Comparable impact of OMT and non-target vessel intervention after failed versus successful CTO-PCI

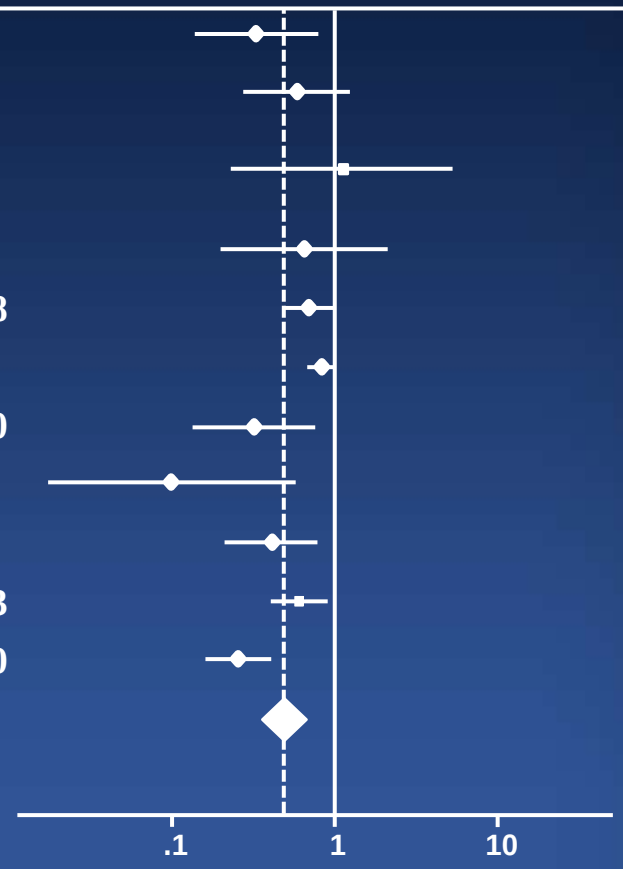
Seung-Whan Lee, MD

Asan Medical Center,
University of Ulsan College of Medicine, Seoul, Korea

CTO Meta-Analysis: Survival

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)



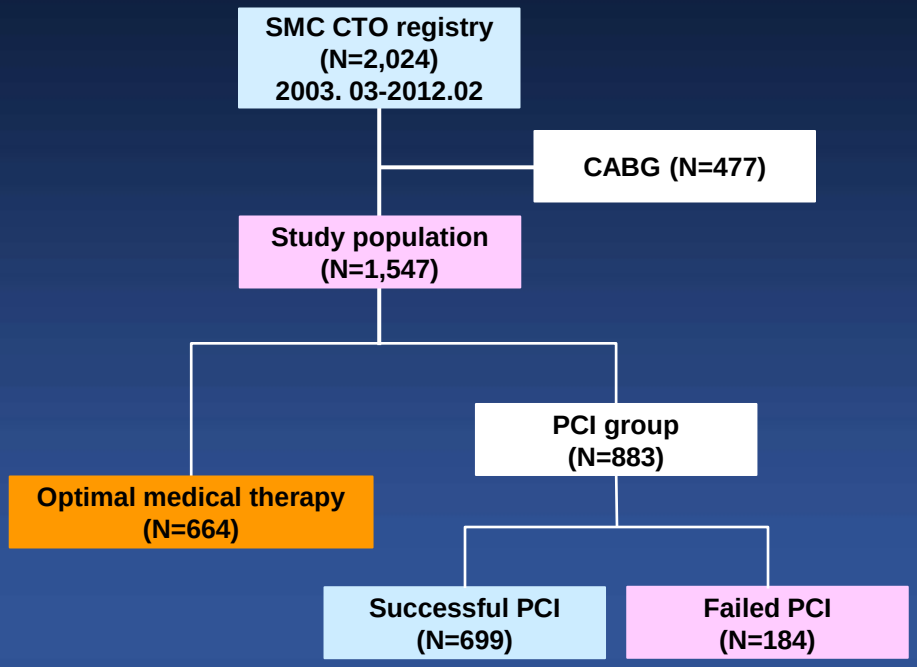
Heterogeneity chi-squared = 33.11 (d.f.=10) p=0.000
I-squared (variation in RR attributable to heterogeneity) = 69.8%
Estimate of between-study variance Tau-squared=0.1572

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

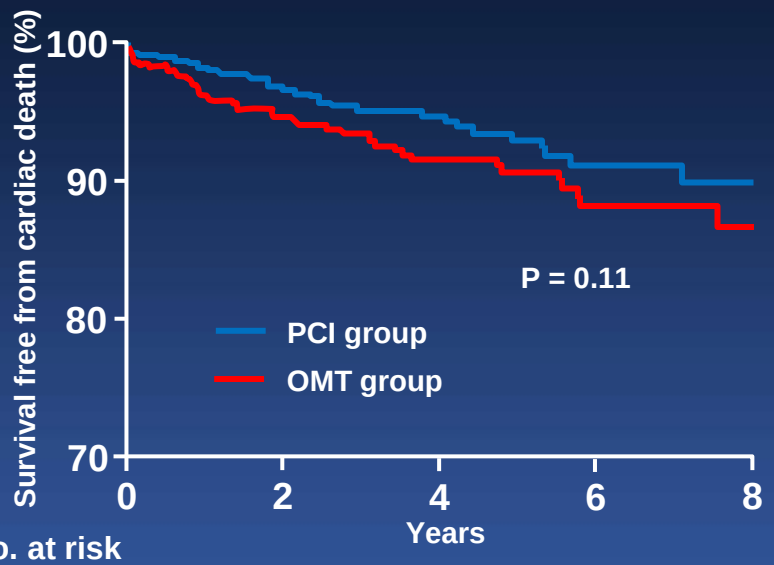
Dedicated medical treatment for CTO

Optimal Medical Therapy vs. Percutaneous Coronary Intervention for Patients With Coronary Chronic Total Occlusion

