CTO-PCI
DON'T CARE OF EXPERTISE

Seung-Whan Lee, MD, PhD

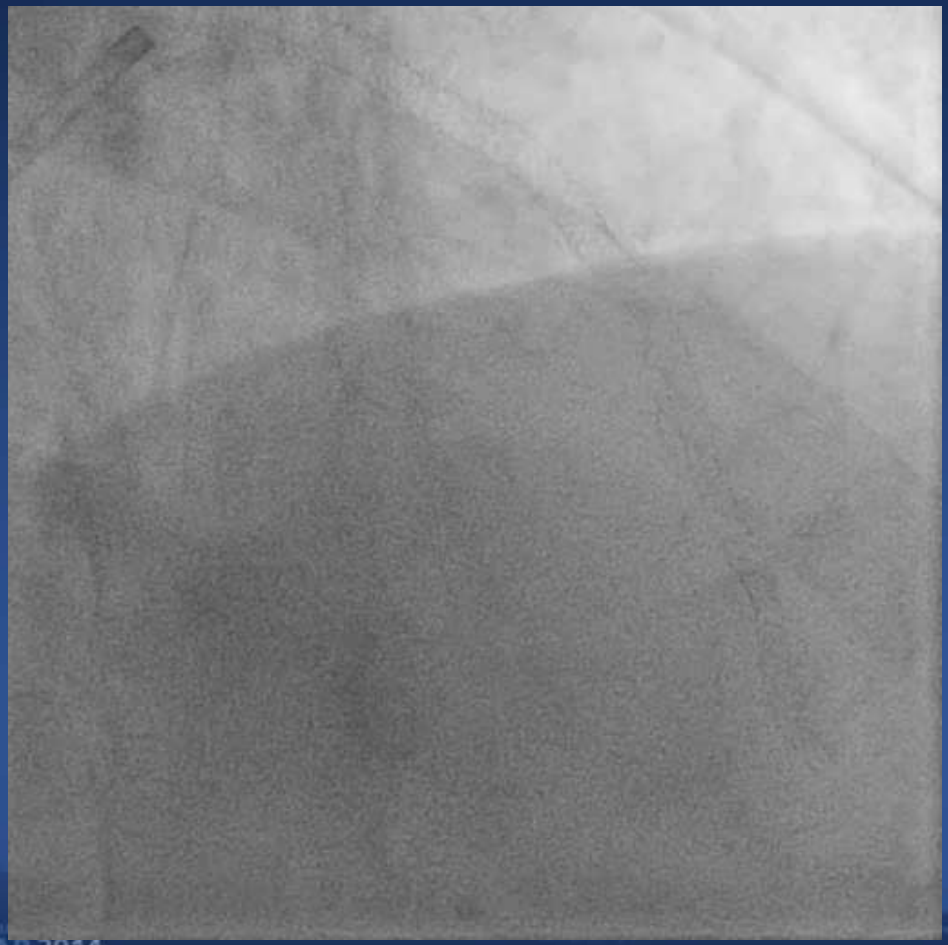
Department of Cardiology, Heart center, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

Long complex CTO

To Treat or Not To Treat

Long complex CTO

Failed or Succeeded ?



Xience 3.5/38 mm,
Xience 2.75/38 mm,
Xience 2.5/18 mm

Procedure time: 180 min
Fluro time: 114 min
Contrast : 680 cc

I am in-born cardiologist and strong believer of CTO-PCI.

However,
I am not afraid of failure
The reason why ?

CTO-PCI

- 2012 ACCF/SCAI/STS.. Guideline
  - PCI for CTO (IIa)
- 2010 ESC Guideline
  - CTO revascularization (IIa)

2012 ACCF/SCAI/STS.. Guideline

Patients Without Prior Bypass Surgery

Indication		Appropriate Use Score (1-9)		
	CCS Angina Class	Asymptomatic	I or II	III or IV
26.	• Intermediate risk finding on non invasive testing • Minimal/No anti-ischemic therapy	I (3)	U (4)	U (6)
27.	• Isolated CTO of 1 major coronary artery • Intermediate risk finding on non invasive testing • Maximal anti-ischemic therapy	U (4)	U (5)	A (7)
28.	• Isolated CTO of 1 major coronary artery • High risk finding on non invasive testing • Minimal/No anti-ischemic therapy	U (4)	U (5)	A (7)
29.	• Isolated CTO of 1 major coronary artery • High risk finding on non invasive testing • Maximal anti-ischemic therapy	U (5)	A (7)	A (8)

