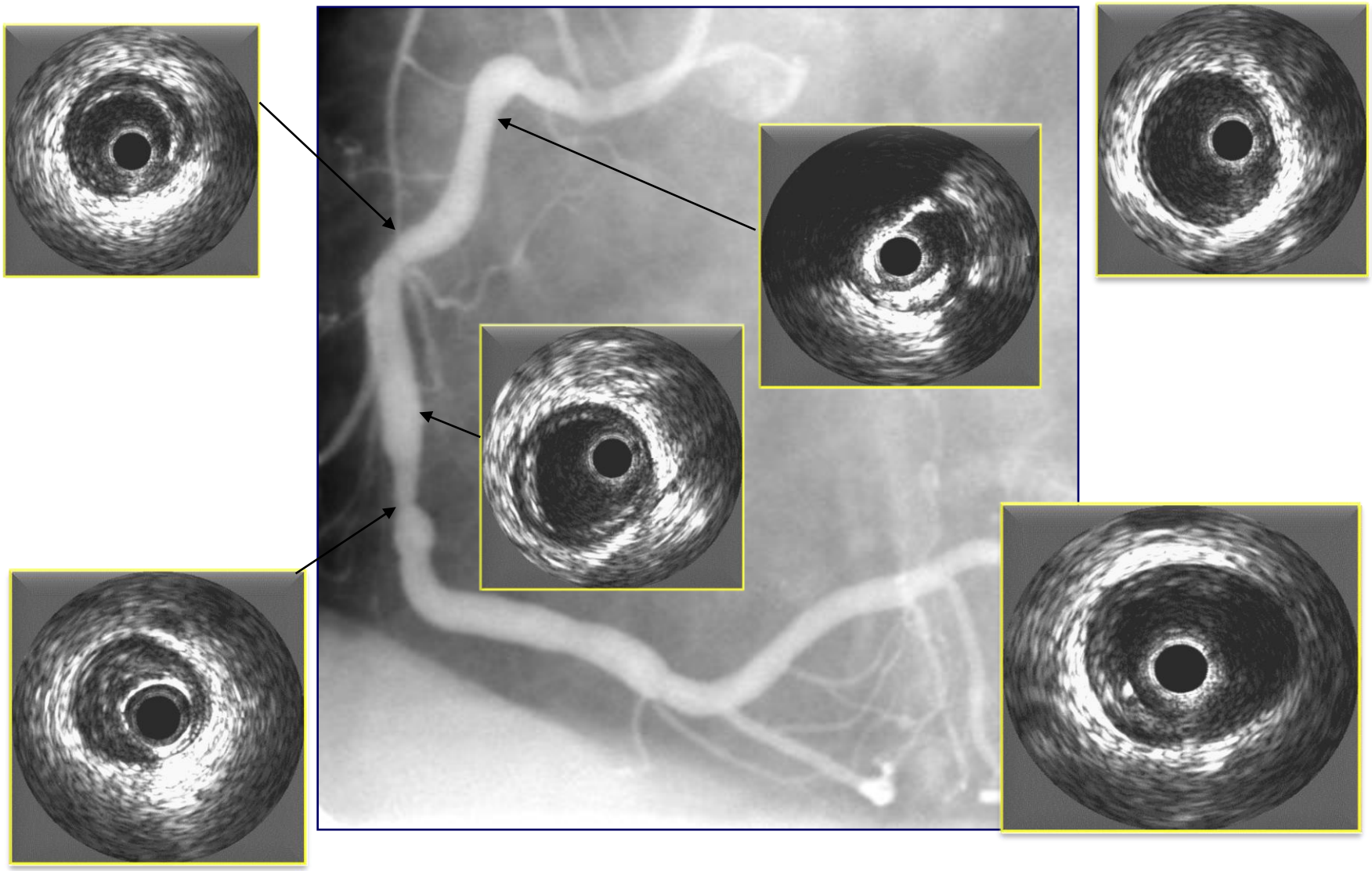
Cardiovascular Center Aalst

Diffuse Disease and Serial Stenoses

Bernard De Bruyne
Cardiovascular Center Aalst
Belgium

Cardiovascular Center Aalst

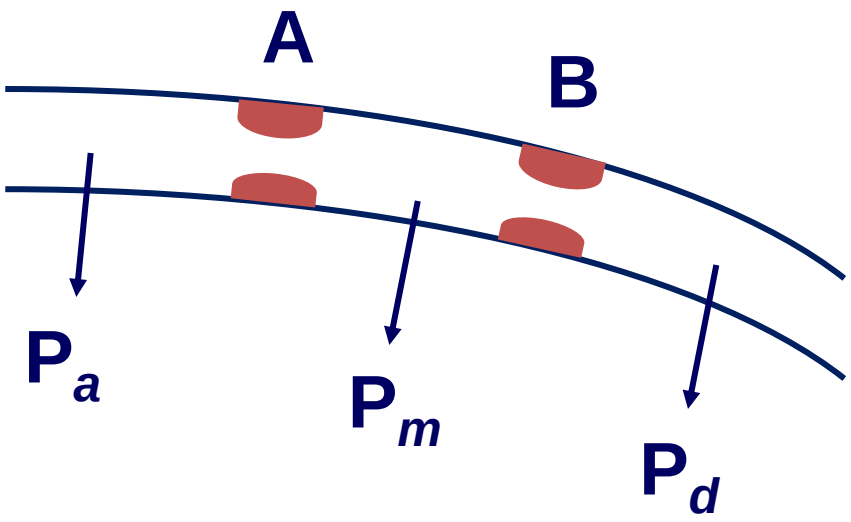
Atherosclerosis is a Diffuse Disease



Cardiovascular Center Aalst

Serial Stenoses

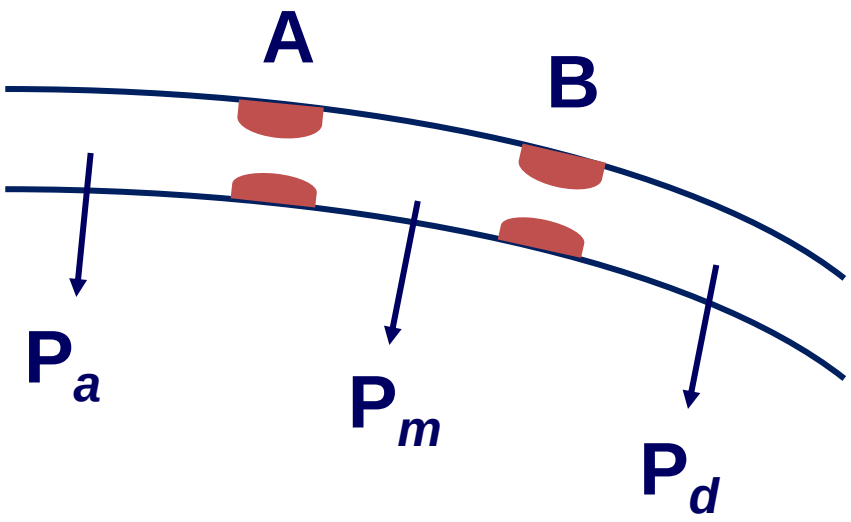
Cardiovascular Center Aalst



When A is isolated, hyperemic flow through stenosis A = maximal

When B: hyperemic flow through stenosis A ≠ maximal .

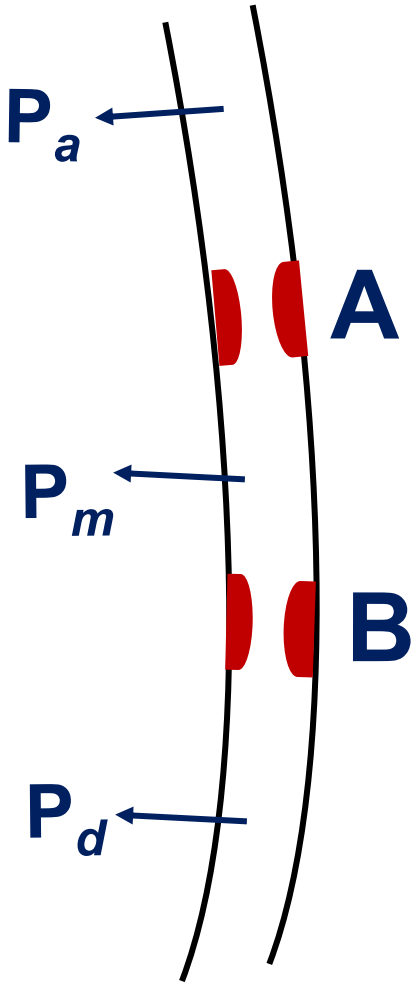
Cardiovascular Center Aalst



When B is isolated, hyperemic flow through stenosis A = maximal

When A: hyperemic flow through stenosis B ≠ maximal .

Cardiovascular Center Aalst



$$FFR(A)_{pred} = \frac{P_d - (P_m/P_a)\,P_w}{P_a - P_m + P_d - P_w}$$

$$FFR(B)_{pred} = \frac{(P_a - P_w)\,(P_m - P_d)}{P_a\,(P_m - P_w)}$$

P_w = Coronary occlusive pressure

Pijls NHJ et al Circulation 2000
De Bruyne B et al Circulation 2000

Cardiovascular Center Aalst

Serial stenoses: 4 rules to keep in mind

1. FFR applies for all stenoses <u>together</u>
2. When two stenoses are present, each of them will influence the flow across the other one (cross-talk between stenoses)
3. The influence of the distal one is much larger and difficult to predict than the influence of the proximal one
4. Their influence will be proportional to the myocardial mass

➔ **Pull back under steady state hyperemia (Adenosine IV)**

Cardiovascular Center Aalst

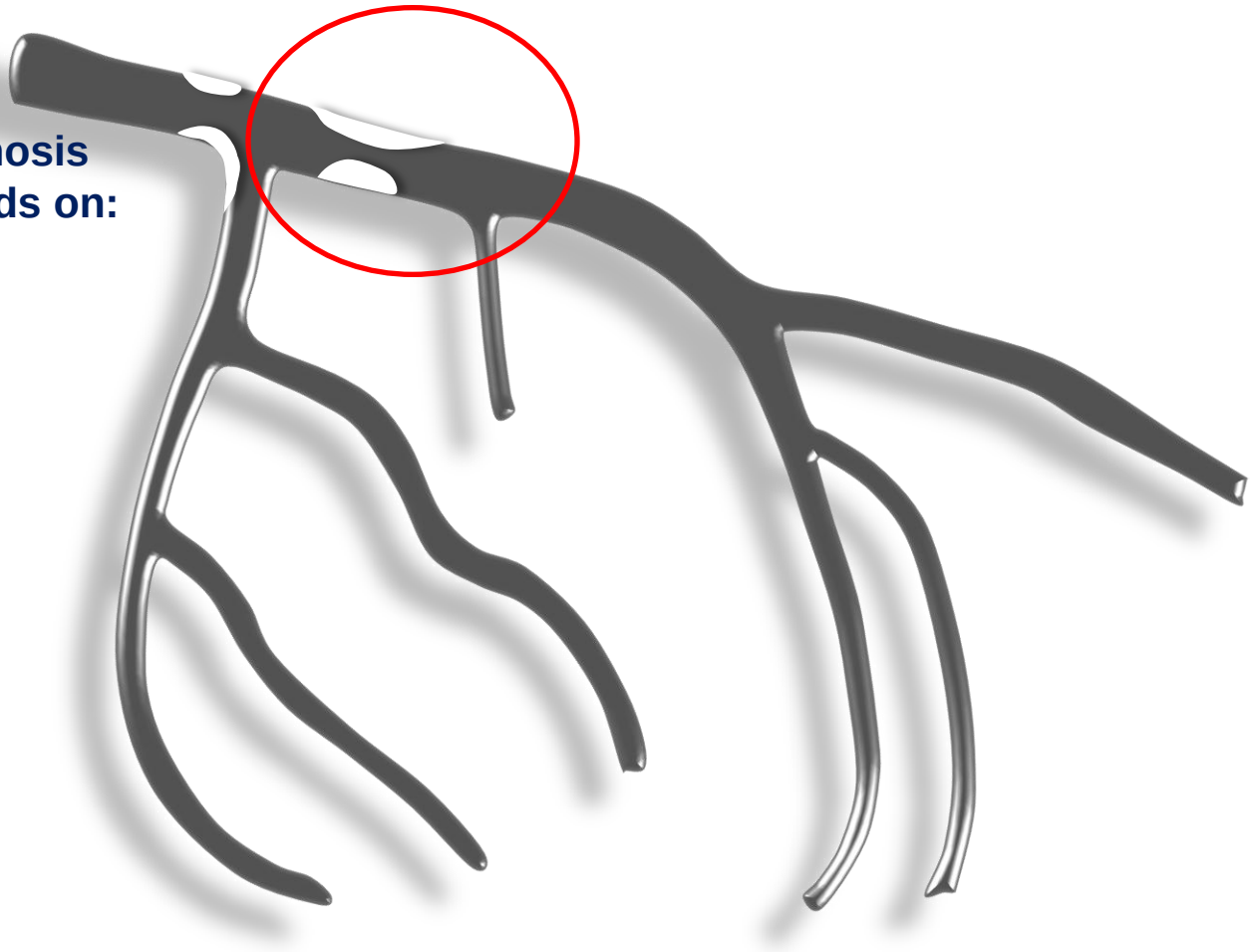
Left Main / LAD complex

Cardiovascular Center Aalst

Left Main Stem Stenoses + LAD stenosis

The influence of a distal stenosis on the FFR of the LM depends on:

- **severity**
- **Myocardial mass**

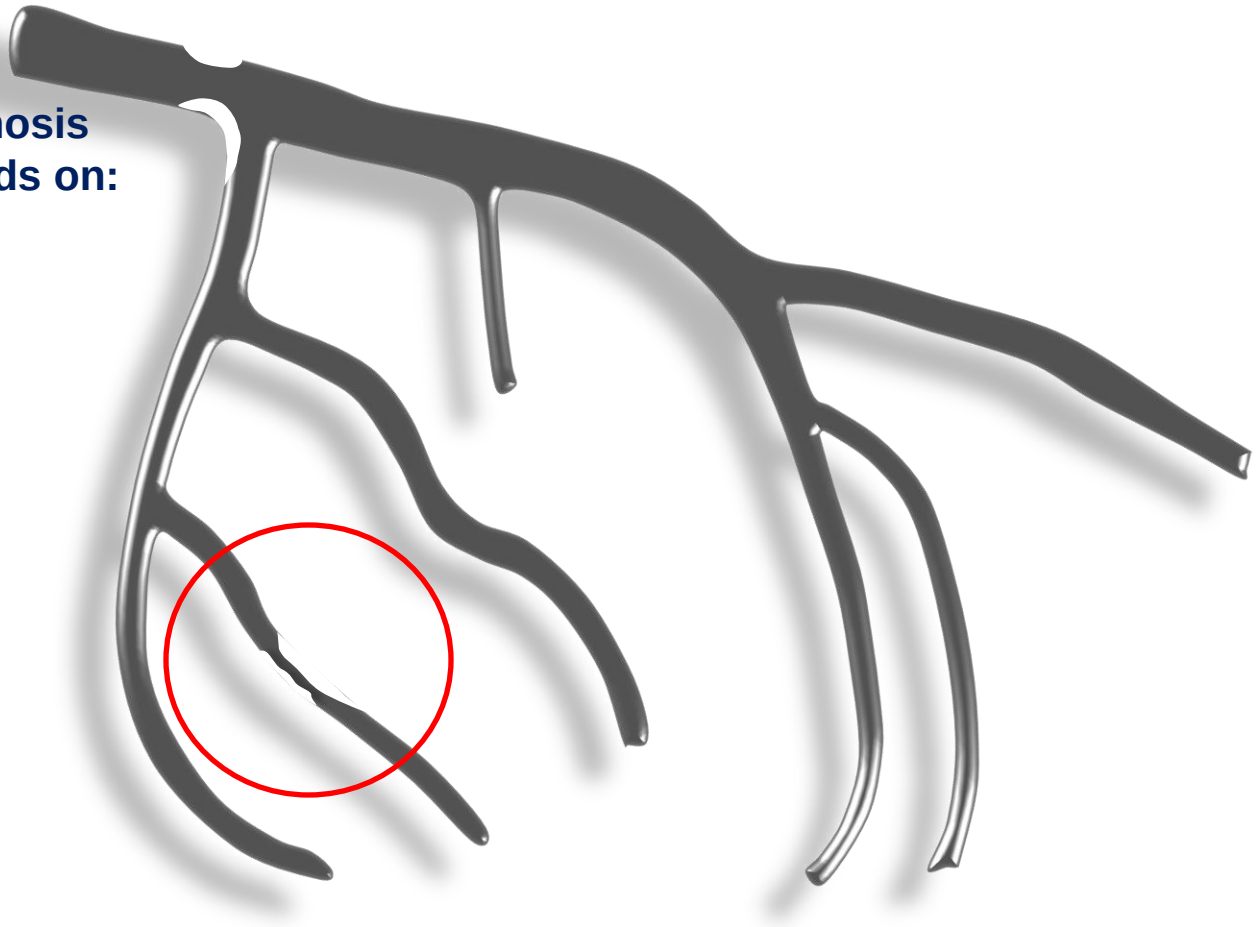


Cardiovascular Center Aalst

Left Main Stem Stenoses + OM_2 stenosis

The influence of a distal stenosis on the FFR of the LM depends on:

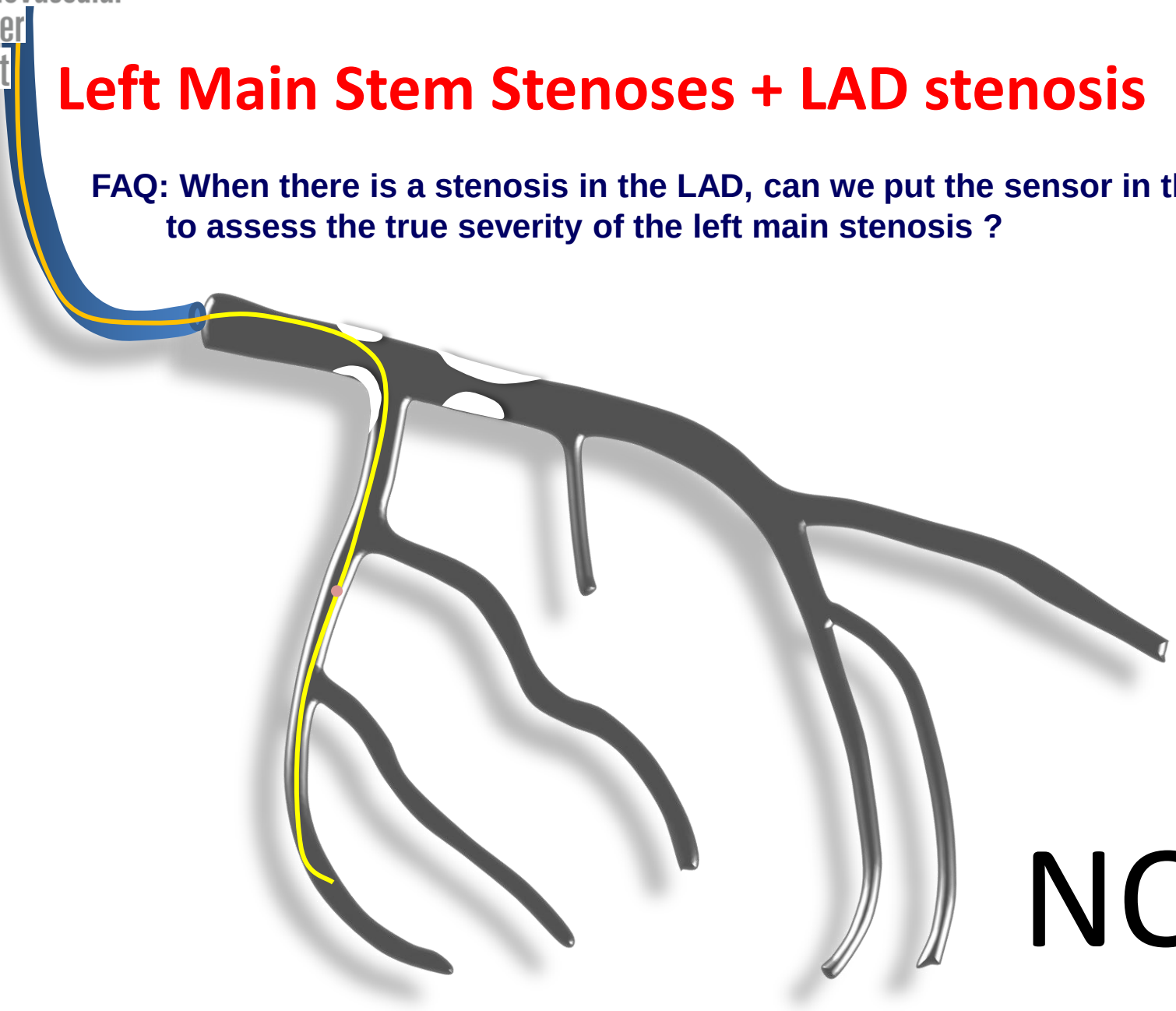
- **severity**
- **Myocardial mass**



Cardiovascular Center Aalst

Left Main Stem Stenoses + LAD stenosis

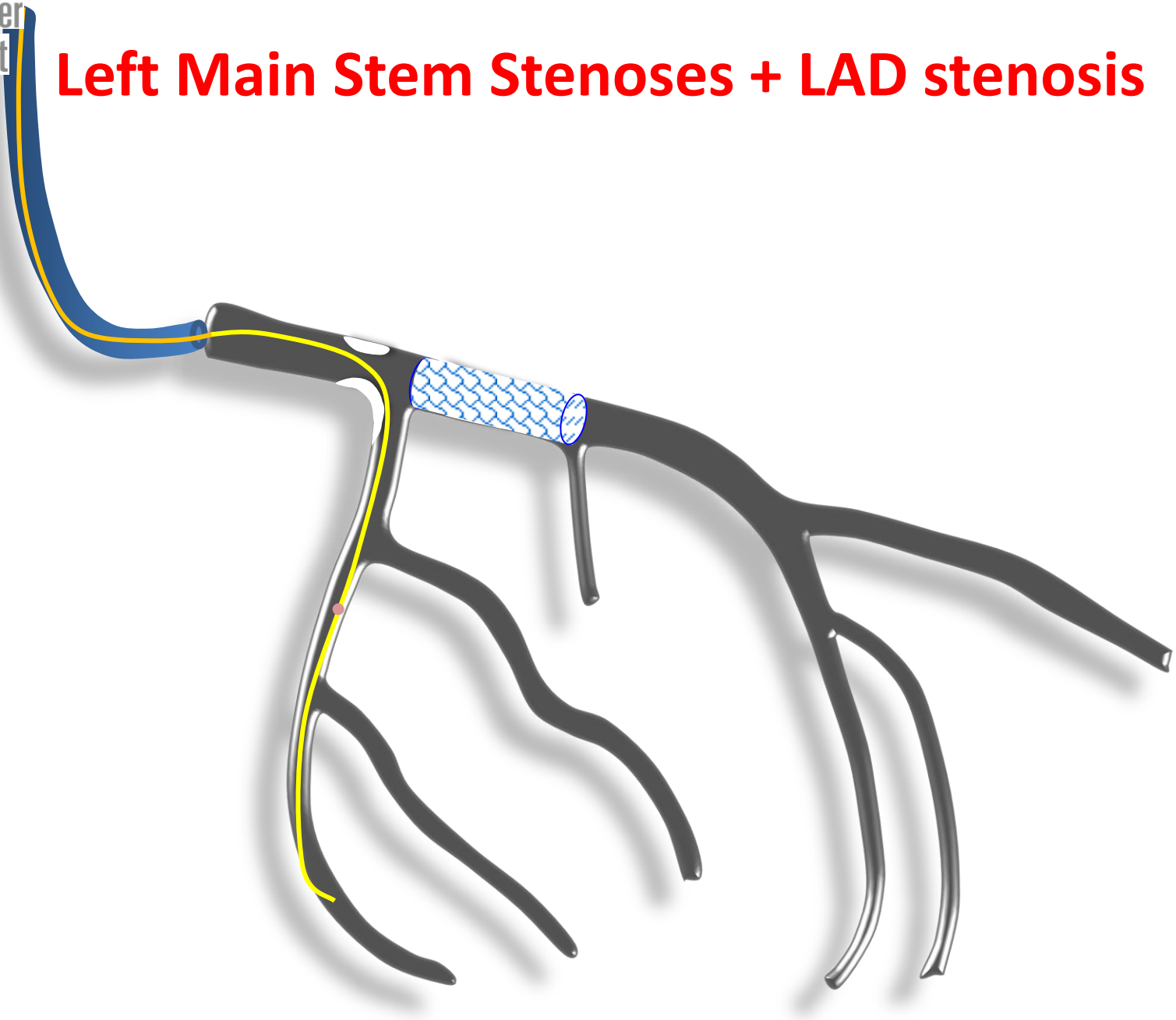
FAQ: When there is a stenosis in the LAD, can we put the sensor in the LCx to assess the true severity of the left main stenosis ?