- A Propensity-Matched Analysis -



Cardiac death-free survival



No. at risk					
PCI	532	398	256	119	24
OMT	532	373	247	126	39

Circ J 2016; 80: 211–217

OMT vs. PCI Group

Propensity-Matched Population

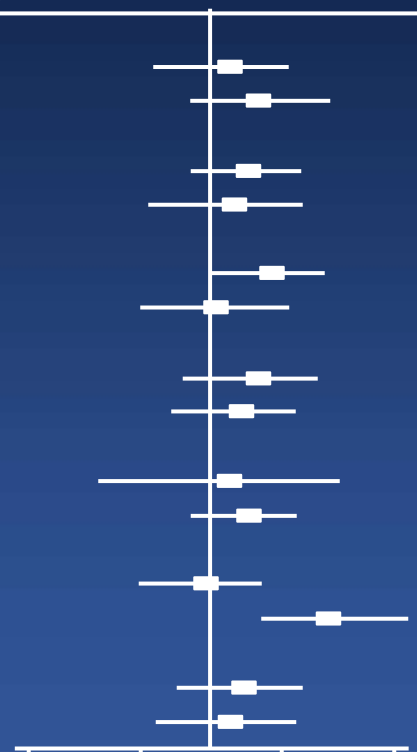
Propensity-matched (n=1,066)	OMT (n=533)	PCI (n=533)	HR (95% CI)	P value
All-cause death	98 (18.4)	62 (11.6)	1.87 (1.27-2.76)	0.002
Cardiac death	44 (8.3)	31 (5.8)	1.57 (0.91-2.72)	0.11
MI	8 (1.5)	7 (1.3)	1.75 (0.51-5.98)	0.37
Cardiac death or MI	45 (8.4)	32 (6.0)	1.62 (0.94-2.79)	0.08
Any revascularization	92 (17.3)	67 (12.6)	1.19 (0.81-1.76)	0.38
MACE*	133 (25.0)	96 (18.0)	1.29 (0.93-1.78)	0.12

Circ J 2016; 80: 211–217

OMT vs. PCI Group

Propensity-Matched Population, subgroup analysis

Subgroups	Number of patients	Hazard ratio	95% CI	P for Interaction
Age				
< 75 years	876	1.21	0.66–2.20	
≥ 75 years	190	1.83	0.88–3.81	0.42
Acute coronary syndrome				
No	877	1.54	0.88–2.72	
Yes	189	1.23	0.56–2.71	0.64
LVEF				
≤40%	189	1.82	1.01–3.29	
>40%	827	1.05	0.49–2.24	0.28
CTO vessel				
Non–LAD	768	1.65	0.85–3.19	
LAD	298	1.35	0.71–2.58	0.66
Proximal or mid portion, CTO				
No	364	1.29	0.35–4.81	
Yes	702	1.44	0.88–2.35	0.92
Collateral flow				
0–2	673	0.87	0.57–1.67	
3	393	4.63	1.57–13.69	0.01
Syntax score				
<23	732	1.60	0.85–2.99	
≥23	334	1.26	0.64–2.45	0.59



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Optimal medical therapy may be a better initial strategy in patients with chronic total occlusion of a single coronary artery

Ji-won Hwang [a,1], Jeong Hoon Yang [a,b,1], Seung-Hyuk Choi [a,*], Jin Kyung Hwang [a], Woo Jin Jang [a], Joo-Yong Hahn [a], Young Bin Song [a], Jin-Ho Choi [a], Sang Hoon Lee [a], Hyeon-Cheol Gwon [a]

[a] Division of Cardiology, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea
[b] Department of Critical Care Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

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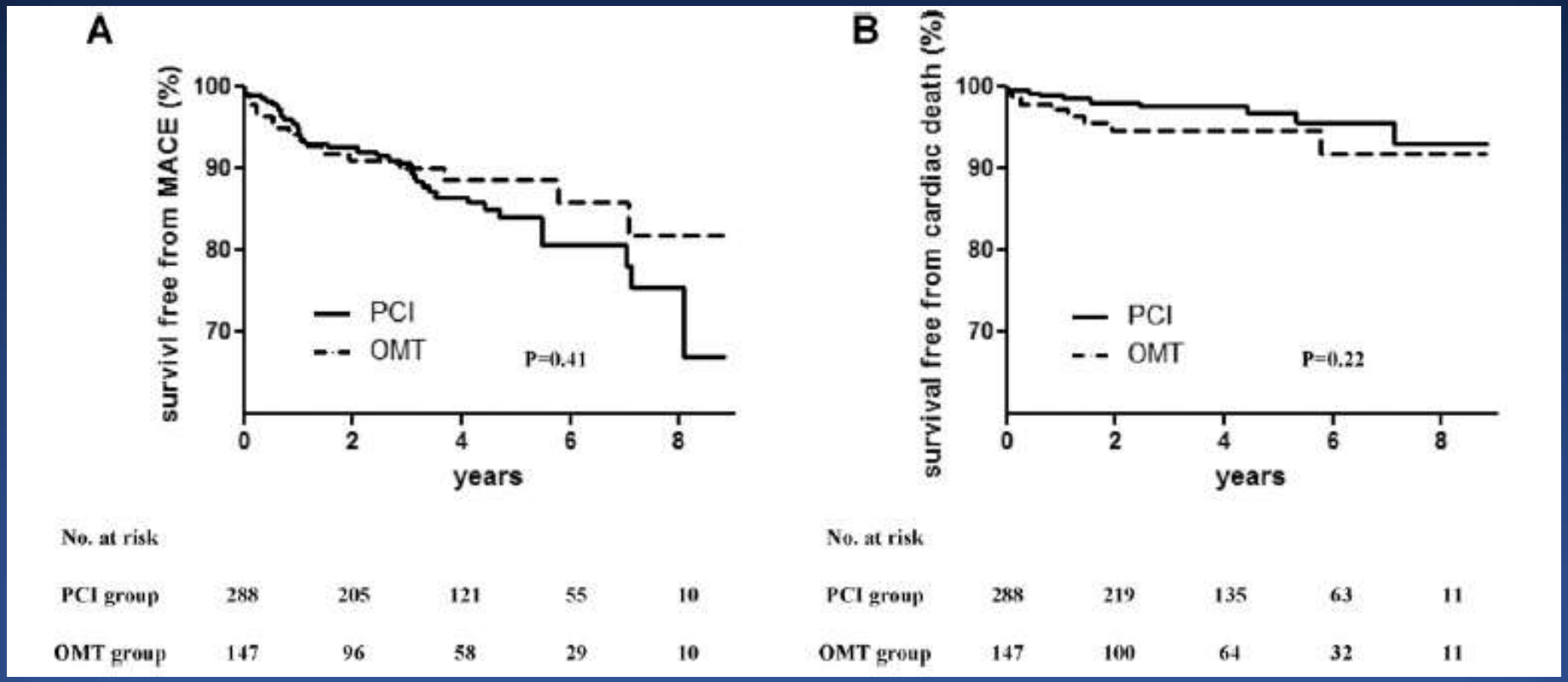
ABSTRACT

