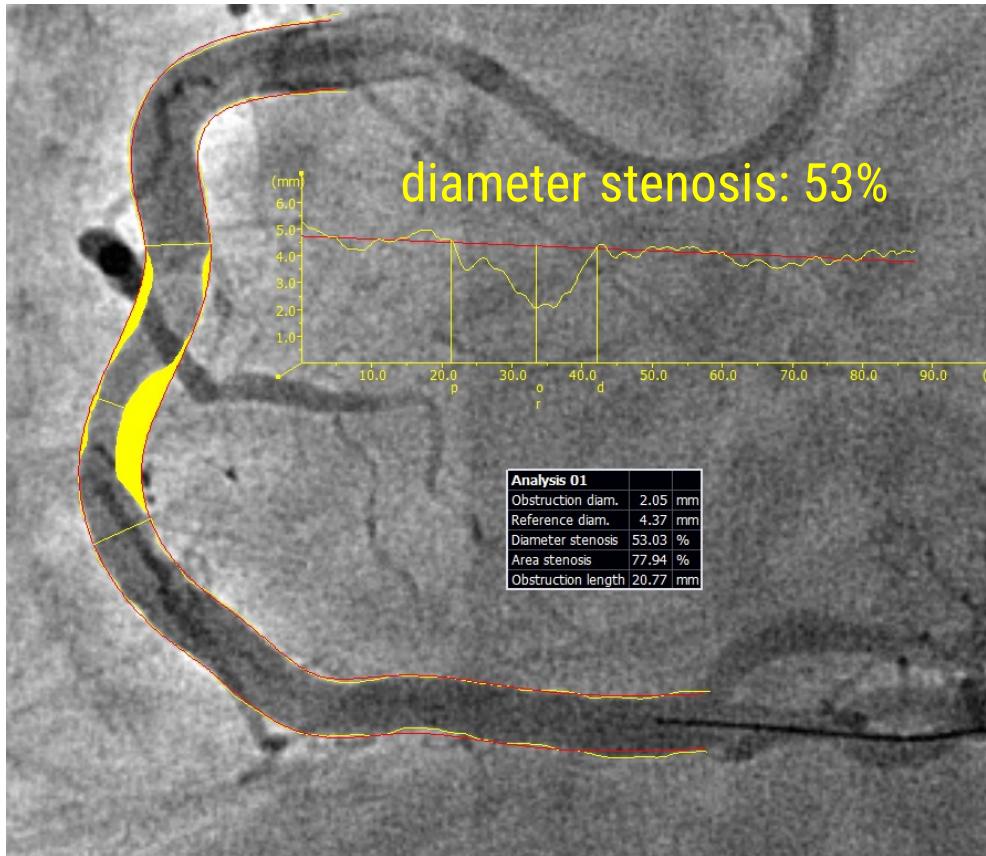


Outils appliqués de QFR : Planification Angioplastie, IMR

Julien Adjedj

Revacularisation ou non?

Quantitative Coronary Angiography (QCA)



Anatomy: diameter stenosis = 53%

vs.

Physiology: FFR = 0.85



FFR virtuelle

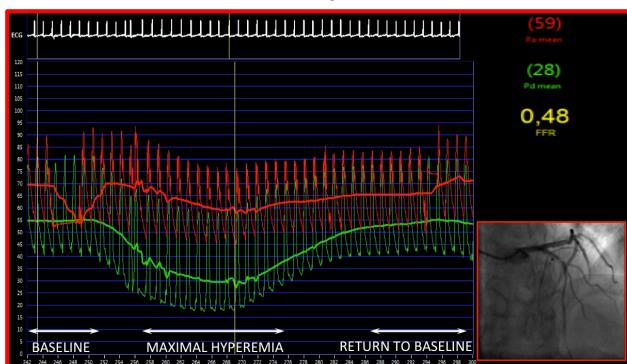
FFR

$$\text{FFR} = \frac{(P_d - P_a) / R_s}{(P_a - P_d) / R_N}$$

FFR =

$$\frac{P_d}{P_a}$$

- Hyperémie maximale $\rightarrow R_s = R_N$
- $P_v \ll P_a$ et P_d



FFR =

$$\frac{Q_s^{\max}}{Q_N^{\max}}$$

FFR virtuelle

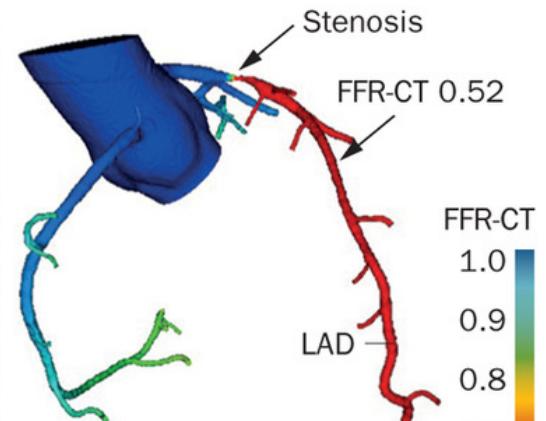
Algorithme

$$\frac{D\mathbf{v}}{Dt} = -\operatorname{grad} V - \frac{1}{\rho} \operatorname{grad} p + \frac{1}{\rho} \operatorname{div} \boldsymbol{\tau}$$

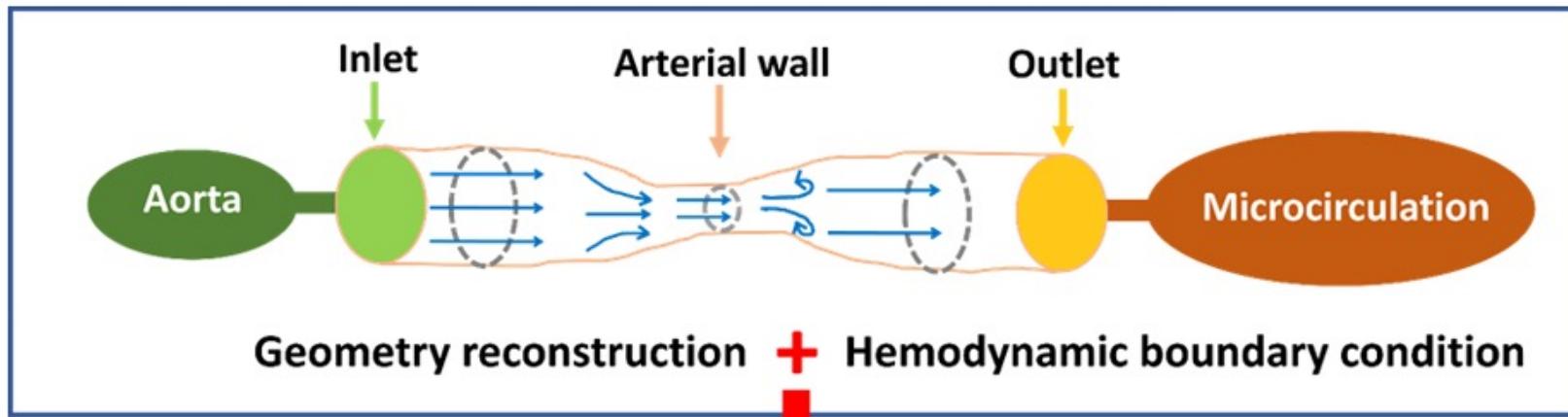
$$\boldsymbol{\tau}_{ik} = \mu \left(\frac{\partial v_i}{\partial x_k} + \frac{\partial v_k}{\partial x_i} - \frac{2}{3} \delta_{ik} \frac{\partial v_s}{\partial x_s} \right) + \mu_\vartheta \delta_{ik} \frac{\partial v_s}{\partial x_s}$$

+

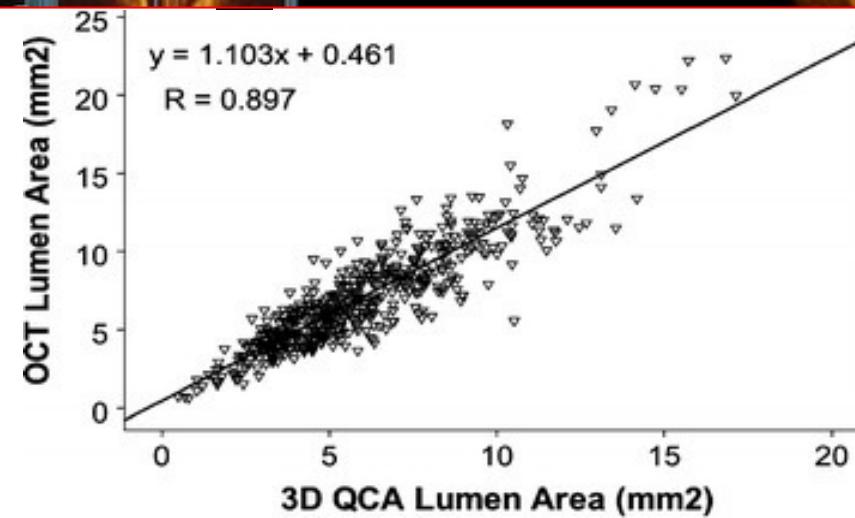
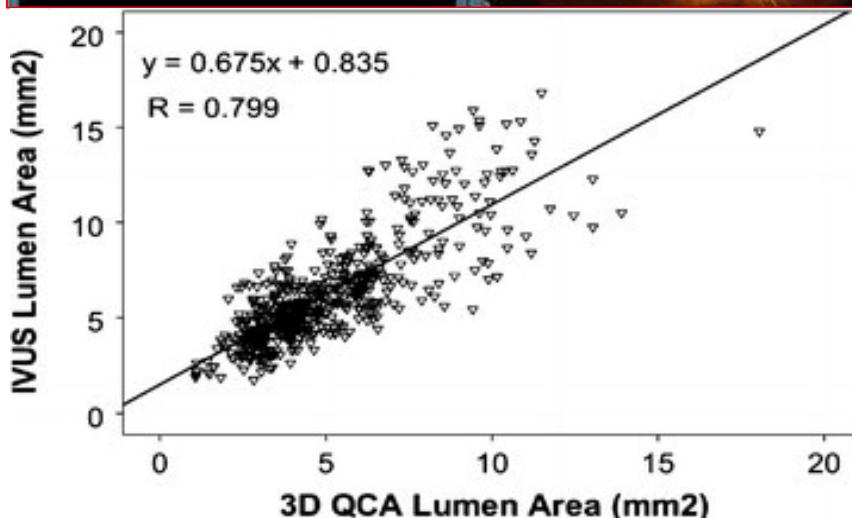
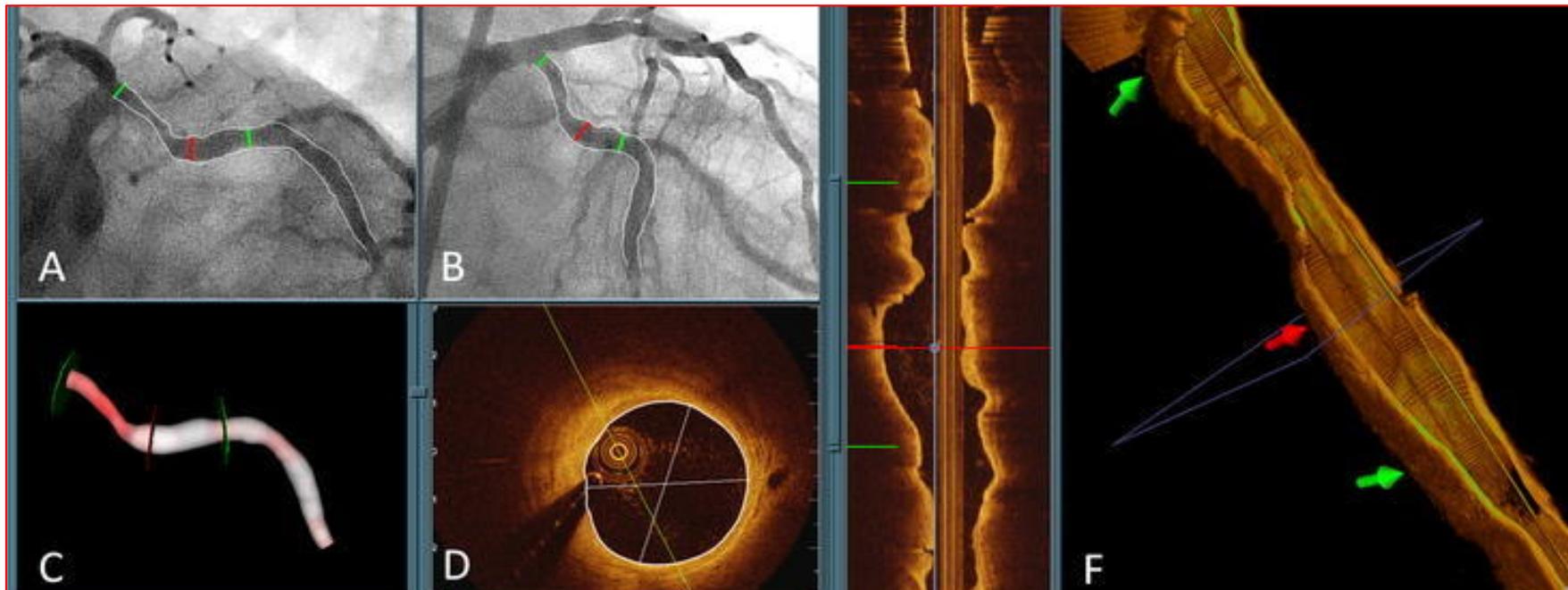
Reconstruction 3D du vaisseau



