



# ***Fractional Flow Reserve (FFR)***

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*AMC Hartcentrum*



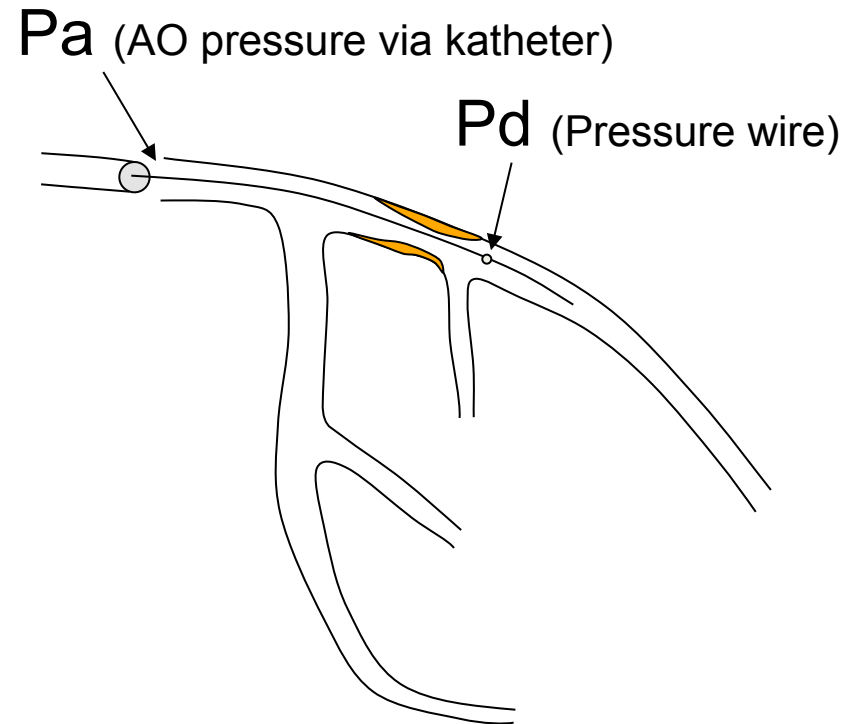
- 
- ***Wat*** is FFR?
  - ***Waarom*** gebruiken we FFR?
  - ***Wanneer*** gebruiken we FFR?
  - ***Waar kan ik op letten?***
- 



**WAT IS FFR?**



$$FFR = \frac{P_d}{P_a}$$

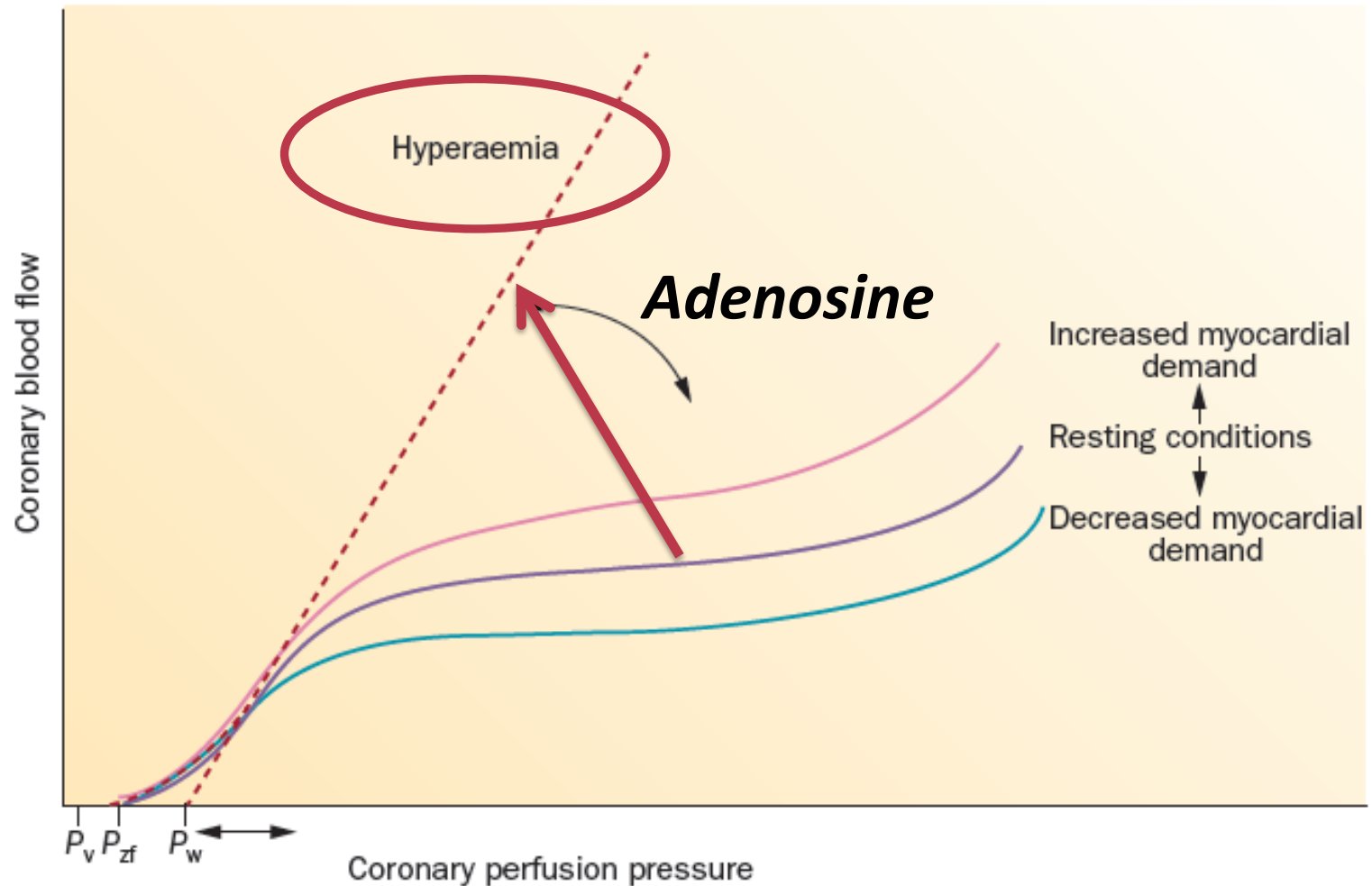


FFR is de ratio van distale coronaire druk tot aorta druk

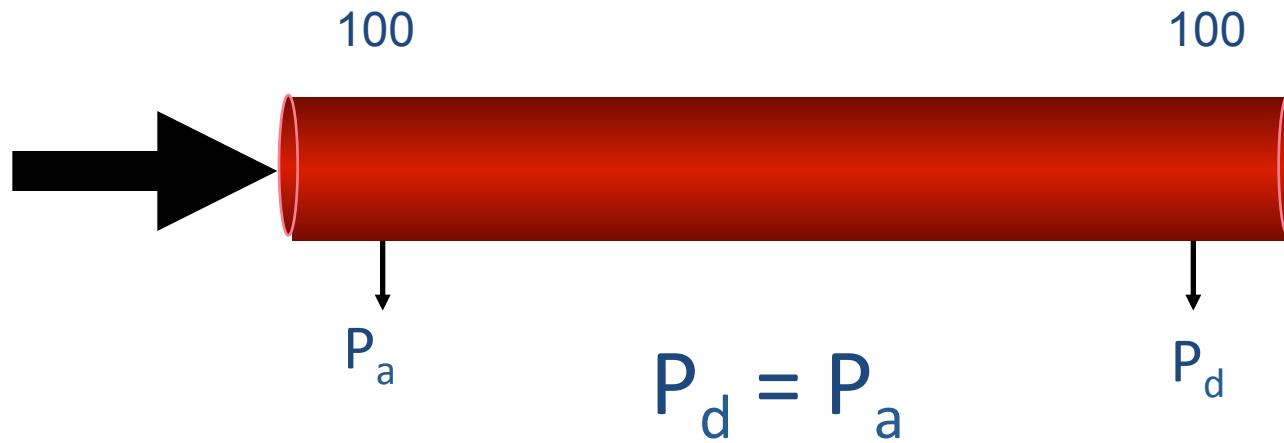
**Bij maximale hyperemie**

***Schat de proportie bloed stroom in de aanwezigheid van een stenose***  
***Als een fractie van verwachte bloedstroom zonder stenose***

