

Faut-il tenter d'ouvrir  
systématiquement  
les occlusions chroniques  
totales  
d'un territoire viable?

## Liens d'Intérêts

### Subventions :

*(absence de rétribution personnelle)*

Sanofi-Aventis, Novartis, Biotronik,  
Astra-Zeneca, The Medicines company,  
BMS

## CTO definition:

A coronary chronic total occlusion (CTO) is defined by:

*« the presence of a TIMI 0 flow within the occluded segment  
with an estimated occlusion duration of  $\geq 3$  months »*

ECC (Euro CTO Club)

*Di Mario Euro intervention 2007*

Rêvons un peu ....  
Ouvrir les Occlusions Chroniques  
pourrait // devrait .....

- 1- Diminuer la MORTALITE
- 2- Diminuer les SYMPTOMES
- 3- Diminuer l'ISCHEMIE RESIDUELLE
- 4- Améliorer la FONCTION VENTRICULAIRE GAUCHE
- 5- Permettre une REVASCULARISATION COMPLETE
- 6- AMELIORER la QUALITE de VIE



## CTO's ANGIOPLASTY and STABLE ANGINA

PCI outcomes in patients with stable obstructive CAD and myocardial ischemia:  
a collaborative meta-analysis of contemporary randomized trials

5 trials, 5286 patients, 4064 with myocardial ischemia

Follow-up: five years

	PCI + OMT	OMT	P value
<u>Death</u>	6.5%	7.3%	ns
Non fatal MI	9.2%	7.6%	ns
Revasc.	18.3%	28.4%	ns
Angina	20.3%	23.3%	ns

**Stergiopoulos and coll;** JAMA Intern. Med. 2014; 174: 232-240

ORIGINAL INVESTIGATIONS

# Long-Term Follow-Up of Elective Chronic Total Coronary Occlusion Angioplasty

Analysis From the U.K. Central Cardiac Audit Database

Sudhakar George, MD,\* James Cockburn, MD,\* Tim C. Clayton, MSc,† Peter Ludman, MD,‡ James Cotton, MD,§ James Spratt, MA,|| Simon Redwood, MD,# Mark de Belder, MD,¶ Adam de Belder, MD,\* Jonathan Hill, MA,\*\* Angela Hoye, MBCuB, PhD,†† Nick Palmer, MD,‡‡ Sudhir Rathore, MD,§§ Anthony Gershlick, MB BS,|||| Carlo Di Mario, MD, PhD,## David Hildick-Smith, MD,\* on behalf of the British Cardiovascular Intervention Society and the National Institute for Cardiovascular Outcomes Research

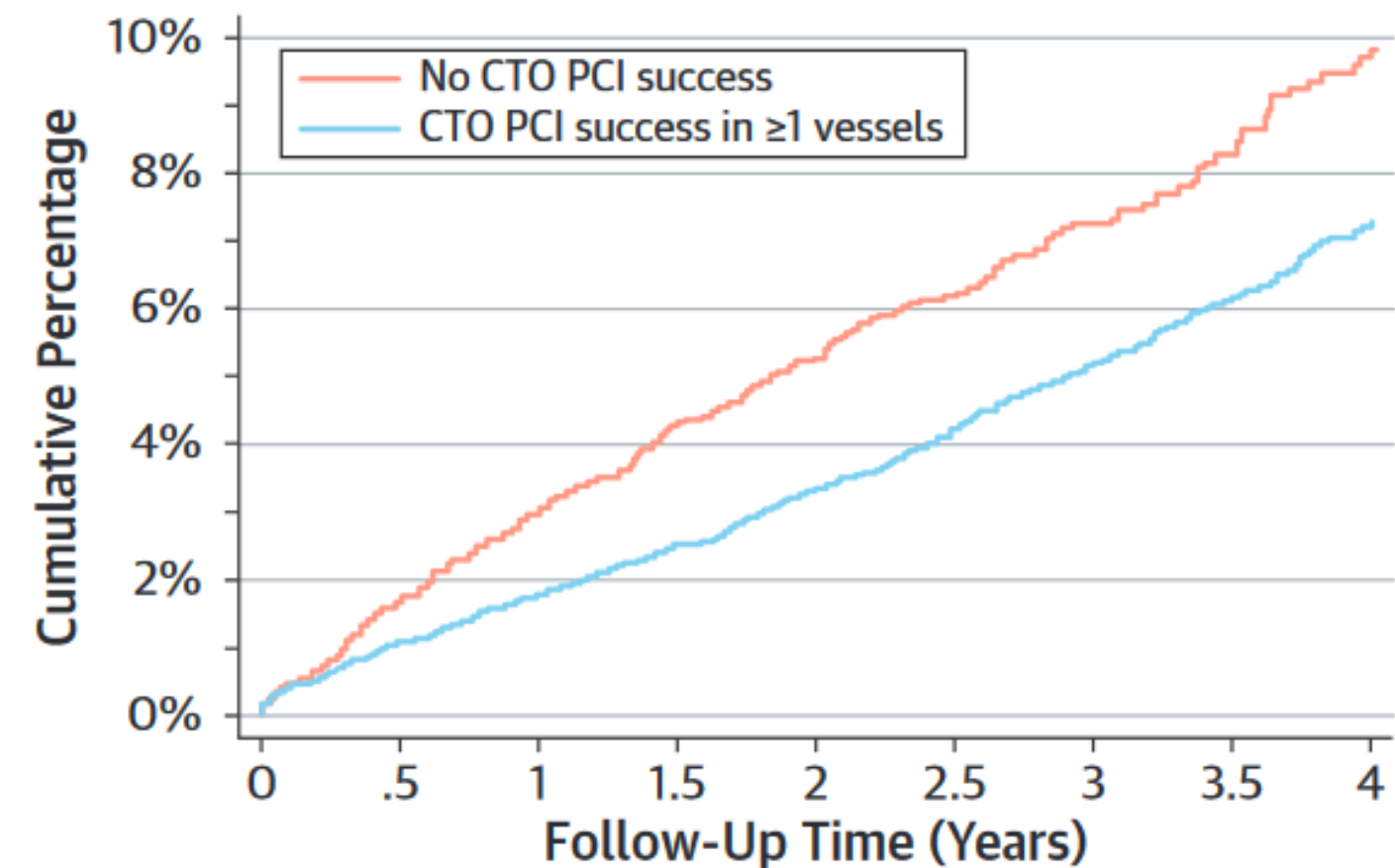


*C'est mieux dans les registres quand l'artère est ouverte....*

*Mais quid du devenir des patients avec CTO s'ils avaient été traités médicalement ou pontés sur les territoires occlus ?*