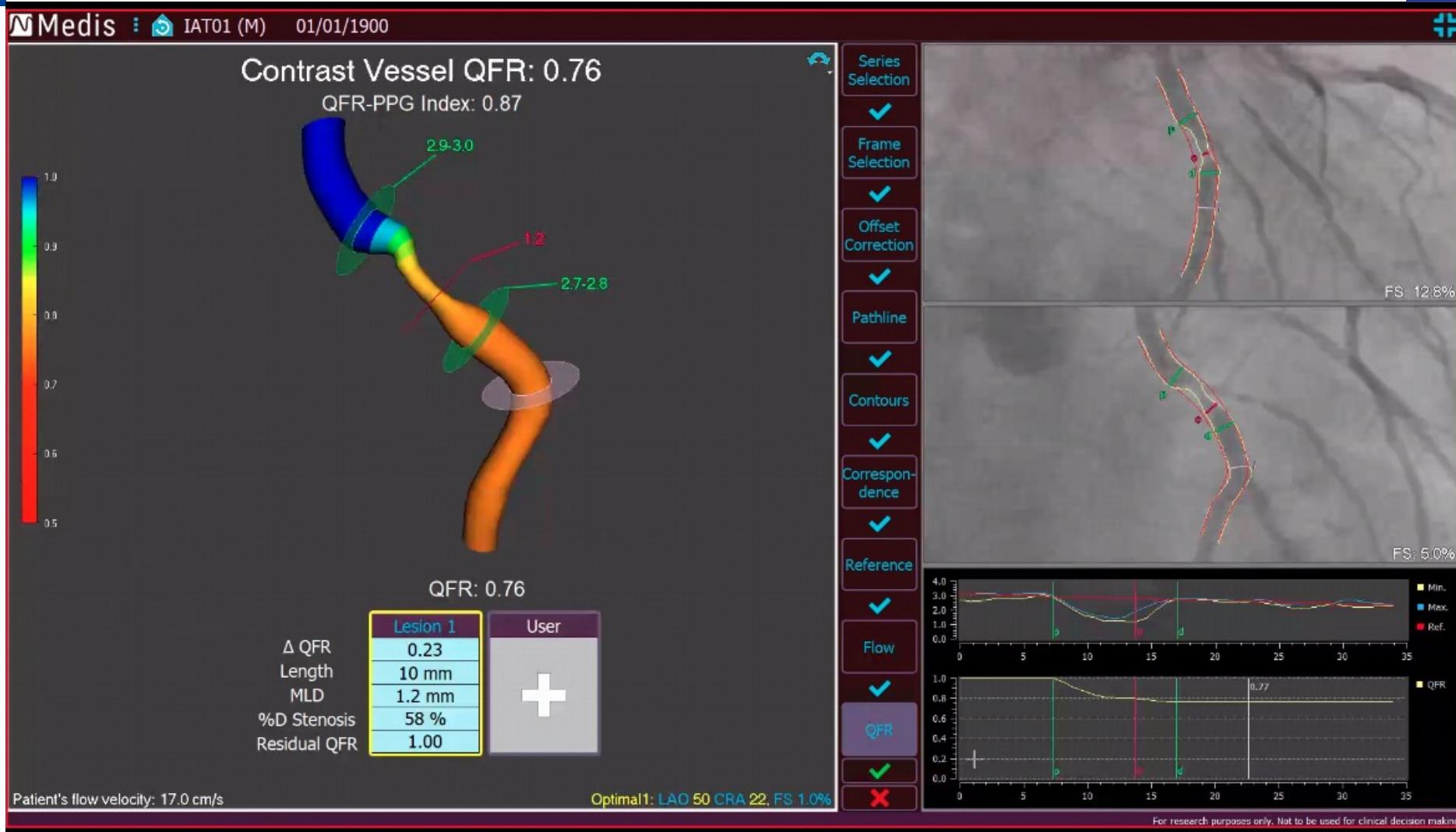
FFR virtuelles: principes



Corrélation 3D QCA et imagerie endocoronaire



Vue d'ensemble

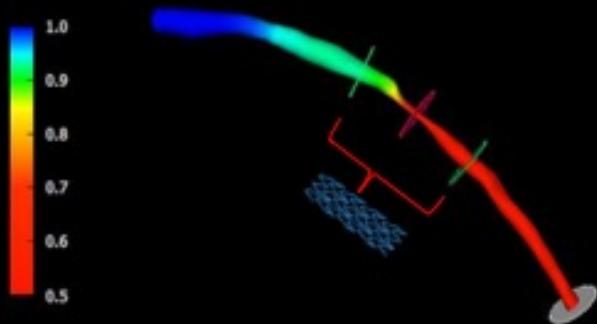




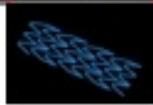
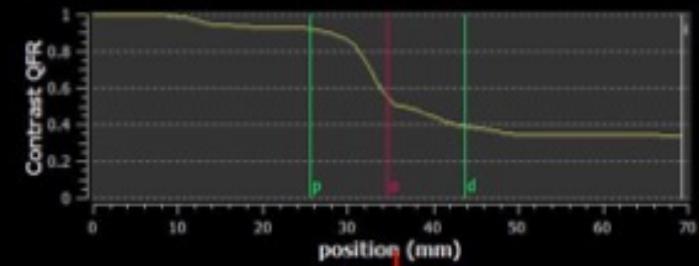
QFR outil d'aide à l'angioplastie?

Pre-PCI angiograms QFR analysis

Contrast QFR
Vessel: 0.34 Index: 0.34



Residual Contrast QFR 0.86
After virtual 18 mm long stenting



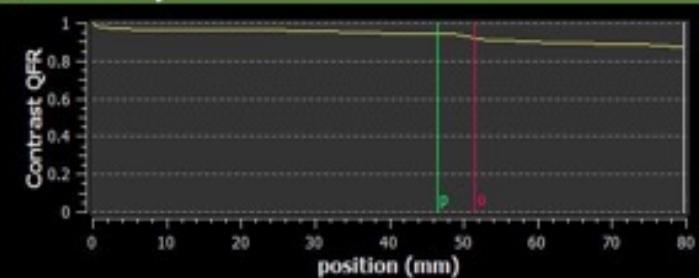
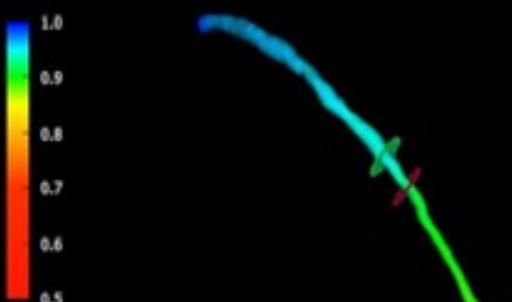
Vessel QFR 0.34

Lesion QFR 0.52 between p and d markers (18 mm)

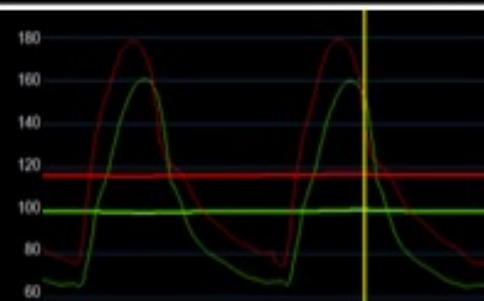
$$\text{Residual QFR} = 0.34 + 0.52 = 0.86$$

