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SUC

LI Jornadas SOLACI

16° Região do Cone Sul

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Montevideo, URUGUAY

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LESIONES CALCIFICADAS: ESCENARIO DESAFIANTE
Evaluación imagenológica: del diagnóstico a la planificación de PCI

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Ex staff de Hemodinamia y enfermedades vasculares periféricas Hospital Costantini. 1998- 2018. Curitiba. Brasil.

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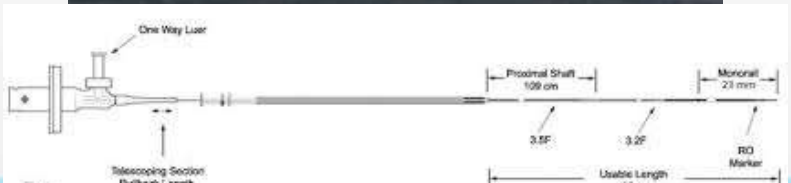
Miembro Titular de sociedades: FAC, CACI, SBC, SBHCI, SOLACI

Jornadas SOLACI
Montevideo, URUGUAY

CardioSUC 2025

Evaluación imagenológica: ANATÓMICOS

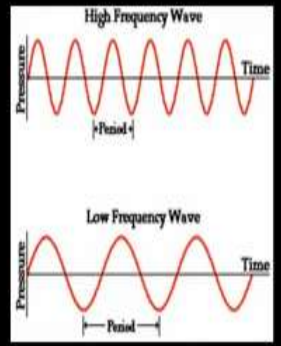
IVUS systems

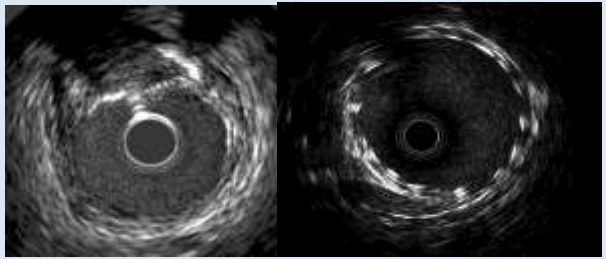


Impacto de la frecuencia del catéter en los parámetros de imagen

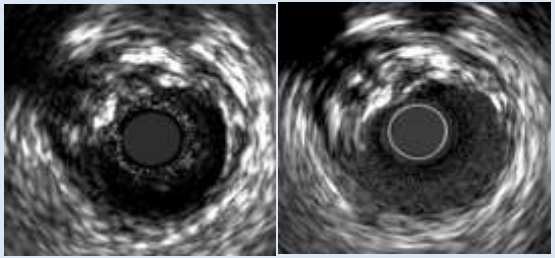
Ultrasound Frequency *Versus* Penetration and Resolution

- **Higher Frequency**
  - Shorter Wavelength
  - More Attenuation
  - Less Penetration
  - Better Axial and Lateral Resolution
- **Lower Frequency**
  - Longer Wavelength
  - Less Attenuation
  - Greater Penetration
  - Lower Axial Resolution



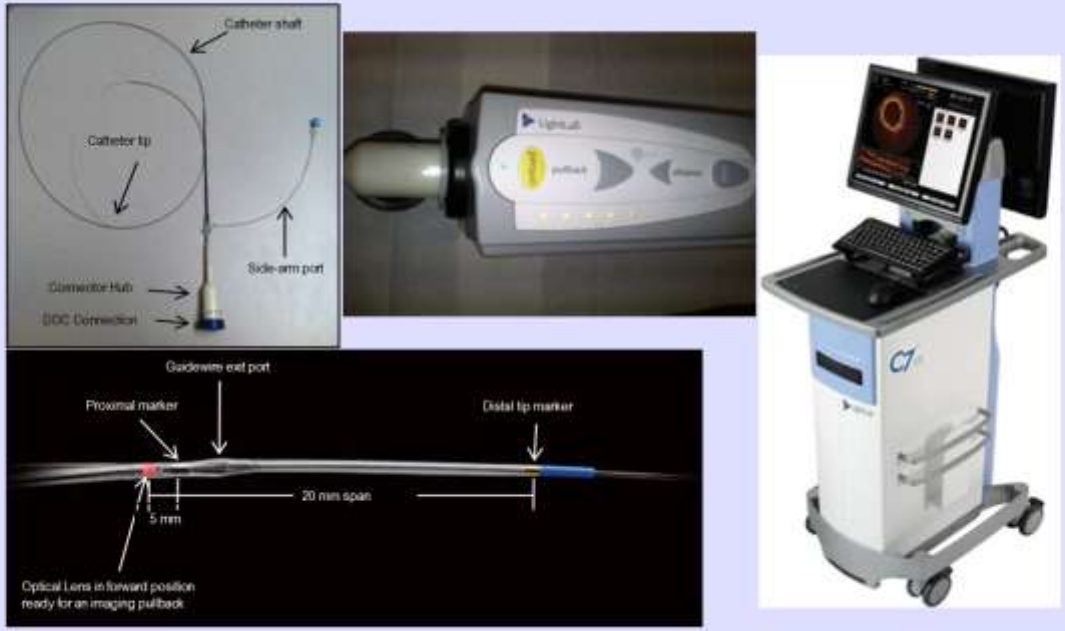


40Mhz **45Mhz**



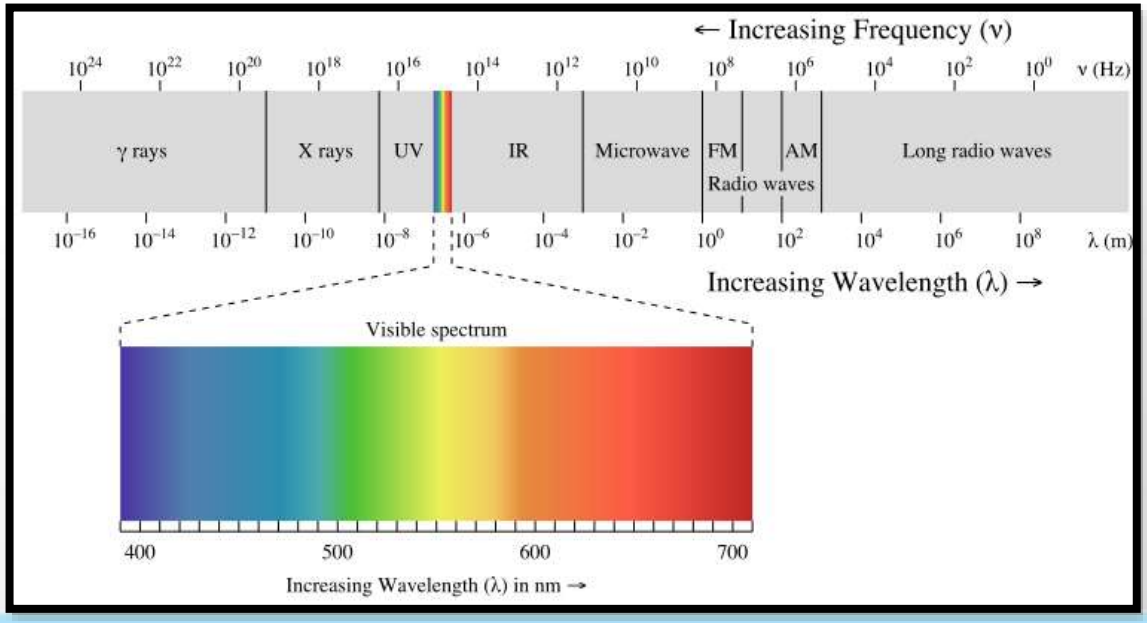
20 Mhz **30Mhz**

OCT system


Catheter shaft
Catheter tip
Side-arm port
Connector Hub
DOC Connection
Guidewire exit port
Proximal marker
Distal tip marker
20 mm span
5 mm
Optical Lens in forward position
ready for an imaging pullback

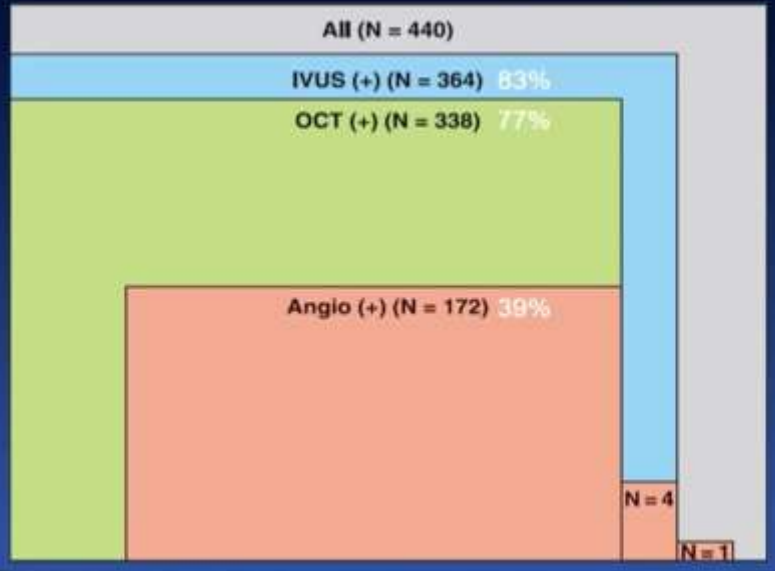
OCT: energy source

– electromagnetic spectrum–



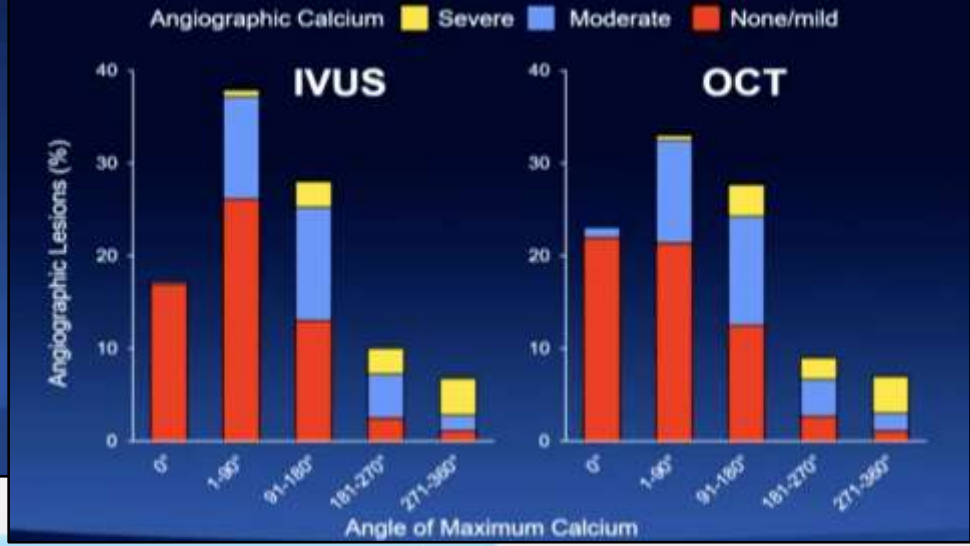
OCT uses infra red light (wave length ~1.300 nm)
[the lesser the wave length, the better the resolution]

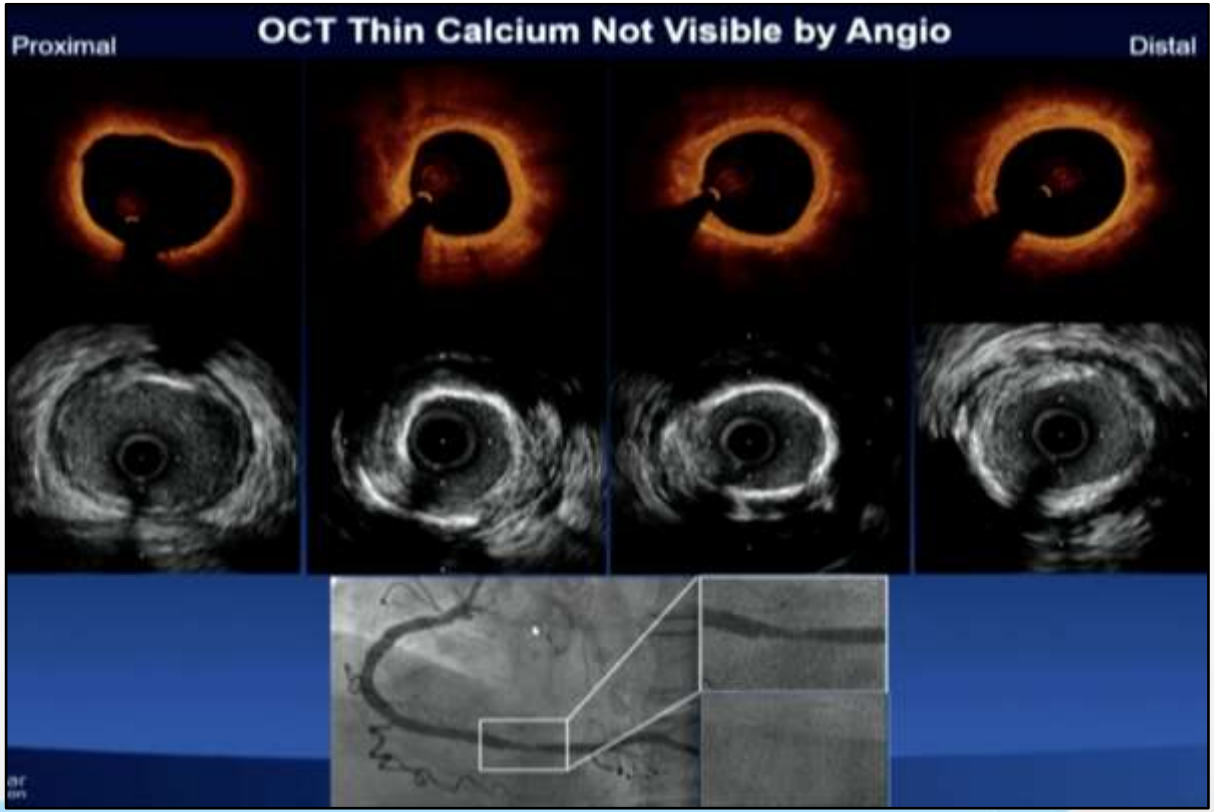
Prevalence of Calcium by Angio or IVI

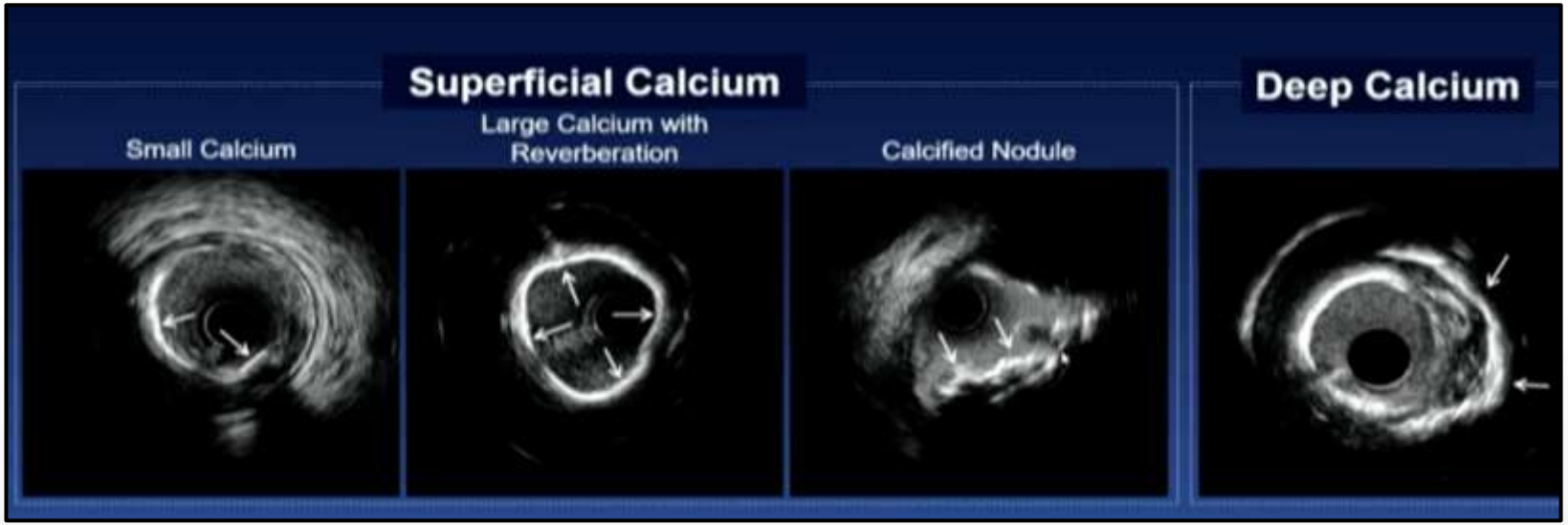


Wang X and Matsumura M, et al. JACC Img 2017;10: 869-79.

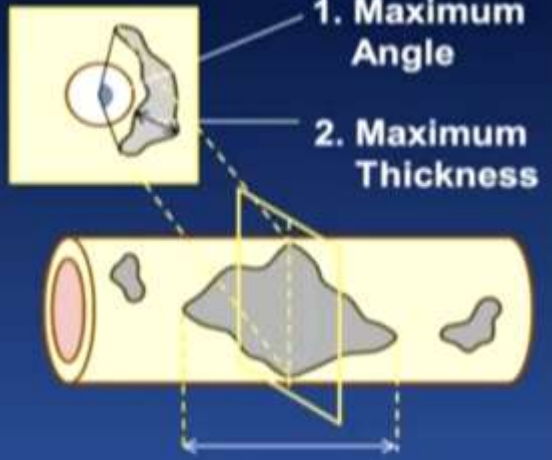
IVUS or OCT and Angiographic Calcium (n=440)




Proximal
OCT Thin Calcium Not Visible by Angio
Distal

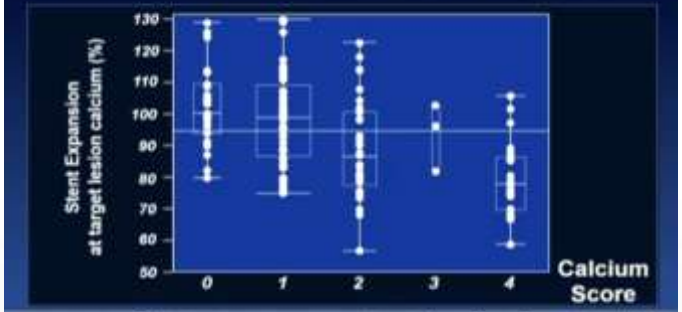

Superficial Calcium
Small Calcium
Large Calcium with Reverberation
Calcified Nodule
Deep Calcium

Calcium Scoring System



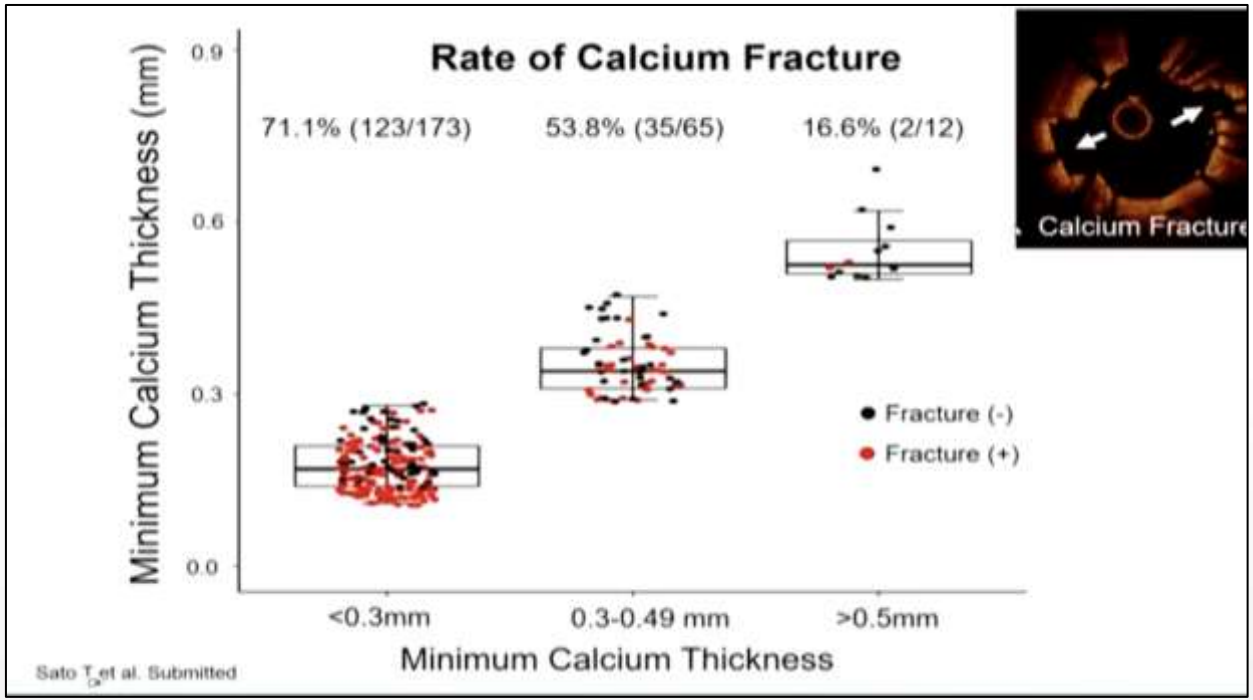
OCT-based CVI Score		
Angle	≤ 180°	➡ 0 point
	> 180°	➡ 2 points
Thick ness	≤ 0.5 mm	➡ 0 point
	> 0.5 mm	➡ 1 point
Length	≤ 5.0 mm	➡ 0 point
	> 5.0 mm	➡ 1 point
Total score: 0 to 4 points		