*Et quid du rôle de la tentative d'angioplastie qui a échoué ?*

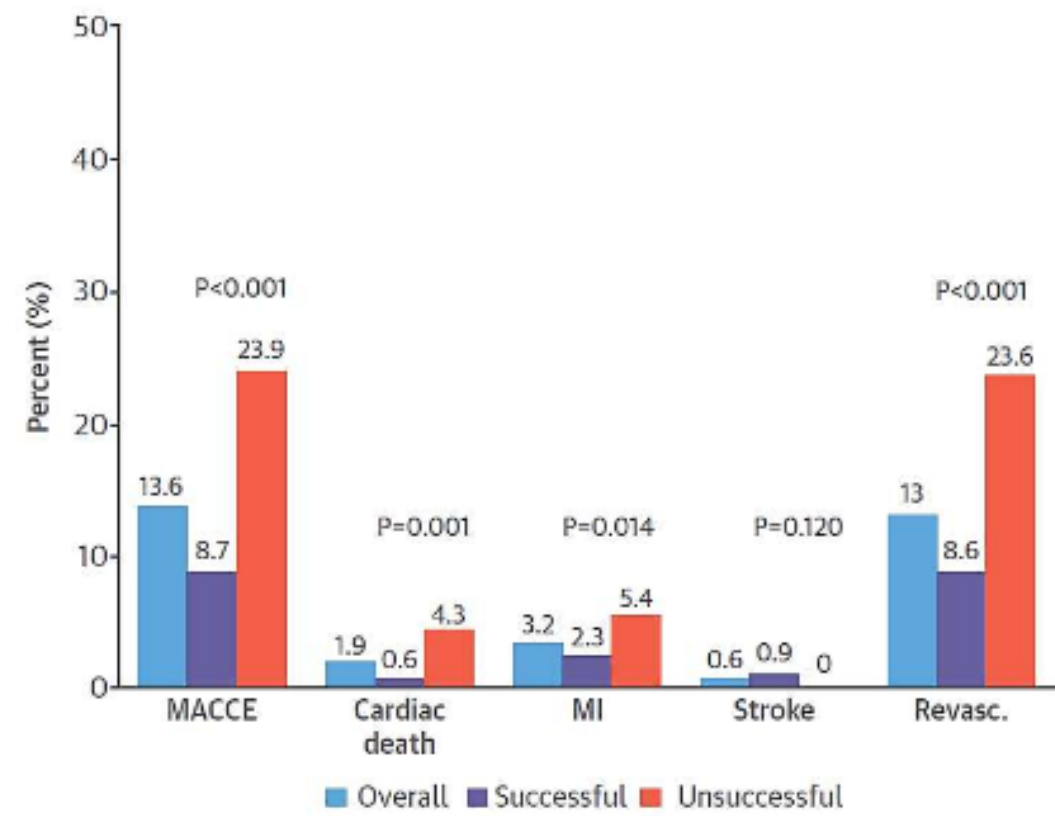
*Publié en 2014 ..*



**FIGURE 1** Kaplan-Meier Curve Showing Differences in Mortality Between Those Procedures With Successful and Failed CTO Interventions

Successful intervention was associated with a decrease in mortality (adjusted hazard ratio: 0.72; 95% confidence interval: 0.62 to 0.83;  $p < 0.001$ ). CTO = chronic total occlusion; PCI = percutaneous coronary intervention.

FIGURE 5 Clinical Outcome According to Procedural Success



Patients with successful retrograde percutaneous coronary intervention (PCI) showed lower rates of overall major adverse cardiac and cerebrovascular events (MACCEs), cardiac death, myocardial infarction (MI), and need for further revascularization (Revasc), compared with those in whom retrograde PCI failed.

TABLE 5 Univariate and Multivariate Logistic Regression Modeling, Procedural Failure

	Univariate			Multivariate		
	OR	95% CI	p Value	OR	95% CI	p Value
Age, per 10-yr increase	1.24	1.11-1.39	0.0002	1.19	1.03-1.34	0.02
Men	0.72	0.51-1.02	0.07	0.70	0.47-1.05	0.08
Diabetes	1.24	0.97-1.59	0.09	1.16	0.86-1.55	0.34
Ejection fraction <35%	0.85	0.52-1.40	0.52	0.89	0.50-1.58	0.68
History of MI	0.84	0.67-1.07	0.15	0.91	0.68-1.20	0.48
History of CABG	1.21	0.91-1.63	0.19	1.22	0.81-1.64	0.44
Prior PCI	1.01	0.80-1.27	0.93	0.98	0.75-1.32	0.95
Occlusion duration						
≥12 vs. <12 months	1.33	0.98-1.79	0.07	1.33	0.93-1.89	0.10
Undetermined vs. <12 months	1.44	1.04-2.00		1.51	1.03-2.20	
Occlusion length ≥20 vs. <20 mm	1.23	0.85-1.78	0.27	0.96	0.59-1.56	0.86
Experience			<0.0001			<0.0001
<50 vs. >100 procedures	2.47	1.88-3.26		3.00	2.14-4.21	
50-100 vs. >100 procedures	2.36	1.72-3.23		2.04	1.42-2.92	
J-CTO score			0.01			0.004
Easy vs. very difficult	0.47	0.16-1.38		0.56	0.10-2.91	
Intermediate vs. very difficult	0.74	0.48-1.14		0.56	0.33-0.95	
Difficult vs. very difficult	0.64	0.47-0.87		0.55	0.38-0.79	

CI = confidence interval; J-CTO = Multicenter CTO Registry in Japan; OR = odds ratio; other abbreviations as in Table 1.

# Circulation

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## Randomized Trial Evaluating Percutaneous Coronary Intervention for the Treatment of Chronic Total Occlusion

### The DECISION-CTO Trial

Seung-Whan Lee, Pil Hyung Lee, Jung-Min Ahn, Duk-Woo Park, Sung-Cheol Yun, Seungbong Han, Heejun Kang, Soo-Jin Kang, Young-Hak Kim, Cheol Whan Lee, Seong-Wook Park, Seung Ho Hur, Seung-Woon Rha, Sung-Ho Her, Si Wan Choi, Bong-Ki Lee, Nae-Hee Lee, Jong-Young Lee, Sang-Sig Cheong, Moo Hyun Kim, Young-Keun Ahn, Sang Wook Lim, ... [Show all Authors](#)

Originally published 2 Apr 2019 | <https://doi.org/10.1161/CIRCULATIONAHA.118.031313> | Circulation. 2019;139:1674–1683

This article is commented on by the following:

834 pts // 398 OMT, 417 CTO-PCI // Ischémie silencieuse, A Stable, ACS

The primary endpoint for CTO-PCI + OMT vs. OMT, major adverse cardiac events (MACE) at 3 years (all-cause mortality, MI, stroke, repeat revascularization),  
was 22.3% vs. 22.4%