Objectives: To compare clinical outcomes of percutaneous coronary intervention (PCI) with those of optimal medical therapy (OMT) alone in patients with chronic total occlusion (CTO) of a single coronary artery.
Background: Limited data are available on the efficacy of OMT for the treatment of single-vessel CTO.
Methods: Between March 2003 and February 2012, we enrolled 2024 CTO patients in a retrospective, observational registry and analyzed 435 patients with CTO of a single coronary artery. We divided patients into an OMT group ($n = 147$) and PCI group ($n = 288$) according to the initial treatment strategy. One-to-many (1:N) propensity score matching with a non-fixed matching ratio was also performed. The primary outcome measured in this study was major adverse cardiac events (MACEs) including cardiac death, myocardial infarction, and repeated coronary revascularization.
Results: The median follow-up duration was 47.6 (interquartile range: 22.9 to 68.9) months. Major adverse cardiac events were noted for 16 patients (10.9%) in the OMT group compared to 41 patients (14.2%) in the PCI group ($p = 0.38$). After propensity-score matching, there were no significant differences between the OMT group and PCI group with respect to MACE frequency (10.1% vs. 16.9%, adjusted hazard ratio [HR], 2.03; 95% confidence interval [CI], 0.88–4.68, $p = 0.10$) or cardiac death (OMT vs. PCI: 5.1% vs. 4.8%, HR, 1.14; 95% CI, 0.30–4.42, $p = 0.85$). Subgroup analysis showed that the rate of MACEs was significantly lower in the OMT group compared to the PCI group among patients with an APPROACH score ≤18 and SYNTAX score ≤12.
Conclusions: As a treatment strategy in patients with single-vessel CTO, PCI did not reduce the risk of MACE or cardiac death. These results suggest that OMT may be a better initial strategy for patients as assessed by low APPROACH and SYNTAX scores.

OMT vs. PCI Group in single CTO

MACE-free survival **Cardiac death-free survival**



No. at risk					
PCI group	288	205	121	55	10
OMT group	147	96	58	29	10

No. at risk					
PCI group	288	219	135	63	11
OMT group	147	100	64	32	11

Hwang JW et al. Int **J** Cardiol. 2016;210:56-62

OMT vs. PCI Group in single CTO

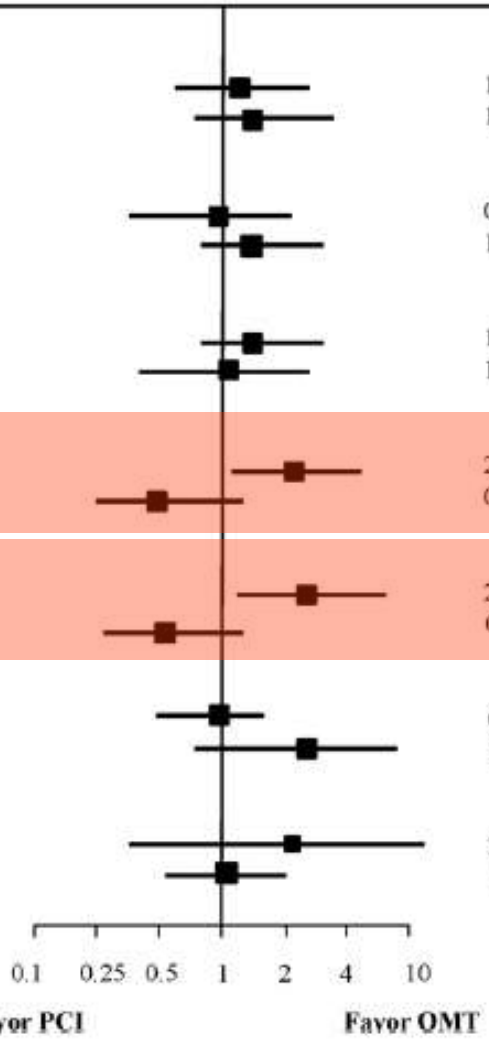
Mean follow-up duration: 47.6 months

Total population (n=435)	OMT (n=147)	PCI (n=288)	Adjusted HR (95% CI)	P value
Cardiac death	8 (5.4)	9 (3.1)	0.59 (0.21-1.66)	0.32
MI	0	1(0.3)	-	NA
Repeat revascularization	9 (6.1)	33 (11.5)	2.17(0.99-4.76)	0.05
TVR	7 (4.8)	25 (8.7)	2.20 (0.90-5.40)	0.08
Non-TVR	3 (2.0)	11 (3.8)	1.84 (0.47-7.19)	0.38
MACE	16 (10.9)	41 (14.2)	1.49 (0.80-2.78)	0.21