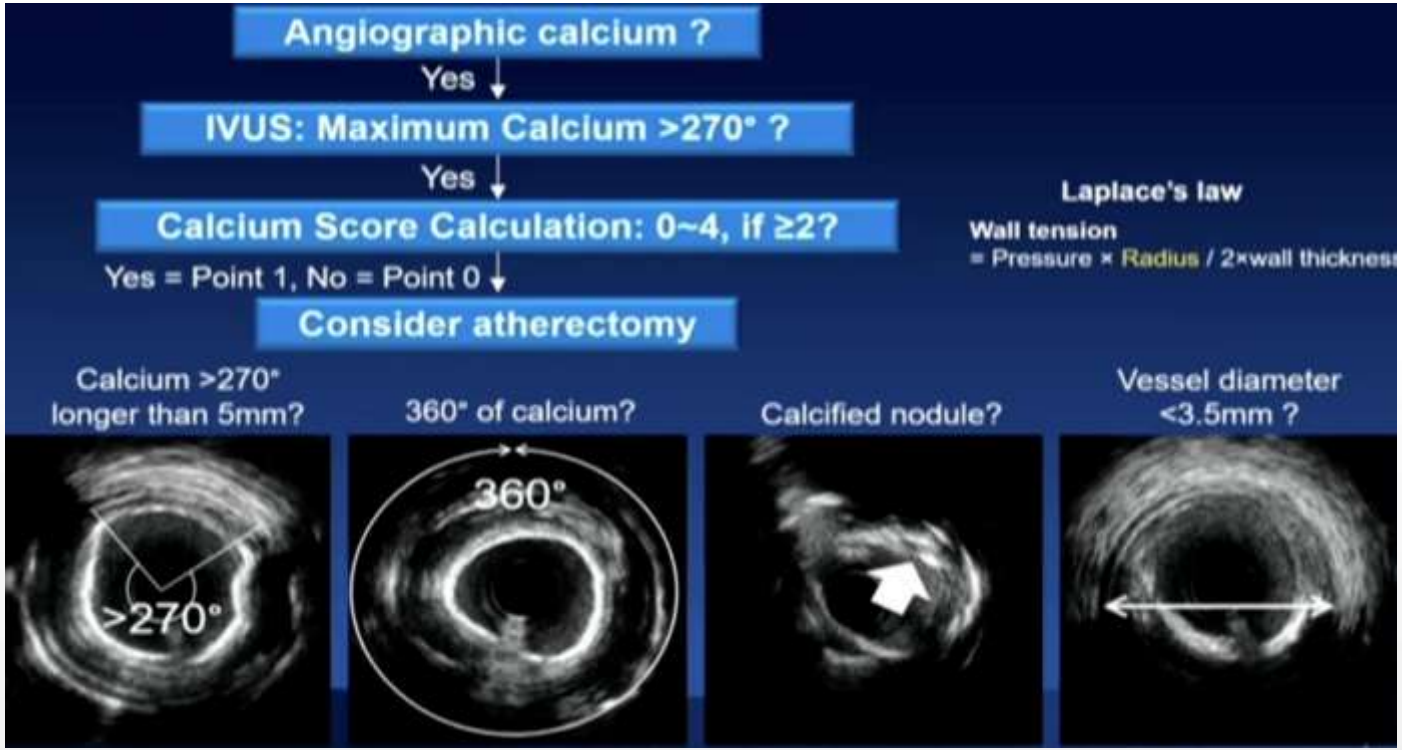
Calcium Score Predicts Stent Expansion

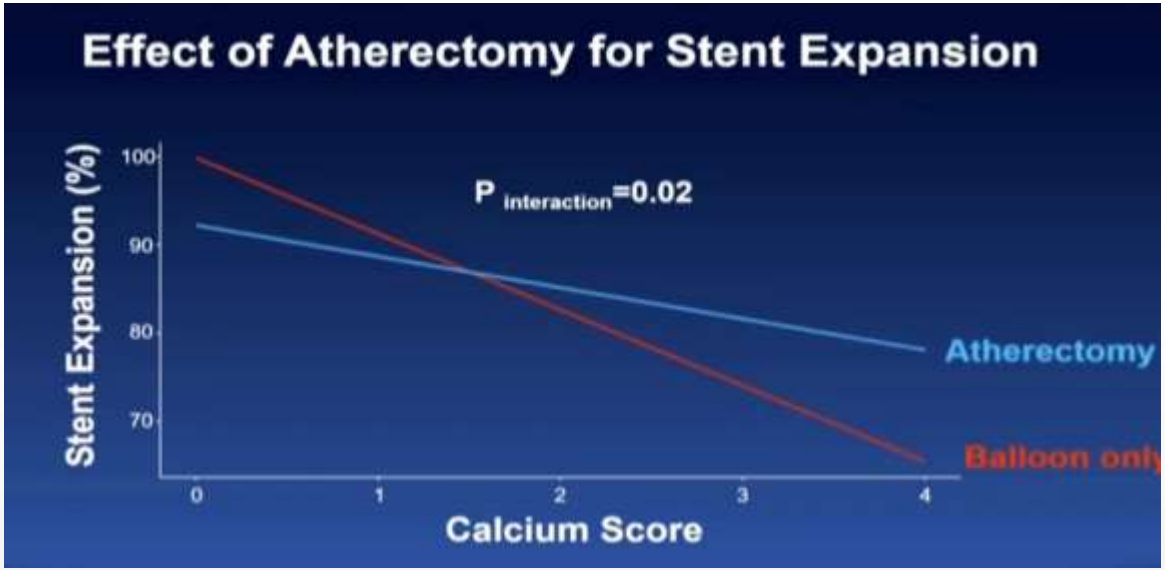


CVI score	0	1	2	3	4	p Value
Expansion at target lesion calcium, %	99	98	86	98	78	<0.01
Expansion at minimum stent area, %	91	85	80	82	69	<0.01

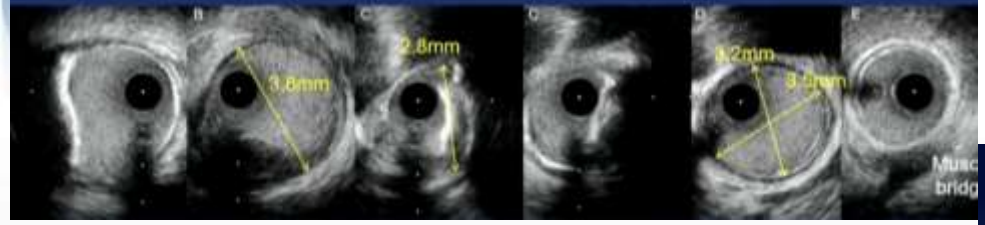
Fujino A et al. EuroIntervention. 2018;13:e2182-9.


Rate of Calcium Fracture
71.1% (123/173)
53.8% (35/65)
16.6% (2/12)
Minimum Calcium Thickness (mm)
0.9
0.6
0.3
0.0
Fracture (-)
Fracture (+)
<0.3mm
0.3-0.49 mm
>0.5mm
Minimum Calcium Thickness
Sato T, et al. Submitted
Calcium Fracture


Angiographic calcium ?
Yes
IVUS: Maximum Calcium >270° ?
Yes
Calcium Score Calculation: 0~4, if ≥2?
Yes = Point 1, No = Point 0
Consider atherectomy
Laplace's law
Wall tension
= Pressure × Radius / 2×wall thickness
Calcium >270° longer than 5mm?
360° of calcium?
Calcified nodule?
Vessel diameter <3.5mm ?
>270°
360°

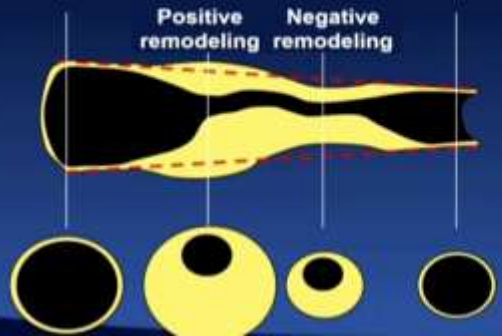

Effect of Atherectomy for Stent Expansion
Stent Expansion (%)
100
90
80
70
P interaction=0.02
Atherectomy
Balloon only
0
1
2
3
4
Calcium Score

Eccentric calcium with negative remodeling

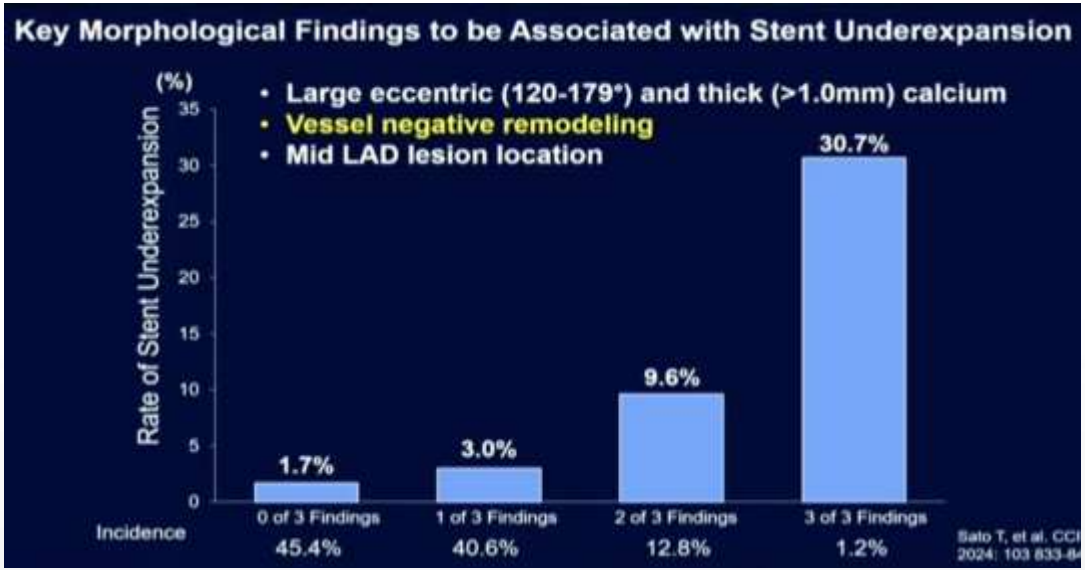


Vessel Remodeling by IVUS

Mintz GS, et al. Circulation 1997: 95, 1791-8.

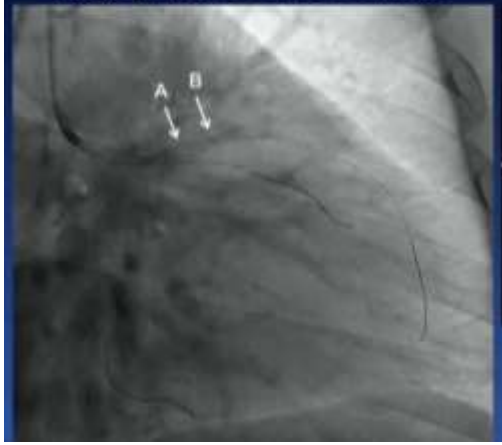


- Negative Remodeling 15%
- Predictor of negative remodeling: superficial calcium

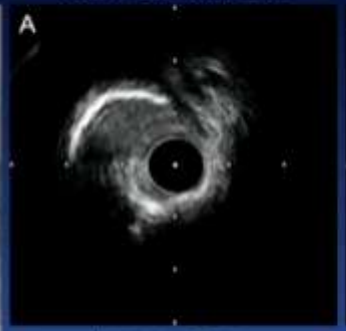

Key Morphological Findings to be Associated with Stent Underexpansion
(%)
Rate of Stent Underexpansion
35
30
25
20
15
10
5
0
• Large eccentric (120-179°) and thick (>1.0mm) calcium
• Vessel negative remodeling
• Mid LAD lesion location
1.7%
3.0%
9.6%
30.7%
Incidence
0 of 3 Findings
45.4%
1 of 3 Findings
40.6%
2 of 3 Findings
12.8%
3 of 3 Findings
1.2%
Sato T, et al. CCI
2024; 103 833-84

Pre IVUS

Angiographic Severe Calcium

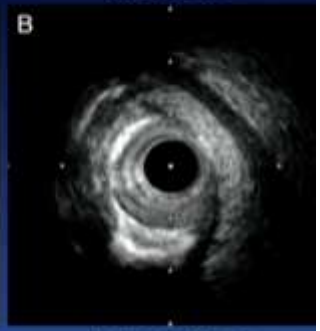


Max Calcium Site



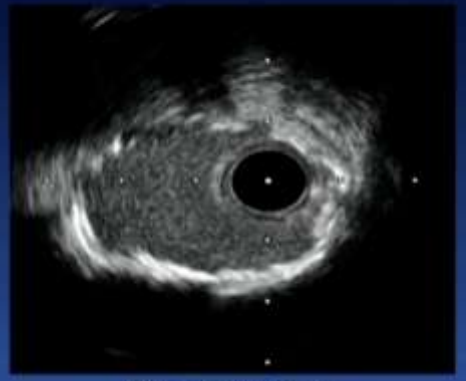
Lumen Area
3.6 mm²

MLA Site

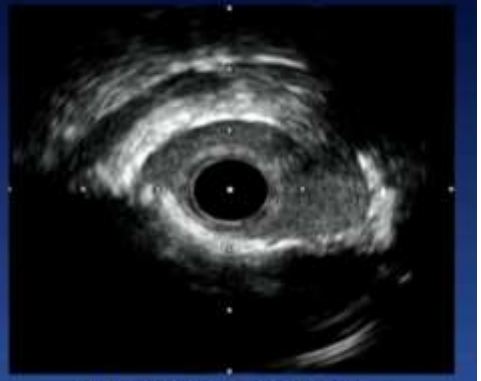


Lumen Area
2.9 mm²

Final IVUS

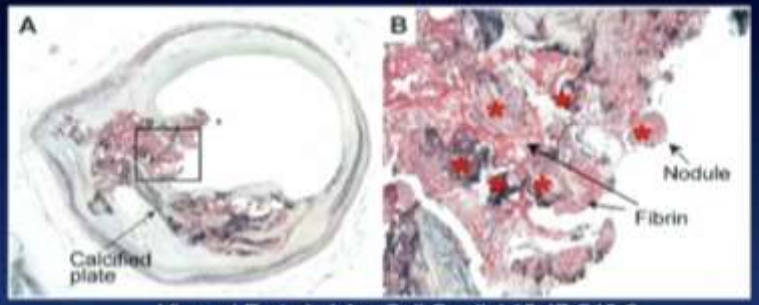


Max Calc Site
Stent Area: 6.3 mm²



Minimum Stent Area
4.6 mm²

Calcified Nodule

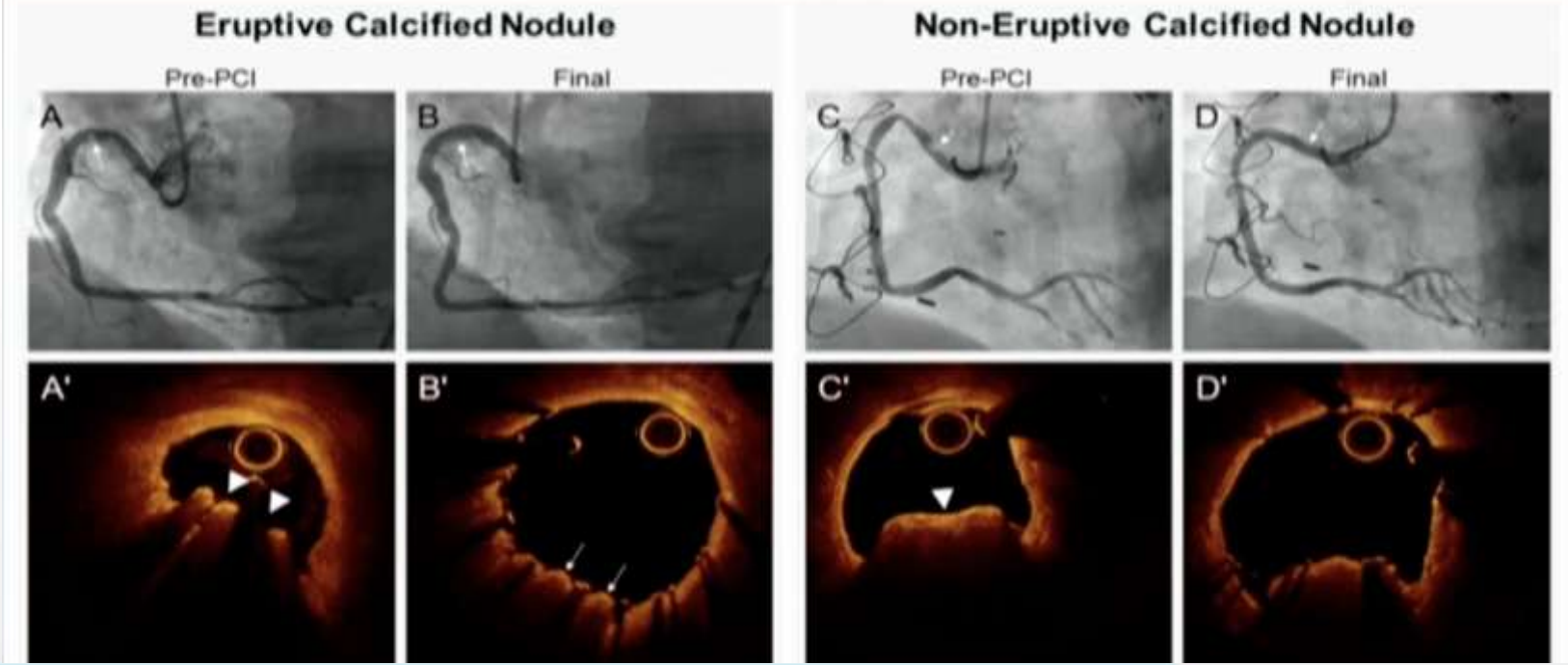


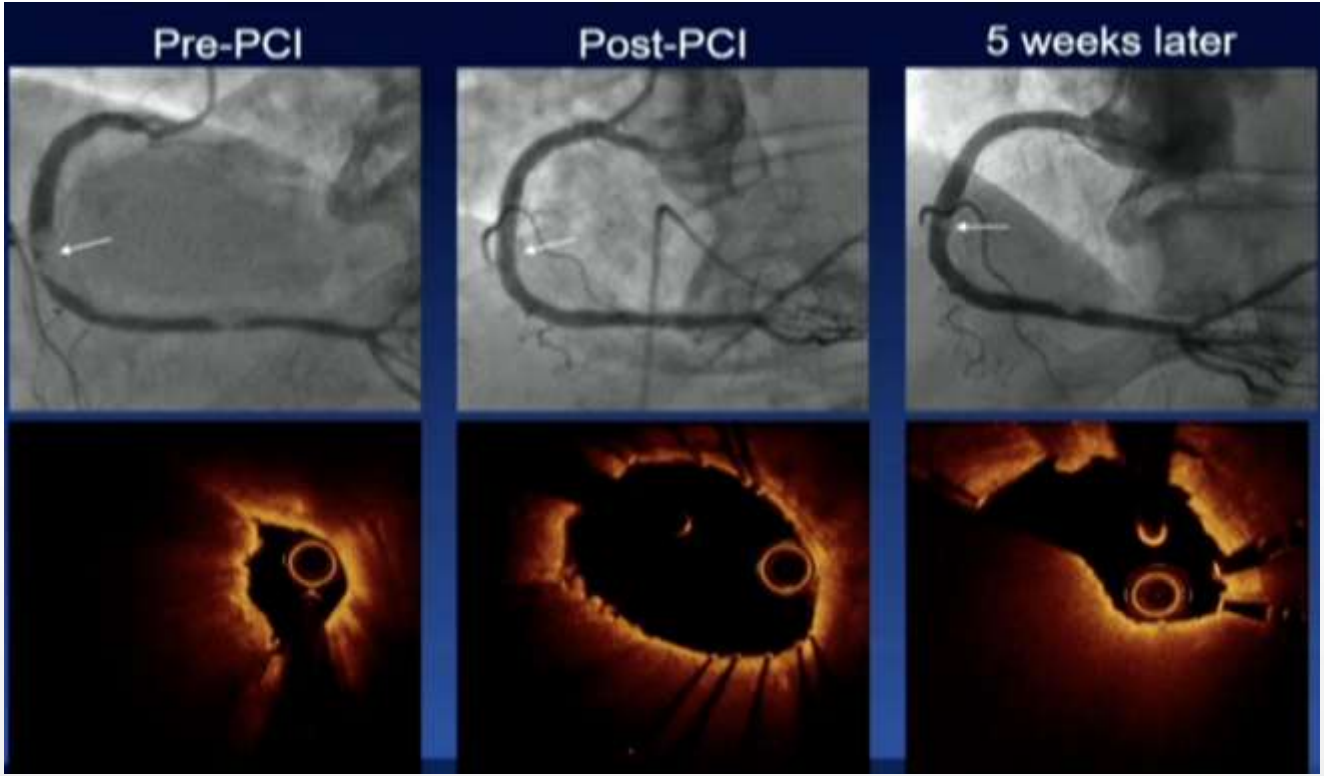
Virmani R et al. J Am Coll Cardiol 18;47:C13-8.

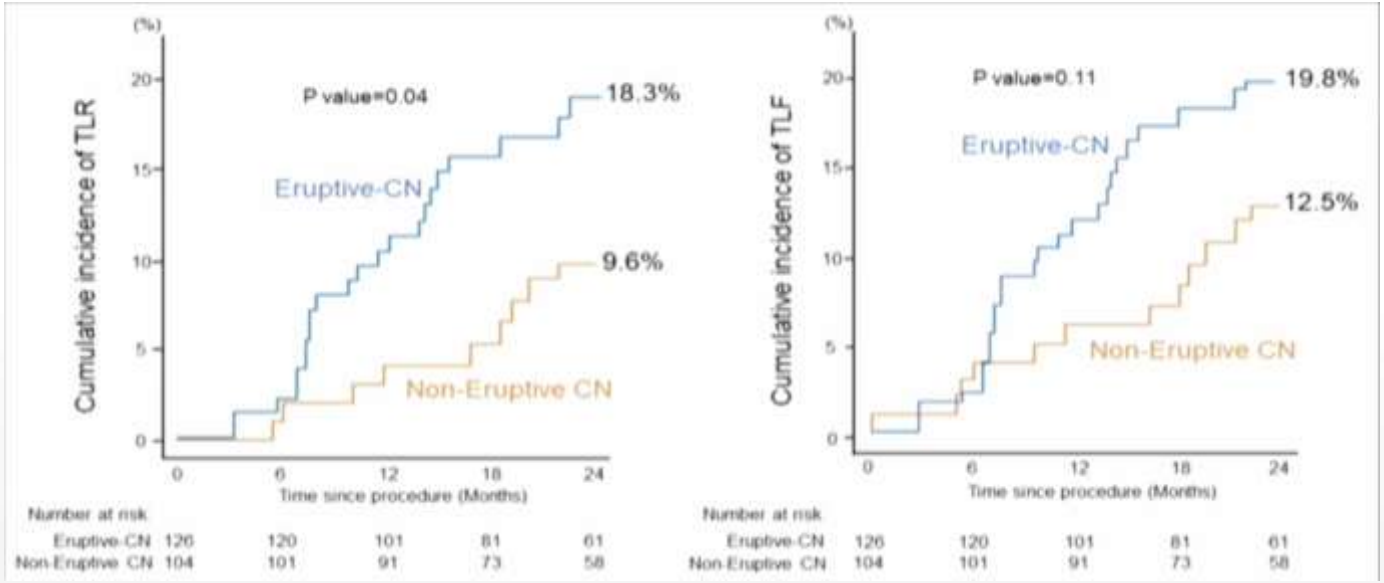
Clinical and Morphological Difference

	Calcified Nodule (n=37)	No Calcified Nodule (n=852)	P Value
Age, yrs	73 (65, 79)	66 (58, 73)	0.001
ACS presentation	45.9%	48.2%	0.79
DM	51.4%	33.3%	0.02
Hemodialysis	18.9%	2.6%	<0.001
Δ Angle in lesion	16 (14, 21)	9 (6, 14)	<0.001
OCT Max Ca angle, °	301 (247, 347)	64 (0, 123)	<0.001
Mean Ca angle, °	166 (134, 202)	48 (0, 81)	<0.001
Max Ca thickness, mm	1.18 (0.94, 1.3)	0.21 (0, 0.75)	<0.001

Eruptive vs Non-Eruptive CN

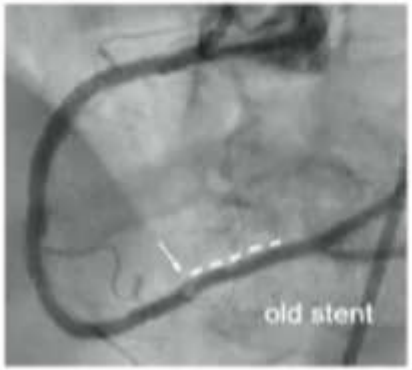


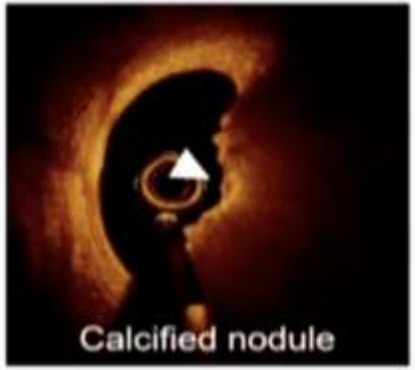

Pre-PCI
Post-PCI
5 weeks later

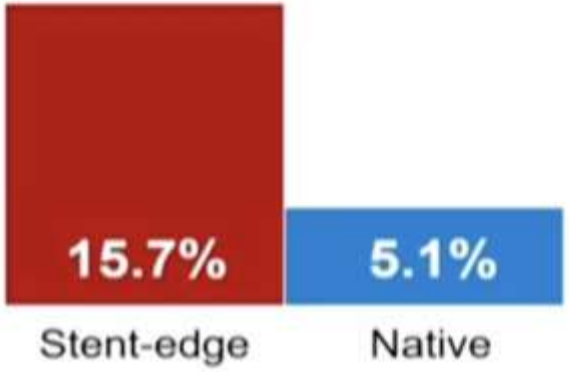

(%)
Cumulative incidence of TLR
P value=0.04
18.3%
Eruptive-CN
9.6%
Non-Eruptive CN
Time since procedure (Months)
Number at risk
Eruptive-CN 126 120 101 81 61
Non-Eruptive CN 104 101 91 73 58
(%)
Cumulative incidence of TLF
P value=0.11
19.8%
Eruptive-CN
12.5%
Non-Eruptive CN
Time since procedure (Months)
Number at risk
Eruptive-CN 126 120 101 81 61
Non-Eruptive CN 104 101 91 73 58

