Oclusión crónica total: quiénes se benefician de la revascularización

Dr Mario Araya
Past president SOLACI
Chile

- Sin conflicto de interés

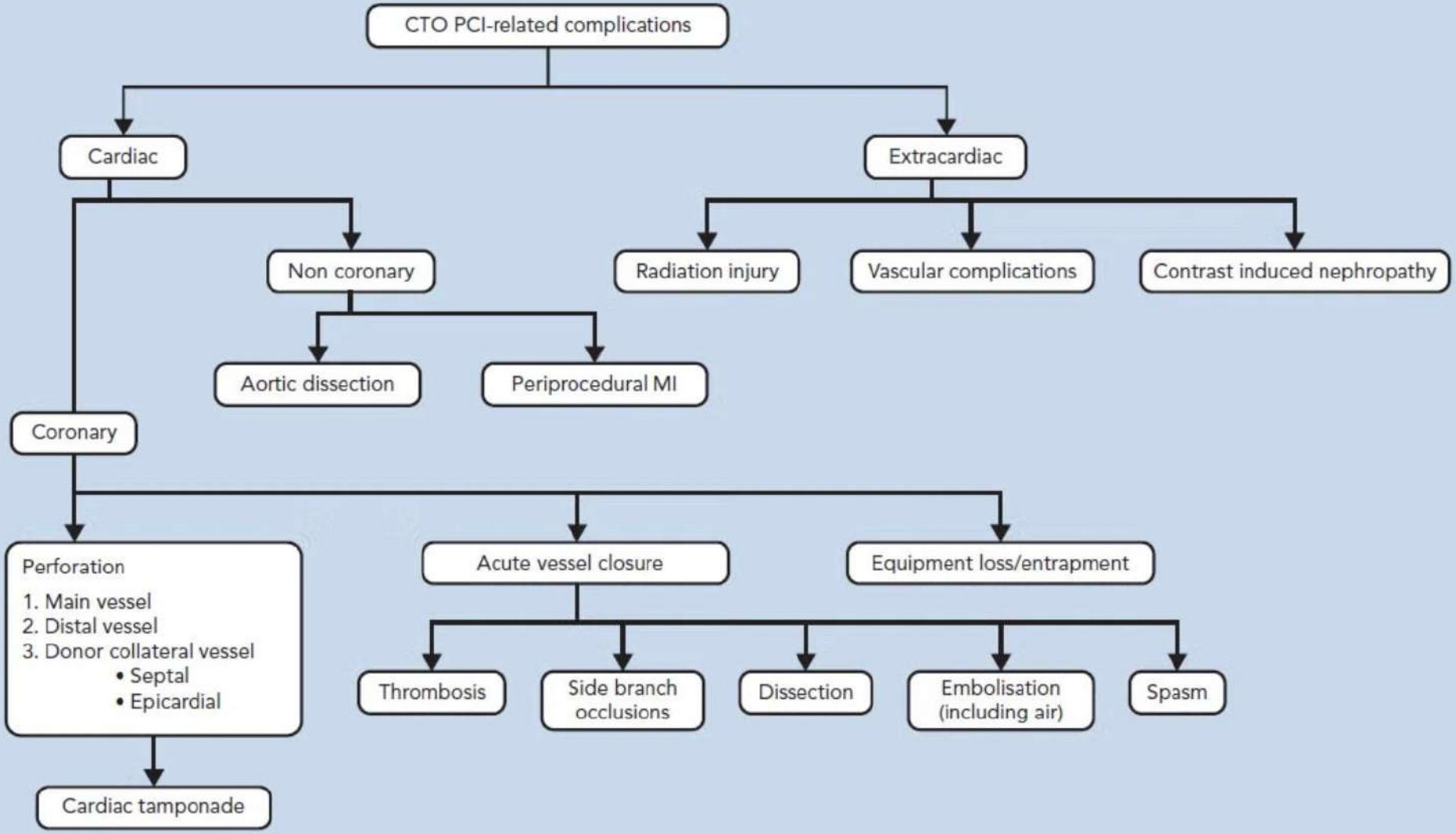
Introducción

- Las oclusiones crónicas (CTO) están presente hasta en un 25% de los pacientes con enfermedad coronaria
- Su manifestación clínica es diversa y depende del % de miocardio irrigado y su viabilidad, así como la existencia de enfermedad en otros vasos.
- Su tratamiento es complejo, asociado a menor tasa de éxito, mayor tasa de falla en seguimiento y un significativo aumento de complicaciones


Riesgo
Beneficio

Determinar riesgos

- El riesgo es proporcional a la complejidad anatómica y al estado del paciente
- En pacientes con FE muy reducida y elevación de PFDVI o PCP considere algún grado de asistencia (protected PCI)
- Analice en detalle anatomía. J-CTO score y distribución de calcio. El CT puede ser su aliado
- Reconocimiento rápido de complicaciones
- Adecuado toolbox para tratarlas
- Analizar en reuniones los eventos adversos


CTO PCI-related complications
Cardiac
Extracardiac
Non coronary
Radiation injury
Vascular complications
Contrast induced nephropathy
Aortic dissection
Periprocedural MI
Coronary
Perforation
1. Main vessel
2. Distal vessel
3. Donor collateral vessel
• Septal
• Epicardial
Acute vessel closure
Equipment loss/entrapment
Thrombosis
Side branch occlusions
Dissection
Embolisation (including air)
Spasm
Cardiac tamponade

> Heart Lung Circ. 2024 Jul;33(7):915-931. doi: 10.1016/j.hlc.2023.11.030. Epub 2024 Jun 4.

Global Consensus Recommendations on Improving the Safety of Chronic Total Occlusion Interventions

Eugene B Wu [1], Arun Kalyanasundaram [2], Emmanouil S Brilakis [3], Kambis Mashayekhi [4], Etsuo Tsuchikane [5]; CTO Global Consensus Group

Collaborators, Affiliations – collapse

Collaborators

CTO Global Consensus Group: Nidal Abi Rafeh [6], Pierfrancesco Agostoni [7], Khaldoon Alaswad [8], Mario Araya [9], Alexandre Avran [10], Mohamed Ayoub [11], Lorenzo Azzalini [12], Avtandil M Babunashvili [13], Baktash Bayani [14], Michael Behnes [15], Ravinay Bhindi [16], Nicolas Boudou [17], Marouane Boukhris [18], Nenad Z Bozinovic [19], Leszek Bryniarski [20], Alexander Bufe [21], Christopher E Buller [22], M Nicholas Burke [3], Heinz Joachim Buettner [23], Pedro Cardoso [24], Mauro Carlino [25], Chi-Kin Chan [26], Jiyan Chen [27], Evald Hoej Christiansen [28], Antonio Colombo [29], Kevin Croce [30], Felix Damas de Los Santos [31], Tony de Martini [32], Joseph Dens [33], Carlo di Mario [34],

Cómo identificar a quienes puedan beneficiarse

Los pacientes con CTO tiene síntomas iguales o peores que los pacientes coronarios “no CTO”

	CTO n=124	No CTO n=1833	
Baseline Health Status			
SAQ Physical Limitation Score	72.1 ± 26.9	77.9 ± 23.4	**0.016**
SAQ Angina Frequency Score	70.1 ± 28.1	72.9 ± 23.6	0.212
SAQ Quality of Life Score	54.3 ± 25.5	56.0 ± 25.4	0.487
Rose Dyspnea Score	1.9 ± 1.5	1.7 ± 1.5	0.209
6-Month Health Status			
SAQ Physical Limitation Score	96.2 ± 12.8	95.7 ± 12.9	0.742
SAQ Angina Frequency Score	91.0 ± 19.0	93.2 ± 15.1	0.126
SAQ Quality of Life Score	80.6 ± 21.4	80.5 ± 19.9	0.951
Rose Dyspnea Score	1.0 ± 1.4	0.9 ± 1.3	0.497

European Cardiovascular Research Center

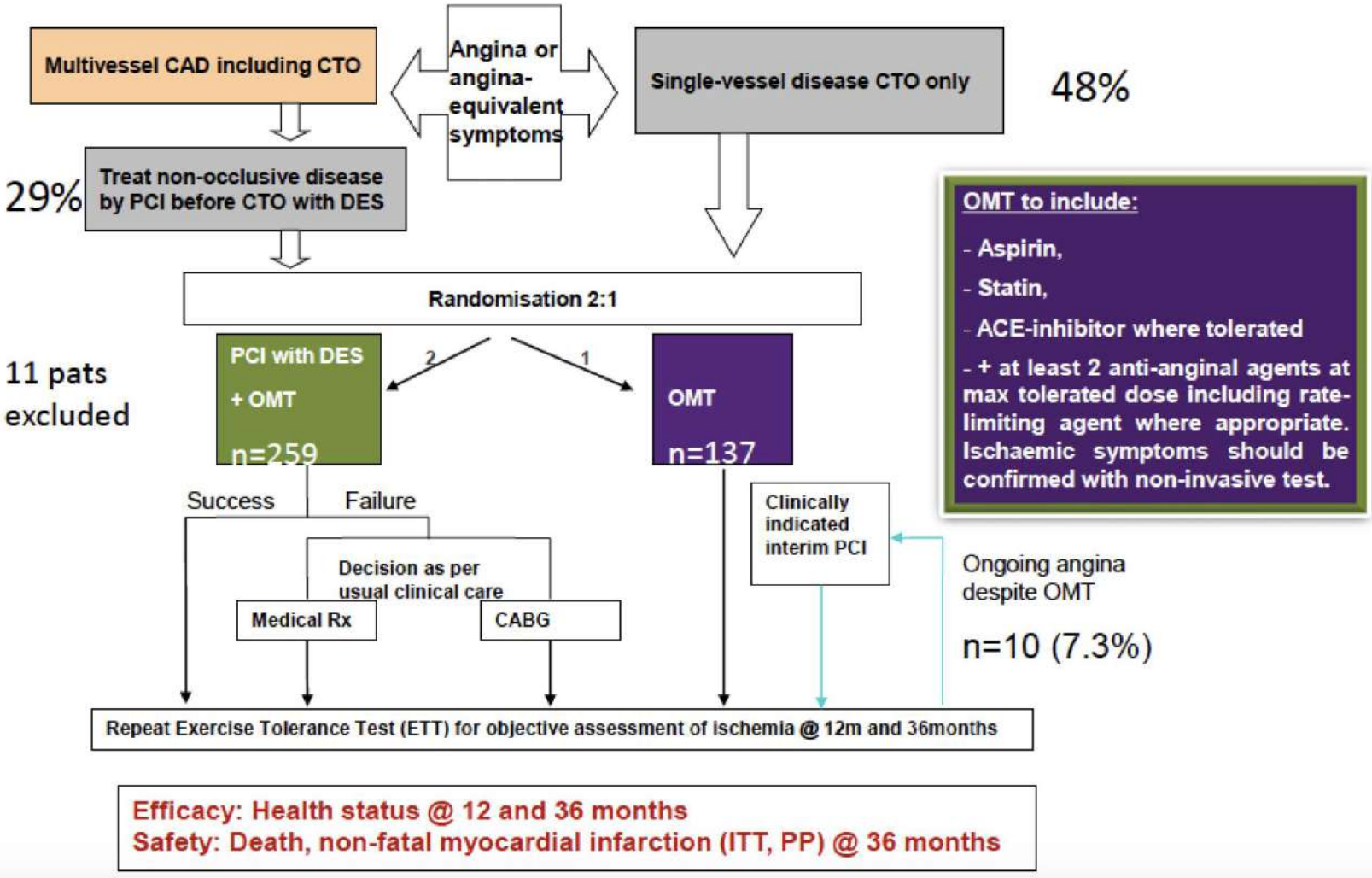
A Randomized Multicentre Trial to Evaluate the Utilization of Revascularization or Optimal Medical Therapy for the Treatment of Chronic Total Coronary Occlusions