NO !

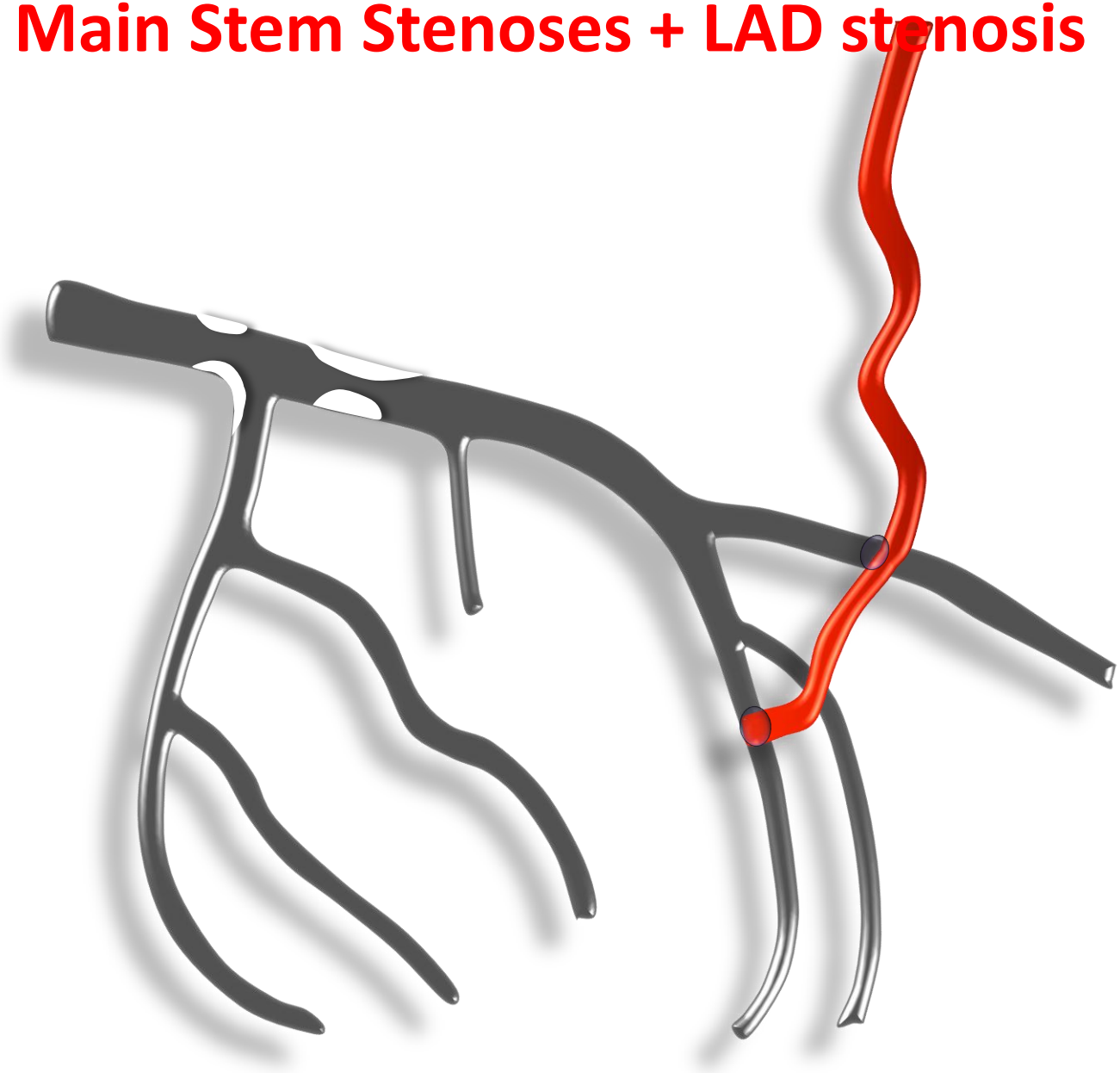
Cardiovascular Center Aalst

Left Main Stem Stenoses + LAD stenosis



Cardiovascular Center Aalst

Left Main Stem Stenoses + LAD stenosis

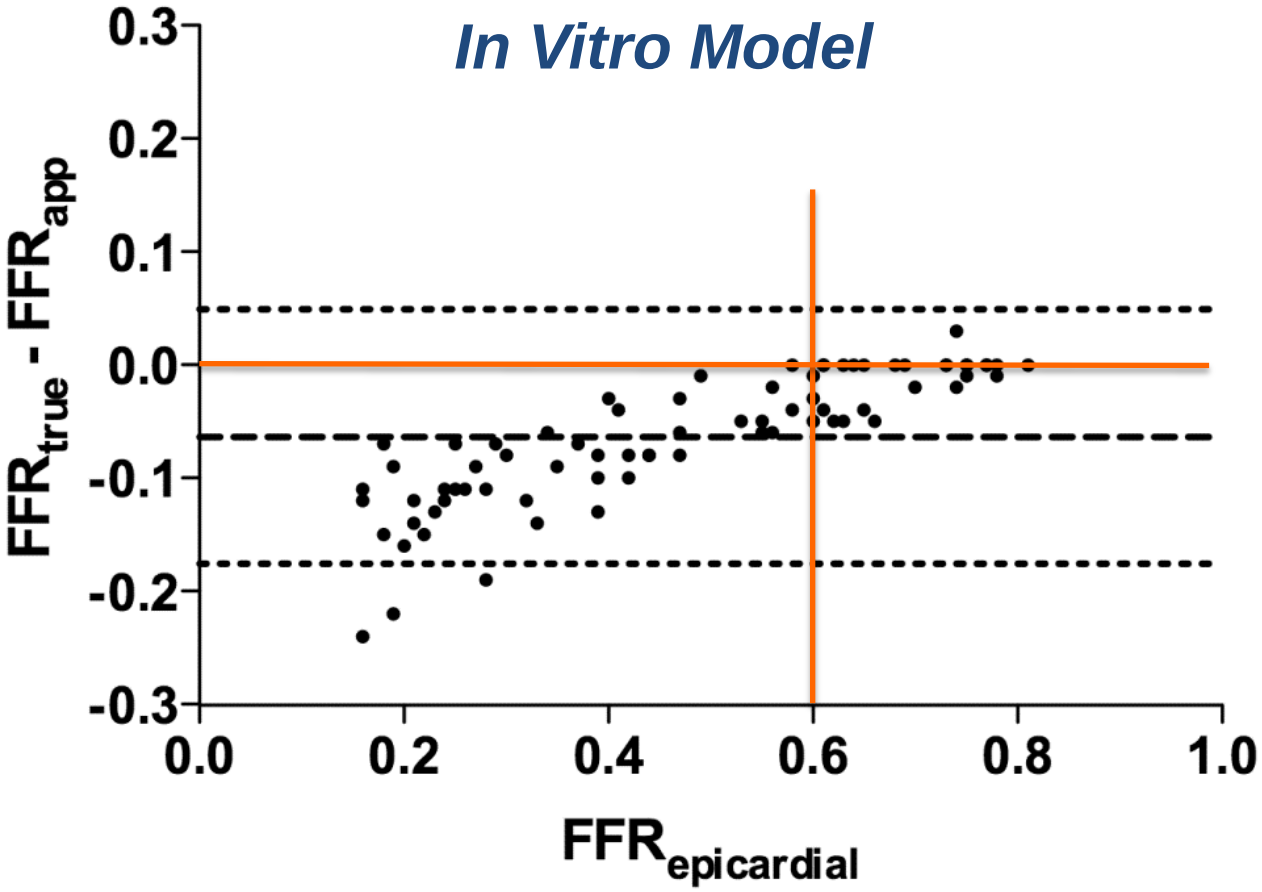


Cardiovascular Center Aalst

Effect of a downstream stenosis on LM FFR?

Cardiovascular Center Aalst

Effect of a downstream stenosis on LM FFR?



Daniels, et al. J Am Coll Cardiol Intv 2012;5:1021-5.

