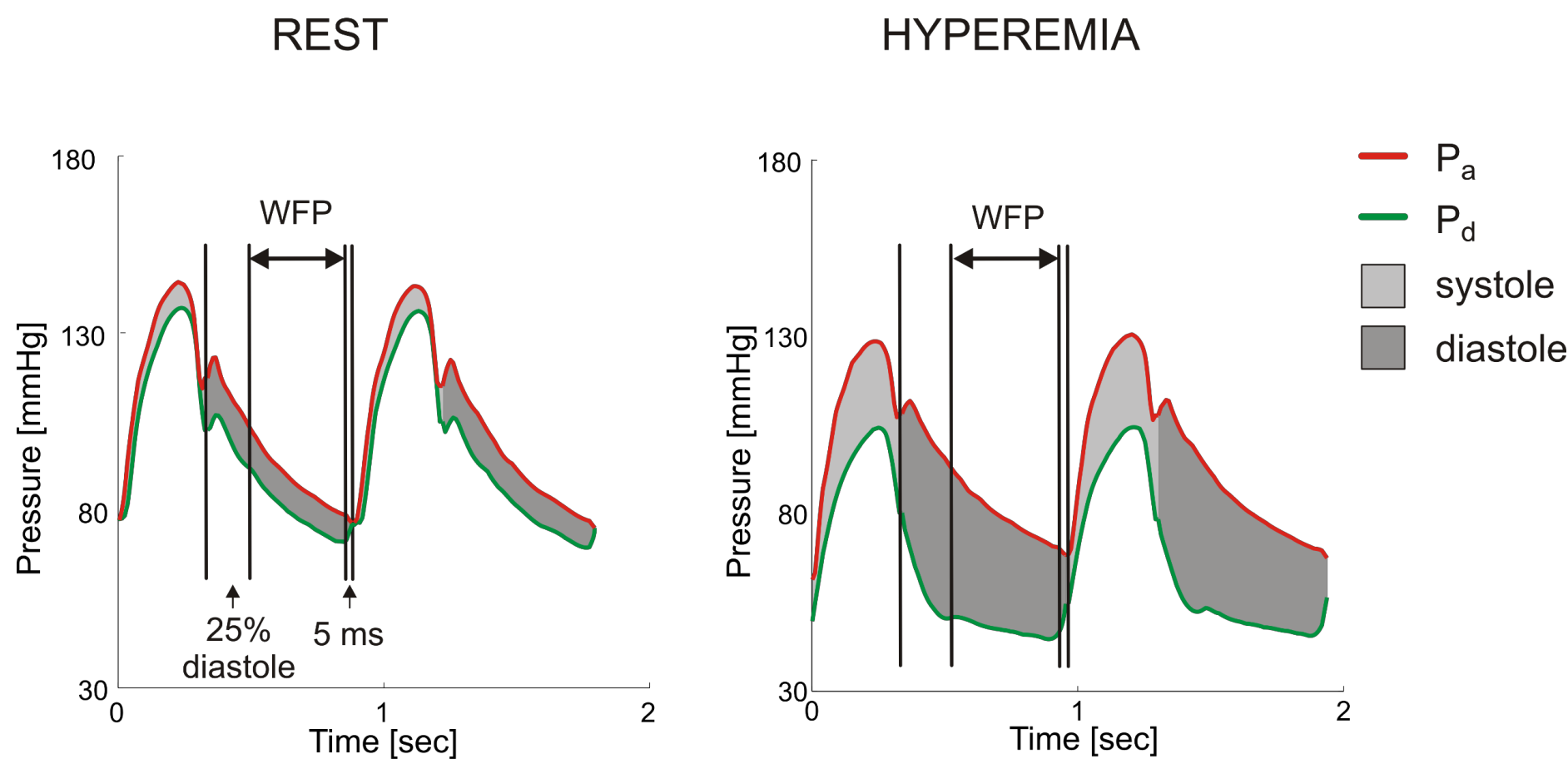


# Pourtant les résistances ne sont pas minimales absolues pendant la WFP

**Table 3** Flow velocity, TG, MVR and physiological indices according to lesion severity defined by anatomical stenosis severity (% diameter stenosis)

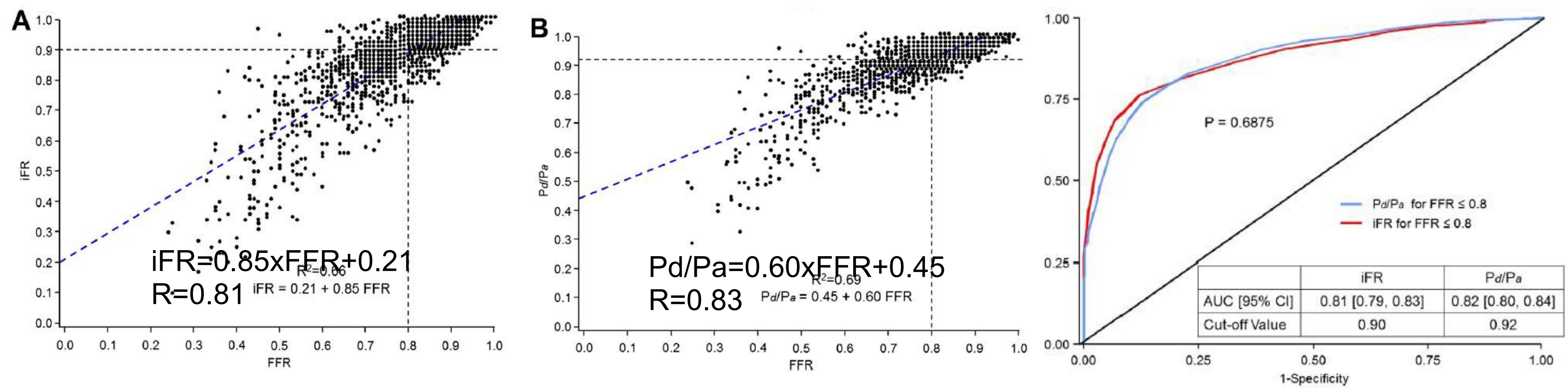
|                                      | QCA $\geq 90\%$ | SD   | QCA 80–89% | SD   | QCA 70–79% | SD   | QCA 60–69% | SD   | QCA 50–59% | SD   | QCA $\leq 49\%$ | SD   | Reference | SD   |
|--------------------------------------|-----------------|------|------------|------|------------|------|------------|------|------------|------|-----------------|------|-----------|------|
| Microvascular Resistance (mmHg/cm/s) |                 |      |            |      |            |      |            |      |            |      |                 |      |           |      |
| Resting wave-free period             | 1.93            | 0.31 | 2.45       | 0.97 | 3.38       | 1.91 | 3.41       | 1.61 | 4.25       | 2.51 | 3.92            | 1.85 | 4.38      | 1.83 |
| Hyperemic wave-free period           | 1.07            | 0.37 | 1.44       | 0.67 | 1.49       | 0.71 | 1.47       | 0.71 | 1.58       | 1.08 | 1.38            | 0.75 | 1.48      | 0.62 |