EURO-CTO

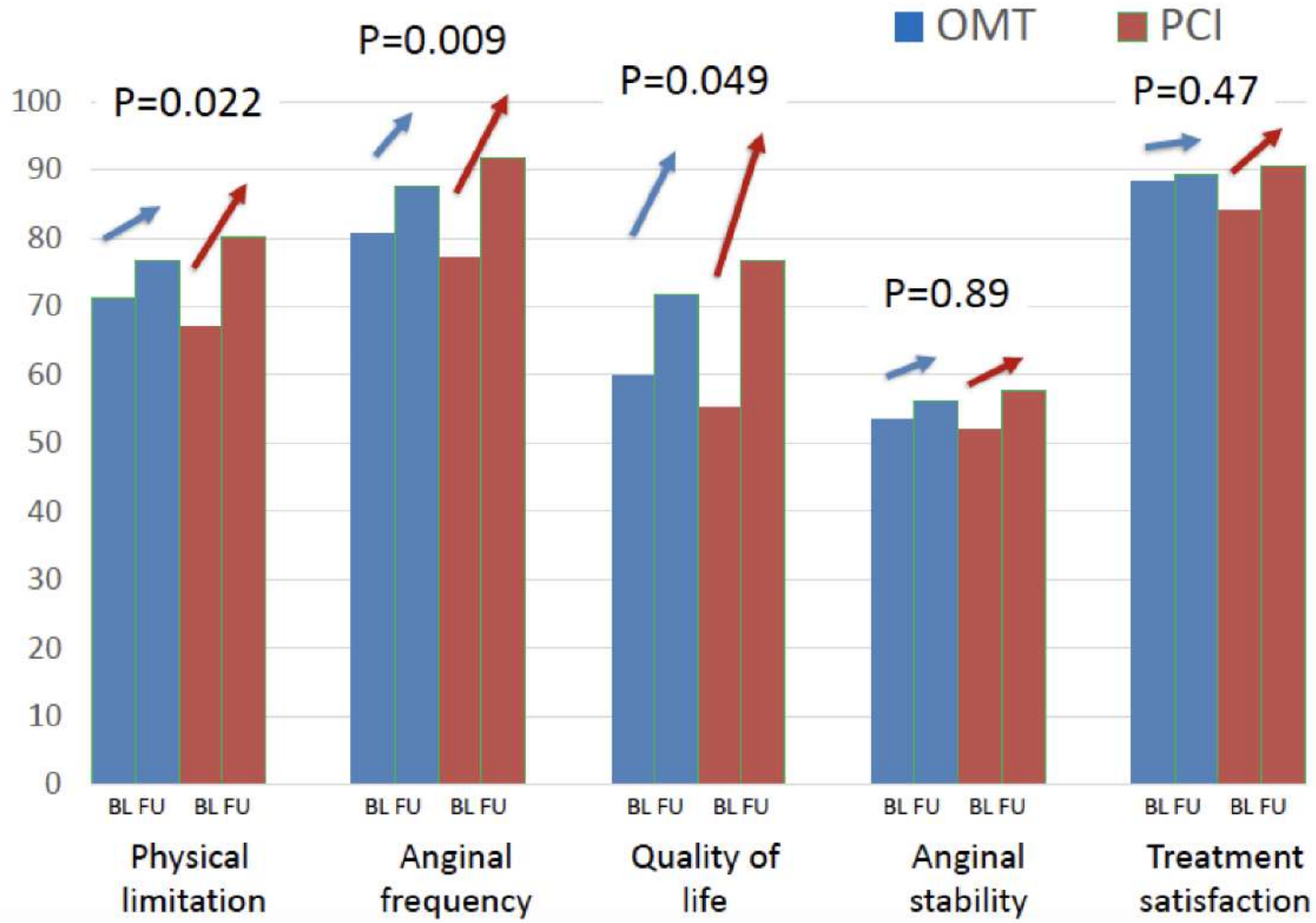
EURO CTO CLUB

NCT01760083

Study flow chart

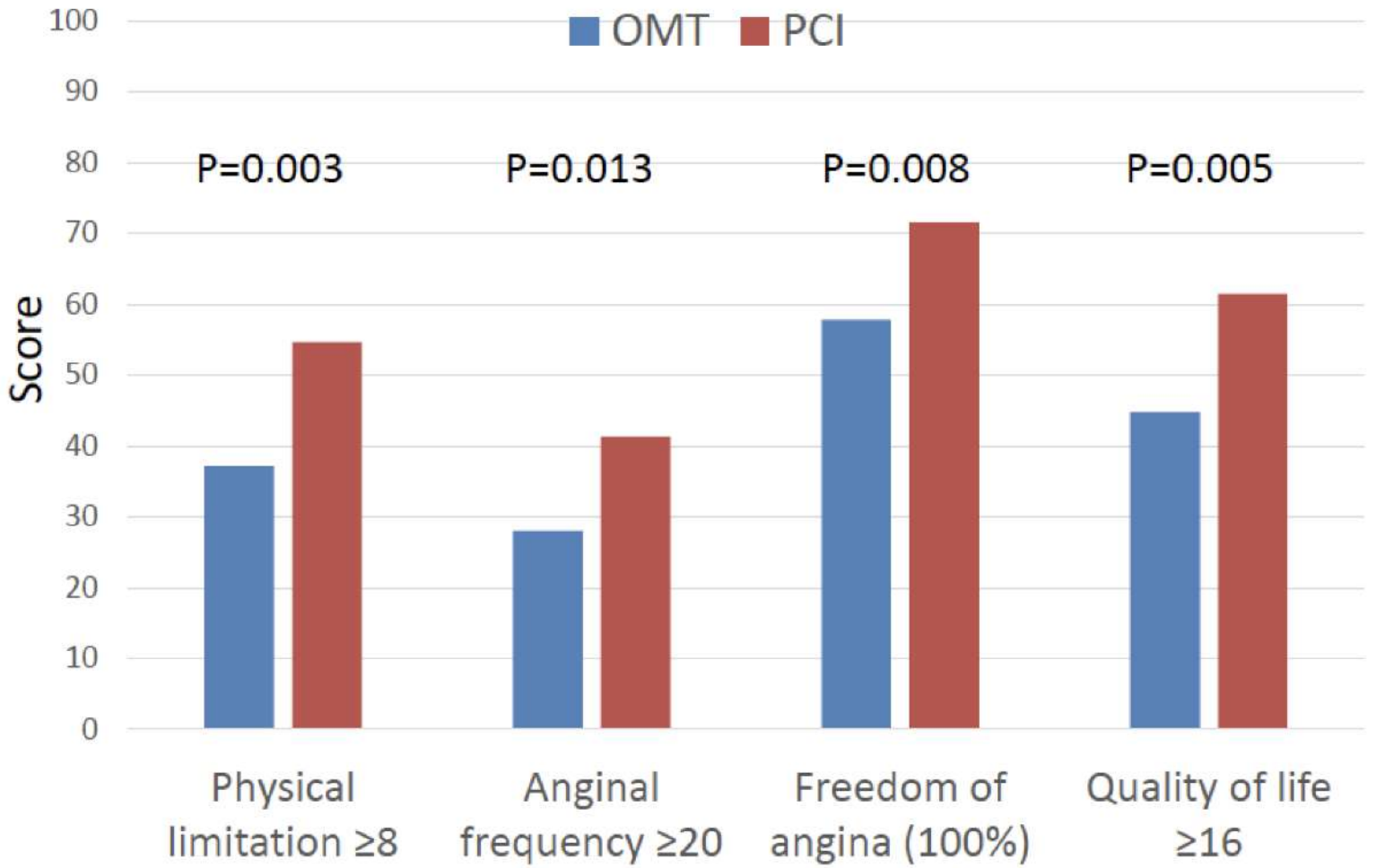


Primary endpoint: SAQ health status (ITT)



For multiple testing the significance level is 0.01

Significant change in SAQ subscale scores *)



Higher score, better health status

*) Spertus et al. JACC 1995;25:333-41

Primary safety endpoint @ 36 months ITT

	OMT (N=137)	PCI (N=259)	P (log rank)
Safety events	4 (2.9)	13 (5.0)	0.32
Cardiovascular death	2 (1.5)	7* (2.7)	0.42
Non-fatal MI	2 (1.5)	6 (2.3)	0.56

Number of patients (%)

- **2 pts died before PCI was performed**
- **2 pts had failed PCI**

CV Death @ 36 months after successful CTO PCI was 1.4%

PCI exitosa vs frustra, impacto en angina

Study	PCI success Events	Total	PCI failure Events	Total	Weight%	Odds ratio [95%CI]
Finci	43	100	74	100	c	0.27 [0.14, 0.50]
Warren	3	25	7	18	2.13	0.20 [0.03, 1.15]
Ivanhoe	90	286	53	144	14.09	0.79 [0.51, 1.23]
Angioi	27	93	56	108	10.72	0.34 [0.18, 0.64]
Olivari	28	248	15	60	6.25	0.38 [0.18, 0.84]
Drozd	120	280	79	149	17.19	0.66 [0.44, 1.01]
Jolicoeur	21	213	14	133	4.53	0.93 [0.43, 2.06]
Borgia	38	237	30	65	11.54	3.53 [1.87, 6.61]
Ciercwierz	44	138	107	138	21.25	0.13 [0.07, 0.23]
TOTAL	**414**	**1621**	**435**	**915**	**100**	**0.38 [0.24, 0.60]**