Cardiovascular Center Aalst

Diffuse Disease

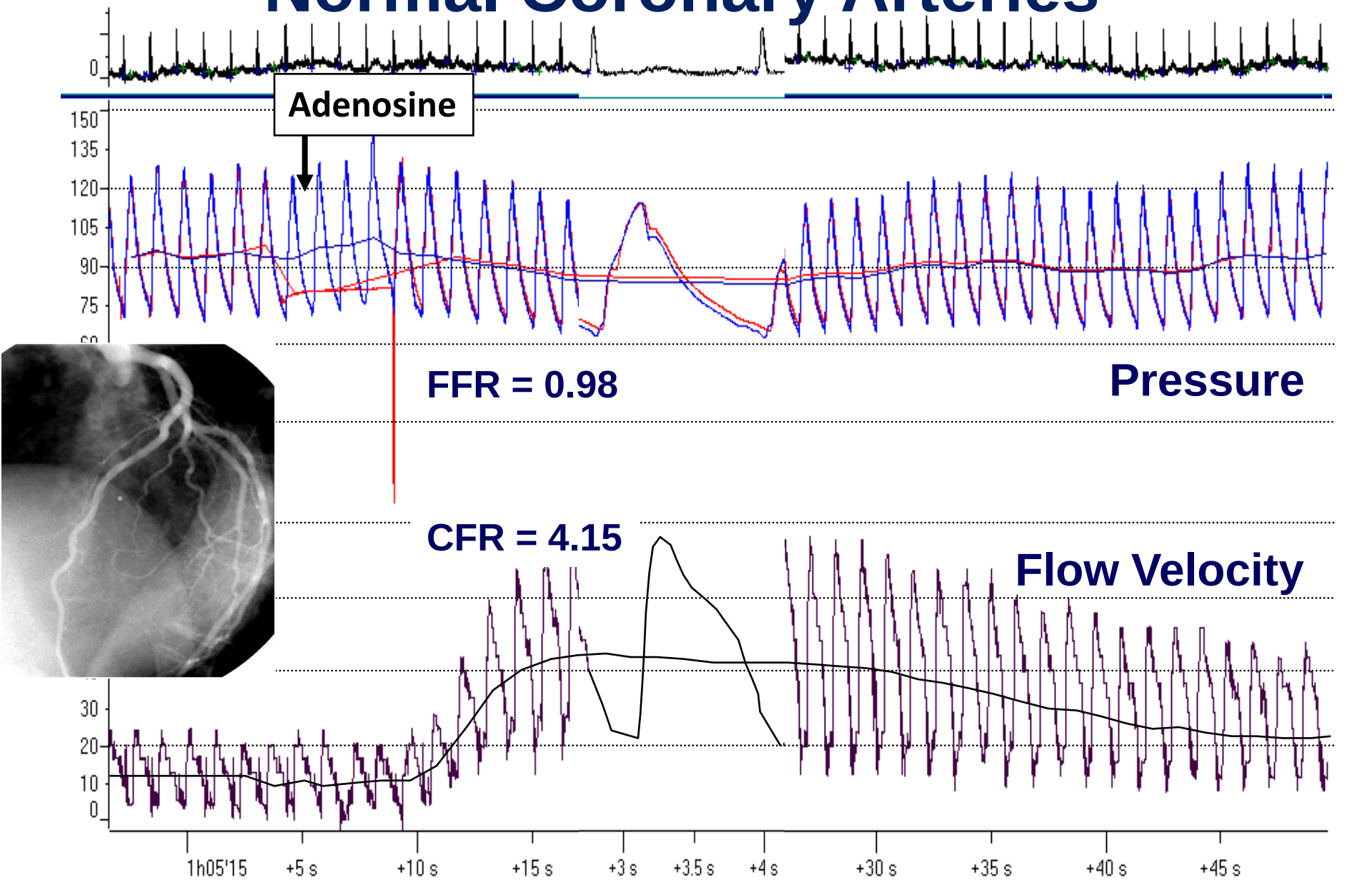
Cardiovascular Center Aalst

Normal Coronary Arteries

32-y-old man
Control post surgical ASD repair

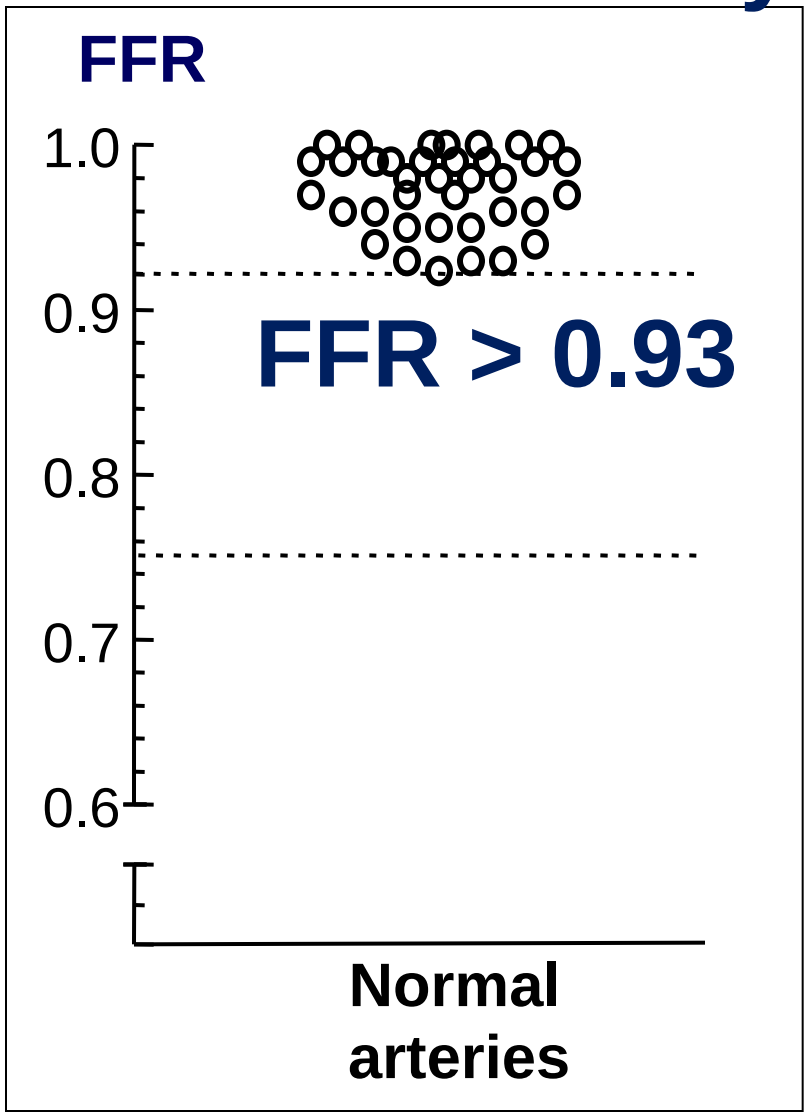
Cardiovascular Center Aalst

Normal Coronary Arteries



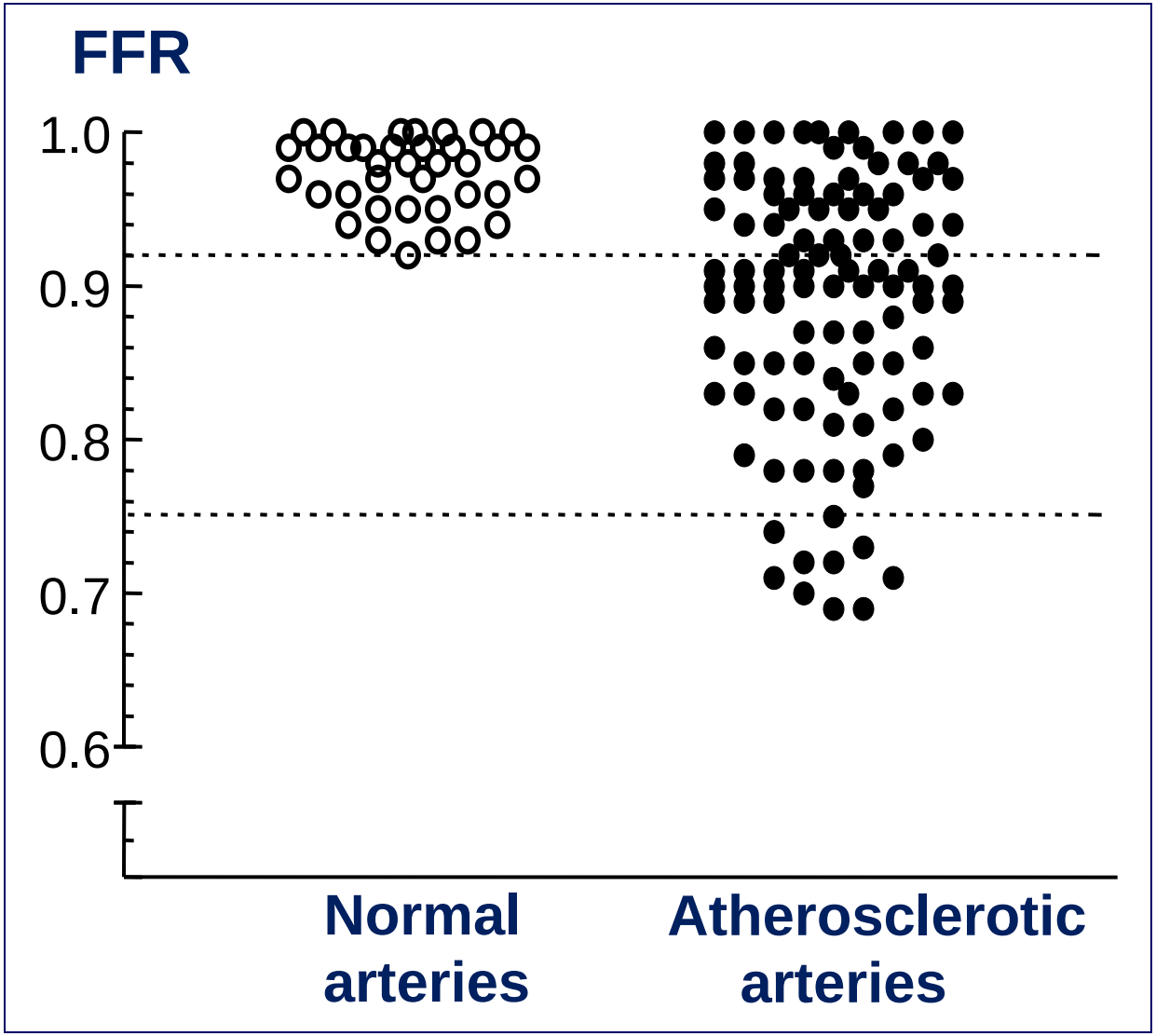
Cardiovascular Center Aalst

FFR in Normal Coronary Arteries



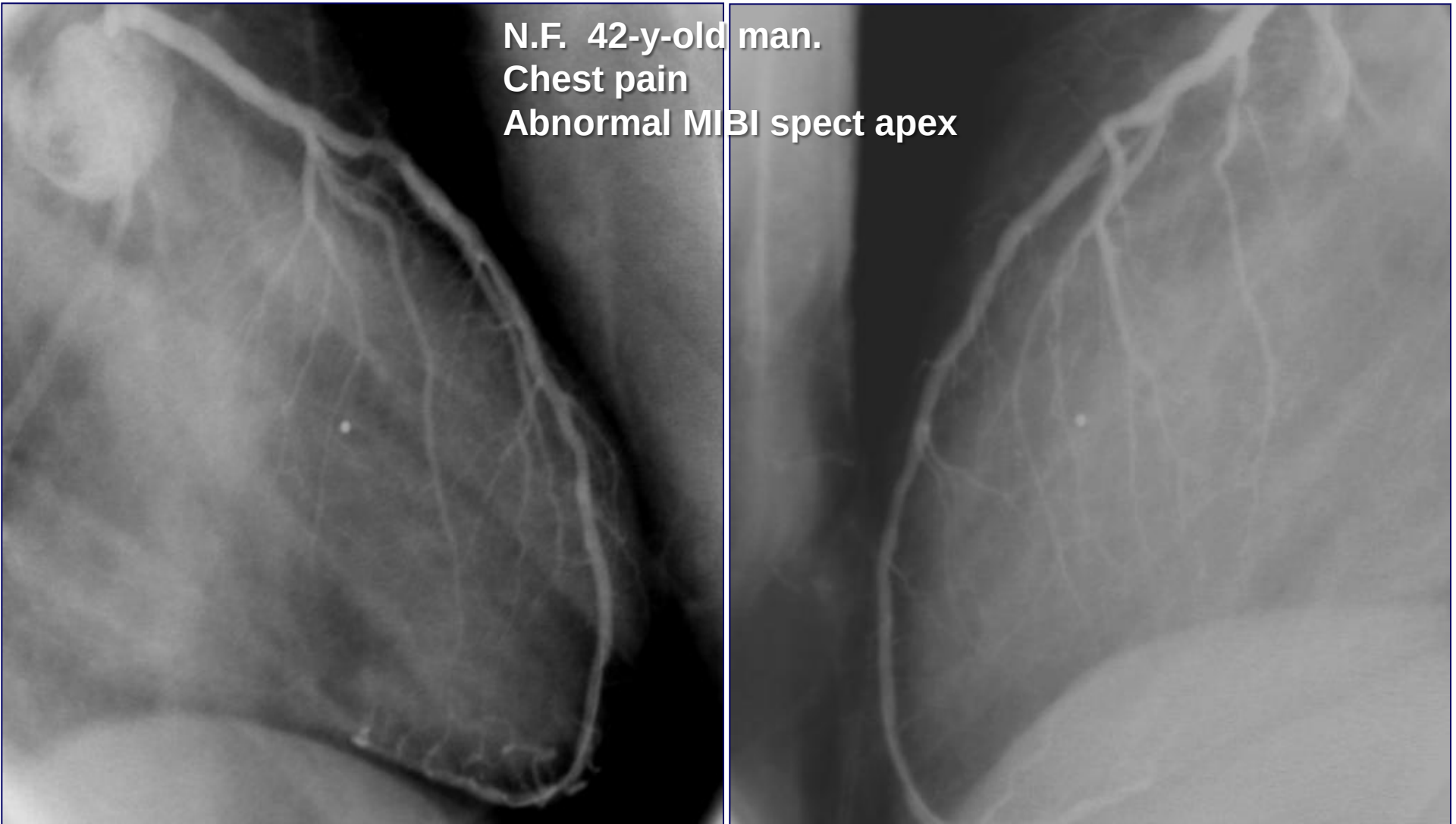
Cardiovascular Center Aalst

FFR in Diffusely Diseased Coronary Arteries



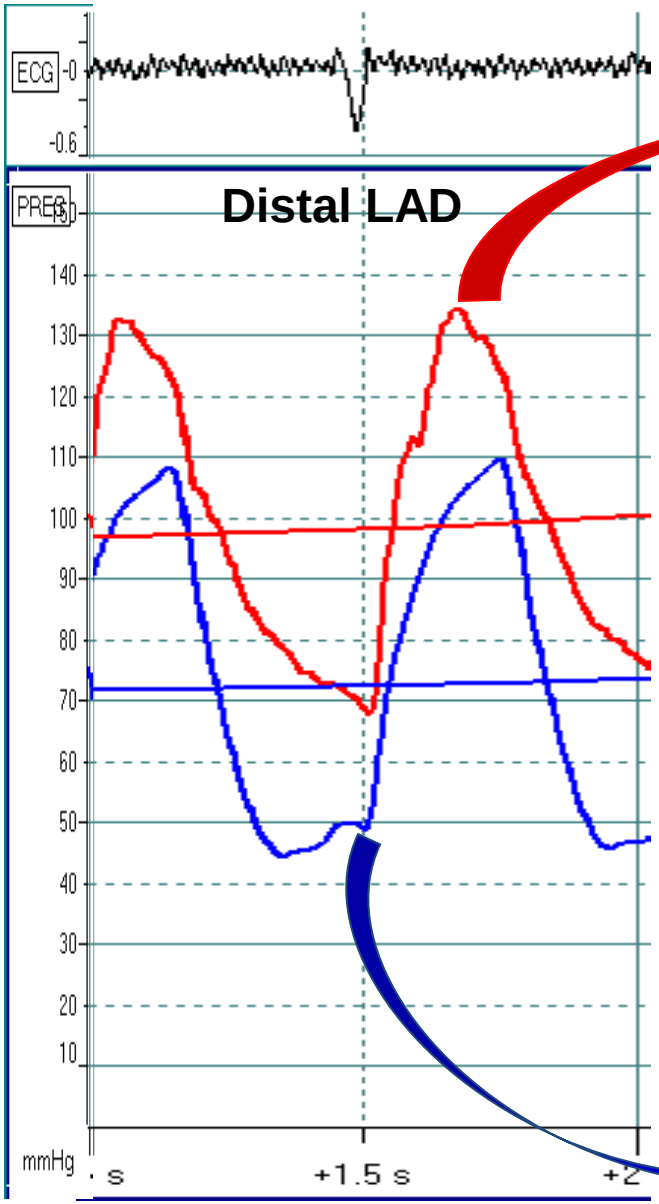
Cardiovascular Center Aalst

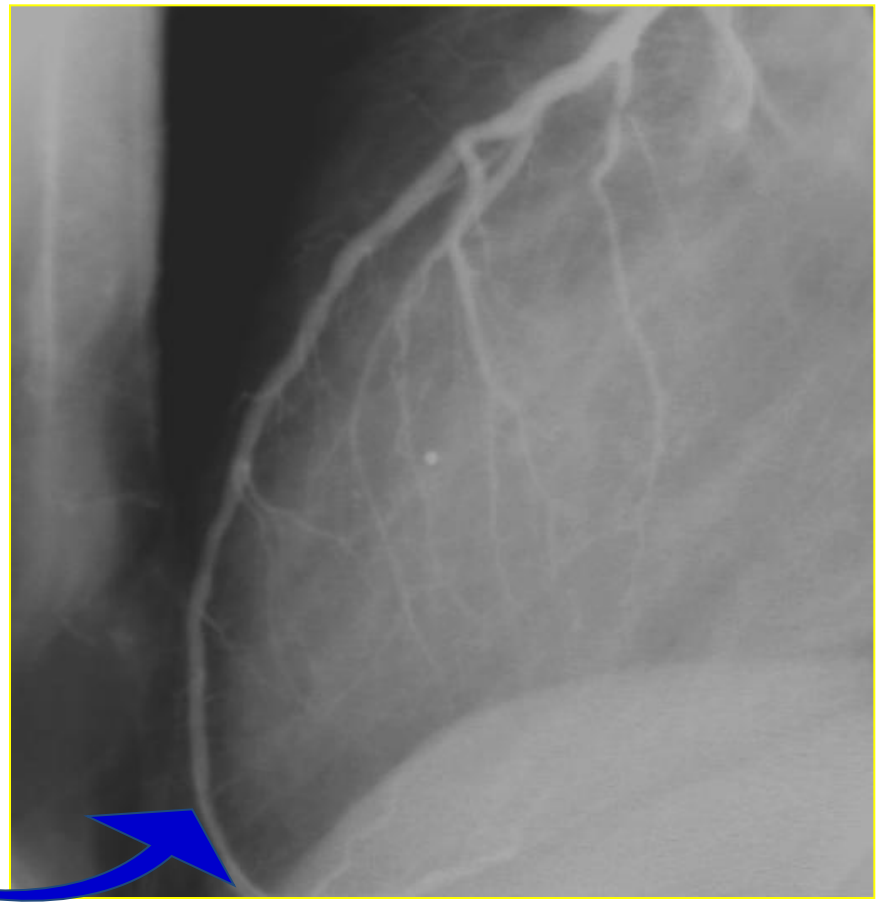
FFR in Diffusely Diseased Coronary Arteries