Ratio: 1.8 1.7 2.3 2.3 2.7 2.8 3.0



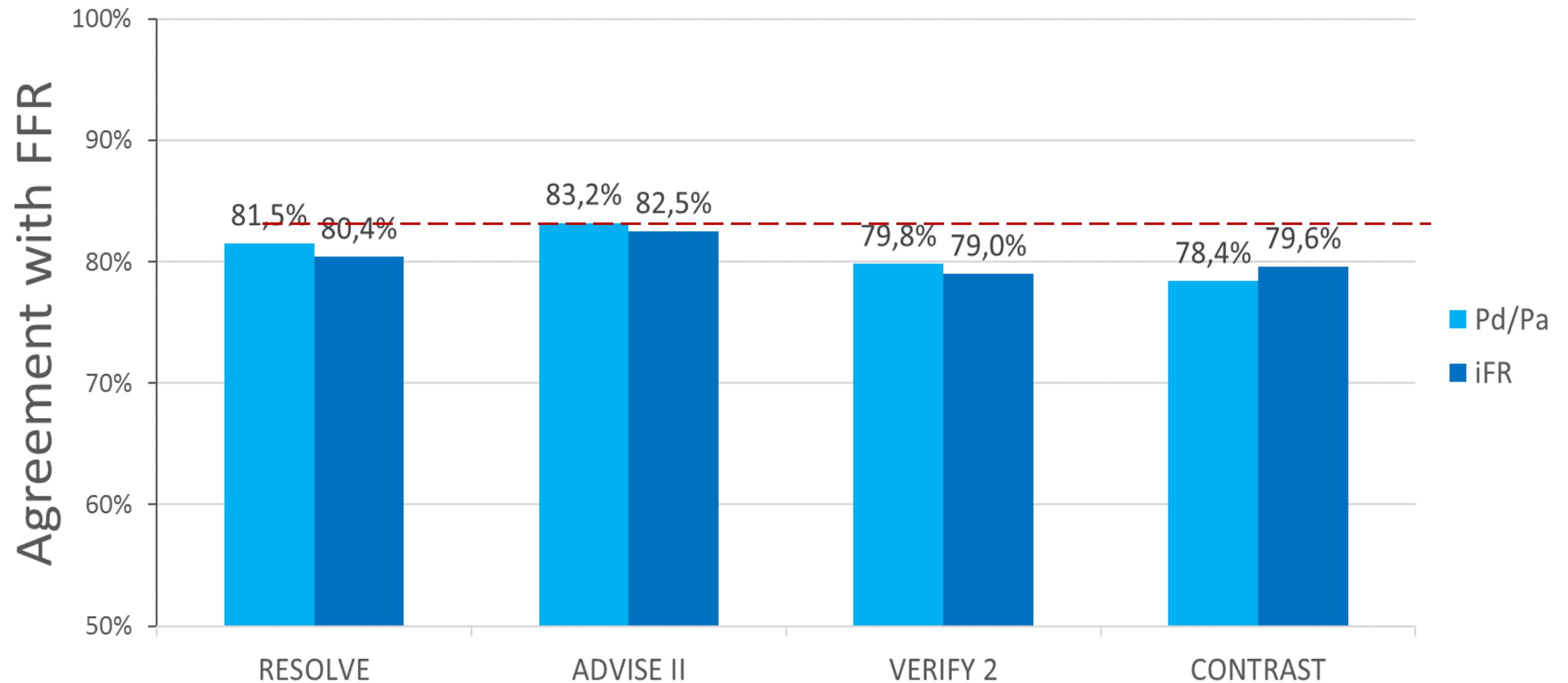
Top - Nijjer SS, *EHJ*. 2016 Jul 7;37(26):2069-80  
Bottom - Berry et al *J Am Coll Cardiol*. 2013 Apr 2;61(13):1421-7

# 80% de corrélation vs FFR, idem Pd/Pa



# iFR et Pd/Pa même corrélation vs FFR

- +3,300 lésions
- Nombreuses études
- Pd/Pa  $\approx$  iFR
- 80% vs FFR

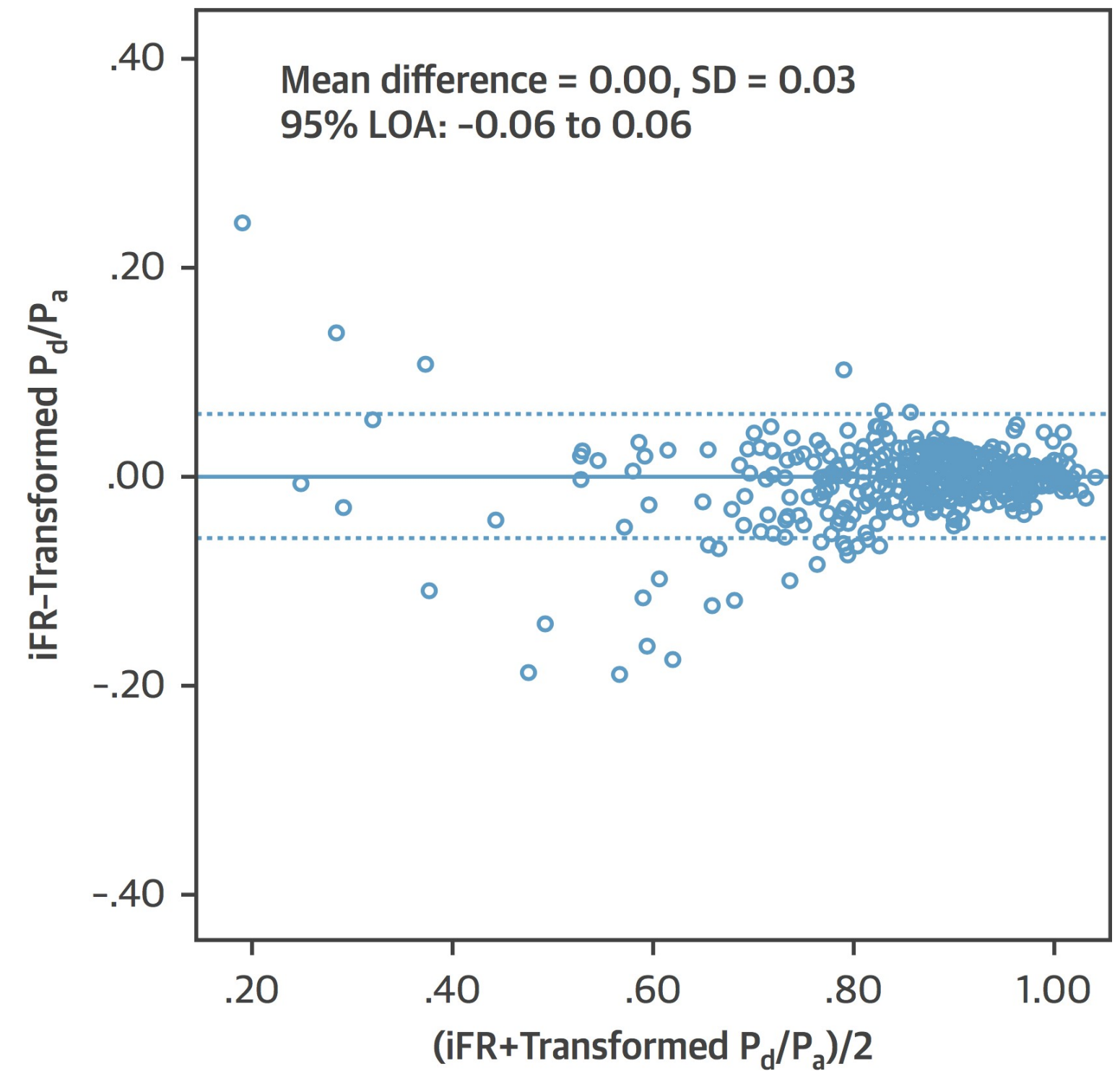
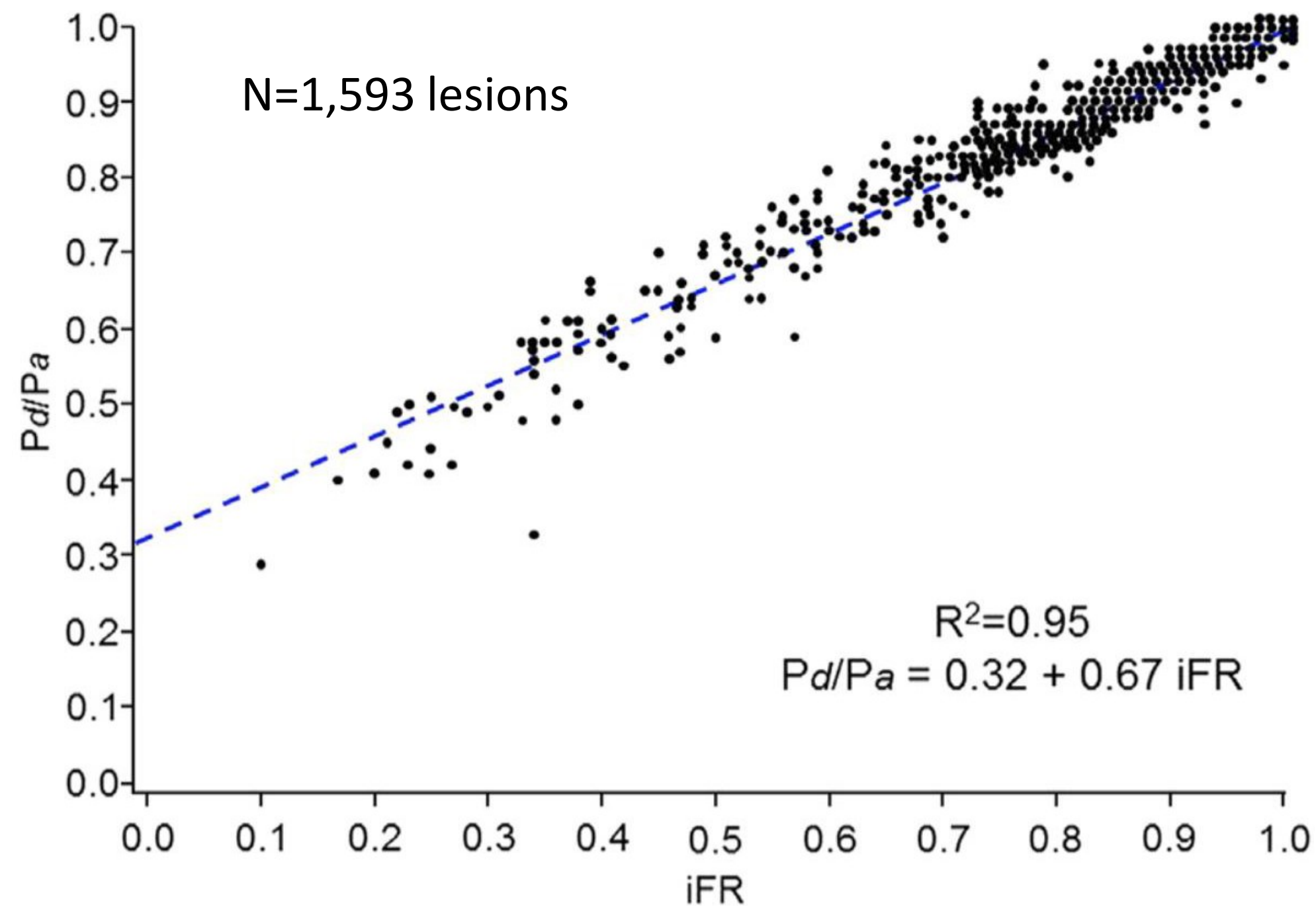