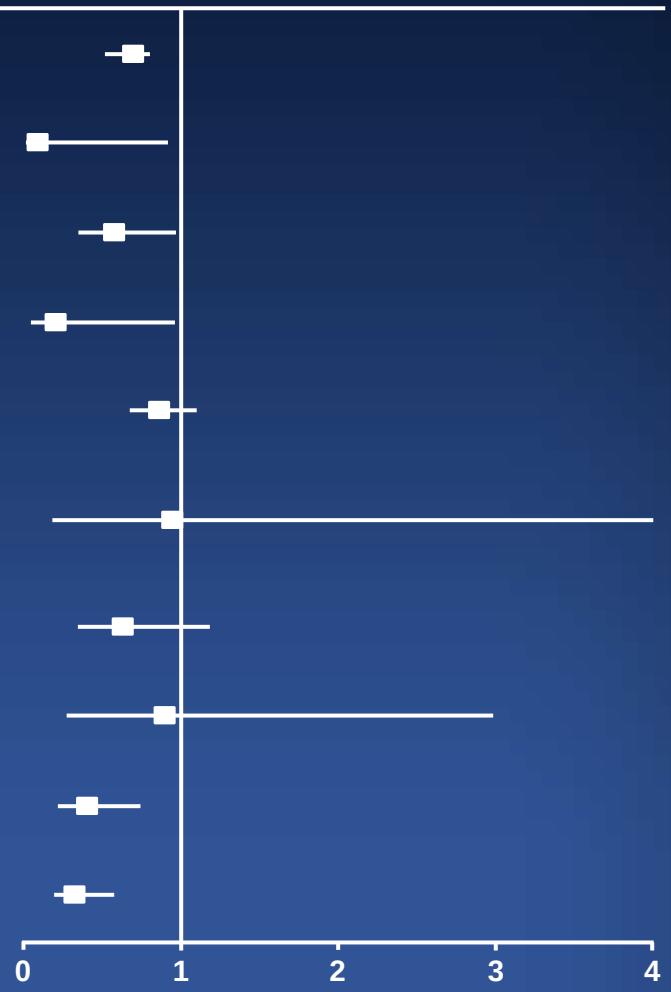
Ischemic burden on non-invasive testing: High
level of anti-ischemic medical treatment: Maximal
symptom status: Symptomatic

1-3: Inappropriate
4-6: Uncertain
7-9: Appropriate
In terms of survival/health outcomes

CTO Meta-Analysis: Survival (I)

Auther (Enrolment period)	Patients N	Cumulative Follow-up	Stent used (%)	Survival rate in successful vs. failed
Suero et al.[6] (1980-1999)	2005	10-yr	BMS(7.0)	73.5% vs 65%, P=.001
Olivari et al.[7*] 1999-2000	369	1-yr	BMS(89.7)	99.7% vs 96.4%, P=.04
Hoye et al.[8] 1992-2002	871	5-yr	BMS(81.0)	93.5% vs 88.0%, P=.02
Aziz et al.[9] 2000-2004	543	2-yr	BMS(97.7)	98.0% vs 94.2%, P=.05
Prasad et al.10 1979-2005	1262	10-yr	DES(29) BMS(NR)	72% vs 77%, P=.03
De Labriolle et al.[11*] 2003-2005	172	2-yr	BMS(9.7)	95.1% vs 94.7%, P=.3
Valenti et al.[12*,o,§] 2003-2006	486	4-yr	DES(84.0)	91.6% vs 87.4%, P=.03
Lee et al.[20] 2003-2006	333	3-yr	DES(100)	96.7 vs 94.7%, P=.28
Mechran et al.[19o] 1998-2007	1791	5-yr	BMS(34.0) DES(66.0)	97.0% vs 94.2%, P<.01
Jones et al.[18] 2003-2010	836	5-yr	DES(76.1)	95.5% vs 82.8%