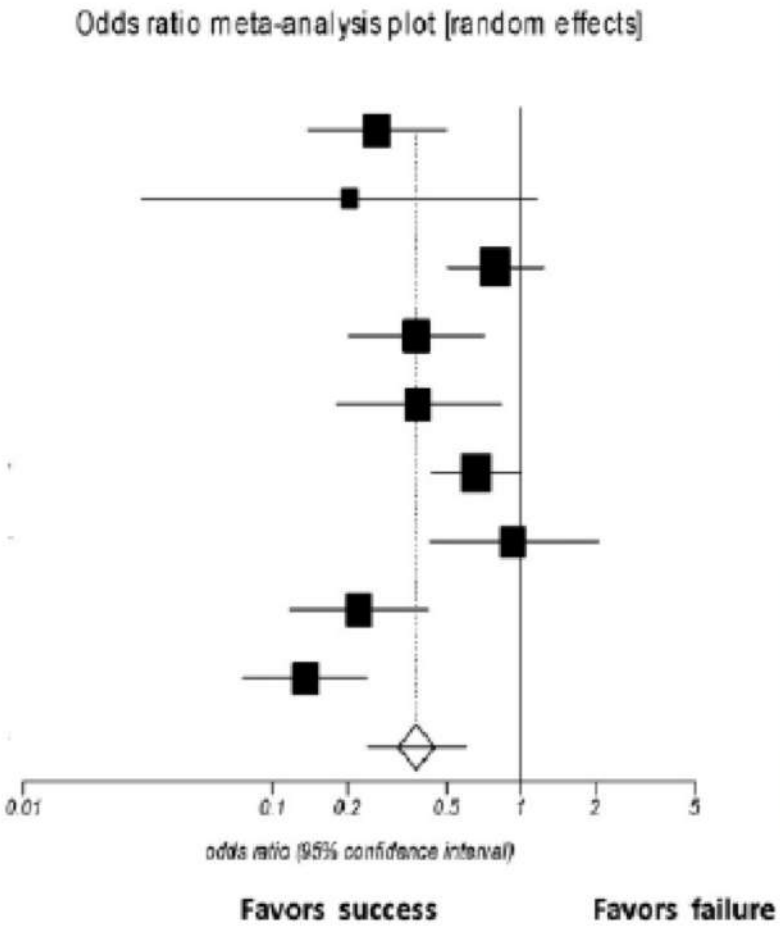
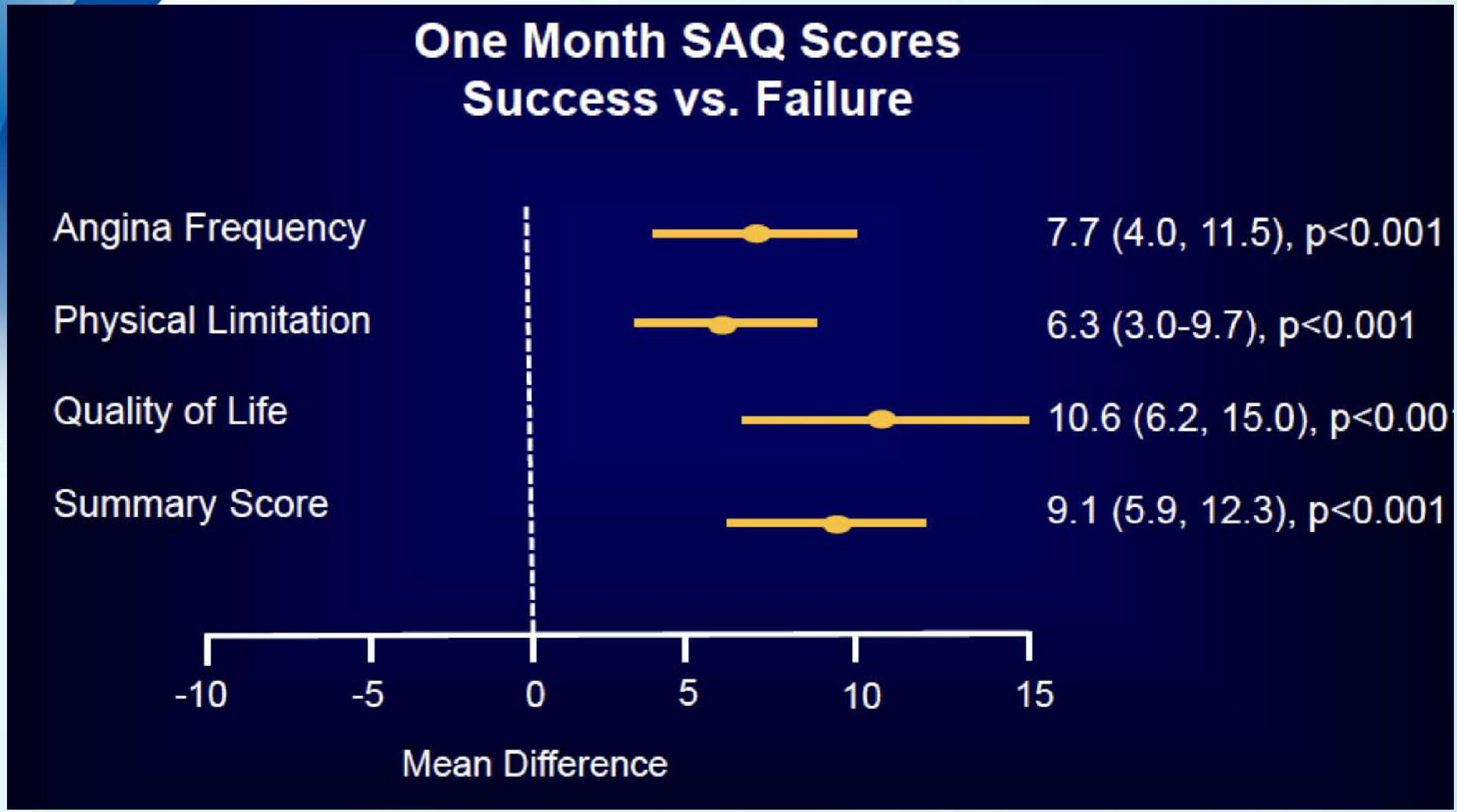


Figure 5. Forest plot for angina with successful versus failed CTO PCI.

Christakopoulos et al. Am J Cardiol 2015;115:1367e1375

Registro OPEN CTO



2021 ACC/AHA/SCAI Guidelines statement on CTO PCI

COR	LOE	RECOMMENDATION
2b	B-R	1. In patients with suitable anatomy who have refractory angina on medical therapy, after treatment of non-CTO lesions, the benefit of PCI of a CTO to improve symptoms is uncertain (1-4).

- *"Despite considerable retrospective and registry data suggesting a clinical benefit of PCI of a CTO, a clear demonstration of benefit from prospective randomized trials has not been forthcoming"*

JACC VOL. 85, NO. 12, 2025

PUBLISHED BY ELSEVIER

Invasive vs Conservative Management of Patients With Chronic Total Occlusion

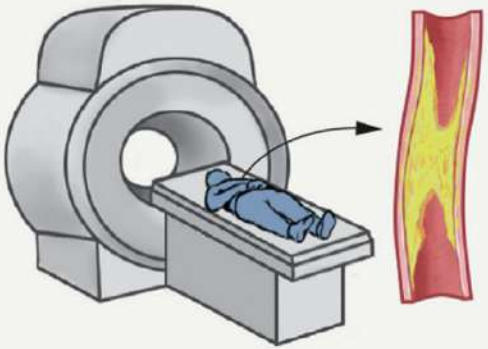
Results From the ISCHEMIA Trial

Sripal Bangalore, MD, MHA,[a] G.B. John Mancini, MD,[b] Jonathan Leipsic, MD,[b] Mathew J. Budoff, MD,[c] Yifan Xu, MPH,[a] Rebecca Anthopolos, DrPH,[a] Emmanouil S. Brilakis, MD, PhD,[d] Aeshita Dwivedi, MD,[e,f] John A. Spertus, MD, MPH,[g] Phil G. Jones, MS,[g] Yoon Joo Cho, MS,[g] Daniel B. Mark, MD, MPH,[h] Cameron J. Hague, MD,[b] James K. Min, MD,[i] Harmony R. Reynolds, MD,[a] Ahmed Elghamaz, MB, BCh,[j] Rajesh Goplan Nair, MD, DM,[k] Kreton Mavromatis, MD,[l] Gilbert Gosselin, MD,[m] Subhash Banerjee, MD,[n] Hristo Pejkov, MD, PhD,[o] Steven Lindsay, MB, BCh, MD,[p] J. Aaron Grantham, MD,[g] David O. Williams, MD,[q] Gregg W. Stone, MD,[r] Sean M. O'Brien, PhD,[h] Judith S. Hochman, MD,[a,*] David J. Maron, MD,[s,*] the ISCHEMIA Research Group

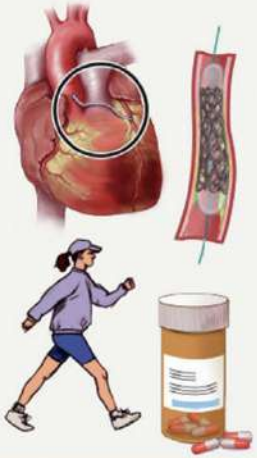
CENTRAL ILLUSTRATION **Effect of INV vs CON on Clinical and QoL Outcomes in Patients With CCTA-Determined CTO in the ISCHEMIA Trial**

1,470 patients from the ISCHEMIA trial with coronary computed tomography angiography (CCTA)-determined chronic total occlusions (CTO)

(Moderate or severe ischemia demonstrated via stress testing)



Initial invasive strategy (INV) n=752



vs

Initial conservative strategy (CON) n=718

ISCHEMIA trial exclusions:

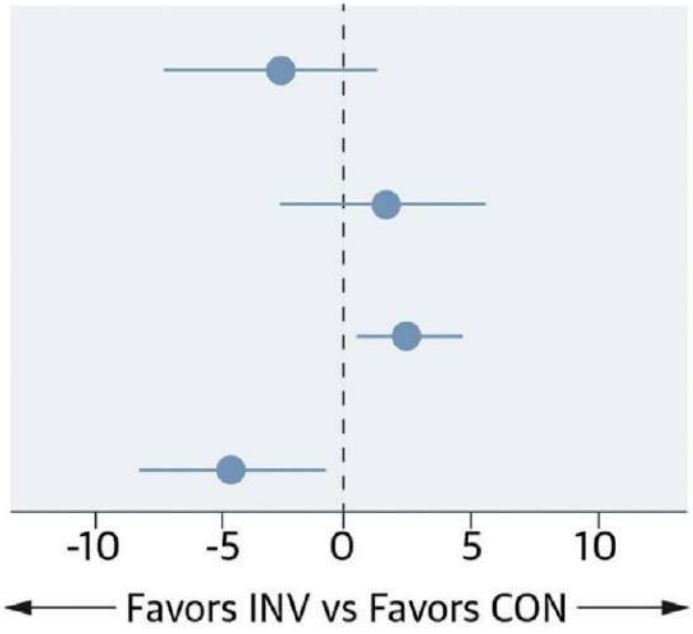
- Left main disease
- Estimated glomerular filtration rate <30
- Dialysis
- Recent acute coronary syndrome
- Heart failure hospitalization
- Intolerable angina despite optimal medical therapy

Invasive vs Conservative (Intention to Treat)

Invasive vs Conservative (Intention to Treat)

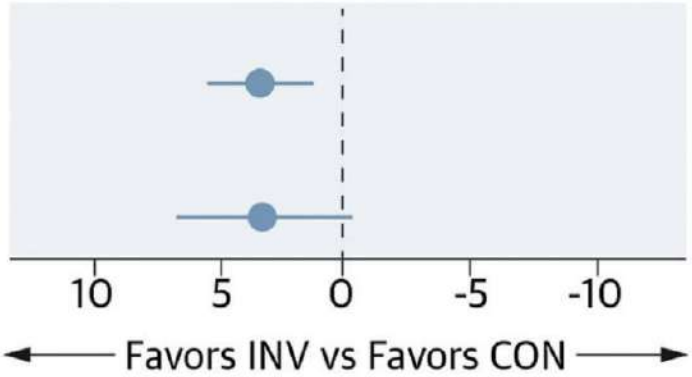
Clinical Outcomes

CV death/MI	-2.1% (-6.0% to 1.8%)
Death	1.2% (-1.9% to 4.2%)
Procedural MI	1.9% (0.5% to 3.4%)
Spontaneous MI	-3.8% (-6.7% to -1.0%)



QoL Outcomes

SAQ-7 AF score	2.9 pts (1.3 to 4.4)
Rose Dyspnea Scale	2.3 pts (5.4 to -0.7)



LIV Jornadas SOLACI
Ciudad de Panamá

ACC.26

The Essex Cardiothoracic Centre

a.r.u. Medical Technology Research Centre

Chronic Total Occlusion Percutaneous Coronary Intervention in Stable Angina – (ORBITA-CTO) A randomized, placebo-controlled trial