RESOLVE = Jeremias A, *JACC*. 2014 Apr 8;63(13):1253-61

ADVISE 2 = Escaned J, *JACC Cardiovasc Interv*. 2015 May;8(6):824-33 and 834-6  
VERIFY 2 = Hennigan B, *Circ Cardiovasc Interv*. 2016;9(11). pii: e004016.

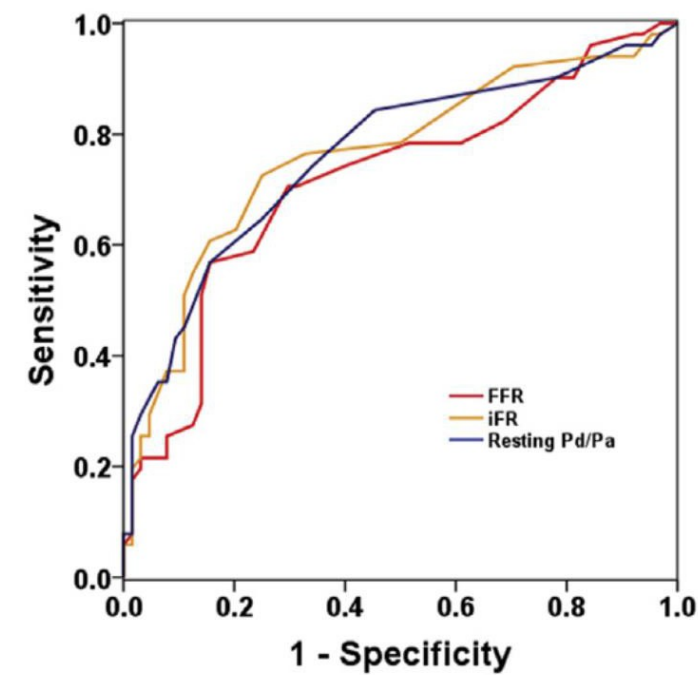
CONTRAST = Johnson NP, *JACC Cardiovasc Interv*. 2016 Apr 25;9(8):757-67

# Pd/Pa et iFR sont bien corrélées



# PET: Pd/Pa $\approx$ iFR

PET-derived CFR<2.0 as a reference standard

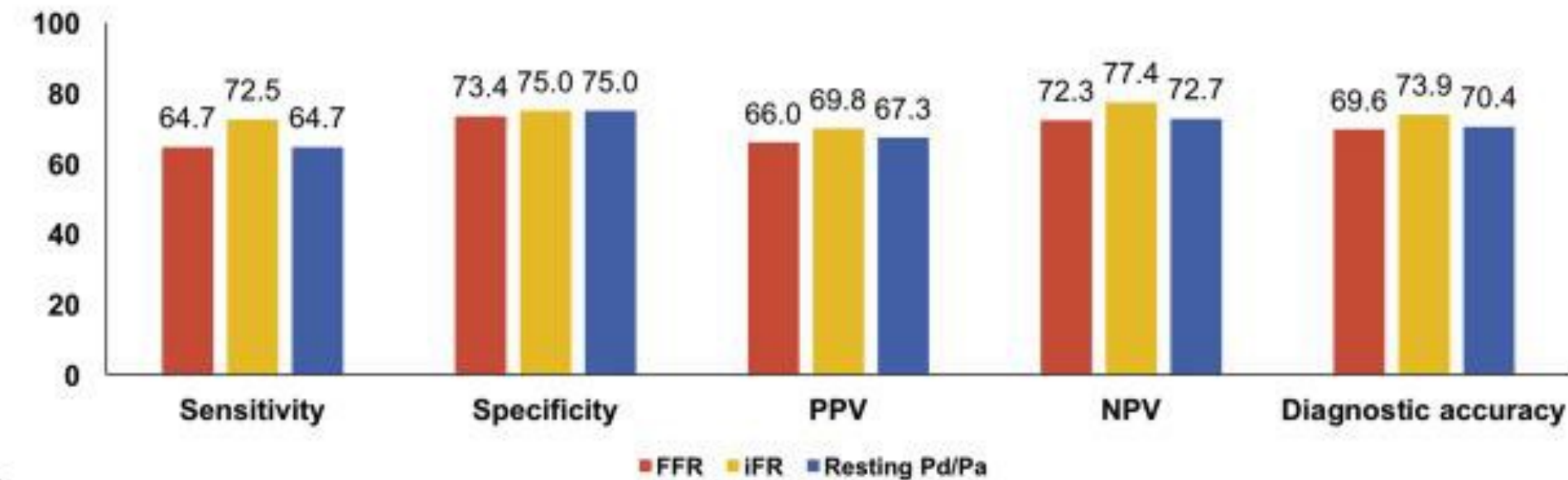


|               | AUC   | 95% CI      | p value |
|---------------|-------|-------------|---------|
| FFR           | 0.716 | 0.619-0.813 | <0.001  |
| iFR           | 0.762 | 0.671-0.854 | <0.001  |
| Resting Pd/Pa | 0.761 | 0.670-0.852 | <0.001  |

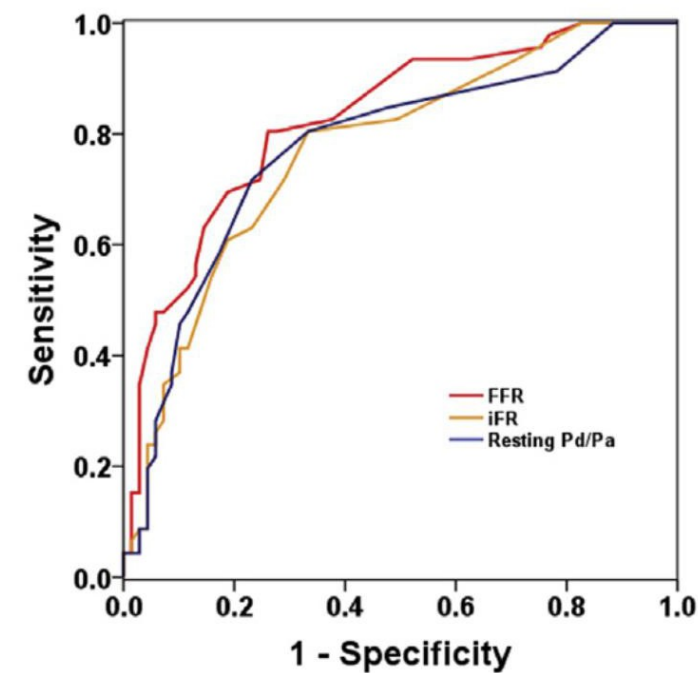
  

| Reference     | Testing       | Difference between areas | p value |
|---------------|---------------|--------------------------|---------|
| iFR           | FFR           | 0.046                    | 0.133   |
| Resting Pd/Pa | FFR           | 0.045                    | 0.183   |
| iFR           | Resting Pd/Pa | 0.001                    | 0.932   |