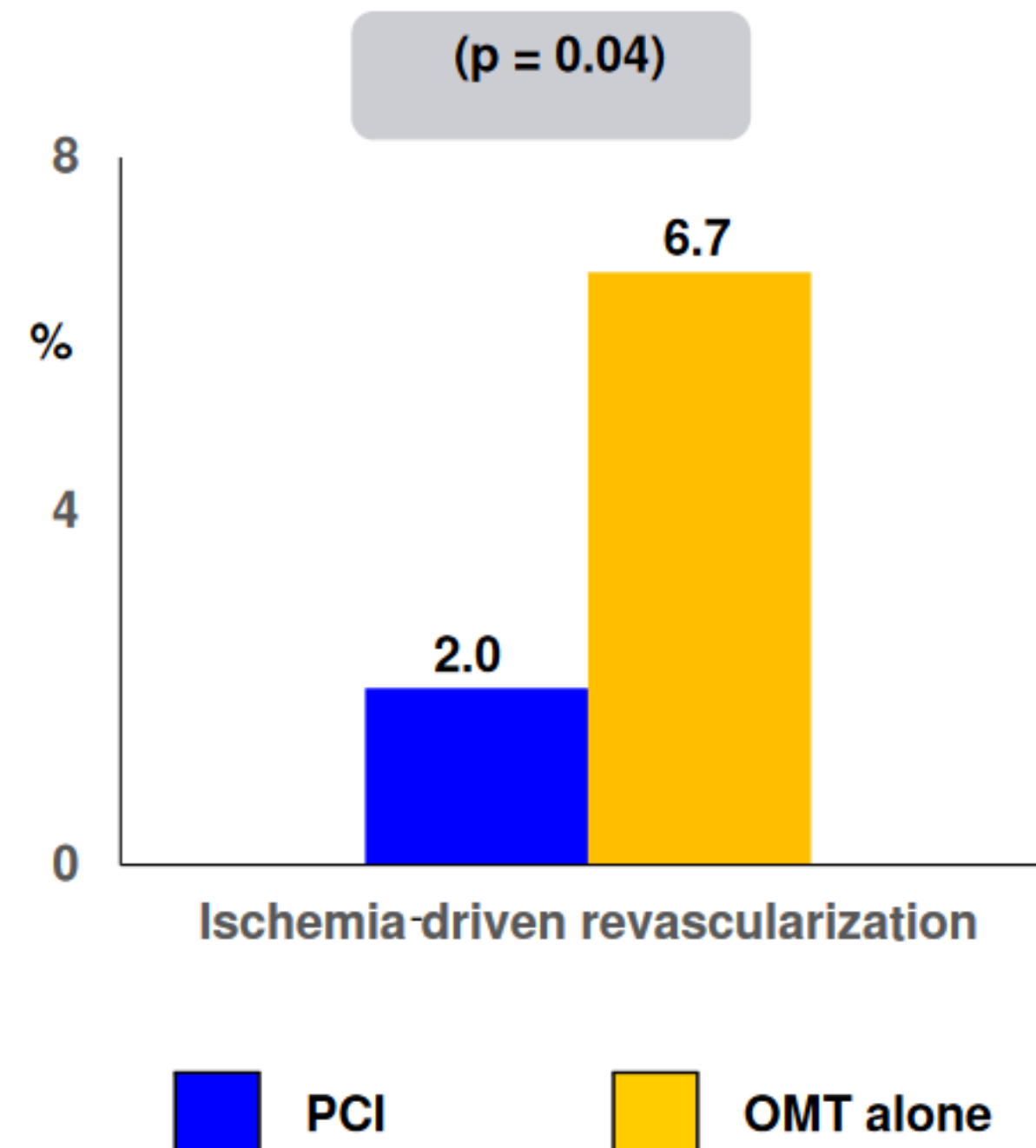
p for noninferiority 0.014

p for superiority = 0.86



## EUROCTO

**Trial design:** Stable angina patients with a chronic total occlusion (CTO) were randomized to PCI with a biolimus-eluting stent plus optimal medical therapy (OMT) (n = 259) vs. OMT alone (n = 137).



www.acc.org

### Results

- Angina frequency score (p = 0.003) and the quality-of-life score (p = 0.007) improved for PCI compared with OMT (intention to treat)
- Major cardiovascular and cerebrovascular events: 5.2% for PCI vs. 6.7% for OMT (p = 0.55)
- Ischemia-driven revascularization: 2.0% for PCI vs. 6.7% for OMT (p = 0.04)

### Conclusions

- Among patients with stable angina due to CTO, PCI improved some, but not all measures of health status (angina frequency and quality of life)
- Ischemia-driven revascularization was less frequent in the PCI group

Werner GS, et al. Eur Heart J 2018;May 2:[Epub]

**INSTITUT CARDIOVASCULAIRE PARIS SUD**

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DOI: 10.1016/j.jacc.2018.11.011

### Percutaneous Intervention for Concurrent Chronic Total Occlusions in Patients With STEMI

The EXPLORE Trial

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**FIGURE 3 Major Adverse Cardiac Events Event Rates at 4-Month Follow-Up**

Major adverse cardiac events consisted of cardiac death, myocardial infarction, and coronary artery bypass graft operation. Abbreviations as in Figure 1.

Left Ventricular Ejection Fraction

Left Ventricular End Diastolic Volume

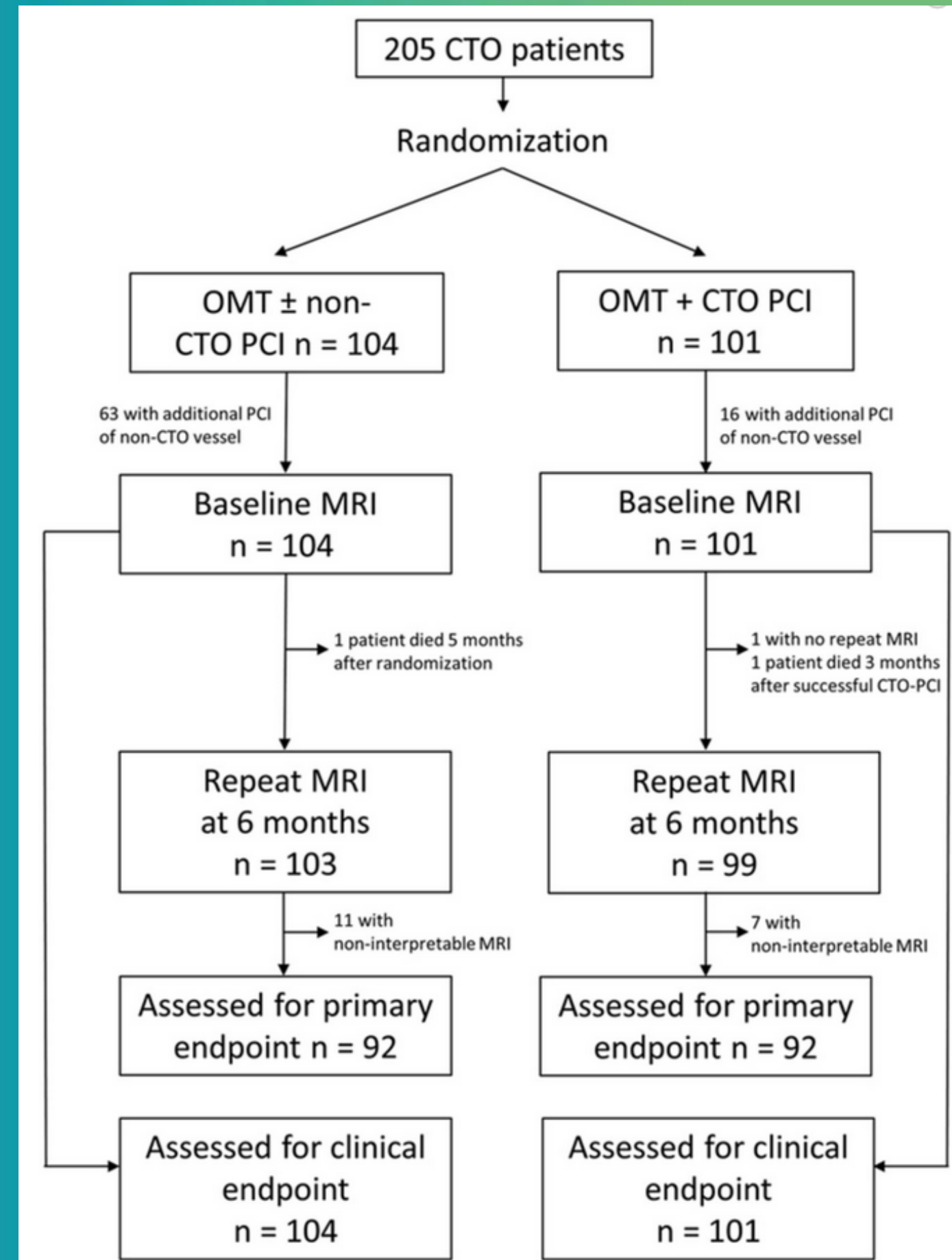
Henriques, J.P.S. et al. J Am Coll Cardiol. 2016;68(15):1622-32.

SE 2928803 Rev C [www.icps.com.fr](http://www.icps.com.fr)

## EXPLORE Trial:

La fonction VG ne change PAS en IRM .....

