23rd TCTAP 2018
Complex PCI: Make It Simple!

Left Main PCI: Unmet Questions?

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Unanswered Questions

- Which Patients Should Undergo PCI vs CABG?
- Which Stent To Use?
- What Techniques To Employ? (One-vs Two stent)

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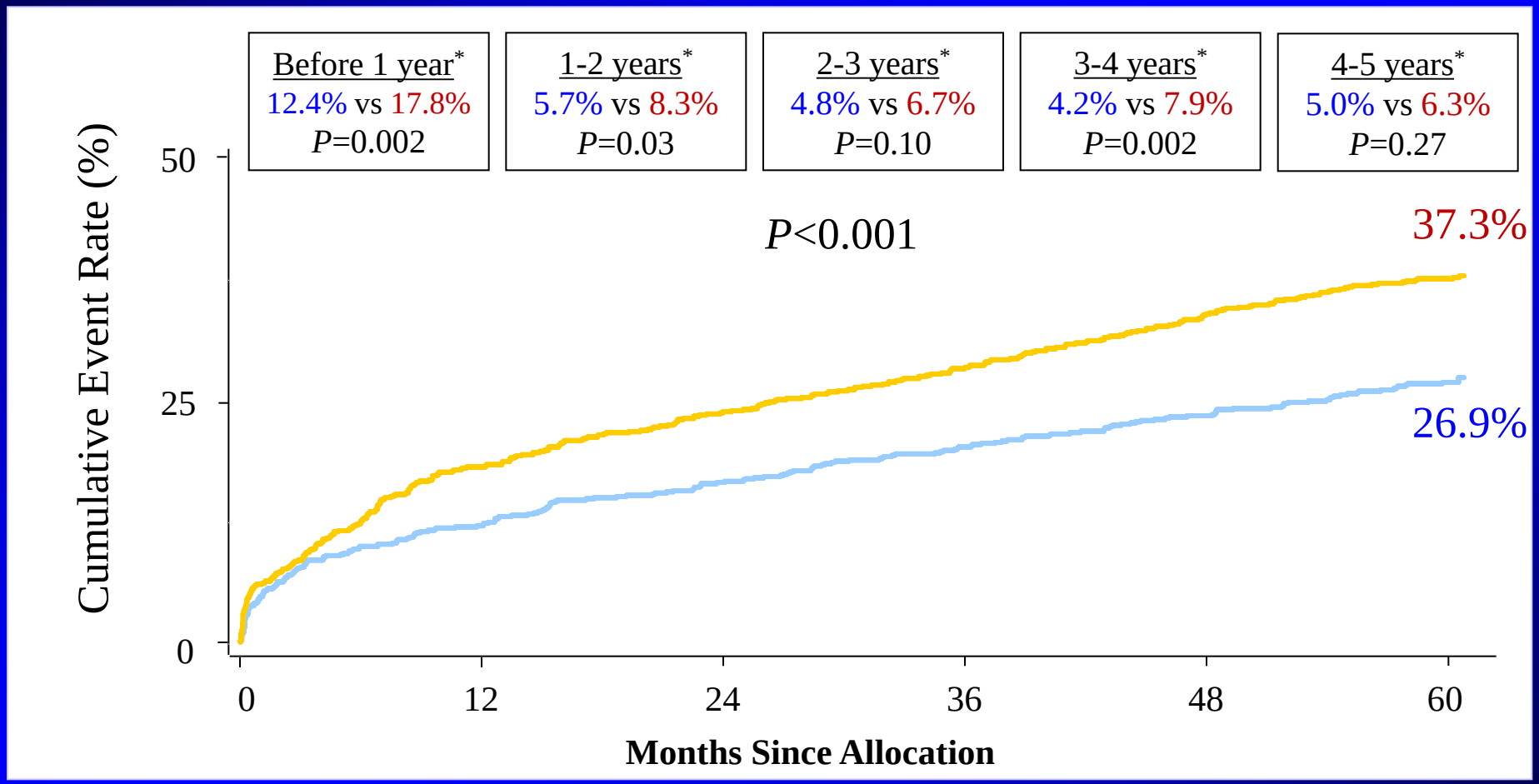
SYNTAX: MACCE to 5 Years