**A**  
PET-derived CFR<2.0 as a reference standard



PET-derived RFR<0.75 as a reference standard

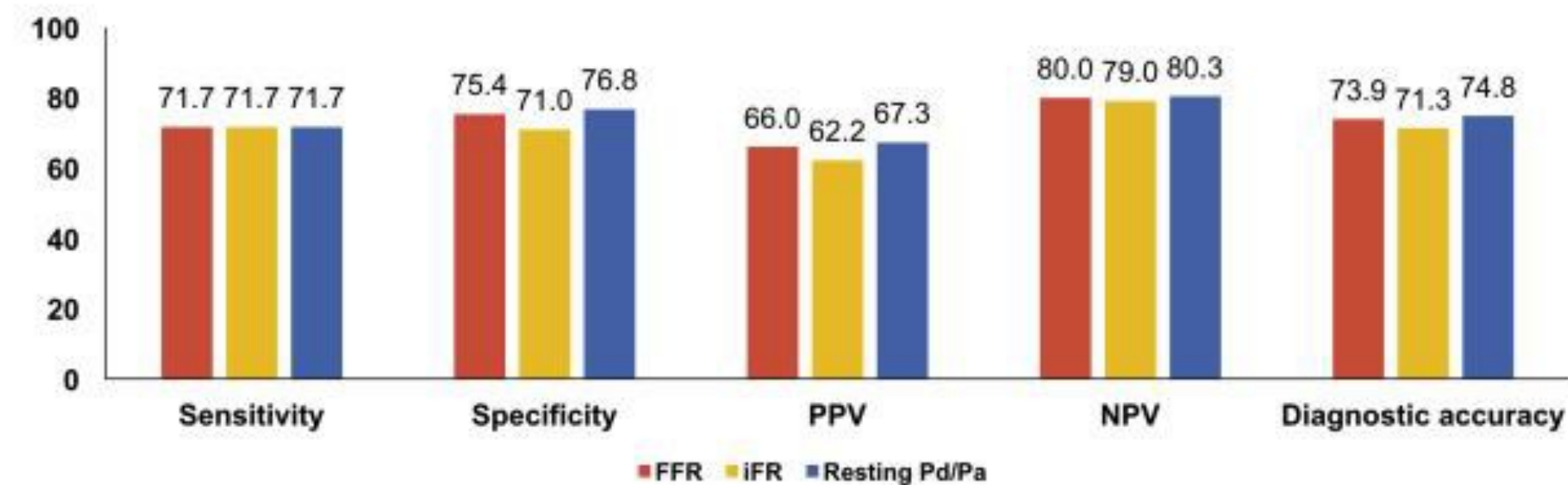


|               | AUC   | 95% CI      | p value |
|---------------|-------|-------------|---------|
| FFR           | 0.826 | 0.749-0.903 | <0.001  |
| iFR           | 0.771 | 0.684-0.858 | <0.001  |
| Resting Pd/Pa | 0.774 | 0.684-0.864 | <0.001  |

| Reference     | Testing | Difference between areas | p value |
|---------------|---------|--------------------------|---------|
| iFR           | FFR     | 0.055                    | 0.047   |
| Resting Pd/Pa | FFR     | 0.052                    | 0.093   |
| Resting Pd/Pa | iFR     | 0.003                    | 0.836   |

**B**  
PET-derived RFR<0.75 as a reference standard



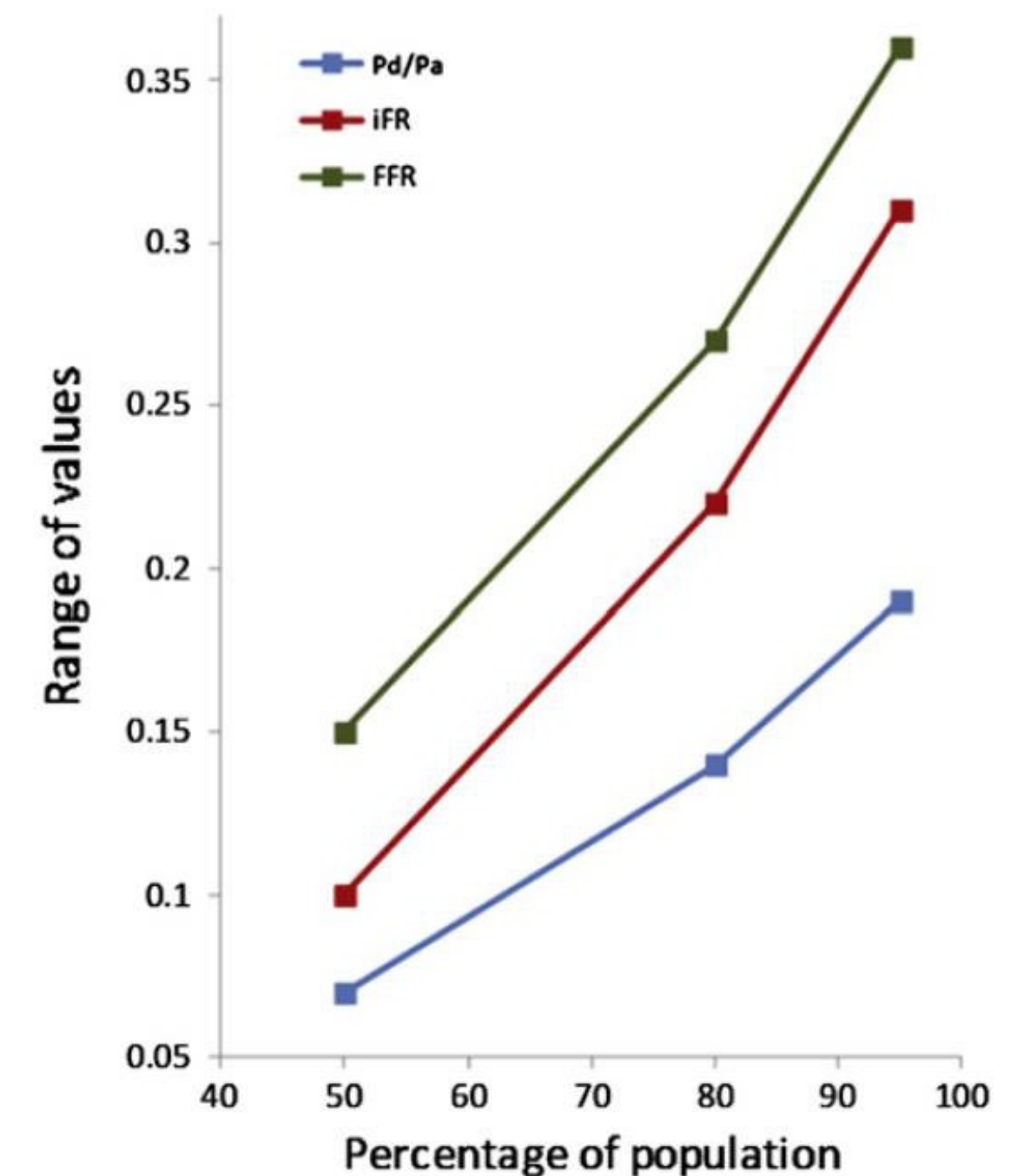
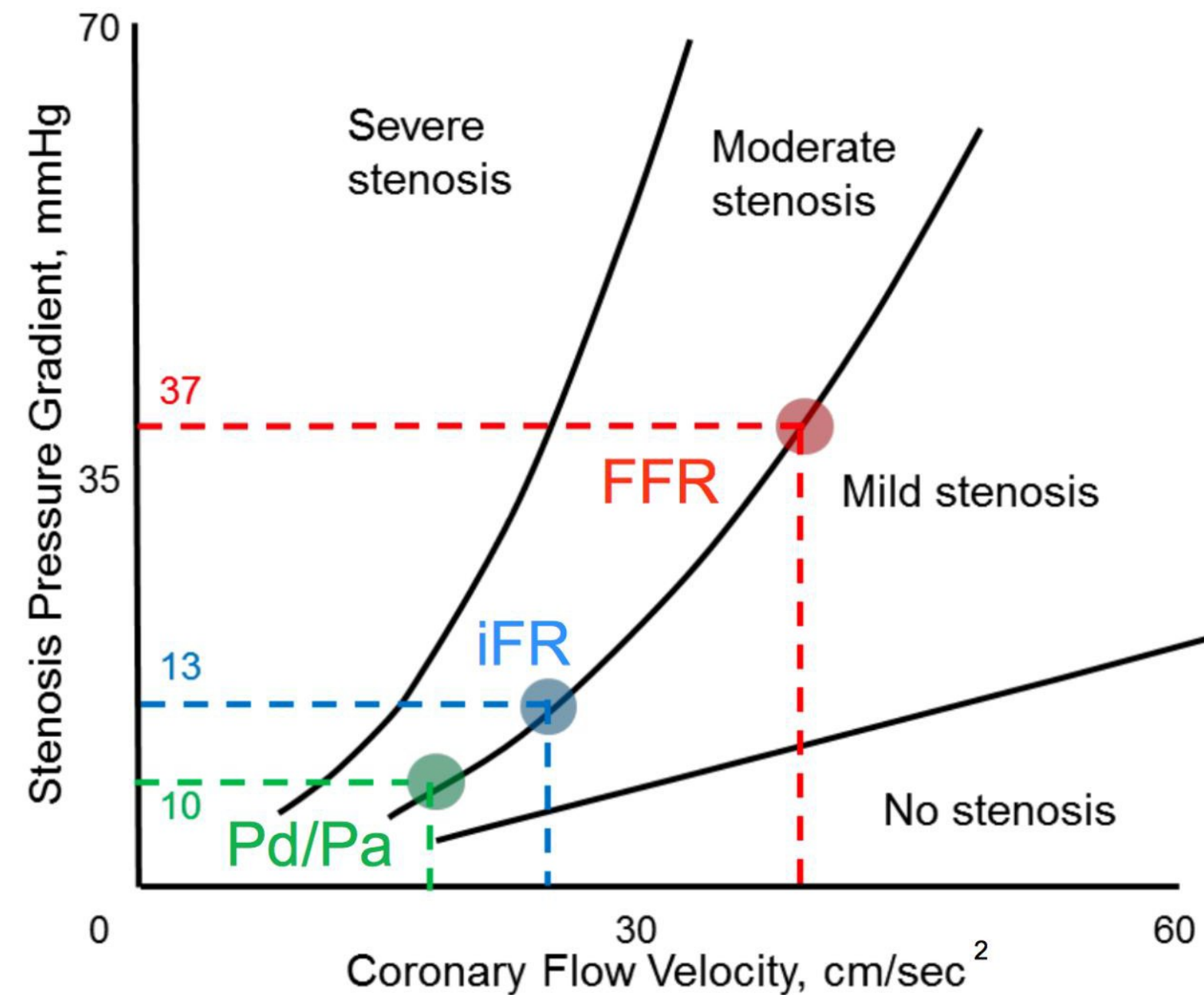
# Pd/Pa a le marquage FDA