Calcified Nodule is more prevalent at Stent Edge

989 old stent edges calcified lesions in 801 pts vs
354 calcified lesions in 350 pts





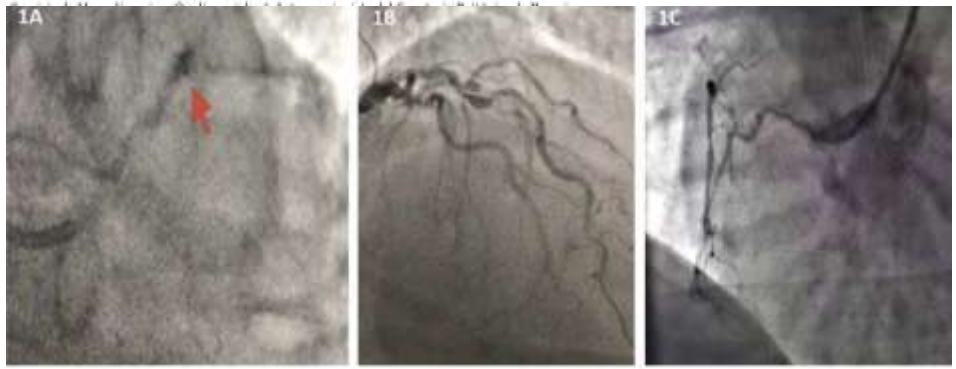


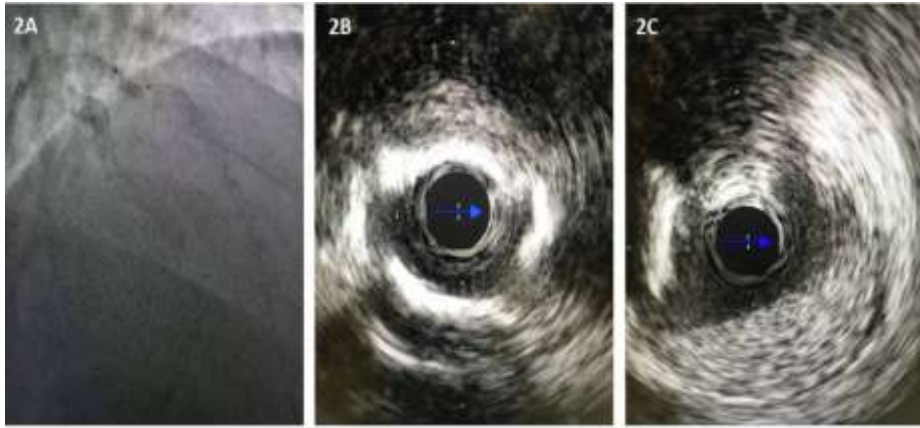
Caso Clínico

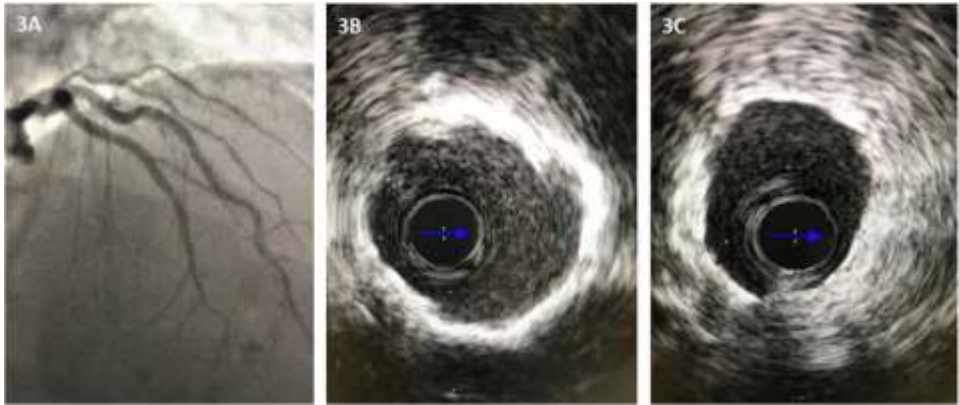
Angioplastia coronaria en lesiones severamente calcificadas facilitada por litotricia coronaria. Reporte de caso

Coronary angioplasty in severely calcified lesions facilitated by coronary lithotripsy. Case report

Tomas Cúneo, Cristian Calenta, Daniel Zanuttini.







1- Cantidad total de volumen de calcio (arco, longitud, grosor) predictor de la expansión del stent

2- El calcio excéntrico espeso junto con la remodelación negativa de los vasos también predice una expansión insuficiente del stent.

3- Un nódulo calcificado eruptivo (o activo) tiene un pronóstico desfavorable en comparación con un nódulo calcificado no eruptivo (curado).

4- El nódulo calcificado se desarrolla a partir de la placa calcificada y los bordes del stent.

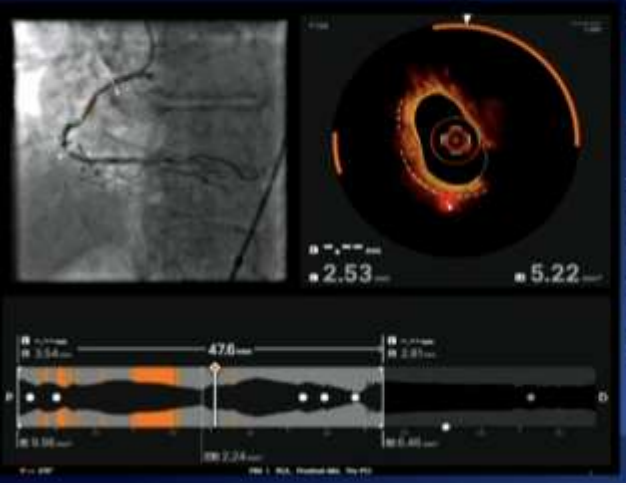
MUCHAS GRACIAS

- **Dr Daniel Aníbal Zanuttini**

- Director del Departamento de Cardiologia Intervencionista y Hemodinamia. ICSB.
  - Sanatorio Británico.
  - Rosario . Argentina

- danielzanuttini10@gmail.com

OCT Ultreon - Abbott Vascular -



Pre-PCI
- Calcium arc
- Maximum calcium thickness
- Calcium length
- EEL diameter
- Co-registration

Stent optimization
- Stent area
- Malapposition

Available soon
- VFR (OCT derived FFR)

Hope to have
- Dissection

NIRS- OCT - SpectraWave -

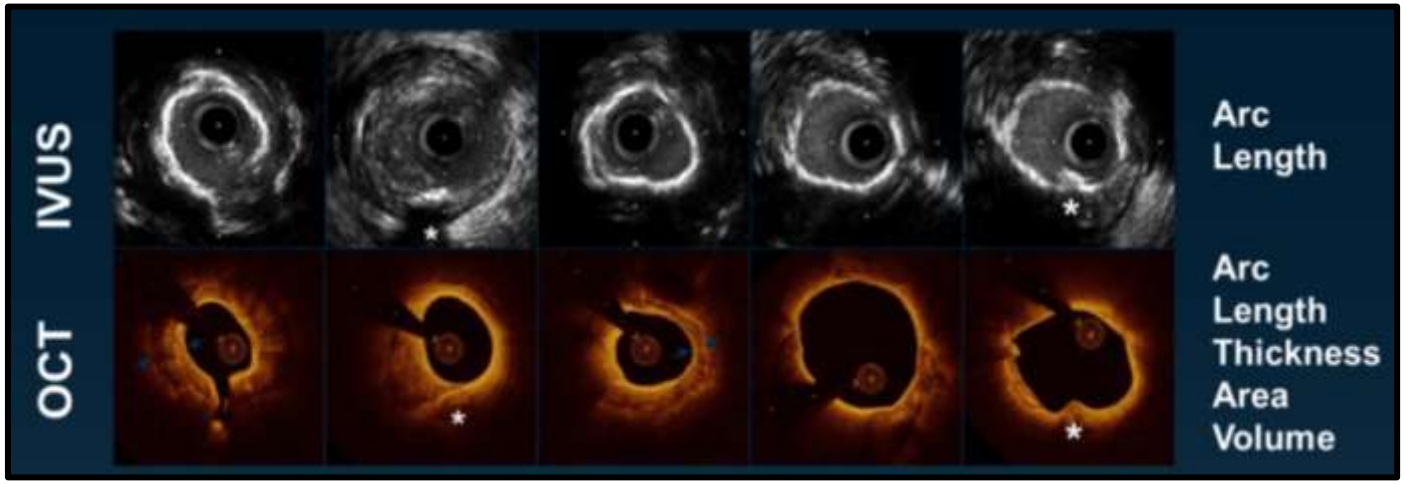
Pre-PCI
- Calcium arc
- Maximum calcium thickness
- Calcium length
- Lipid distribution (NIRS)
- EEL diameter
- Co-registration

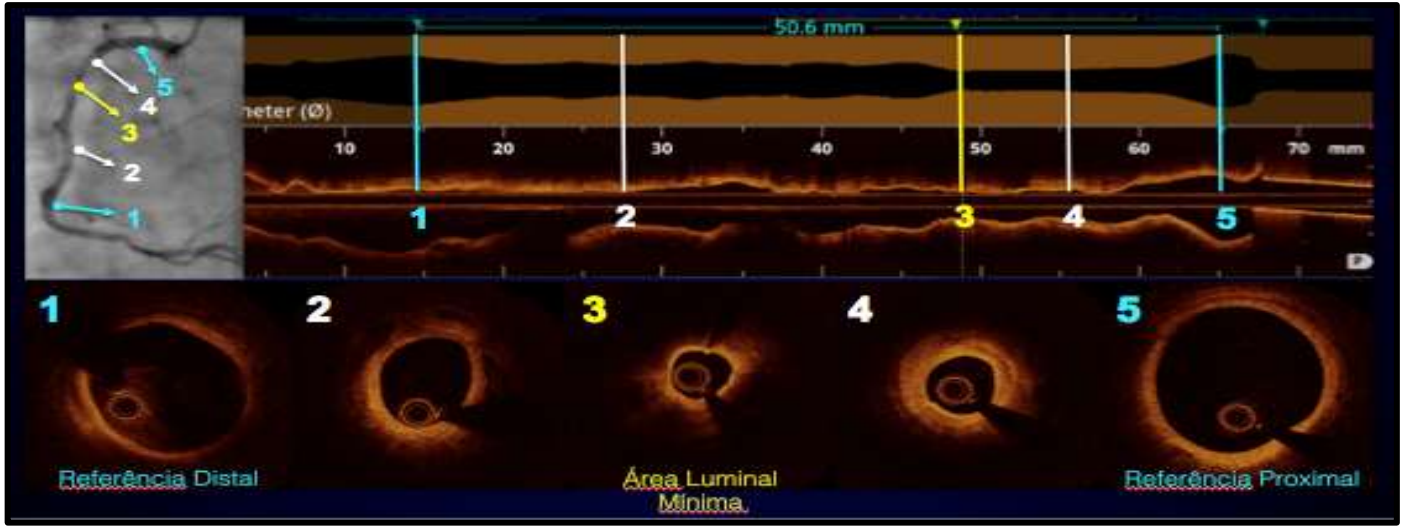
Stent optimization
- Minimum stent area
- Stent expansion

Coming soon
- Angio FFR using one view

Hope to have
- Dissection

Calcio


IVUS
OCT
Arc
Length
Arc
Length
Thickness
Area
Volume

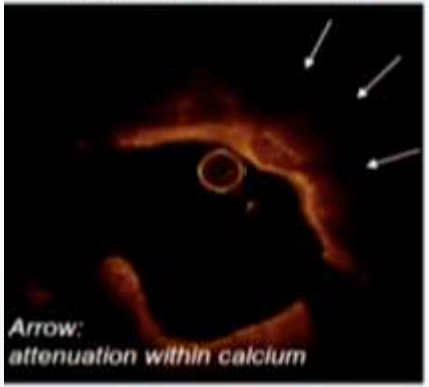

50.6 mm
10
20
30
40
50
60
70 mm
1
2
3
4
5
Referência Distal
Área Luminal
Mínima
Referência Proximal

Factors Associated with 2-Year TLF

	HR (95% CI)	p value
Eruptive CN vs noneruptive CN (reference)	2.07 (1.01, 4.50)	0.048
Circumference of CN, per mm	1.65 (1.01, 2.71)	0.047
Δ Angle in lesions, per 10°	2.43 (1.63, 3.63)	0.00001
Stent area at CN site, per mm^2	0.78 (0.63, 0.94)	0.009
Age, per 10 years	0.66 (0.42, 1.03)	0.07
Diabetes mellitus	1.40 (0.68, 2.89)	0.35
Chronic kidney disease	1.59 (0.65, 3.87)	0.30

Factors Associated with a New CN Development

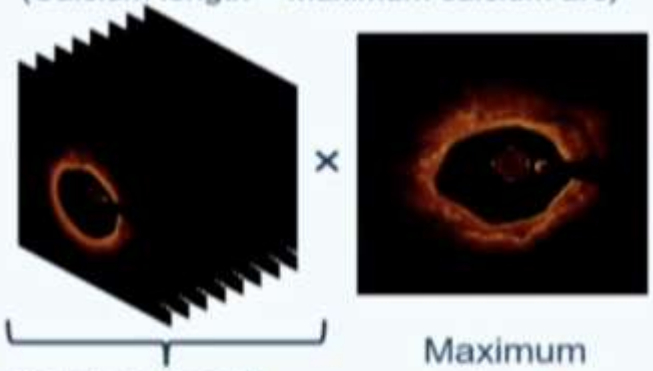
Calcium with attenuation



OR 3.13
(95%CI 1.04-9.41)

Calcium volume index

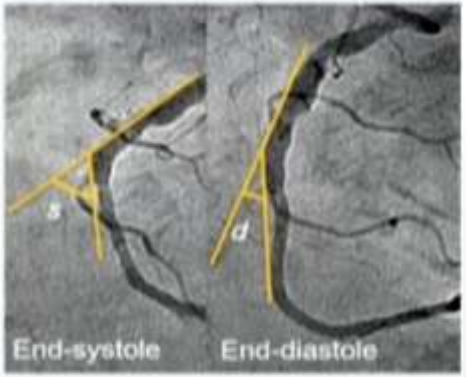
(Calcium length × Maximum calcium arc)



OR 3.35
(95%CI 1.22-9.23)

In-lesion Δangle, per10°

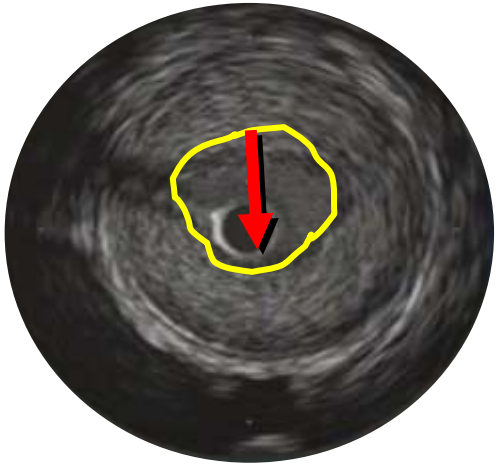
(Δangle = s-d)



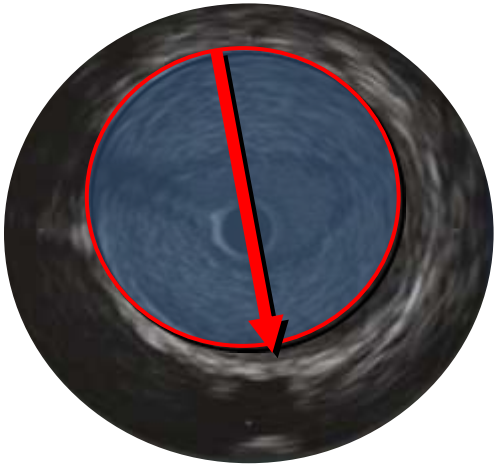
OR 2.32
(95%CI 1.26-4.27)

DIAGNÓSTICO

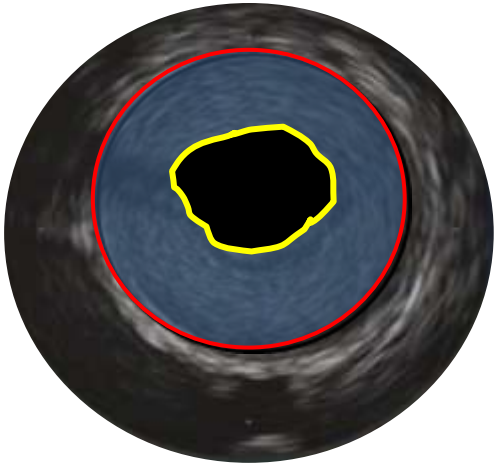
1) Evaluación de lesiones Intermedias (40-70%)



Área Luminal - mm²



Área Total do Vaso



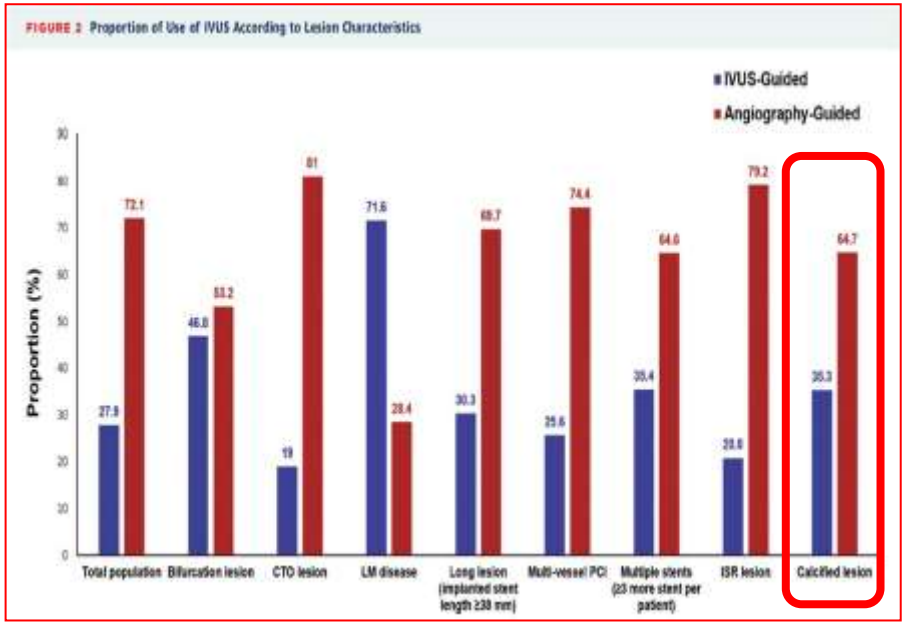
Área da Placa

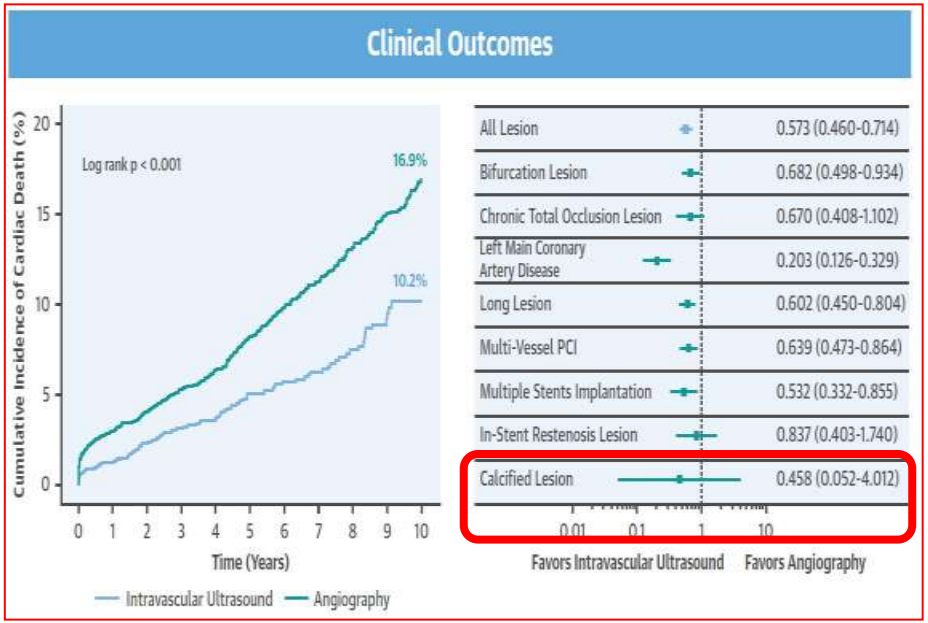
IMPACT OF IVUS- GUIDED PCI on Long-Term Clinical Outcomes in Patienets Undergoing Complex Procedures

2019

(IVUS-Guided - 1.674 Patients) vs (Angography-Guided - 4.331 Patients)

Follow up @ 10 years





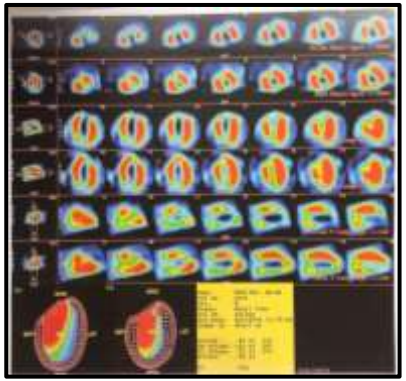
Ki Hong Choi; JACC Cardiovasc Interv. 2019 Apr 8;12(7):607-620

IVUS en lesión de bifurcación

Trabajo reciente de identificación de predictores por IVUS
de oclusión aguda de ramo lateral en lesiones de bifurcación, post implante de stent en ramo principal. Conclusión: el grosor de la placa de MV en el sitio de la unión y la relación del diámetro de SB son factores predictivos de oclusión aguda de SB justo después del cruce del stent único.

ETE 12/09/18
FEY 62%.

