



Resténose intrastent.. résistante

**Géraud SOUTEYRAND
CHU CLERMONT-FERRAND**

Resténose intrastent

Mr F 66 ans

FDRCV : HTA, Tabac

ATCD maladie de Hodgkin avec RT en 1979

Cardiopathie ischémique : Nécrose inférieure en 2000 ATL Cx et Cdte

Stent coronaire droite moyenne en 2010

Stent coronaire droite proximale en 2014 Titan

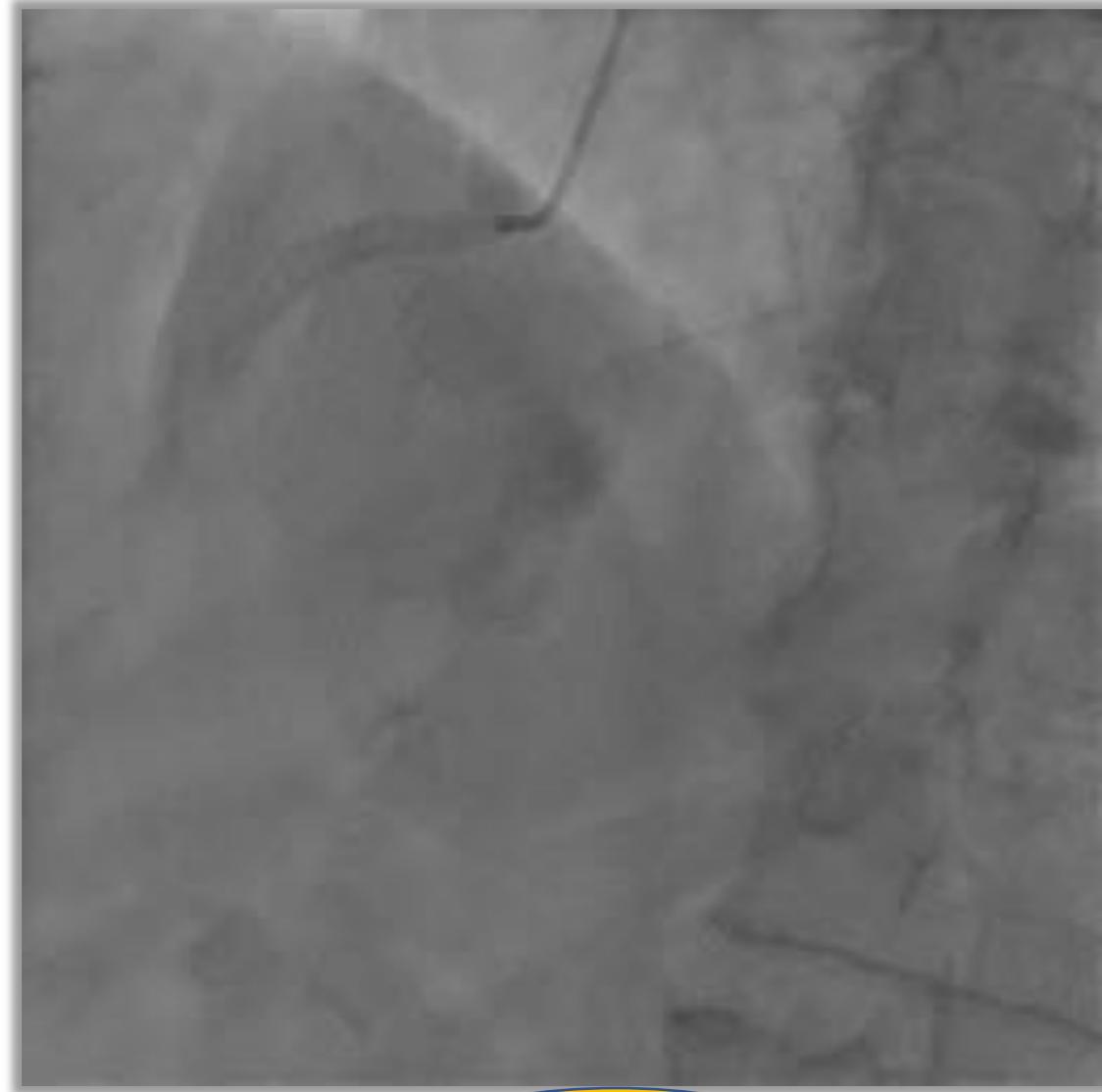
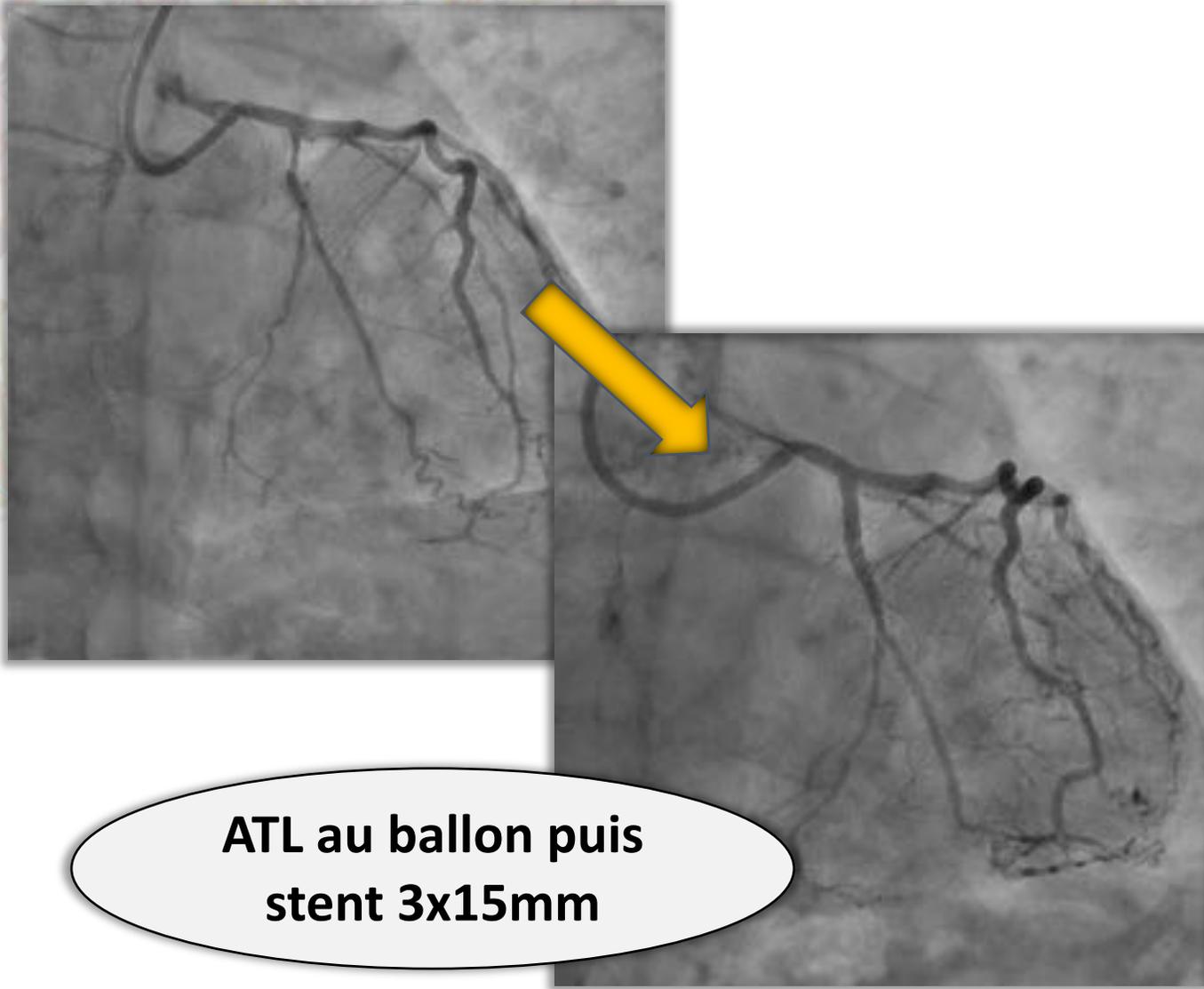
2018 resténose coronaire droite moyenne traitée par ballon actif

2022 : Angor au moindre effort puis de repos

ETT : FE à 55% avec hypokinésie inféro-basale

Biologie : ø troponine, LDL CT à 1.46g/L

Coronarographie



CAT ?