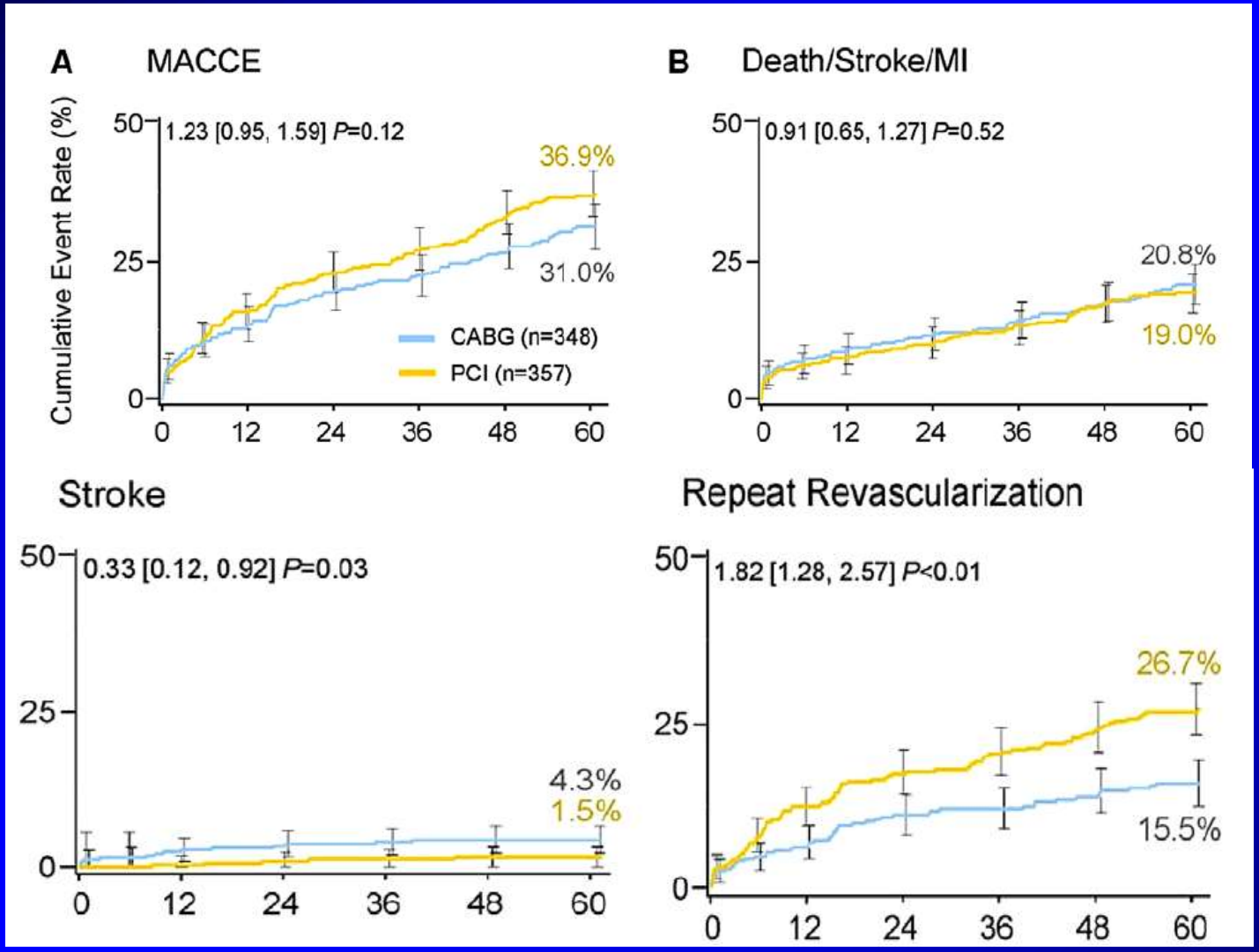
CABG (N=897) TAXUS (N=903)



Cumulative KM Event Rate ± 1.5 SE; log-rank *P* value; *Binary rates

ITT population

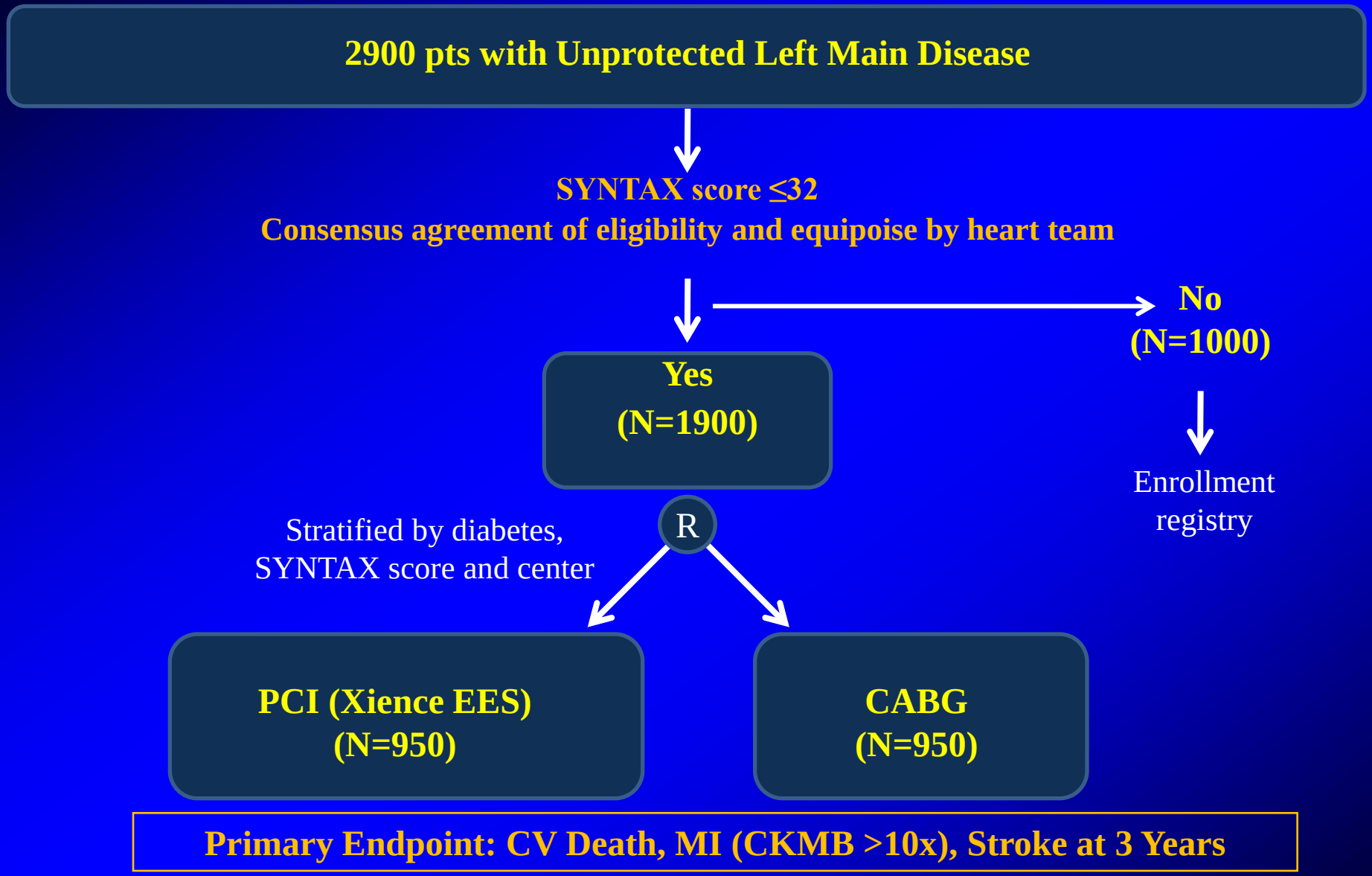
SYNTAX Left Main Subgroup: 5 Year Events