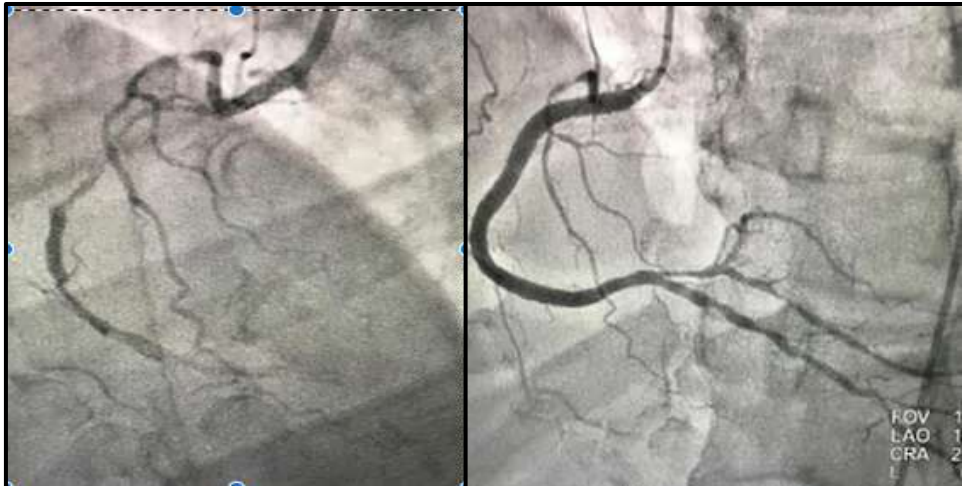
Insuficiencia mitral moderada a severa, mixomatosa.
Insuficiencia aortica leve.
Leve aumento AI

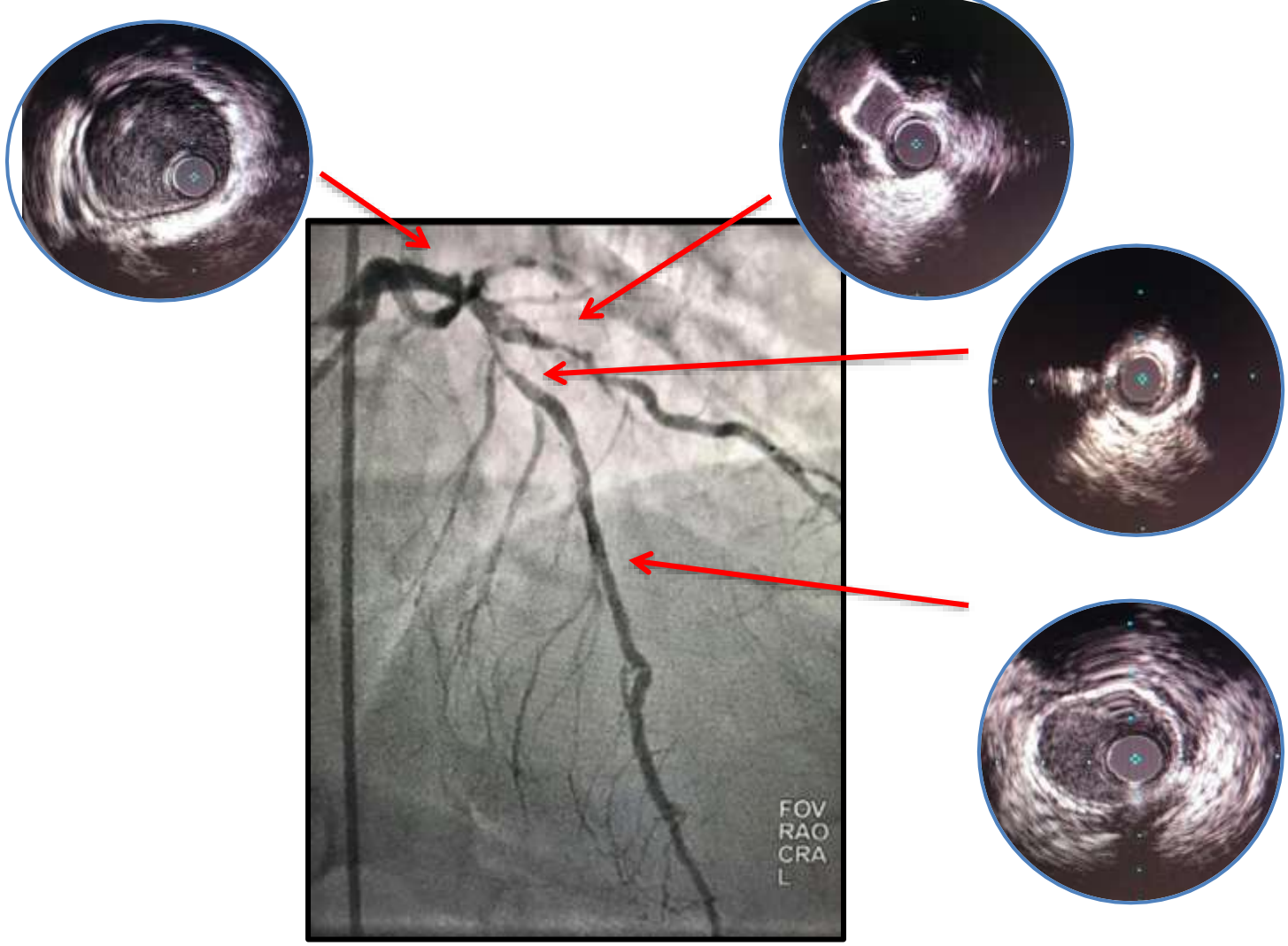


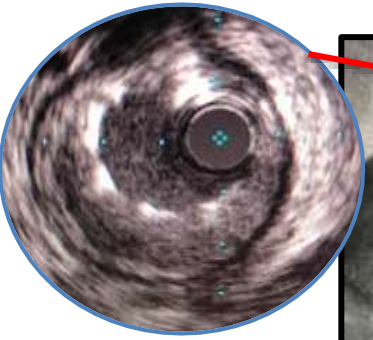
SPECT 06/08/18
Esfuerzo con infra ST,
ISQUEMIA severa extensa
Pequeña necrosis antero lateral

Resultados:

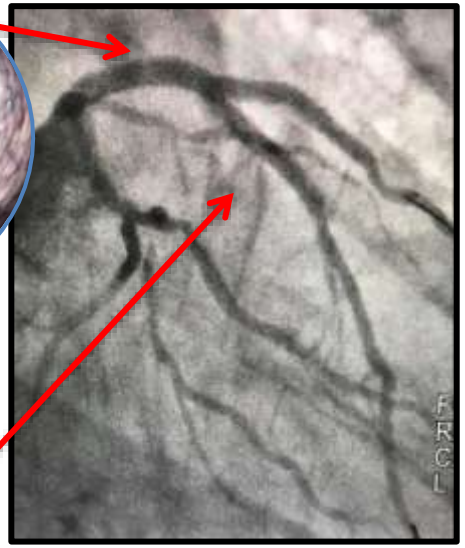
Negativa a CABG.
22/09/18
ATC CD con 2 DES

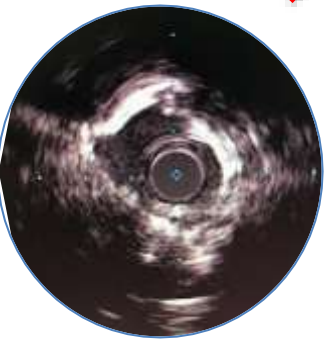


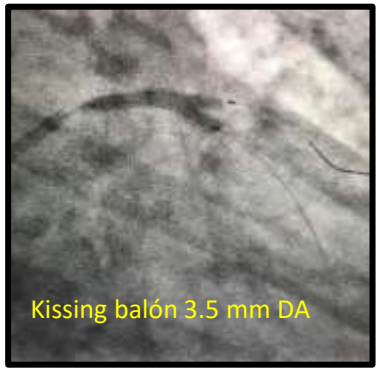

FOV
RAO
CRA
L

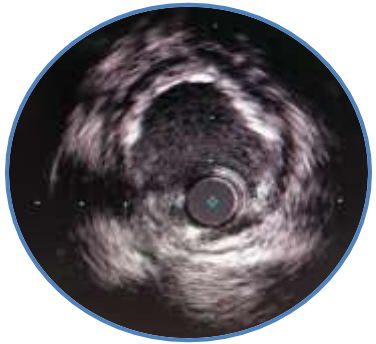


DLM 2,1 mm
AREA 5,5 mm2



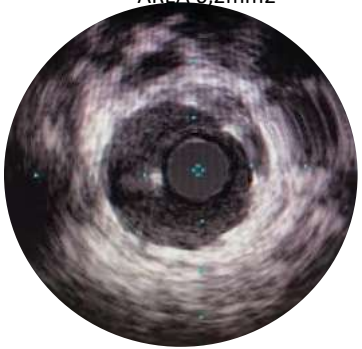


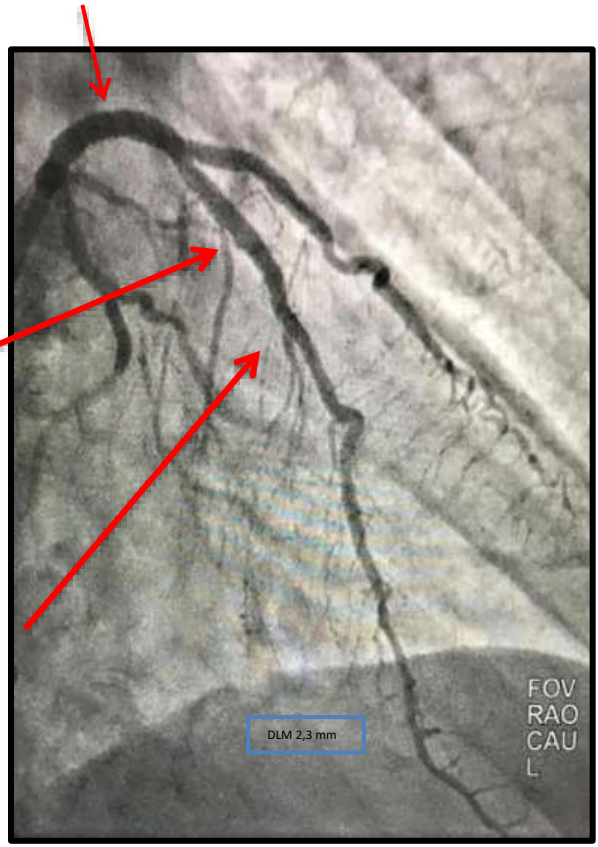




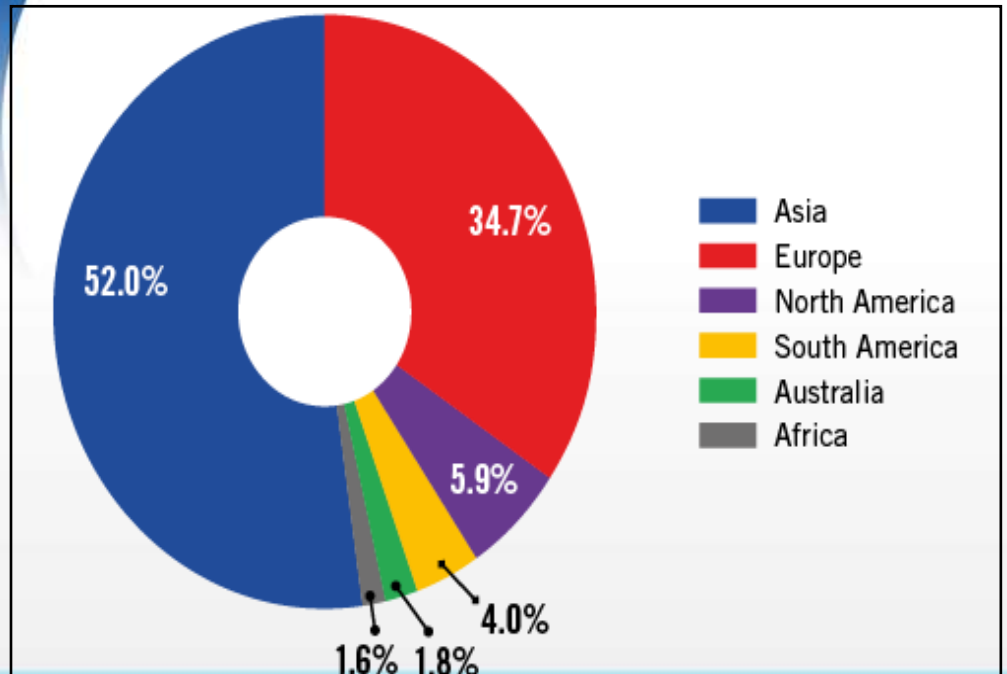
DLM 3,2 mm
AREA 8,5 mm2

AREA 6,2mm2





Current use of intracoronary imaging in interventional practice – Results of a European Association of Percutaneous Cardiovascular Interventions (EAPCI) and Japanese Association of Cardiovascular Interventions and Therapeutics (CVIT) Clinical Practice Survey



Factors limiting the clinical use of IVUS / OCT

65.9 %	High cost
35 %	Prolongation of the diagnostic procedure or intervention
29.3 %	Regulatory issues (reimbursement)
17.1%	Lack of training for use and interpretation of these modalities
12.1%	Absence of established criteria for corrective measures based on 'abnormal' imaging findings
9.5 %	Risk of procedural complications
8.3 %	Clinical value is not established
8.6 %	I do not know

MUCHAS GRACIAS

- **Dr Daniel Aníbal Zanuttini**

- Director del Departamento de Cardiologia Intervencionista y Hemodinamia. ICSB.
  - Sanatorio Británico.
  - Rosario . Argentina

- danielzanuttini10@gmail.com

Comentarios finales

- Angioplastias guiadas por imágenes (IVUS), produce cambios en resultados largo plazo, en PCI complejas, especialmente en reducir revascularización de la lesión tratada.

- Para obtener estos beneficios, las imágenes deberían ser correctamente interpretadas, y los operadores deberían reaccionar a los resultados del IVUS.

- Guía por IVUS para lesiones complejas y detección del mecanismo de falla del stent

(Clase I, evidencia A)

PRE intervención: evaluación vaso y características lesión

POST intervención: expansión del Stent, aposición y complicaciones agudas (disección).

- Desde el momento que tomó su desición de darle el tiempo necesario para re evaluar su caso por IVUS, intente identificar las diferentes imágenes / complicaciones.

Take Home Message

1. Total amount of calcium volume (arc, length, thickness) predicts stent expansion.
2. Though relatively infrequent, thick eccentric calcium along with vessel negative remodeling also predicts stent under-expansion.
3. Eruptive (or active) calcified nodule has poor outcome compared with non-eruptive (healed) calcified nodule.
4. Calcified nodule develops from calcified plaque and stent edges

INDICACIONES

- DIAGNÓSTICO
  - Evaluación de lesiones Intermedias (40-70%)
  - Evaluación de lesiones ambiguas y morfologías inusuales
  - Evaluación de vasculopatía post transplante

- INTERVENCIÓN
  - Evaluación del tamaño de vaso
  - Evaluación de las características de la placa Evaluación del mecanismo de reestenosis y/o trombosis intrastent
  - Guía para la correcta implantación de stents coronarios
  - Cobertura completa de la lesión
  - Evaluación de las complicaciones post colocación de stent

- INVESTIGACIÓN

FUNCIONALES: FFR-iFR-RFR

ANATÓMICOS: IVUS - OCT

Long-Term Follow-Up After Percutaneous Transluminal Coronary Angioplasty Was Not Performed Based on Intravascular Ultrasound Findings

Importance of Lumen Dimensions

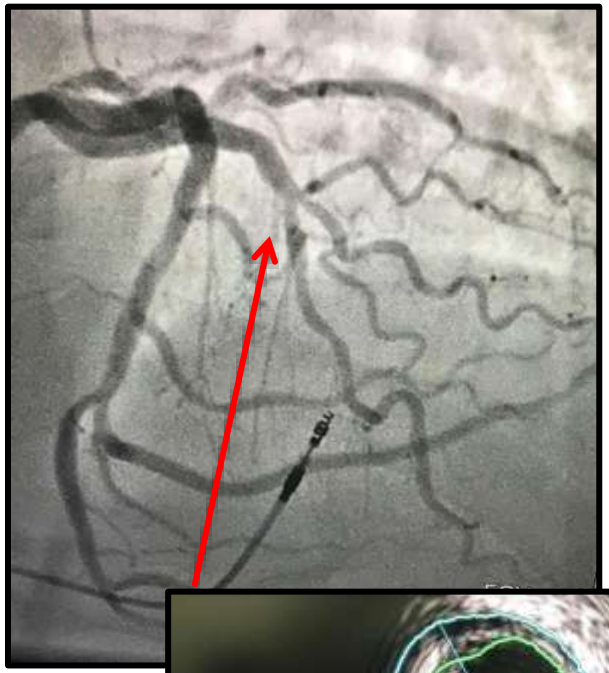
Andrea S. Abizaid, MD; Gary S. Mintz, MD; Roxana Mehran, MD; Alexandre Abizaid, MD; Alexandra J. Lansky, MD; Augusto D. Pichard, MD; Lowell F. Satler, MD; Hongsheng Wu, PhD; Chrysoula Pappas, MD; Kenneth M. Kent, MD; Martin B. Leon, MD

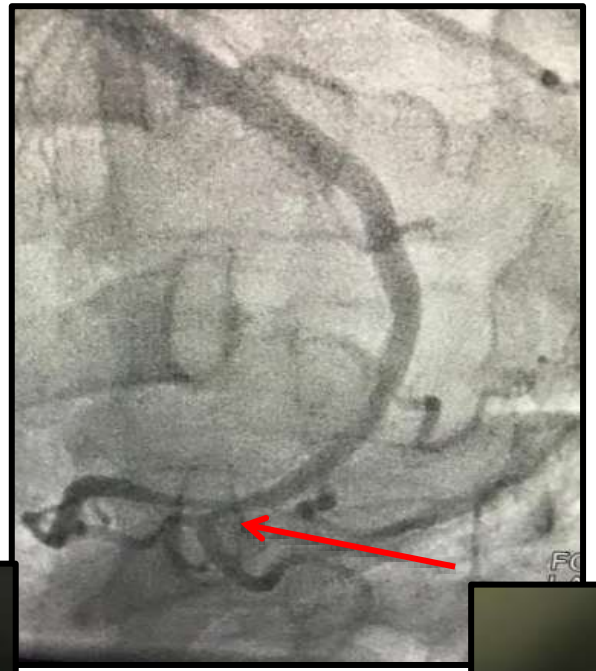
Background—Angiography is limited in determining the anatomic severity of coronary artery stenoses. Clinical decision-making in patients with symptoms and intermediate lesions remains challenging.

Methods and Results—The current analysis included 300 patients (357 intermediate native artery lesions) in whom intervention was deferred based on intravascular ultrasound (IVUS) findings. Standard clinical, angiographic, and IVUS parameters were collected. Patients were followed for >1 year. Events occurred in 24 patients (8%). They included 2 cardiac deaths, 4 myocardial infarctions, and 18 target-lesion revascularizations (TLR; 12 percutaneous transluminal coronary angiographies and 6 coronary artery bypass grafts; only 3 TLRs occurred within 6 months after the IVUS study). All significant univariate clinical, angiographic, and IVUS parameters ($P<0.05$) were tested in multivariate models. These included diabetes mellitus, IVUS lesion lumen area, maximum lumen diameter, minimum lumen diameter, plaque area, plaque burden, and area stenosis (AS). No angiographic measurement was significant at $P<0.05$. The only independent predictors of an event (death, myocardial infarction, or TLR) were IVUS minimum lumen area and AS. The only independent predictors of TLR were diabetes mellitus, IVUS minimum lumen area, and AS. In 248 lesions with a minimum lumen area ≥ 4.0 mm^2, the event rate was only 4.4% and the TLR rate 2.8%.

Conclusions—Long-term follow-up after IVUS-guided deferred interventions in patients with de novo intermediate native artery lesions showed a low event rate. In patients with a minimum lumen area ≥ 4.0 mm^2, the event rate was especially low. IVUS imaging is an acceptable alternative to physiological assessment in these patients. (***Circulation.*** **1999;100:256-261.**)

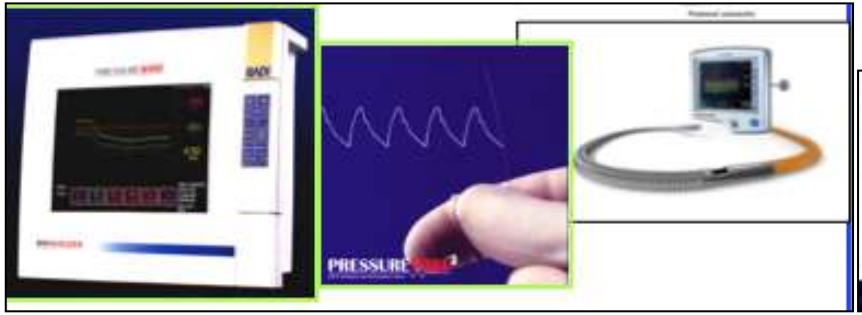
DIAGNÓSTICO

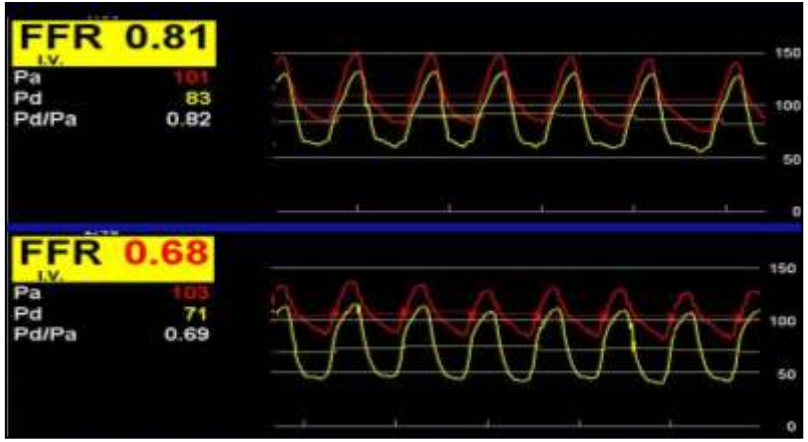




FFR

Evaluación imagenológica: FUNCIONALES





European Heart Journal
doi:10.1093/eurheartj/ehq277

Guidelines on myocardial revascularization

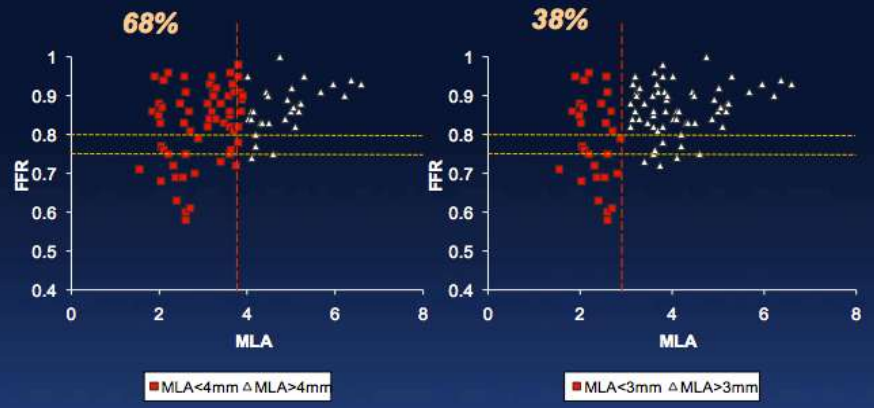
The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Developed with the special contribution of the European Association

Table 33 Recommendations for specific percutaneous coronary intervention devices and pharmacotherapy

	Class[a]	Level[b]	Ref.[c]
FFR-guided PCI is recommended for detection of ischaemia-related lesion(s) when objective evidence of vessel-related ischaemia is not available.	I	A	15, 28