Resténose intrastent

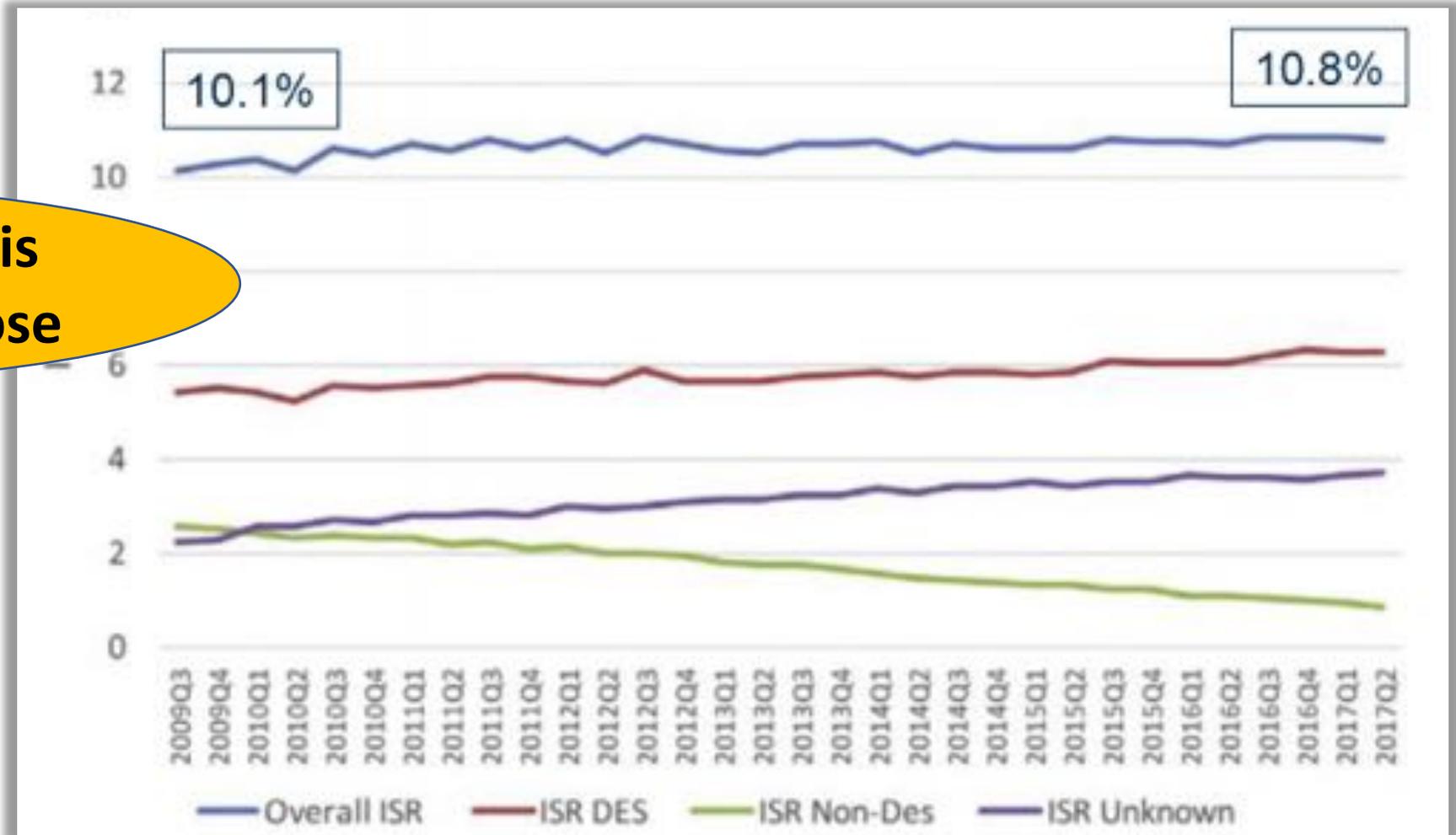
**Moi j'en ai jamais!!!
C'est un phénomène local à
Clermont avec leur
truffade!!**



Resténose intrastent

5,100,394 patients Cath-PCI NCDR

Activité aux Etats-Unis
Taux ATL pour resténose

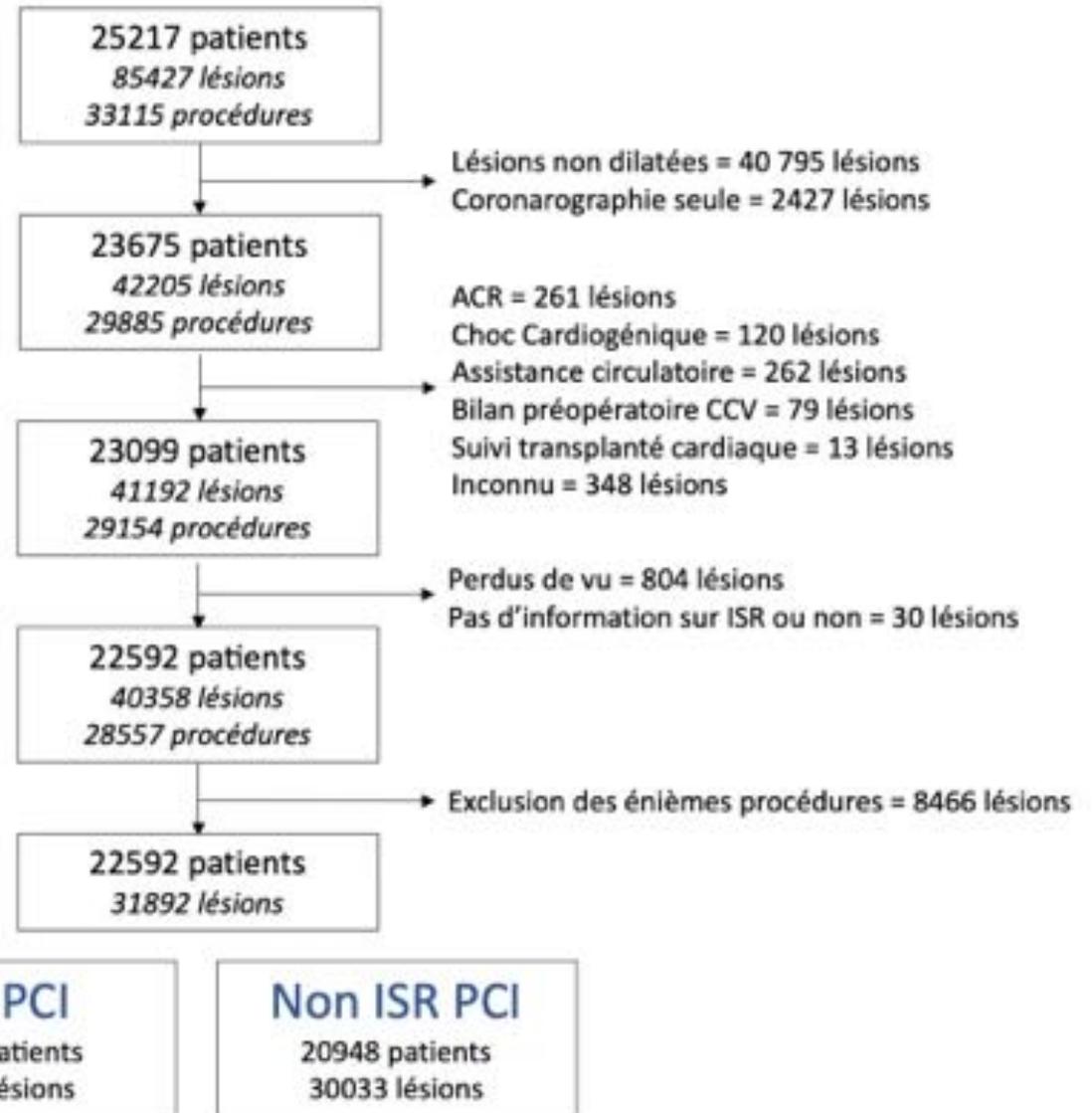


Resténose intrastent

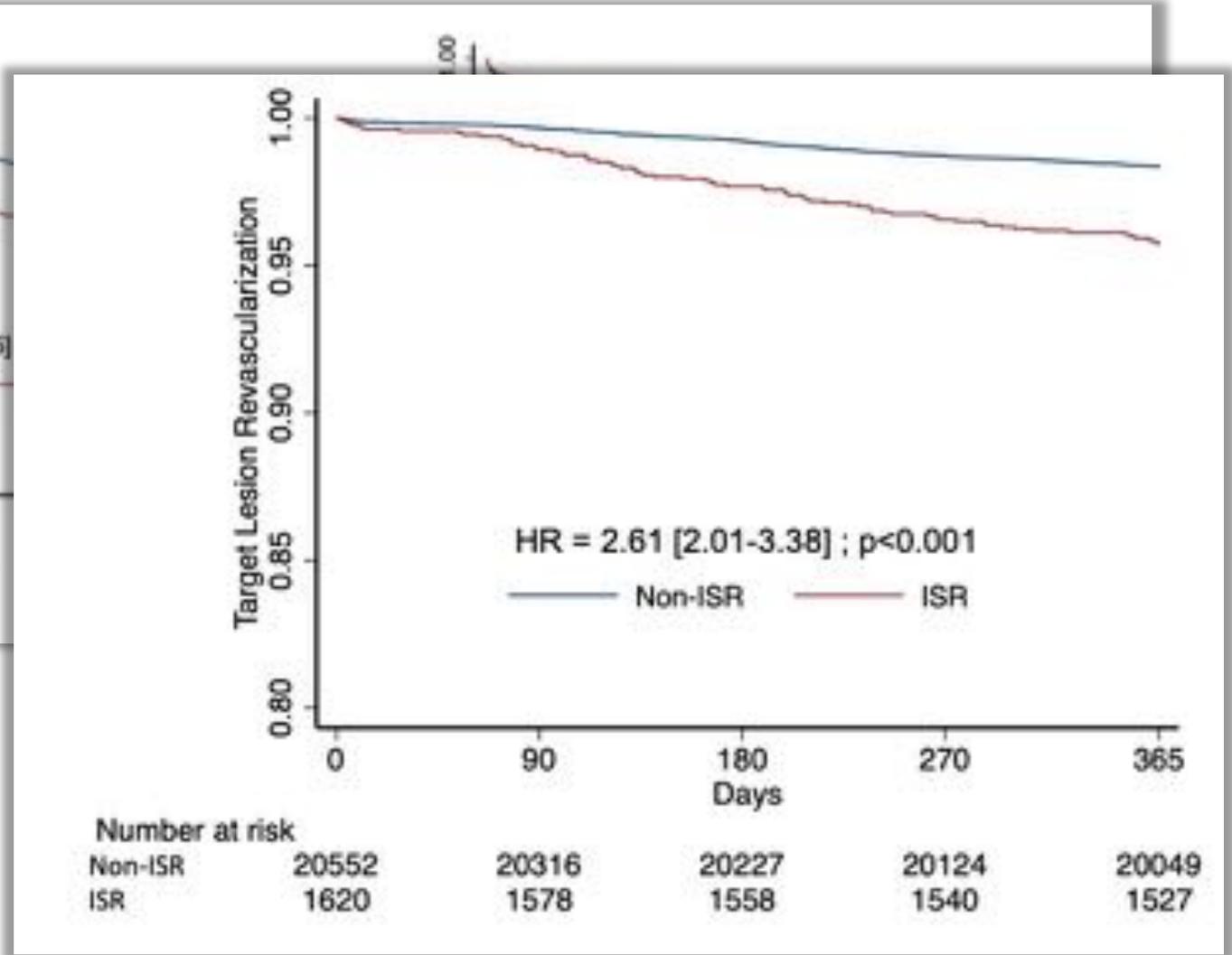
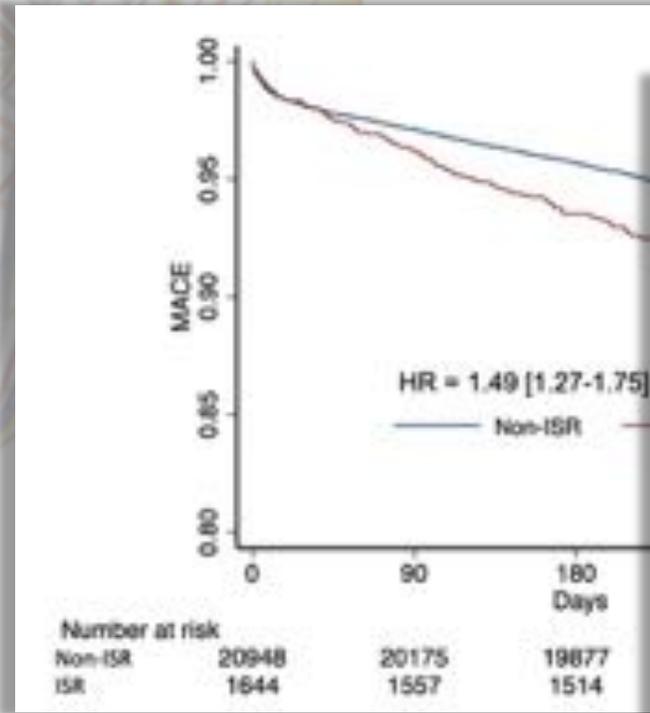
FRANCE PCI 2014-2018