Conclusions: No difference in MACCE at 5 Years.
PCI pts lower stroke but higher revascularization rate vs CABG

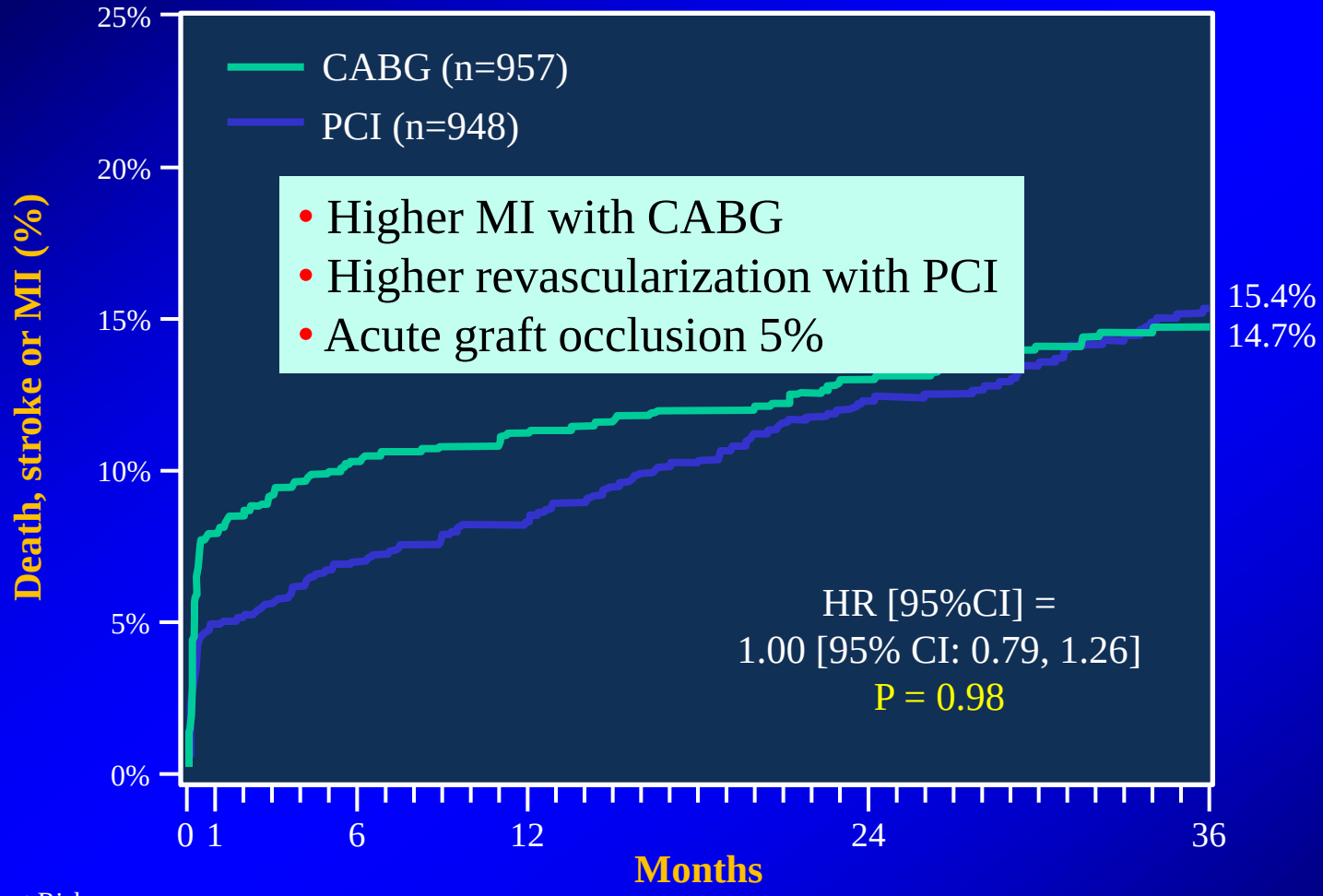
MC Morice et al Circulation 2014; 129: 2388-2394

EXCEL Trial: Study Design



GW Stone et al N Engl J Med 2016; 375: 2223-2235

EXCEL Primary Endpoint: Death, Stroke or MI at 3 Years



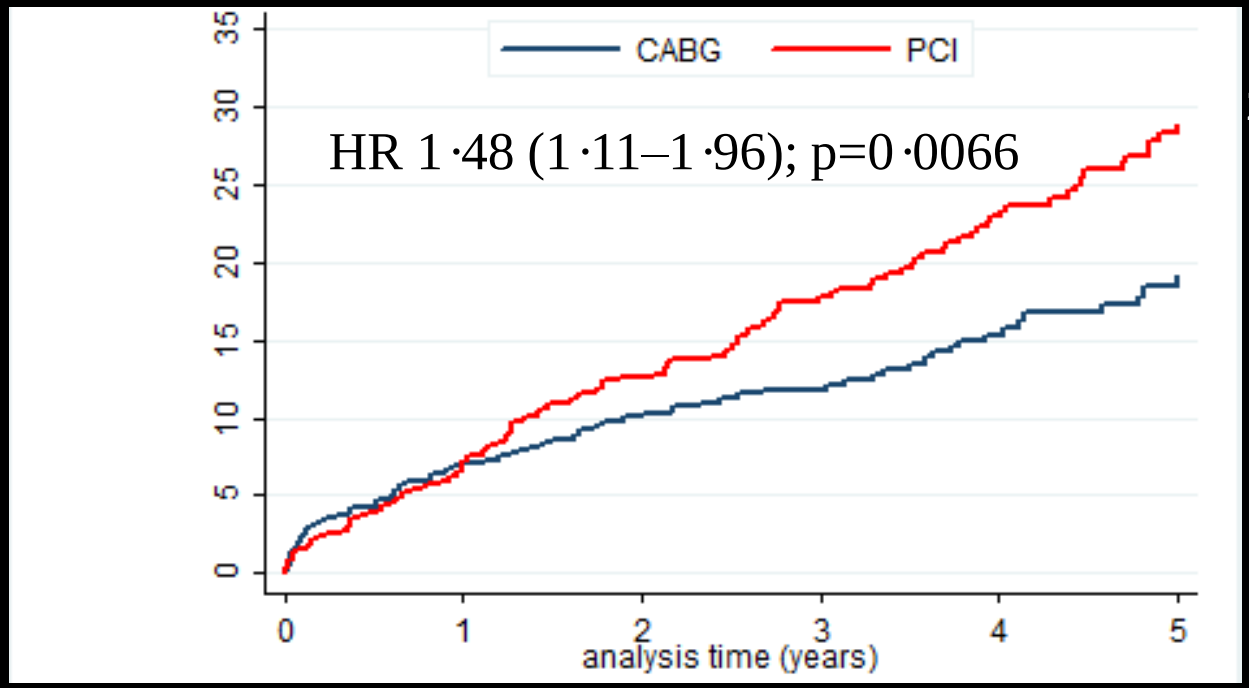
No. at Risk:

PCI	948	896	875	850	784	445
CABG	957	868	836	817	763	458

GW Stone et al N Engl J Med 2016; 375: 2223-2235

NOBLE (Nordic-Baltic-British Left Main Revascularization) Primary Endpoint: MACCE At 5 Years

n= 1201 (SAP/UA/NSTEMI) pts randomised 1:1 to treatment with PCI or CABG



PCI did <u>not</u> show non-inferiority and CABG was superior to PCI

Makikallio T el al Lancet 2016; 388: 2743-2752

NOBLE: Kaplan-Meier 5 year Estimates by Intention-To-Treat

	PCI (n=592)	CABG (n=592)	Hazard ratio (95% CI)	p value
MACCE	29% (121)	19% (81)	1·48 (1·11–1·96)	0·0066
All-cause mortality	12% (36)	9% (33)	1·07 (0·67–1·72)	0·77
Cardiac death	3% (14)	3% (15)	0·93 (0·45–1·92)	0·84
Vascular death	1% (2)	<1% (1)	1·96 (0·18–21·66)	0·55
Non-procedural myocardial infarction	7% (29)	2% (10)	2·88 (1·40–5·90)	0·0040
Revascularisation (total)	16% (71)	10% (47)	1·50 (1·04–2·17)	0·032
Revascularisation with PCI	13% (56)	10% (45)	1·23 (0·83–1·83)	0·29
Revascularisation with CABG	4% (19)	<1% (2)	9·40 (2·19–40·38)	0·0026
Target lesion revascularisation	12% (50)	8% (36)	1·38 (0·90–2·12)	0·14
Target LMCA revascularisation	10% (41)	9% (33)	1·23 (0·78–1·94)	0·37
De-novo lesion revascularisation*	6% (24)	3% (11)	2·34 (1·16–4·74)	0·018
Symptomatic graft occlusion or definite stent thrombosis	3% (9)	4% (15)	0·59 (0·26–1·36)	0·22
Possible stent thrombosis	1% (4)	0	..	..
Probable stent thrombosis	<1% (2)	0	..	..
Stroke	5% (16)	2% (7)	2·25 (0·93–5·48)	0·07

Makikallio T el al Lancet 2016; 388: 2743-2752

What Did We Learn from EXCEL and NOBLE?

- Both NOBLE and EXCEL trials showed that PCI and CABG confer a similar survival benefit in revascularization of ULMCAD over intermediate-term follow-up
- Repeat revascularization is more likely with PCI compared to CABG, and there may be an increased risk of spontaneous MI with PCI when using non-EES DES
- Need for an experienced heart team, familiar with current best practices and techniques, in managing these patients to achieve optimal outcomes
- Longer-term follow-up data from both trials will provide insights into the durability of the results for both PCI and CABG
- The decision between PCI and CABG for ULMCAD should be based on weighing the benefits and risks of PCI versus CABG and taking patient preference into consideration