Sarosh Khan MBBS MRCP

@dr_skhan1

Chief Investigator: John Davies MBBS PhD

On behalf of the ORBITA-CTO investigators

ORBITA CTO

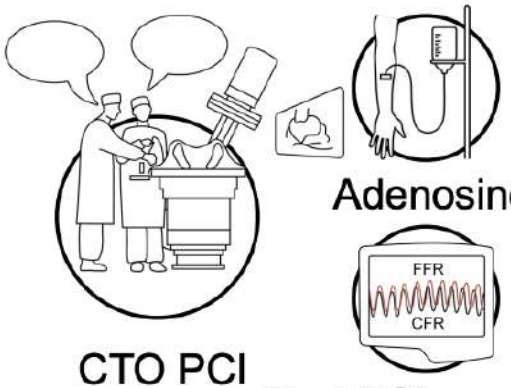
AMERICAN COLLEGE of CARDIOLOGY

Inclusion

- Single vessel CTO with ischemia and viability
- Symptomatic with angina or equivalent
- Accepted by CTO operator
- J-CTO ≤ 3

Randomization

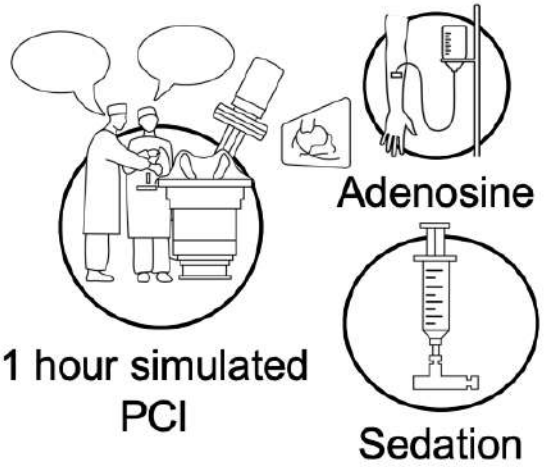
CTO PCI



CTO PCI

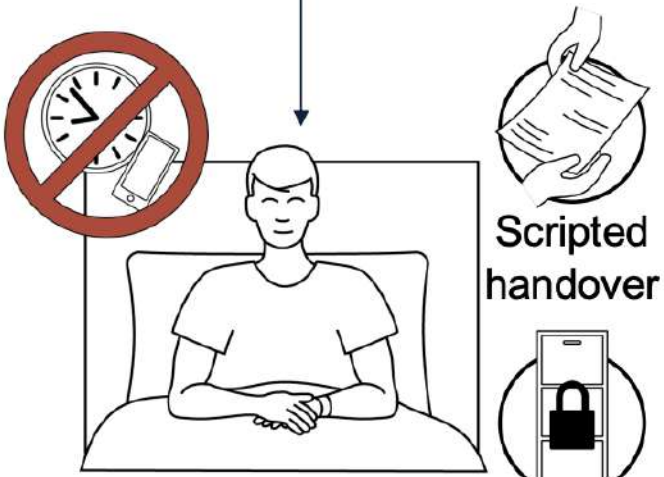
Post PCI coronary physiology

PLACEBO



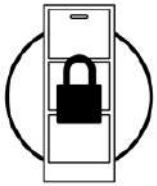
1 hour simulated PCI

Sedation



3-hour recovery

Scripted handover

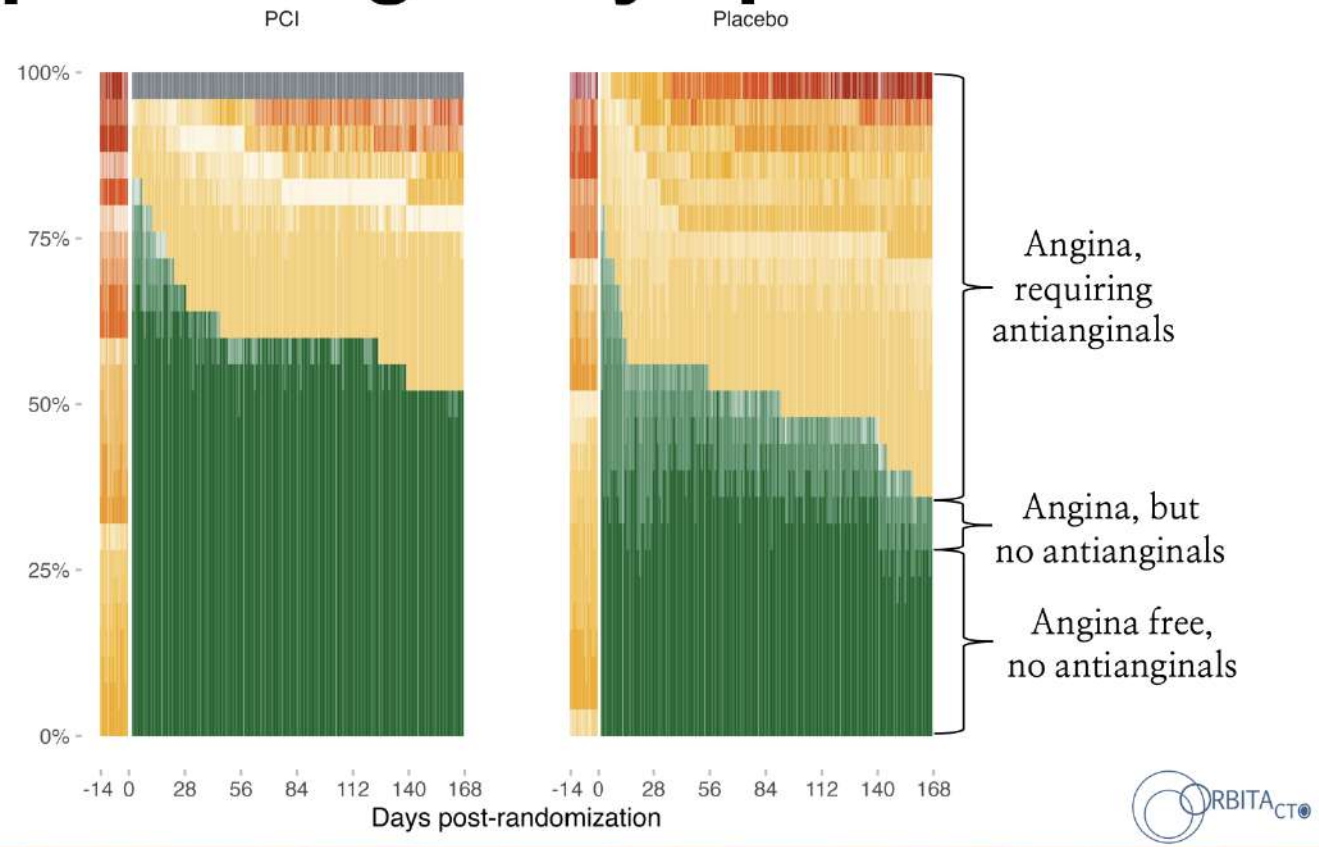


Paperwork

Primary endpoint: angina symptom score

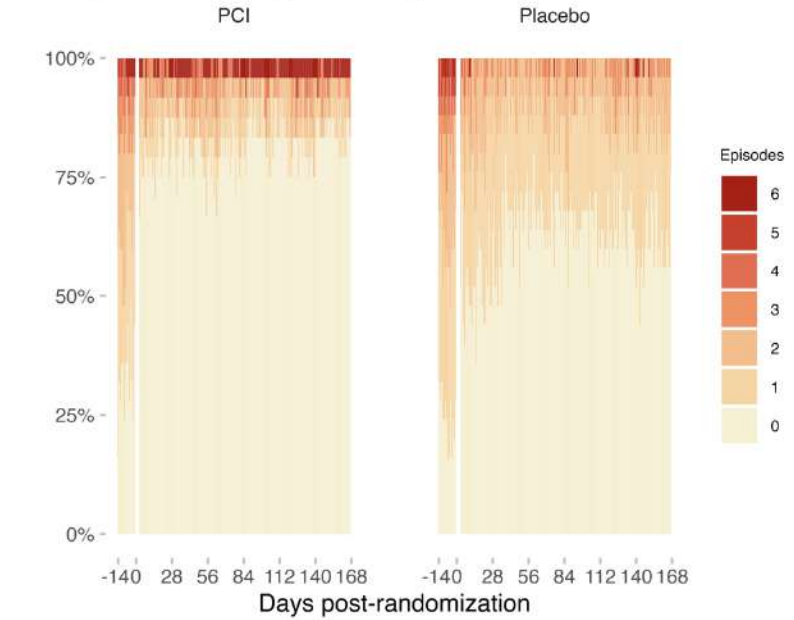
CTO PCI improved angina symptom score
OR 4.38
(CrI 1.57 to 12.69)
Pr(benefit)= 99.6%

CTO PCI led to and additional 30.6 days free from angina
(CrI 11.1 to 50.7)
Pr(benefit)> 99.9%



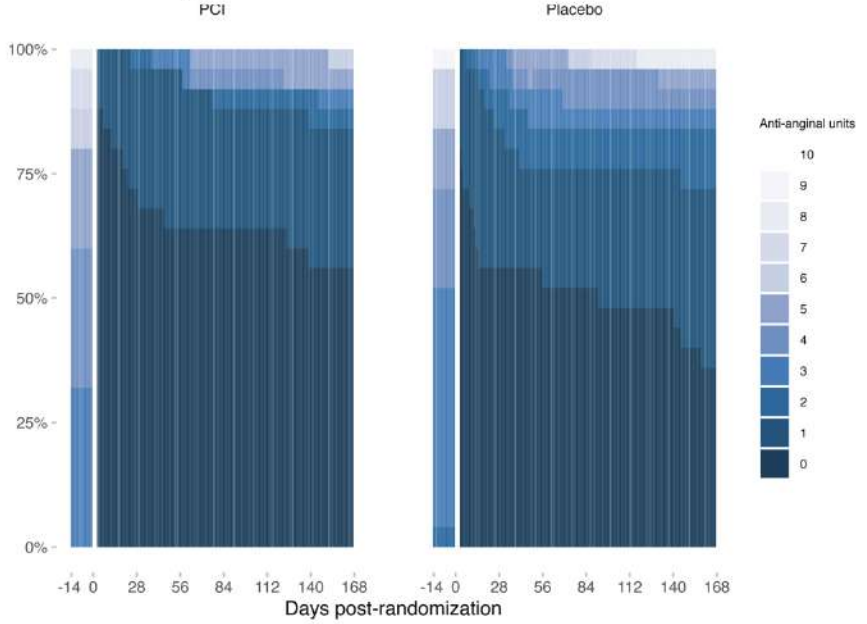
CTO PCI reduced angina frequency

Angina frequency



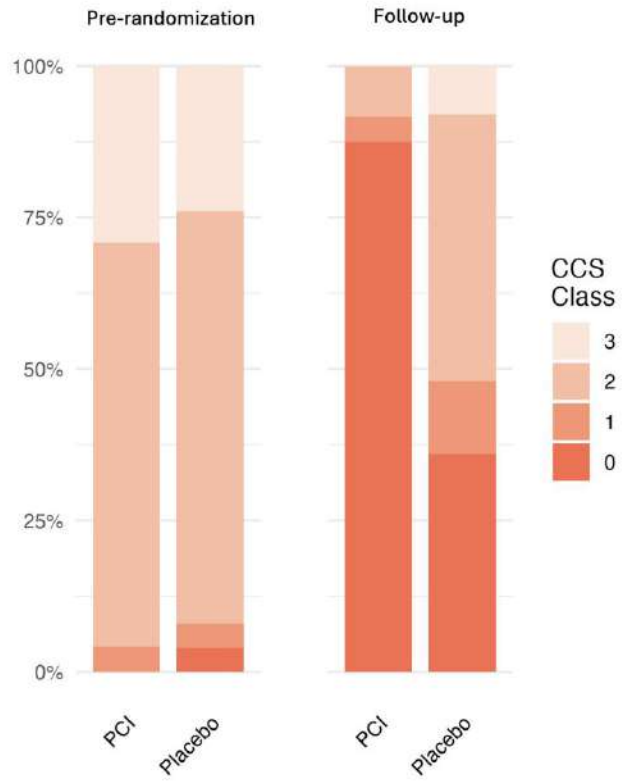
PCI improved angina frequency
OR 4.38 (1.55 to 11.78), Pr(benefit)= 99.7%