# Hyperemia

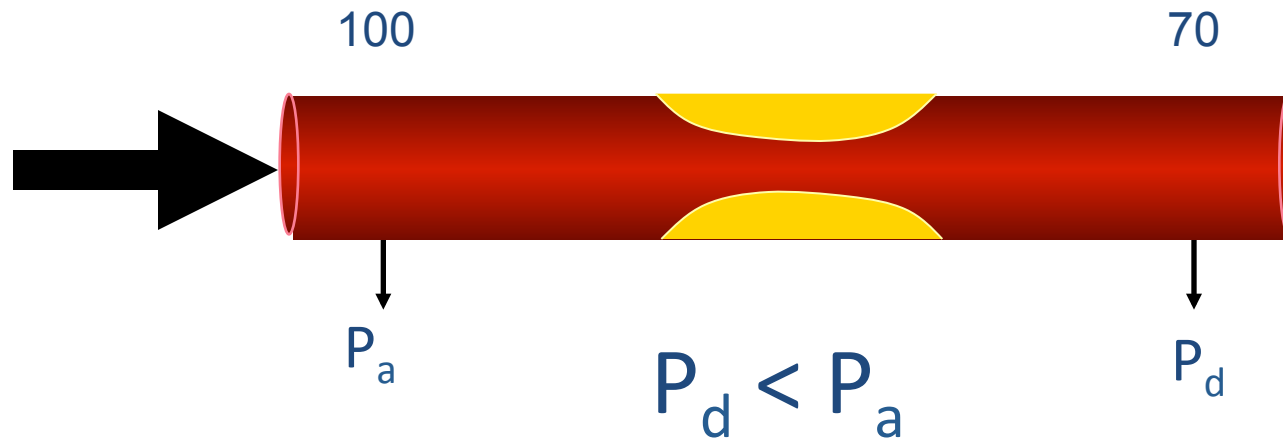


# Normale FFR = 1.0



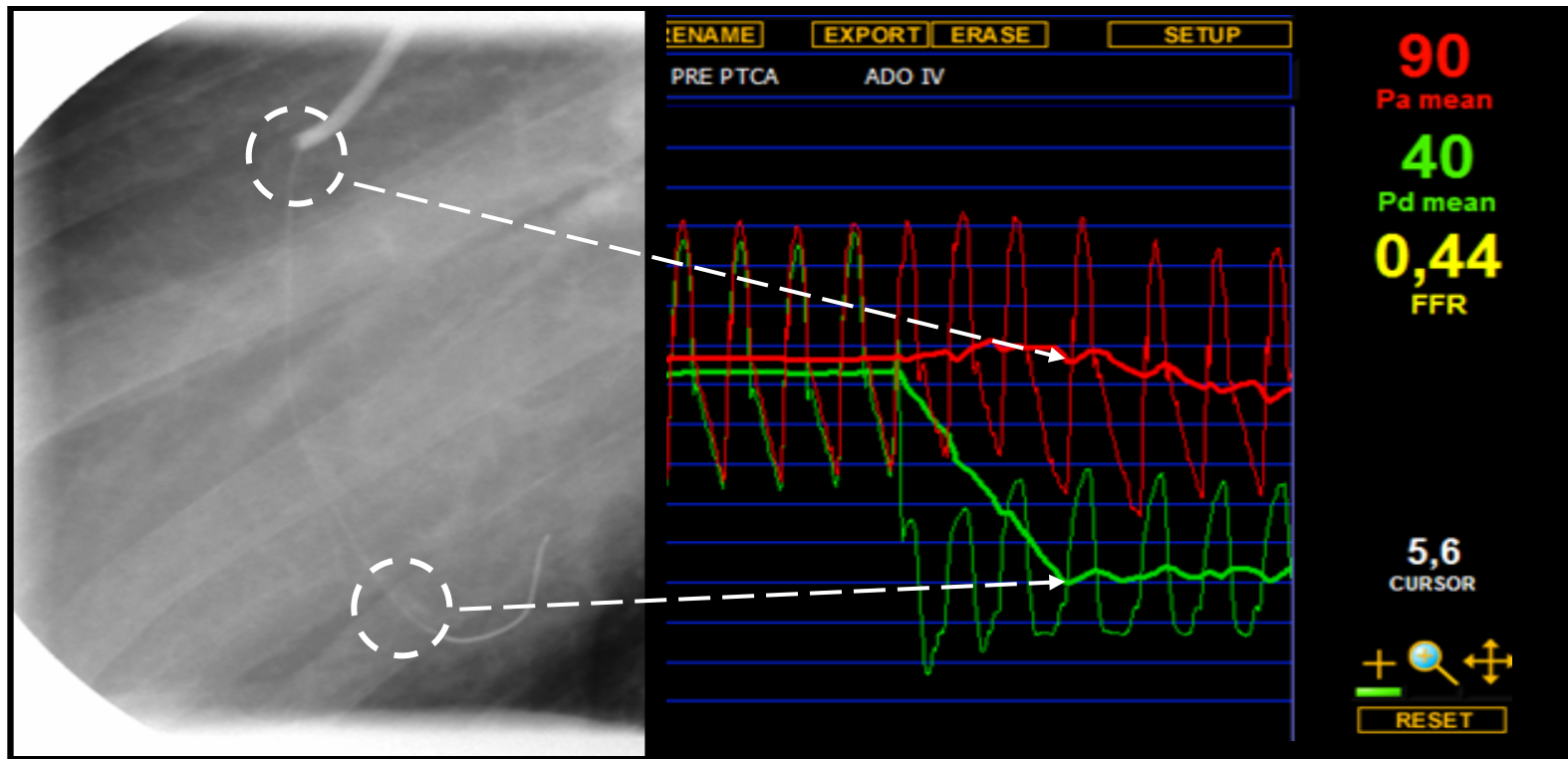
$$FFR_{\text{myo}} = \frac{P_d}{P_a} = 1$$

# FFR in aanwezigheid stenose



$$\text{FFR}_{\text{myo}} = \frac{P_d}{P_a} < 1$$

# Hoe werkt FFR?

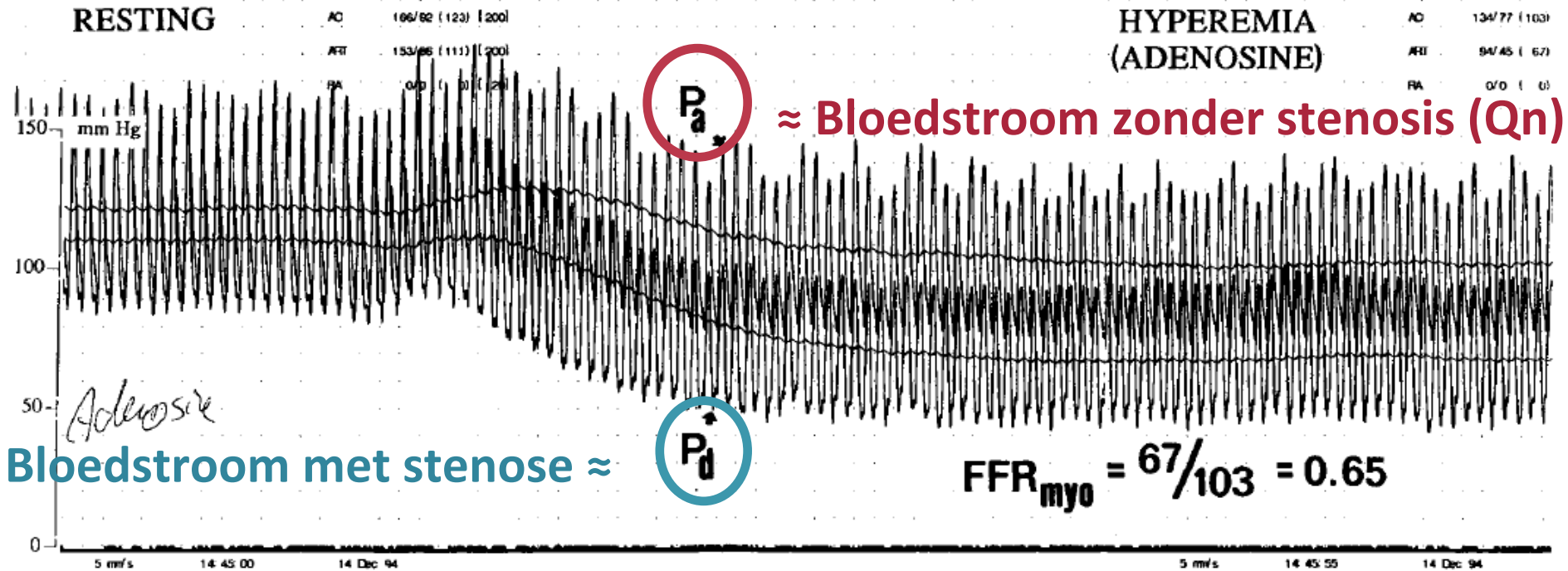


$$FFR_{\text{myo}} = \text{Pd/Pa} \text{ bij hyperemie}$$

$$FFR_{\text{myo}} = 40/90 = 0.44$$

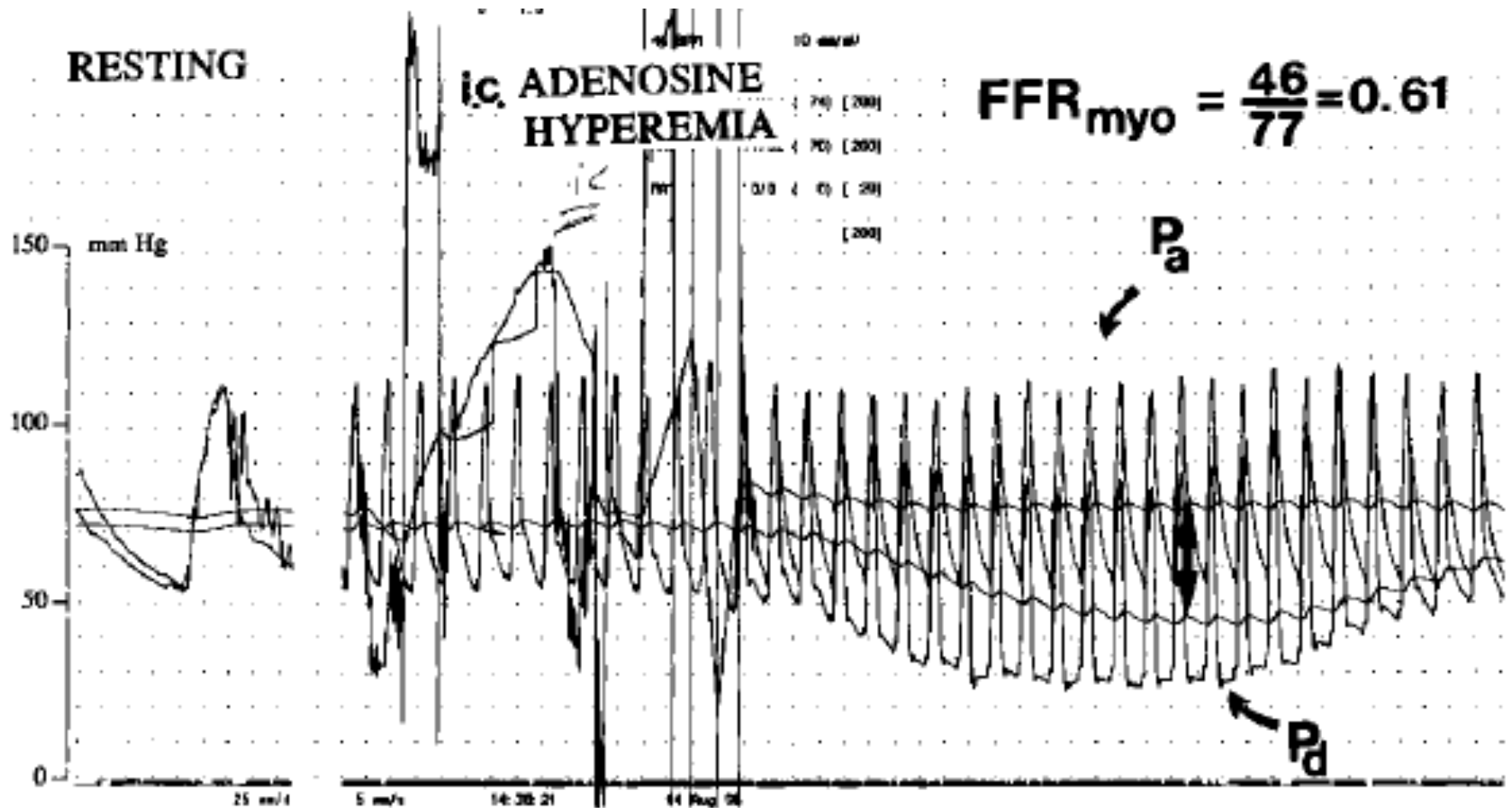


# Adenosine: intraveneus



$$Q_s / Q_n \approx \frac{P_d \text{ (distaal coronair)}}{P_a \text{ (aorta)}} = FFR$$