304 pts STEMI + un second territoire occlus, non coupable



REVASC Trial: La fonction VG ne change pas en IRM .....  
205 pts stables randomisés

*Mashayeki and Coll JACC: Cardiovascular Intervention september 2018*

## Successful Recanalization of Native Coronary Chronic Total Occlusion Is Not Associated With Improved Long-Term Survival



Pil Hyung Lee, MD, Seung-Whan Lee, MD, PhD, Hee-Soon Park, MD, Se Hun Kang, MD, Byeong Joo Bae, MD, Mineok Chang, MD, Jae-Hyung Roh, MD, Sung-Han Yoon, MD, Jung-Min Ahn, MD, Duk-Woo Park, MD, PhD, Soo-Jin Kang, MD, PhD, Young-Hak Kim, MD, PhD, Cheol Whan Lee, MD, PhD, Seong-Wook Park, MD, PhD, Seung-Jung Park, MD, PhD

### ABSTRACT

**OBJECTIVES** The purpose of this study was to evaluate long-term clinical outcomes after drug-eluting stent-supported percutaneous coronary intervention (PCI) for native coronary total occlusion (CTO).

**BACKGROUND** The benefit of successful recanalization of CTO on prognosis remains uncertain.

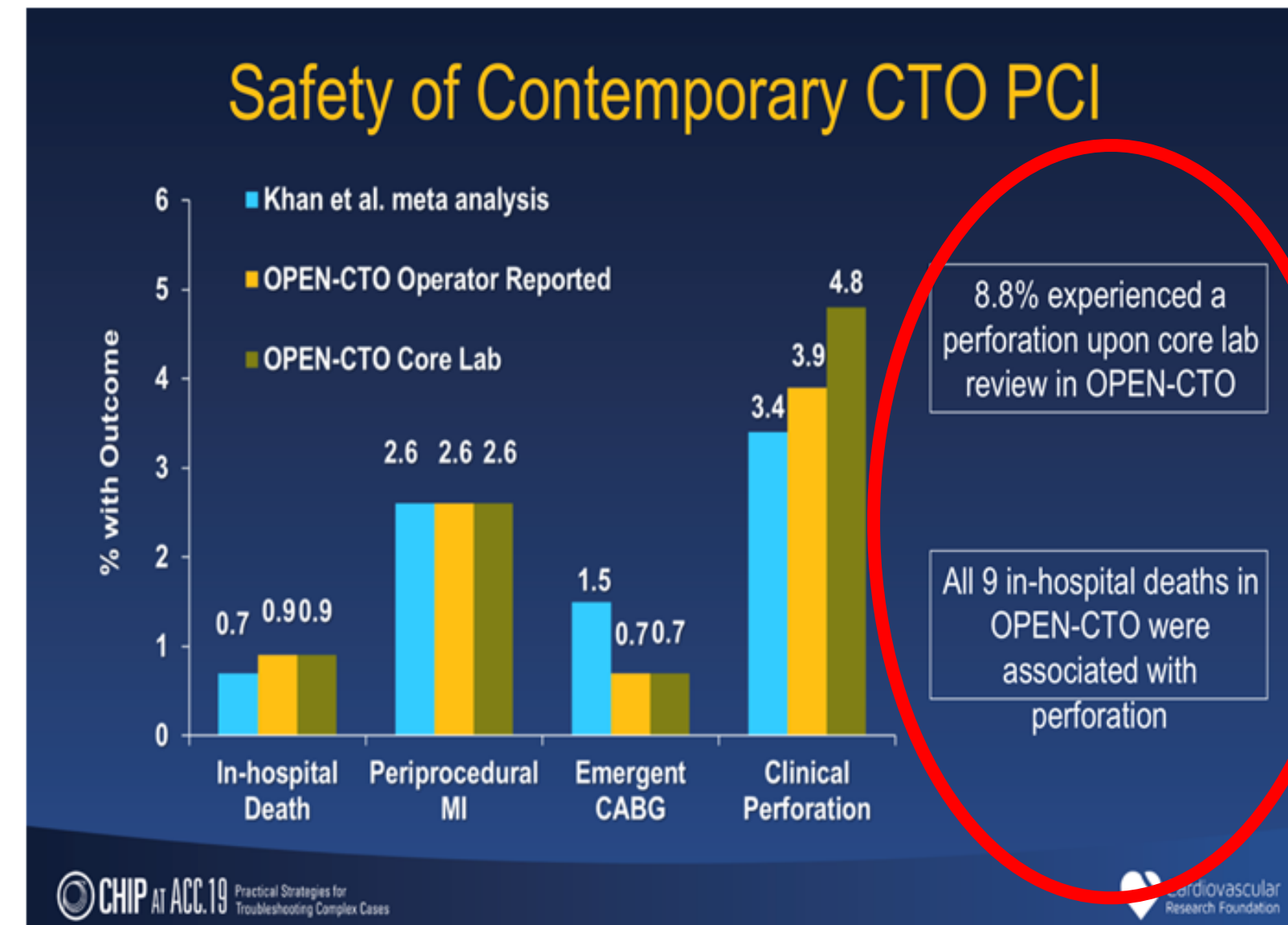
**METHODS** Between March 2003 and May 2014, 1,173 consecutive patients with CTO of native coronary vessels requiring PCI were enrolled. Drug-eluting stent implantation was performed in all successful procedures (1,004 patients, 85.6%).

**RESULTS** During a median follow-up of 4.6 years, the adjusted risks of all-cause mortality (hazard ratio [HR]: 1.04; 95% confidence interval [CI]: 0.53 to 2.04;  $p = 0.92$ ) and the composite of death or myocardial infarction (HR: 1.05; 95% CI: 0.56 to 1.94;  $p = 0.89$ ) were found to be comparable between patients with successful and failed CTO-PCI, whereas the adjusted risk of target vessel revascularization (HR: 0.15; 95% CI: 0.10 to 0.25;  $p < 0.001$ ) and coronary artery bypass grafting (HR: 0.02; 95% CI: 0.006 to 0.06,  $p < 0.001$ ) was significantly higher in patients with failed CTO-PCI. Among patients ( $n = 879$ ) in whom complete revascularization for non-CTO vessels was performed, the risk of death or the composite of death or myocardial infarction were not found to differ between patients who underwent successful recanalization of the remaining CTO and patients who did not. This finding was consistent regardless of whether the patient had a multivessel disease including CTO or only had a single CTO disease.

**CONCLUSIONS** Successful CTO-PCI compared with failed PCI was not associated with a lesser risk for mortality. However, successful CTO-PCI was associated with significantly less subsequent coronary artery bypass grafting. (J Am Coll Cardiol Intv 2016;9:530-8) © 2016 by the American College of Cardiology Foundation.

## CTO pourquoi oui : Taux de réussite élevée et de complication faible

1. CTO technique mature dans des mains expérimentées
2. Importance de la courbe d'apprentissage
3. **Bien connaître ses limites, dans les études, centres à haut volumes et praticiens très expérimentés**
  - Taux de succès de 90%
  - Taux de complication de 3%
4. Prédicteurs connus de succès et de complications (voie rétrograde)



Courtesy Dr. Laurent QUILLIET.....

## Comparison Succes vs Failure after Angioplasty of a CTO

Meta-analysis of 65 studies, 2000-2011, 18 061 patients, 18 941 CTO vessels

Outcome	Successfull	Unsuccessful	Chi 2	P value
Mace	84 (3.7)	14 (4.3)	0.2	0.68
Death	19 (0.42)	17(1.54)	15.1	< 0.0001
Emerg. CABG	1 (0.03)	1 (0.17)	0.1	0.74
Stroke	3 (0.007)	4 (0.4)	4.1	0.04
MI	1.6 (2.8)	25 (3.0)	0.03	0.87
Q-Wave MI	10 (0.3)	6 (0.5)	1.3	0.26
Perforation	67(3.65)	55(10.7)	39.2	< 0.0001
Tamponnade	0%	7(1.65)	16.8	< 0.0001
Vasc. Compl.	33 (1.7)	6 (0.9)	1.7	0.20
Nephropathy	18 (5.0)	5 (4.6)	0.03	0.86

Patel and Coll JACC Cardiovasc. Interv. 2013 Feb; 6 (2): 128-36

L'échec a un coût .....