Adjusted HR survival in successful vs. failed



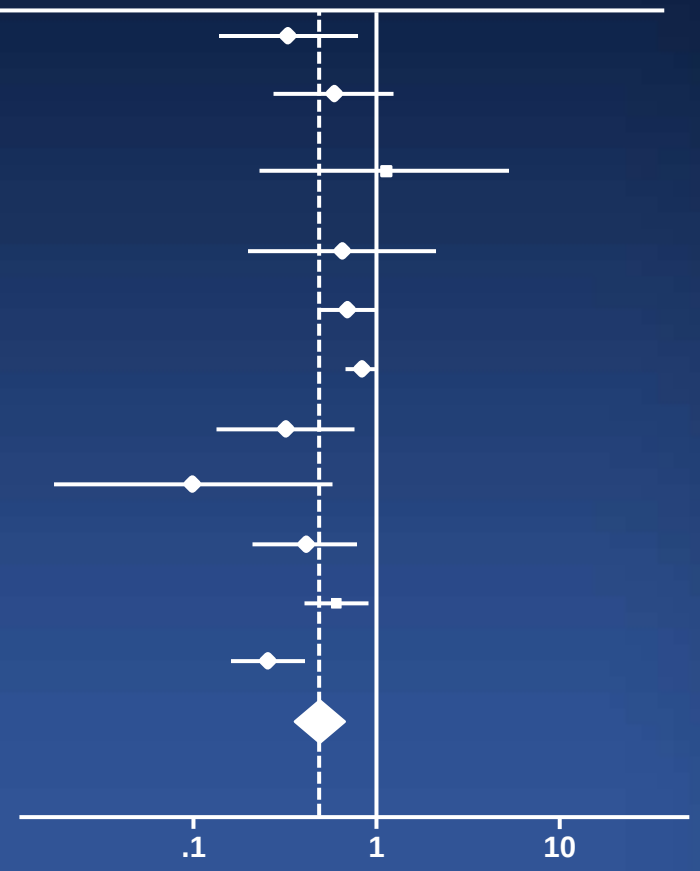
Long-term survival rates and relative risk estimtes of successful vs failed CTOs PCI in observational studies, including patients freated with stens. In the graph, black squares represent hazard ratios (except for one study in which odds ratio is represented), and bars indicate 95% CI, *Unadjusted hazard ratio. °Cardiac survival. §Odds ratio. HR, hazard ratios.

Tamburino C, et al. Am Heart J. 2013;165:133

CTO Meta-Analysis: Survival (II)

Study	PCI Successful n/N	PCI failed n/N	RR(95% CI)	%Weight
Aziz	9/377	12/166	0.33(0.14-0.77)	7.63
Borgia	19/237	9/65	0.58(0.28-1.22)	8.68
de Labriolle	7/127	2/40	1.10(0.24-5.01)	3.41
Lee	8/251	4/82	0.65(0.20-2.11)	5.07
Mehran	74/1226	49/565	0.70(0.49-0.98)	13.88
Noguchi	7/134	15/92	0.32(0.14-0.76)	7.51
Prasad	220/914	101/348	0.83(0.68-1.01)	15.60
Chen	2/132	3/20	0.10(0.02-0.57)	2.80
Valenti	17/344	17/142	0.41(0.22-0.78)	9.88
Yi	135/1202	24/130	0.61(0.41-0.90)	13.23
Jones	26/582	44/254	0.26(0.16-0.41)	12.30
D+Lpooled	654/5526	280/1904	0.50(0.36-0.68)	100
RR				

RR(Random effects model)



Favors successful PCI Favors failed PCI

Heterogeneity chi-squared = 33.11 (d.f.=10) p=0.000
I-squared (variation in RR attributable to heterogeneity) = 69.8%
Estimate of between-study variance Tau-squared=0.1572

Khan MF, et al. CCI:2013;82:95

CTO Meta-Analysis: Survival (III)