Unanswered Questions

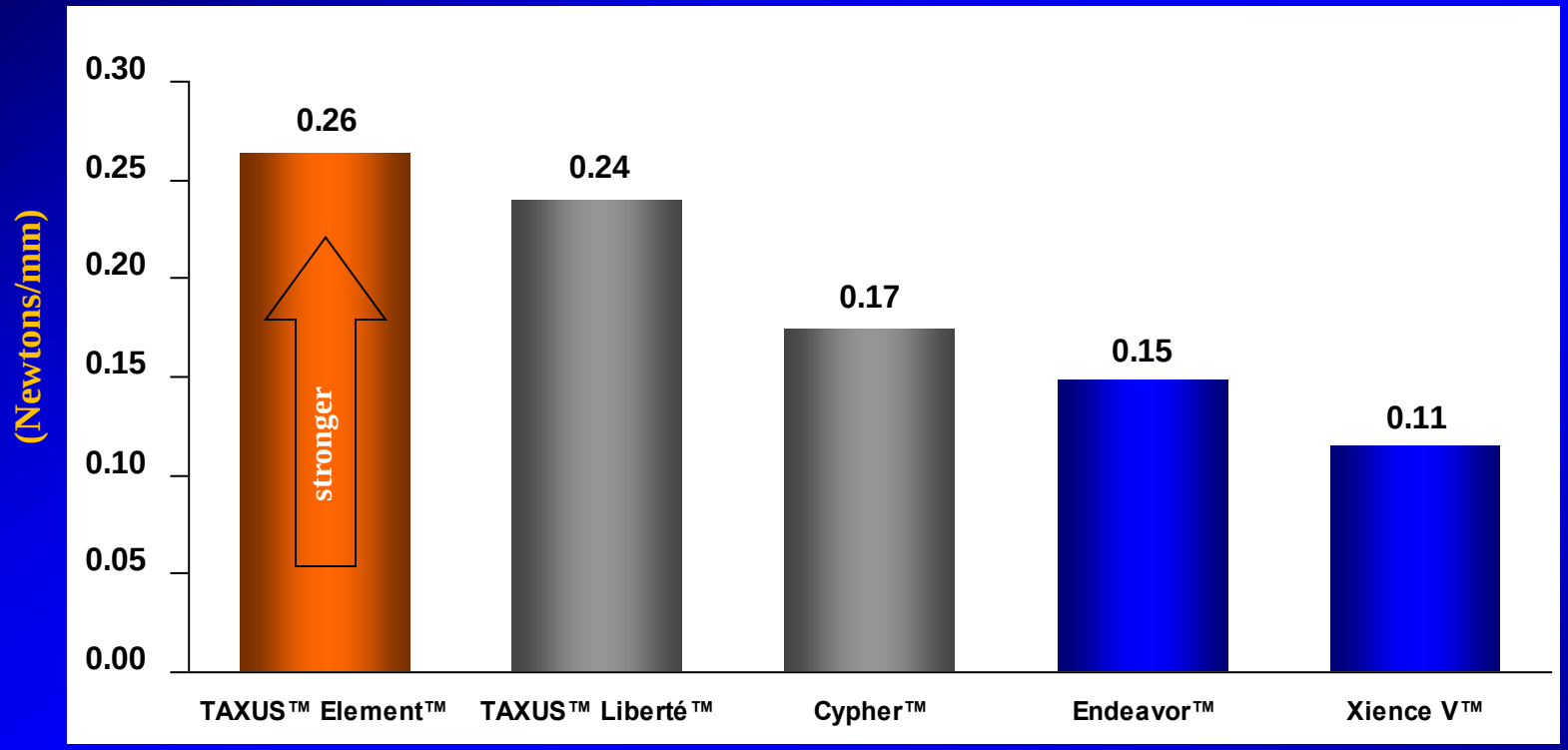
- Which Patients Should Undergo PCI vs CABG?
- **Which Stent To Use?**
- What Techniques To Employ? (One-vs Two stent)

Special Stent Considerations for Left Main PCI

- Radial strength
- Large calibred vessel
  (often size mismatch with daughter vessels)
- Side branch access (for complex distal bifurcation stenting)

Comparison of Stent Radial Force Bench Test

(Amount of radial force required to reduce the diameter of a deployed stent)



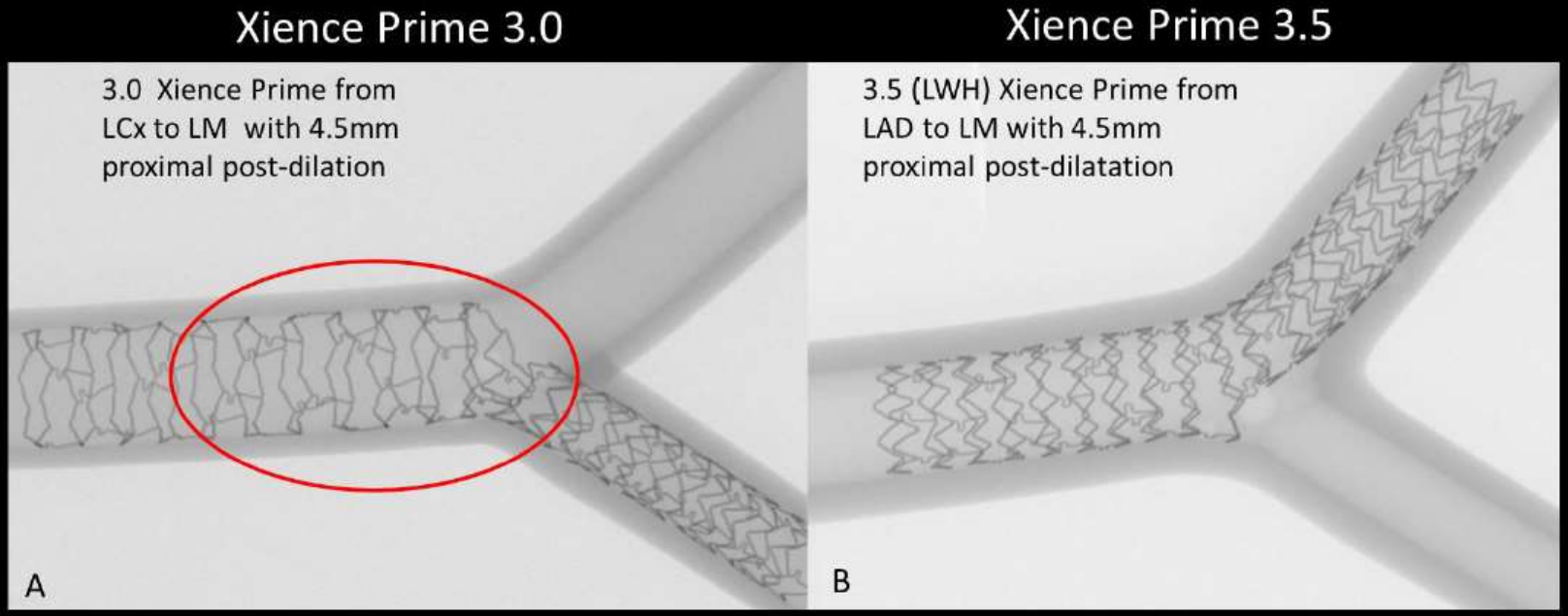
PtCr Alloy

Stainless Steel Alloys

Cobalt Alloys

Maximal Expansion Capacity of DES Platforms: A Critical Factor for Stent Selection in the Treatment of Left Main Bifurcations

- How to select a stent in Left-Main ?