# Determinants and Prognostic Significance of Periprocedural Myocardial Injury in Patients With Successful Percutaneous Chronic Total Occlusion Interventions



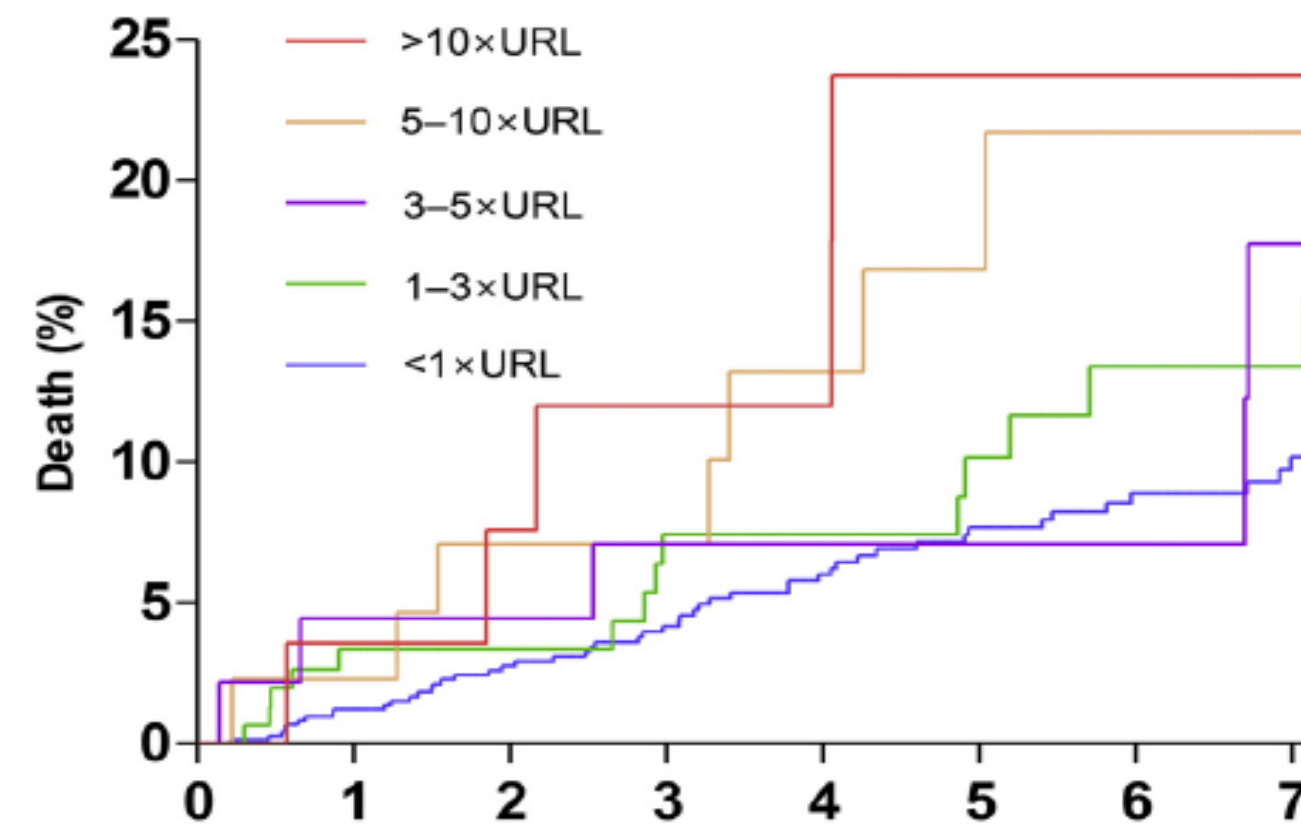
Seung-Whan Lee, MD, PhD, Pil Hyung Lee, MD, Se Hun Kang, MD, Hanul Choi, MD, Mineok Chang, MD, Jae-Hyung Roh, MD, Sung-Han Yoon, MD, Jung-Min Ahn, MD, Duk-Woo Park, MD, PhD, Soo-Jin Kang, MD, PhD, Young-Hak Kim, MD, PhD, Cheol Whan Lee, MD, PhD, Seong-Wook Park, MD, PhD, Seung-Jung Park, MD, PhD

Lee SW et al.

JACC

Cardiovasc Interv. 2016;9(21):2220-2228

FIGURE 4 Incidence of Death According to Intermediate Levels of Peak CK-MB Values



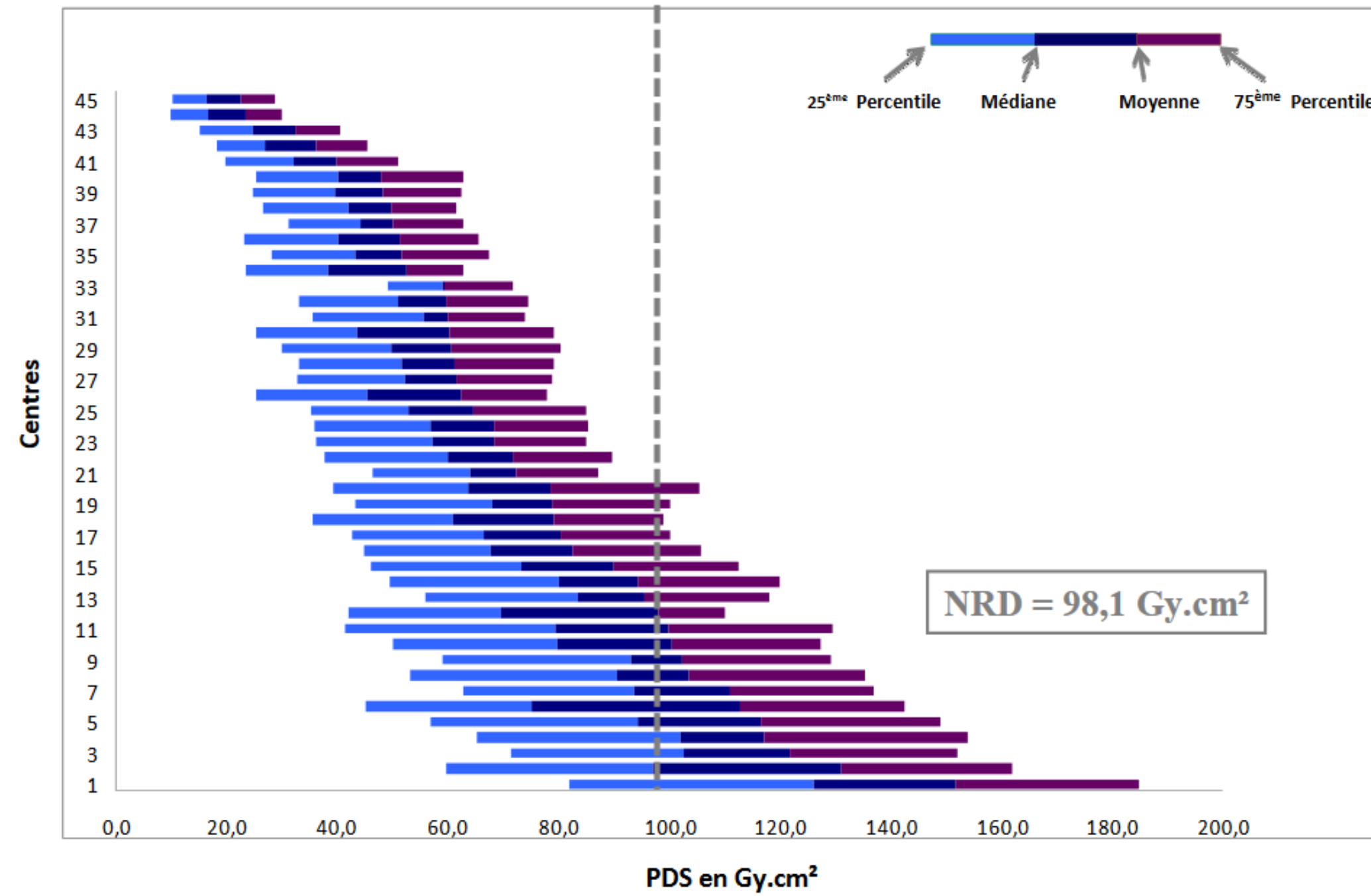
	Years after CTO-PCI			
No. of patients at risk	1	2	3	4
>10×URL	30	23	16	12
5–10×URL	47	39	28	23
3–5×URL	44	34	26	13
1–3×URL	159	112	80	46
<1×URL	778	600	425	279