Post-PCI angiograms QFR analysis

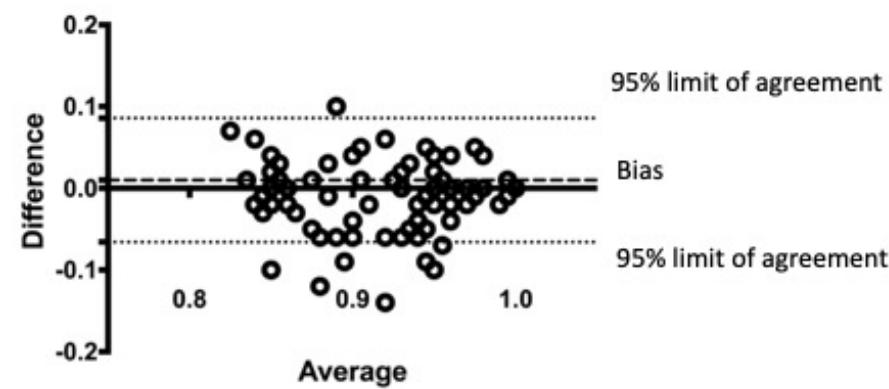
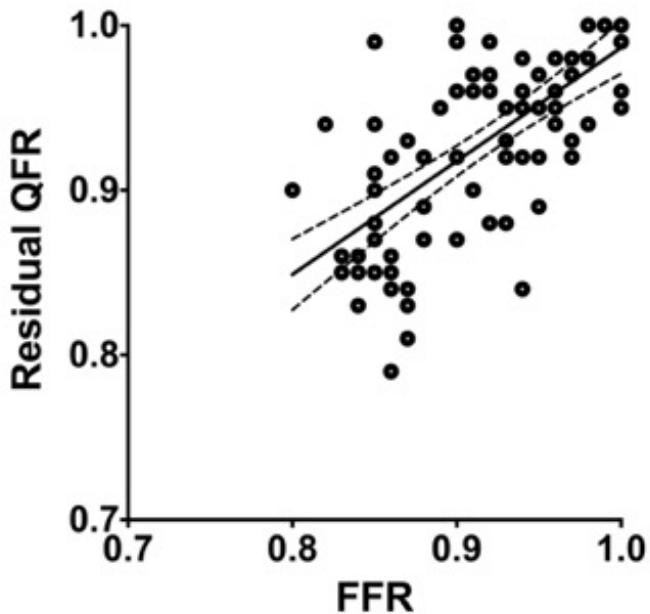
Contrast QFR
Vessel: 0.87 Index: 0.87



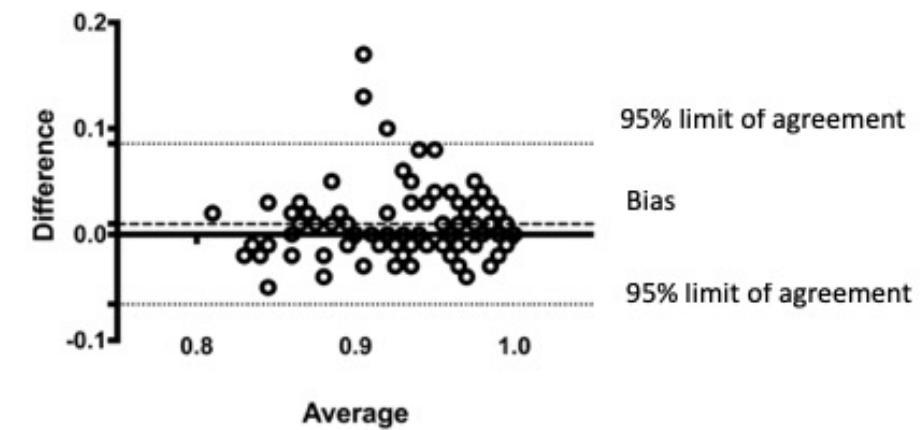
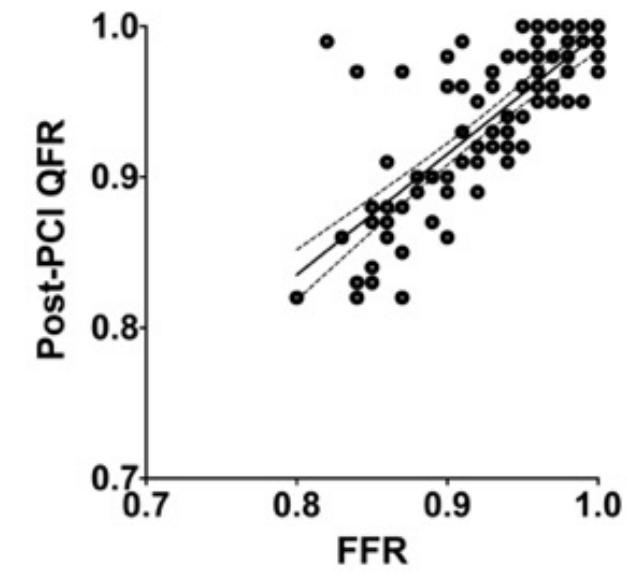
FFR Pd Pa
0.86 100 117



$R=0.68$, (95% CI: 0.53-0.78) n=84

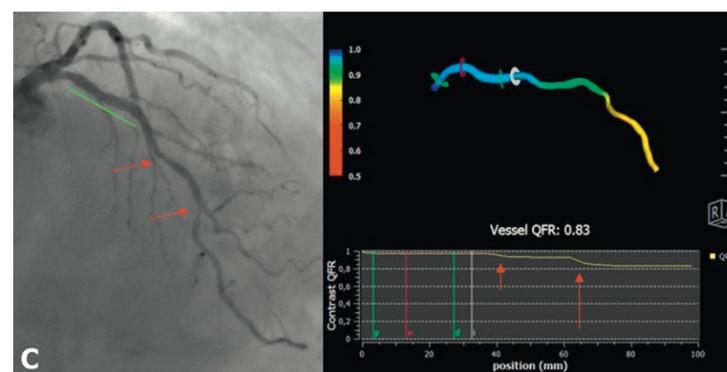
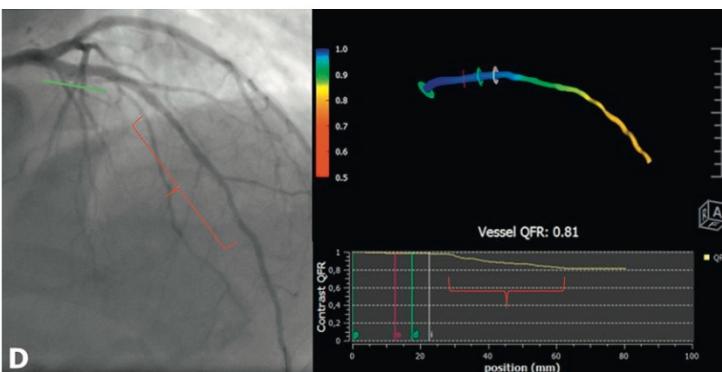
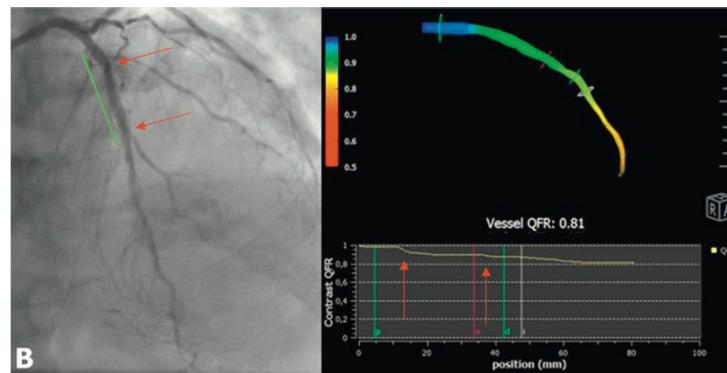
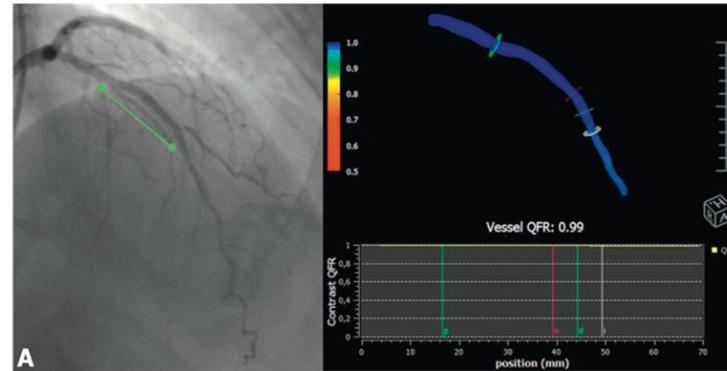
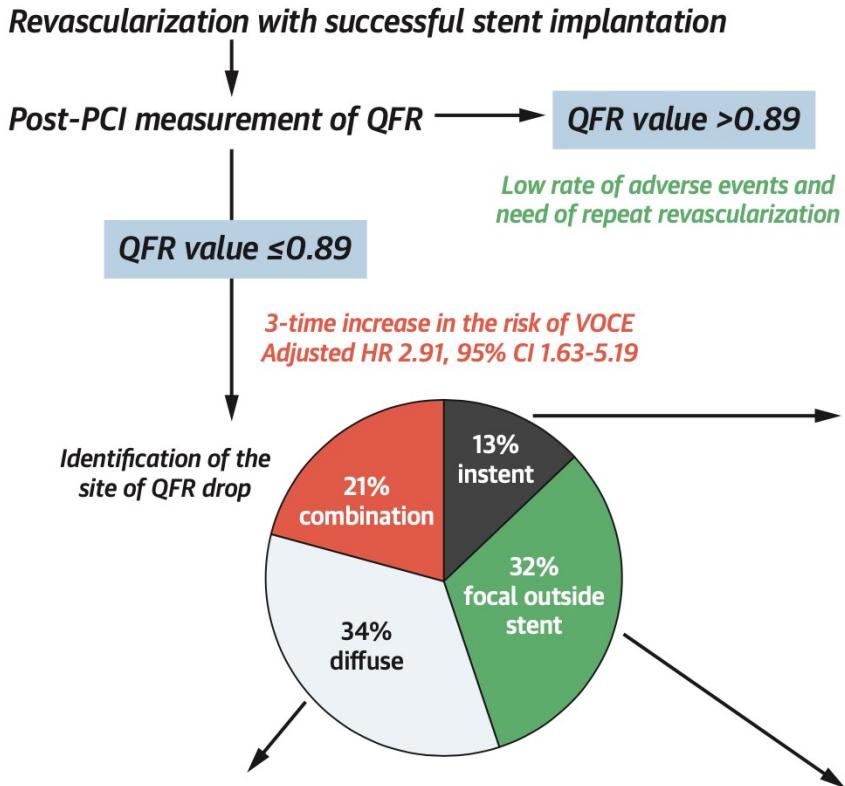


$R=0.79$, (95% CI: 0.70-0.86) n=93



CENTRAL ILLUSTRATION In Each Panel Is Shown the Final Angiographic Projection, the Three-Dimensional Reconstruction of the Vessel With the Vessel Contrast Quantitative Flow Ratio, and the Quantitative Flow Ratio Curve