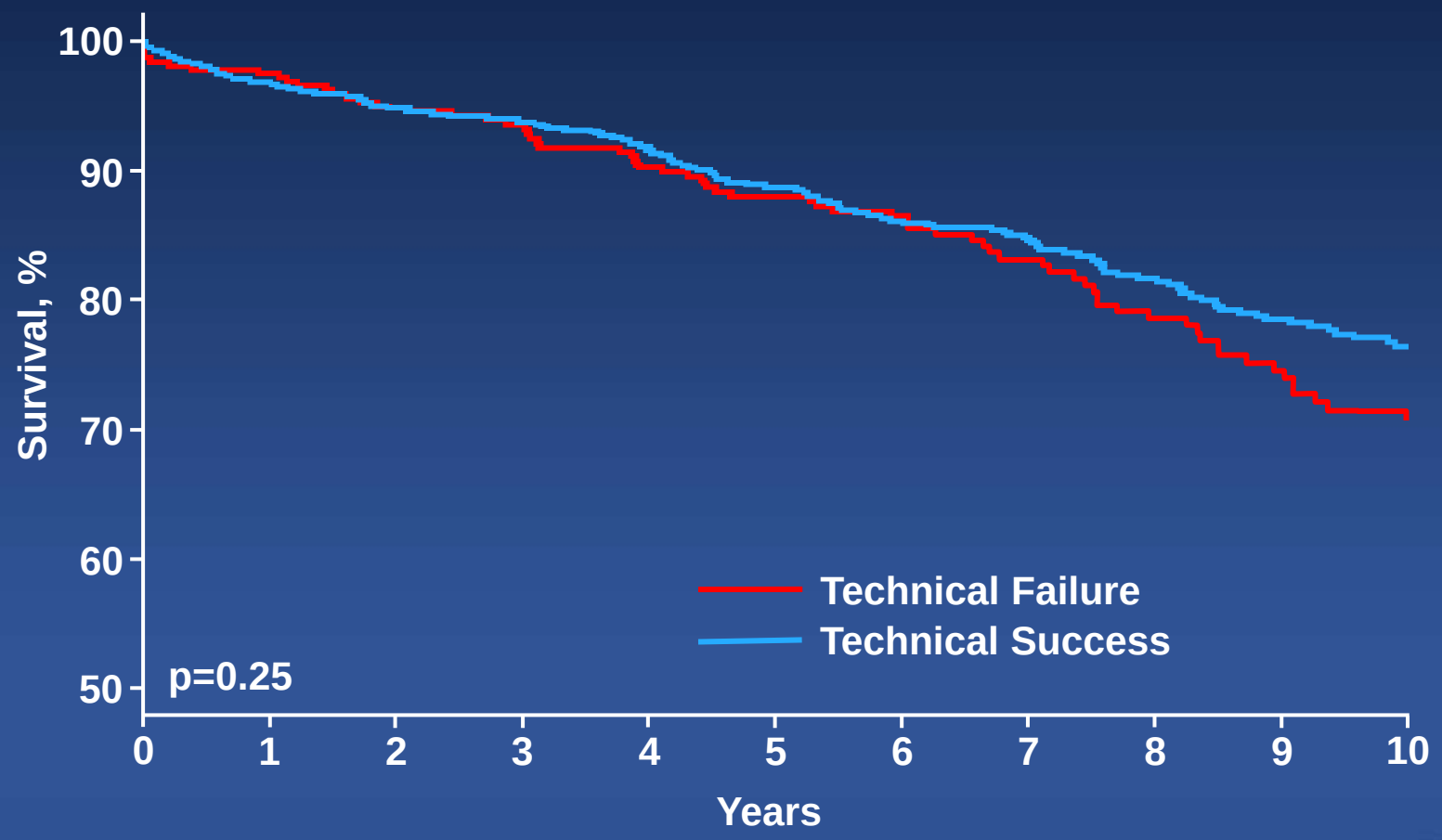
Study name	Statistics for each study					Odds ratio and 95% CI
	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value	Relative weight
Aziz 2007	0.248	0.095	0.648	-2.846	0.004	5.78
de Labriolle 2008	1.108	0.221	5.563	0.125	0.901	2.05
Drozd 2008	0.944	0.272	3.275	-0.091	0.928	3.45
Mehran 2011	0.461	0.280	0.757	-3.057	0.002	21.61
Jolicoeur 2012	0.614	0.194	1.943	-0.830	0.406	4.01
Arslan 2006	0.409	0.218	0.766	-2.792	0.005	13.53
Lee 2011	0.171	0.074	0.395	-4.140	0.000	7.64
	0.391	0.311	0.493	-7.957	0.000	