IVUS vs. FFR for intermediate coronary stenosis

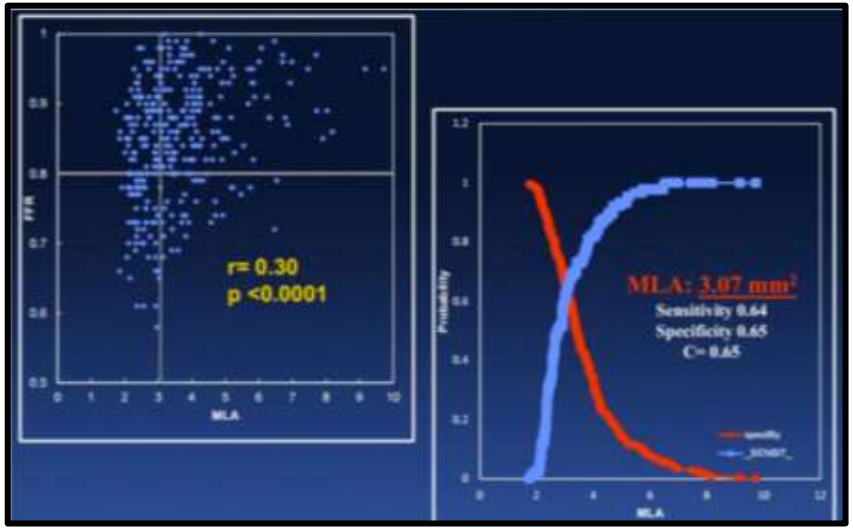


42 (67.7%) with MLA <4mm² had non ischemic FFR >0.8

47 (75.8%) with MLA <4mm² had non ischemic FFR >0.75

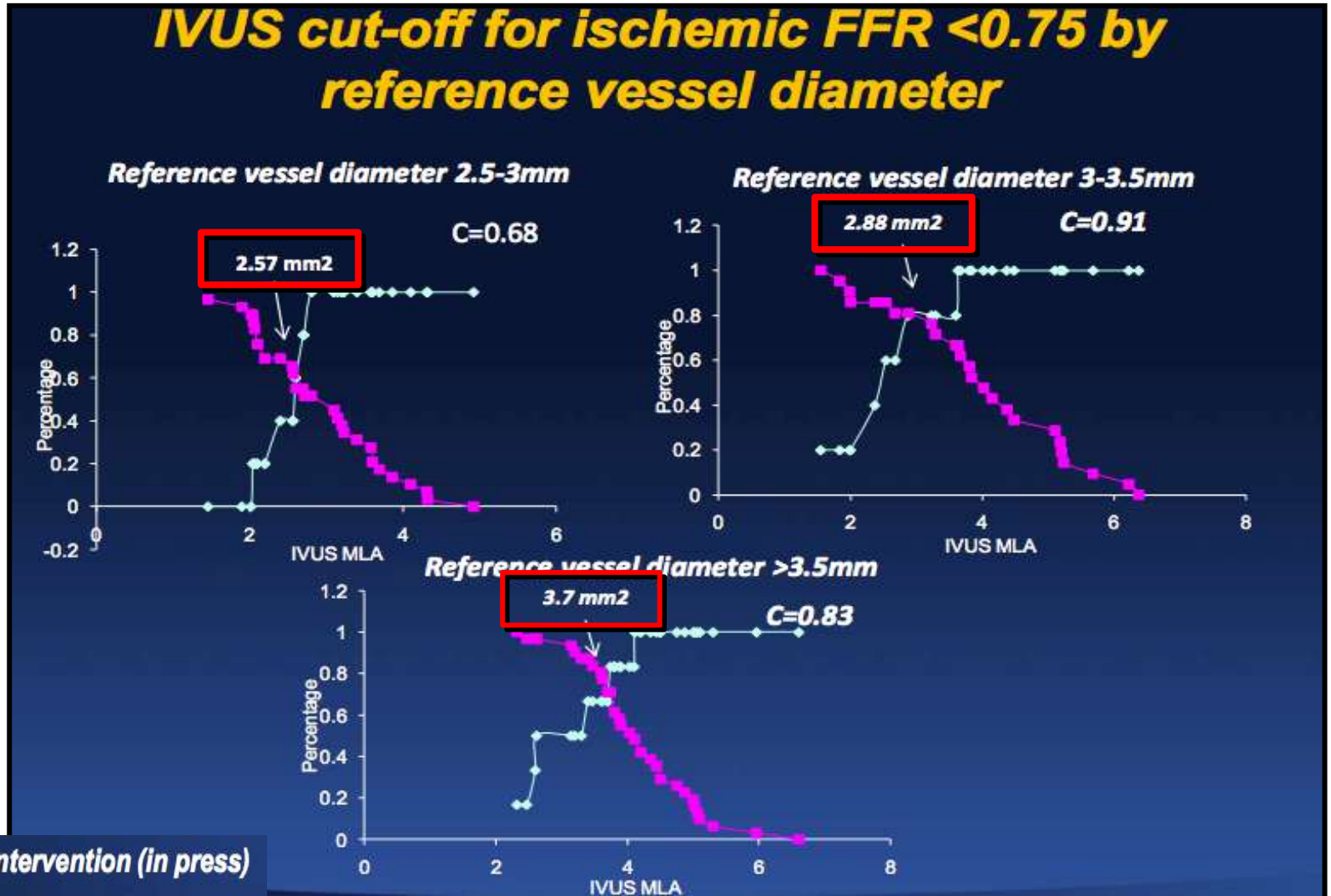
11 (37.9%) with MLA <3mm² had non ischemic FFR >0.8

17 (58.6%) with MLA <3mm² had non ischemic FFR >0.75



Ben-Dor Euro intervention (in press)

IVUS cut-off for ischemic FFR <0.75 by reference vessel diameter



Ben-Dor Euro intervention (in press)

iFR

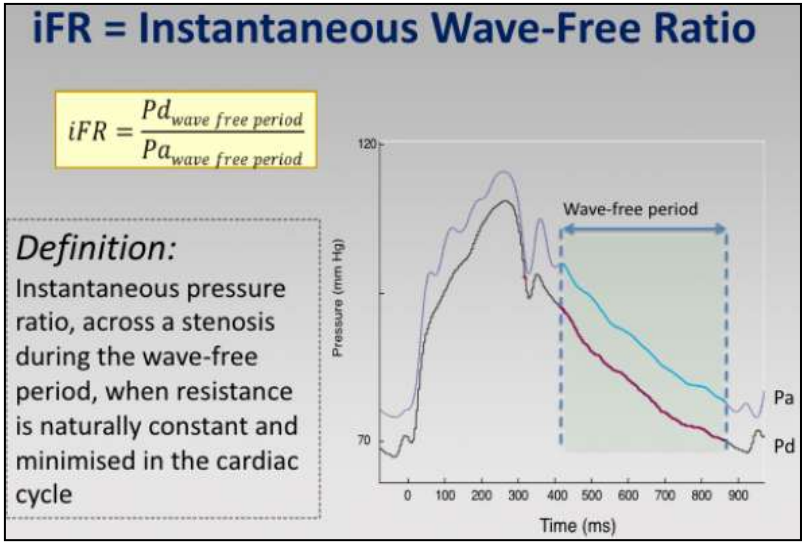
Relação entre a pressão distal à estenose e a pressão medida na ponta do cateter-guia em condições de ***repouso,*** em uma janela de tempo específica da diástole**,** quando a

transmissão de ondas de pulso é ausente

(wave-free period)

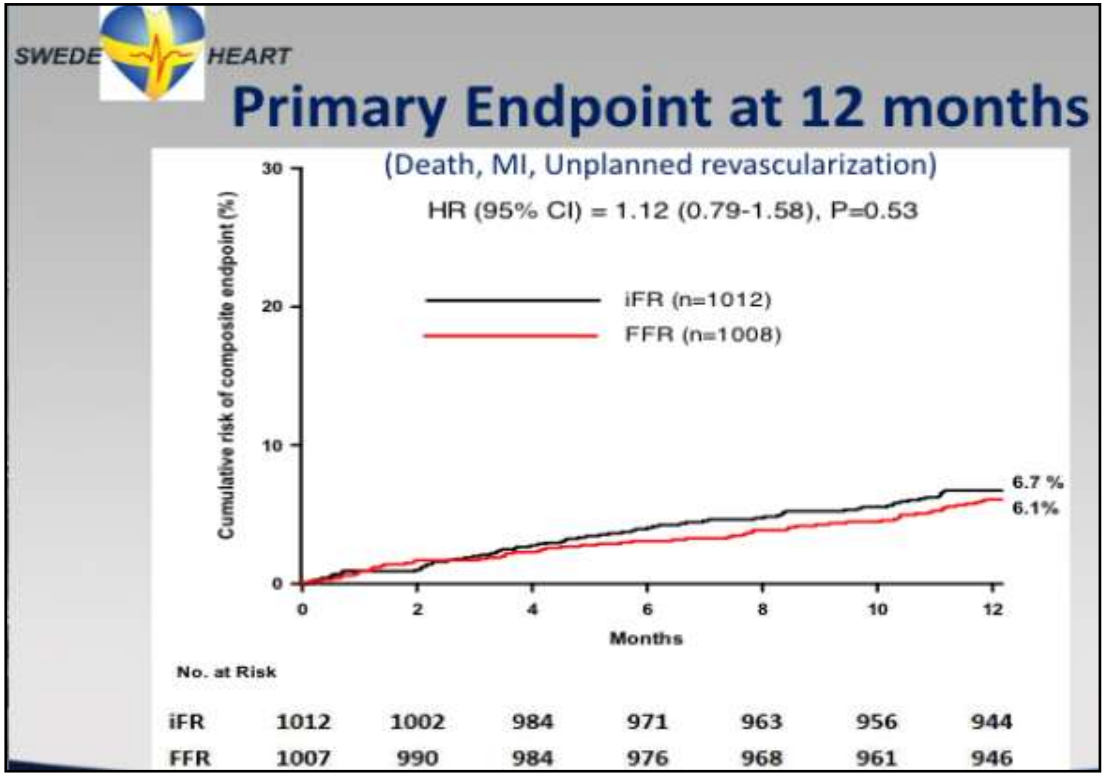
e o fluxo coronário tem sua velocidade mais alta.

Índice instantáneo no período diastólico " sem ondas" do ciclo cardíaco (iFR) . É uma alternativa que não requer adenosina nehum outro vasodilatador: nesse período a resistencia da microcirculação é característicamente estável e mínima.



DEFINE-FLAIR (n = 2.492)

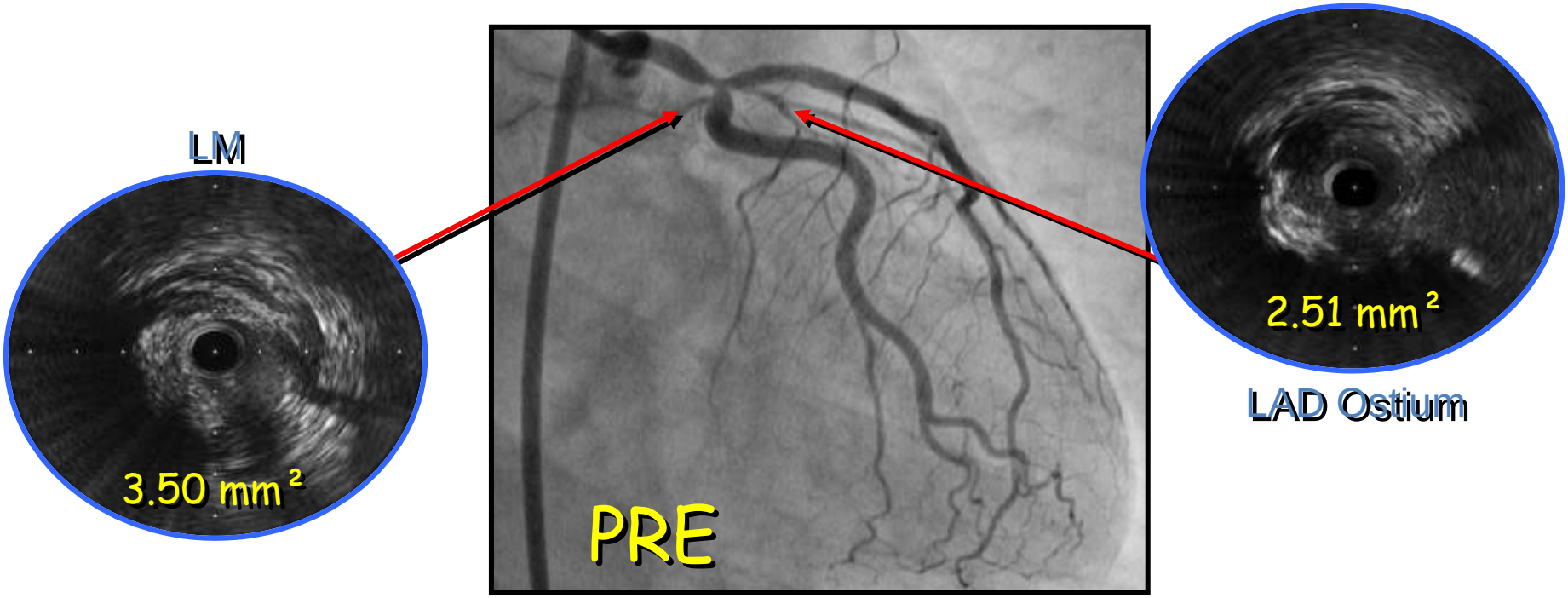
SWEDEHEART (n = 2,037)



Corte 0,89

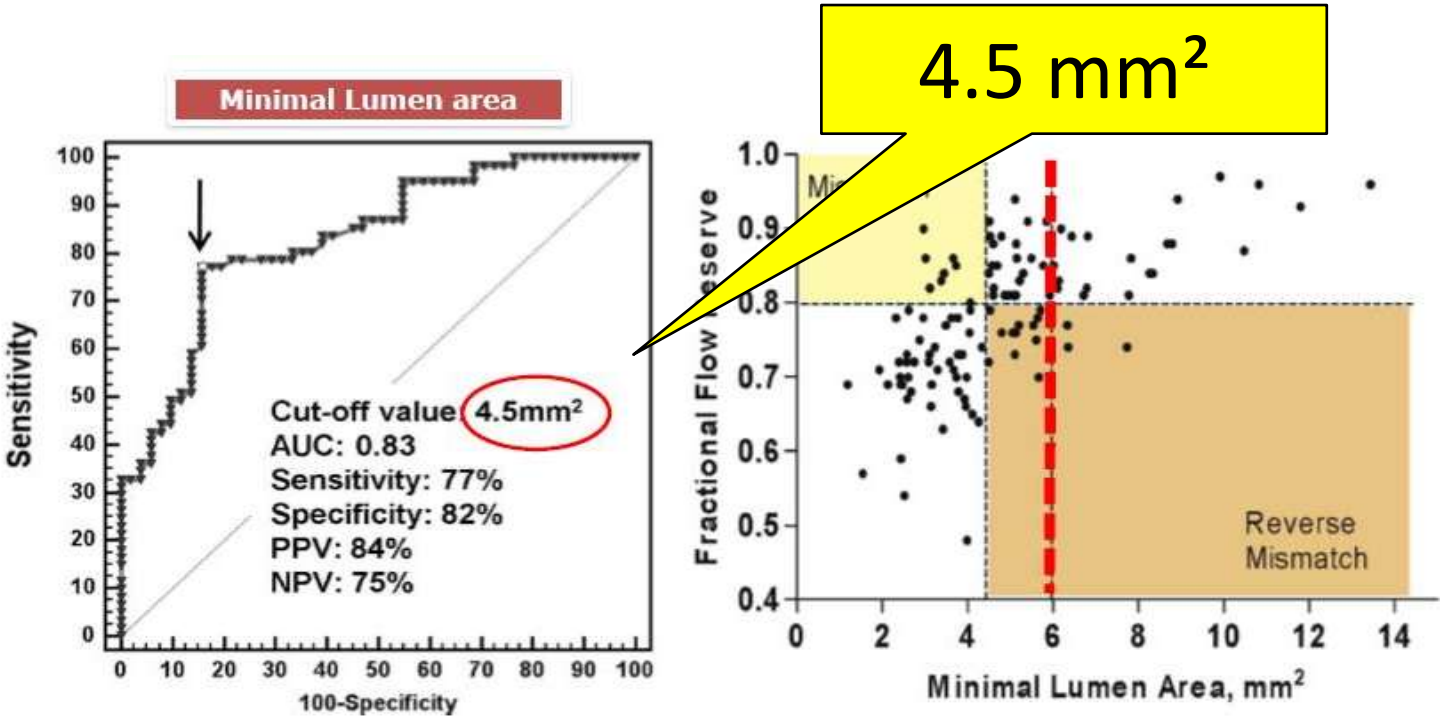
DIAGNÓSTICO

2) Evaluación de lesiones ambiguas y morfologías inusuales



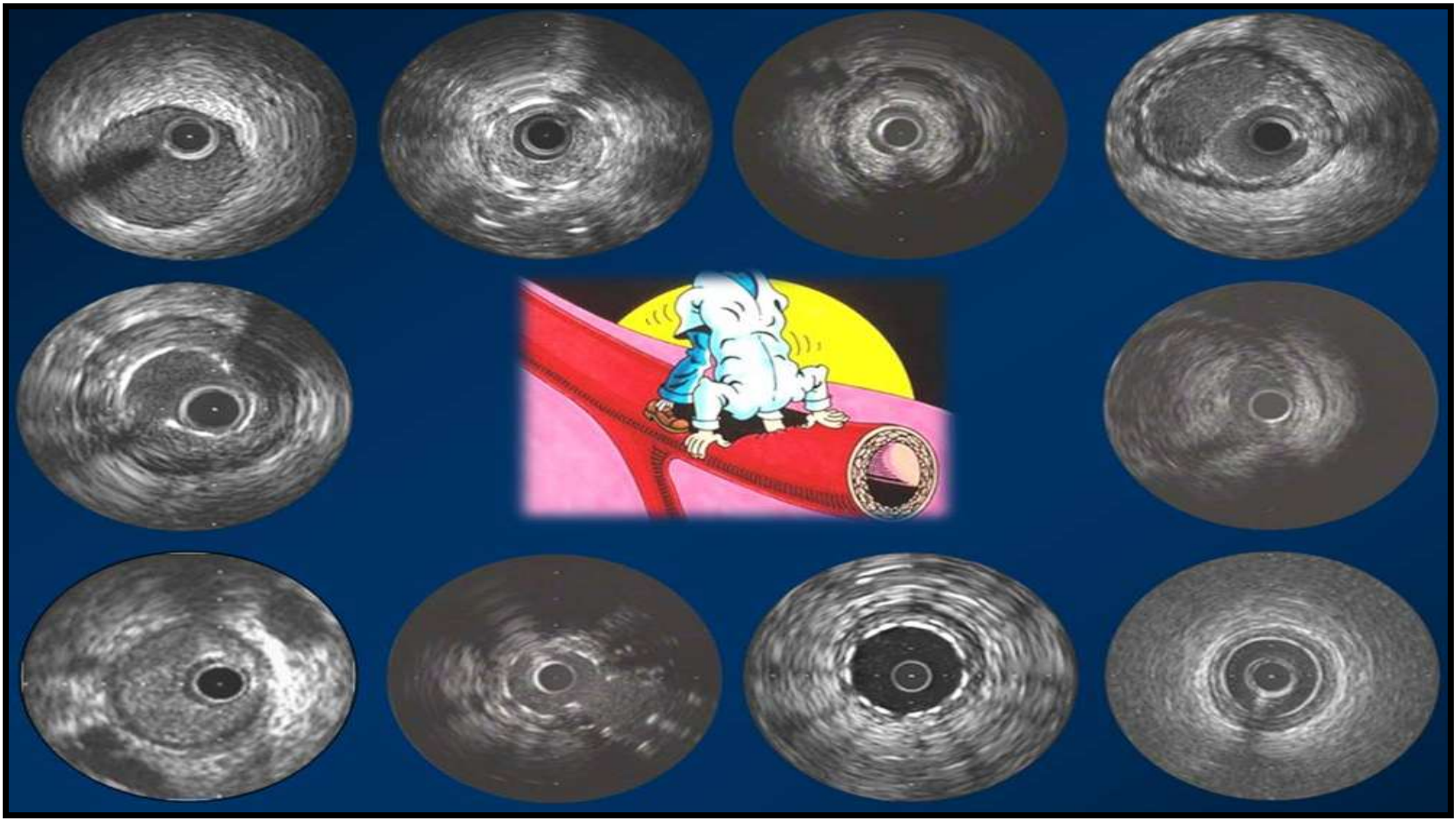
Intravascular Ultrasound-Derived Minimal Lumen Area Criteria for Functionally Significant Left Main Coronary Artery Stenosis

112 patients with isolated ostial and shaft intermediate LMCA stenosis (angiographic diameter stenosis of 30% to 80%) who underwent IVUS and FFR measurement.