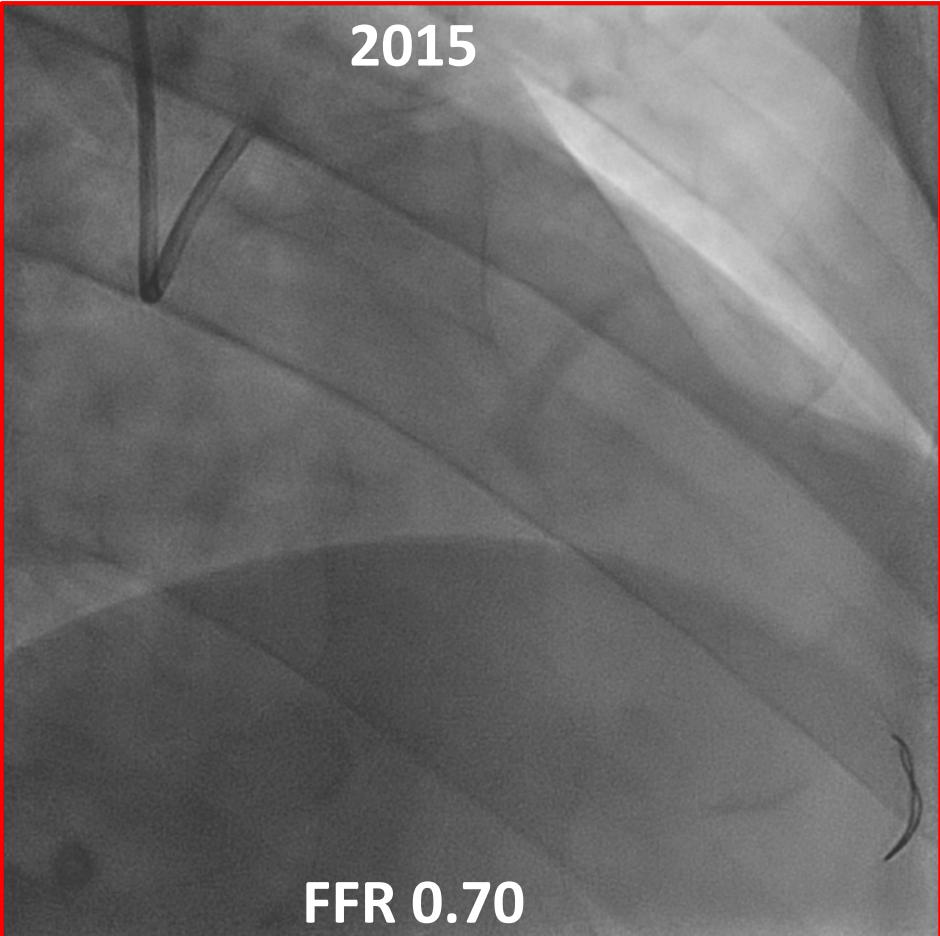
CARDIO RUN



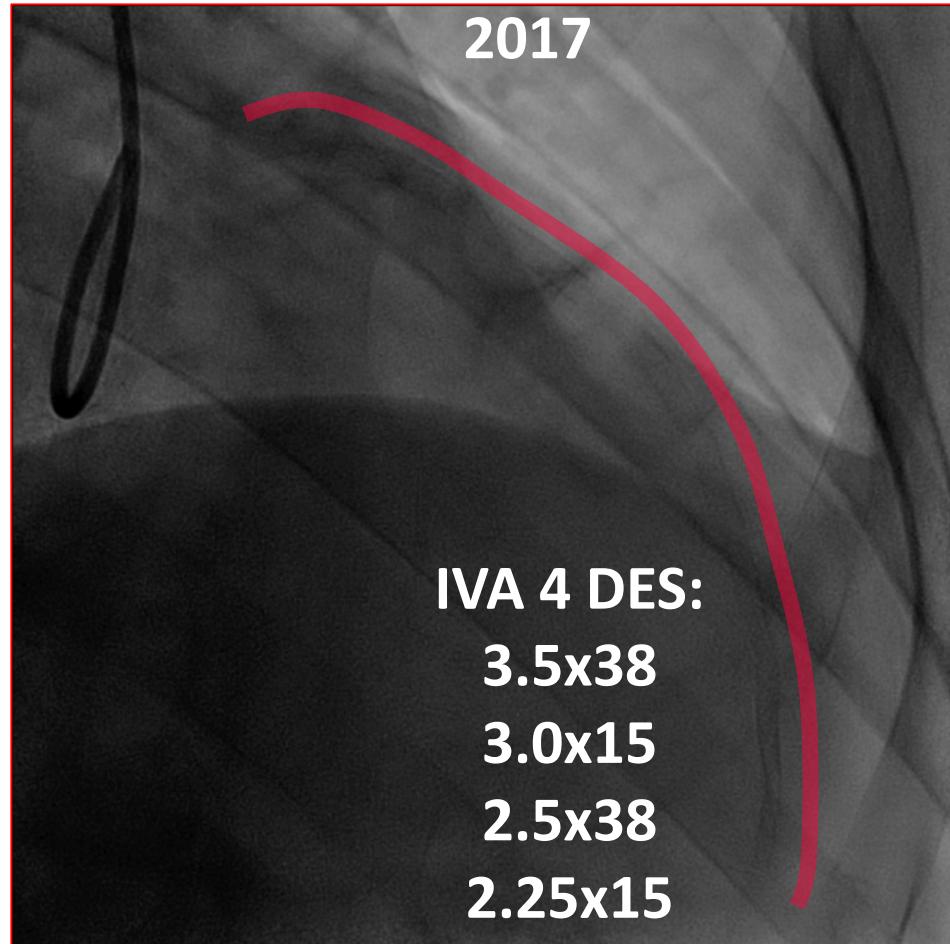
Cas clinique

Patient de 54 ans, angor stable CCS III, ATCD IDM inf

2015

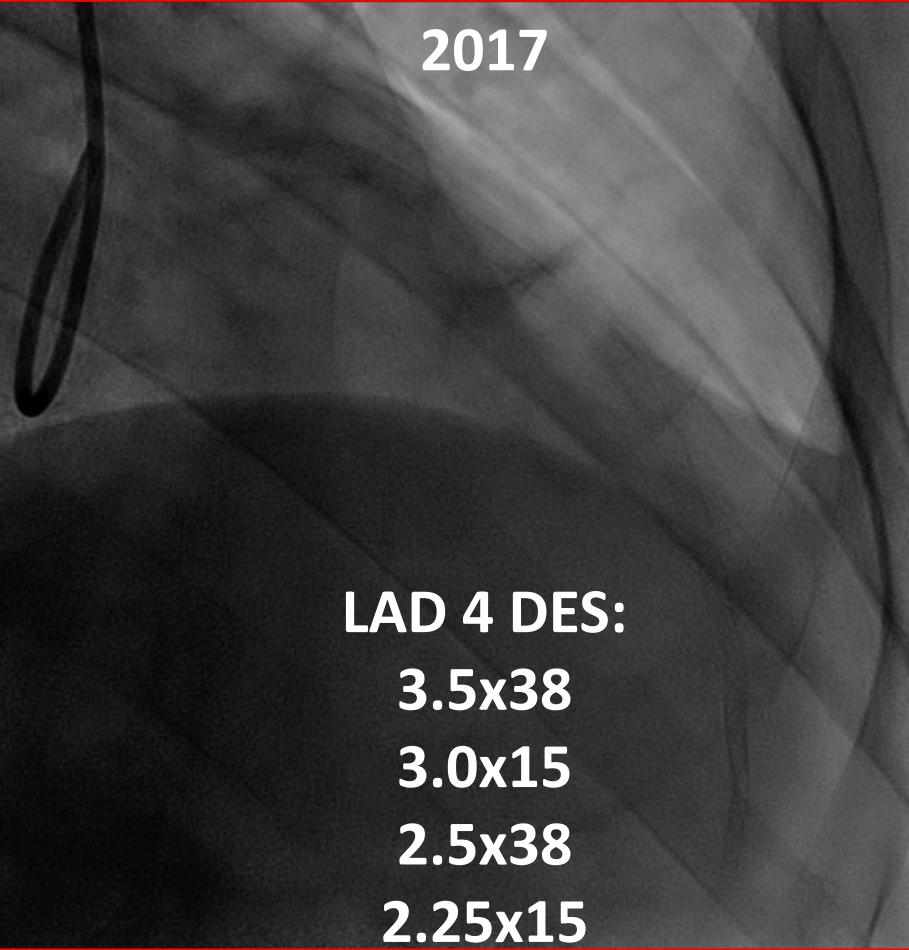


2017



Cas clinique

Patient de 54 ans, angor stable CCS III, ATCD IDM inf



2017

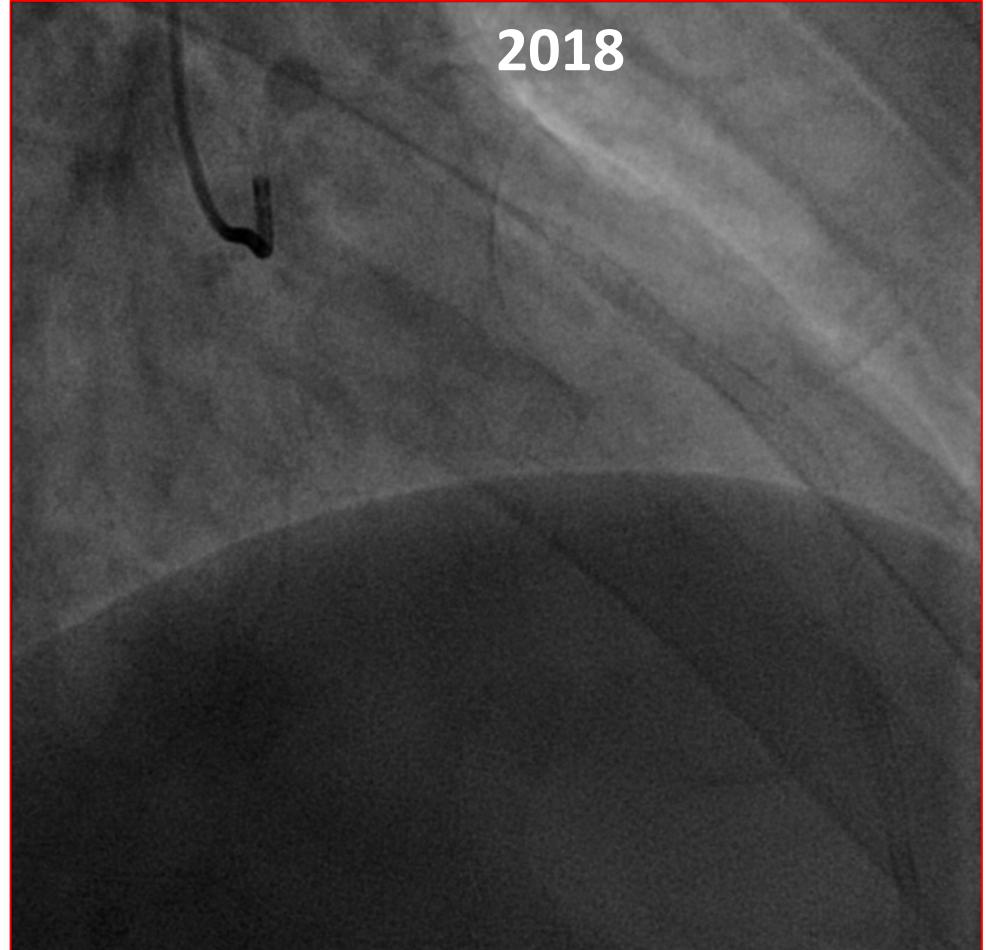
LAD 4 DES:

3.5x38

3.0x15

2.5x38

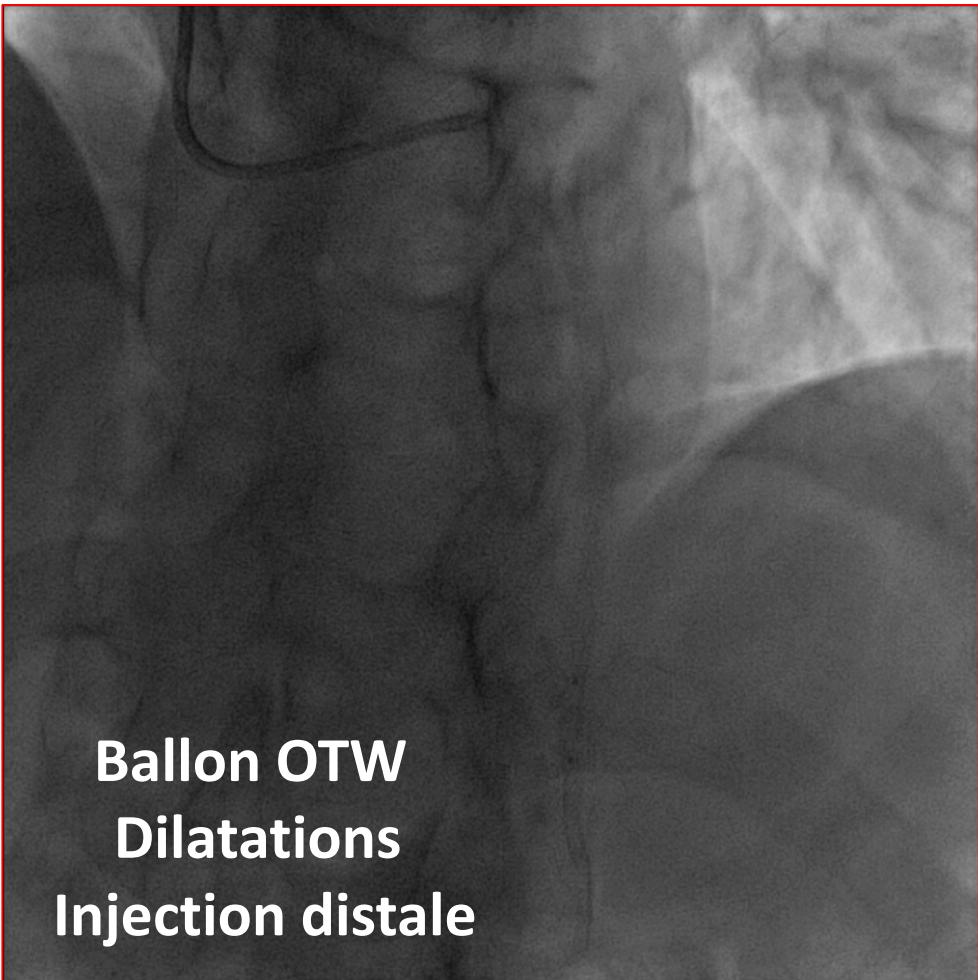
2.25x15



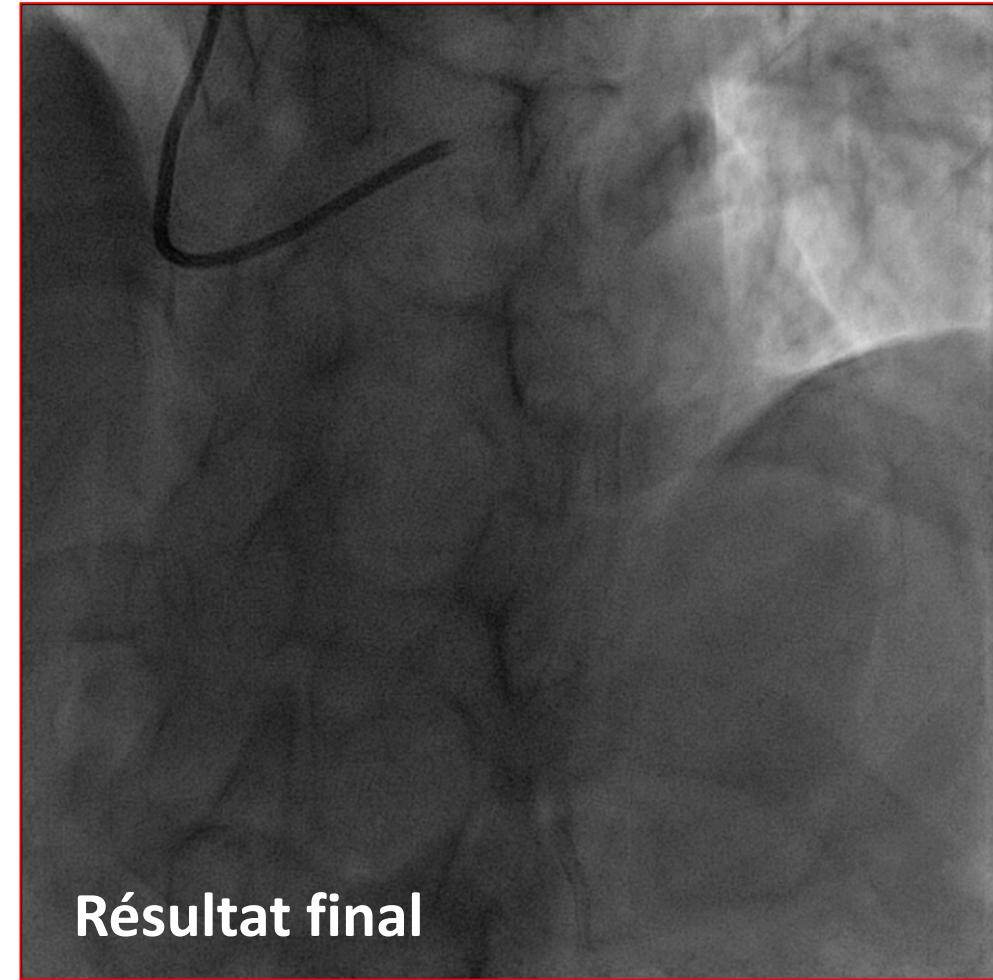
2018

Cas clinique

Patient de 54 ans, angor stable CCS III, ATCD IDM inf

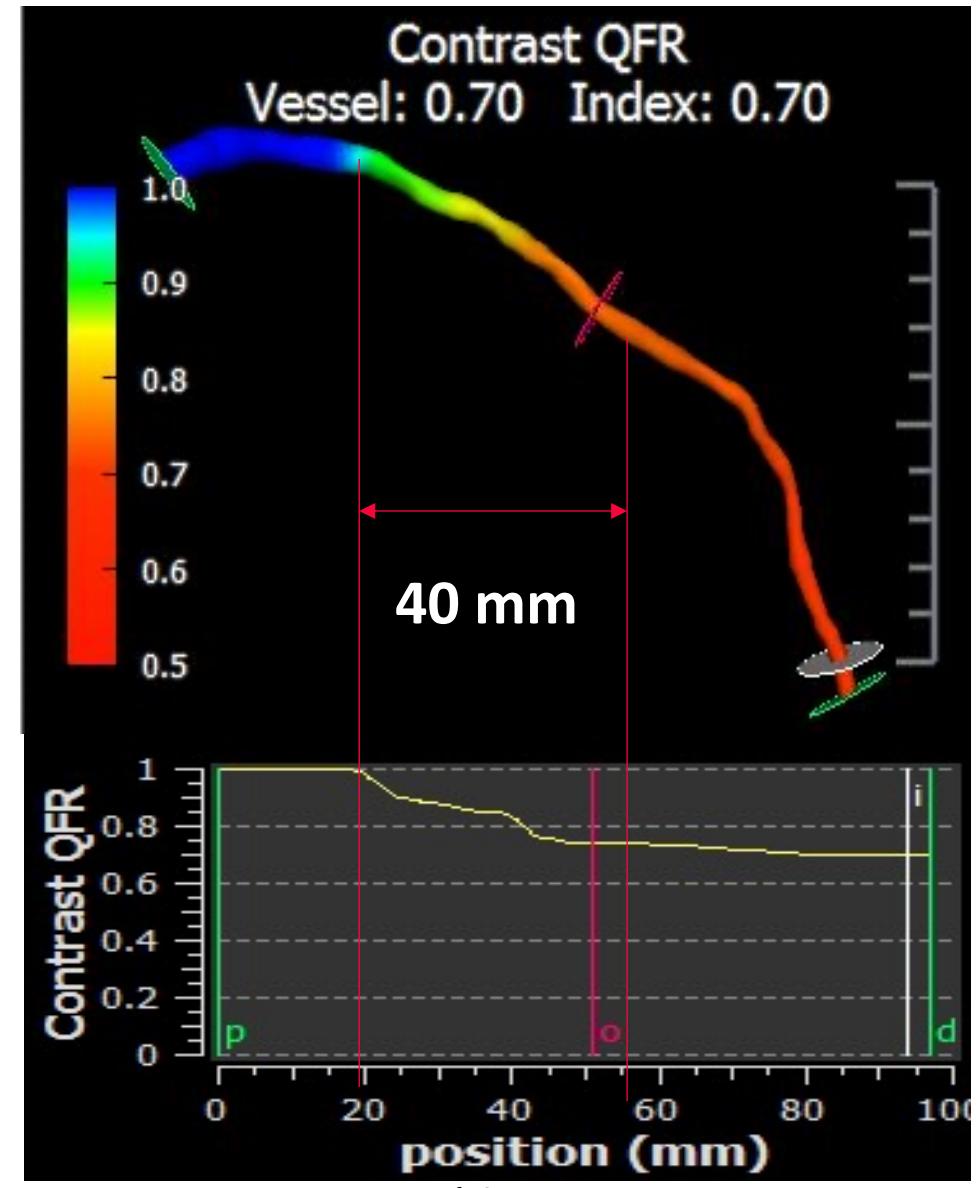
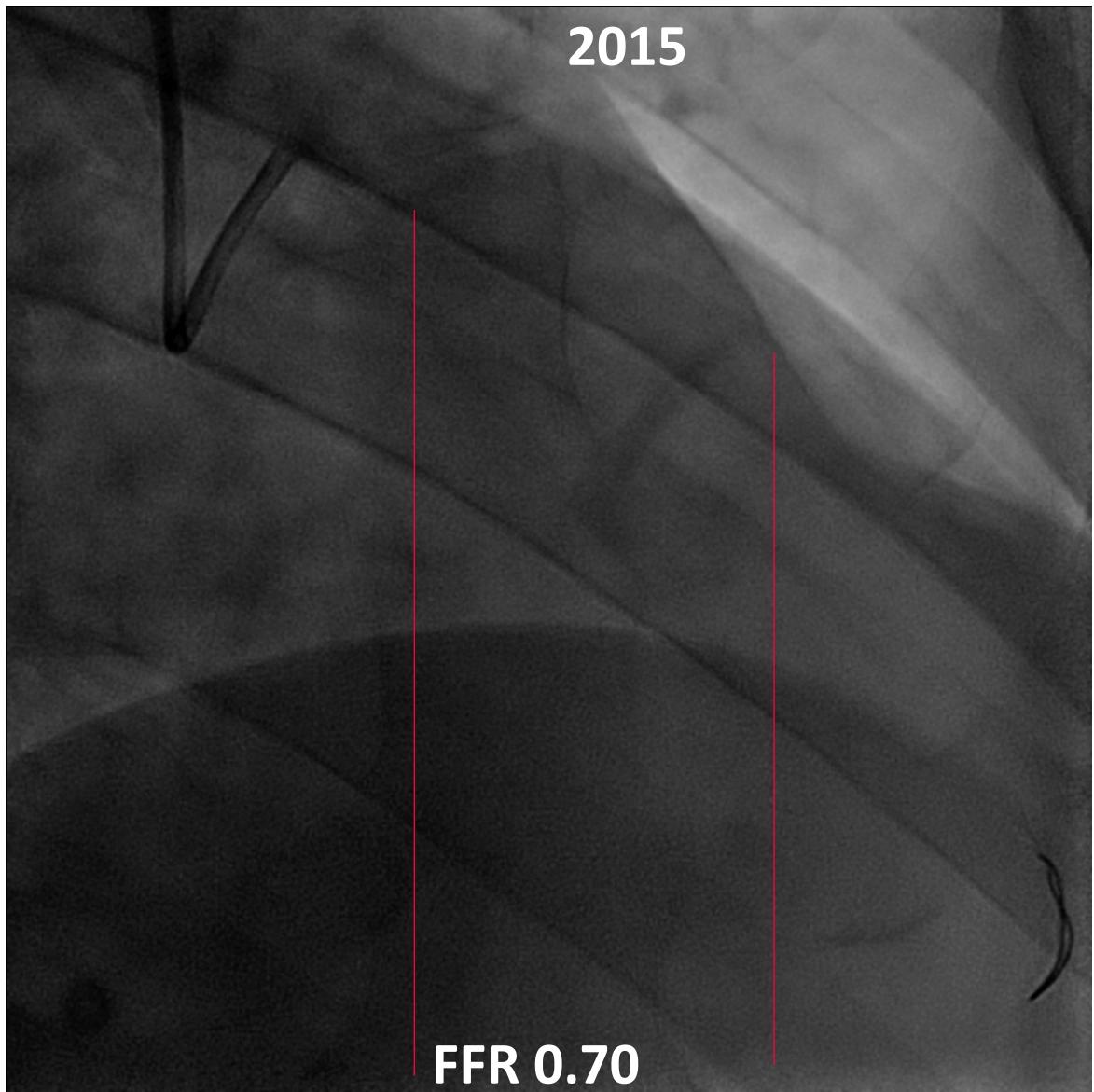


**Ballon OTW
Dilatations
Injection distale**



Résultat final

De retour en 2015



INOCA: défi de demain

Vasospastic Angina

No Obstructive CAD

Normal adenosine physiology
(FFR 0.84, CFR 5.3, IMR 9)

ACh GTN
Occlusive vasospasm with ACh (resolves with nitrate)

Vasospastic Angina

- 1 - Calcium channel blocker
- 2 - Long-acting Nitrate
- Avoid beta-blockers
- Event prevention: ACEI, Statin