# Adenosine: coronair

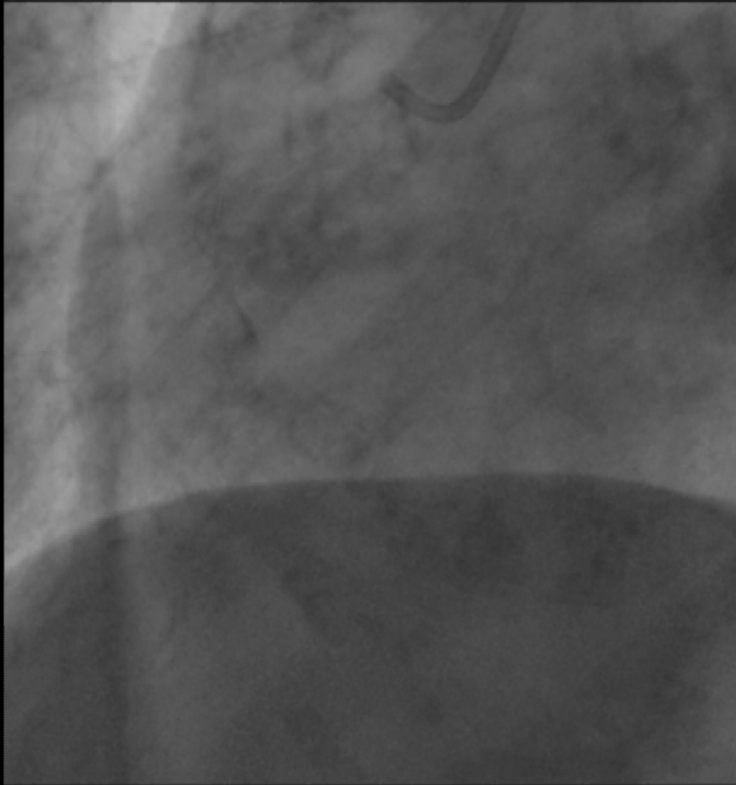




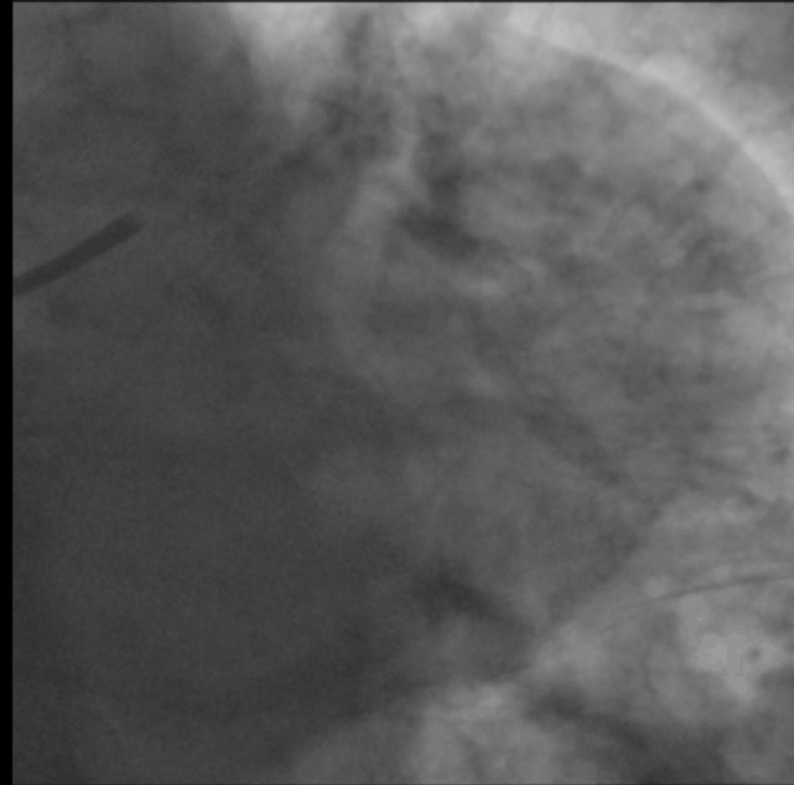
**WAAROM FFR?**



# Angiografie



RAO -10,4°  
Caudal -40,2°

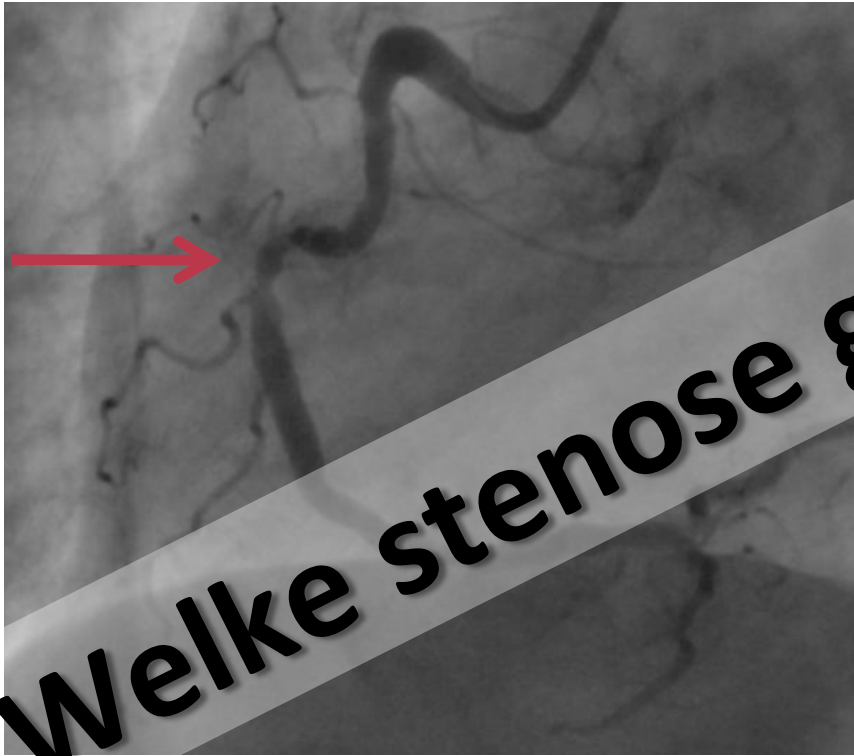


**RCA**

**LCA**

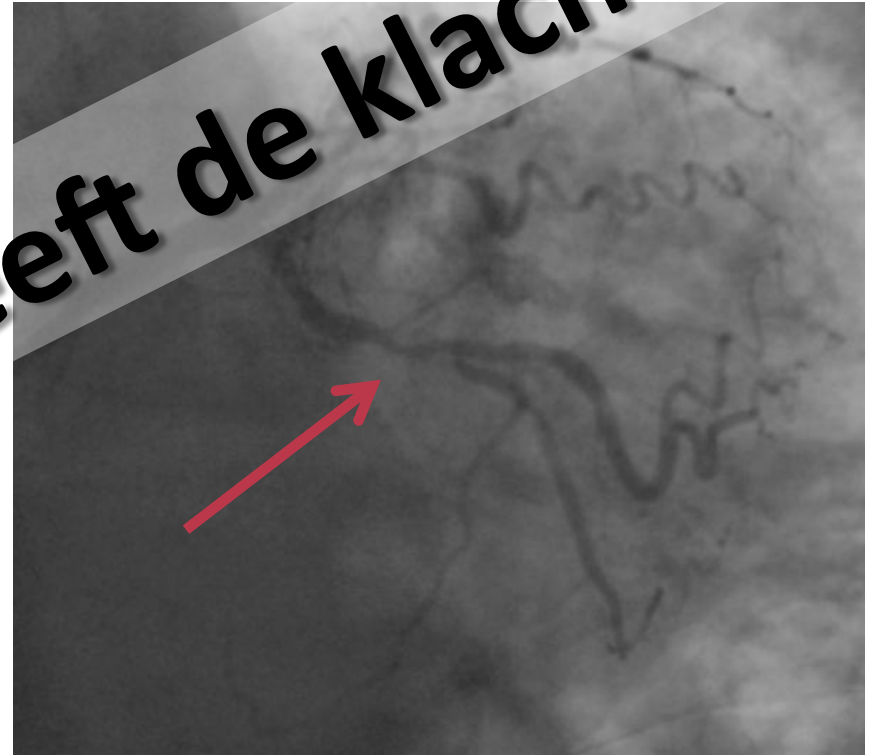
# Angiografie

RCA



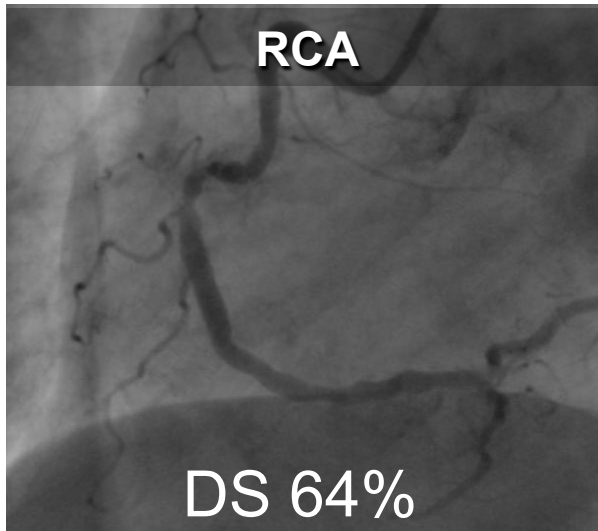
DS: 64%