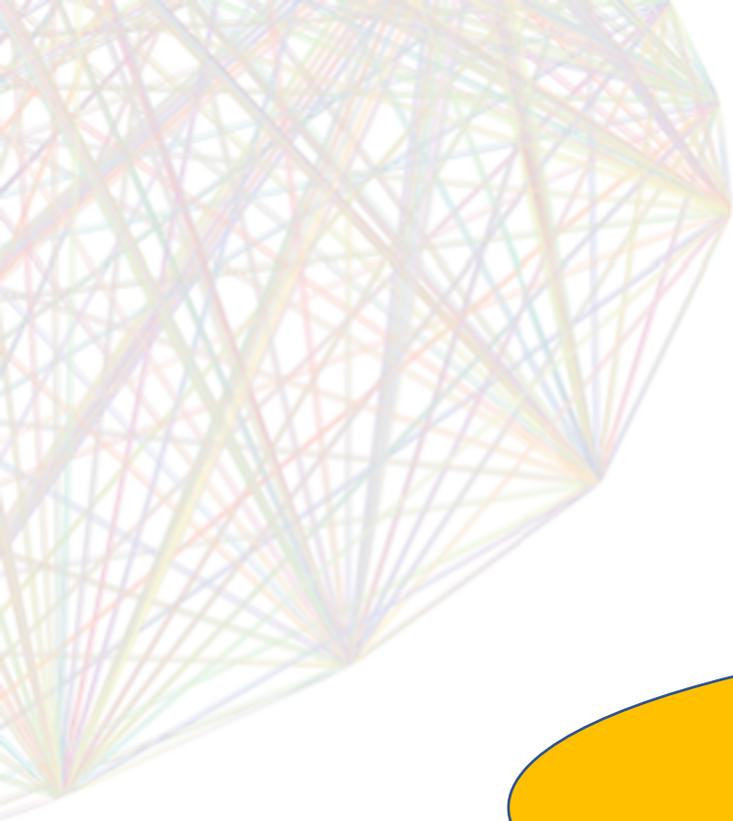
7.3% pour resténose

FPCI 2014-2018



Resténose intrastent





**Resténose intrastent...
Résistante ?**

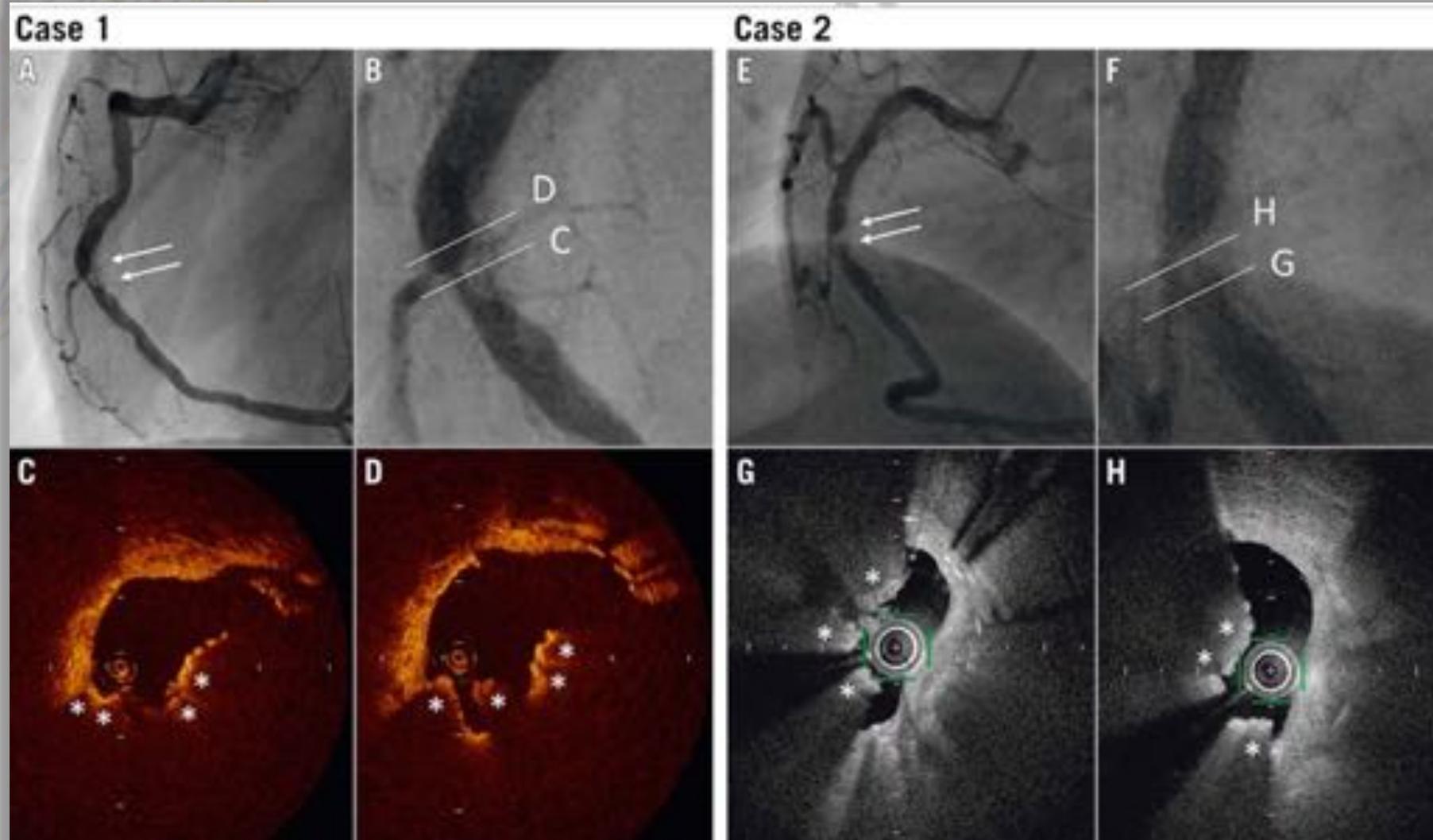
**651 lésions (432 pts) avec resténose intrastent entre 2008 et
2016
Avec OCT**

Contrôle angiographique à 6-8 mois

32 lésions avec nodule calcifié = 4.9%

Resténose intrastent

Prevalence, predictors, and outcomes of in-stent restenosis with calcified nodules