Hwang JW et al. Int **J** Cardiol. 2016;210:56-62

OMT vs. PCI Group

Subgroups	Number of patients	Adjusted hazard ratio (95% CI)	p value	p for interaction
Age				
< 65 years	256	1.17 (0.53 – 2.59)	0.69	
≥ 65 years	179	1.58 (0.67 – 3.77)	0.30	0.640
CTO at LAD				
Yes	187	0.94 (0.37 – 2.35)	0.89	
No	248	1.58 (0.75 – 3.35)	0.23	0.346
LV EF				
> 50%	346	1.56 (0.74 – 3.30)	0.24	
≤ 50%	89	1.11 (0.43 – 2.88)	0.83	0.569
APPROACH score				
≤ 18	240	2.32 (1.04 – 5.20)	0.041	
> 18	195	0.55 (0.24 – 1.27)	0.16	0.012
SYNTAX score				
≤ 12	227	2.63 (1.07 – 6.50)	0.035	
> 12	208	0.61 (0.28 – 1.31)	0.21	0.011
proximal to mid location				
Yes	306	0.93 (0.49 – 1.76)	0.82	0.170
No	129	2.62 (0.69 – 9.96)	0.16	
CTO at branched vessel				
Yes	88	2.10 (0.38 – 11.64)	0.40	0.489
No	347	1.08 (0.58 – 1.99)	0.82	



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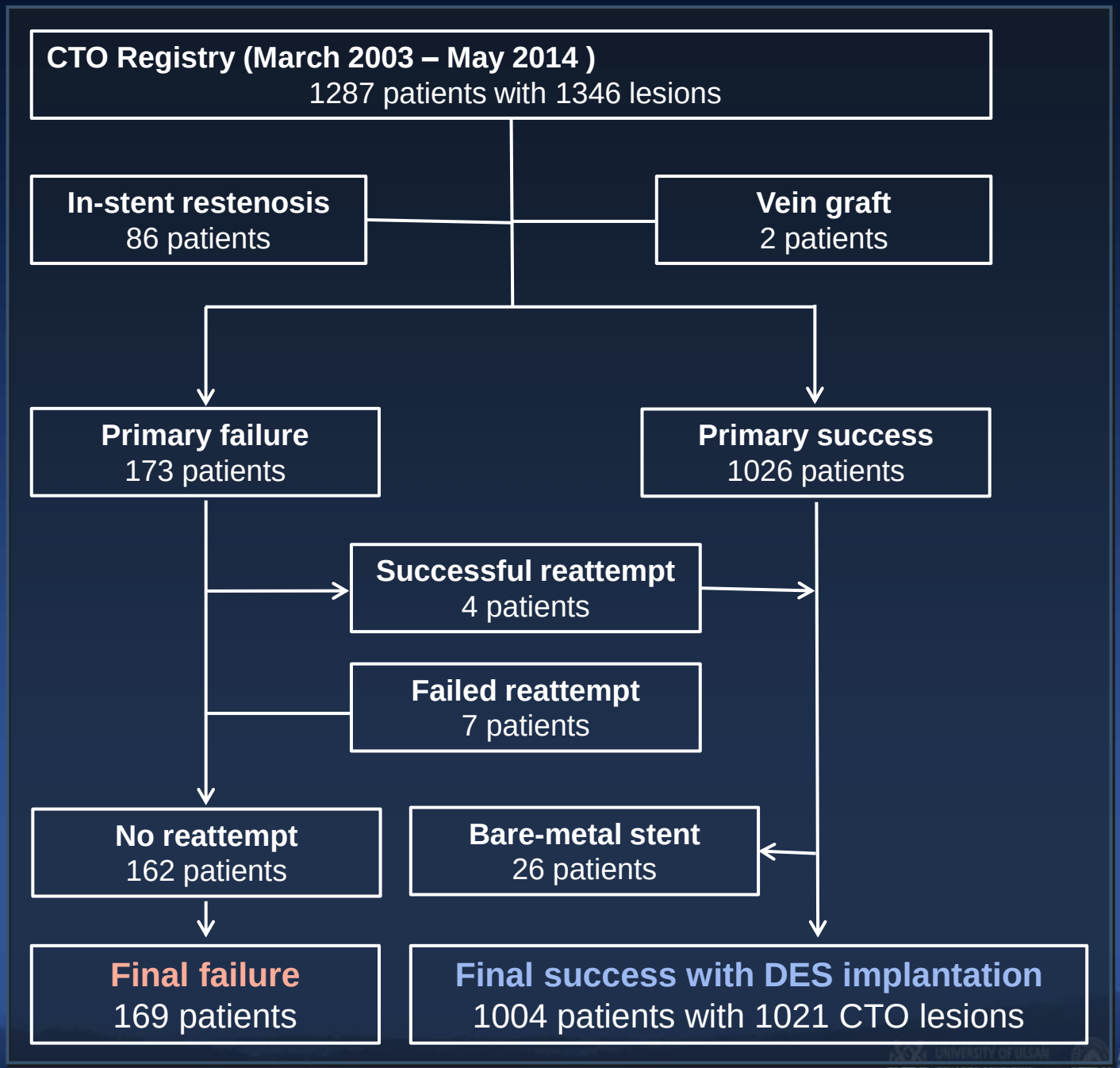
Fate of failed PCI in the current Era ?