Cardiovascular Center Aalst

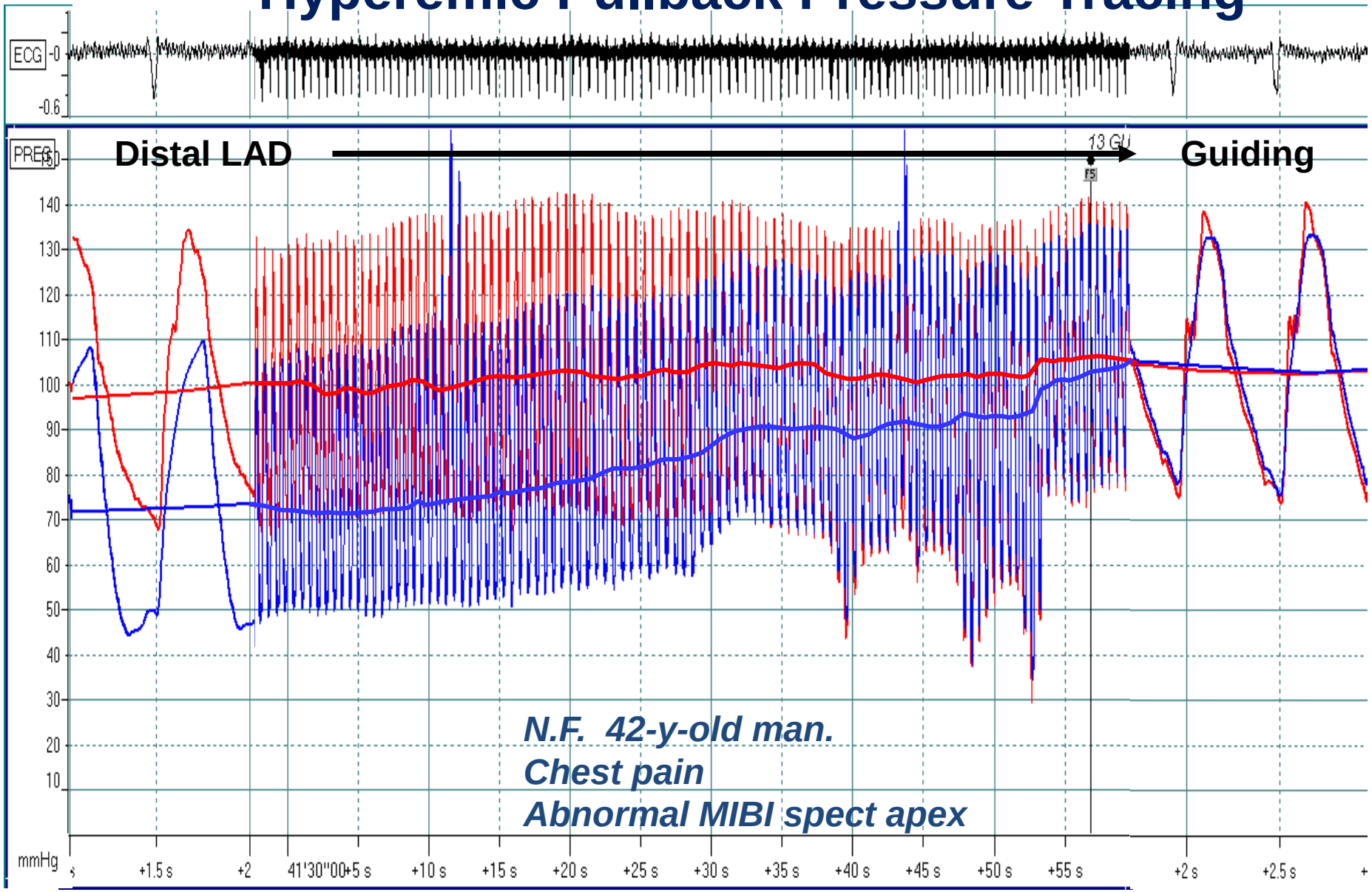
FFR in Diffusely Diseased Coronary Arteries





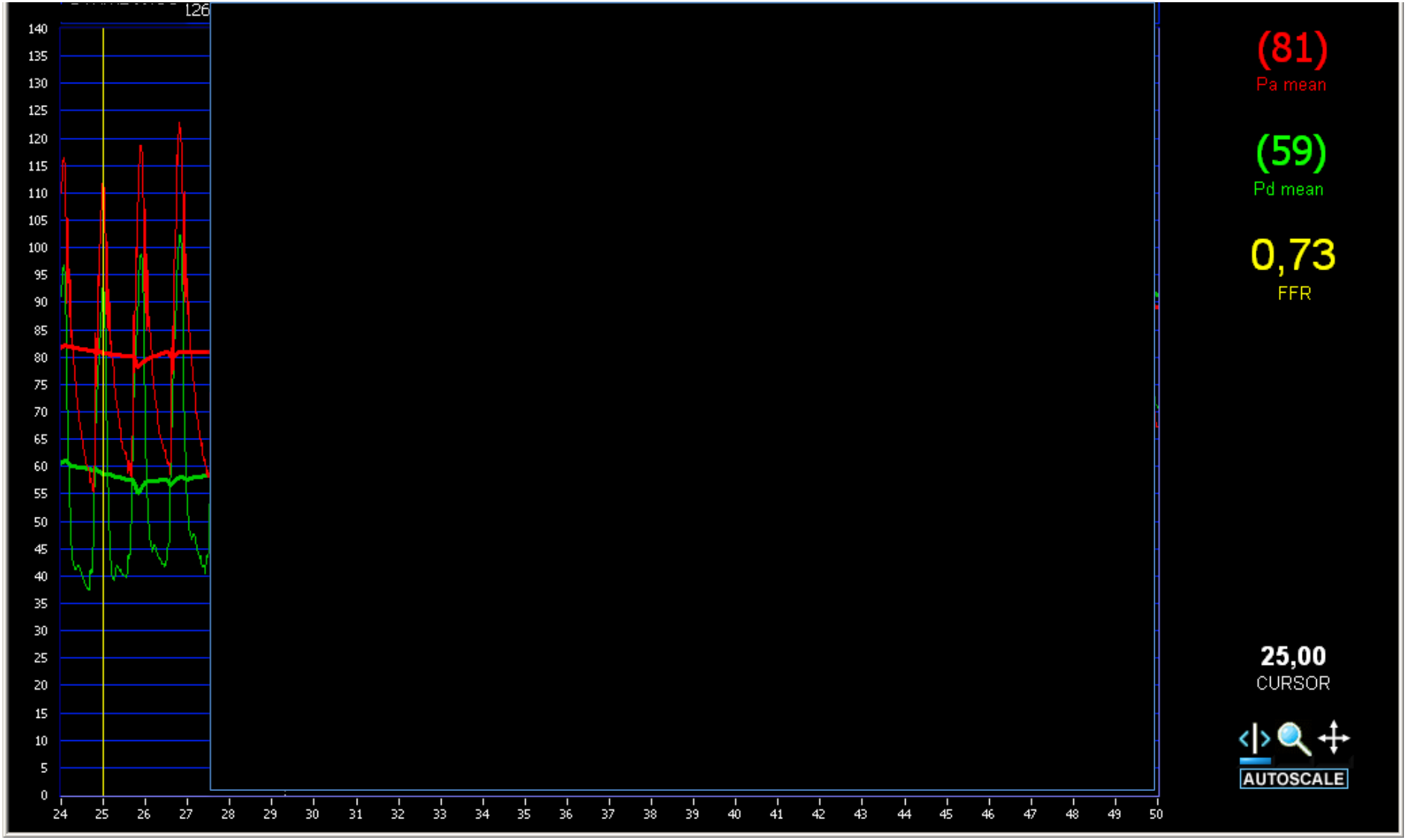
Cardiovascular Center Aalst

FFR in Diffusely Diseased Coronary Arteries
Hyperemic Pullback Pressure Tracing



Cardiovascular
Center
Aalst

Cardiovascular Center Aalst



Cardiovascular Center Aalst

Conclusion

FFR in often abnormal in diffusely atherosclerotic coronary arteries

Clinical Implications

1. Cause of ischemia in some patients

2. Cause of “false positive” non-invasive stress testing

3. Caveat for FFR after stent implantation

Cardiovascular Center Aalst

How to Distinguish Focal from Diffuse ?