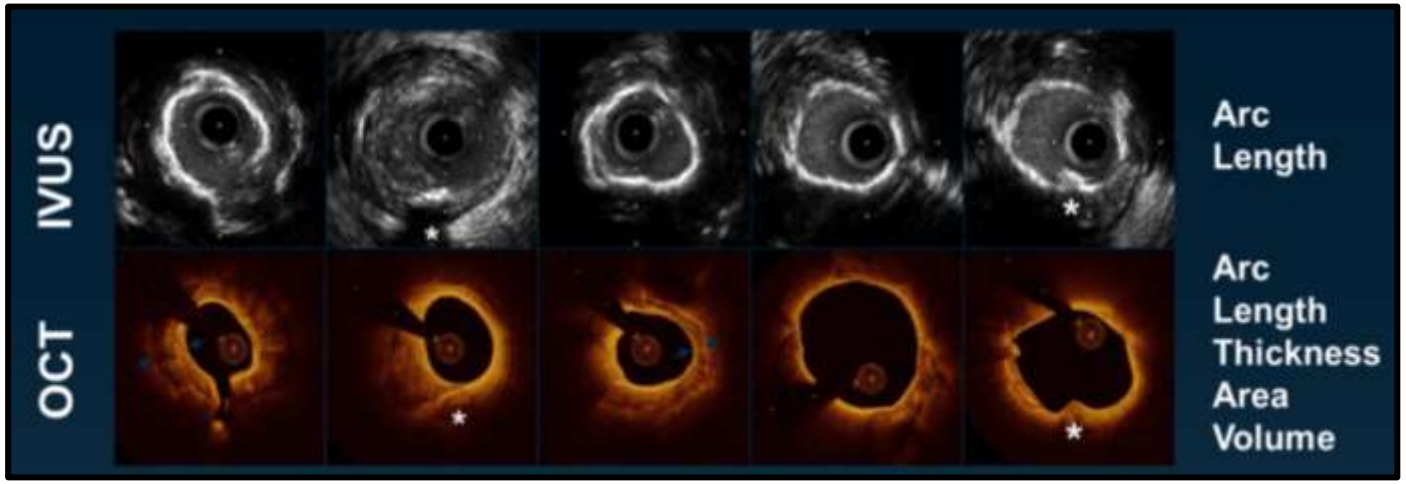


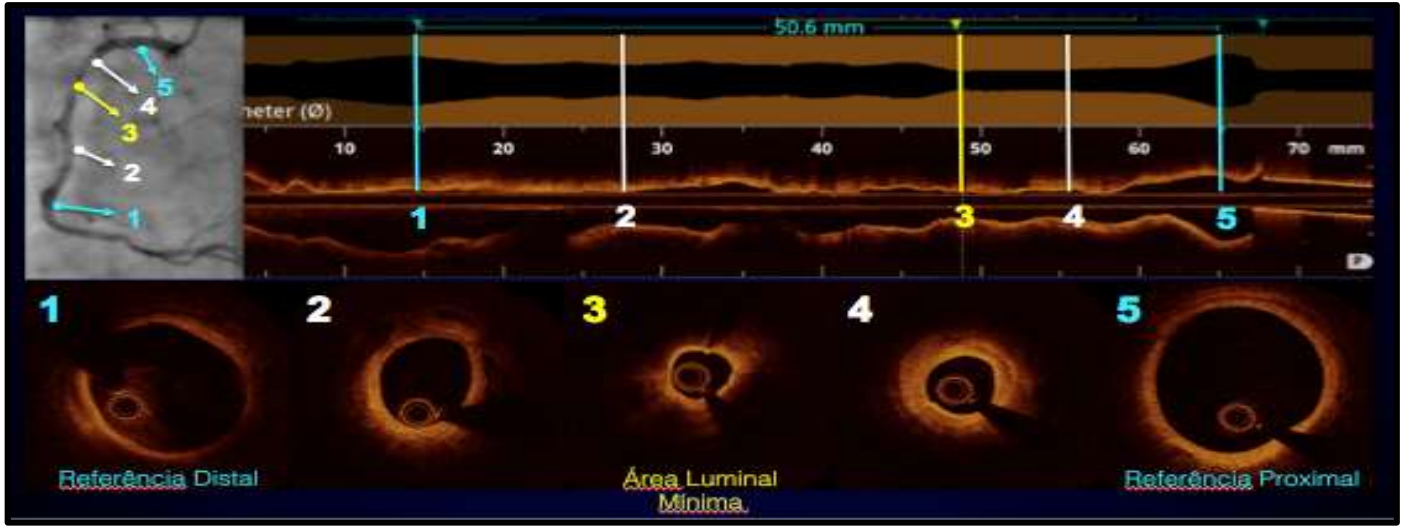
IVUS - OCT

- DIAGNÓSTICO
  - Evaluación de lesiones Intermedias
  - Evaluación de lesiones ambiguas y morfologías inusuales
  - Evaluación de vasculopatía post transplante
- INTERVENCIÓN
  - PRE
    - Evaluación del tamaño de vaso (diámetro/longitude)
    - Evaluación de las características de la placa
    - Evaluación del mecanismo de restenosis.
    - Evaluación del mecanismo de trombosis intrastent
  - POST
    - Guía para la correcta implantación de stents coronarios
    - Cobertura completa de la lesión
    - Evaluación de las complicaciones post colocación de stent
- INVESTIGACIÓN



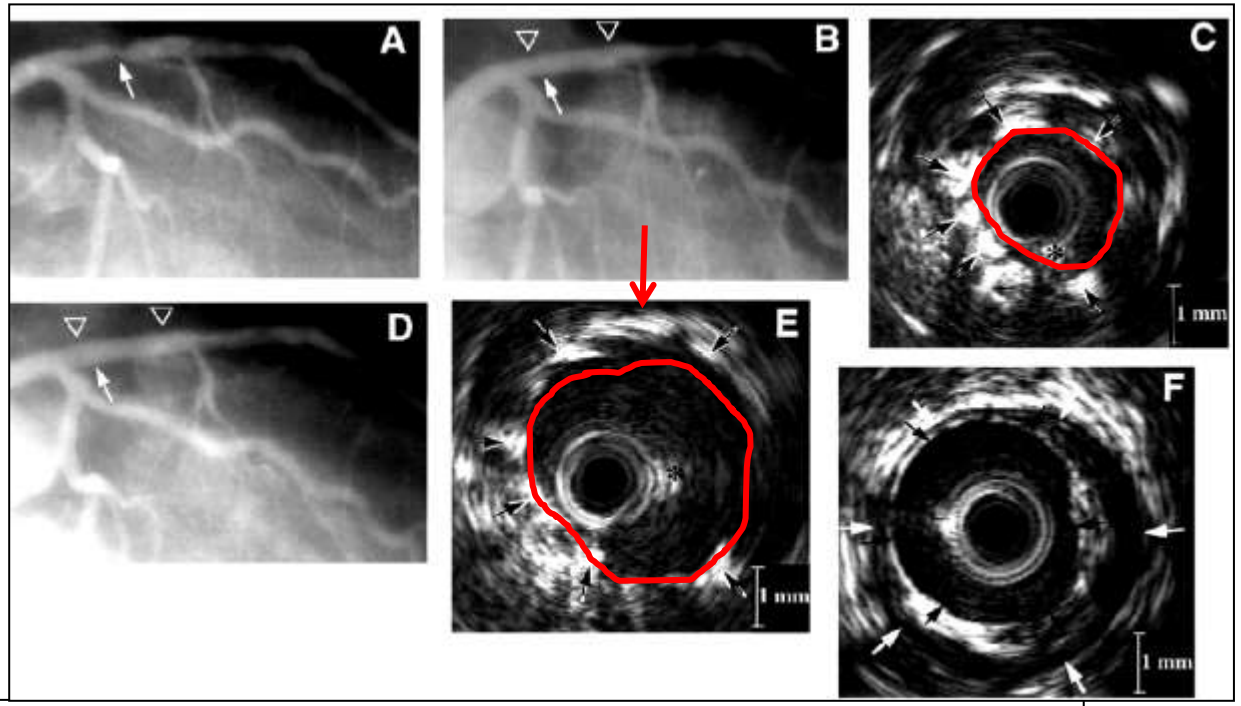
Calcio


IVUS
OCT
Arc
Length
Arc
Length
Thickness
Area
Volume


50.6 mm
10
20
30
40
50
60
70 mm
1
2
3
4
5
Referência Distal
Área Luminal
Mínima
Referência Proximal

Intracoronary Stenting Without Anticoagulation Accomplished With Intravascular Ultrasound Guidance

Antonio Colombo, MD; Patrick Hall, MD; Shigeru Nakamura, MD; Yaron Almagor, MD; Luigi Maiello, MD; Giovanni Martini, CCP; Antonio Gaglione, MD; Steven L. Goldberg, MD; Jonathan M. Tobis, MD



Despite this aggressive inflation approach, 40% of the stents with an acceptable angiographic result still required additional dilatation with higher pressures or, less commonly, a dilatation with a larger balloon

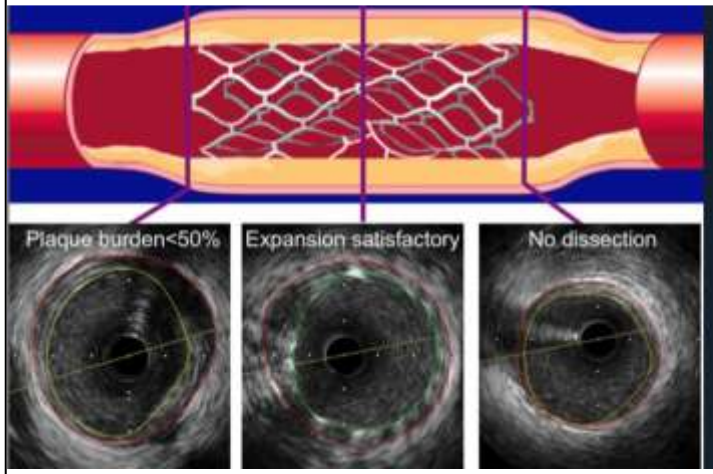
Guía para la correcta implantación de stent coronario

APOSICIÓN. EXPANSIÓN

Cobertura completa de la lesión

Disección. Protrusión de placa. Trombo

ULTIMATE trial



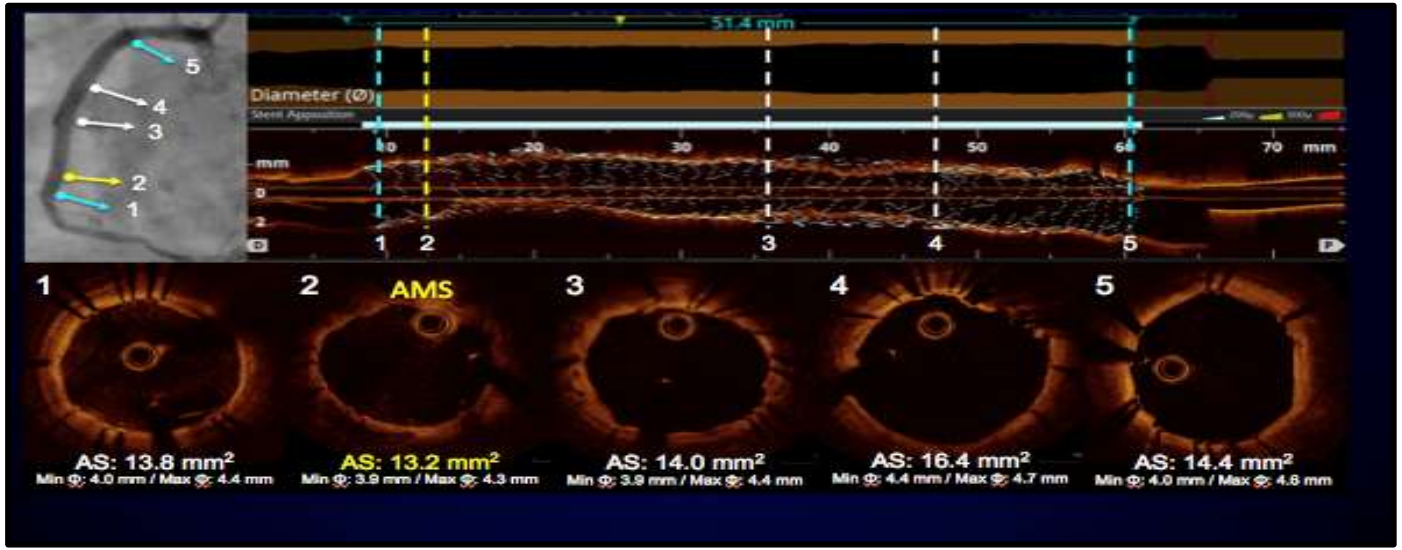
1. Minimal lumen CSA in stented segment >5.0 mm^2, or 90% of distal reference lumen CSA;
2. Plaque burden at the 5-mm proximal or distal to the stent edge <50%;
3. no edge dissection involving media with length >3mm.

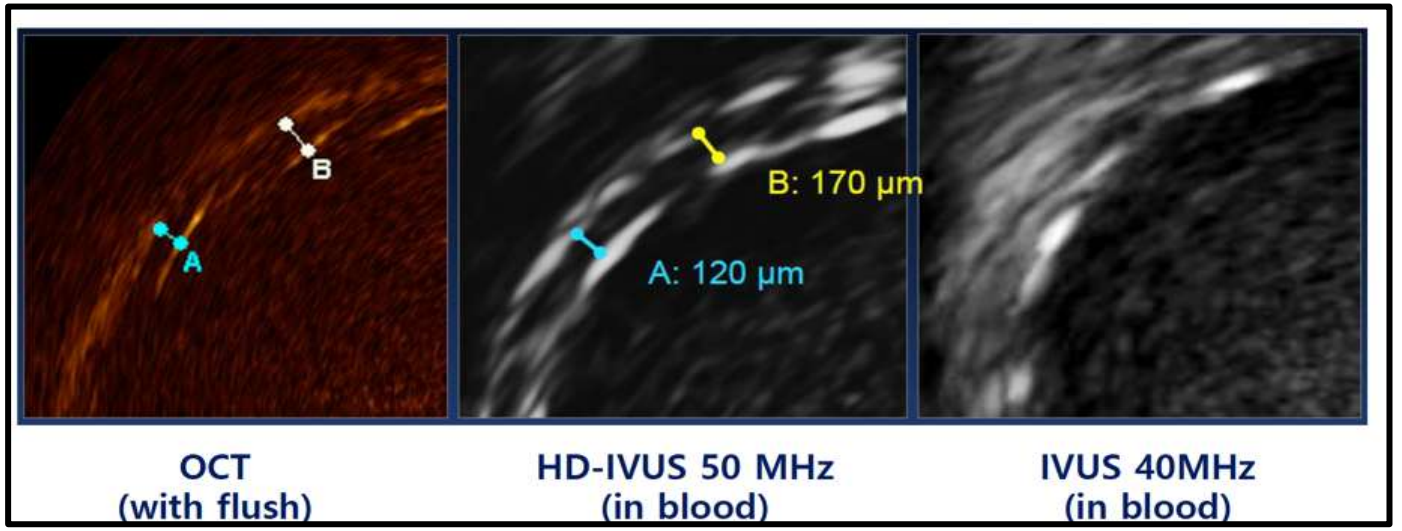
Zhang J, et al. J Am Coll Cardiol 2018;Sep 24:[Epub]

IVUS Predictors of DES
Thrombosis & Restenosis

	• DES Thrombosis	• DES Restenosis
Underexpansion (CSA ≤ 5 mm²)	• Fujii et al. J Am Coll Cardiol 2005;45:995-8 •Takebayashi et al, AJC 2005 • Kim et al AJC, 2006 • Okabe et al., Am J Cardiol. 2007;100:615-20 • Liu et al. JACC Interventions 2009;2:428-34	• Sonoda et al. J Am Coll Cardiol 2004;43:1959-63 • Fujii et al. Circulation 2004; 109:1085-1088 • Hong et al. Eur Heart J 2006; 27:1305-10 •TAXUS IV, V, VI and ATLAS WH, LL, DS meta-analysis. JACC CardiovascInterv. 2009;2:1269-75 • Doi et al. JACC Cardiovasc Interv. 2009;2:1269-75
Peri-stent optimization - Remained lesions - Geographic miss - Large plaque burden…	• Fujii et al. J Am Coll Cardiol 2005;45:995-8 • Okabe et al., Am J Cardiol. 2007;100:615-20 • Liu et al. JACC Interventions 2009;2:428-34	• Sakurai et al. Am J Cardiol 2005; 96:1251-3 • Costa et al, Am J Cardiol, 2008; 101:1704-11 • Liu et al, Am J Cardiol, 2009;103:501-6

Aposición del Stent





ILUMIEN III: OPTIMIZE PCI

A Randomized Controlled Trial Comparing OCT-Guided, IVUS-Guided and Angiography-Guided PCI

Ziad A Ali, MD, DPhil
Columbia University Medical Center
New-York Presybyterian Hospital
Cardiovascular Research Foundation

Background

- PCI is most commonly guided by angiography alone.
- IVUS-guidance has been shown to reduce major adverse cardiovascular events (MACE) after PCI.
- OCT provides superior resolution to IVUS, but data supporting improved or equivalent outcomes are lacking.

Conclusions

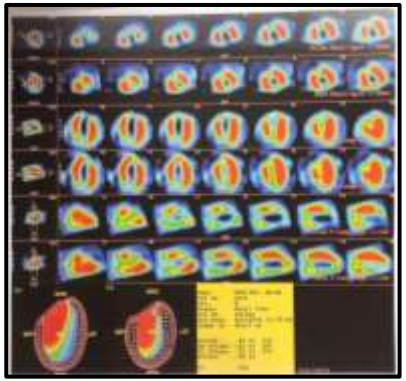
- OCT-guided PCI using a specific EEL-based stent optimization strategy was non-inferior to IVUS-guided PCI for achieving MSA.
- OCT-guided PCI resulted in superior stent expansion and procedural success compared to angiography-guided PCI.
- OCT-guided PCI resulted in the fewest untreated major dissections and areas of major stent malapposition.

IVUS en lesión de bifurcación

Trabajo reciente de identificación de predictores por IVUS
de oclusión aguda de ramo lateral en lesiones de bifurcación, post implante de stent en ramo principal. Conclusión: el grosor de la placa de MV en el sitio de la unión y la relación del diámetro de SB son factores predictivos de oclusión aguda de SB justo después del cruce del stent único.

ETE 12/09/18
FEY 62%.

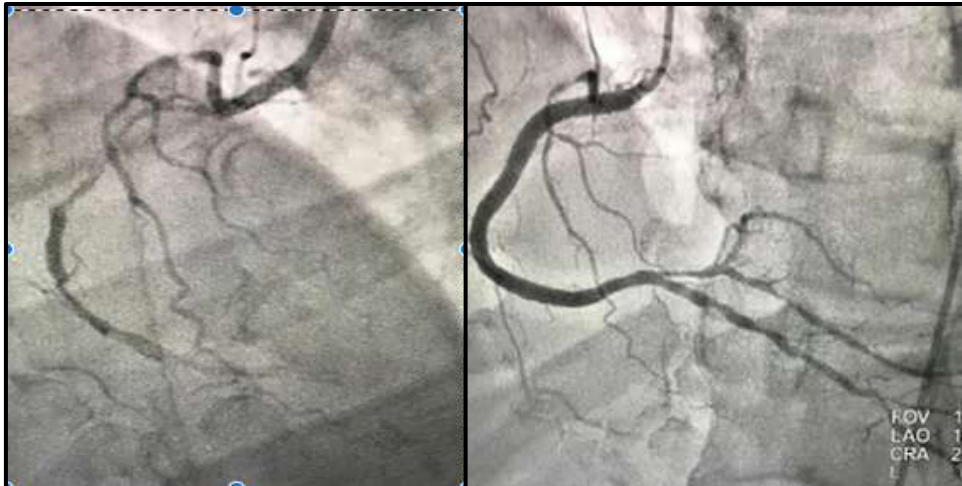
Insuficiencia mitral moderada a severa, mixomatosa.
Insuficiencia aortica leve.
Leve aumento AI

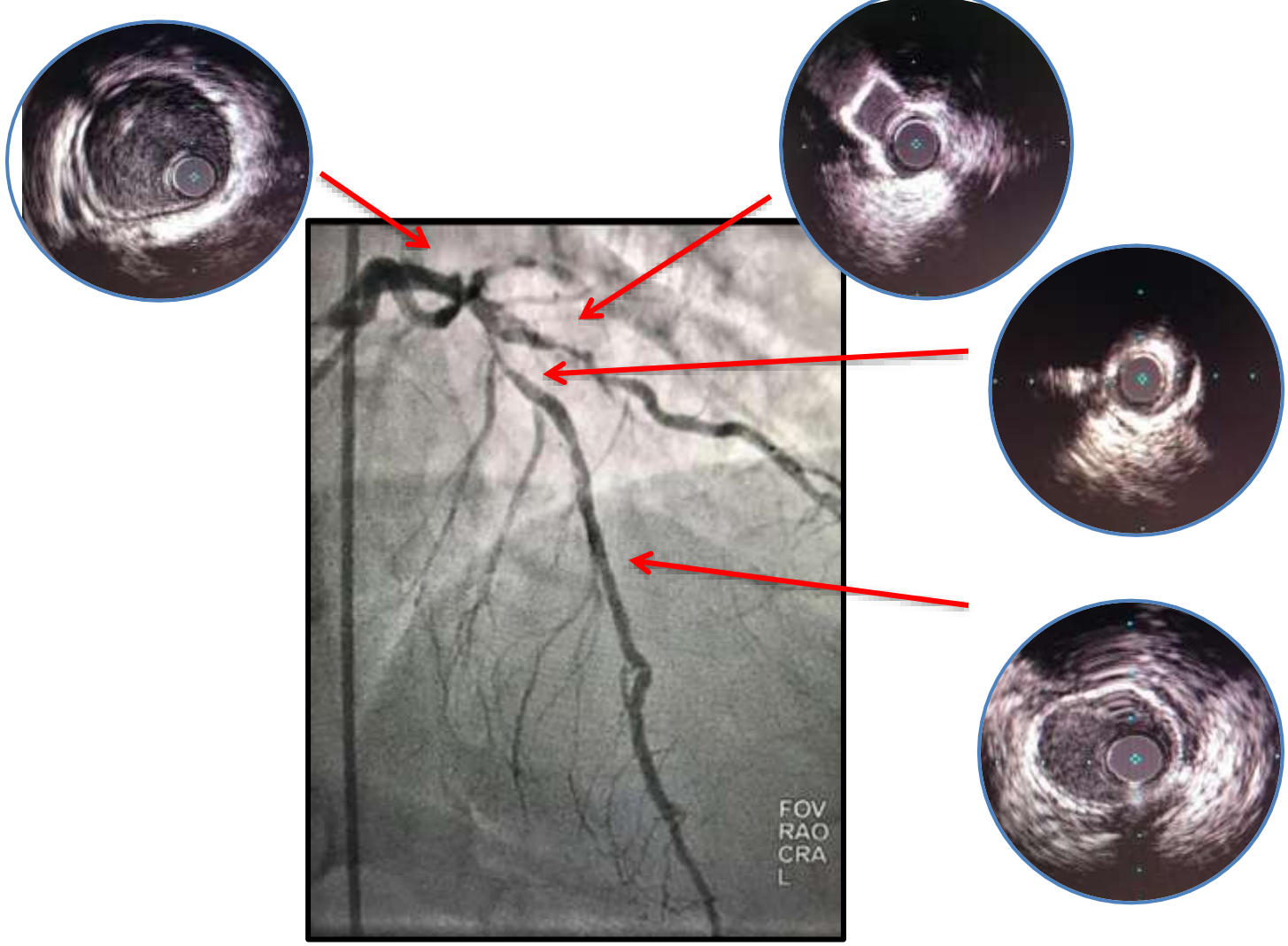


SPECT 06/08/18
Esfuerzo con infra ST,
ISQUEMIA severa extensa
Pequeña necrosis antero lateral

Resultados:

Negativa a CABG.
22/09/18
ATC CD con 2 DES

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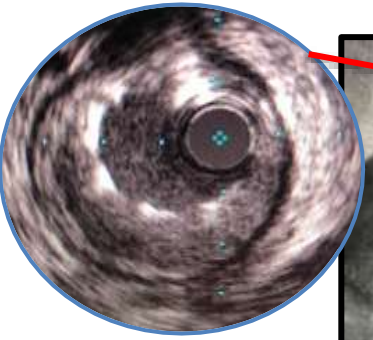
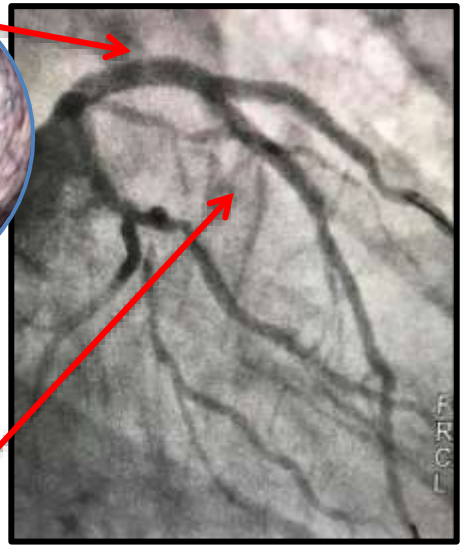
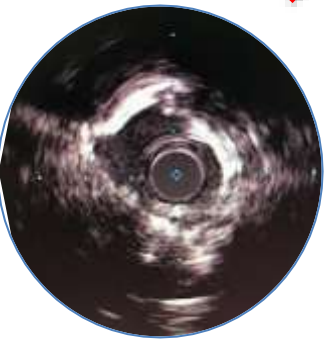
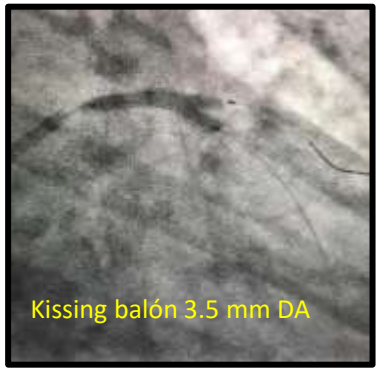
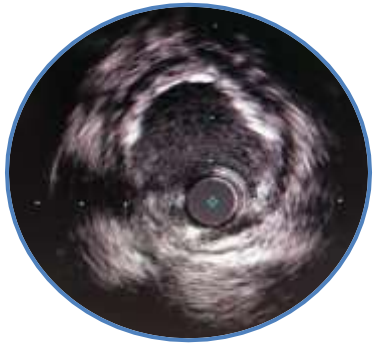