- In presence of a large diameter mismatch, we should look at stent model designs and expansion capacity
- Or upscale to a larger diameter (at low pressure)

Post-dilatation expansion and DES model designs

Balloon Max. size		Element	Xience	Taxus	Integrity	BioMatrix	Cypher
4.0	2.25	Very Small (2 cells) *max exp.: 3.0mm*	Medium vessel workhorse (6 crowns , 3 cells) *max. expansion: 4.4mm*	Small vessel workhorse (6 crowns, 2 cells) *max expansion: 3.4mm*	Small vessel workhorse (7crowns, 2 cells*) *max expansion: 4.9mm*	Medium vessel workhorse (6 crowns, 2 cells) max expansion: 4.6mm	Medium vessel workhorse (6 crowns, 6 cells) max expansion: 4.7mm
	2.50	Small vessel workhorse (8 crowns, 2 cells)					
5.0	2.75						
	3.00						
	3.50						Large vessel (7 crowns, 7 cells) max expansion: 5.8mm
	4.00	Large vessel (10 crowns, 2 cells) *max expansion: 5.7mm*	*5.6mm*	Large vessel (9 crowns, 3 cells) *max expansion: 6.0mm*		5.9mm	
6.0	4.50						
	5.00						

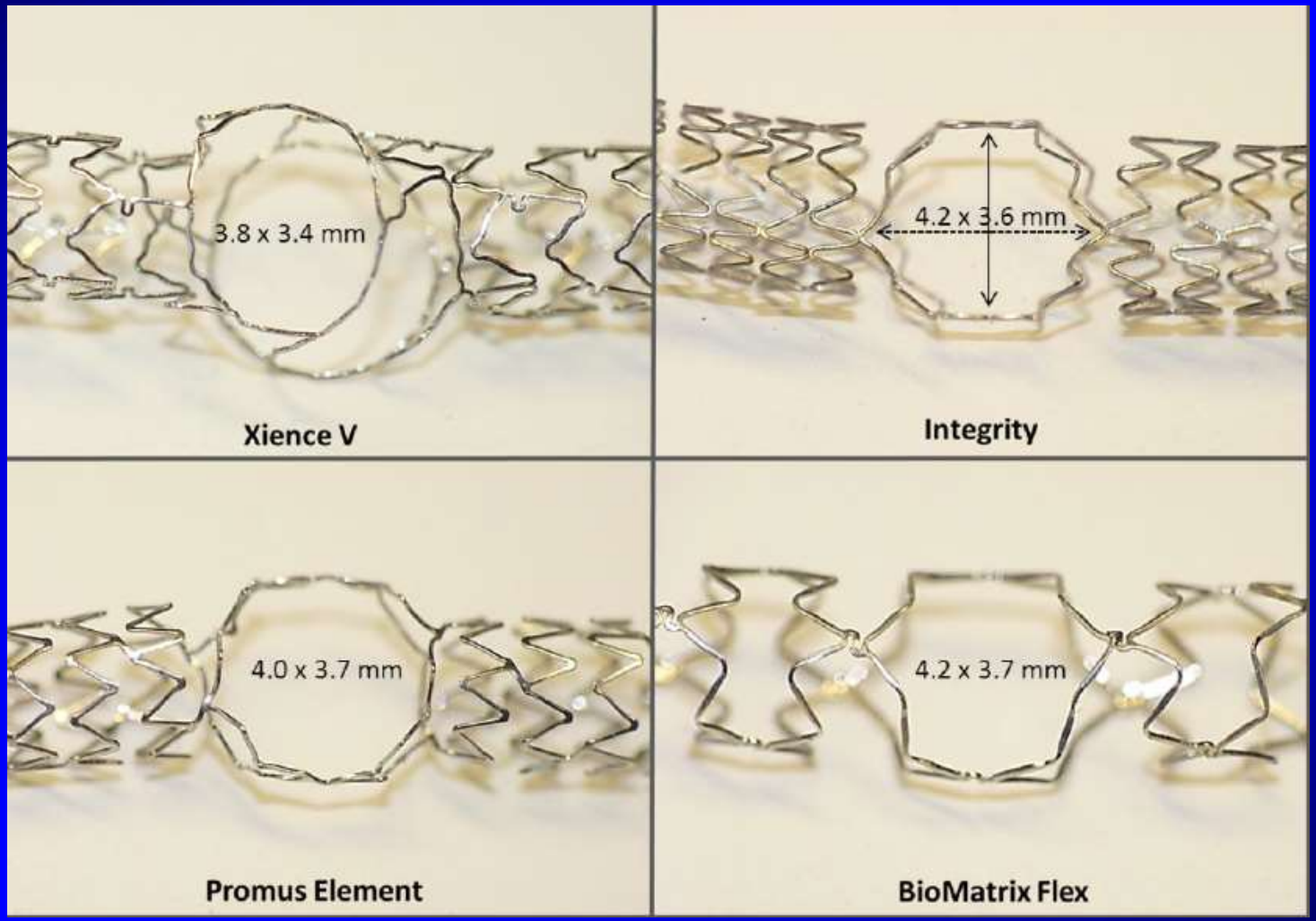
- All stents have capacity to be overexpanded well above their labelled maximal diameter
- For most DESs, MLD > 5.5mm was achieved after 6.0mm balloon post-dilatation

- *Minimal stent LD excluding struts*
- *Limited to 6.0 mm balloon at 14 ATM*

Foin N et al Eurointervention 2013; 8: 1315-25

Side Branch Access

Cell size after SB dilatation: Comparison of 4 DES designs
(3.0mm stent, dilatation across cell with 4.0mm NC Balloon at 14 ATM)



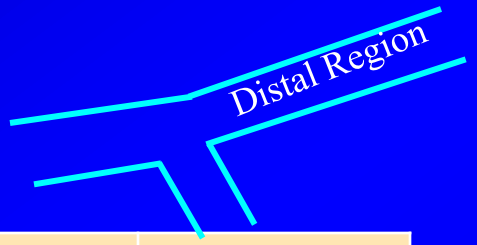
Foin et al EuroIntervention 2013; 9: 885-7

Did Different Stents Used In EXCEL and NOBLE Matter?