Pull Back Hyperemic Pressure Tracing

Cardiovascular Center Aalst

51-y-o man.

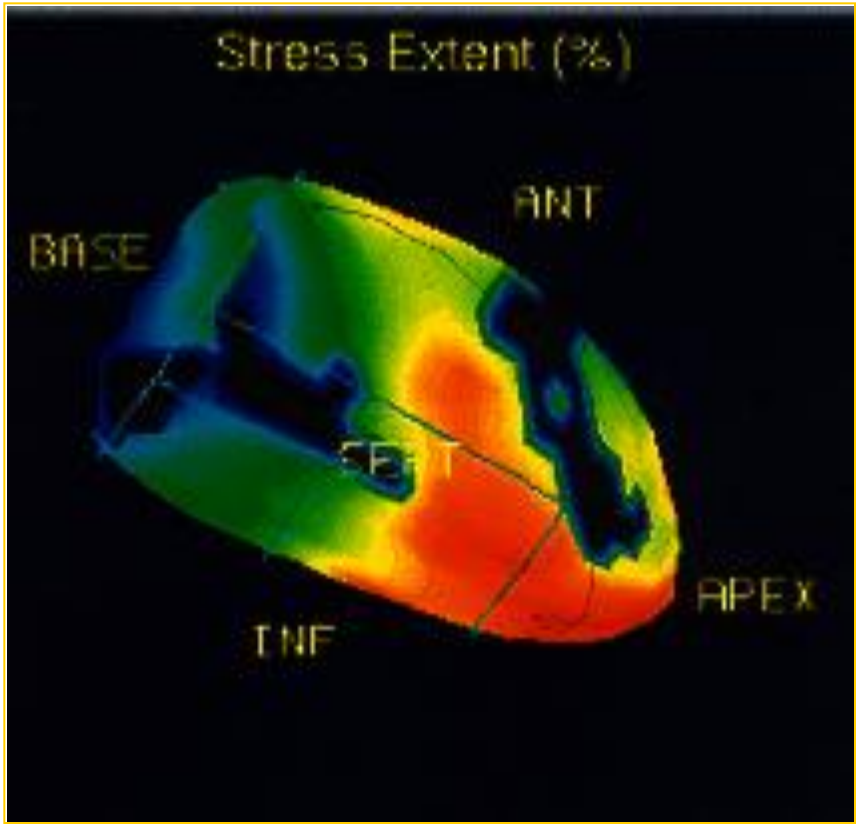
Risk Factors

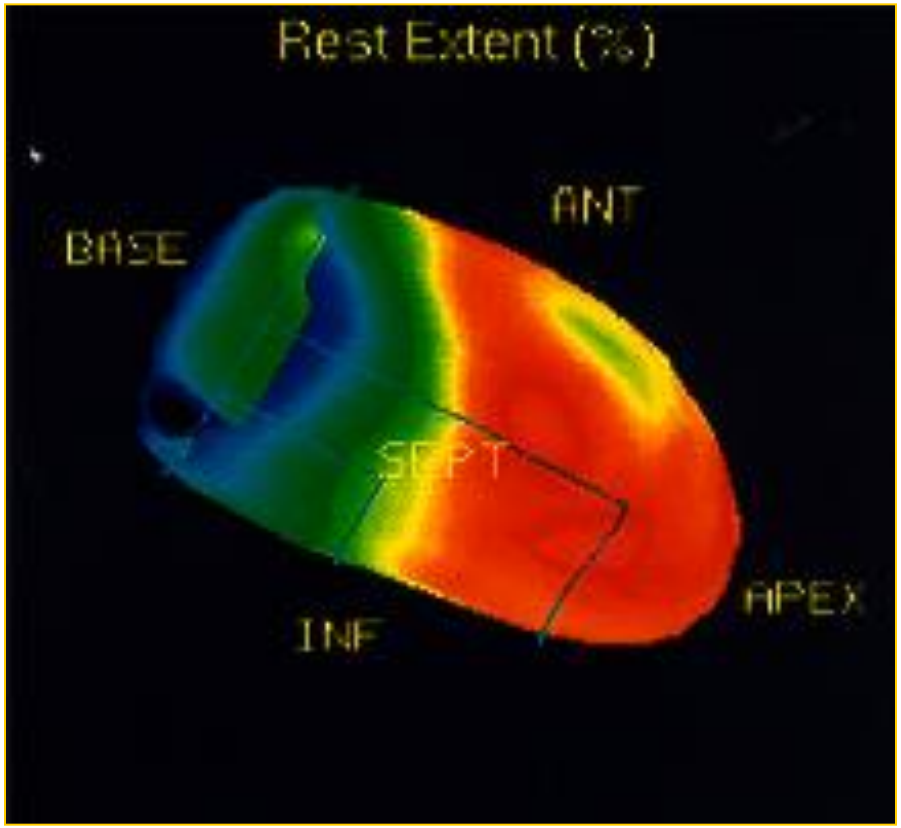
- **Familial history of CAD**
- **Former smoker (stopped 11 years ago)**
- **Hyperlipidemia**

Current Problem

- **Since 3 months, typical angina CCS class 1-2**
- **Dubious exercise ECG**
- **Reversible myocardial ischemia at MIBI Spect**

Van Puymbroeck Eddy 75139
DOB 27/11/50





Cardiovascular Center Aalst

51-y-o man.

Risk Factors

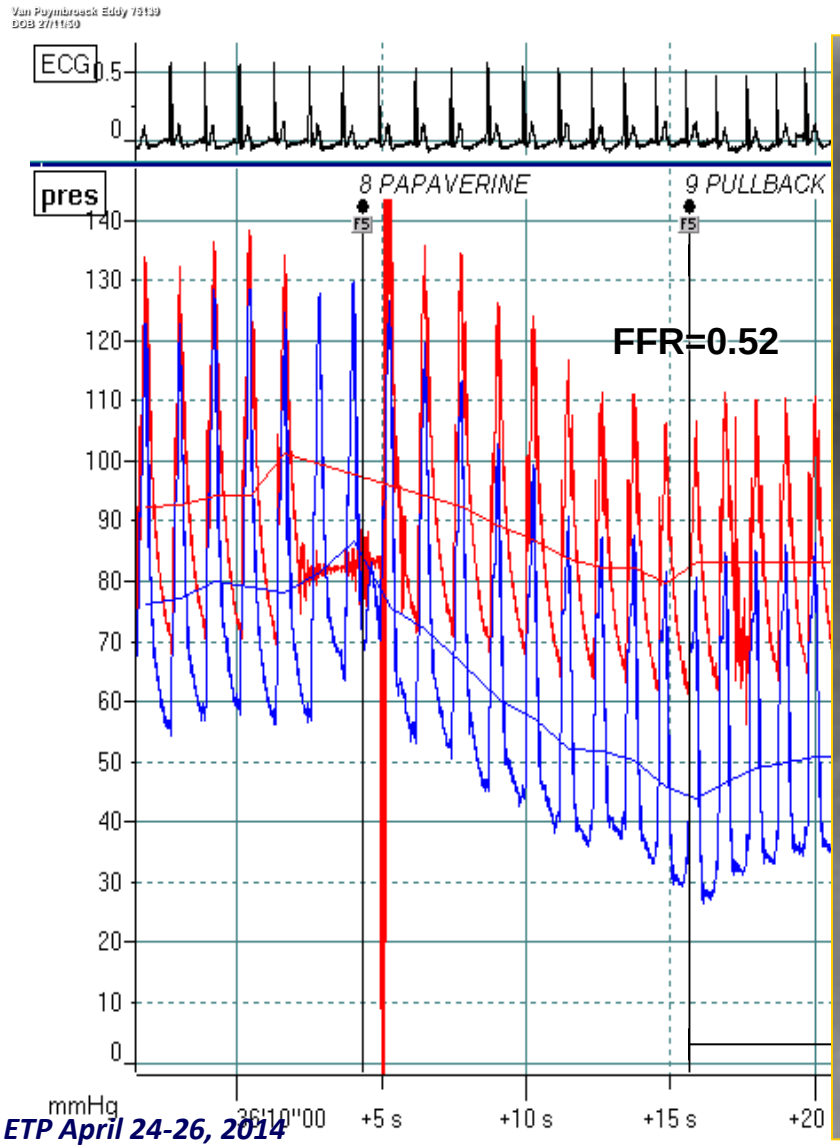
- **Familial history of CAD**
- **Former smoker (stopped 11 years ago)**
- **Hyperlipidemia**

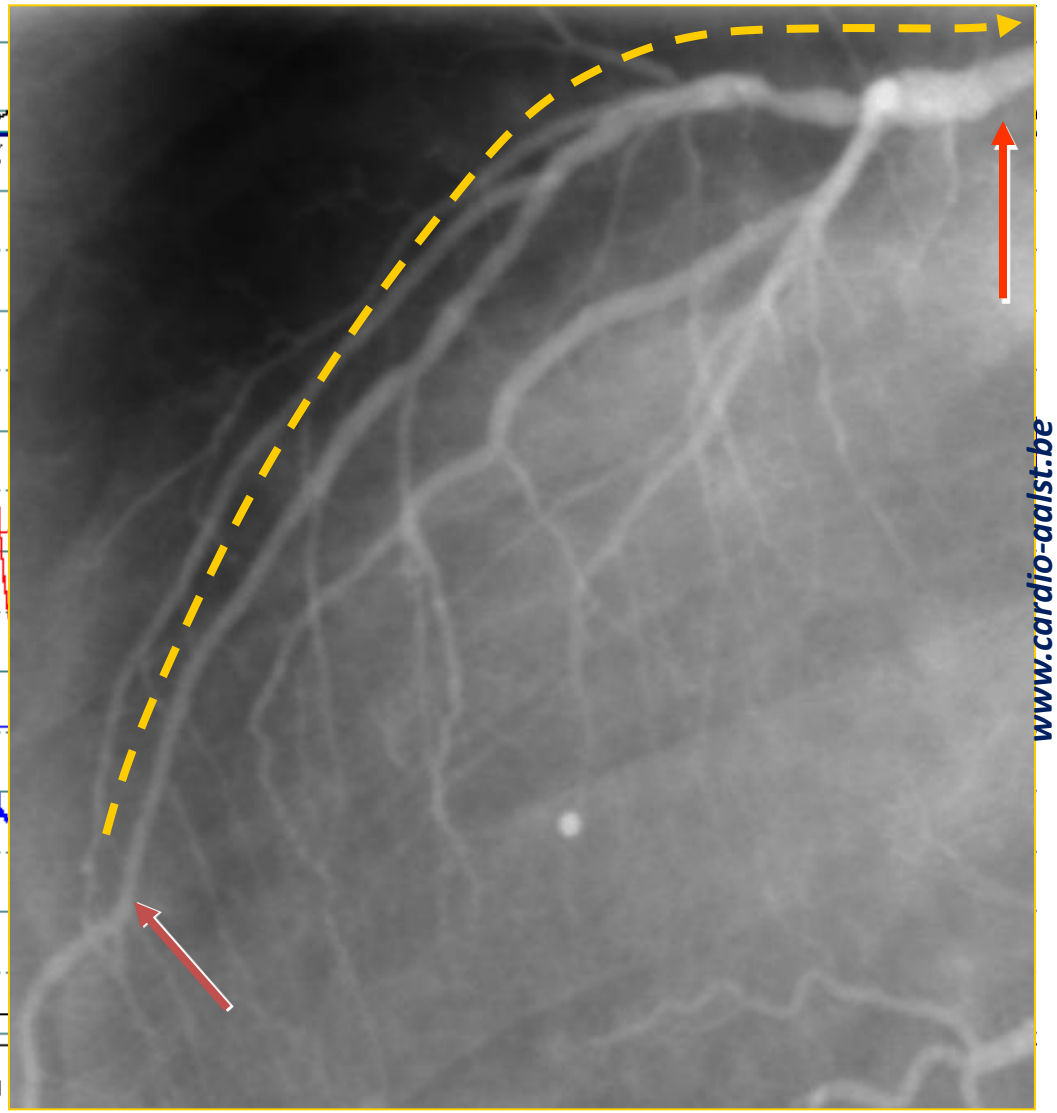
Current Problem

- **Since 3 months, typical angina CCS class 1-2**
- **Dubious exercise ECG**
- **Reversible myocardial ischemia at MIBI Spect**