- Lifestyle and cardiac rehabilitation

Invasive Coronary Assessment in INOCA

1 Coronary Angiography

- Consider:
 - Obstructive CAD
 - Myocardial bridging
 - 'Flush' ostial branch occlusion

Coronary flow reserve - abnormal CFR ≤ 2.0
Microvascular resistance - IMR ≥ 25 or HMR > 2.4

2 Guidewire (adenosine)

- Epicardial vasospasm
- Microvascular vasospasm

4 Diagnosis & Management

- Microvascular angina
- Vasospastic angina
- Mixed angina
- Non-Cardiac (normal IDP)

Microvascular Angina

No Obstructive CAD

Microvascular Dysfunction
(FFR 0.90, CFR 1.7, IMR 27)

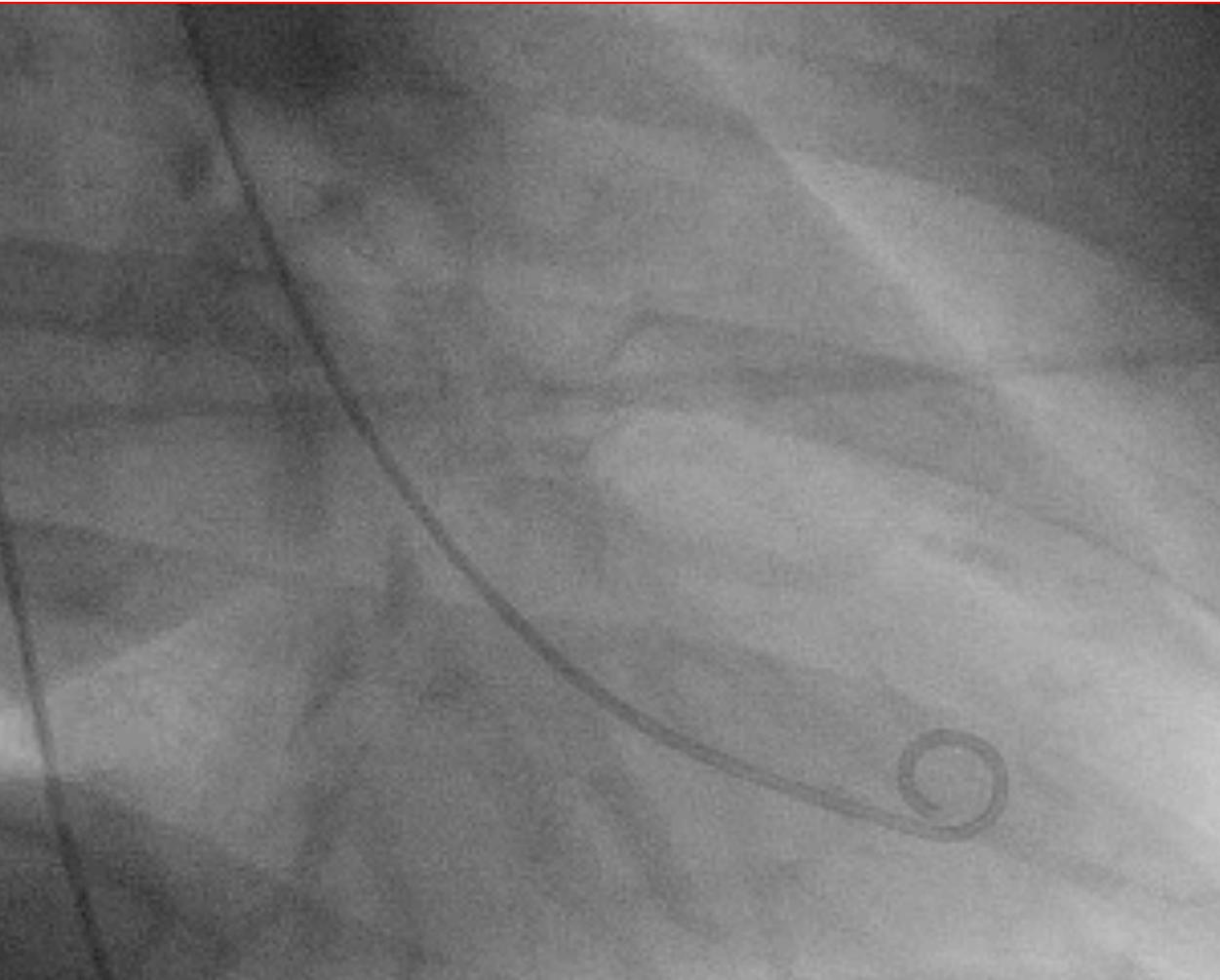
ACh GTN
Endothelial dysfunction but no gross vasospasm to ACh