AMC CTO-PCI registry

SUCCESS (N=1004) VS. Failure (n=169)

4.6-year follow-up

Lee et al. JACC Cardiovasc Interv. 2016;9:530-8


CTO Registry (March 2003 – May 2014)
1287 patients with 1346 lesions
In-stent restenosis
86 patients
Vein graft
2 patients
Primary failure
173 patients
Primary success
1026 patients
Successful reattempt
4 patients
Failed reattempt
7 patients
No reattempt
162 patients
Bare-metal stent
26 patients
Final failure
169 patients
Final success with DES implantation
1004 patients with 1021 CTO lesions

Baseline clinical characteristics

	Successful PCI (N=1004)	Failed PCI (N=169)	P value
Age, years	59.4 ± 10.6	60.5 ± 9.3	0.16
Sex, male	829 (82.6)	141 (83.4)	0.87
Body mass index, kg/m^2	25.5 ± 3.1	25.2 ± 2.7	0.28
Hypertension	600 (59.8)	109 (64.5)	0.28
Diabetes mellitus	311 (31.0)	54 (32.0)	0.87
Hypercholesterolemia	644 (64.1)	100 (59.2)	0.25
Current smoker	271 (27.0)	39 (23.1)	0.33
Previous PCI	205 (20.4)	35 (20.7)	1.00
Previous myocardial infarction	82 (8.2)	23 (13.6)	0.03
Previous CABG	26 (2.6)	7 (4.1)	0.38
Previous heart failure	100 (10.0)	18 (10.7)	0.89
Previous stroke	63 (6.3)	11 (6.5)	1.00
Peripheral vascular disease	18 (1.8)	1 (0.6)	0.42
Chronic lung disease	28 (2.8)	4 (2.4)	0.96
Renal dysfunction*	19 (1.9)	8 (4.7)	0.05
Clinical diagnosis at presentation			0.20
Stable angina	730 (72.7)	134 (79.3)	
Unstable angina	184 (18.3)	24 (14.2)	
Acute myocardial infarction	90 (9.0)	11 (6.5)	
Atrial fibrillation	18 (1.8)	2 (1.2)	0.81
Left ventricular ejection fraction, %	57.6 ± 8.6	57.5 ± 8.5	0.88
Left ventricular ejection fraction <40%	41 (4.1)	3 (1.8)	0.21

*Renal dysfunction was defined as creatinine ≥2.0 mg/dL or requiring dialysis.

Angiographic characteristics

*N=1190 CTO lesions (1021 vs. 169)	Successful PCI (N=1008)	Failed PCI (N=169)	P value
CTO located in*			0.02
Left anterior descending artery	460 (45.1)	55 (32.5)	
Left circumflex artery	151 (14.8)	28 (16.6)	
Right coronary artery	407 (39.9)	86 (50.9)	
Left main coronary artery	3 (0.3)	0	
Multiple (≥2) CTO	76 (7.6)	17 (10.1)	0.34
Multivessel disease	558 (55.6)	117 (69.2)	0.001
Triple-vessel disease	190 (18.9)	47 (27.8)	0.01
Left main disease	42 (4.2)	9 (5.3)	0.64
CTO length, mm*	13.7 ± 9.1	18.8 ± 11.7	<0.001
Lesion length, mm*	39.0 ± 19.4	45.0 ± 21.5	<0.001
Collateral flow, Rentrop scale*			0.19
0/1	228 (22.3)	38 (22.5)	
2	374 (36.6)	73 (43.2)	
3	419 (41.0)	58 (34.3)	

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Procedural characteristics

TABLE 3: PROCEDURAL CHARACTERISTICS

*N=1190 CTO lesions (1021 vs. 169)	Successful PCI (N=1008)	Failed PCI (N=169)	P value
Stent type			NA
1st generation DES	463 (46.1)	NA	
2nd generation DES	541 (53.9)	NA	
Number of stents per lesion*	1.77 ± 0.78	NA	NA
Length of stent per lesion, mm*	46.2 ± 21.0	NA	NA
Average stent diameter, mm*	3.15 ± 0.32	NA	NA
Double coronary injection*	331 (32.4)	45 (26.6)	0.16
Success by retrograde approach*	87 (8.5)	NA	NA
Intravascular ultrasound use*	894 (87.6)	NA	NA
Contrast media amount, ml	426 ± 200	514 ± 233	<0.001
Non-target lesion intervention	349 (34.8)	70 (41.4)	0.11

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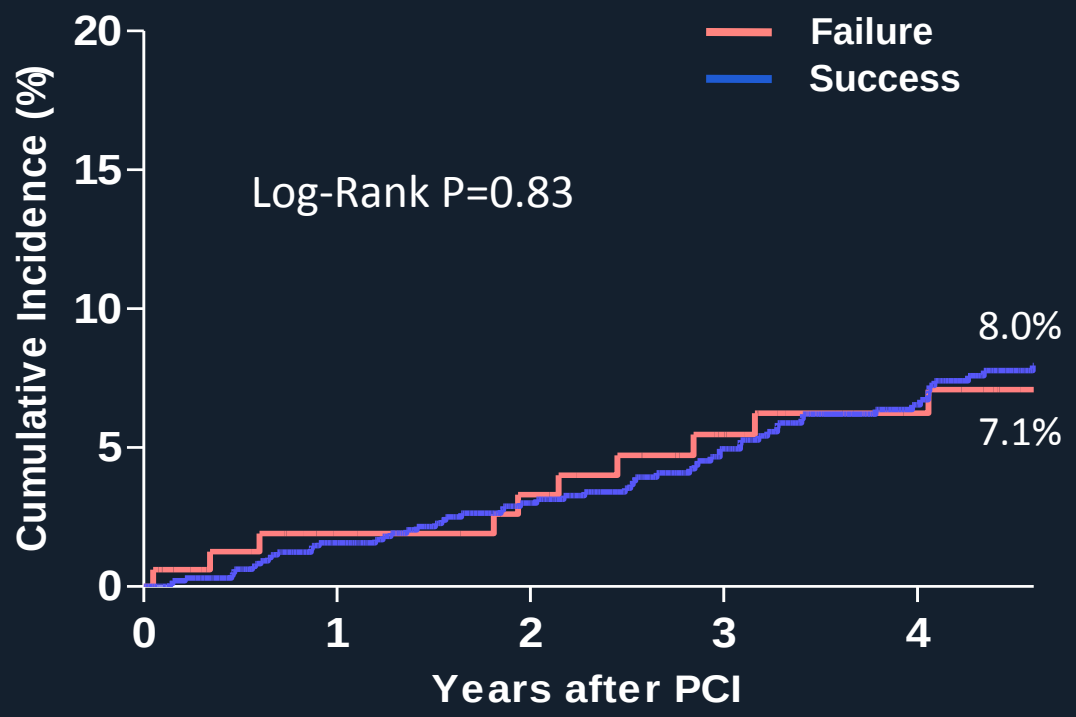
Unadjusted Kaplan-Meier Curve