Successful CTO-PCI using a predominantly stent-based strategy is associated with a significant reduction in short- and long-term mortality compared to unsuccessful CTO-PCI

Pancholy SB, et al. Am J Cardiol 2013;111:521

CTO: The Mayo Clinic 25-Year Experience

1,262 CTO pts analyzed: Technical failure to treat CTO was not an independent predictor of long-term mortality. (HR=1.16; [95% CI 0.90-1.5], p=0.25)



Prasad A, et al. JACC 2007;49:1611

Long-Term Outcomes After Percutaneous Coronary Intervention for Chronic Total Occlusion (from the CREDO-Kyoto Registry Cohort-2)

Erika Yamamoto, MD[a], Masahiro Natsuaki, MD[a,*], Takeshi Morimoto, MD[b], Yutaka Furukawa, MD[c], Yoshihisa Nakagawa, MD[d], Koh Ono, MD[a], Kazuaki Mitsudo, MD[e], Masakiyo Nobuyoshi, MD[f], Osamu Doi, MD[g], Takashi Tamura, MD[h], Masaru Tanaka, MD[i], and Takeshi Kimura, MD[a], on behalf of the CREDO-Kyoto PCI/CABG Registry Cohort-2 Investigators

CTO-PCI: Success vs. Failure

variable	Adjusted HR (95% CI)	p
All-cause death	0.93 (0.64-1.37)	0.69
Cardiac death	0.71 (0.44-1.16)	0.16
MI	0.60 (0.33-1.13)	0.11
Stroke	0.81 (0.49-1.40)	0.45
Coronary bypass	0.09 (0.06-0.15)	<0.0001
Any revascularization	0.50 (0.41-0.60)	<0.0001

Am J Cardiol 2013;112:767-774

AMC CTO-PCI registry

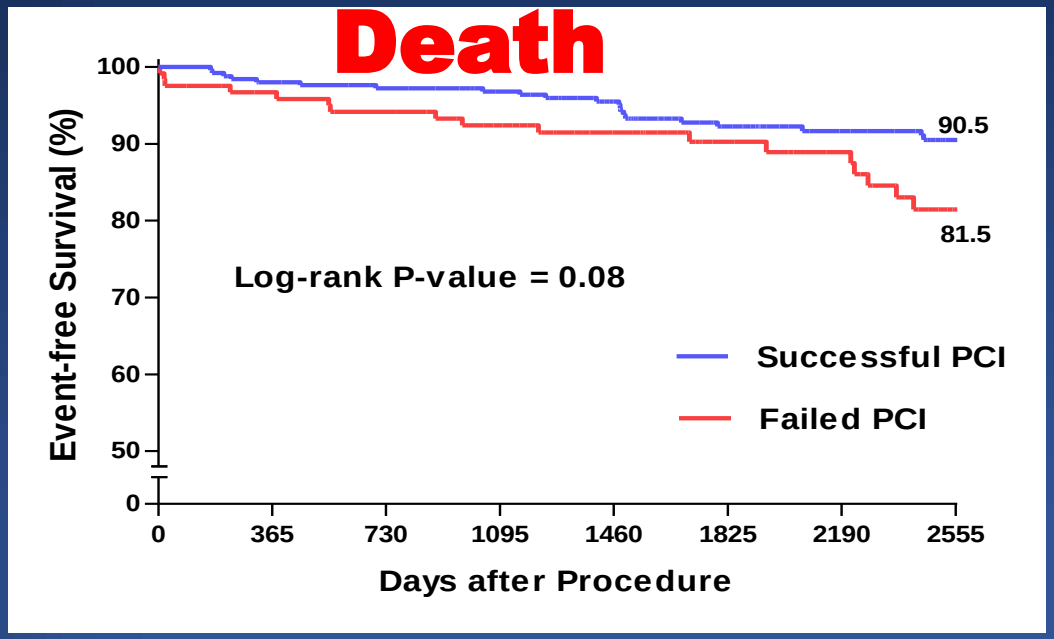
SUCCESS (N=253) VS. Failure (n=124)