- NOBLE, 11% who underwent PCI received a 1st generation DES. The 2nd generation DES biolimus-eluting stent (BES) was not introduced as the "stent of choice" until well into enrollment.
- More spontaneous MI in the PCI group (**6%**) in NOBLE, compared with **4.3%** in PCI group in EXCEL
- In NOBLE, **2%** definite stent thrombosis rate on 5-year Kaplan Meier estimates (0.8% for recipients of the BES) compared to EXCEL which had a **0.7%** rate of stent thrombosis over 3 years.
- Higher rate of spontaneous MI and revascularization drove the primary composite endpoint in favor of CABG in NOBLE.

IDEAL Left Main: OCT Analysis

First randomized study comparing two types of DES in LM on apposition and coverage



Distal Main	BP-PtCr-EES (N=48)	PP-CoCr-EES (N=43)	P-Value
Mean lumen area	9.51 ± 2.05	8.85 ± 2.59	0.177
Minimal lumen area	7.37 ± 2.20	6.74 ± 2.43	0.198
Endoluminal: Mean stent area	9.87 ± 1.86	9.35 ± 2.36	0.251
Endoluminal: Mean neo-intima areas	0.72 ± 0.31	0.84 ± 0.48	0.912
Uncovered struts (%)	0.00 ± 0.00	0.02 ± 0.16	0.291
Covered >20 micron (%)	96.29 ± 4.13	97.23 ± 2.42	0.468
Malapposed struts (%)	3.07 ± 6.80	1.62 ± 2.69	0.758
Endoluminal: Mean ISA area	0.18 ± 0.39	0.11 ± 0.23	0.758

Conclusion

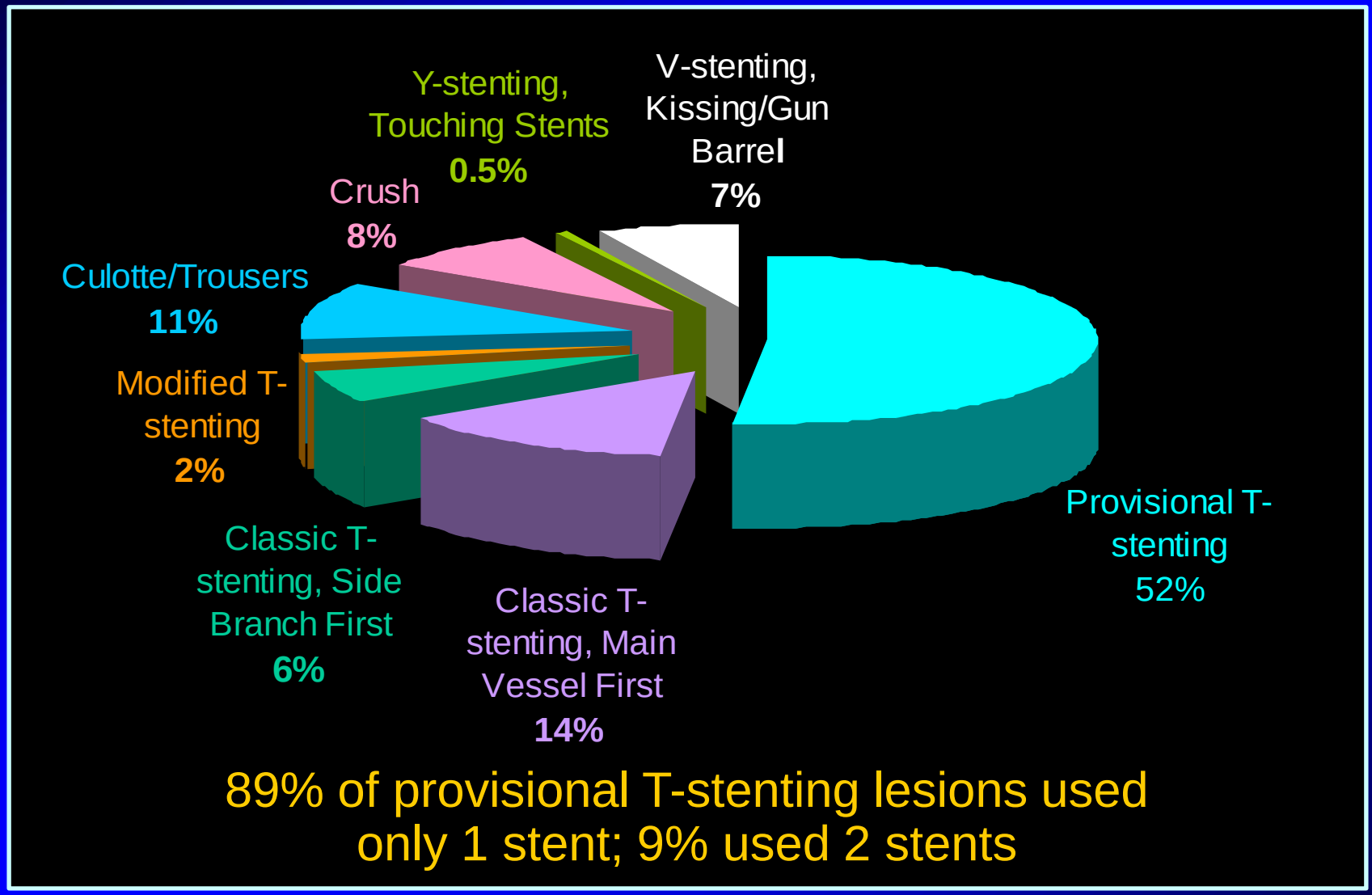
- 100% coverage at 3 months for both DES types
- Very low % malapposition for both DES types

Unanswered Questions

- Which Group Should Undergo PCI vs CABG?
- What Stents To Use?
- **What Techniques To Employ? (One-vs Two stent)**