Pd/Pa is the ratio of distal coronary arterial pressure to aortic pressure measured at resting conditions. The physician may use Pd/Pa at rest, along with knowledge of patient history, medical expertise and clinical judgment to determine if additional measurement of FFR during hyperemia or therapeutic intervention is indicated.

Physician use and data analysis was completed and published publicly. Comparison to FFR was equivalent clinically, and comparison to iFR (as per the guidelines) was shown equivalent in clinical literature and publication.

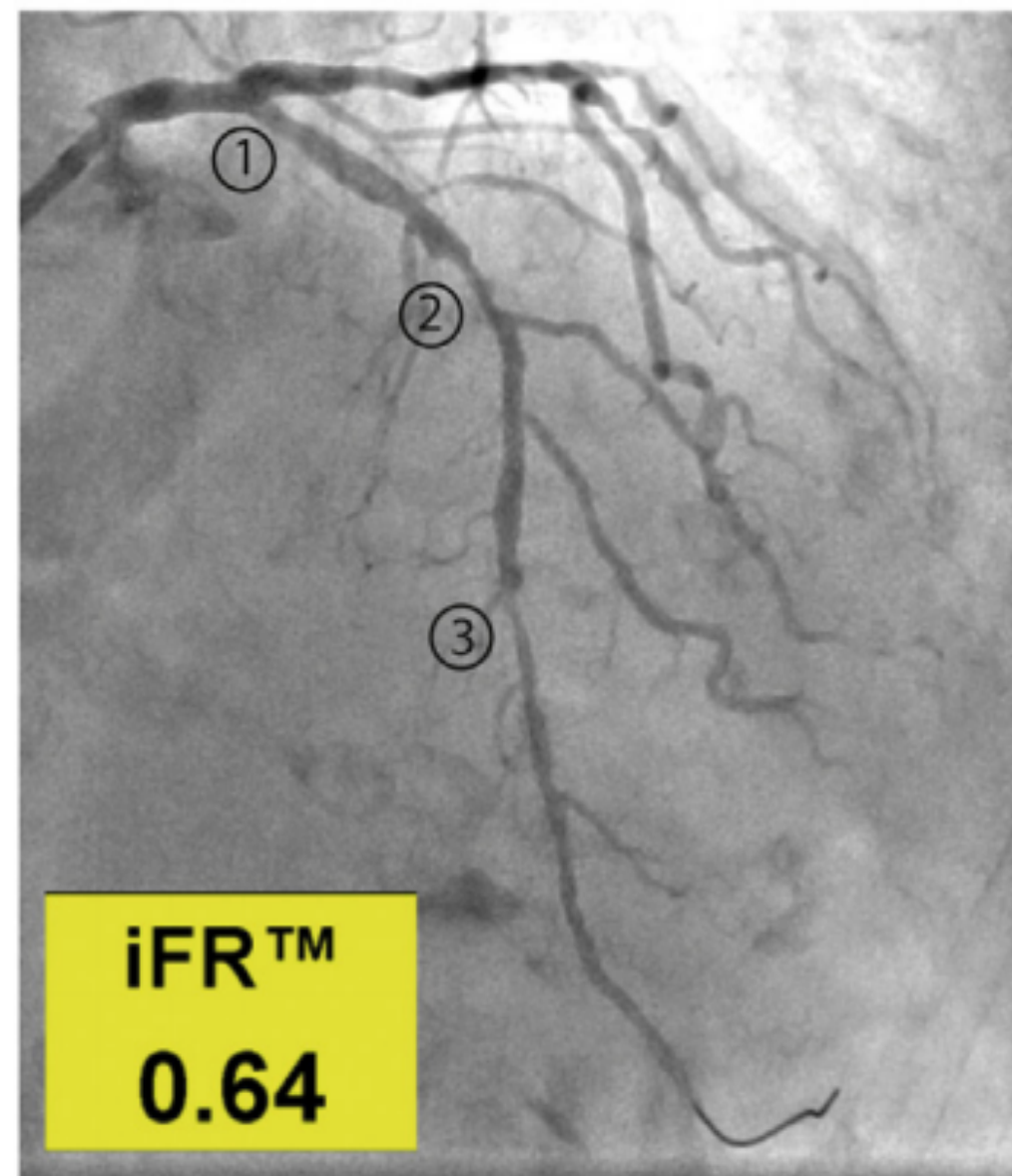
# Les indexes Diastoliques ont possiblement un meilleur pouvoir discr minant que le moyennage sur le cycle complet.

- Diastole -> D bit trans st notique plus  lev  -> Gradient plus important
- Les mesures diastoliques sont plus sensibles aux petites modifications en particulier pendant le pullback.