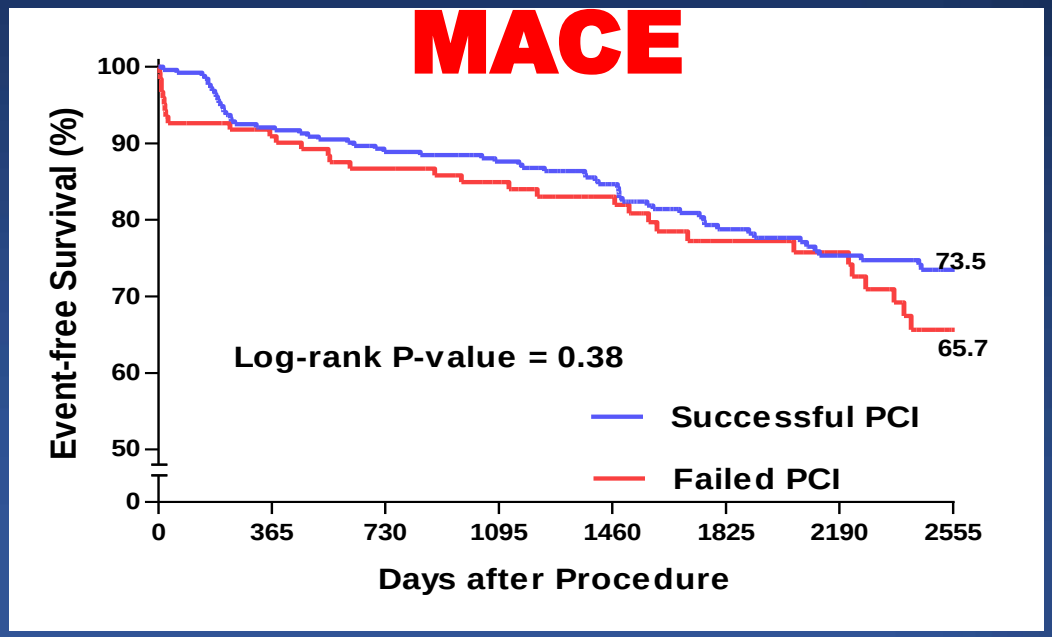
7-year follow-up

AMC CTO registry

SUCCESS (N=253) VS. Failure (n=124)