Cardiovascular Center Aalst

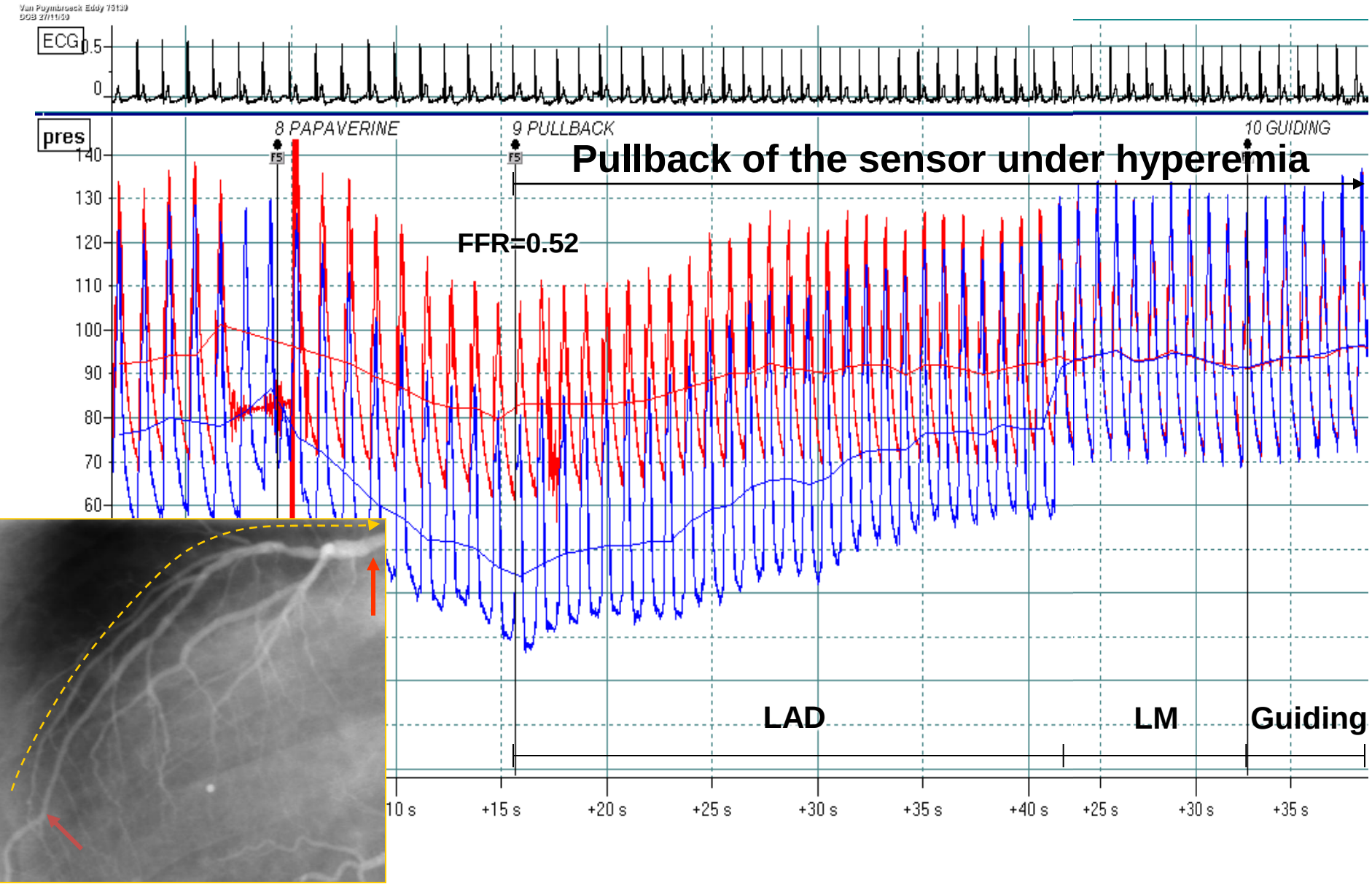
Pull Back in de LAD under Maximal Hyperemia





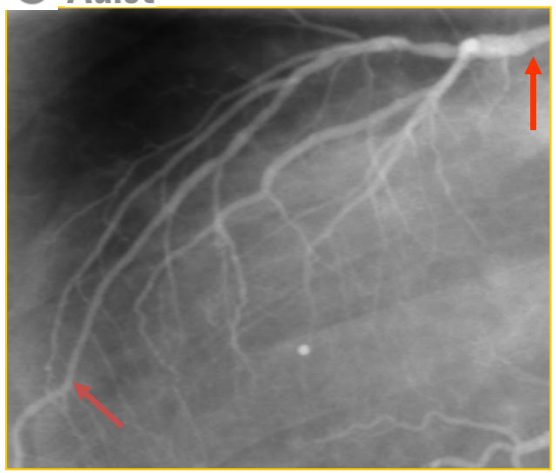
Cardiovascular Center Aalst

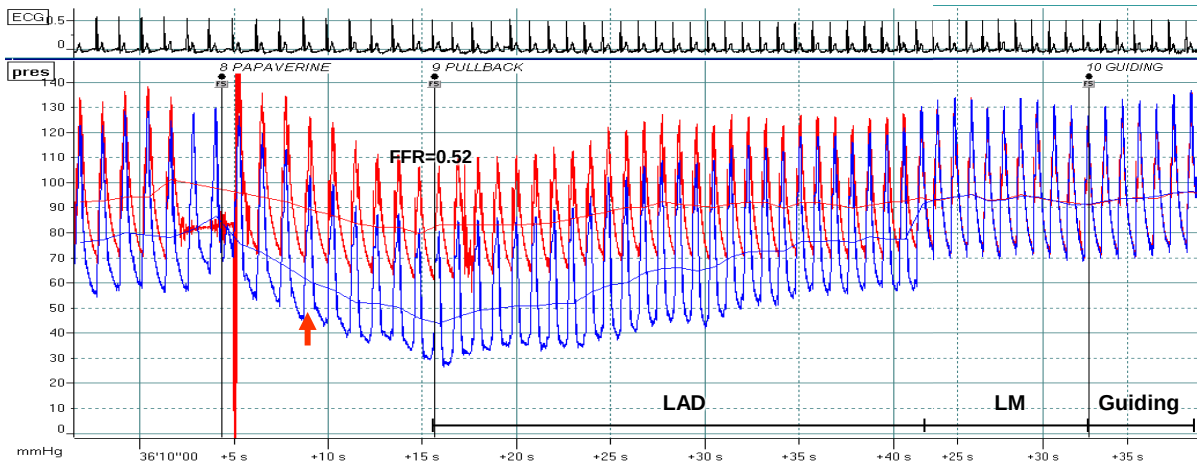
Pull Back in de LAD under Maximal Hyperemia