Microvascular Angina

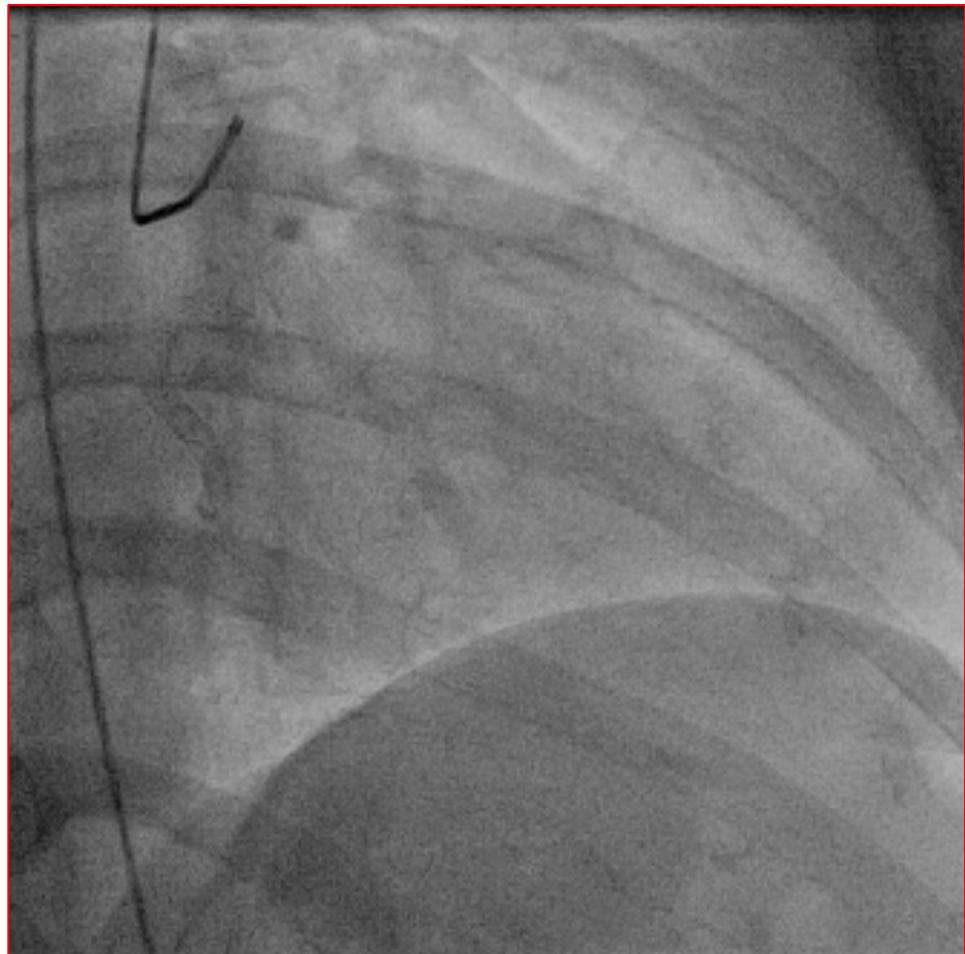
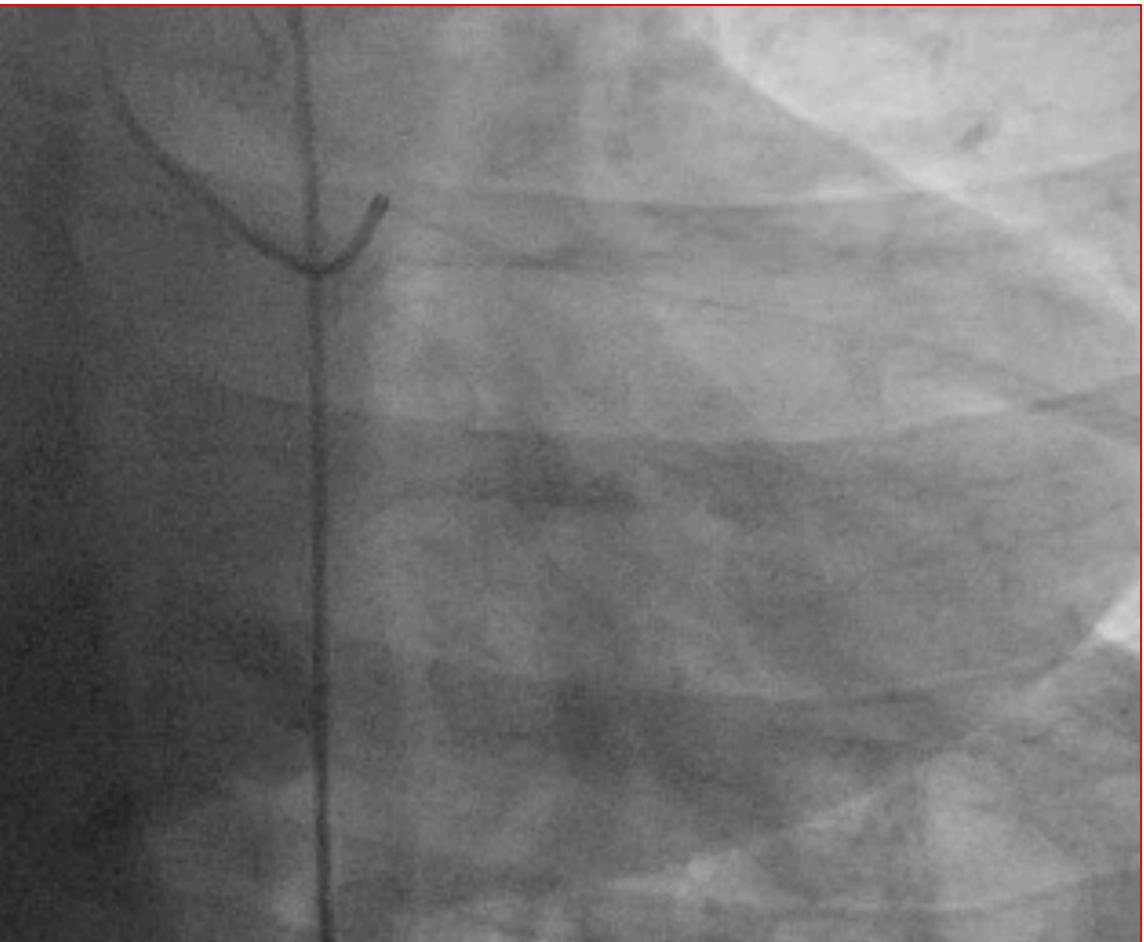
- 1 – Beta-blocker
- 2 – Calcium channel blocker
- Avoid long acting nitrates
- Event prevention: ACEI, Statin
- Weight loss and cardiac rehabilitation

Cas clinique: Patiente de 42 ans

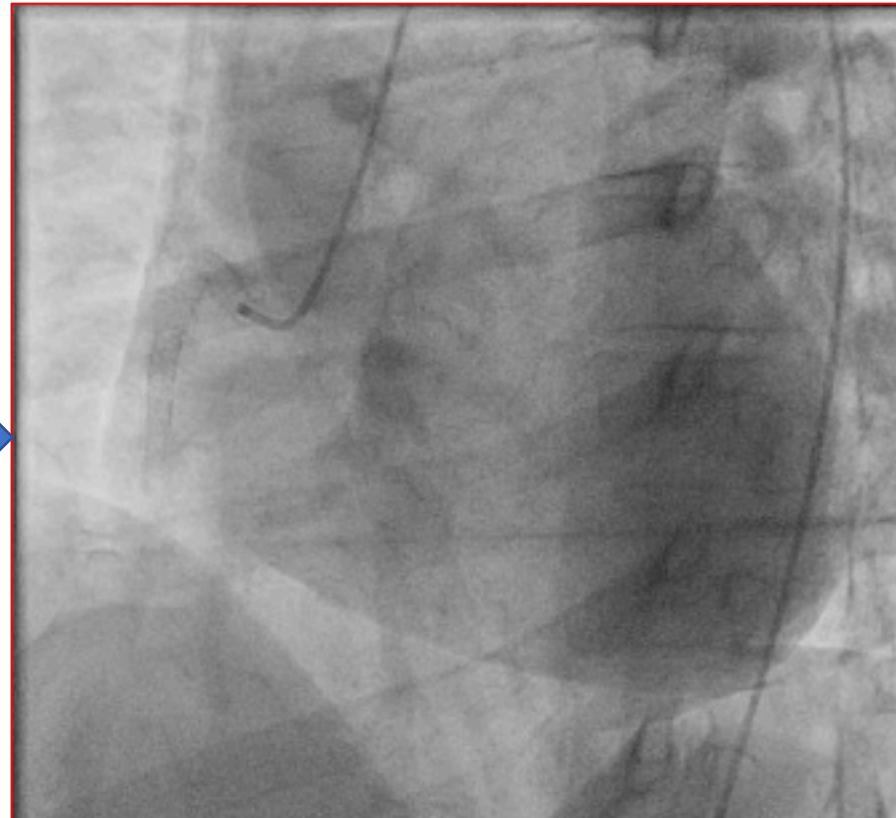
- Angor stable depuis 3 ans
- Herédité et tabac sevré
- Coro angioplastie de la CD x 2
- Coro x 5
- ECG repos normal test non invasif -