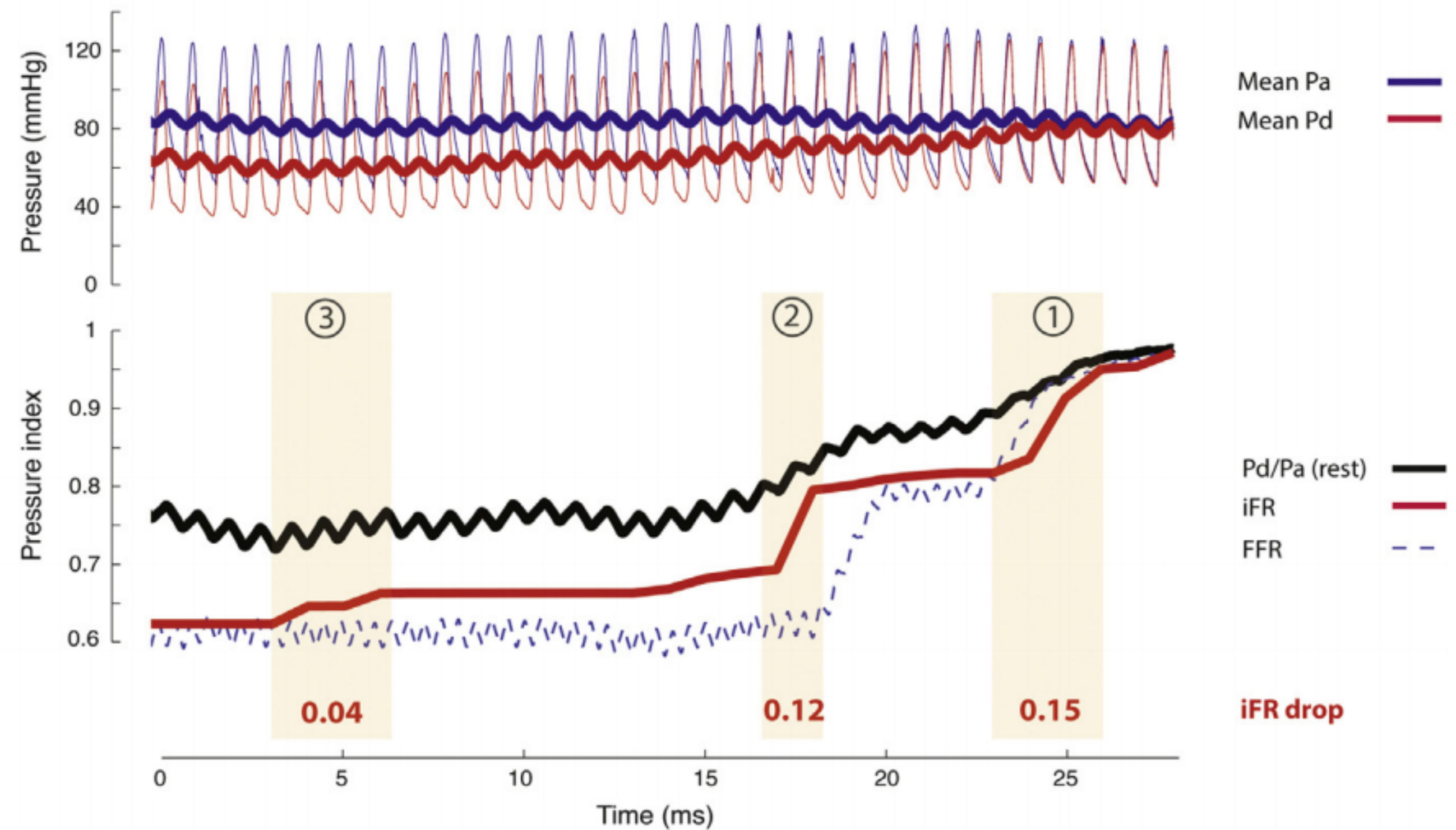


Left - Nijjer et al European Heart Journal 37(26):ehv626 adapted  
Right - Jin Joo Park IJC 168 (2013) 4070-4075

# Pull back au repos

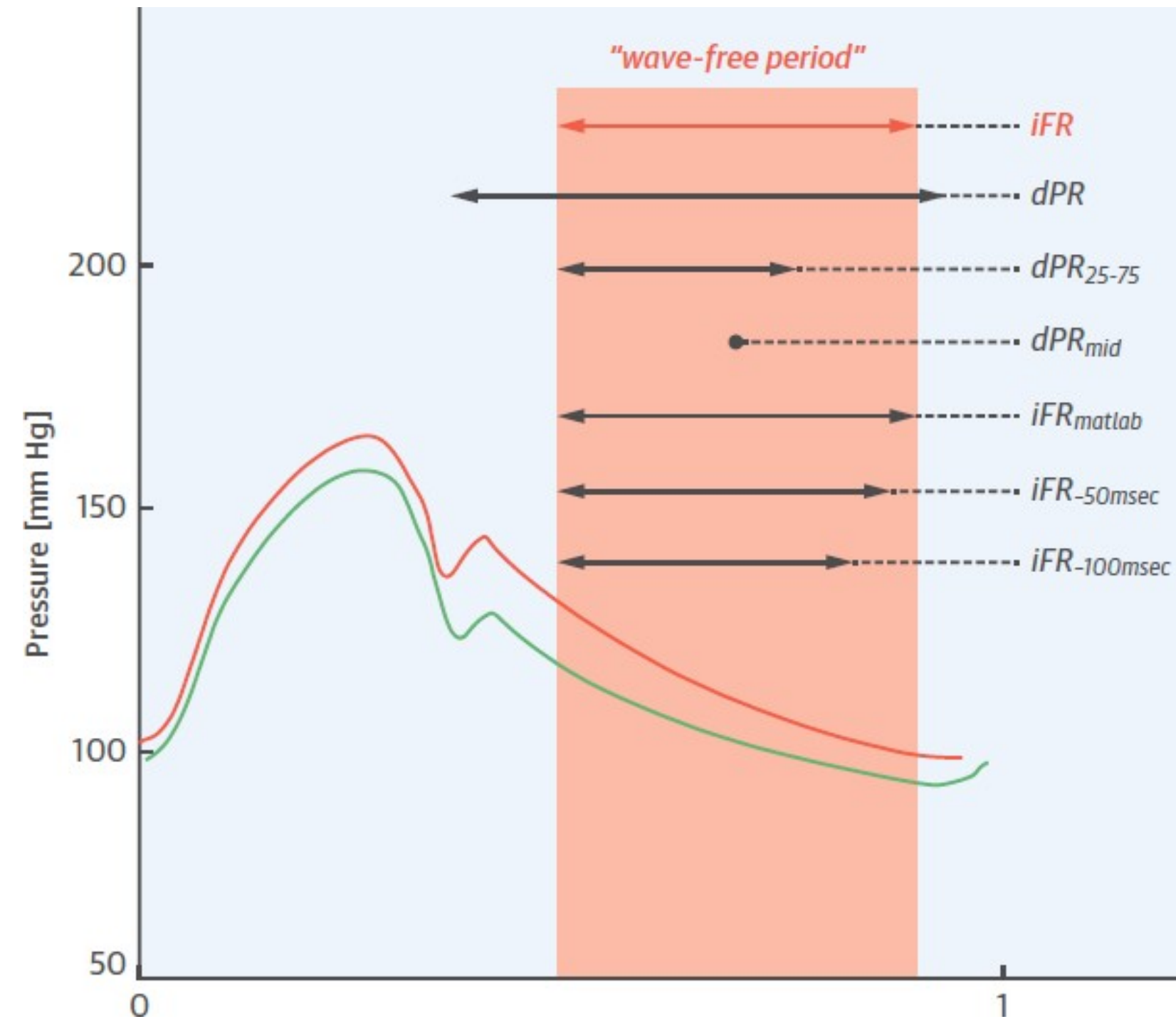
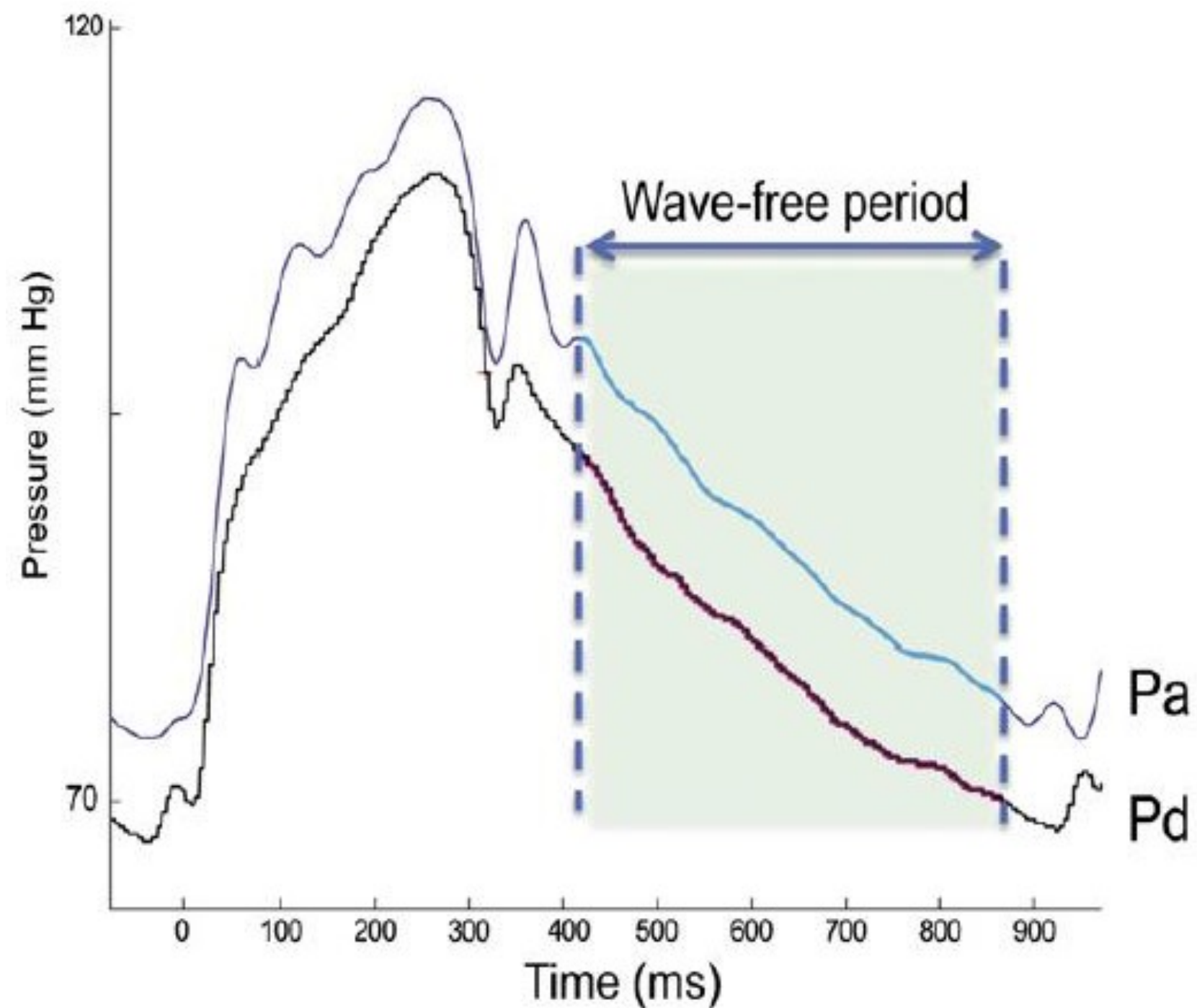