Abbreviations as in Figure 1.



Collège National des  
Cardiologues des  
Hôpitaux  
Enquête RAY'ACT 2010

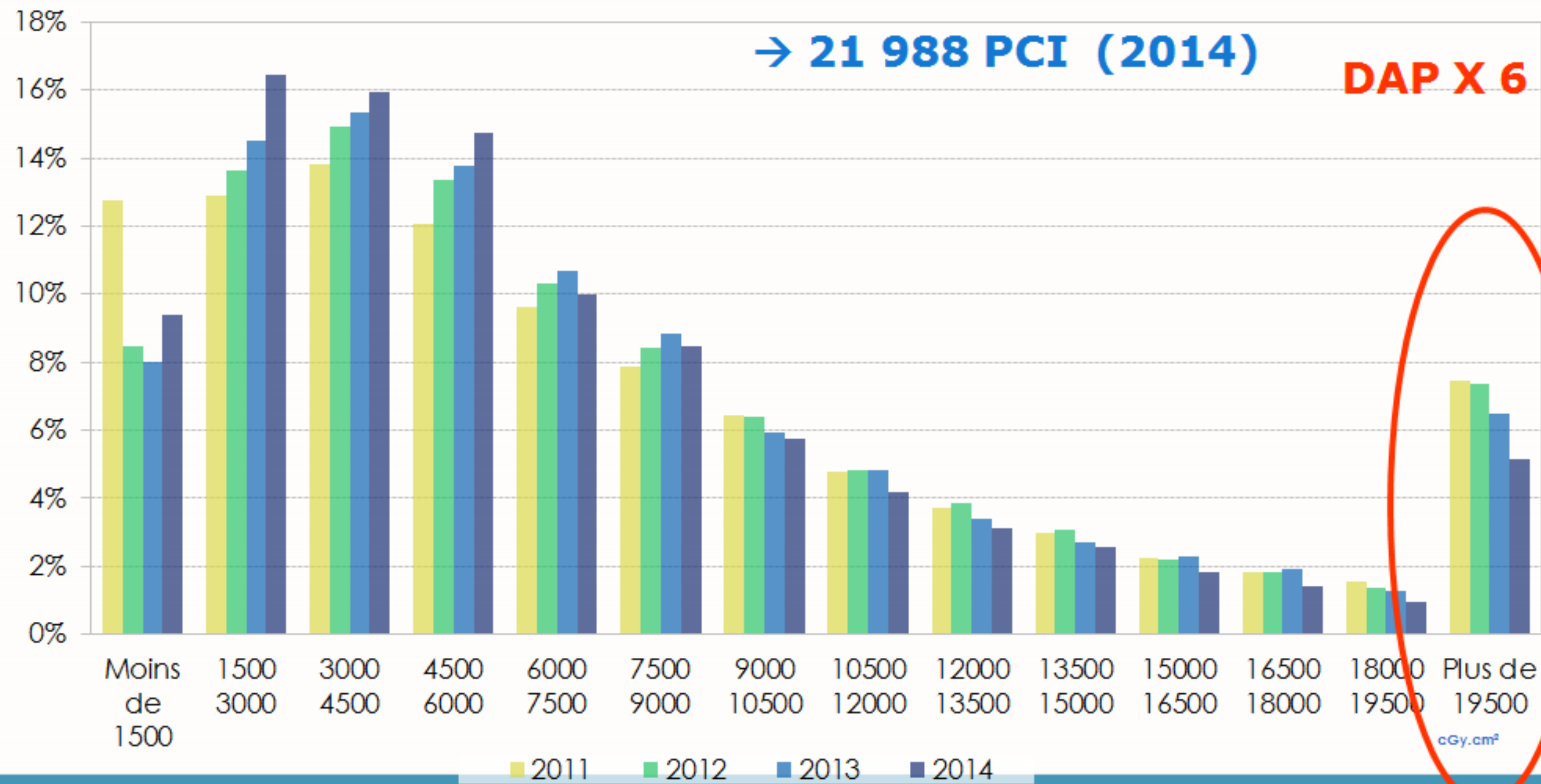
### PDS Angioplastie Coronaire / ICP





## Great PARIS Area : Dose Area Product (cGy.cm<sup>2</sup>)

	2009	2010	2011	2012	2013	2014
DM	69%	83%	89%	93%	95%	95%



## Cost-effectiveness .....

A decision analytic model for stable angina  
60 years old patient, 5 years

CTO	OMT	CABG
27 805 USD	31 512 USD	???????
QALYs 2.38	QALYs 1.99	???????

Gada and coll. Heart, 2012 déc;98 (24) :1790-7

5 6 7  
JUN 2019





European Society  
of Cardiology

European Heart Journal (2019) 40, 87–165  
doi:10.1093/eurheartj/ehy394

ESC/EACTS GUIDELINES

## 2018 ESC/EACTS Guidelines on myocardial revascularization

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

Developed with the special contribution of the European Association for Percutaneous Cardiovascular Interventions (EAPCI)

**Authors/Task Force Members:** Franz-Josef Neumann\* (ESC Chairperson) (Germany), Miguel Sousa-Uva\*<sup>1</sup> (EACTS Chairperson) (Portugal), Anders Ahlsson<sup>1</sup> (Sweden), Fernando Alfonso (Spain), Adrian P. Banning (UK), Umberto Benedetto<sup>1</sup> (UK), Robert A. Byrne (Germany), Jean-Philippe Collet (France), Volkmar Falk<sup>1</sup> (Germany), Stuart J. Head<sup>1</sup> (The Netherlands), Peter Jüni (Canada), Adnan Kastrati (Germany), Akos Koller (Hungary), Steen D. Kristensen (Denmark), Josef Niebauer (Austria), Dimitrios J. Richter (Greece), Petar M. Seferović (Serbia), Dirk Sibbing (Germany), Giulio G. Stefanini (Italy), Stephan Windecker (Switzerland), Rashmi Yadav<sup>1</sup> (UK), Michael O. Zembala<sup>1</sup> (Poland)

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ESC Committee for Practice Guidelines (CPG), EACTS Clinical Guidelines Committee, and National Cardiac Societies document reviewers: listed in the Appendix.