Antianginal use



No difference in antianginal use
OR 1.54 (0.37 to 6.46), Pr(benefit)= 71.5%

CTO PCI improved CCS Class



Mean difference -0.70
(-0.27 to -1.13)
Pr(benefit)> 99.9%

Otros beneficios potenciales

- Disminución de la isquemia
- Mejoría de función ventricular
- Efecto antiarrítmico
- Pronóstico favorable en revascularización completa de EMV
- Efecto deletéreo en infarto agudo

Catheterization and Cardiovascular Interventions 00:000–000 (2011)

Original Studies

301 CTO succesfully treated (Myocardial Perfusion Imaging) at basal and 12 months post PCI

Changes in Myocardial Ischemic Burden Following Percutaneous Coronary Intervention of Chronic Total Occlusions

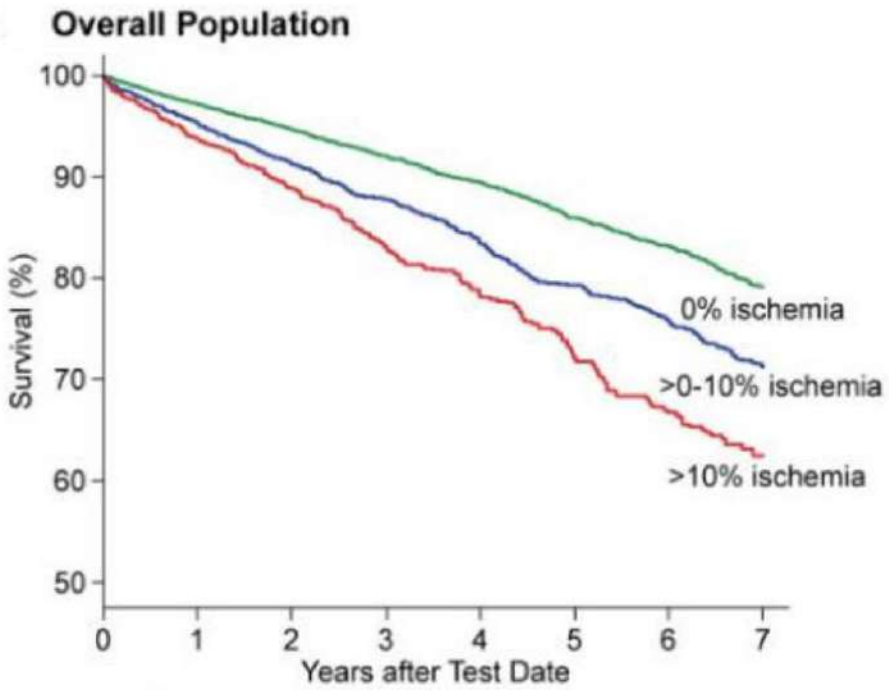
David M. Safley,[1,2*] MD, Sindhu Koshy,[1] MD, J. Aaron Grantham,[1,2] MD, Kevin A. Bybee,[1,2] MD, John A. House,[1] MS, Kevin F. Kennedy,[1] MS, and Barry D. Rutherford,[1,2] MD

Variable	MPI before ($n = 301$)	MPI after ($n = 301$)	P-value
% Myocardium ischemic	13.1 ± 11.9	6.9 ± 6.4	<0.001
Region			
Left anterior descending	5.0 ± 6.25	2.63 ± 3.63	<0.001
Left circumflex	3.63 ± 4.38	2.13 ± 3.13	<0.001
Right coronary artery	4.50 ± 5.38	2.13 ± 2.89	<0.001
Ejection fraction	0.57 ± 0.15	0.58 ± 0.17	0.51

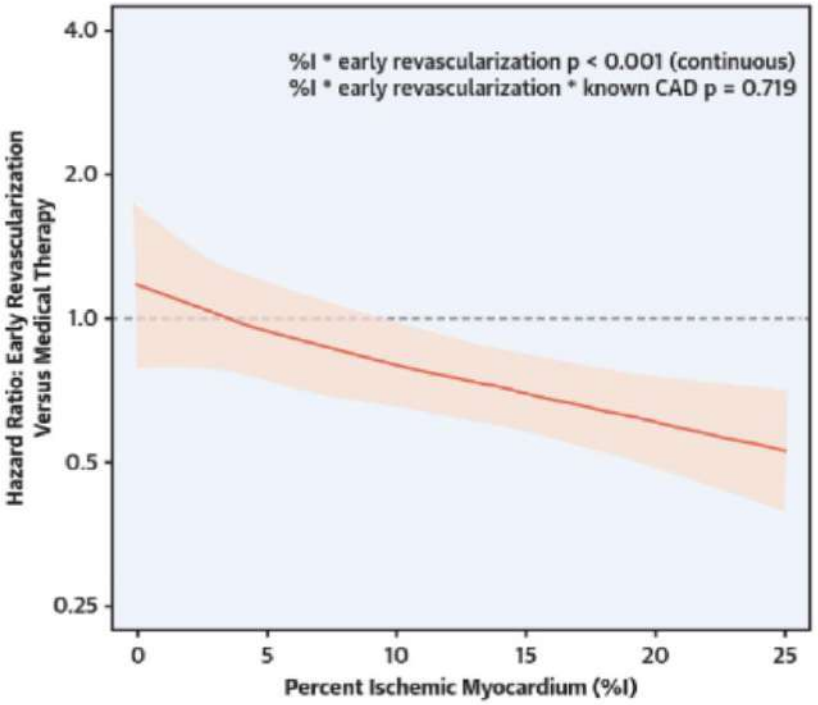
Safley, Grantham, Rutherford et al Catheter Cardiovasc Interv 2011

Use of PET to Determine Need for CTO PCI Intervention

Massachusetts General Hospital
Corrigan Minehan Heart Center



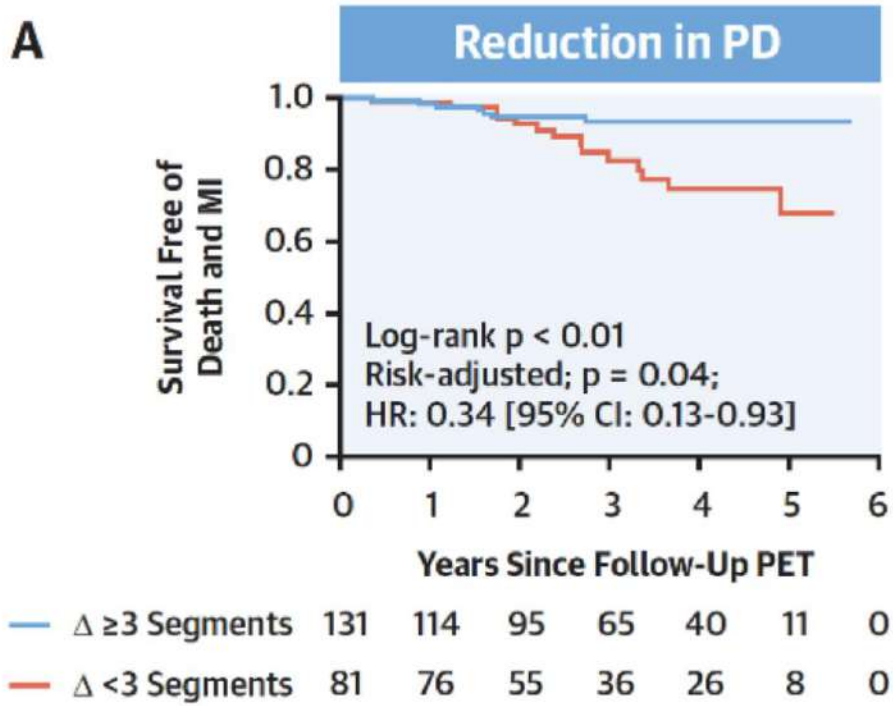
Patel KK, et al. *Eur Heart J*. 2020;41(6):759-768.

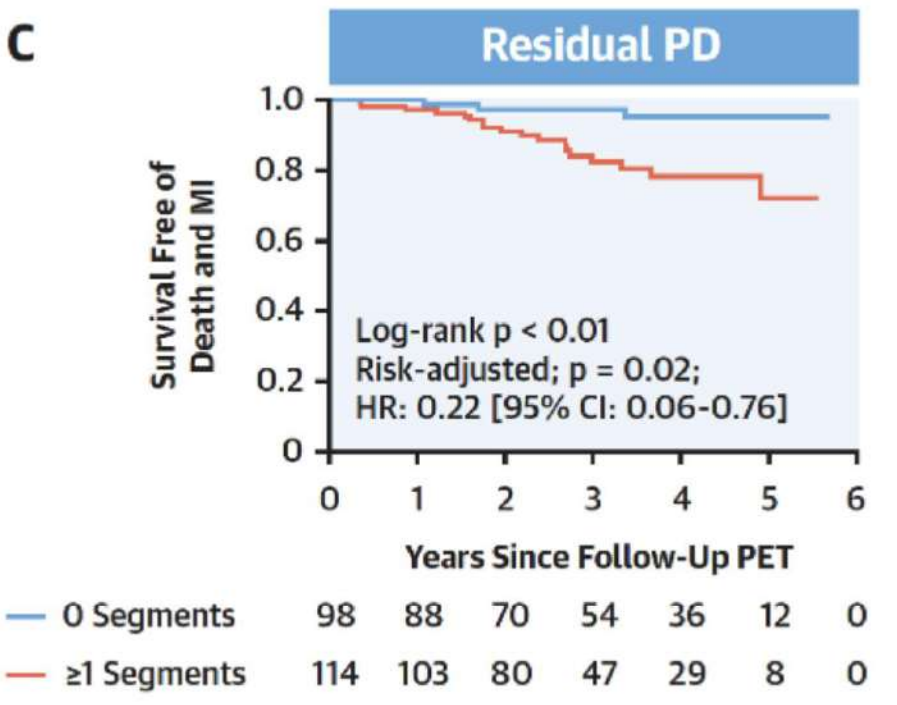


Patel KK, et al. *J Am Coll Cardiol*. 2019;74(13):1645-1654.