Death



No. at Risk					
Success	1004	891	763	638	543
Failure	169	147	139	126	111

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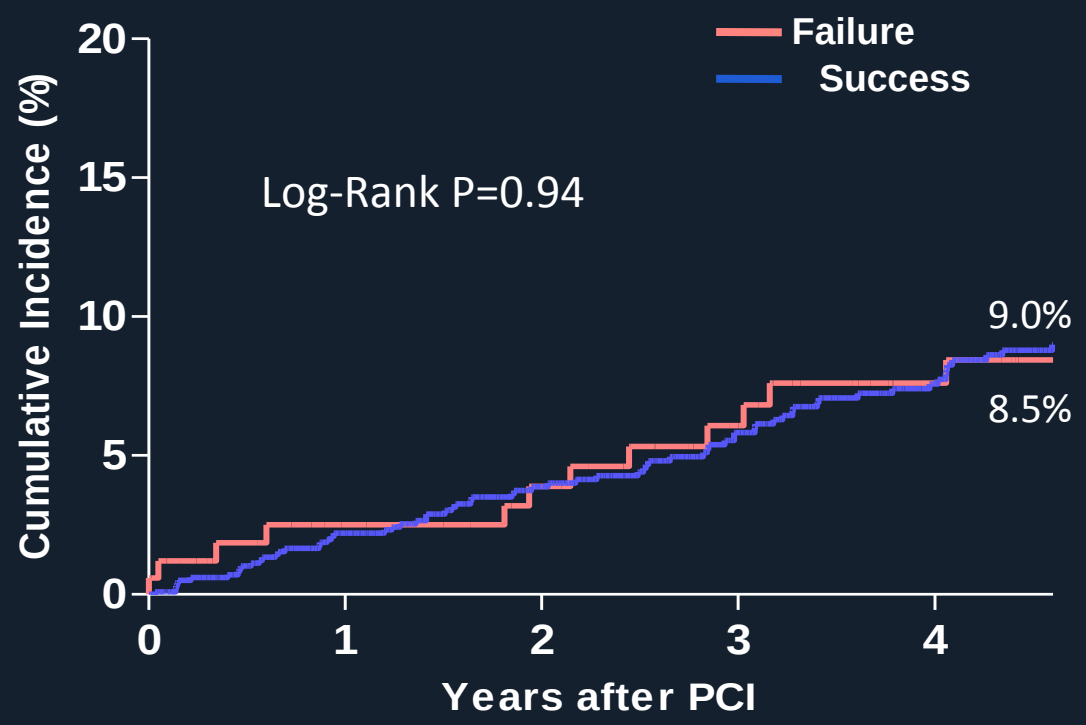
Unadjusted Kaplan-Meier Curve

Death or Q-wave MI



No. at Risk					
Success	1004	885	756	632	538
Failure	169	146	138	126	110

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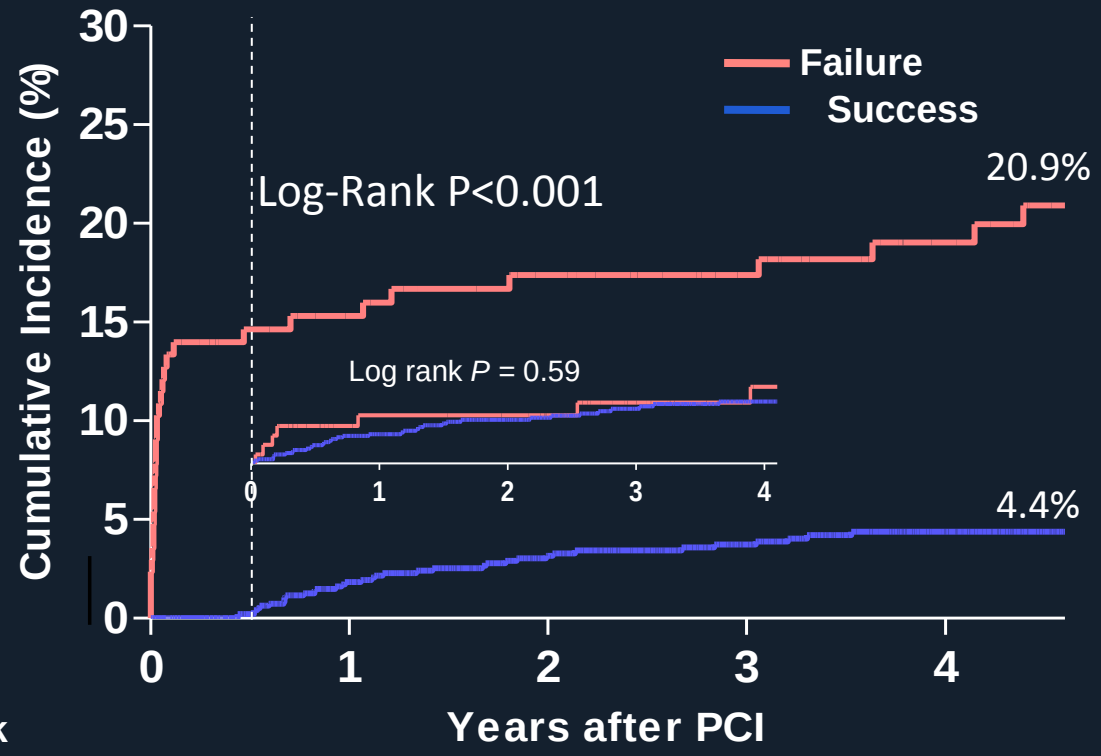
Unadjusted Kaplan-Meier Curve