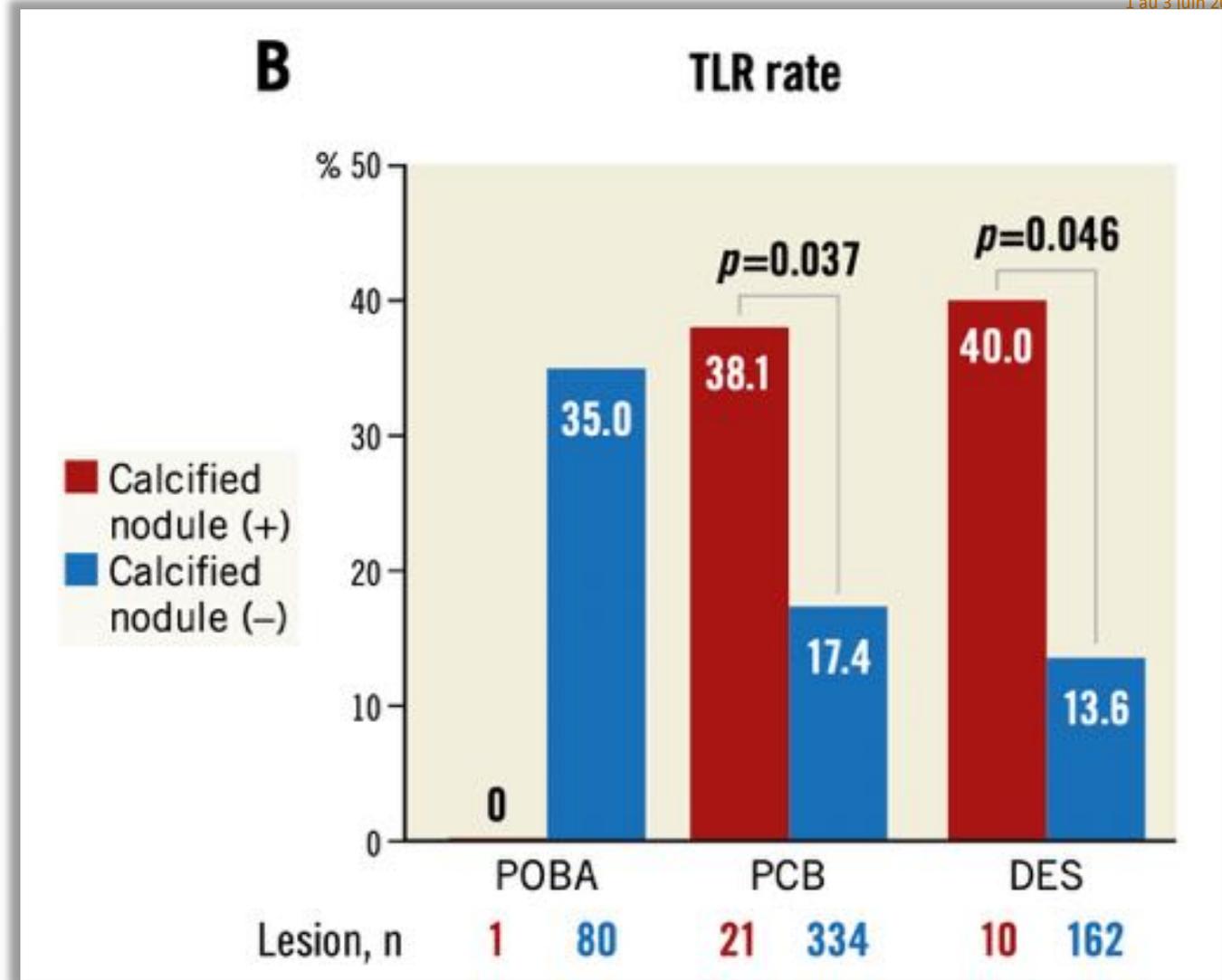
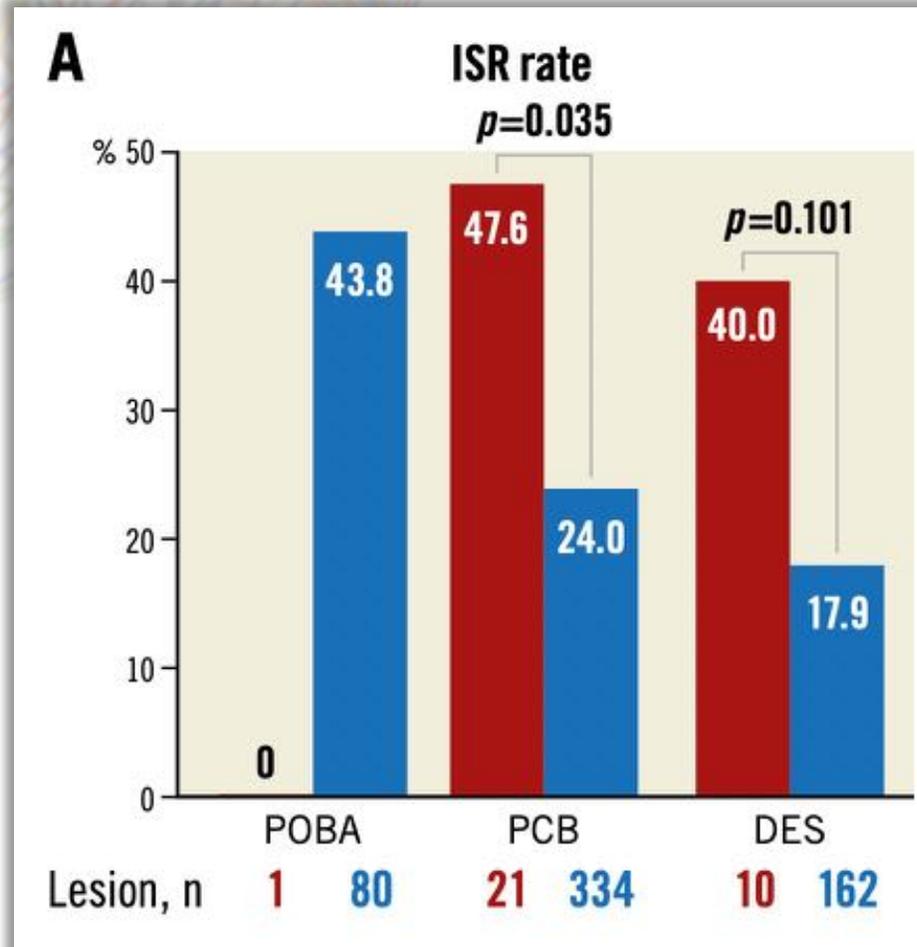
Resténose intrastent

Prédicteurs nodules calcifiés en cas RIS

	Multivariate analysis Odds ratio (95% CI)	p-value
Female	3.212 (1.079-9.564)	0.036
Diabetes mellitus	1.603 (0.575-4.473)	0.368
Haemodialysis	3.633 (1.182-11.156)	0.024
ISR after PCB dilatation	1.455 (0.435-4.865)	0.543
First time ISR	0.522 (0.210-1.293)	0.160
Right coronary artery lesion	1.366 (0.491-3.800)	0.551
Presence of ISA in a previous stent	3.228 (1.435-7.257)	0.005
ISR in bifurcation lesion	0.255 (0.040-1.644)	0.151
ISR in calcified lesion	12.441 (4.797-32.266)	0.000

Resténose intrastent

Evolution à 6-8mois



OCT et Resténose intrastent

**In-stent restenosis characteristics and repeat stenting
underexpansion: insights from optical coherence tomography**

143 lésions avec resténose intrastent

Guidage OCT systématique pré et post

Rétrospective, 2 centres

**Sous expansion post angioplastie = stent expansion
< 70% ou MSA < 4.5mm²**

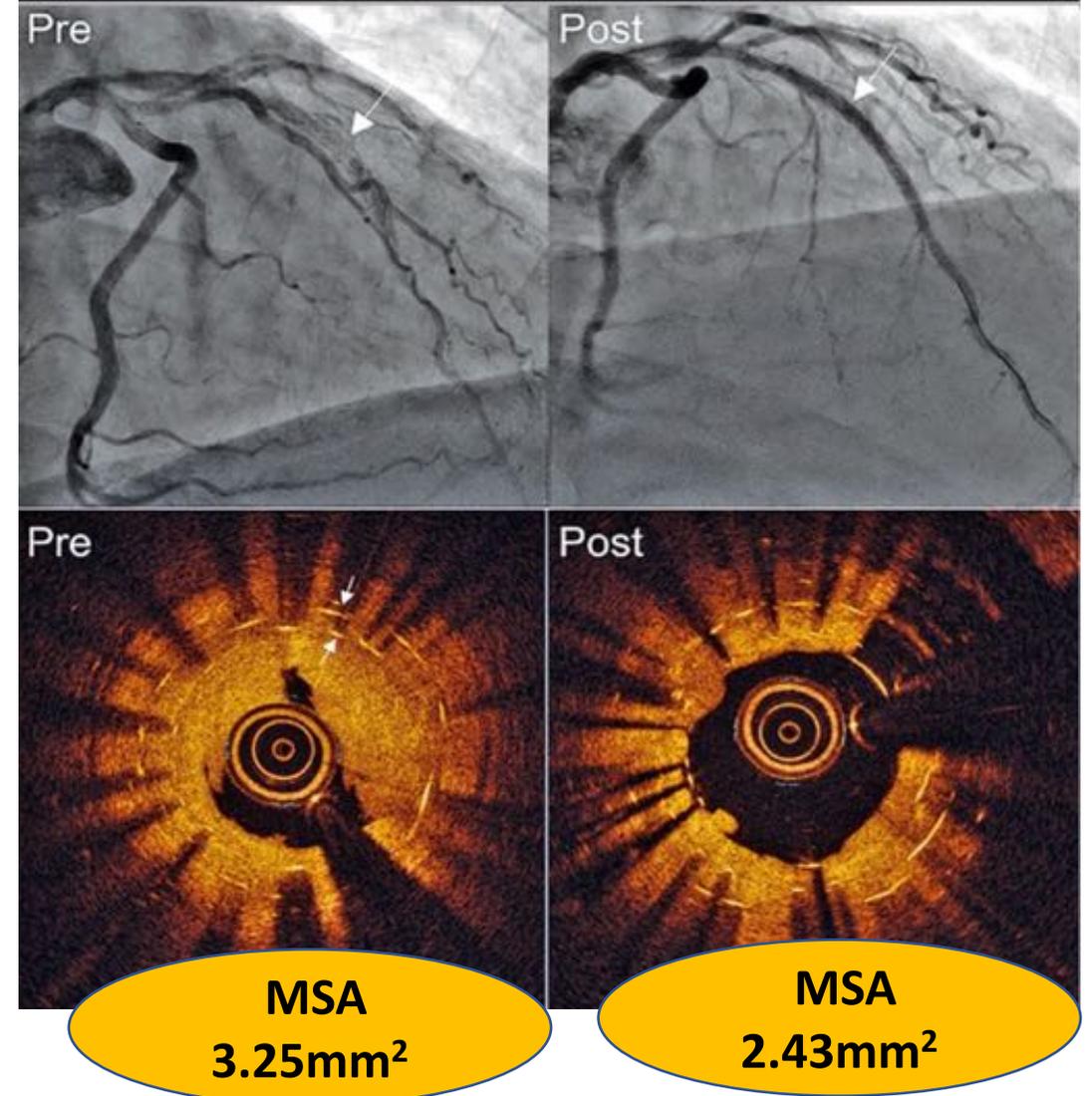
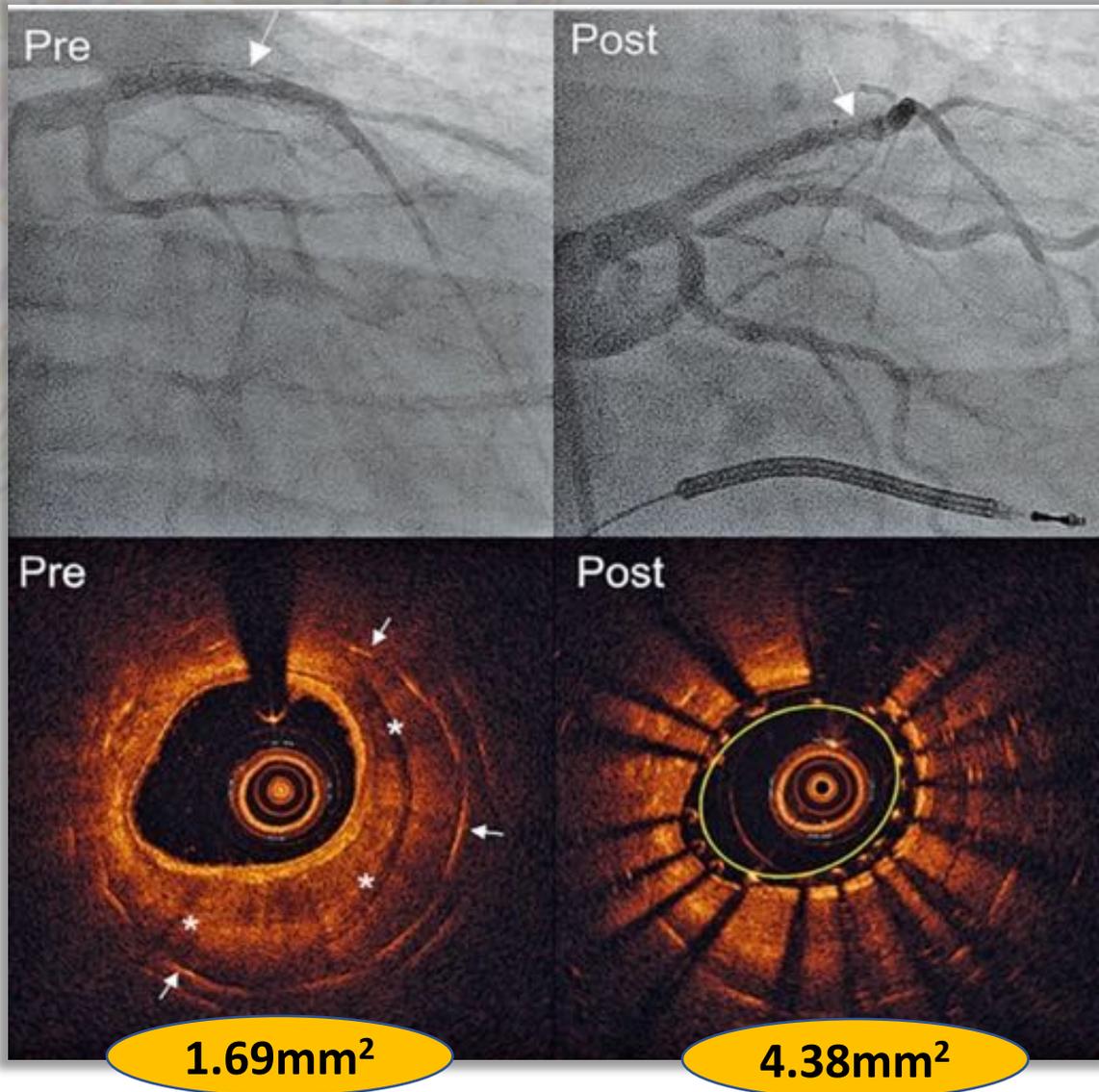
OCT et Resténose intrastent