Ischemic Burden Reduction and Long-term Outcomes After CTO PCI

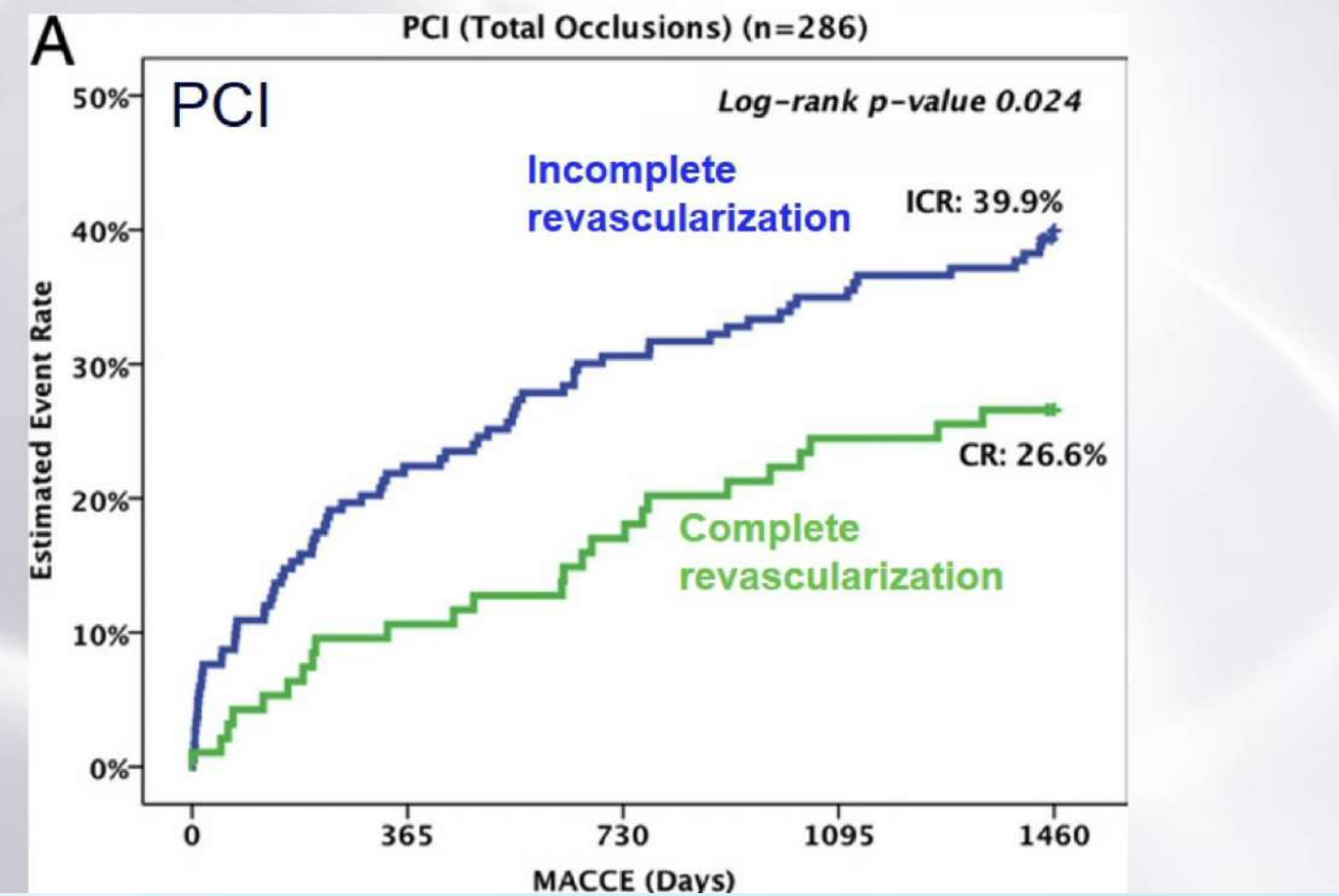
Massachusetts General Hospital
Corrigan Minehan Heart Center





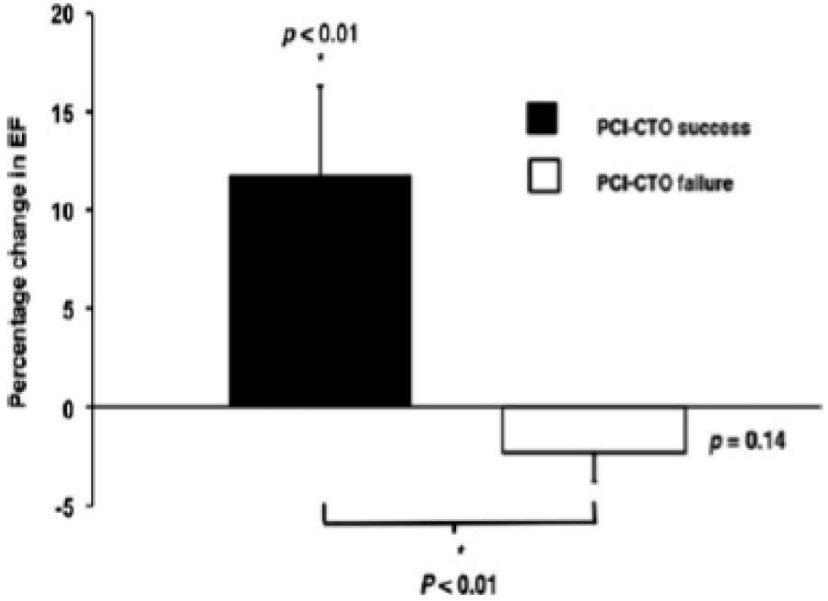
Schumacher SP, Knaapen P, et al. *JACC Cardiovasc Interv.* 2021;14(13):1407-1418.

El mayor determinante de revascularización incompleta en SYNTAX es la presencia de CTO (HR 2.70)

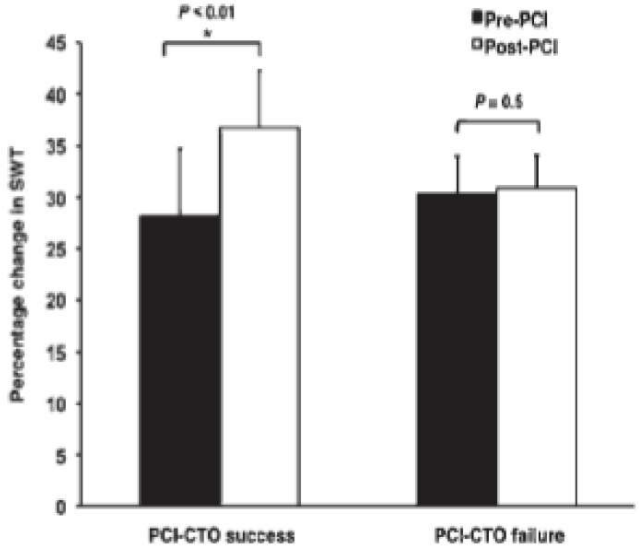


Improvement in Ejection Fraction

Ejection Fraction (EF)



Segmental Wall Thickening (SWT)

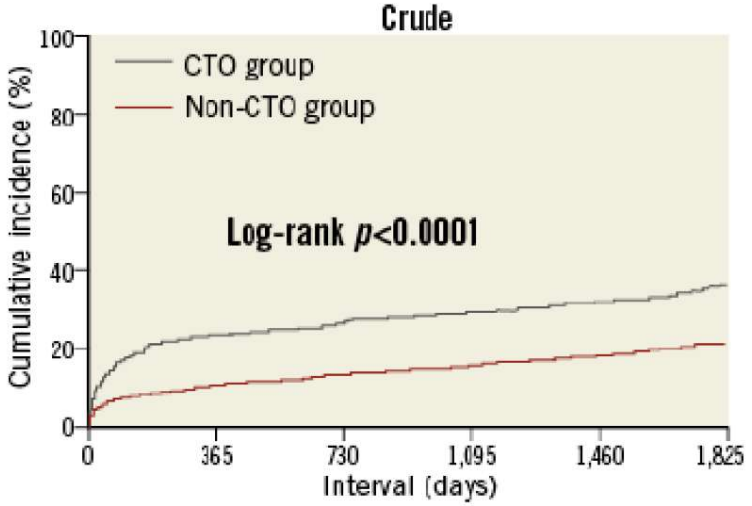


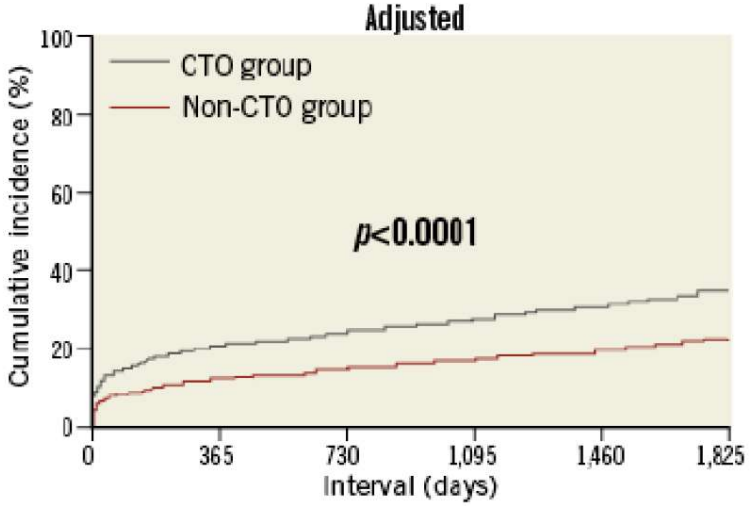
MRI assessment at baseline and at 6 months shows an improvement in EF and SWT in patients who had successful CTO-PCI

Paul et al, *Heart* 2011.

CREDO-Kyoto AMI Registry: Impact of Non-Culprit CTO on 5 year Survival

2,045 STEMI pts with MVD; results remained significant after excluding 30-day deaths





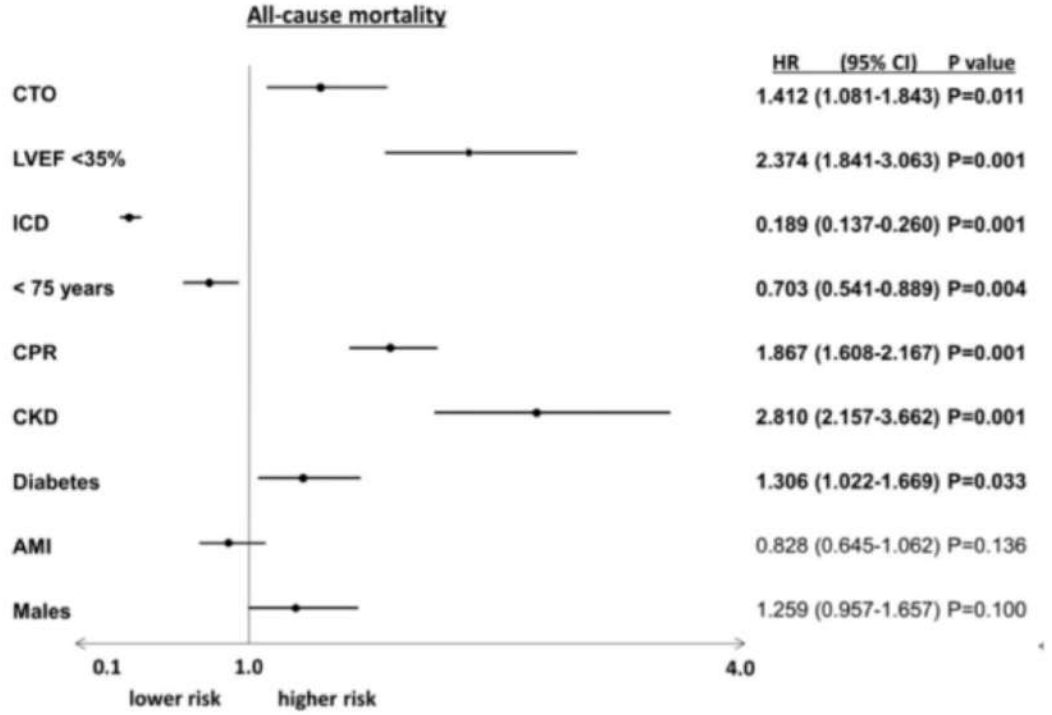
Interval	0 day	1 year	3 years	5 years
CTO group				
Number of patients with at least one event		92	113	143
Number of patients at risk	383	284	256	135
Cumulative incidence		24.2%	29.9%	37.0%
Non-CTO group				
Number of patients with at least one event		189	267	351
Number of patients at risk	1,662	1,452	1,339	838
Cumulative incidence		11.4%	16.2%	22.0%