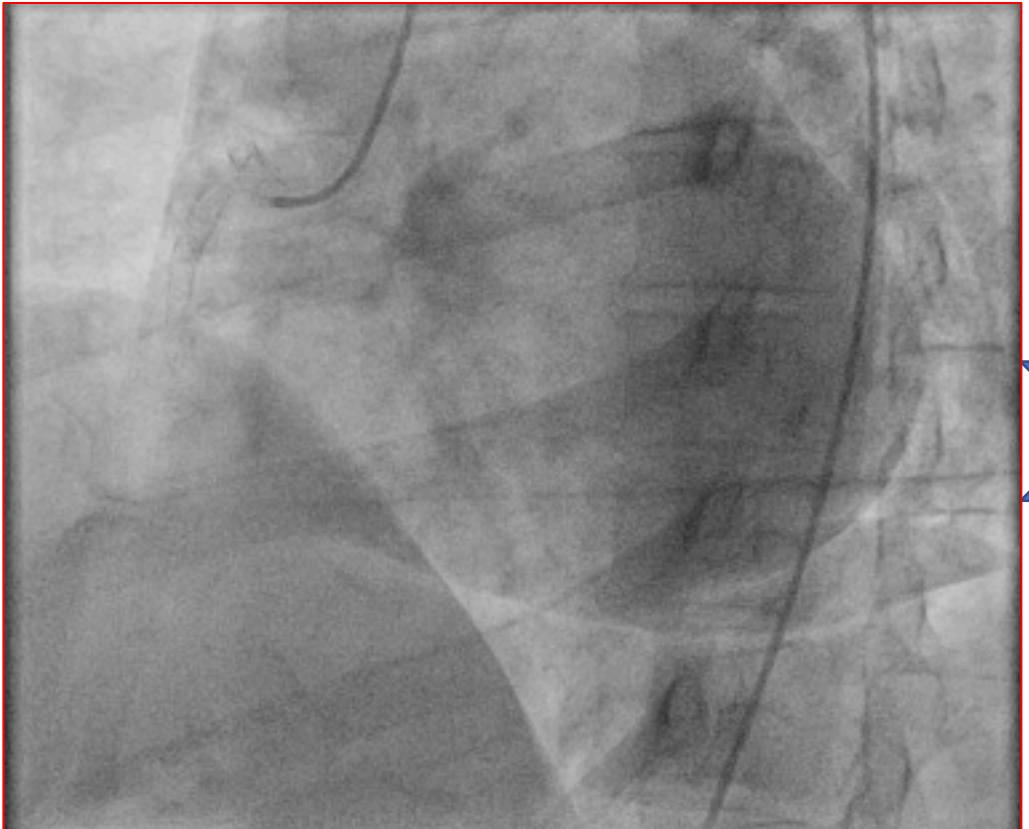
Cas clinique: Patiente de 42 ans



Cas clinique: Patiente de 42 ans



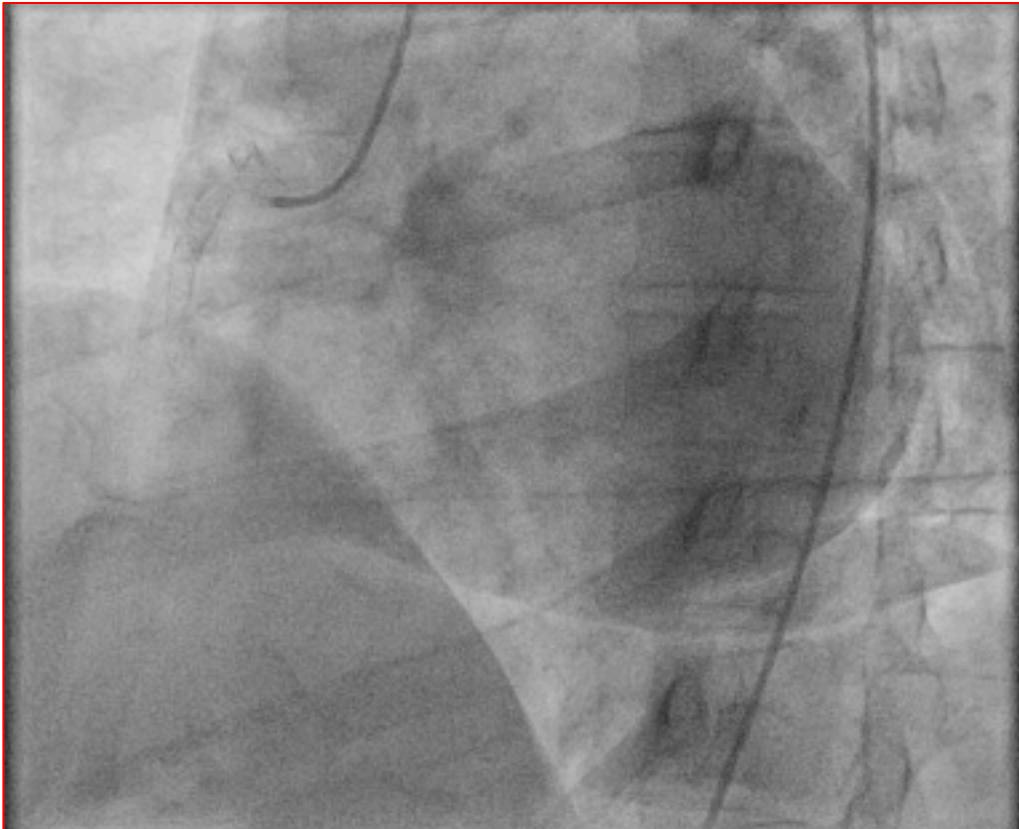
Cas clinique: Patiente de 42 ans



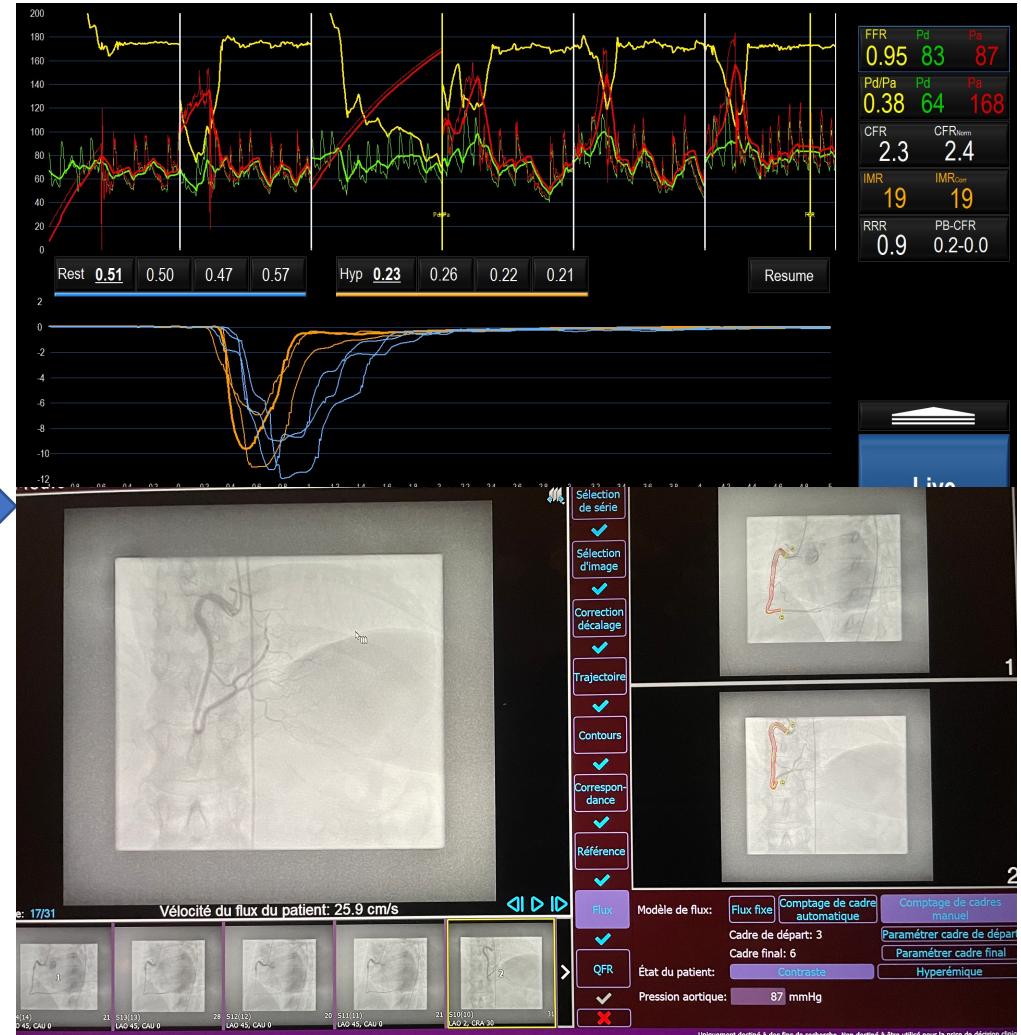
IMR

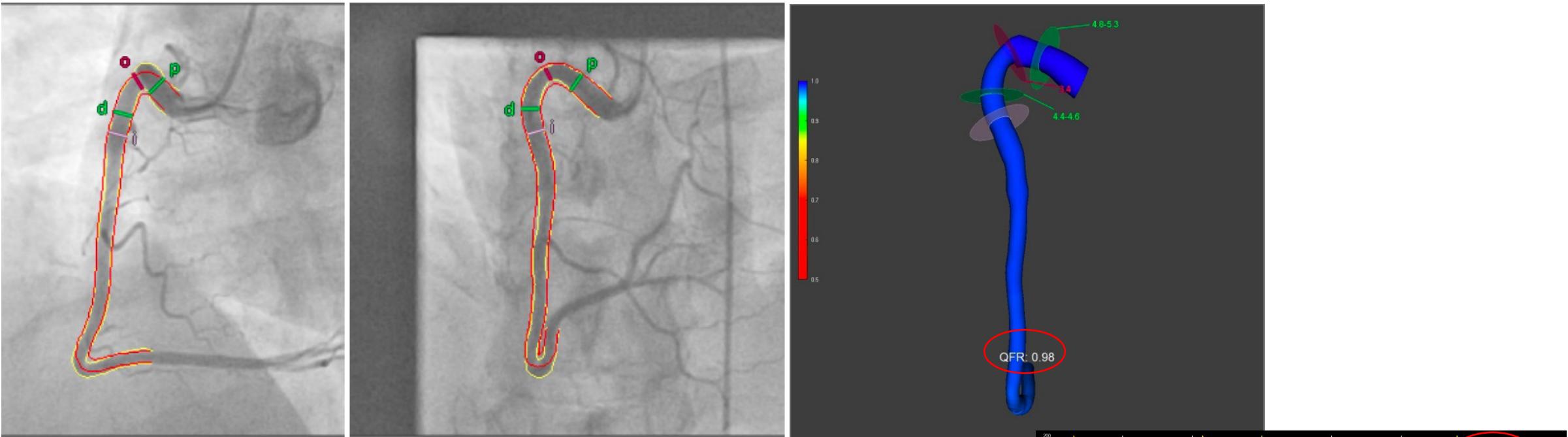


Cas clinique: Patiente de 42 ans



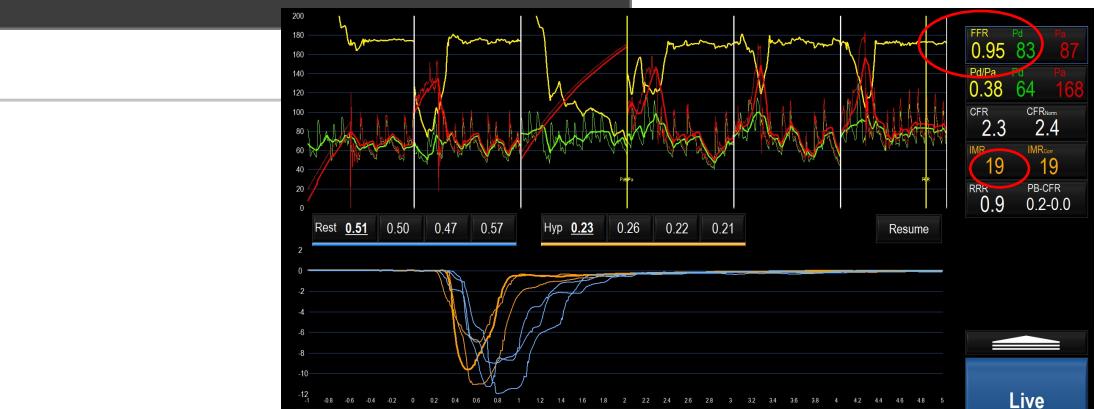
IMR
virtuelle





Résultats QFR vaisseau

	Contraste	Flux fixe
QFR vaisseau	0.98	0.98
QFR sur indice	0.99	0.99
Résistance	3.59	29.5 mm
Vitesse du flux	25.9	mmHg*s/m
Angio IMR (cf)	30.76	cm/s
Angio IMR (hf)	18.49	mmHg*s
		mmHg*s



Conclusion perspective de la QFR

- **QFR permet de donner:**

1. Valeur de FFR
 2. Taille du vaisseau/lésion (OCT)
 3. Valeur FFR post angioplastie
 4. Microcirculation
- IMR (recherche seulement)**

.... En 1 à 2 minutes sur PC standard avec une coronarographie diagnostique.... À suivre de près