In-stent restenosis characteristics and repeat stenting underexpansion: insights from optical coherence tomography

		New stent underexpansion		p-value
		Yes (n=33)	No (n=110)	
Restenotic stent type	Bare metal stent	5 (15.2)	13 (11.8)	0.88
	First-generation drug-eluting stent	10 (30.3)	34 (30.9)	
	Second-generation drug-eluting stent	18 (54.5)	63 (57.3)	
Predilatation		28 (84.8)	87 (79.1)	0.62
Non-compliant balloon		8 (24.2)	17 (15.5)	0.24
Scoring balloon		14 (42.4)	45 (40.9)	0.88
Maximum predilatation pressure, atm		15 (12-19)	14 (12-18)	0.70
Mean new stent diameter, mm		2.75 (2.50-3.00)	3.00 (2.75-3.50)	0.001
Total new stent length, mm		23.0 (16.5-38.0)	22.0 (15.0-33.0)	0.64
Maximum post-dilation balloon diameter, mm		3.00 (2.75-3.38)	3.25 (3.00-3.50)	0.009
Maximum post-dilation pressure, atm		18 (14-20)	20 (16-20)	0.34
Balloon-to-artery ratio*		1.18 (1.04-1.42)	1.30 (1.09-1.44)	0.22

OCT et Resténose intrastent

In-stent restenosis characteristics and repeat stenting
underexpansion: insights from optical coherence tomography



OCT et Resténose intrastent

In-stent restenosis characteristics and repeat stenting underexpansion: insights from optical coherence tomography

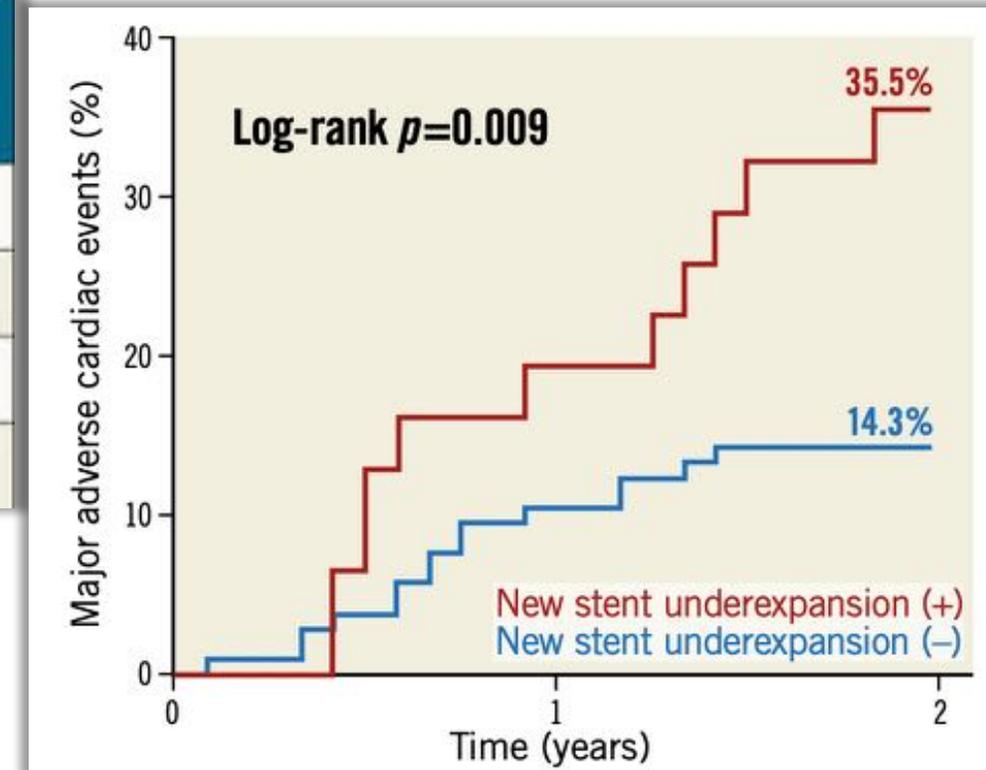
	New stent underexpansion		p-value
	Yes (n=33)	No (n=110)	
Pre-percutaneous coronary intervention			
Old stent expansion, %	74.0 (56.1-105.3)	101.0 (82.3-120.6)	0.001
Old stent underexpansion	13 (39.4)	5 (4.5)	<0.001
Minimum lumen CSA, mm ²	1.62 (1.27-2.13)	1.81 (1.35-2.26)	0.21
NIH area, mm ²	2.49 (1.40-3.56)	3.37 (2.34-4.72)	0.003
Max NIH, %	62.9 (41.9-74.0)	66.1 (56.2-75.3)	0.12
Double layers of old stent	17 (51.5)	12 (10.9)	<0.001
Calcium length, mm	6.3 (2.4-9.8)	3.0 (1.9-4.7)	0.01
Calcium in NIH	11 (33.3)	21 (19.1)	0.09
Maximum calcium angle, °	311 (196-360)	129 (102-194)	0.009
Maximum calcium thickness, mm	0.72 (0.50-0.94)	0.47 (0.39-0.66)	0.01
Final			
New stent MSA, mm ²	3.07 (2.41-3.55)	4.86 (4.10-6.04)	<0.001
New stent expansion, %	59.0 (52.4-64.9)	89.6 (80.0-100.1)	<0.001

OCT et Resténose intrastent

In-stent restenosis characteristics and repeat stenting
underexpansion: insights from optical coherence tomography

Suivi à 2 ans

	New stent underexpansion		p-value
	Yes (n=33)	No (n=110)	
Major adverse cardiac events*	35.5% (11)	14.3% (14)	0.009
Death	3.3% (1)	1.0% (1)	0.36
Myocardial infarction	9.7% (3)	1.9% (2)	0.046
Target vessel revascularisation	32.4% (10)	13.3% (14)	0.01



Coronarographie



Traitement médical
Aspirine-Clopidogrel
Contrôle coronarographique

OCT et Resténose intrastent

Restenosis		
DES are recommended for the treatment of in-stent restenosis of BMS or DES. ^{373,375,378,379}	I	A
Drug-coated balloons are recommended for the treatment of in-stent restenosis of BMS or DES. ^{373,375,378,379}	I	A
In patients with recurrent episodes of diffuse in-stent restenosis, CABG should be considered by the Heart Team over a new PCI attempt.	IIa	C
IVUS and/or OCT should be considered to detect stent-related mechanical problems leading to restenosis.	IIa	C

Clinical use of intracoronary imaging. Part 1: guidance and optimization of coronary interventions. An expert consensus document of the European Association of Percutaneous Cardiovascular Interventions