7-year follow-up





No clinical benefit of CTO-PCI

AMC CTO registry

7-year follow-up

CTO-PCI: Success vs. Failure

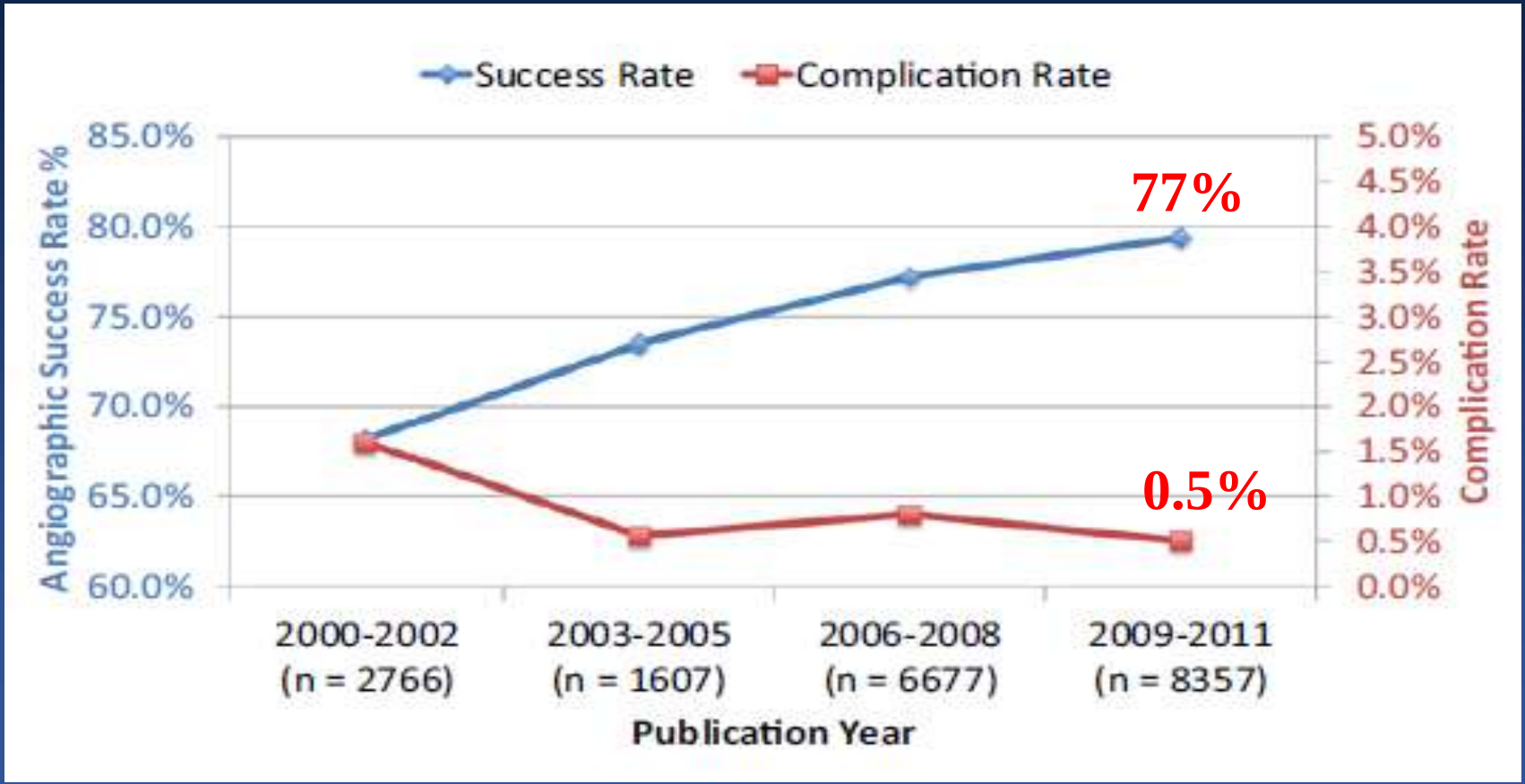
variable	Crude HR (95% CI)	p	IPTW Adjusted HR (95% CI)	P
Death	1.76 (0.94-3.30)	0.07	0.99 (0.47-2.08)	0.98
MI	1.00 (0.26-3.89)	0.99	0.52 (0.13-2.10)	0.36
TVR	1.00 (0.51-1.97)	0.99	0.87 (0.40-1.88)	0.72
Death or MI	1.56 (0.87-2.79)	0.13	0.90 (0.45-1.78)	0.77
Stroke	0.19 (0.02-1.49)	0.11	0.99 (0.13-7.12)	0.99
MACE	1.20 (0.79-1.85)	0.38	1.00 (0.57-1.74)	0.99

Limitations of Studies Assessing Survival According to CTO PCI Success

- Heterogeneous Definitions of CTOs
- Lack of Standardized CTO Recanalization Techniques
- Observational Studies, Mostly Small Single-Center
- Potential for Bias (CTO Success vs. Failed)
- Over-Fitting of Multivariate Analysis Models
- No Stratification According to Ischemic Burden
- Lack of Stratification According to the SYNTAX Score
- Limited Information on Completeness of Revascularization
- Limited Data on OMT Strategies
- Lack of Systematic LVEF Assessment
- Lack of CABG Group for Comparison
- Lack of a Multi-Center Prospective Randomized Trial