RCx

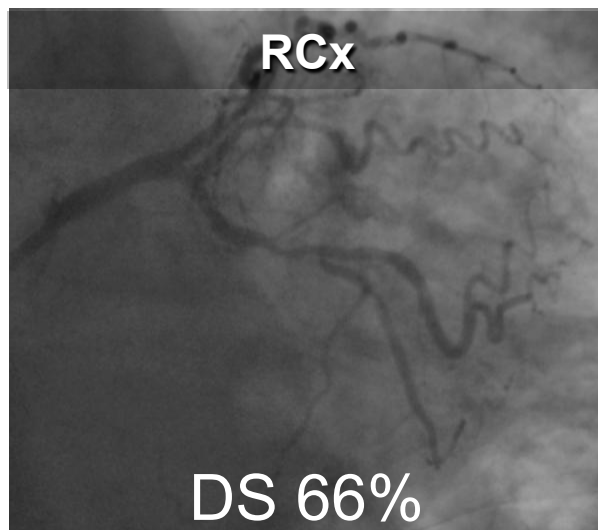


DS: 66%

# Angiografie versus FFR



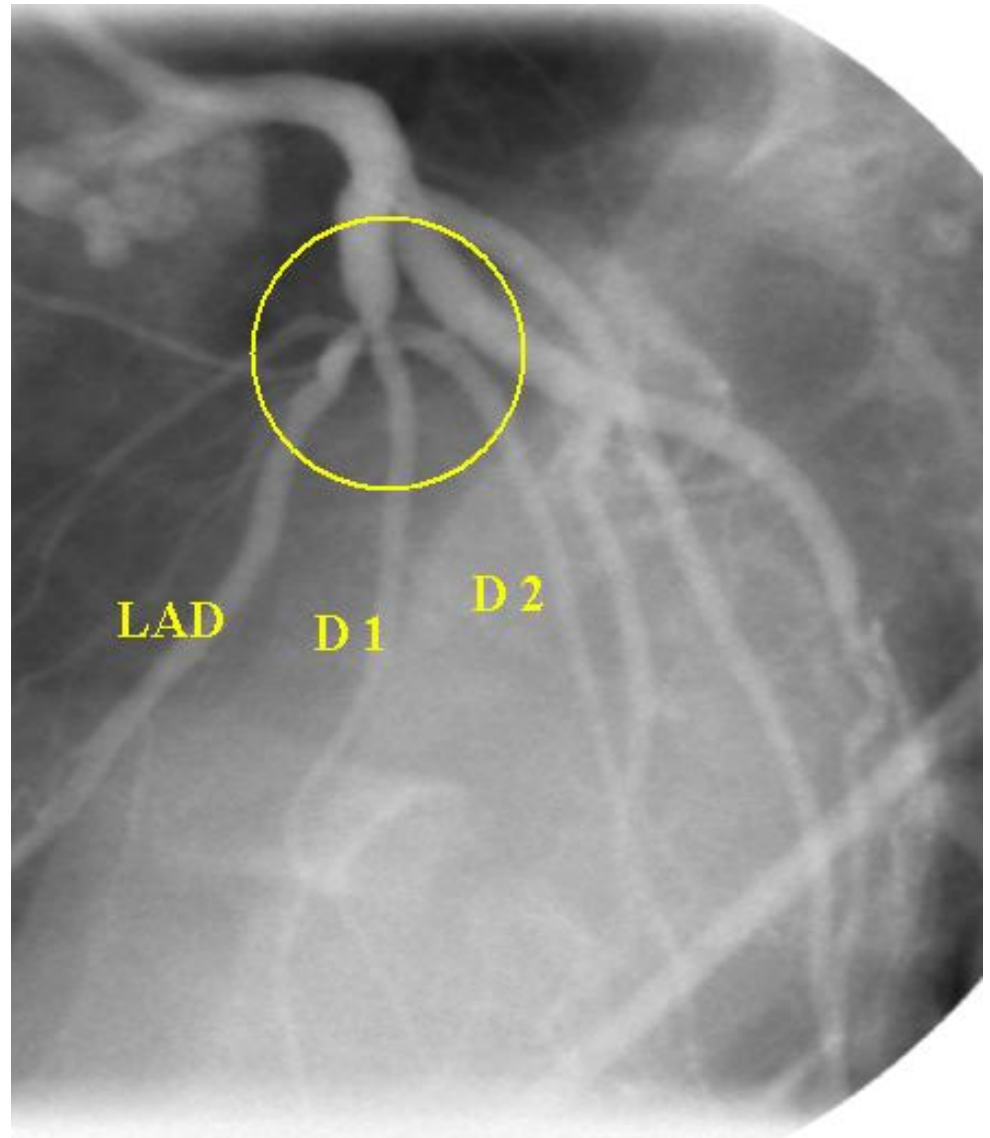
**FFR 0.72**



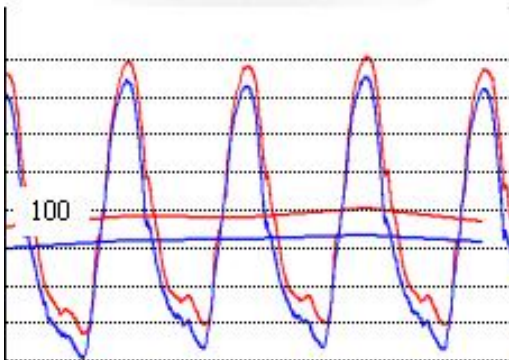
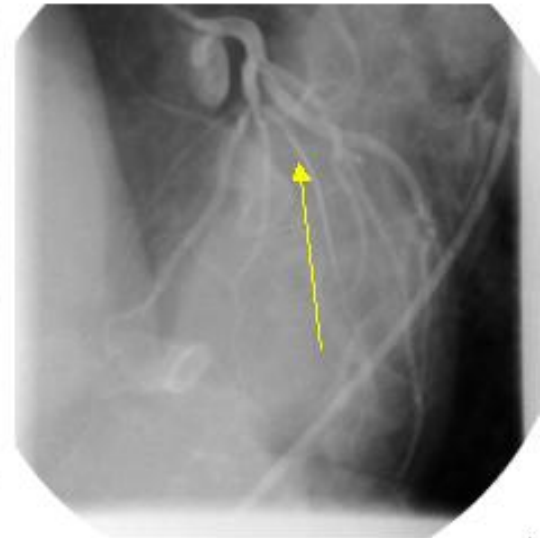
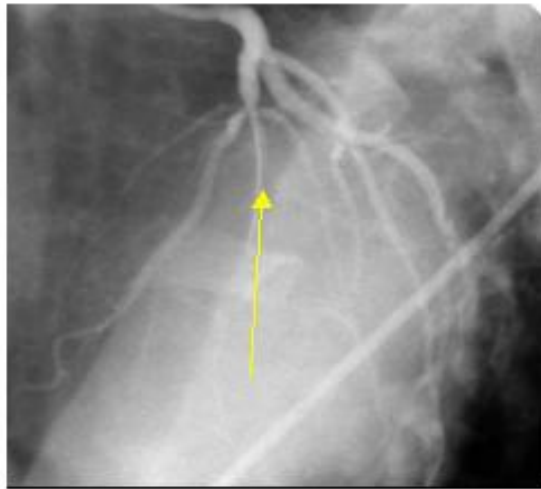
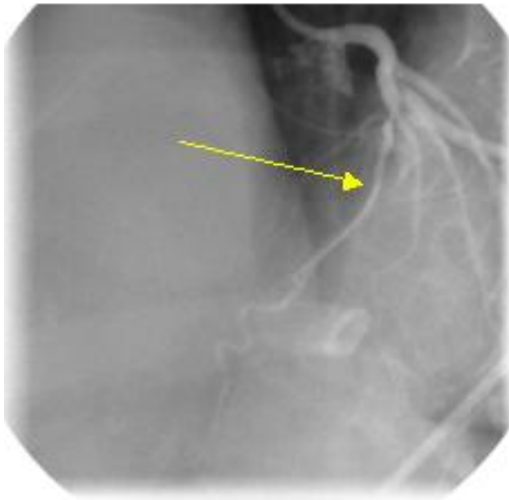
**FFR 0.88**

# Tri-furcatie

Welke stent?!