Endorsed by the Chinese Society of Cardiology

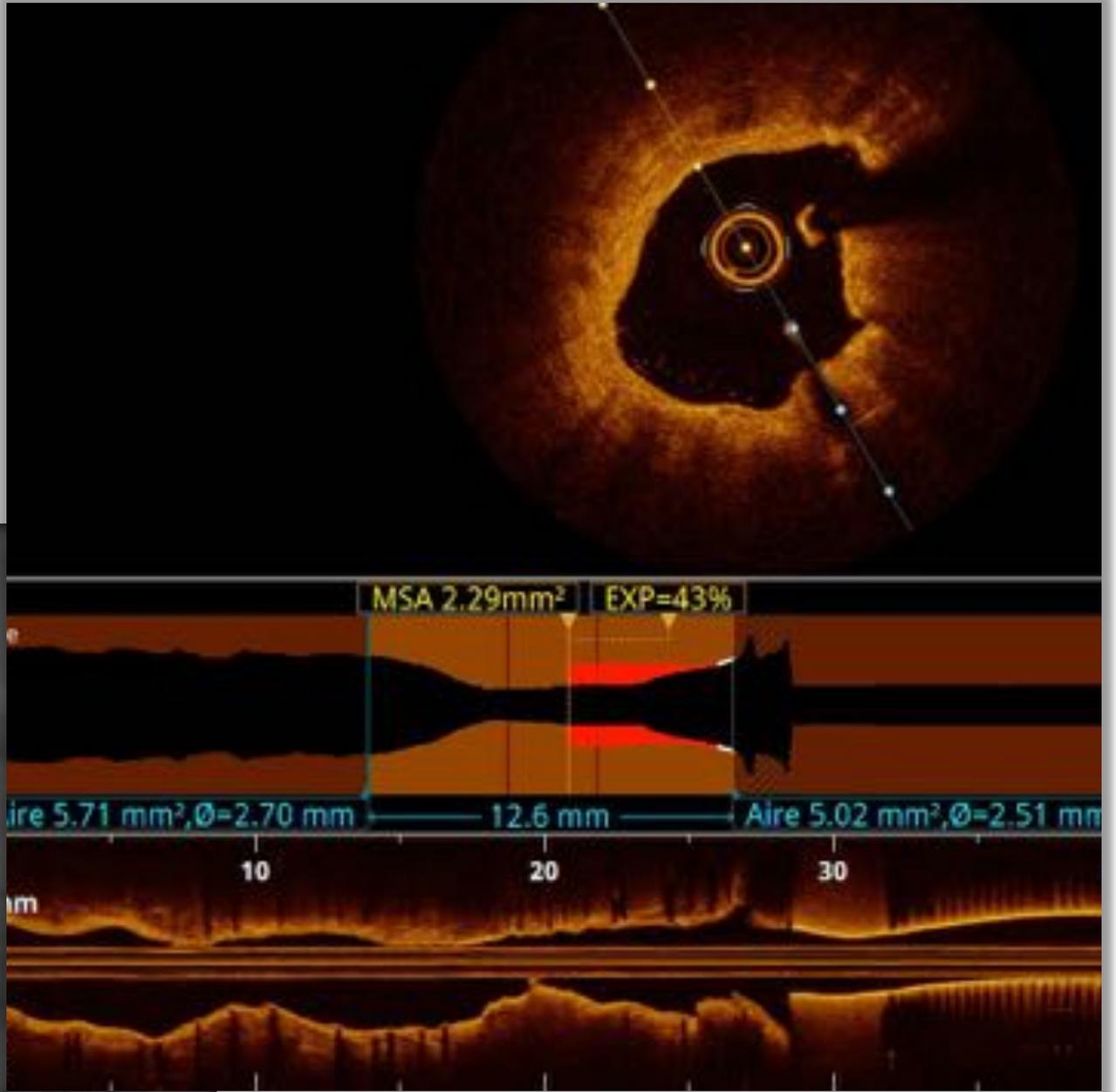
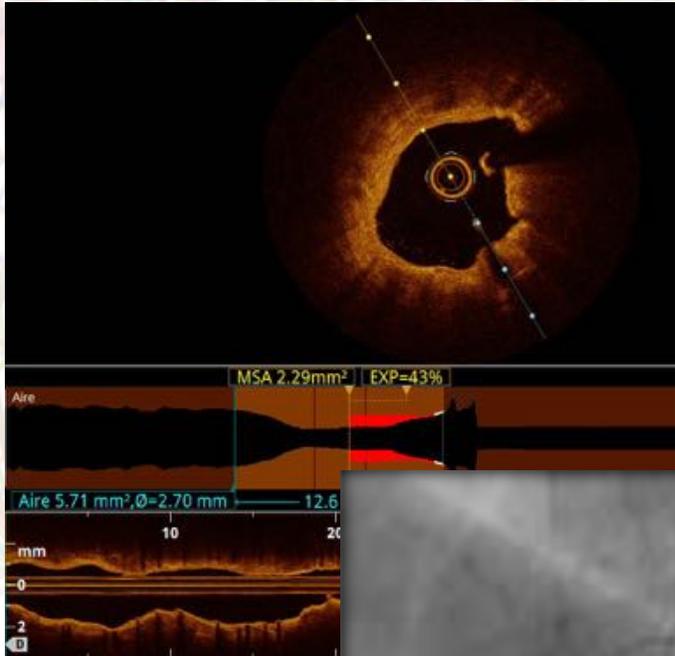
Lorenz Räber¹, Gary S. Mintz², Konstantinos C. Koskinas¹, Thomas W. Johnson³, Niels R. Holm⁴, Yoshinubo Onuma⁵, Maria D. Radu⁶, Michael Joner^{7,8}, Bo Yu⁹, Haibo Jia⁹, Nicolas Menevau^{10,11}, Jose M. de la Torre Hernandez¹², Javier Escaned¹³, Jonathan Hill¹⁴, Francesco Prati¹⁵, Antonio Colombo¹⁶, Carlo di Mario¹⁷, Evelyn Regar¹⁸, Davide Capodanno¹⁹, William Wijns²⁰, Robert A. Byrne²¹, and Giulio Guagliumi^{22*}

Coordinating editor: Prof Patrick W. Serruys, MD, PhD, Imperial College, London, UK

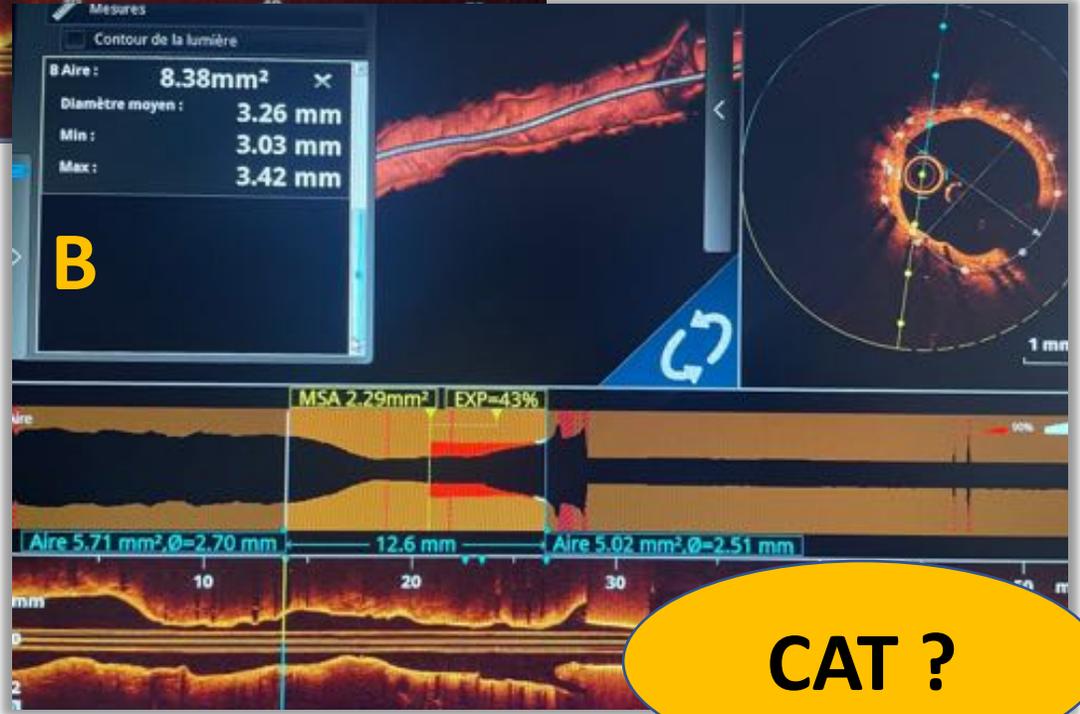
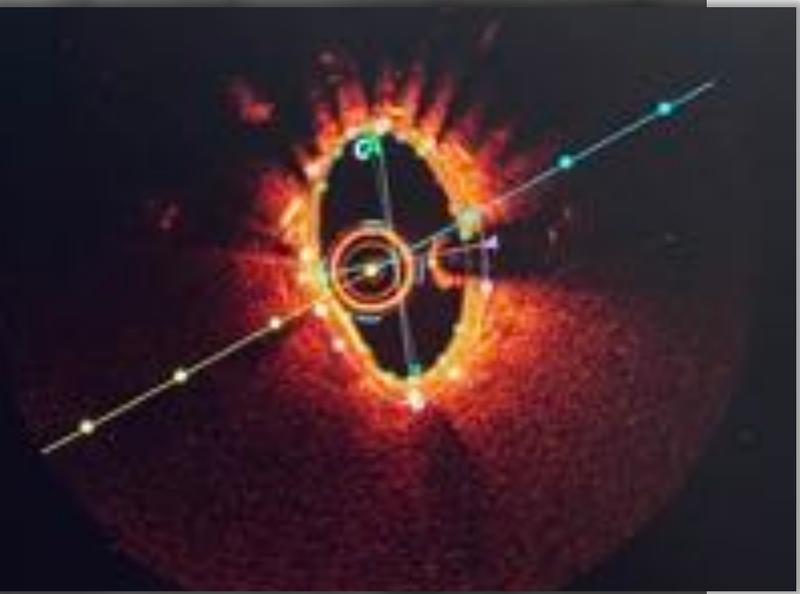
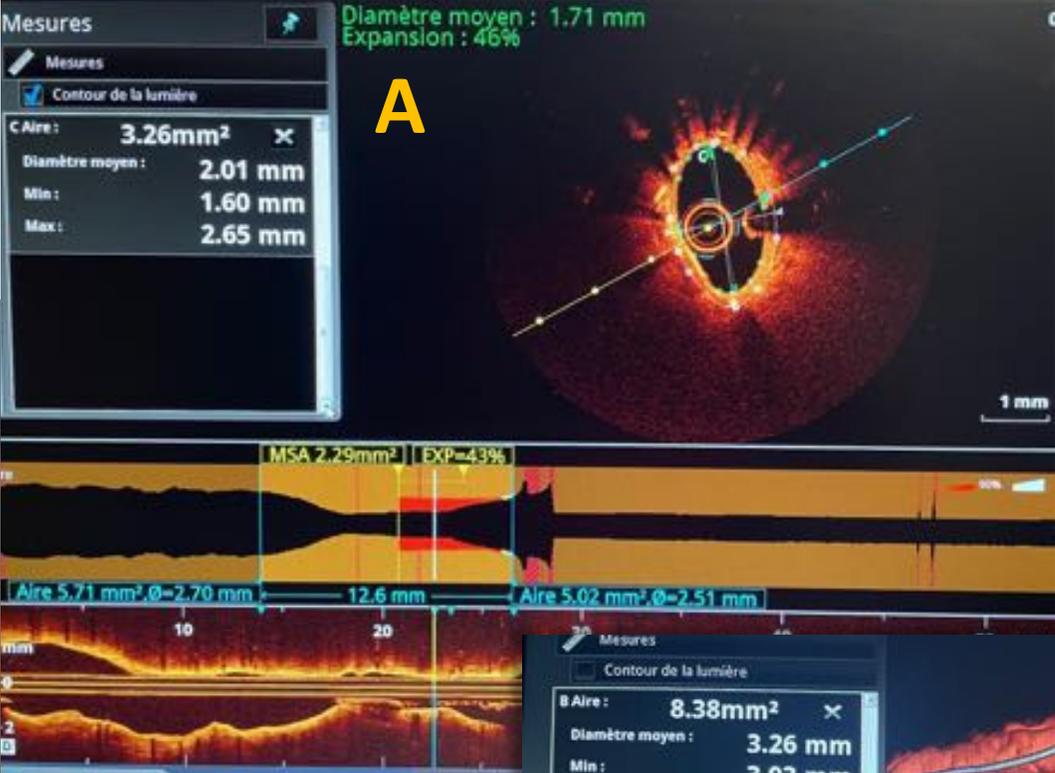
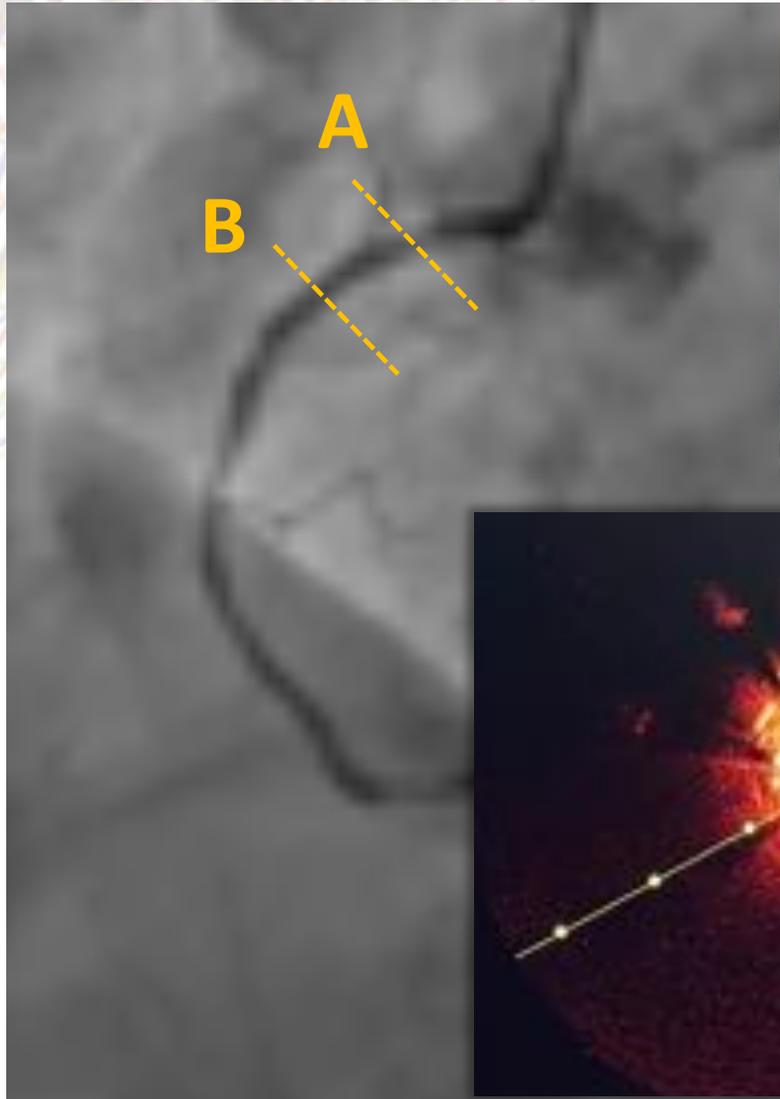
Document Reviewers: Fernando Alfonso, Ravinay Bhindi, Ziad Ali, and Rickey Carter