DLM 2,1 mm
AREA 5,5 mm2



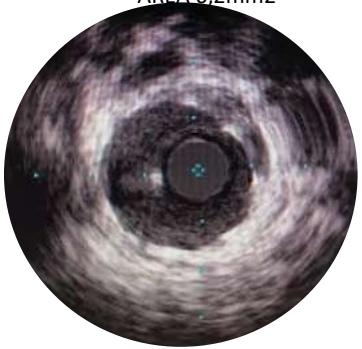


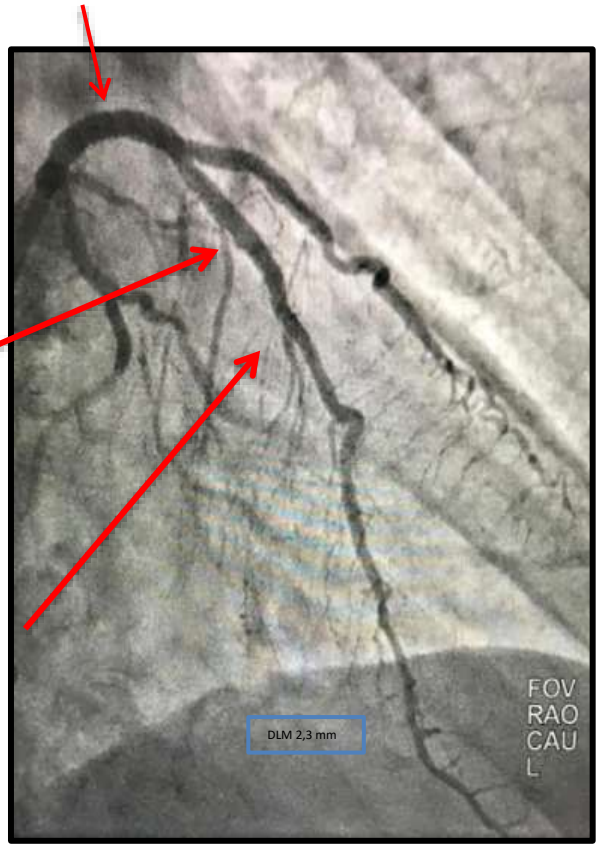




DLM 3,2 mm
AREA 8,5 mm2

AREA 6,2mm2

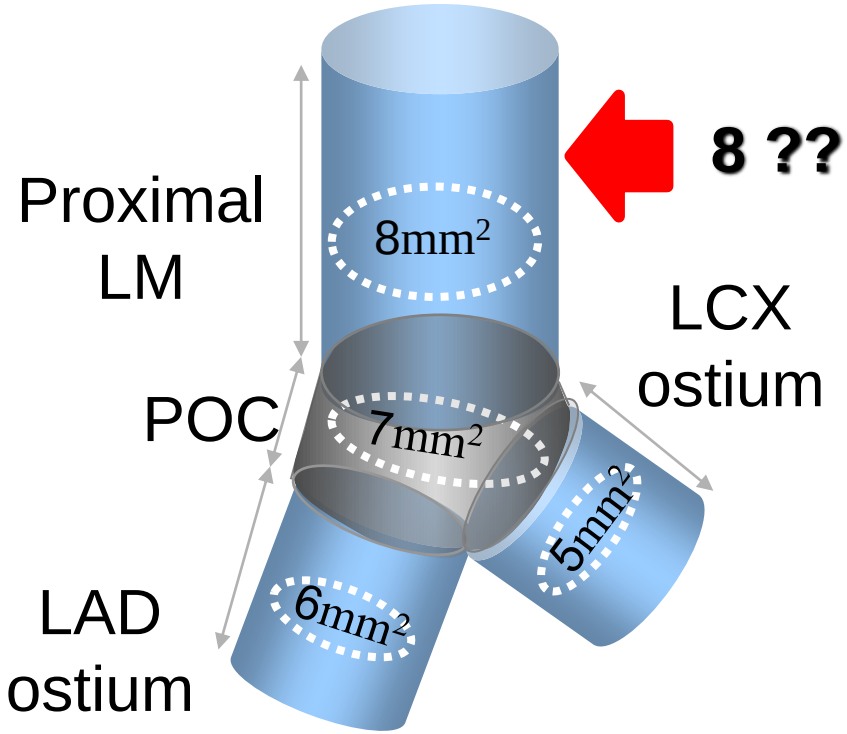




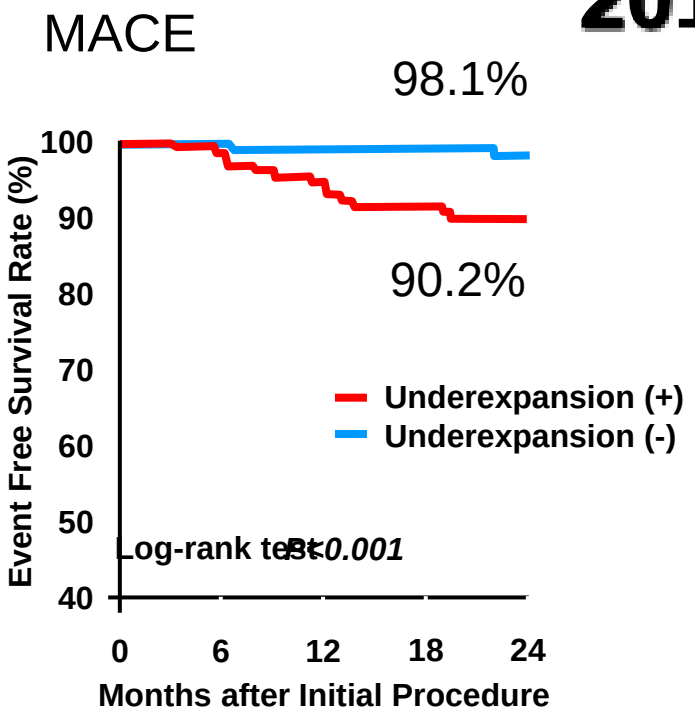
Guía para la correcta implantación de stent coronario

Seung-Jung Park Group

2011



Add 0.5 mm² to each location for non-Asian (or larger BSA) pts



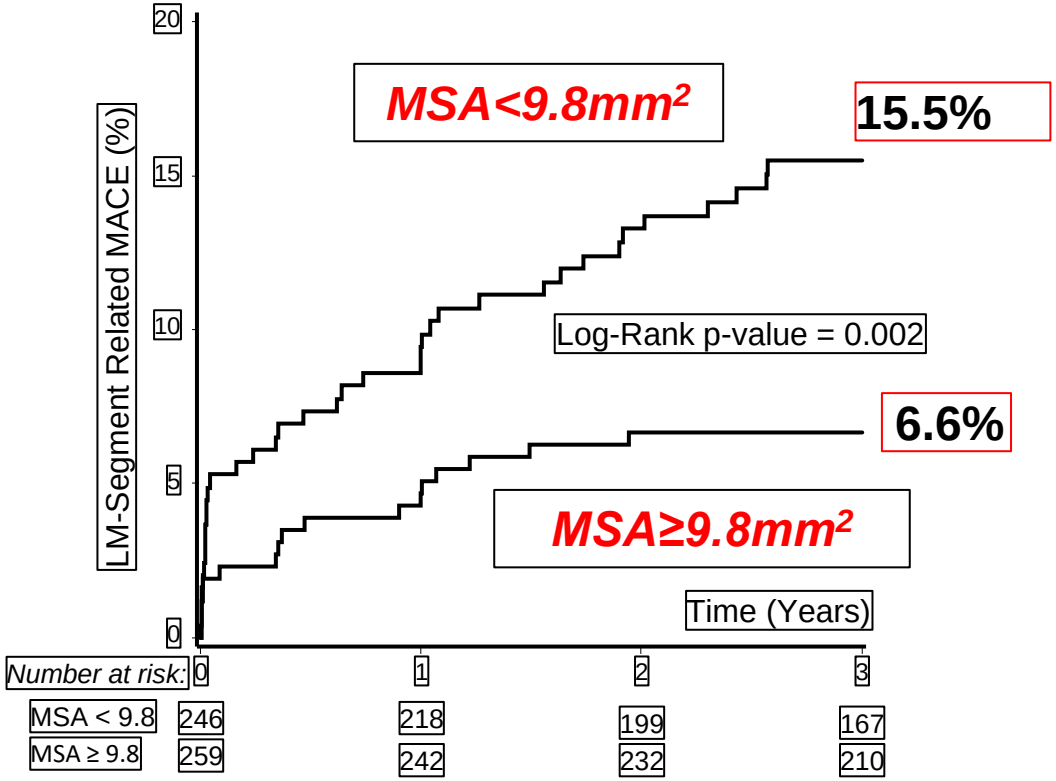
No. at risk

Underexpansion (+)	133	131	126	121	75
Underexpansion (-)	260	260	255	246	129

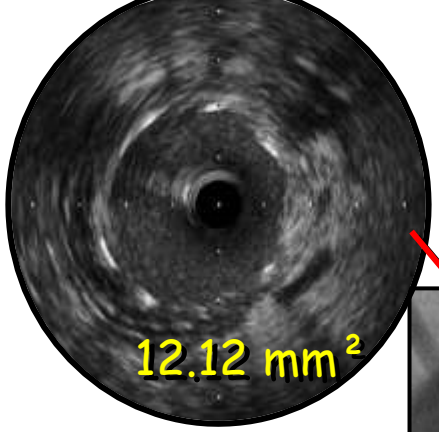
EXCEL: MSA to Predict LMCA-Related Events

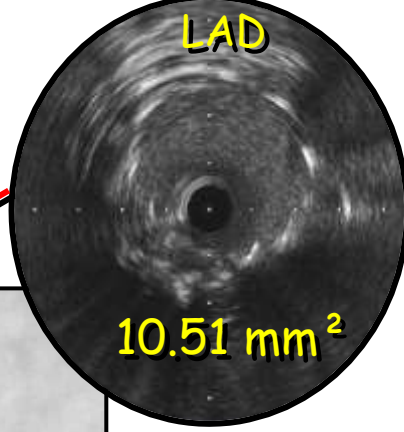
LM THE BIG
IS BETTER

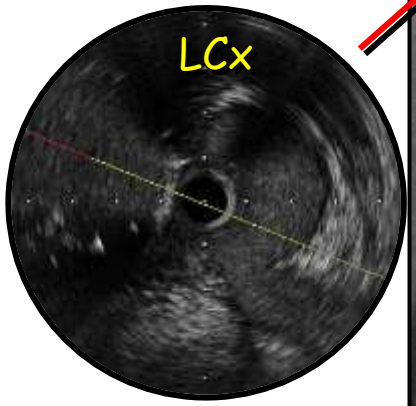
BIGGER IS BETTER
(Donald S Baim) Circulation 1992;86:1827-35)



Gary Mintz., CRT 2019







Promus
Element
4.0 * 20

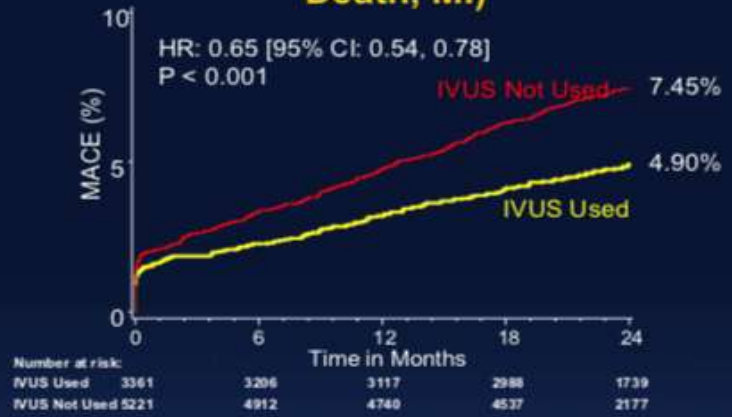
Current Guidelines for Use of IVUS and OCT

	ESC	AHA/ACC
IVUS	**Class IIa (level of evidence: B)** IVUS in selected patients to optimise stent implantation. IVUS to assess severity and optimise treatment of unprotected LMS lesions **Class IIa (level of evidence: C)** IVUS to assess mechanisms of stent failure.	**Class IIa (level of evidence: B)** IVUS is reasonable for the assessment of angiographically indeterminant left main CAD IVUS and coronary angiography are reasonable 4 to 6 weeks and 1 year after cardiac transplantation to exclude donor CAD, detect rapidly progressive cardiac allograft vasculopathy and provide prognostic information **Class IIa (level of evidence: B)** IVUS is reasonable to determine the mechanism of stent restenosis **Class IIb (level of evidence: B)** IVUS may be reasonable for the assessment of non-left main coronary arteries with angiographically intermediate coronary stenoses (50–70 % diameter stenosis) IVUS may be considered for guidance of coronary stent implantation, particularly in cases of left main coronary artery stenting **Class IIb (level of evidence: C)** IVUS may be reasonable to determine the mechanism of stent thrombosis
OCT	**Class IIa (level of evidence: C)** OCT to assess mechanisms of stent failure **Class IIb (level of evidence: C)** OCT in selected patients to optimise stent implantation	The appropriate role for optical coherence tomography in routine clinical-decision making has not been established

EVIDENCIAS

PARA EL USO DE IMAGENES INTRACORONARIAS

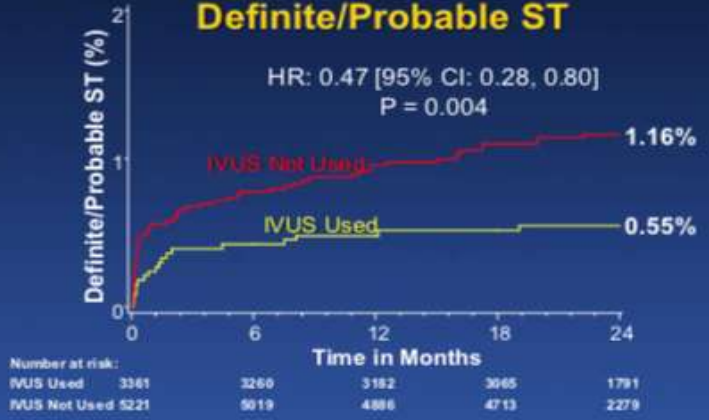
MACE (Definite/Probable ST, Cardiac Death, MI)



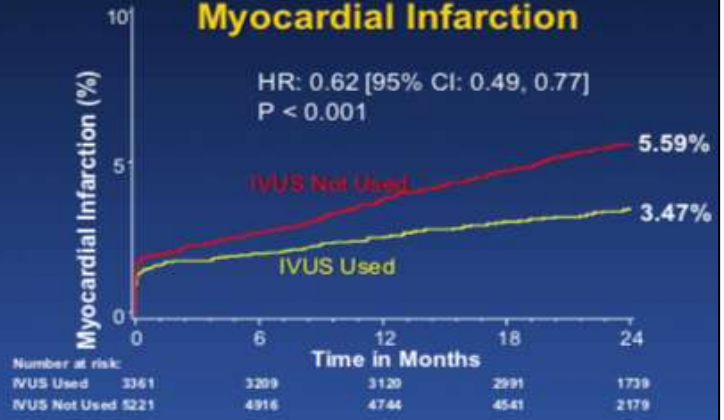
ADAPT-DES (3361 pts treated with IVUS-guidance vs 5221 pts treated with angiographic guidance)

All-comers

Definite/Probable ST



Myocardial Infarction

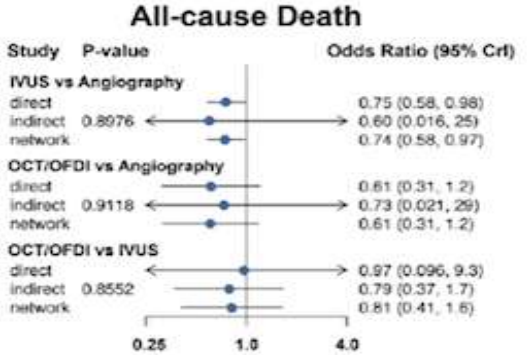


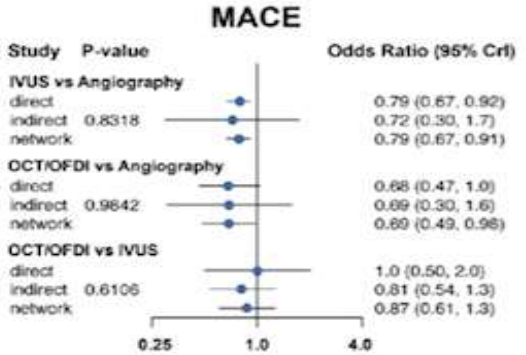
Maehara et al. J Am Coll Cardiol 2013;62:B21-B22

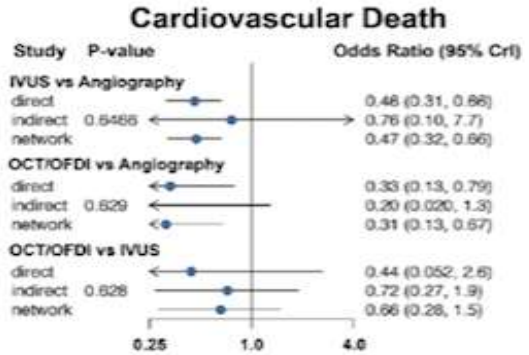
Clinical Outcomes Following Intravascular Imaging-Guided Versus Coronary Angiography–Guided Percutaneous Coronary Intervention With Stent Implantation

2017

A Systematic Review and Bayesian Network Meta-Analysis of 31 Studies and 17,882 Patients







CONCLUSIONS Compared with CA, the use of intravascular imaging techniques for PCI guidance reduces the risk of cardiovascular death and adverse events. (J Am Coll Cardiol Intv 2017;10:2488–98) © 2017 by the American College of Cardiology Foundation.

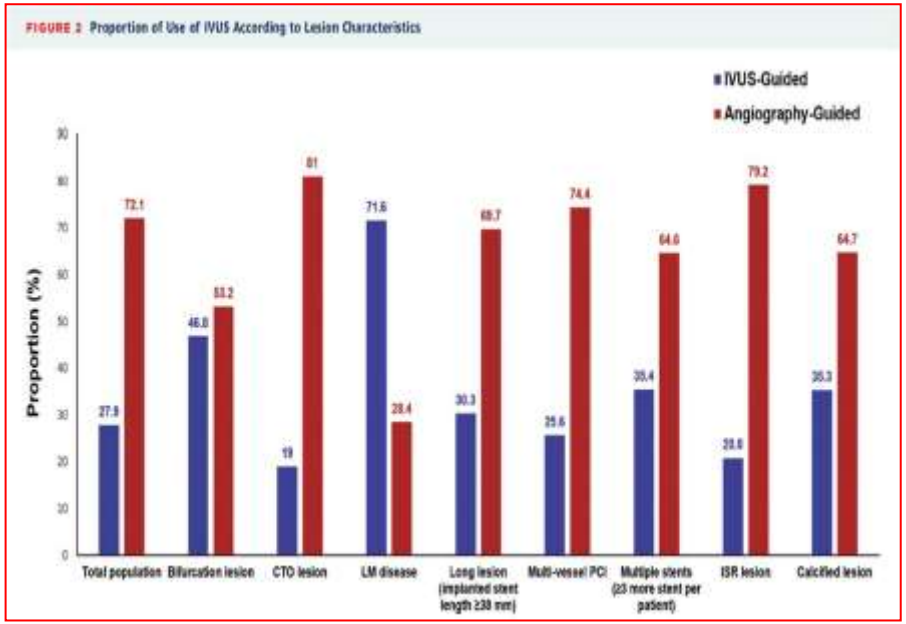
Buccheri S, et al. J Am Coll Cardiol Interv 2017;10:2488-2498

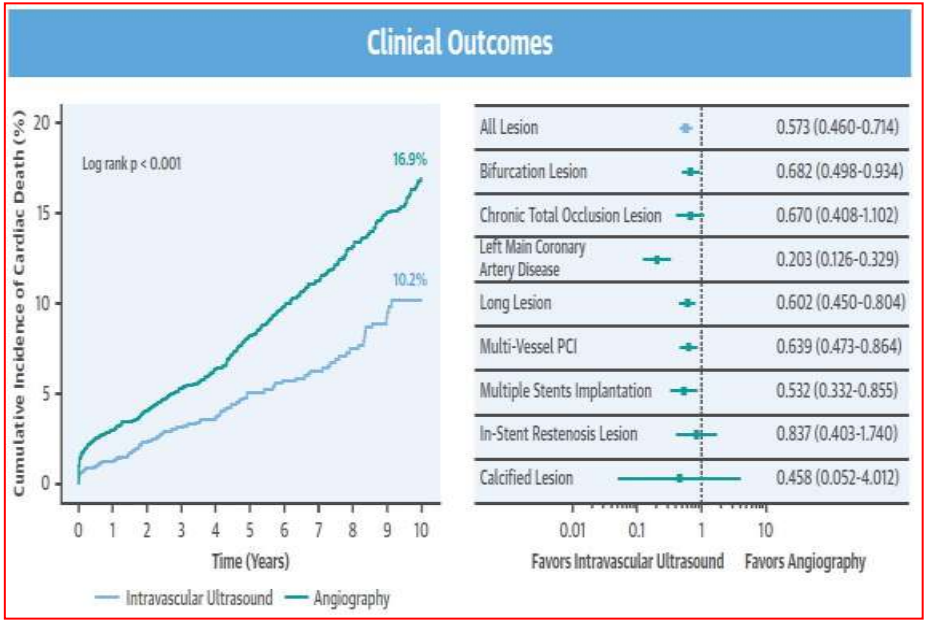
IMPACT OF IVUS- GUIDED PCI on Long-Term Clinical Outcomes in Patienets Undergoing Complex Procedures

2019

(IVUS-Guided - 1.674 Patients) vs (Angography-Guided - 4.331 Patients)

Follow up @ 10 years



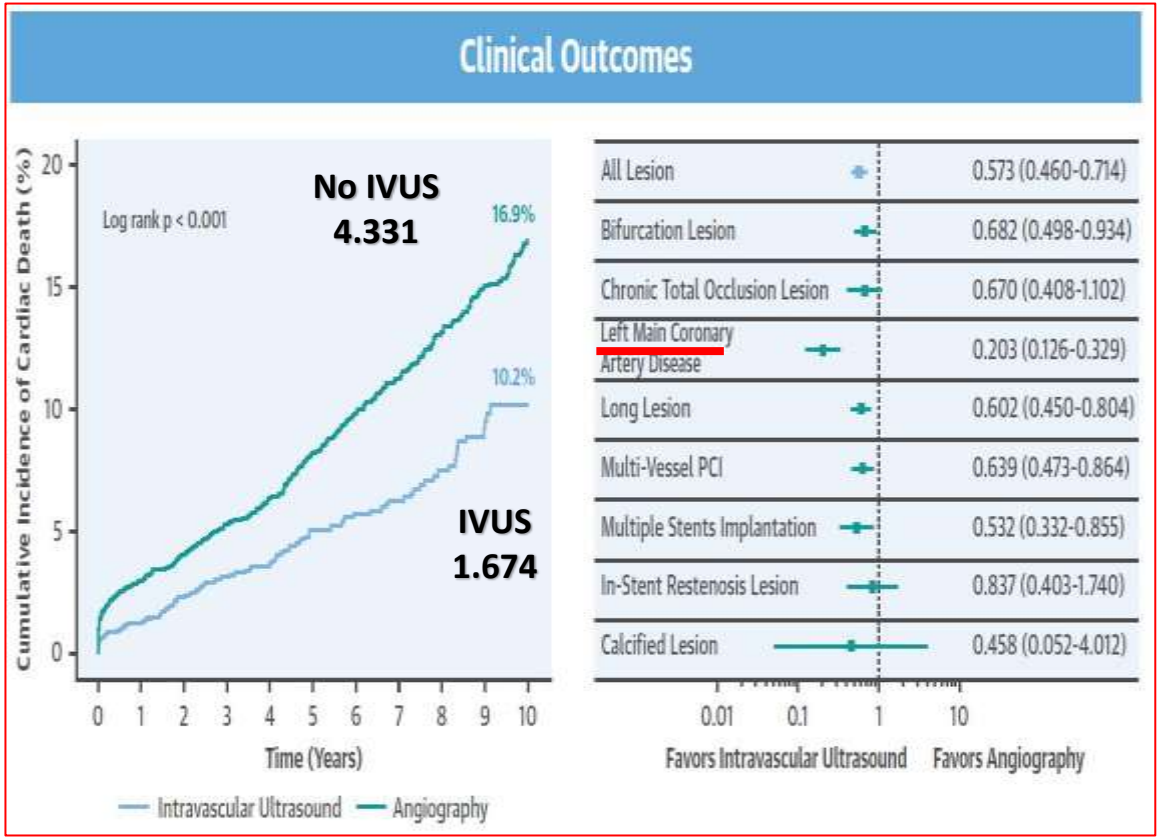


Ki Hong Choi; JACC Cardiovasc Interv. 2019 Apr 8;12(7):607-620

IMPACT OF IVUS- GUIDED PCI on Long-Term Clinical Outcomes in Patienets Undergoing Complex Procedures

2019

Follow up @ 10 years



JACC Cardiovasc Interv. 2019 Apr 8;12(7):607-20

Artículo Original de Investigación

Optimización mediante ultrasonido intravascular de la angioplastia de tronco de coronaria izquierda

Optimization by intravascular ultrasound of left main coronary artery angioplasty

Daniel A. Zanuttini, Tomas Cúneo, Luis Keller, Camila Redondo, Santiago Torres, Daniel Piskorz

Instituto de Cardiología del Sanatorio Británico SRL de Rosario Argentina

INFORMACIÓN DEL ARTÍCULO

Recibido el 21 de Marazo de 2021
Aceptado después de revisión
el 17 de Abril de 2021
www.revistafac.org.ar

Los autores declaran no tener conflicto de intereses

33,4%

Palabras clave:
Tronco de coronaria izquierda.
Angioplastia.
Stents liberadores de droga.
Ultrasonido intravascular.