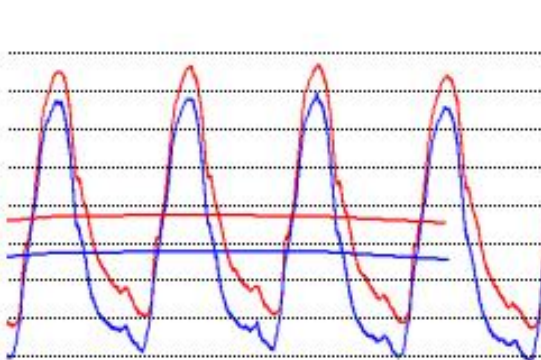


# Tri-furcatie



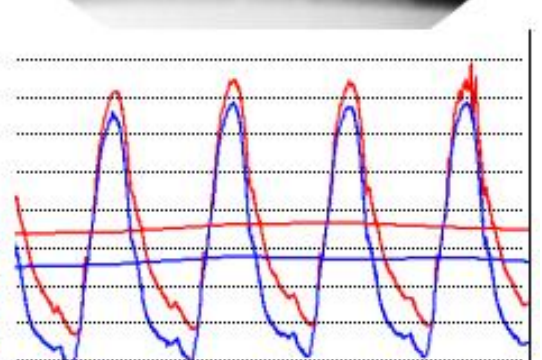
**FFR = 92/98 = 0.94**

**NO stent needed**



**FFR = 87/97 = 0.90**

**NO stent needed**

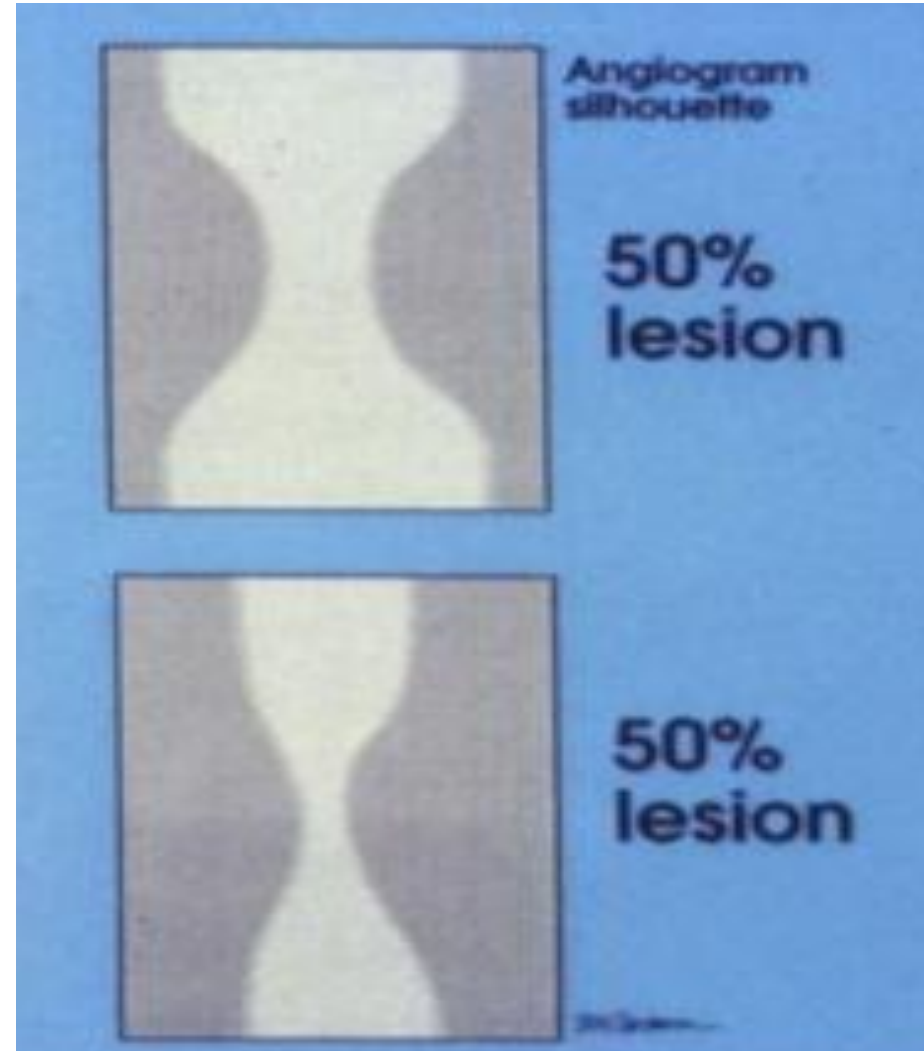


**FFR = 87/96 = 0.90**

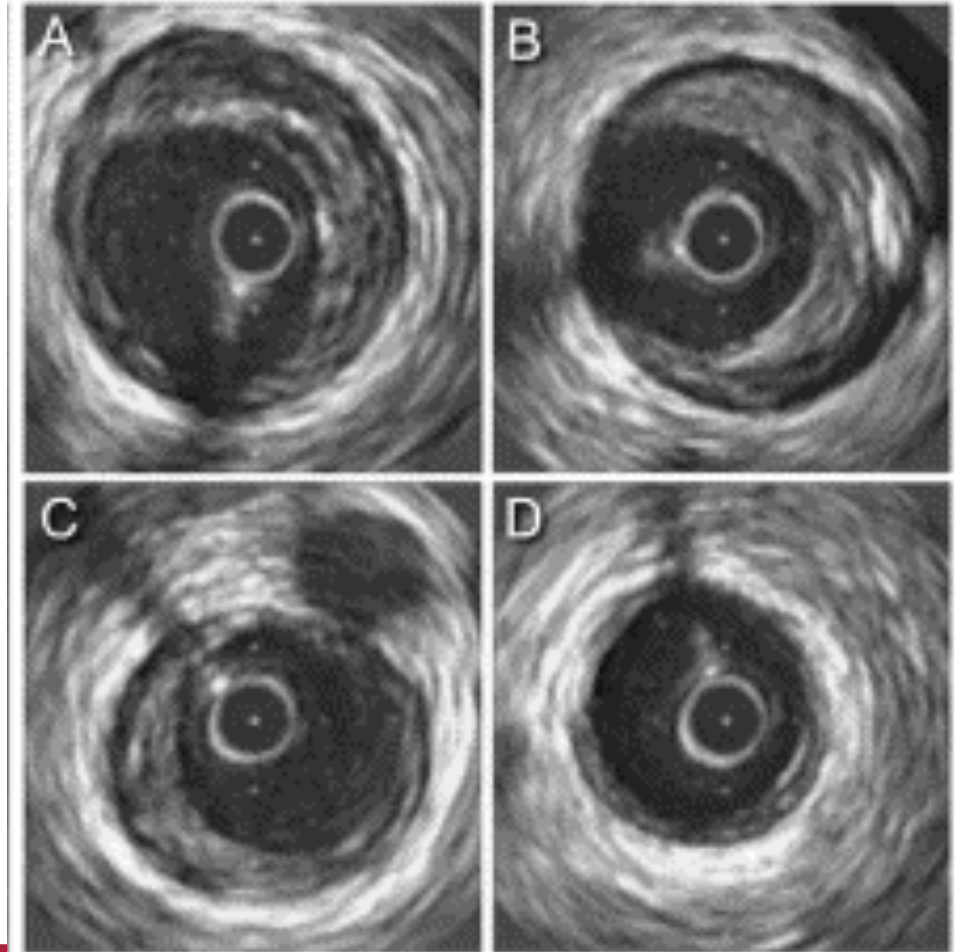
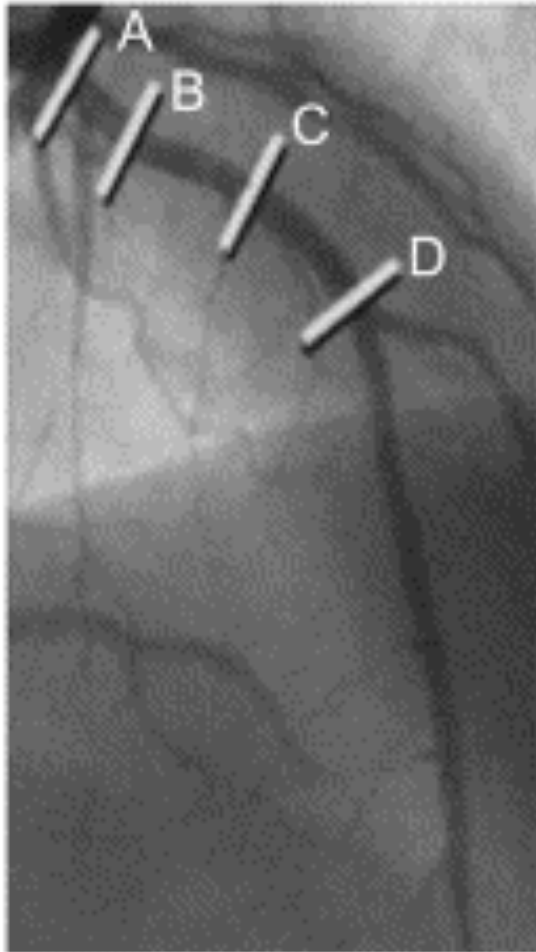
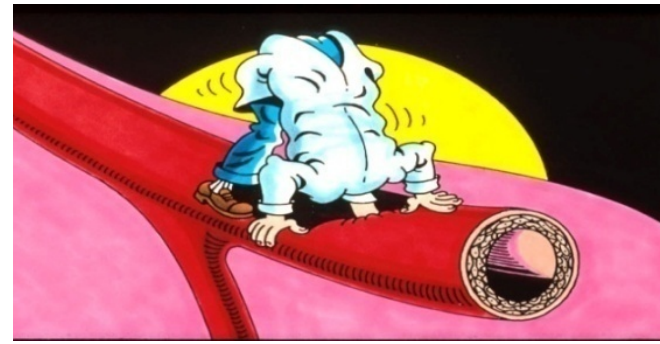
**NO stent needed**



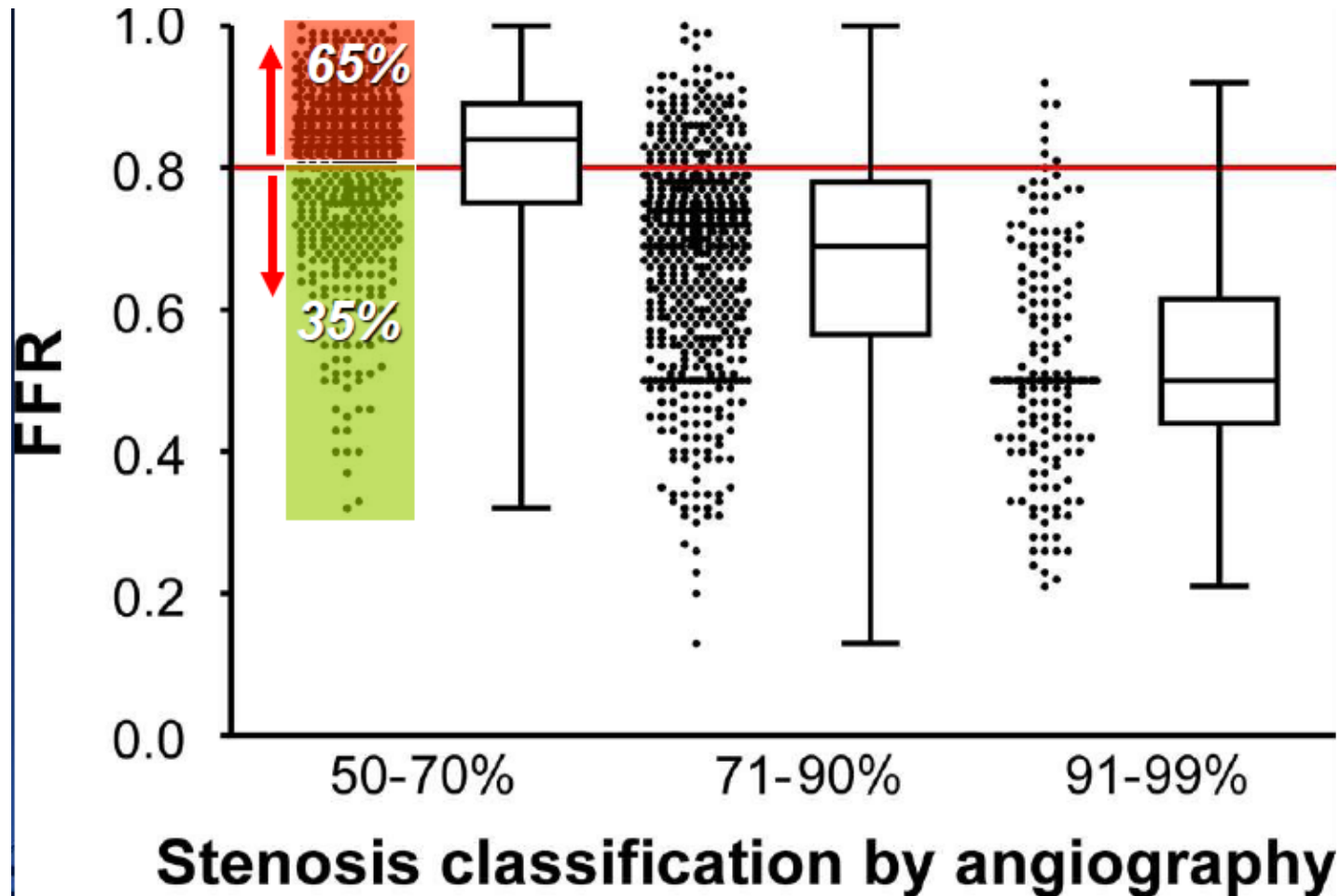
# Illusie van luminologie



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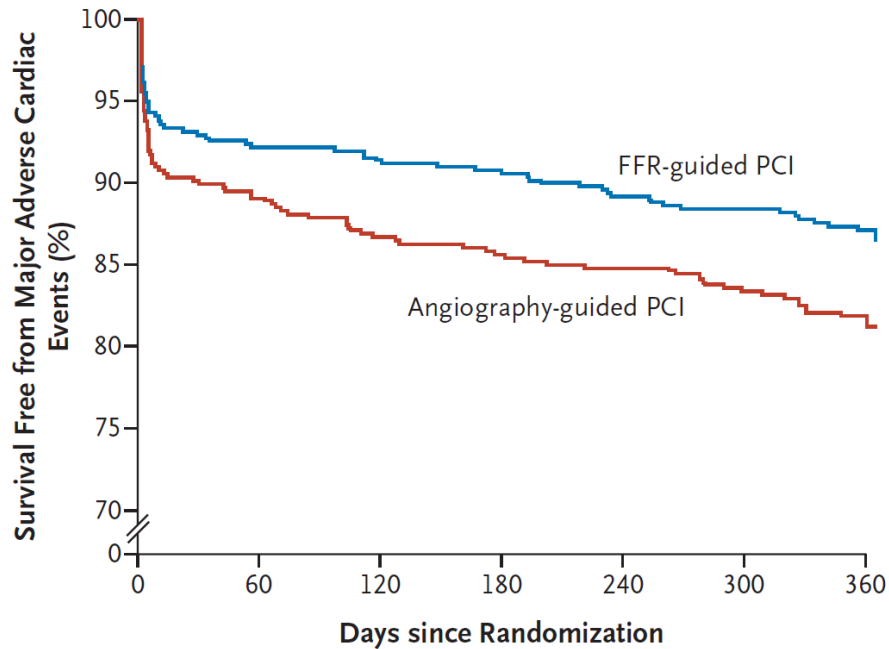