**Recommendations on criteria for the choice between coronary artery bypass grafting and percutaneous coronary intervention**

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
<b>Assessment of surgical risk<sup>c</sup></b>		
It is recommended that the STS score is calculated to assess in-hospital or 30 day mortality, and in-hospital morbidity after CABG. <sup>112,114,138</sup>	I	B
Calculation of the EuroSCORE II score may be considered to assess in-hospital mortality after CABG. <sup>112</sup>	IIb	B
<b>Assessment of CAD complexity</b>		
In patients with LM or multivessel disease, it is recommended that the SYNTAX score is calculated to assess the anatomical complexity of CAD and the long-term risk of mortality and morbidity after PCI. <sup>117-124</sup>	I	B
When considering the decision between CABG and PCI, completeness of revascularization should be prioritized. <sup>131,132,134-136</sup>	IIa	B

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EuroSCORE = European System for Cardiac Operative Risk Evaluation; CABG = coronary artery bypass grafting; CAD = coronary artery disease; LM = left main; PCI = percutaneous coronary intervention; STS = Society of Thoracic Surgeons; SYNTAX = Synergy between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery.



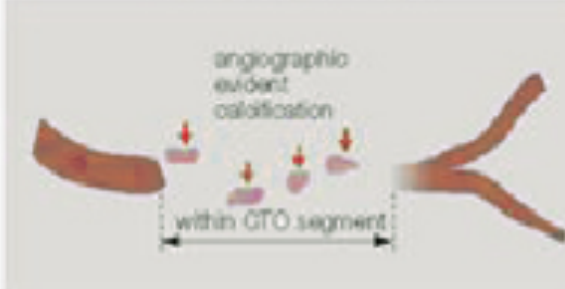
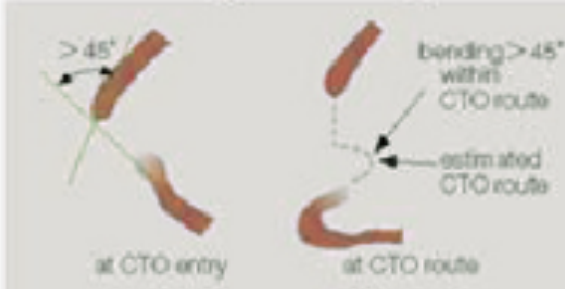
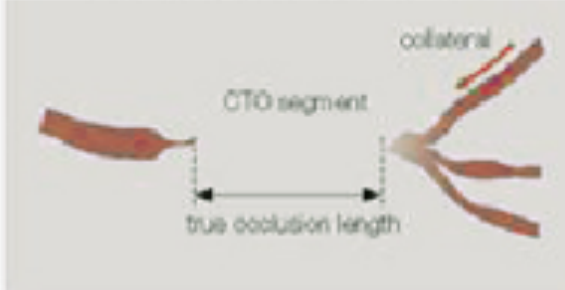
<sup>a</sup>Class of recommendation.

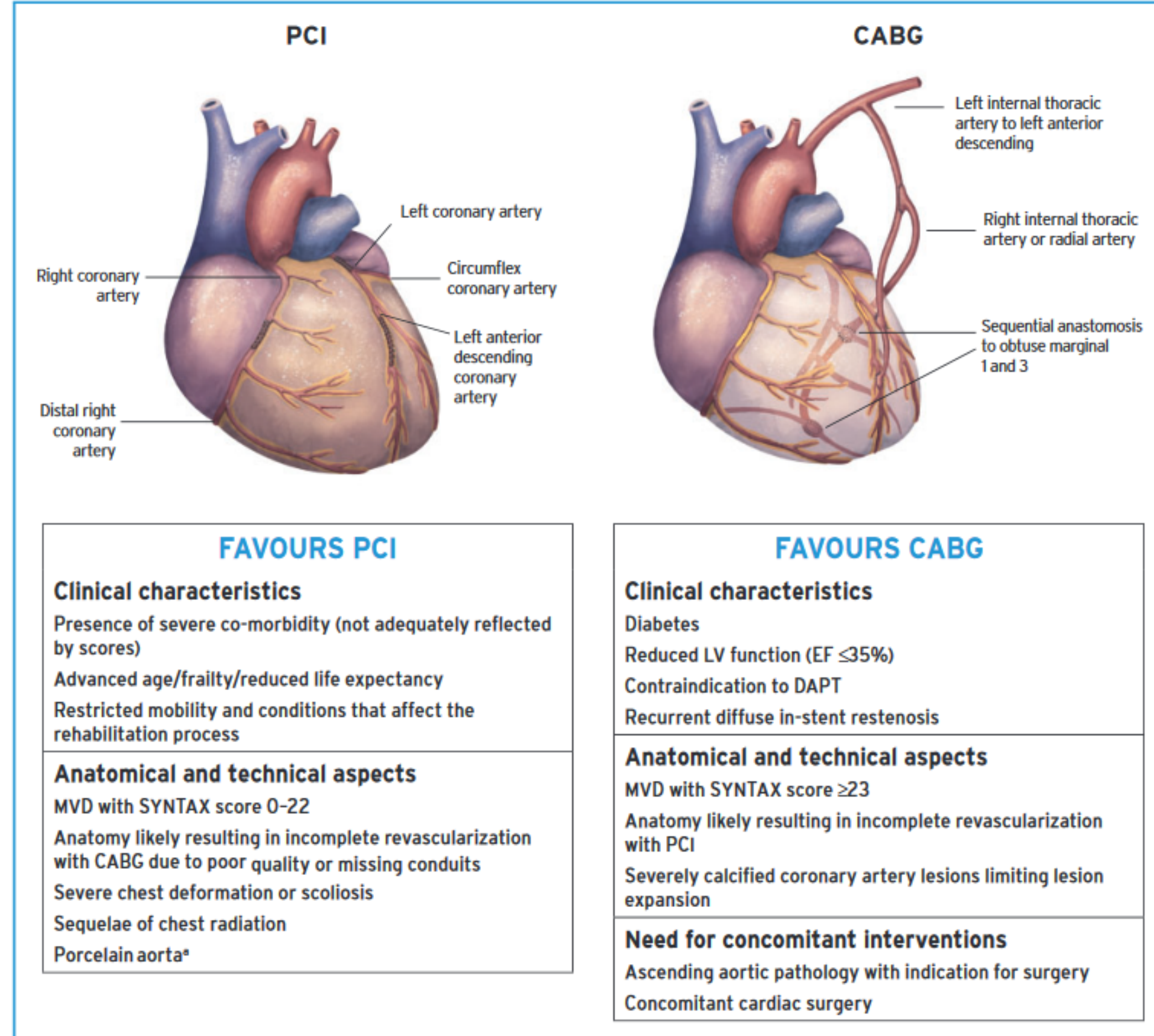
<sup>b</sup>Level of evidence.

<sup>c</sup>Level of evidence refers to prediction of outcomes.