RESUMEN

Introducción: La cirugía de revascularización miocárdica es el tratamiento convencional para pacientes (p) con lesión de tronco de coronaria izquierda no protegido (TCINP). La Angioplastia Transluminal Coronaria (ATC) con stents liberadores de droga (DES) es una opción factible, con bajas tasas de revascularización debido a reestenosis de la lesión tratada, y con mortalidad similar a la cirugía. **Objetivo:** Evaluar la efectividad de ATC con DES optimizada por ultrasonido intra-coronario (IVUS) en pacientes con enfermedad de TCINP.

Métodos: registro prospectivo consecutivo de p con lesión de TCINP tratados con ATC con DES guiada por IVUS. Se consideraron eventos combinados de muerte, infarto de miocardio, accidente cerebro-vascular (ACV) o revascularización de lesión tratada (RVT).

Resultados: 24 p, edad media 65,7±12,1 años; sexo masculino 83%, diabetes 21%. Enfermedad multi-vaso 88%. Lesión calcificada 13,6%. Fueron implantados 1,5 ± 0,85 stents/paciente. Syntax Score < 22 en 66,6%, 23-32 en 29,1%. Lesiones en bifurcaciones 87%. Implantados con técnica de stent provisional 77,3%. Area luminal media del DES 9,3 mm2. Re-intervención con balón por hipoexpansión y/o falta de aposición en pared 33,3%. Evolución intra-hospitalaria: 1 p infarto sub-clínico (4,1%). Seguimiento promedio 283 ± [illegible] días: 1 p IAM secundario a trombosis tardía de stent (2,7%). Mortalidad y ACV intrahospitalaria y alejada 0%.

Conclusiones: la ATC con DES optimizada con la guía de IVUS en lesiones de TCI NP en nuestra experiencia es un procedimiento seguro, con baja incidencia de complicaciones mayores intra-hospitalaria y alejadas, por lo que puede ser considerado una alternativa a la cirugía de revascularización miocárdica.

Optimization by intravascular ultrasound of left main coronary artery angioplasty

REINTERVENCION DEL STENT

Artículo Original de Investigación

Optimización mediante ultrasonido intravascular de la angioplastía de bifurcación coronaria.

Optimization of coronary bifurcation angioplasty by intravascular ultrasound

Daniel A. Zanuttini, Tomas Cúneo, Lorena Gigli, Gabriel Tissera, Sebastian Cabrera, Luis Keller; Daniel Piskorz.

Instituto de Cardiología del Sanatorio Británico SRL. Rosario. Santa Fe, Argentina

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www.revistafac.org.ar

Los autores declaran no tener conflicto de intereses

22,6%

Palabras clave:
Bifurcación coronaria.
Angioplastia .
Stents Liberadores de Droga.
Ultrasonido Intravascular.

RESUMEN

Introducción: La Angioplastia Transluminal Coronaria (ATC) con stents liberadores de droga (DES) de las lesiones en bifurcación coronaria continua siendo compleja, con tasas importantes de revascularización debidas a reestenosis; sin embargo es una opción factible. Es conocida la limitación de la angiografía sobre los elementos anatómicos y morfológicos de las bifurcaciones, que ya han mostrado valor pronóstico.

Objetivo: Evaluar la efectividad de ATC con DES optimizada por ultrasonido intracoronario (IVUS) en pacientes con enfermedad de bifurcación coronaria. Material y métodos: registro retrospectivo, unicéntrico y de brazo único. Del 11/2018 hasta 10/2021 fueron realizadas 457 angioplastias coronarias, de ellas, se identificaron 84 pacientes consecutivos con lesión de bifurcación coronaria sometidos a ATC con implante de DES guiado por IVUS.

Resultados: Los pacientes fueron seguidos en promedio durante 324 ± 83 días. Edad media 61,4 ± 18,3 años; sexo masculino 82%, diabetes 27%. Enfermedad multi-vaso 88%. Lesión calcificada 13,6% en angiografía y 27% por IVUS. Syntax Score < 22 en 69,1%, 23-32 en 27,3%. Bifurcación más frecuente descendente anterior-diagonal 53,5%. Implantados con técnica de stent provisional 78,5%. Área luminal media del DES 7,3 mm2 en el vaso principal. Re-intervención con balón por hipoexpansión y/o falta de aposición en pared 22,6%. Evolución intra-hospitalaria: 2 p infarto sub-clínico (2,4%). Seguimiento: 1 p IAM secundario a trombosis de stent (1,2%) en vaso lateral revascularizado. Mortalidad y ACV intrahospitalaria y alejada 0 %. Dos stents (1,9%) presentaron trombosis tardía, implantados en vaso lateral, sin evento clínico.

Conclusión: la ATC con DES optimizada con la guía de IVUS en lesiones de bifurcación coronaria es un procedimiento seguro, con baja incidencia de complicaciones mayores intra-hospitalaria y alejadas. El óptimo implante del stent tendría impacto en los resultados del procedimiento.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Intravascular Imaging–Guided or Angiography-Guided Complex PCI

J.M. Lee, K.H. Choi, Y.B. Song, J.-Y. Lee, S.-J. Lee, S.Y. Lee, S.M. Kim, K.H. Yun, J.Y. Cho, C.J. Kim, H.-S. Ahn, C.-W. Nam, H.-J. Yoon, Y.H. Park, W.S. Lee, J.-O. Jeong, P.S. Song, J.-H. Doh, S.-H. Jo, C.-H. Yoon, M.G. Kang, J.-S. Koh, K.Y. Lee, Y.-H. Lim, Y.-H. Cho, J.-M. Cho, W.J. Jang, K.-J. Chun, D. Hong, T.K. Park, J.H. Yang, S.-H. Choi, H.-C. Gwon, and J.-Y. Hahn, for the RENOVATE-COMPLEX-PCI Investigators*

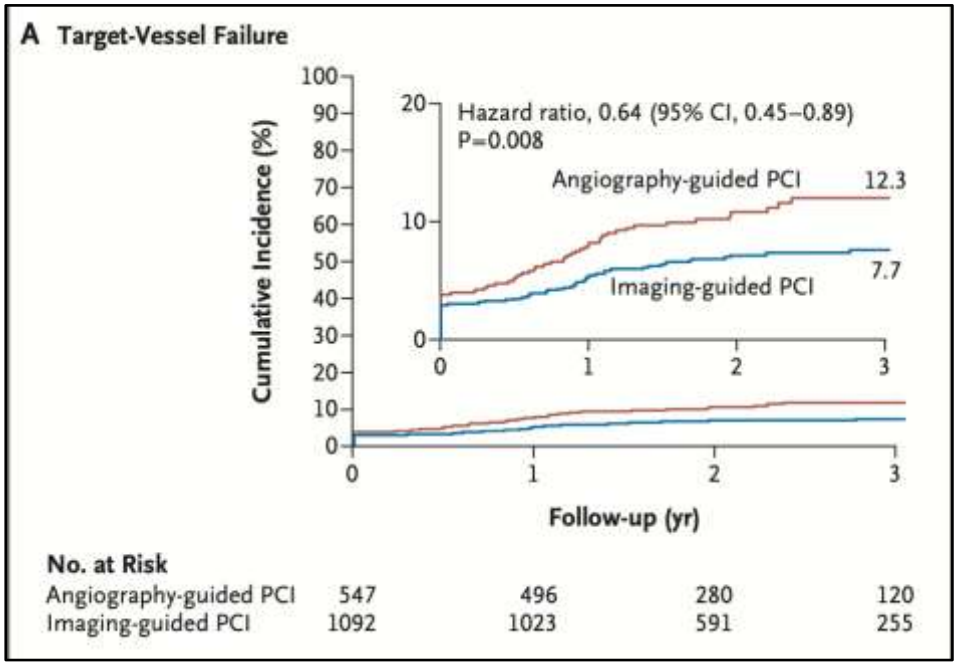
This article was published on March 5, 2023, at NEJM.org.

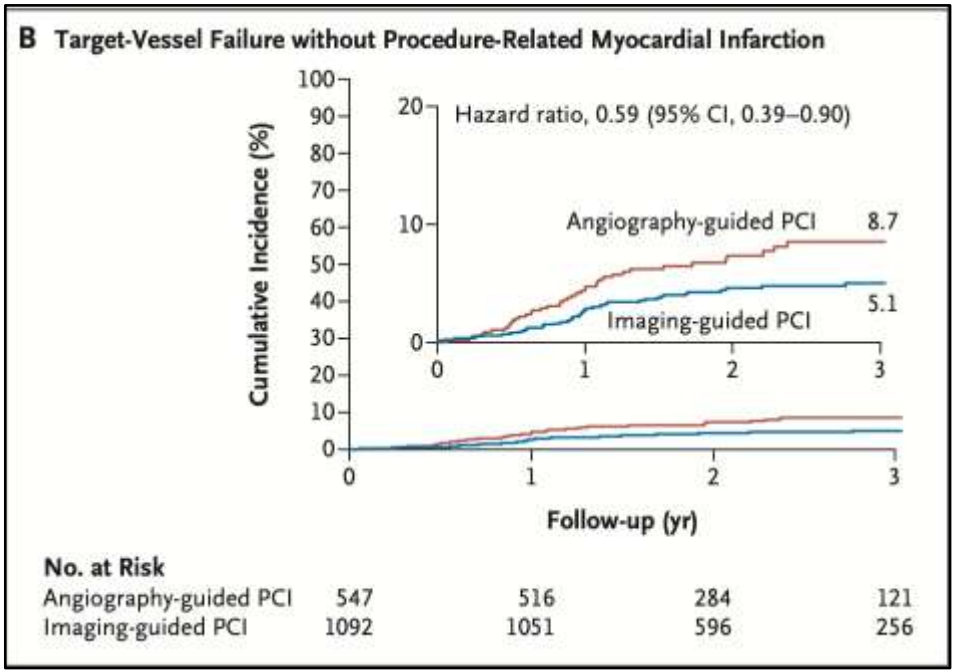
Table 2. Target-Lesion and Procedural Characteristics.*

Characteristic	Total (N = 1639)	Intravascular Imaging–Guided PCI Group (N = 1092)	Angiography-Guided PCI Group (N = 547)
Target-lesion characteristics			
Complex coronary lesions — no. (%)†			
True bifurcation lesion	359 (21.9)	233 (21.3)	126 (23.0)
Chronic total occlusion	319 (19.5)	220 (20.1)	99 (18.1)
Unprotected left main coronary artery disease	192 (11.7)	138 (12.6)	54 (9.9)
Diffuse long coronary-artery lesion	898 (54.8)	617 (56.5)	281 (51.4)
Multivessel PCI involving ≥2 major coronary arteries	622 (37.9)	409 (37.5)	213 (38.9)
Lesion necessitating use of ≥3 stents	305 (18.6)	208 (19.0)	97 (17.7)
Lesion with in-stent restenosis	236 (14.4)	158 (14.5)	78 (14.3)
Severely calcified lesion	231 (14.1)	157 (14.4)	74 (13.5)
Ostial lesions of major coronary artery	251 (15.3)	182 (16.7)	69 (12.6)
≥3 Complex coronary lesions — no. (%)	505 (30.8)	352 (32.2)	153 (28.0)
No. of vessels with disease — no. (%)			
1	526 (32.1)	342 (31.3)	184 (33.6)
2	621 (37.9)	420 (38.5)	201 (36.7)
3	492 (30.0)	330 (30.2)	162 (29.6)
Procedural characteristics			
Total no. of target lesions treated	1.5±0.7	1.5±0.7	1.5±0.7
Intravascular imaging device used — no./total no. (%)‡	1091/1639 (66.6)	1078/1092 (98.7)	13/547 (2.4)
Intravascular ultrasonography	813/1091 (74.5)	800/1078 (74.2)	13/13 (100)
Optical coherence tomography	278/1091 (25.5)	278/1078 (25.8)	0/13
Volume of contrast media used — ml	207.3±116.5	214.2±118.5	193.7±111.3
Median procedural time (IQR) — min	65 (47–89)	70 (51–95)	53.5 (40–75)
Procedural success — no. (%)	1613 (98.4)	1073 (98.3)	540 (98.7)

Table 3. Primary and Secondary End Points According to Competing-Risk Analyses.*

End Point	Total (N=1639)	Intravascular Imaging–Guided PCI Group (N=1092)	Angiography-Guided PCI Group (N=547)	Hazard Ratio (95% CI)
		number (cumulative incidence, %)		
Primary end point: target-vessel failure†	136 (9.2)	76 (7.7)	60 (12.3)	0.64 (0.45–0.89)‡
Secondary end points§				
Target-vessel failure without procedure-related myocardial infarction	88 (6.3)	48 (5.1)	40 (8.7)	0.59 (0.39–0.90)
Target-vessel–related myocardial infarction or death from cardiac causes	96 (6.4)	53 (5.3)	43 (8.5)	0.63 (0.42–0.93)
Death from any cause¶	70 (5.6)	42 (5.3)	28 (6.4)	0.71 (0.44–1.15)
Death from cardiac causes	33 (2.4)	16 (1.7)	17 (3.8)	0.47 (0.24–0.93)
Myocardial infarction‖	75 (5.0)	43 (4.4)	32 (6.2)	0.78 (0.48–1.25)
Target-vessel–related myocardial infarction	68 (4.3)	38 (3.7)	30 (5.6)	0.74 (0.45–1.22)
Spontaneous myocardial infarction	17 (1.2)	8 (0.9)	9 (1.8)	0.66 (0.23–1.90)
Procedure-related myocardial infarction	52 (3.2)	30 (2.7)	22 (4.0)	0.77 (0.43–1.35)
Non–target-vessel–related myocardial infarction	8 (0.8)	5 (0.8)	3 (0.8)	1.24 (0.24–6.40)
Repeat revascularization**	87 (6.6)	55 (6.3)	32 (7.1)	0.95 (0.60–1.48)
Target-vessel revascularization	57 (4.1)	32 (3.4)	25 (5.5)	0.69 (0.40–1.18)
Target-lesion revascularization	44 (3.2)	24 (2.6)	20 (4.4)	0.66 (0.36–1.22)
Definite stent thrombosis††	5 (0.3)	1 (0.1)	4 (0.7)	0.25 (0.02–2.75)
Contrast-induced nephropathy‡‡	40 (2.4)	26 (2.4)	14 (2.6)	0.99 (0.51–1.92)



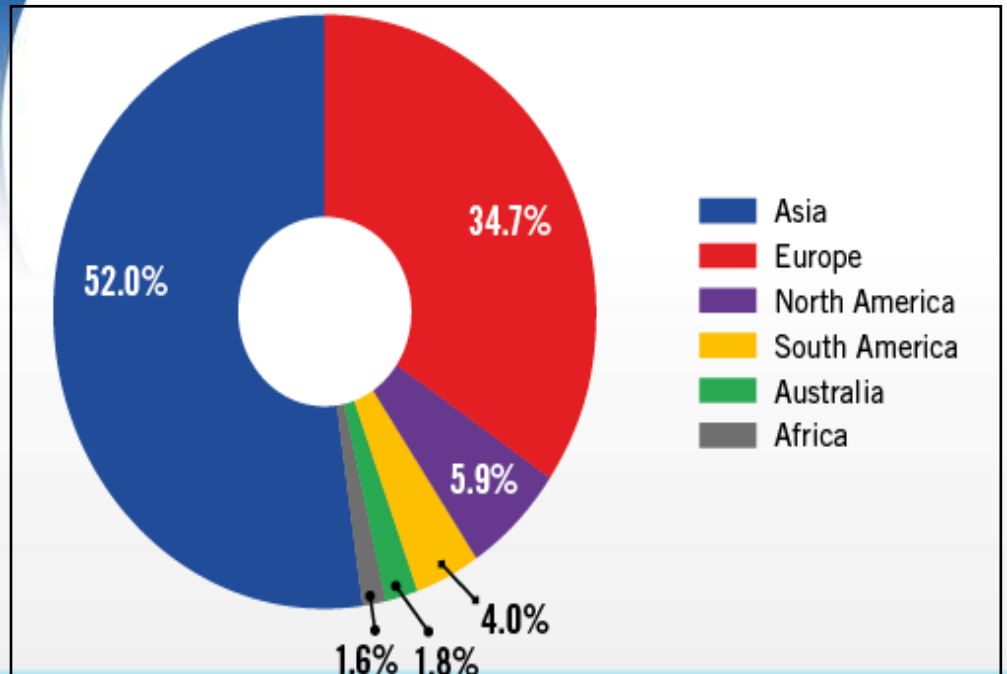


CONCLUSION:

Lesiones complejas. ICP guiada por imágenes intravasculares

- menor riesgo de una combinación de MUERTE por causas cardíacas, IAM relacionado con el vaso diana o revascularización del vaso diana impulsada clínicamente
  vs. la ICP guiada por angiografía. .

Current use of intracoronary imaging in interventional practice – Results of a European Association of Percutaneous Cardiovascular Interventions (EAPCI) and Japanese Association of Cardiovascular Interventions and Therapeutics (CVIT) Clinical Practice Survey



Factors limiting the clinical use of IVUS / OCT

65.9 %	High cost
35 %	Prolongation of the diagnostic procedure or intervention
29.3 %	Regulatory issues (reimbursement)
17.1%	Lack of training for use and interpretation of these modalities
12.1%	Absence of established criteria for corrective measures based on 'abnormal' imaging findings
9.5 %	Risk of procedural complications
8.3 %	Clinical value is not established
8.6 %	I do not know

Comentarios finales

- Angioplastias guiadas por imágenes (IVUS), produce cambios en resultados largo plazo, en PCI complejas, especialmente en reducir revascularización de la lesión tratada.

- Para obtener estos beneficios, las imágenes deberían ser correctamente interpretadas, y los operadores deberían reaccionar a los resultados del IVUS.

- Guía por IVUS para lesiones complejas y detección del mecanismo de falla del stent

(Clase I, evidencia A)

PRE intervención: evaluación vaso y características lesión

POST intervención: expansión del Stent, aposición y complicaciones agudas (disección).

- Desde el momento que tomó su desición de darle el tiempo necesario para re evaluar su caso por IVUS, intente identificar las diferentes imágenes / complicaciones.

MUCHAS GRACIAS

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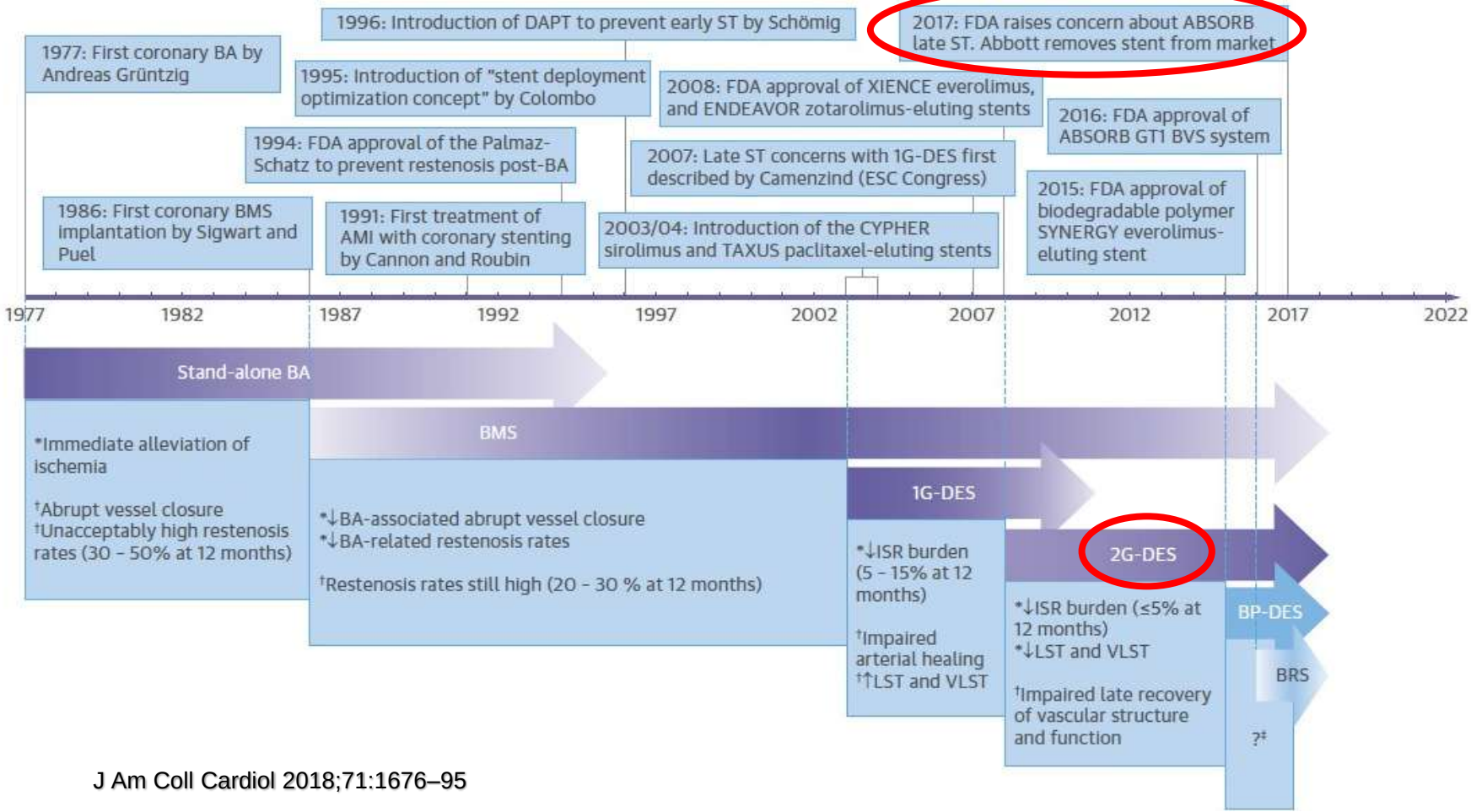
Milestones in the Evolution of PCI Over the First 40 Years



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