# FFR versus angiografie



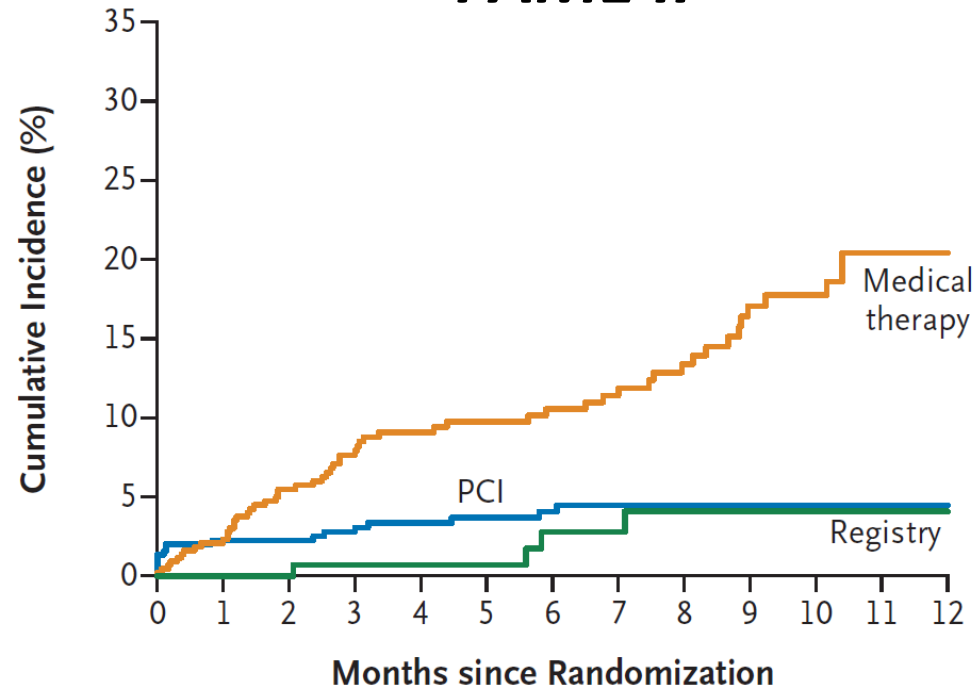
# Fractional Flow Reserve

## FAME 1



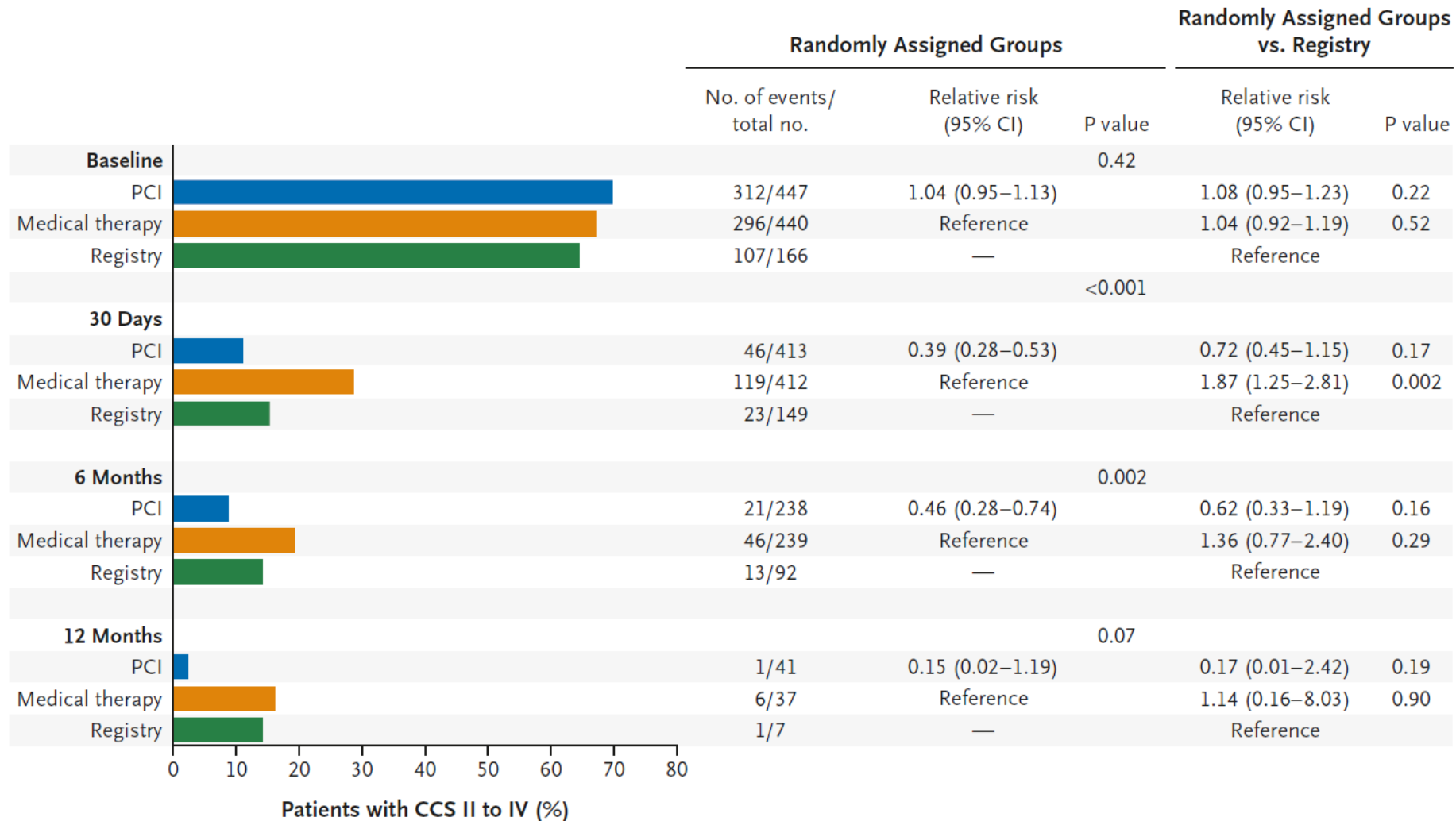
Relative Risk with FFR Guidance (95%CI) 0.72 (0.54–0.96)

## FAME II 2

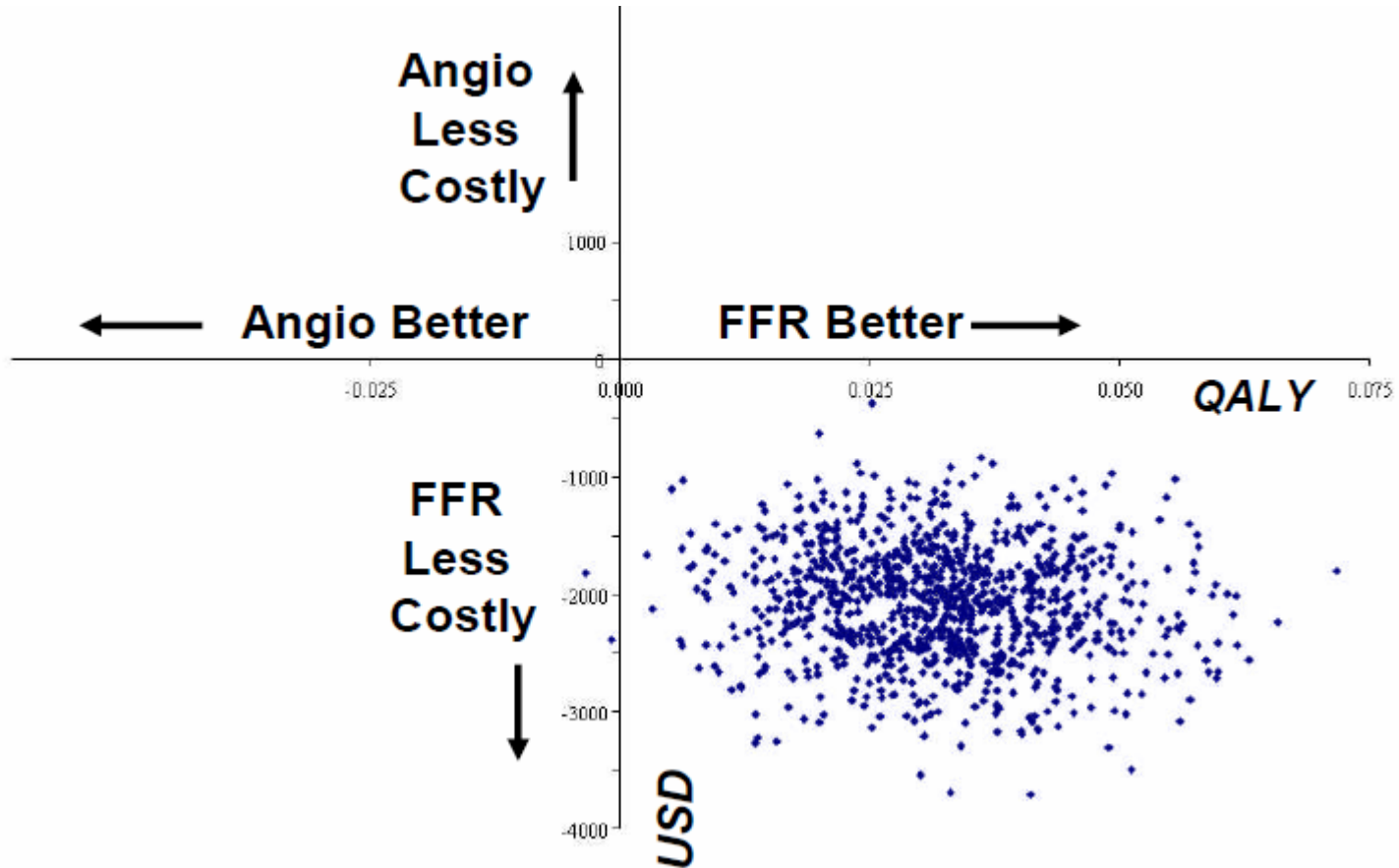


PCI vs. medical therapy:  
Hazard ratio, 0.32 (95% CI, 0.19–0.53); P<0.001

# FFR en angina pectoris



# Kosten effectiviteit van FFR



# ESC Guidelines

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>	Ref. <sup>c</sup>
FFR is recommended to identify hemodynamically relevant coronary lesion(s) when evidence of ischaemia is not available.	I	A	399, 401, 405
Revascularization of stenoses with FFR <0.80 is recommended in patients with angina symptoms or a positive stress test.	I	B	400