Three discrete lesions with diffuse disease;  
the hemodynamic impact of the lesions  
can be detected using an iFR manual pullback



Nijjer et al JACC Vol 7, No. 12, 2014

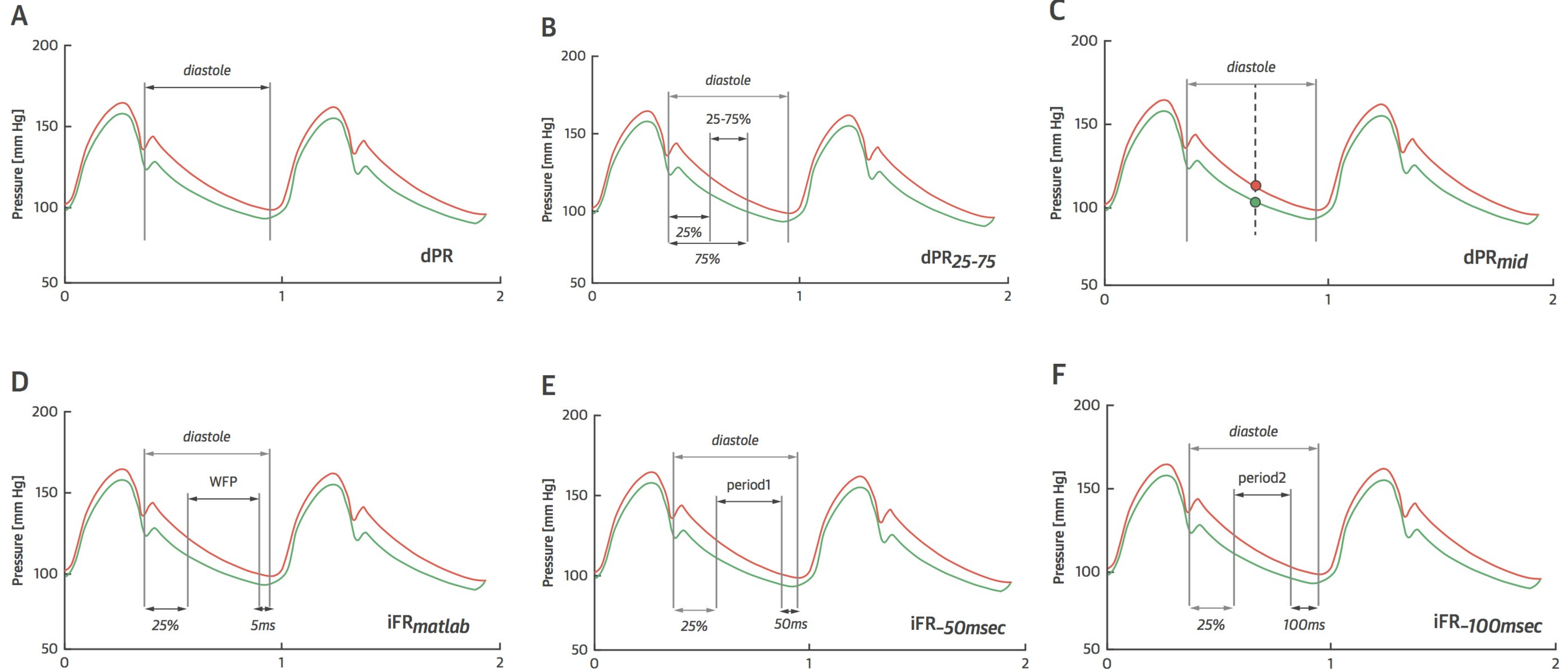
# Les autres indexes diastoliques



Left - JJ Park Int J of Cardiology 168 (2013) 4070–4075

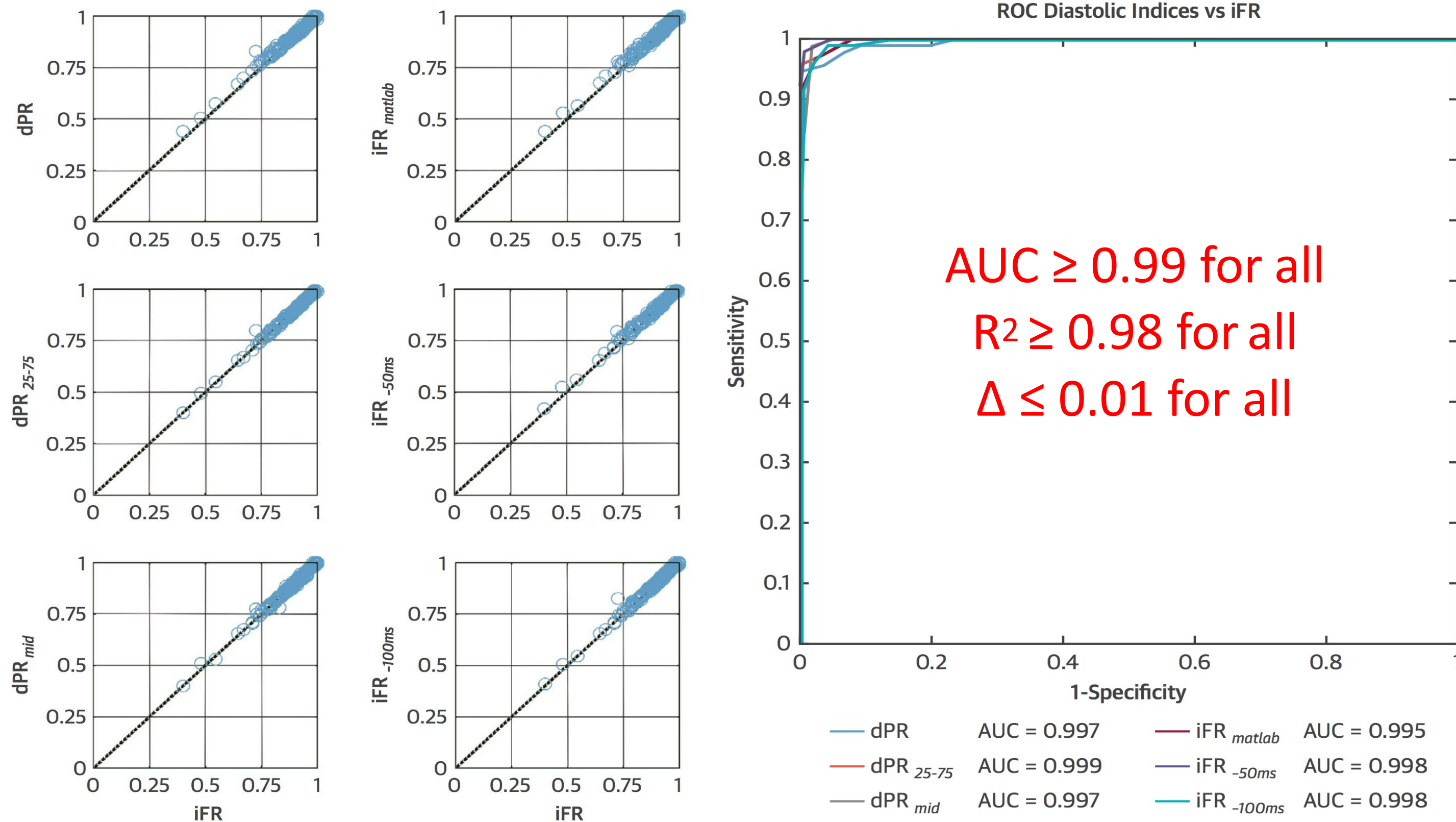
Right - van't Veer et al. Jacc Vol.70, No.25, 201 Dec 26, 2017:3088–96