„Analysis of restenosis or stent thrombosis is **highly recommended**“
..mandatory in investigational Devices.“

OCT



Coronarographie

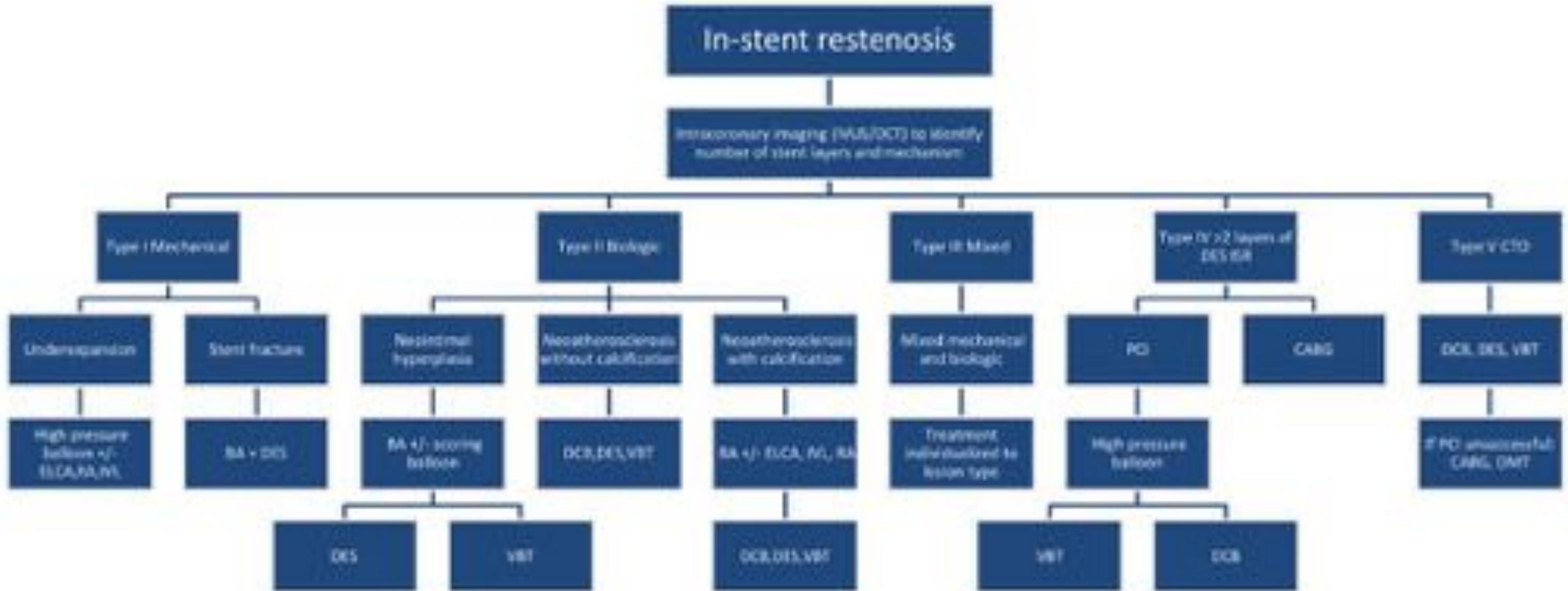


CAT ?

OCT et Resténose intrastent

Restenosis of Drug-Eluting Stents

A New Classification System Based on Disease Mechanism to Guide Treatment and State-of-the-Art Review



OCT et Resténose intrastent

Restenosis of Drug-Eluting Stents

A New Classification System Based on Disease Mechanism to Guide Treatment and State-of-the-Art Review

Management

Type	Definition	Treatment Options	
I	Mechanical	Underexpansion (Type I A)	High-pressure balloon
		Stent fracture (Type I B)	DES
II	Biologic	Intimal hyperplasia (Type II A)	Balloon, DCB, DES, and VBT
		Neointimal hyperplasia, noncalcified (Type II B)	DCB and DES
		Neointimal hyperplasia, calcified (Type II C)	Scoring balloon, ELCA, and RA
III	Mixed pattern: Combined mechanical and biologic etiology	High-pressure balloon with DCB, DES, or VBT	
IV	Chronic total occlusion	DCB or DES, VBT for multiple layers, CABG as needed	
V	>2 layers of stent	Balloon, DCB, VBT, and CABG	

Figure 3. Proposed treatment algorithm for in-stent restenosis.

BA indicates balloon angioplasty; CABG, coronary artery bypass graft; CTO, chronic total occlusion; DCB, drug-coated balloon; DES, drug-eluting stent; ELCA: excimer laser coronary atherectomy; ISR, in-stent restenosis; IVL, intravascular lithotripsy; IVUS, intravascular ultrasound; OCT, optical coherence tomography; OMT, optimal medical therapy; PCI, percutaneous coronary intervention; RA, rotational atherectomy; and VBT, vascular brachytherapy.