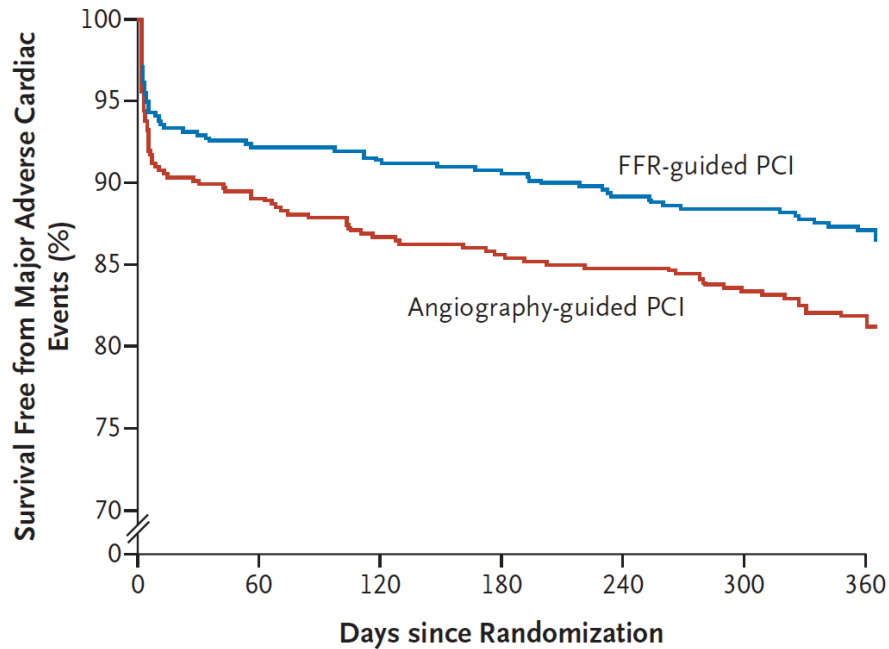
**WANNEER FFR?**





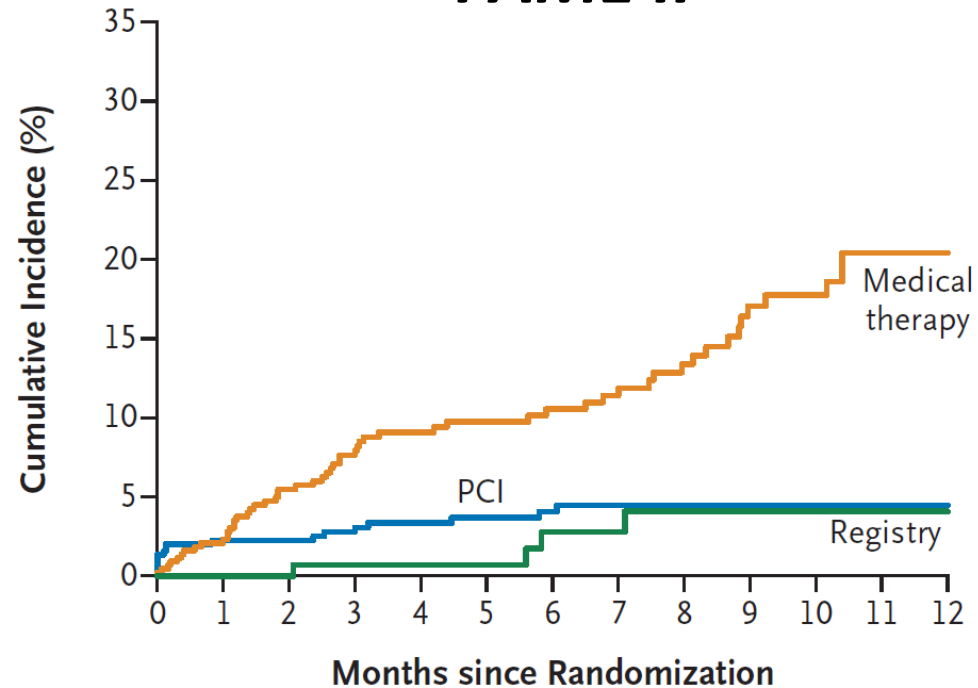
# Fractional Flow Reserve

## FAME 1



Relative Risk with FFR Guidance (95%CI) 0.72 (0.54–0.96)

## FAME II 2



PCI vs. medical therapy:  
Hazard ratio, 0.32 (95% CI, 0.19–0.53); P<0.001

**Table 32 Use of stable coronary artery disease patients on optical medical therapy (adapted from ESC/EACTS 2010 Guidelines)<sup>172</sup>**

Indication <sup>a</sup>	To improve prognosis:		To improve symptoms persistent on OMT:		Ref. <sup>f</sup>
	Class <sup>d</sup>	Level <sup>e</sup>	Class <sup>d</sup>	Level <sup>e</sup>	
A Heart Team approach to revascularization is recommended in patients with unprotected left main, 2–3 vessel disease, diabetes or comorbidities.	I	C	I	C	266, 426–428
Left main >50% diameter stenosis <sup>b</sup> .	I	A	I	A	172
Any proximal LAD >50% diameter stenosis <sup>b</sup> .	I	A	I	A	172
2–3 vessel disease with impaired LV function / CHF.	I	B	IIa	B	172
Single remaining vessel (>50% diameter stenosis <sup>b</sup> ).	I	C	I	A	172
Proven large area of ischaemia (>10% LV <sup>c</sup> )	I	B	I	B	172
Any significant stenosis with limiting symptoms or symptoms non responsive/intolerant to OMT.	NA	NA	I	A	172
Dyspnoea/cardiac heart failure with >10% ischaemia/viability <sup>c</sup> supplied by stenosis >50%.	IIb	B <sup>429, 430</sup>	IIa	B	172
No limiting symptoms with OMT in vessel other than left main or proximal LAD or single remaining vessel or vessel subtending area of ischaemia <10% of myocardium or with FFR ≥0.80.	III	A	III	C	23, 25, 172, 400

References attached to these recommendations can be found in Table 8 of the original ESC guidelines for myocardial revascularization.<sup>172</sup>

CCS = Canadian Cardiovascular Society; CHF: congestive heart failure; FFR = fractional flow reserve; LAD = left anterior descending; LV = left ventricle; NA: not available; OMT = optimal medical treatment; SCAD = stable coronary artery disease.

<sup>a</sup> In asymptomatic patients, the decision will be guided by the extent of ischaemia on stress testing.

<sup>b</sup> With documented ischaemia or FFR < 0.80 for angiographic diameter stenoses 50–90%.

<sup>c</sup> As assessed by non-invasive test (SPECT, MRI, stress echocardiography).

<sup>d</sup> Class of recommendation.

<sup>e</sup> Level of evidence.

<sup>f</sup> Reference(s) supporting levels of evidence.



**WAAR KAN IK OP LETTEN?**



# Het meten van FFR

1

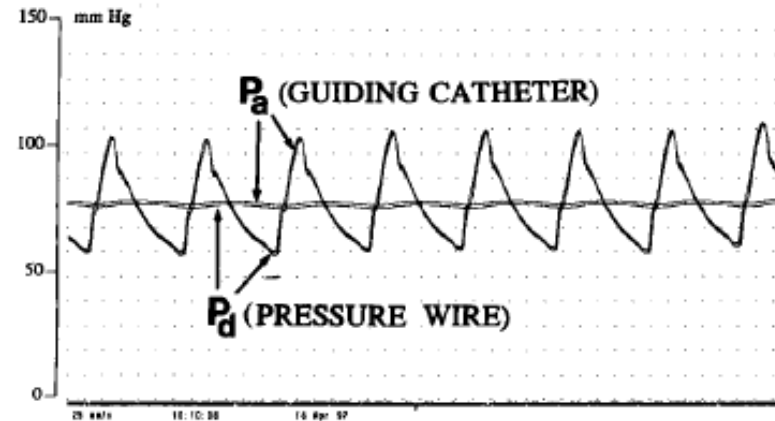
## Vorbereiding

- Flush pressure wire
- Zero Pa op cathlab druksysteem
- Zero Pa op FFR console

2

## Normaliseren

- IC nitraten geven
- Pressure wire met sensor ter plaatse van het ostium van de guide catheter
- *Introducer needle verwijderen*
- Normaliseer Pa en Pd drukken



# Het meten van FFR

1

## Vorbereiding

- Flush pressure wire
- Zero Pa op cathlab druksysteem
- Zero Pa op FFR console

2

## Normaliseren

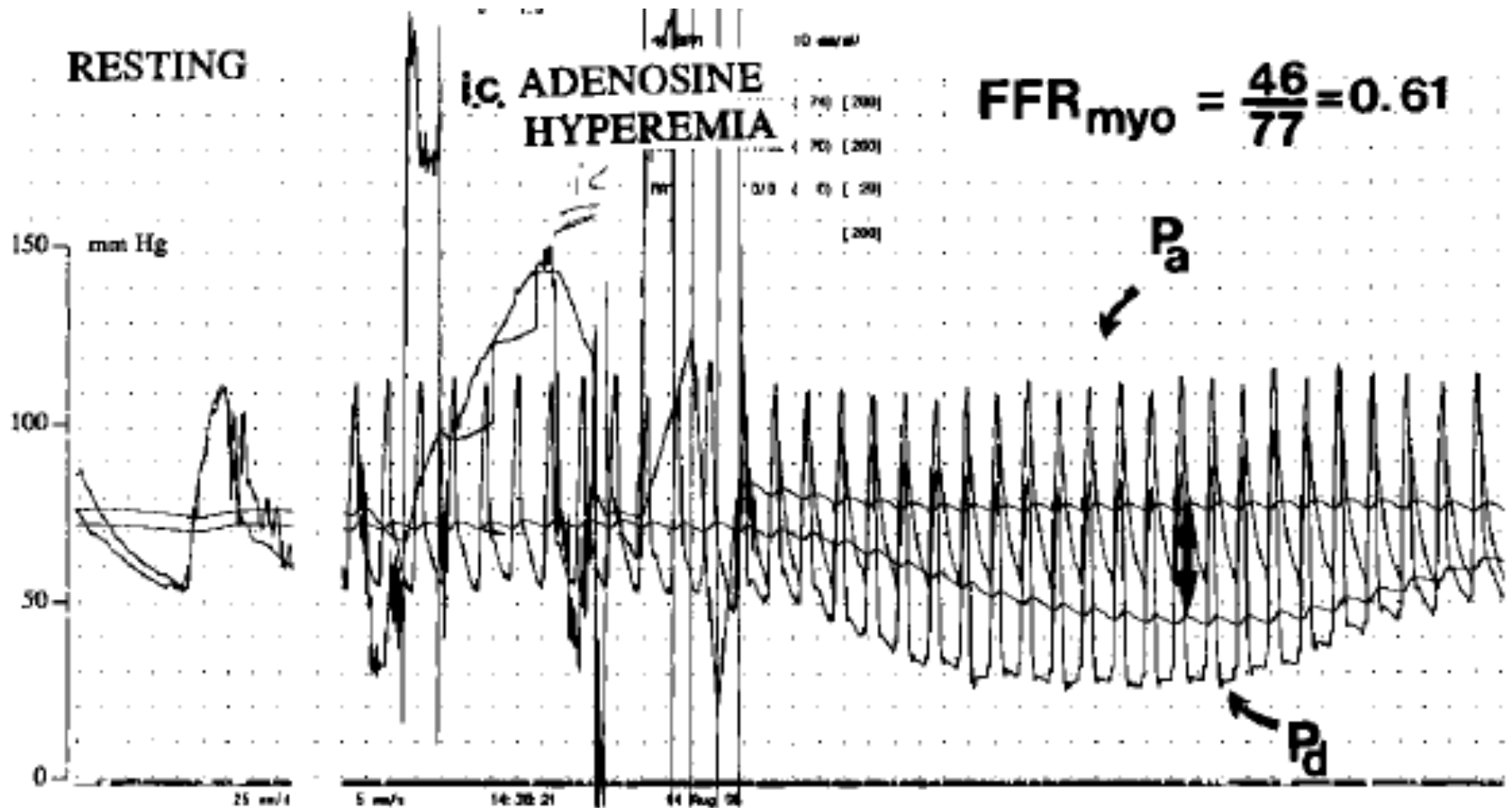
- IC nitraten geven
- Pressure wire met sensor ter plaatse van het ostium van de guide catheter
- Introducer naald verwijderen
- Normaliseer Pa en Pd drukken