Trend of Success & Complications

Meta Analysis of 18,061 Patients

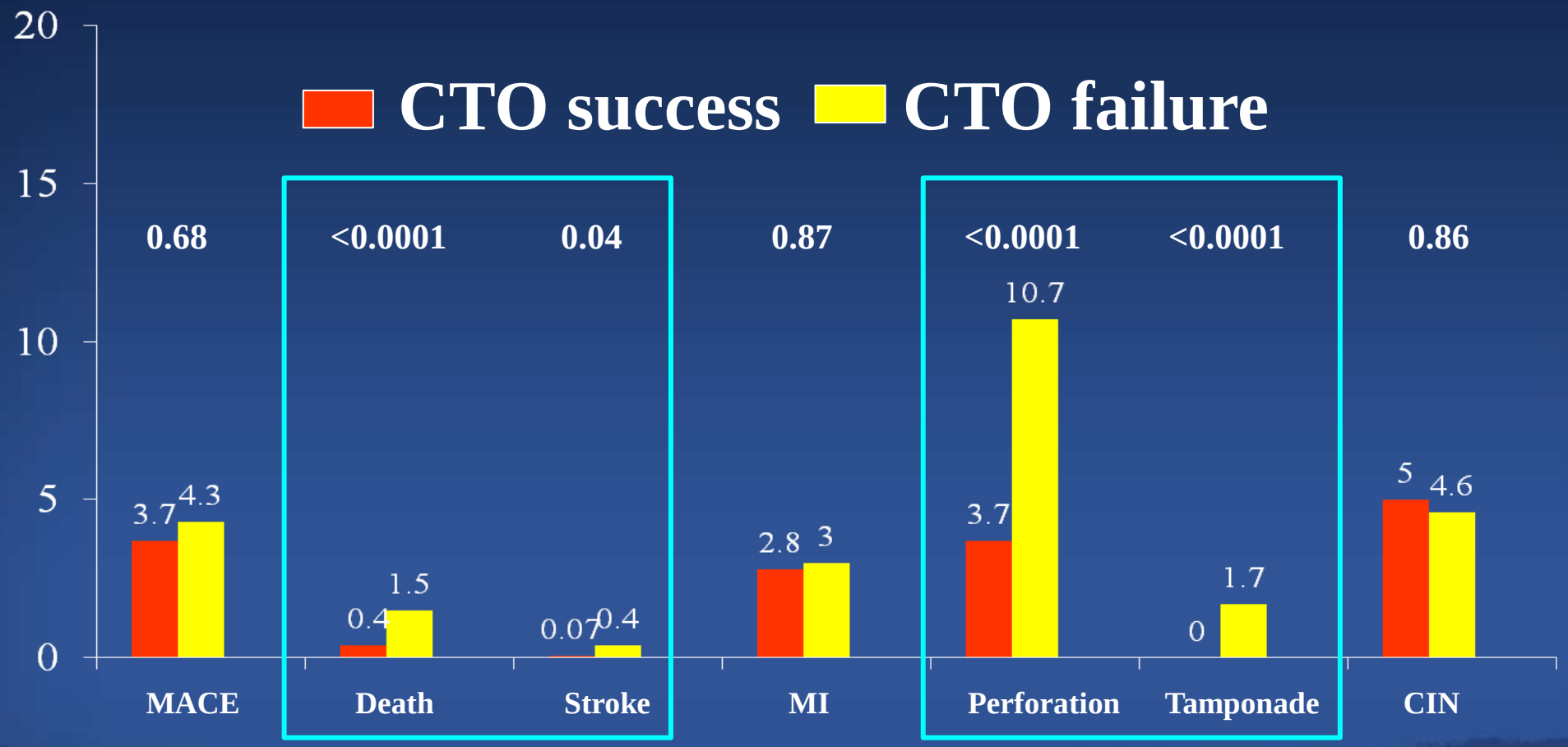


Emergency CABG 0.1%
Tamponade 0.3%

Patel VG et al. J Am Coll Cardiol Intv 2013;6:128–36

CTO-PCI Complications

Meta Analysis of 18,061 Patients



Patel VG et al. J Am Coll Cardiol Intv 2013;6:128–36

To Treat or Not To Treat, Still Controversial Issue

Role of CTO-PCI ?

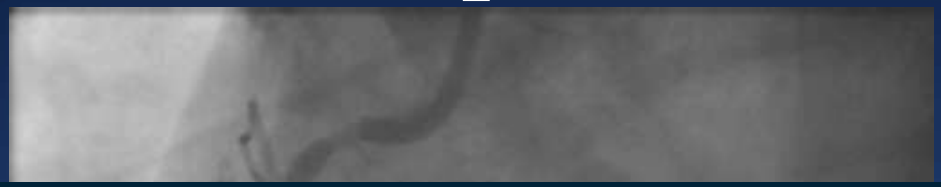
Ongoing Trial:

EUROCTO (n=1200: NCT01760083)

DECISION-CTO (n=1284:NCT0107805)

Diversity of CTO

Simple



Complex

Easy treatable CTO can be managed by not expert,
But complex CTO is not easily cared by not expert.
However, most important thing is finishing procedure without complication, which provide another good option for optimal medical treatment !!!

Easy treatable

Hard works

Thank you for your attention