OCT et Resténose intrastent

Restenosis of Drug-Eluting Stents

A New Classification System Based on Disease Mechanism to Guide Treatment and State-of-the-Art Review

Management

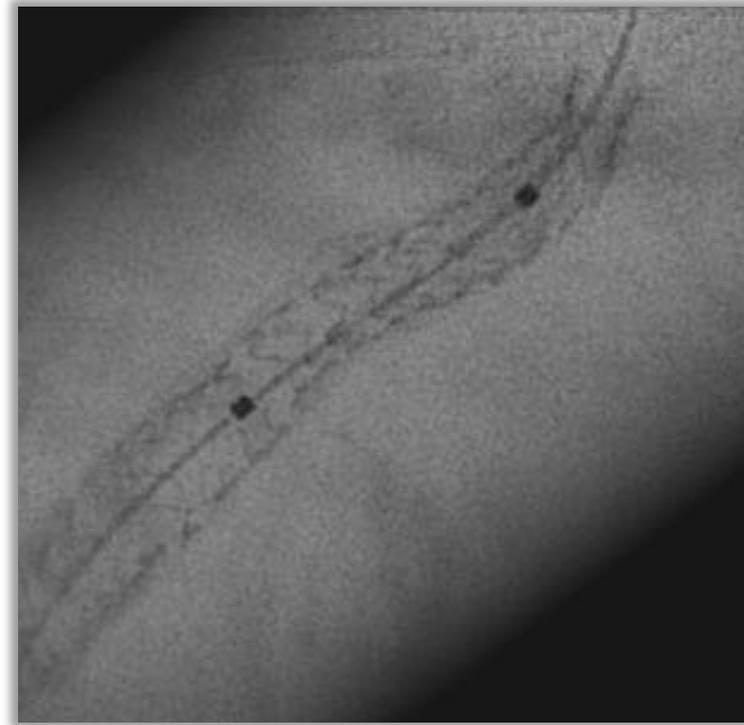
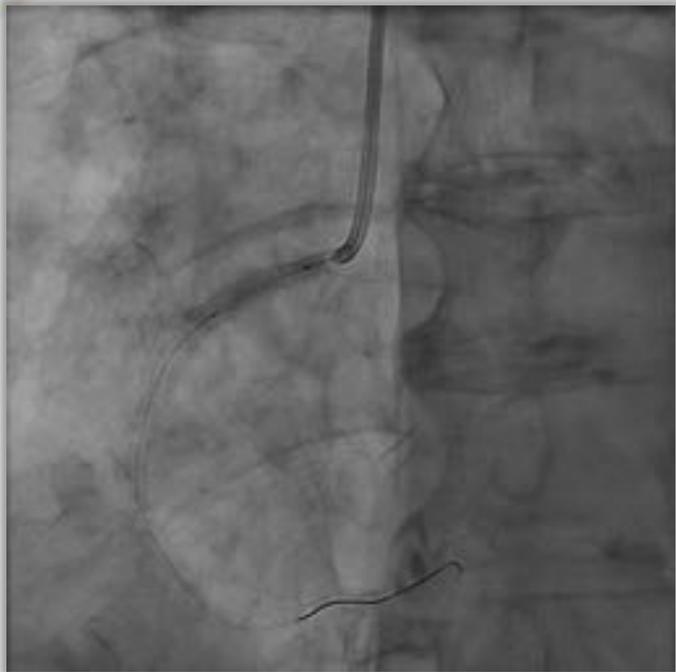
Type	Definition		Treatment Options
I	Mechanical	Underexpansion (Type I A)	High-pressure balloon IVL?
		Stent fracture (Type I B)	DES
II	Biologic	Intimal hyperplasia (Type II A)	Balloon, DCB, DES, and VBT ?
		Neointimal hyperplasia, noncalcified (Type II B)	DCB and DES ?
		Neointimal hyperplasia, calcified (Type II C)	Scoring balloon, ELCA, and RA
III	Mixed pattern: Combined mechanical and biologic etiology		High-pressure balloon with DCB, DES, or VBT
IV	Chronic total occlusion		DCB or DES, VBT for multiple layers, CABG as needed
V	>2 layers of stent		Balloon, DCB, VBT, and CABG ?

Figure 3. Proposed treatment algorithm for in-stent restenosis.

BA indicates balloon angioplasty; CABG, coronary artery bypass graft; CTO, chronic total occlusion; DCB, drug-coated balloon; DES, drug-eluting stent; ELCA: excimer laser coronary atherectomy; ISR, in-stent restenosis; IVL, intravascular lithotripsy; IVUS, intravascular ultrasound; OCT, optical coherence tomography; OMT, optimal medical therapy; PCI, percutaneous coronary intervention; RA, rotational atherectomy; and VBT, vascular brachytherapy.

Coronarographie

**Décision ballon
Schockwave[®] 3,5x12mm**



**Post dilatation au ballon
non compliant 3,5mm**

Coronarographie

Contrôle OCT post shockwave



Mesures

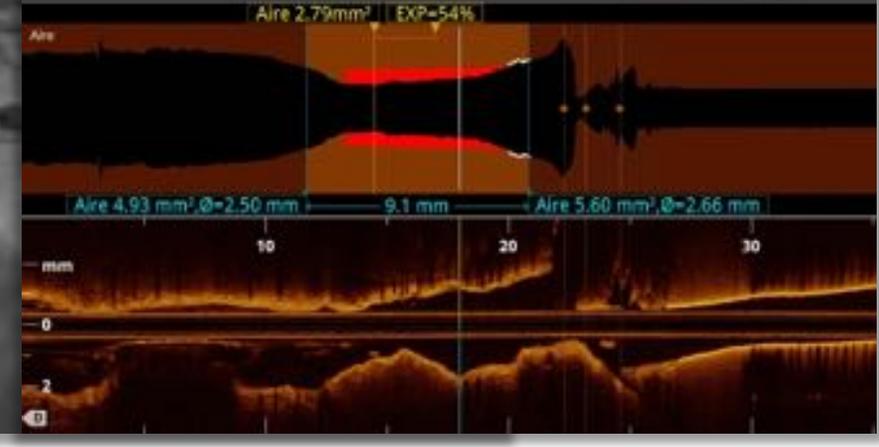
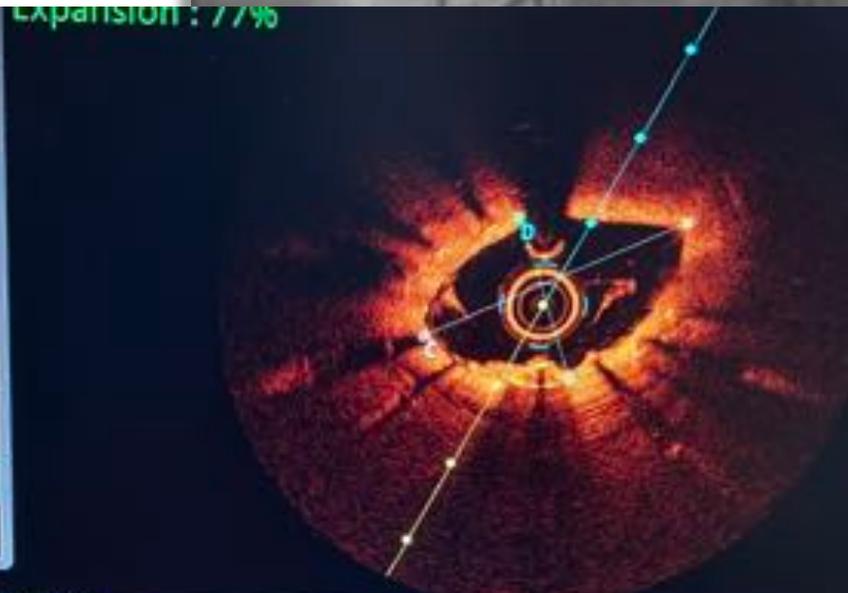
Contour de la lumière

Contour de la lumière :

Aire :	3.30mm ²
Diamètre moyen :	2.01 mm
Min :	1.55 mm
Max :	2.75 mm

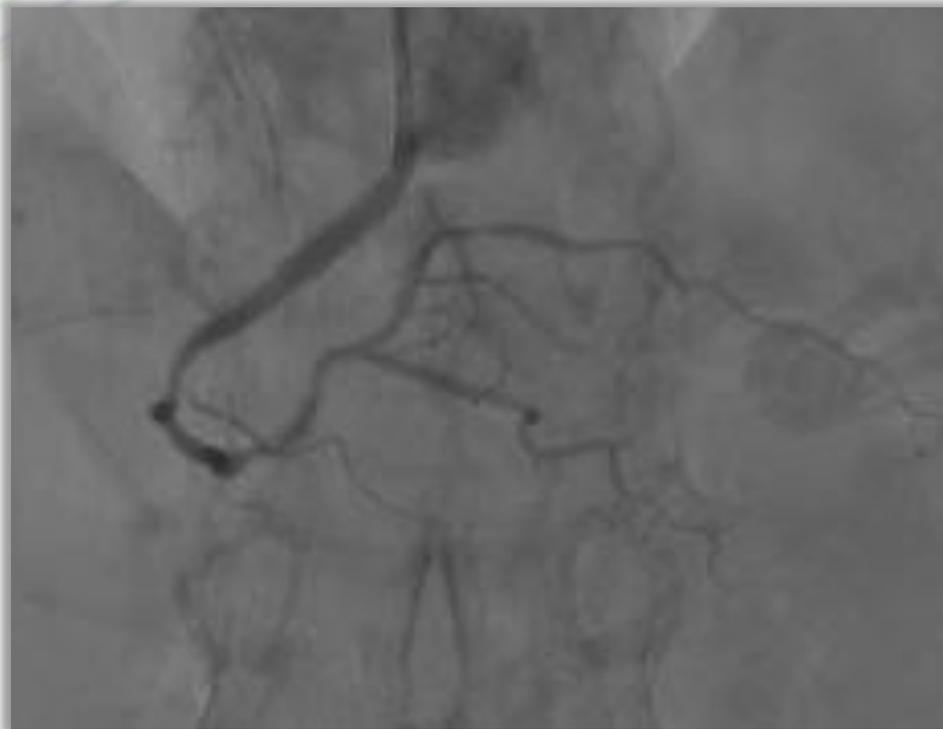
C Longueur : 3.01mm ✕

D Longueur : 1.86mm ✕

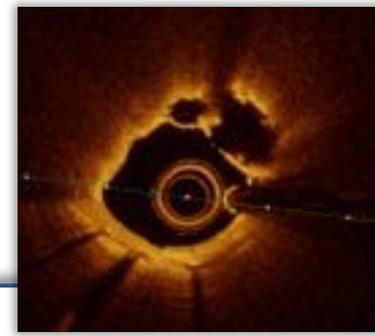


Coronarographie

**Décision dilatation au ballon
OPN de 3.5mm à 35 atm
Puis ballon actif 3,5mm**



CONCLUSIONS



- **Resténose intrastent = notre quotidien**
- **Apport de l'OCT dans la resténose intrastent**
 - **pour le diagnostic**
 - **critères de réussite d'angioplastie++**

REST-