Interval	1 year	3 years	5 years
CTO group			
Cumulative incidence probability	17.0%	23.0%	29.8%
Non-CTO group			
Cumulative incidence probability	13.0%	17.9%	23.8%

Watanabe et al, Eurointervention 2017

Prognostic Risk Factors for Mortality in Ventricular Tachyarrhythmias

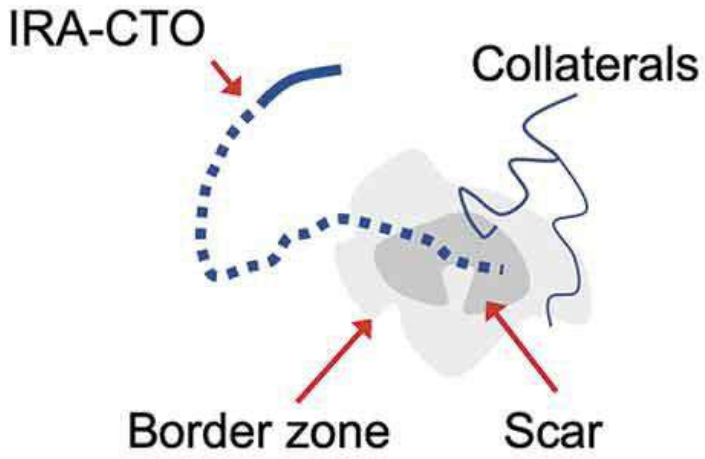
1,461 pts with arrhythmias, 20% had CTO
Mortality (mean 18 months) of 46% with CTO vs. 27% without CTO



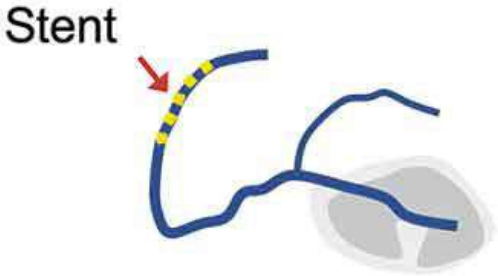
Behnes et al, Eurointervention 2019

IRA-CTO

CTO PCI



- Large scar border zone
- Residual ischemia
- Hibernating myocardium
- Heterogeneity in repolarization
- ↑ Risk of ventricular arrhythmia



- Elimination ischemia
- ↓ Scar border zone area
- ↓ QT(c) dispersion
- ↓ Late potentials
- ↓ T wave peak-end interval
- Reverse mechanical remodeling