## J-CTO SCORE SHEET

Version 1.0

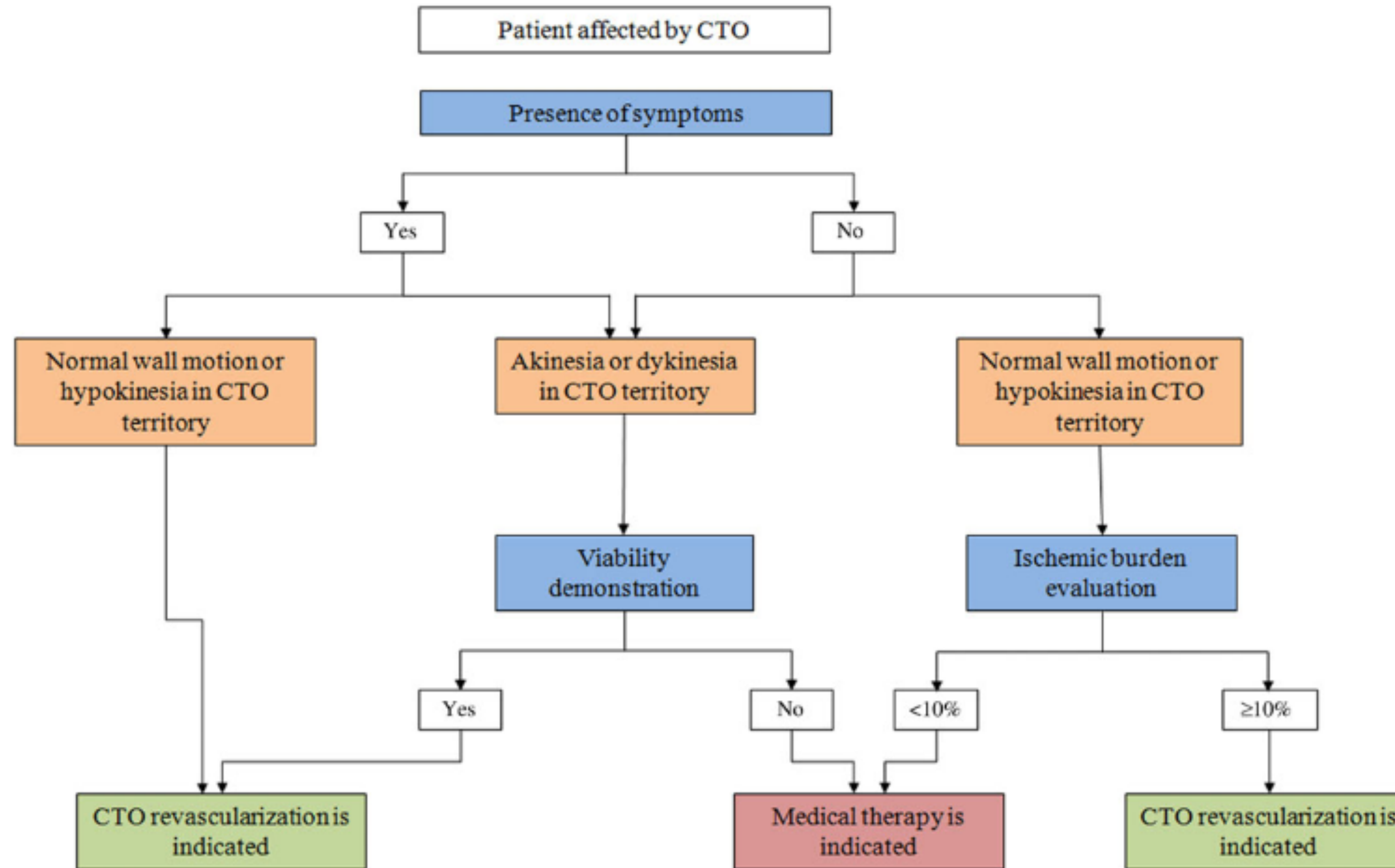
Variables and definitions		
<p><b>Tapered</b></p> 	<p><b>Blunt</b></p> 	<p>Entry with any tapered tip or dimple indicating direction of true lumen is categorized as "tapered".</p> <p><b>Entry shape</b></p> <input type="checkbox"/> Tapered (0) <input type="checkbox"/> Blunt (1)
		point
<p><b>Calcification</b></p> 		<p>Regardless of severity, 1 point is assigned if any evident calcification is detected within the CTO segment.</p> <p><b>Calcification</b></p> <input type="checkbox"/> Absence (0) <input type="checkbox"/> Presence (1)
		point
<p><b>Bending &gt;45degrees</b></p> 		<p>One point is assigned if bending &gt; 45 degrees is detected within the CTO segment. Any tortuosity separated from the CTO segment is excluded from this assessment.</p> <p><b>Bending &gt;45°</b></p> <input type="checkbox"/> Absence (0) <input type="checkbox"/> Presence (1)
		point
<p><b>Occlusion length</b></p> 		<p>Using good collateral images, try to measure "true" distance of occlusion, which tends to be shorter than the first impression.</p> <p><b>Occl.Length</b></p> <input type="checkbox"/> < 20mm (0) <input type="checkbox"/> ≥ 20mm (1)
		point
<p><b>Re-try lesion</b></p> <p>Is this Re-try (2<sup>nd</sup> attempt) lesion ? (previously attempted but failed)</p>		<p><b>Re-try lesion</b></p> <input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1)
		point
<p>Category of difficulty (total point)</p> <input type="checkbox"/> easy (0) <input type="checkbox"/> Intermediate (1) <input type="checkbox"/> difficult (2) <input type="checkbox"/> very difficult (≥3)		<p><b>Total</b></p> <div style="border: 1px solid gray; width: 30px; height: 20px; display: inline-block; margin-right: 5px;"></div> points



CABG = coronary artery bypass grafting; Cx = circumflex; DAPT = dual antiplatelet therapy; EF = ejection fraction; LAD = left anterior descending coronary artery; LIMA = left internal mammary artery; LV= left ventricular; MVD = multivessel coronary artery disease; PCI = percutaneous coronary intervention; PDA = posterior descending artery; RA = radial artery; RIMA = right internal mammary artery; SYNTAX = Synergy between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery.  
 \*Consider no-touch off-pump CABG in case of porcelain aorta.

**Figure 3** Aspects to be considered by the Heart Team for decision-making between percutaneous coronary intervention and coronary artery bypass grafting among patients with stable multivessel and/or left main coronary artery disease.

©ESC 2018



**Figure 2** Indications of CTO revascularization according to symptoms, ischaemia, and viability. CTO, chronic total occlusion.



		Asymptomatic			Symptomatic Class II			Symptomatic Class III-IV		
		Low risk	Interm. risk	High risk	Low risk	Interm. risk	High risk	Low risk	Interm risk	High risk
Single-vessel disease	CTO	I	U	U	U	U	A	U	A	A
	Non-CTO	I	U	A	U	A	A	A	A	A

			No left main involvement		Left main involvement	
			No LAD Low Syntax score	High Syntax score with LAD involvement	Low Syntax score	High Syntax score
Multi vessel disease	CTO	PCI	A	U	U	I
		CABG	A	A	A	A
	Non-CTO	PCI	A	U	A	I
		CABG	A	A	A	A

I	Inappropriate	U	uncertain	A	Appropriate
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**Figure 3** Suggested workflow from appropriate use criteria document for CTO and non-CTO revascularization in single- and multivessel diseases. CABG, coronary artery bypass graft; CTO, chronic total occlusion; PCI, percutaneous coronary intervention.

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JUN 2019

## Les ennemis de l'angioplasticien:

1/ Orgueil // Frime

2/ Bulles

3/ Thrombus

4/ Air

5/ Rayons X



Mettre les intérêts du patient au centre de la discussion

Avoir une réelle « Heart Team »,  
avec un ou plusieurs chirurgiens et cliniciens en  
chair et en os, présents  
= Organiser les contre-pouvoirs

Ne pas confondre faisabilité et Indication

Evaluer les chances de succès,  
les risques d'échec,  
les conséquences possibles d'un échec

Informez loyalement le patient

Proposer une solution alternative

Donner un temps de réflexion

Proscrire les procédures Ad Hoc

## Mes Indications de choix:

- Patient restant symptomatique sous traitement médical
- Avec la preuve d'une large ischémie > 10%
- CTO raisonnablement faisable en antérograde
- Temps d'irradiation < 30 minutes

(My) firsts cases of CTO retrograde intervention  
2007



« What is reasonable in the search of  
technical challenges ? »

Jeff Tuche MD Plastic Surgeon Miami