Cardiovascular Center Aalst

Pull Back in de LAD under Maximal Hyperemia

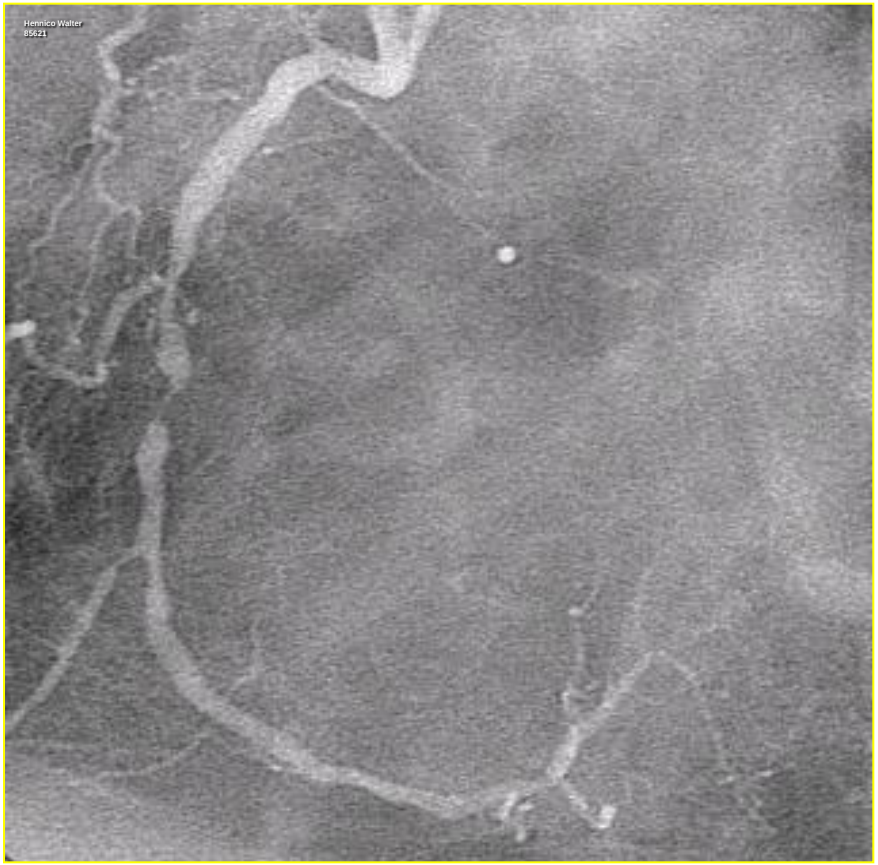




Cardiovascular Center Aalst

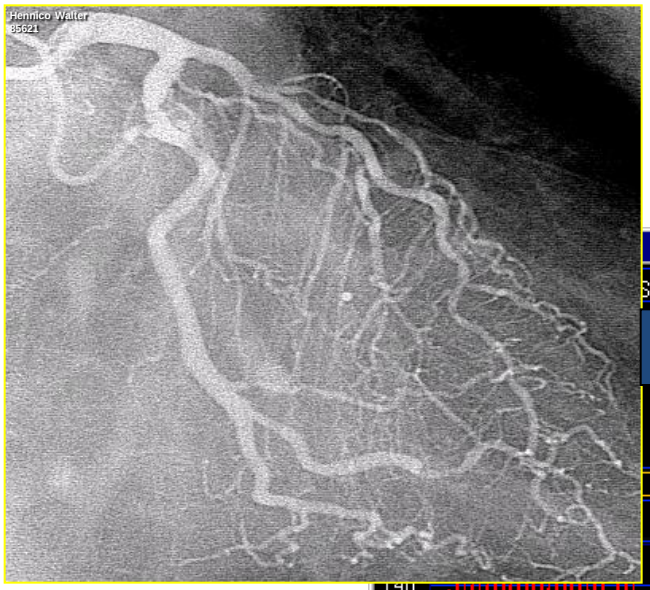
H.W. (85621) 57-y-o man

Unstable Angina

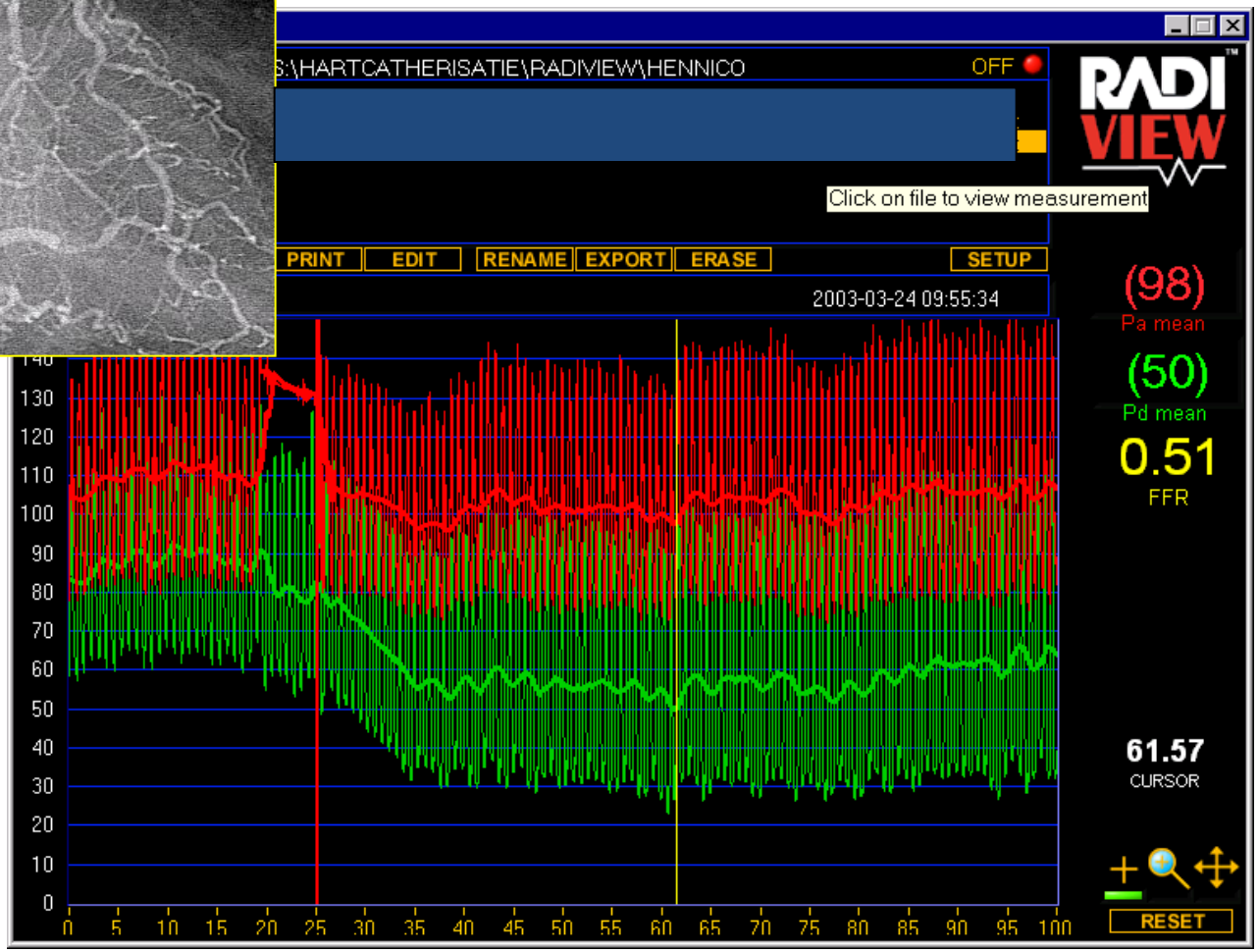


Cardiovascular Center Aalst

H.W. (85621) 57-y-o man **Unstable Angina**



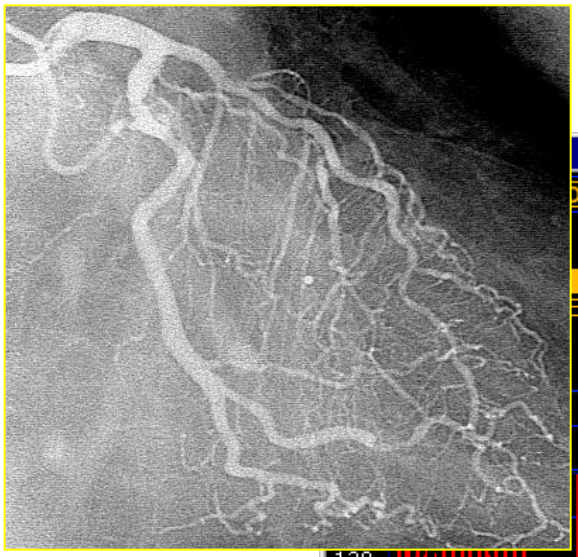
Sensor Left in Distal LAD



Cardiovascular Center Aalst

H.W. (85621) 57-y-o man Unstable Angina

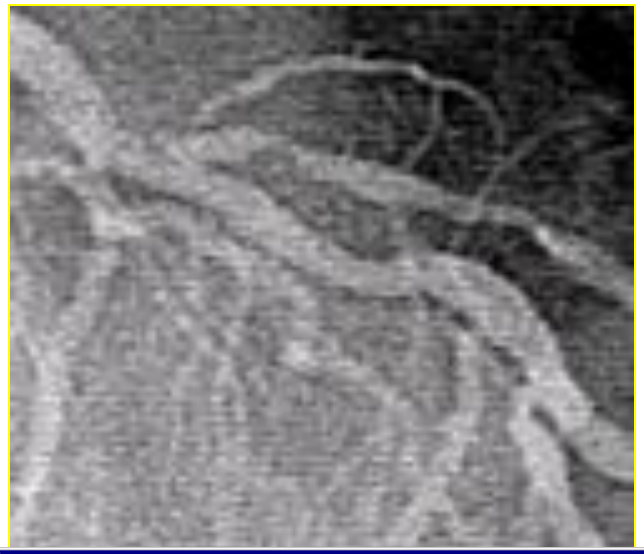
Pullback of Sensor from Distal LAD to LM

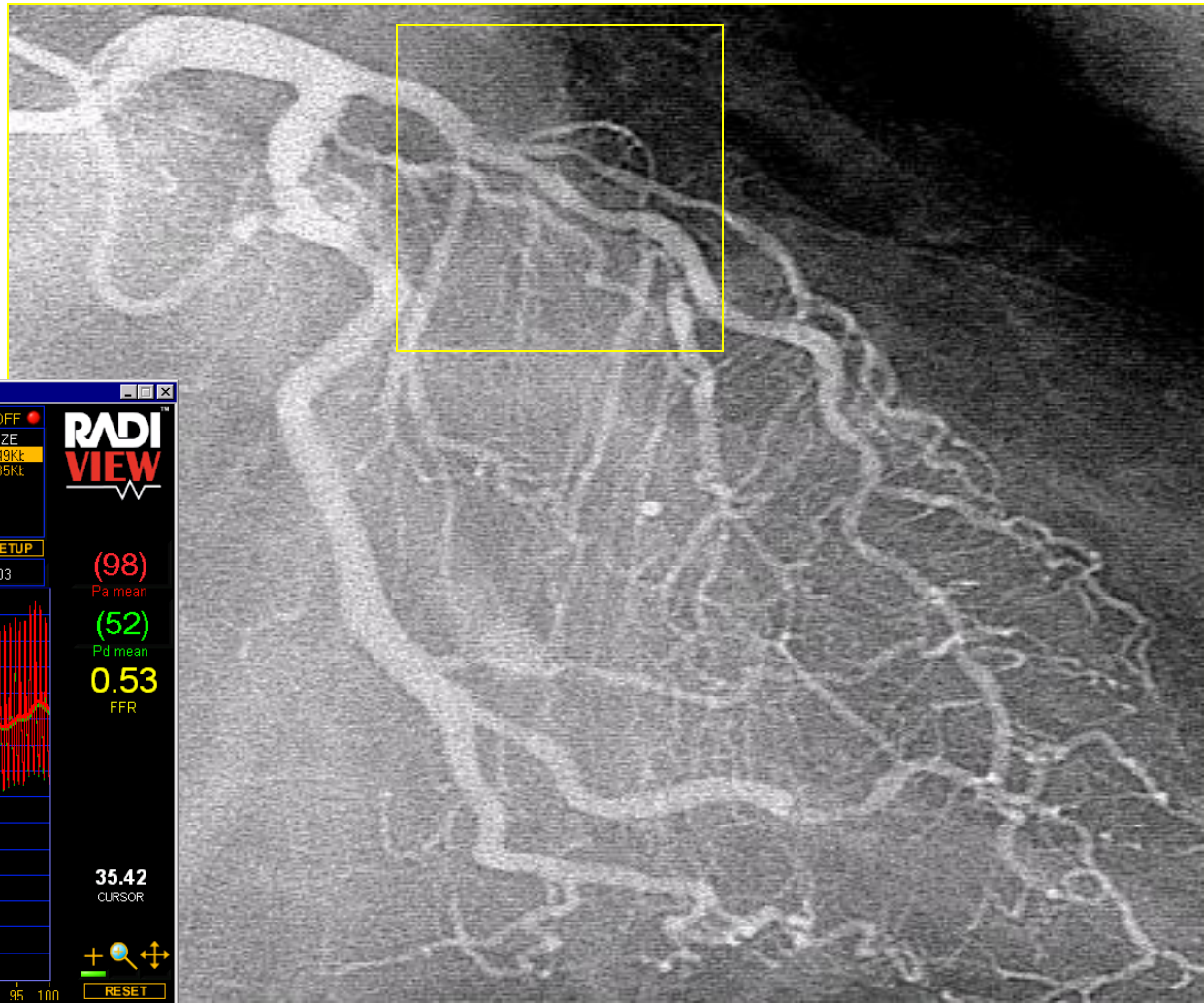


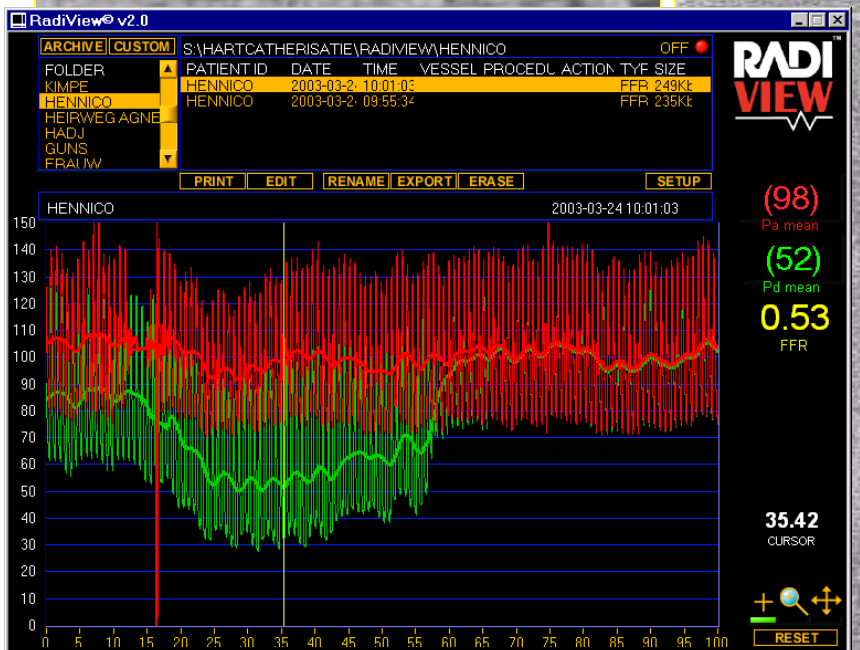
Cardiovascular Center Aalst

H.W. (85621) 57-y-o man **Unstable Angina**

Pullback of Sensor from Distal LAD to LM







Cardiovascular Center Aalst

Pressure Measurements and Diffuse Disease

Pullback pressure tracings obtained under steady state maximal hyperemia is presently the only available means to localize and to quantify the abnormal resistance along an epicardial vessel.

Cardiovascular Center Aalst

Pressure Measurements in Diffuse Disease

To keep in Mind

1. Atherosclerosis is diffuse in nature (atherosclerotic “plaque” = rare)

2. This “diffuse disease” is often reponsible for a marked pressure gradient

3. FFR of all stenoses <u>together</u> can be calculated from the ratio Pd / Pa during maximal hyperemia

4. The pressure gradient through one stenosis can be “masked” by the presence of a second stenosis, especially when the latter is located more distally

5. The severity of one stenosis can be “unmasked” by PCI of a second stenosis

Cardiovascular Center Aalst

Pressure Measurements in Diffuse Disease

To keep in Mind (Cont'd)

1. **When 2 "focal" stenoses:**

   - PCI the most severe stenosis or the distal stenosis
   - Repeat hyperemic pressure pullback afterwards

2. **When diffuse disease and no angiographical focal stenosis:**

   - Place the sensor very distal
   - Induce steady state hyperemia (ADO IV)
   - Pull back manually under hyperemia and under fluoro (one eye on the fluoro, one eye on the pressure tracing)
   - Stent when focal hyperemic $\Delta P > 10\text{-}12$ mm Hg (if FFR in the distal part of the vessel < 0.75)