3

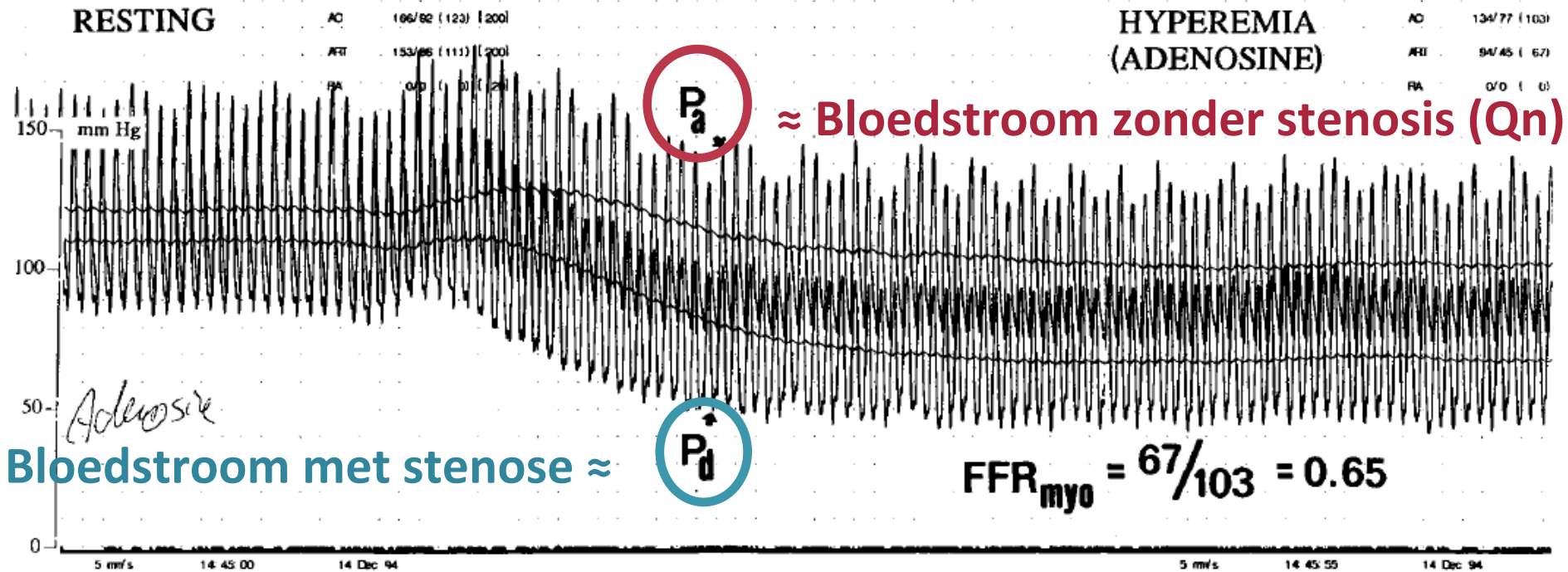
## Measuring

- Pressure wire distaal van de stenose
- Introducer naald verwijderen
- Y-connector poort dicht
- Controleer Pa en Pd signalen
- ***HYPEREMIE***

# Intracoronary adenosine

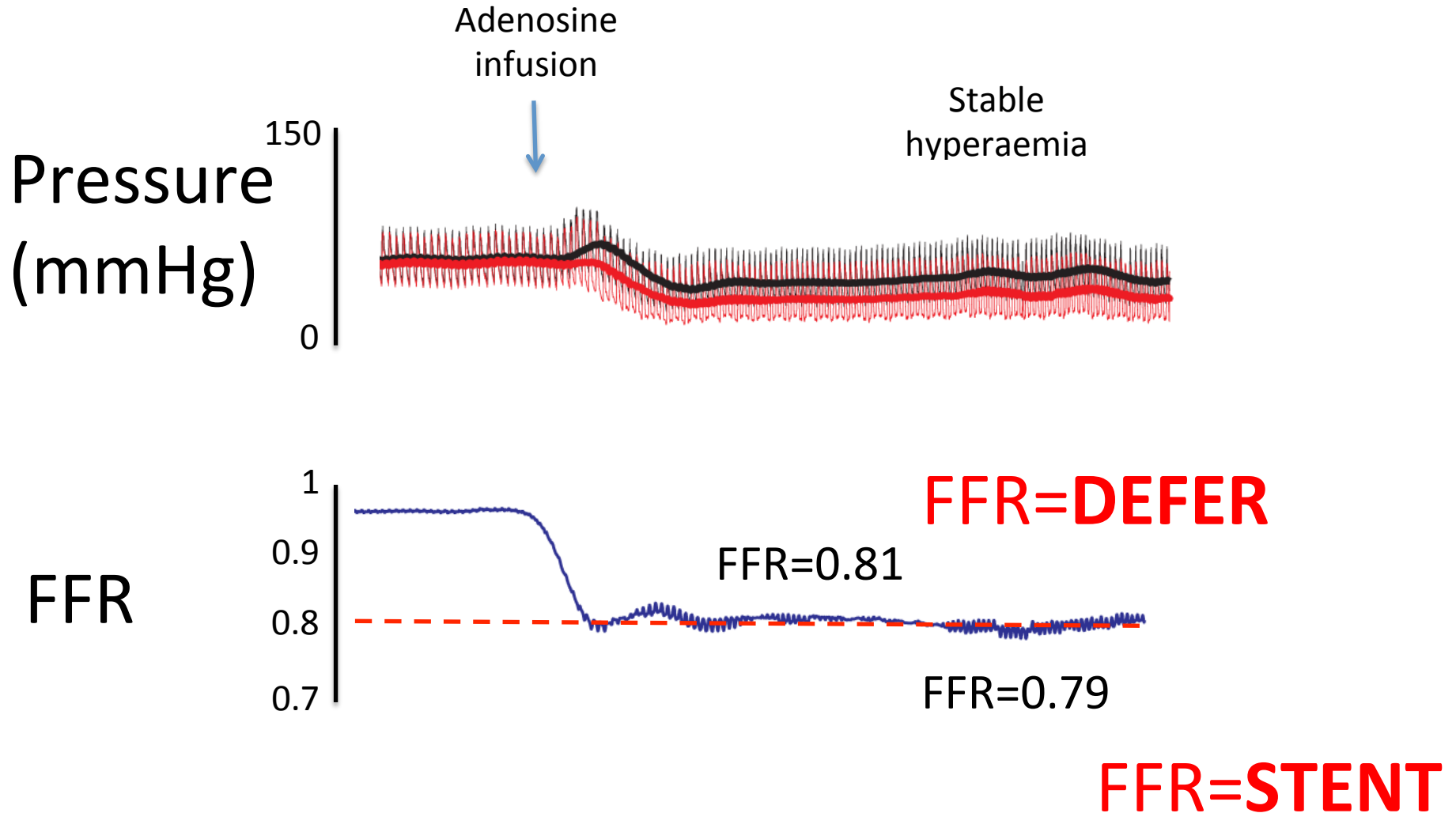


# Adenosine: intraveneus

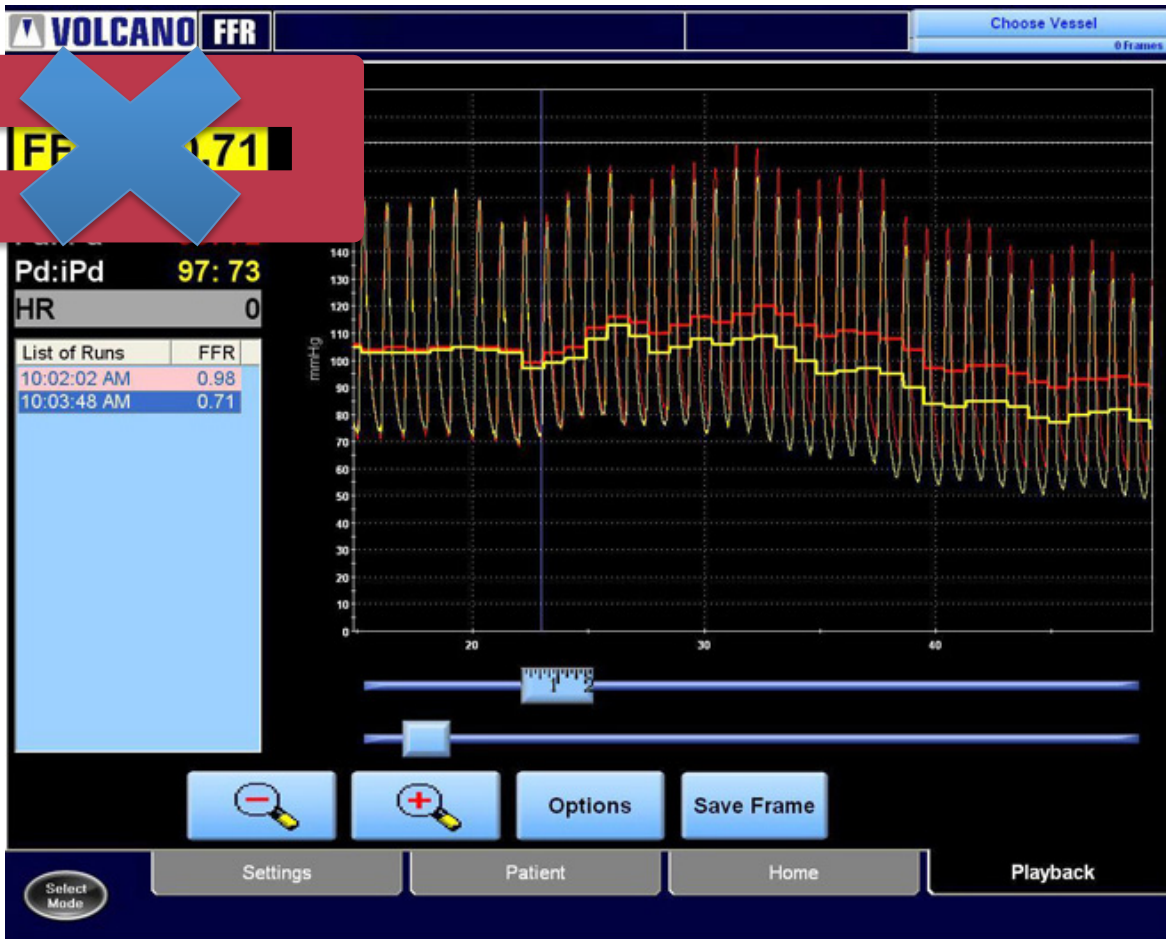


$$Q_s / Q_n \approx \frac{P_d \text{ (distaal coronair)}}{P_a \text{ (aorta)}} = FFR$$

# Welke FFR moeten we gebruiken?







# Take Home

- **Wat** is FFR?
  - [Distale druk/aorta druk] om te schatten in welke mate de vernauwing de bloedstroom hindert
- **Waarom** gebruiken we FFR?
  - Angiografie is niet voldoende om stenose-ernst te bepalen
  - Bewezen betere uitkomsten van revascularisatie
- **Wanneer** gebruiken we FFR?
  - Eigenlijk in alle revascularisatie targets, maar volgens de guidelines in stenoses >50% en <90% zonder aangetoonde ischemie.
- **Waar kan ik op letten?**
  - Voorbereiding [pomp klaar, adenosine klaar, “nullen”]
  - Bepalen van de FFR!