Target vessel revascularization



No. at Risk					
Success	1004	875	738	613	519
Failure	169	125	115	104	90

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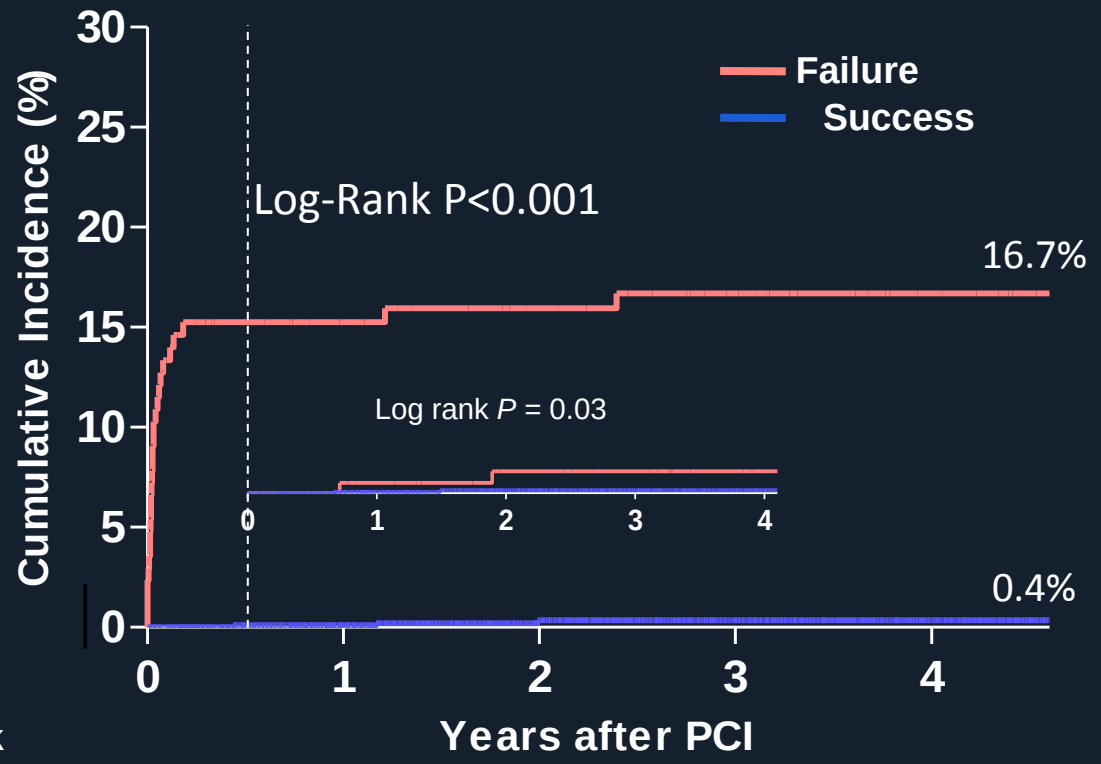
Unadjusted Kaplan-Meier Curve

CABG



No. at Risk					
Success	1004	890	760	635	540
Failure	169	125	117	105	92

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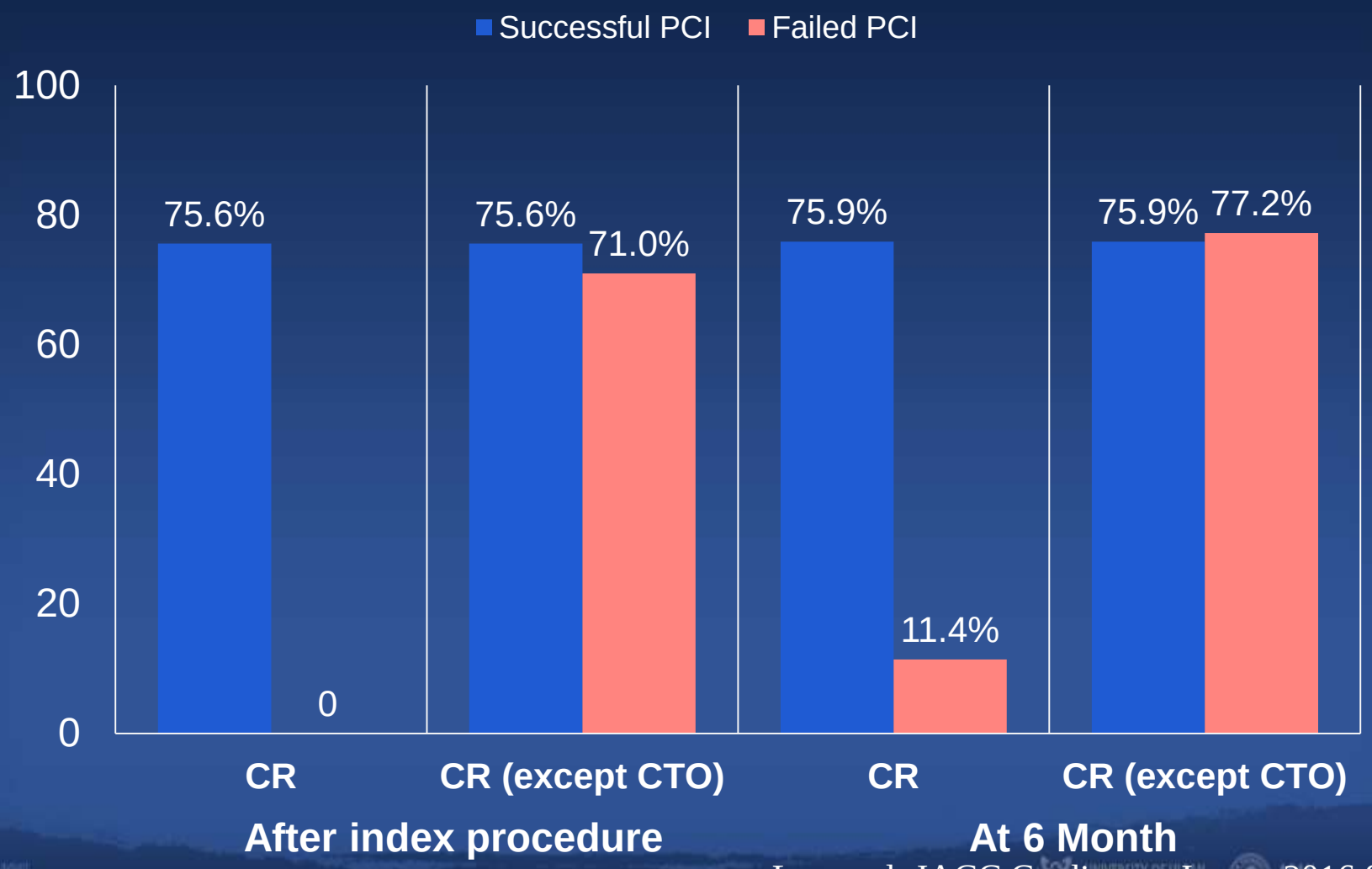
Complete Revascularization Rate