# 6 definitions du ratio de pression diastolique (dPR)

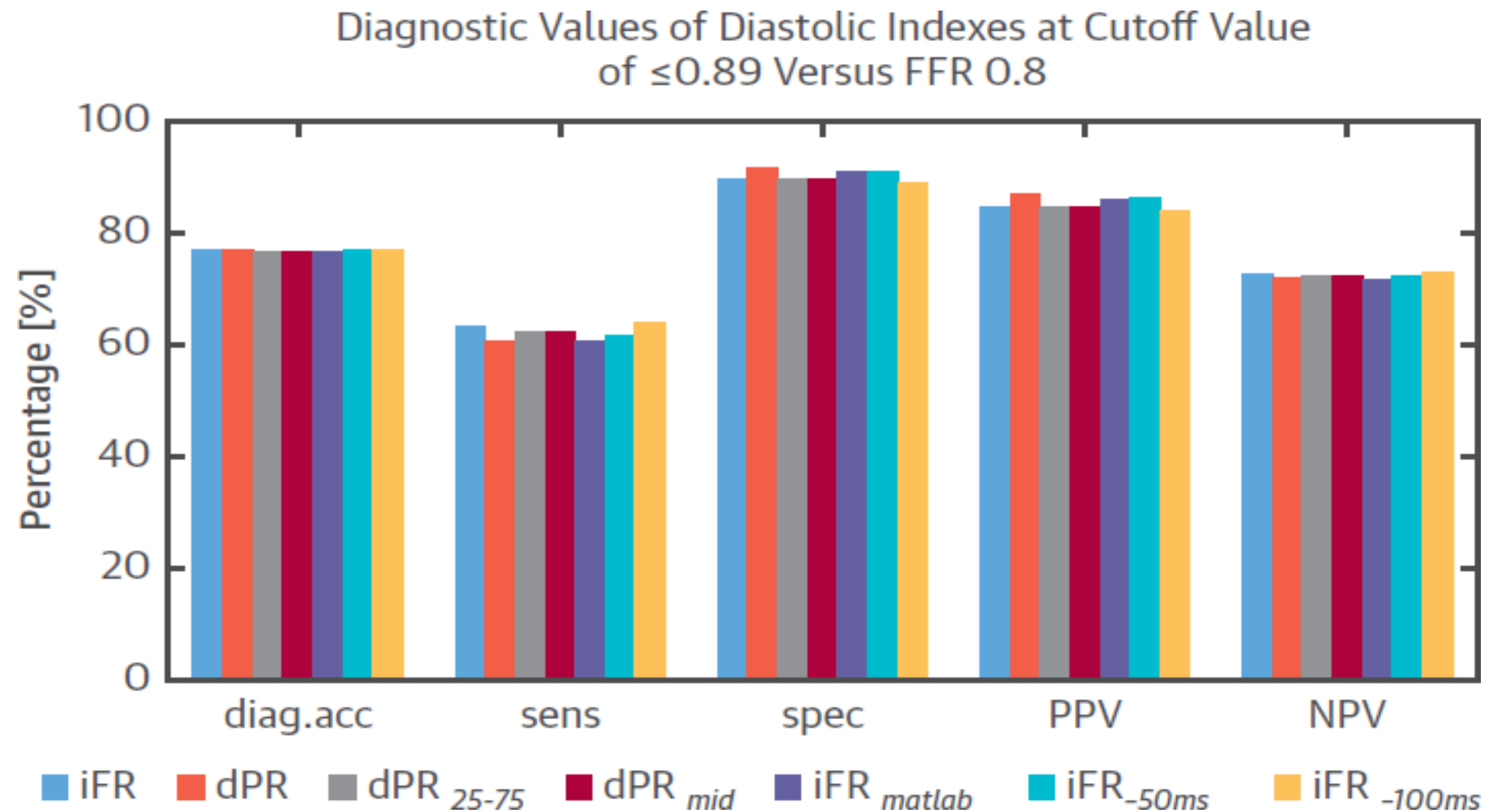


# 6 definitions: dPR = iFR

n=257



# Précisions diagnostique idem vs FFR



van 't Veer M, JACC. 2017 Dec 26;70(25):3088-3096.

# Le dernier né ....RFR: Resting Full cycle Ratio

- Definition:  $P_d/P_a$  minimum sur tout le cycle cardiaque
- Haute sensibilité pour le pull back au repos
- Robuste – indépendant courbe de pression ou ECG

# En résumé iFR - Pd/Pa - RFR

|                  | <b>Pd/Pa</b><br><b>Moyennage sur</b><br><b>l'ensemble du cycle</b> | <b>iFR</b><br><b>Diastolic Wave Free</b><br><b>Period</b> | <b><i>RFR</i></b> |
|------------------|--------------------------------------------------------------------|-----------------------------------------------------------|-------------------|
| Précision vs FFR | 81.5%<br>ROC 0.876                                                 | 80.4%<br>ROC 0.875                                        | ?                 |
| Cutoff vs FFR    | $\leq 0.91$                                                        | $\leq 0.89$                                               | ?                 |
| Hyperemia        | Non                                                                | Non                                                       | Non               |
| Pullback         | moyen                                                              | bien                                                      | ?                 |

1. RESOLVE, Jeremias et al JACC 2014
2. US Food and Drug Administration, 510(k) Number: K172182, August 18, 2017
3. Kobayashi J Am Coll Cardiol. 2017 Oct 24;70(17):2105-2113.
4. ADVISE2 Escaned JACC, VOL.8, No.6, 2015

# Reco ACC/AHA/SCAI 2017

## CORRECTION

Patel MR, Calhoon JH, Dehmer GJ, Grantham JA, Maddox TM, Maron DJ, Smith PK

ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons

J Am Coll Cardiol 2017;69:2212–41.

1. Page 2218, the following sentence has been added to the end of the final paragraph of Section 2. “Methods”:

“Other physiologic measurements using the ratio of distal coronary to aortic pressure without hyperemia exist, and correlate with FFR, but are not as well-validated and lack the clinical outcomes data existing for FFR.”

3. Page 2218, Section 3. “Assumptions”, “General Assumptions”. The following sentence has been added to the

end of assumption 6: “FFR is the reference standard for invasively assessing the physiological significance of a coronary artery stenosis before PCI. Newer physiological measurements that do not require hyperemia measure the ratio of distal coronary pressure to aortic pressure during the whole cardiac cycle or the wave-free portion of the cycle. Both indices have similar diagnostic concordance with FFR but have different normal values and have not been as well-studied as FFR. Substitution of one of the newer physiological measurements for FFR may be considered provided the appropriate reference values are used.”

## Summary:

FFR reste le gold standard, les indexes de repos  
Pd/Pa or iFR peuvent être utilisés