LATAM CTO REGISTRY

IMPROVING KNOWLEDGE OF COMPLEX PCI DATA IN LATIN AMERICA

3561
PROCEDURES

72
CTO CENTERS

9
COUNTRIES

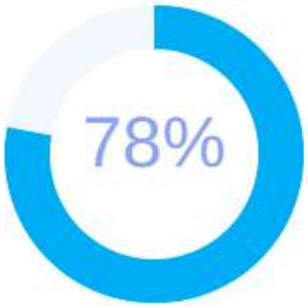
https://latamctoregistry.com/

VIEW ON YOUR CENTER DATA

Average Age:
62 ± 15

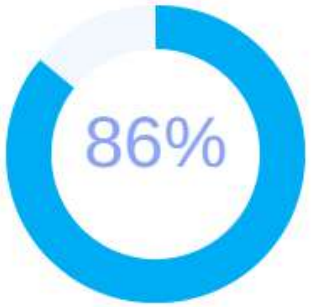
Ejection Fraction:
48 ± 19

Male Gender



White Race

Hypertension



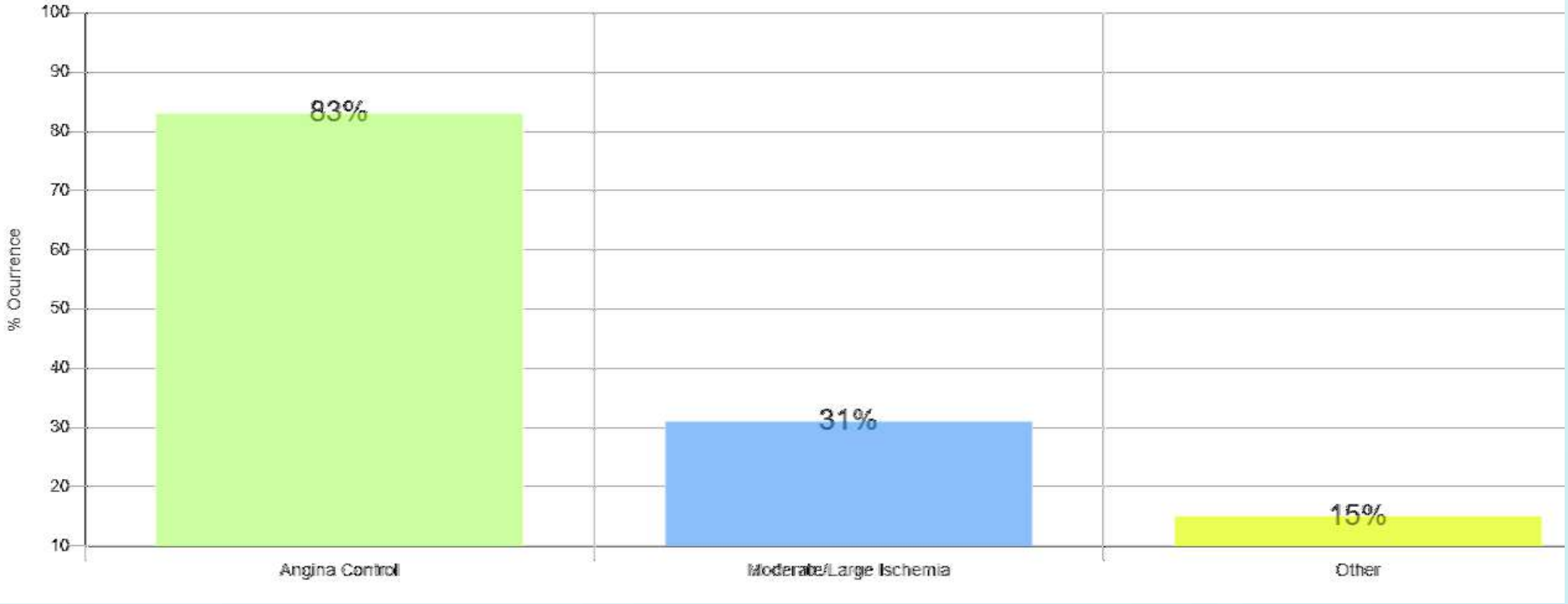
Previous PCI

Previous CTO Attempt

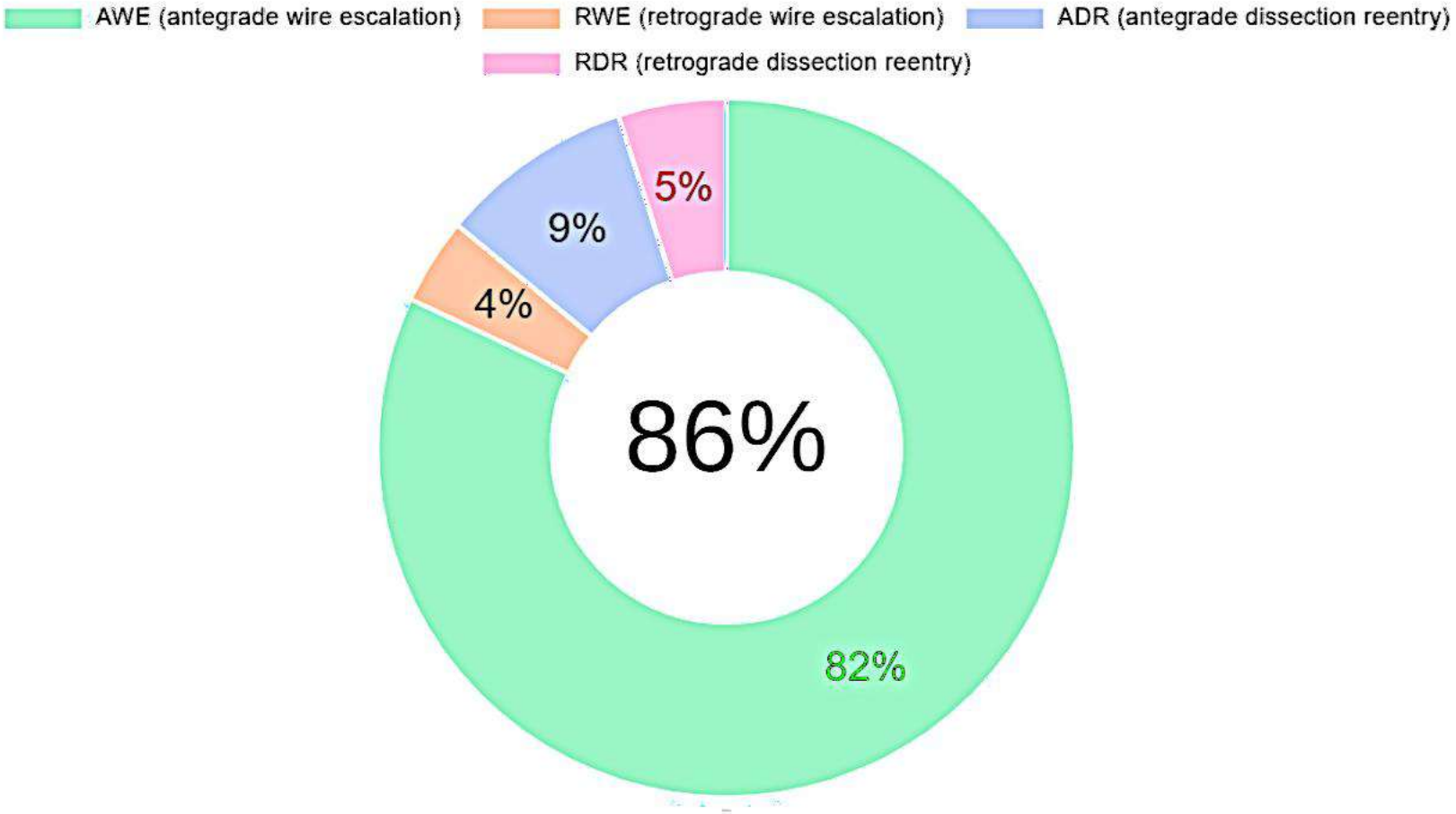
Diabetes

VIEW ON YOUR CENTER DATA

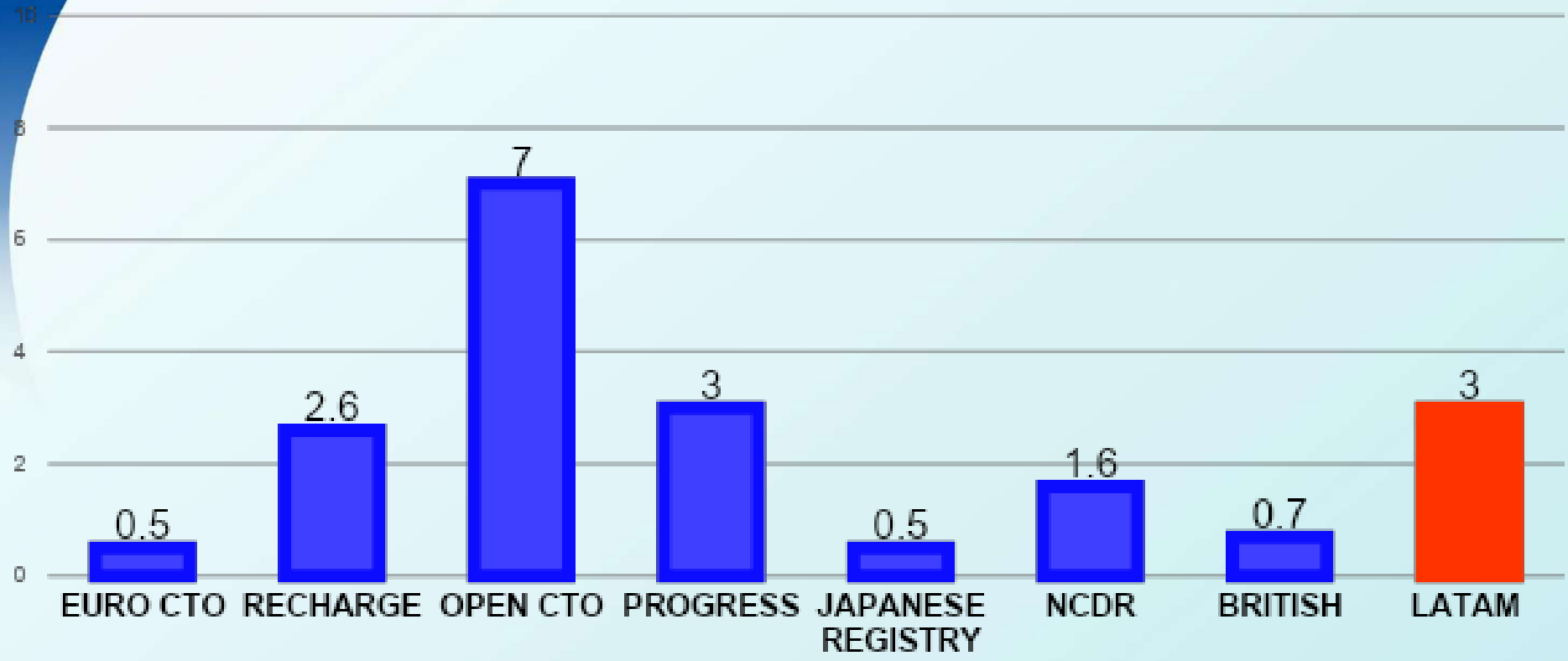
Procedural Indication

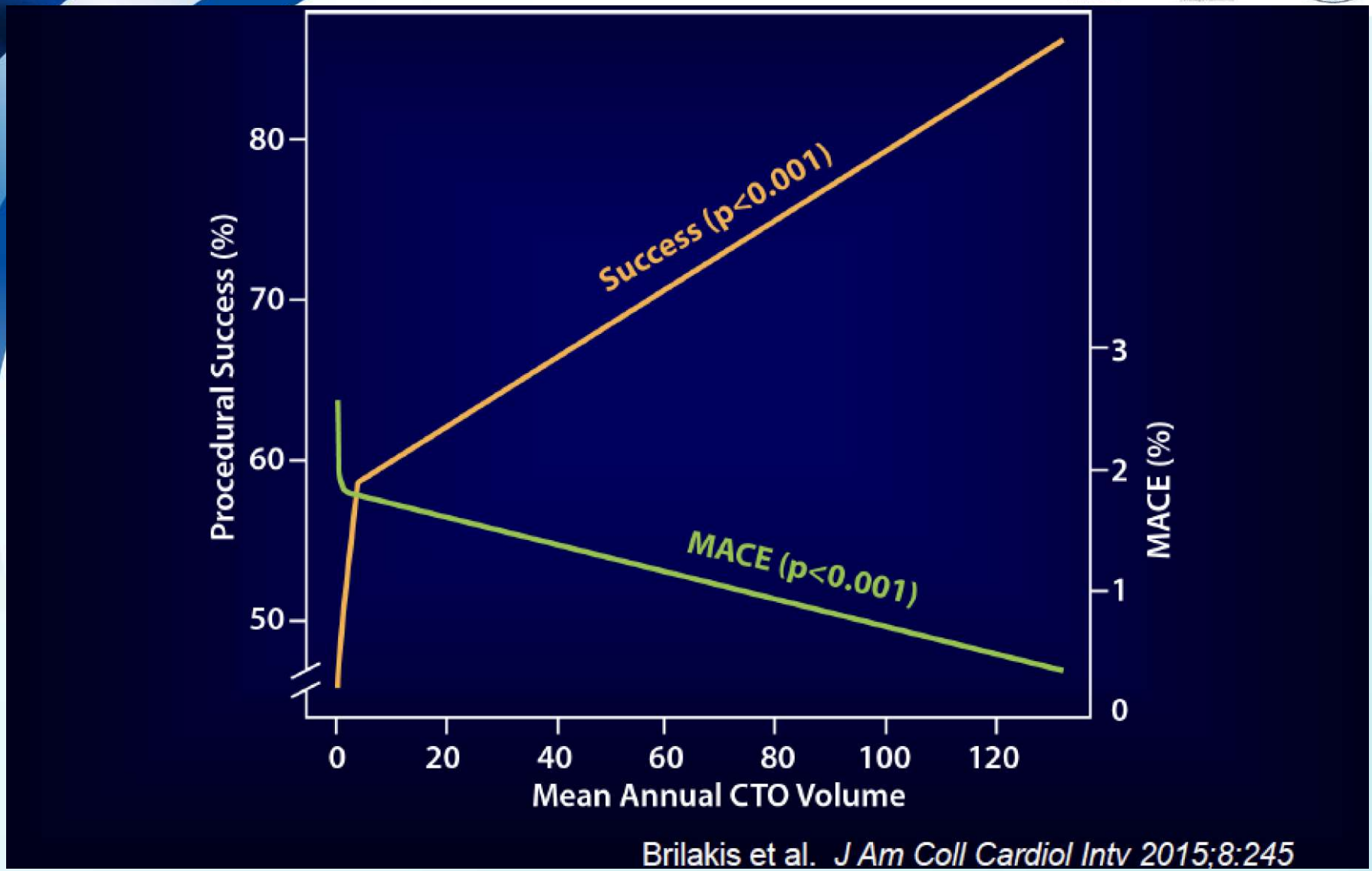


Successful Procedures



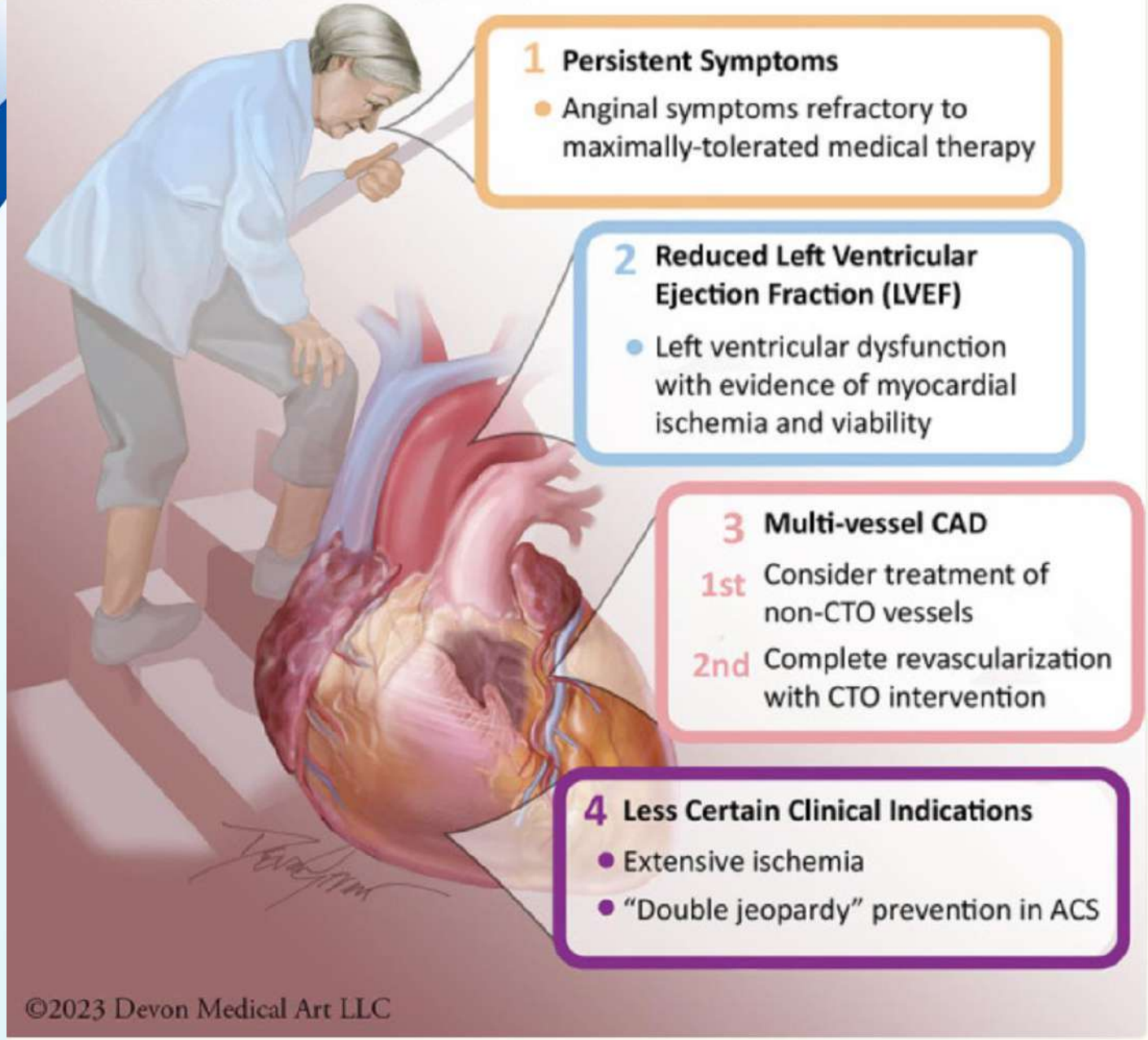
MACE en registro LATAM CTO vs otros registros publicados





Brilakis et al. *J Am Coll Cardiol Intv 2015;8:245*

Indications for CTO PCI



1 Persistent Symptoms

- Anginal symptoms refractory to maximally-tolerated medical therapy

2 Reduced Left Ventricular Ejection Fraction (LVEF)

- Left ventricular dysfunction with evidence of myocardial ischemia and viability

3 Multi-vessel CAD

1st Consider treatment of non-CTO vessels

2nd Complete revascularization with CTO intervention

4 Less Certain Clinical Indications

- Extensive ischemia
- "Double jeopardy" prevention in ACS

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Ciudad de Panamá

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