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Clinical Outcomes According to the Complete Revascularization (CR)

	CR including CTO	CR excluding CTO	Hazard ratio (95% CI)	*P* value
Single-vessel disease	**n = 446**	**n = 52**		
All-cause mortality	27 (8.2)	2 (4.7)	1.57 (0.37–6.60)	0.54
Death or Q-wave MI	31 (9.3)	3 (7.5)	1.20 (0.37–3.93)	0.76
TVR	18 (5.0)	8 (17.9)	0.22 (0.10–0.51)	<0.001
Multivessel disease	**n = 313**	**n = 68**		
All-cause mortality	22 (9.2)	6 (10.8)	0.82 (0.33–2.01)	0.66
Death or Q-wave MI	24 (9.9)	6 (10.8)	0.89 (0.37–2.18)	0.80
TVR	6 (2.3)	7 (11.9)	0.18 (0.06–0.53)	0.002
Total	**n = 759**	**n = 120**		
All-cause mortality	49 (8.7)	8 (8.3)	1.00 (0.47–2.11)	1.00
Death or Q-wave MI	55 (9.6)	9 (9.5)	1.00 (0.49–2.02)	0.99
TVR	24 (3.9)	15 (14.3)	0.23 (0.12–0.44)	<0.001

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Hazard Ratios of Clinical Outcomes

Outcome rates at 4.6 years

Outcome	Successful PCI (n = 1004)	Failed PCI (n = 169)	HR (95% CI)	*P* value	Multivariable adjusted HR (95% CI)	*P* value
All-cause mortality	59 (8.0)	10 (7.1)	1.08 (0.55–2.10)	0.83	1.04 (0.53–2.04)	0.92
Cardiac death	38 (5.3)	7 (5.1)	1.00 (0.45–2.24)	1.00	1.00 (0.45–2.26)	0.99
Death or Q-wave MI	68 (9.0)	12 (8.5)	1.02 (0.55–1.89)	0.94	1.05 (0.56–1.94)	0.89
Q-wave MI	11 (1.3)	3 (2.1)	0.63 (0.18–2.28)	0.49	0.57 (0.16–2.06)	0.39
TVR	36 (4.4)	32 (20.9)	0.17 (0.11–0.27)	<0.001	0.15 (0.10–0.25)	<0.001
Death, Q-wave MI, or TVR	100 (12.8)	41 (27.1)	0.38 (0.26–0.54)	<0.001	0.42 (0.29–0.60)	<0.001
CABG	3 (0.4)	27 (16.7)	0.02 (0.01–0.06)	<0.001	0.02 (0.01–0.06)	<0.001
Any coronary revascularization	65 (8.6)	41 (28.1)	0.24 (0.16–0.35)	<0.001	0.23 (0.16–0.34)	<0.001
Stroke	3 (0.5)	2 (1.5)	0.28 (0.05–1.68)	0.16	0.29 (0.05–1.72)	0.17

Event rates are shown as Kaplan–Meier estimates (number and percentage of events).
Hazard ratios are for patients who received successful PCI compared with patients with failed PCI.

DECISION-CTO

CTO lesions - eligible for DES implantation
(Single CTO or MVD with 1 or 2 CTOs)

Non-inferiority design

1:1 randomization

Randomization is stratified by CTO location (LAD vs. Non-LAD), DM and Involving center

DES (n=642)	**Medical Treatment (n=642)**
DES in non-CTO lesions, **Treat CTO lesions**	**DES in non-CTO lesions,** **Not treat CTO lesions**

Optimal Medical Treatment

Clinical outcomes at 3 years
(Composite of Death, MI, Stroke and any Revascularization)

Primary end-point: Composite of death, MI, stroke, and any revascularization
Secondary end-point: any revascularization, hospitalization due to acute coronary syndrome. death, MI, LVEF, and angina class, clinical outcomes at 5yr, 10yrs

Conclusions

- CTO-PCI is still an one of default strategy for CTO revascularization and has showed mortality benefits.
- Recently dedicated optimal medical treatment for CTO showed comparable impact or even better outcomes for lower atherosclerotic burden patients compared to CTO-PCI.
- Moreover, OMT and non-target vessel intervention for failed CTO-PCI showed comparable survival compared to successful CTO-PCI.
- However, previous reports was registry data. Therefore, randomized trial could give an answer for OMT role in CTO patients.

Thank you for your attention