SYNTAX: Left Main Distal Stenting Techniques

LM Distal PCI (211 LM lesions)



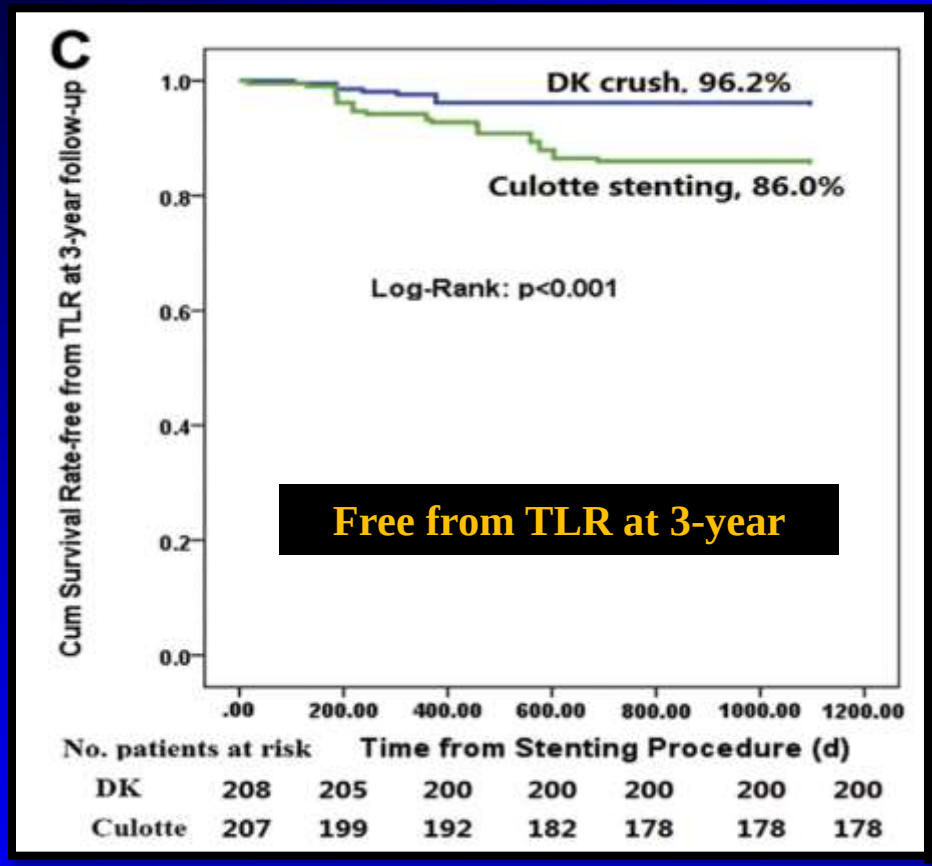
89% of provisional T-stenting lesions used only 1 stent; 9% used 2 stents

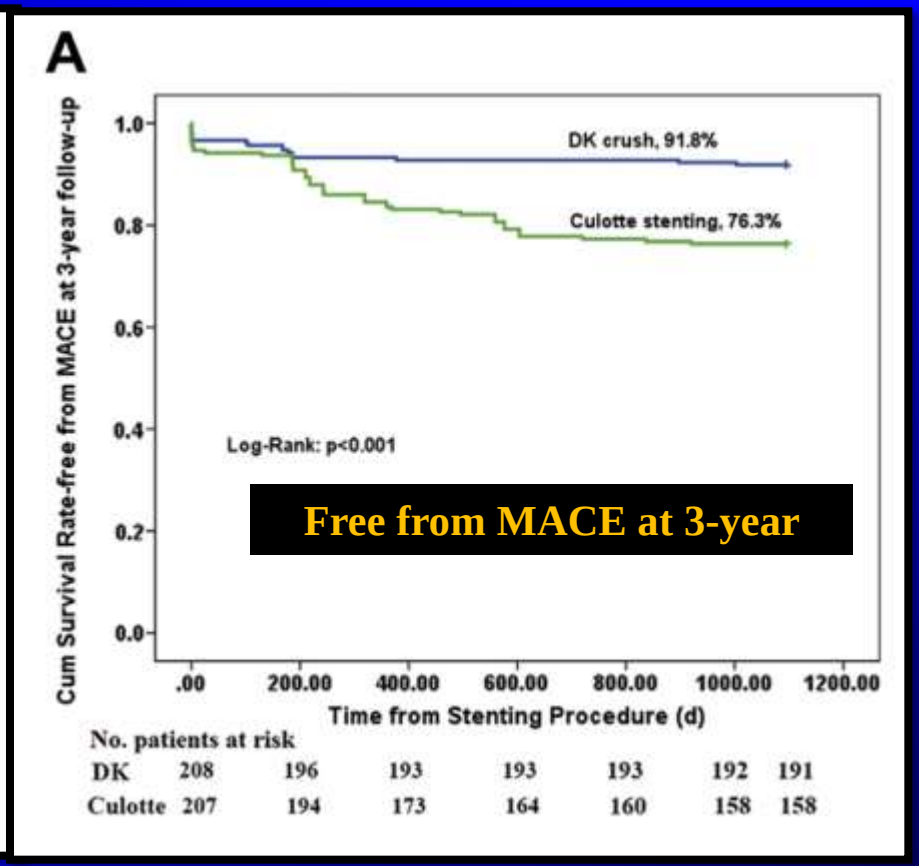
EXCEL Trial: Planned Routine 2 Stents
for LM Distal Bifurcation Disease
(n=185; 34.8%)

Planned 2-stent technique	Site-assessed N=185
T, Modified T, TAP	50.8%
Culotte	23.2%
Crush/Mini-Crush	14.4%
V Stent	6.1%
Simultaneous Kissing Stent	2.8%
Other	2.8%

Kandzari DE et al TCT 2017

DK CRUSH-III (DK Crush vs Culotte of Distal Left Main Bifurcation): 3 Year Clinical Follow Up

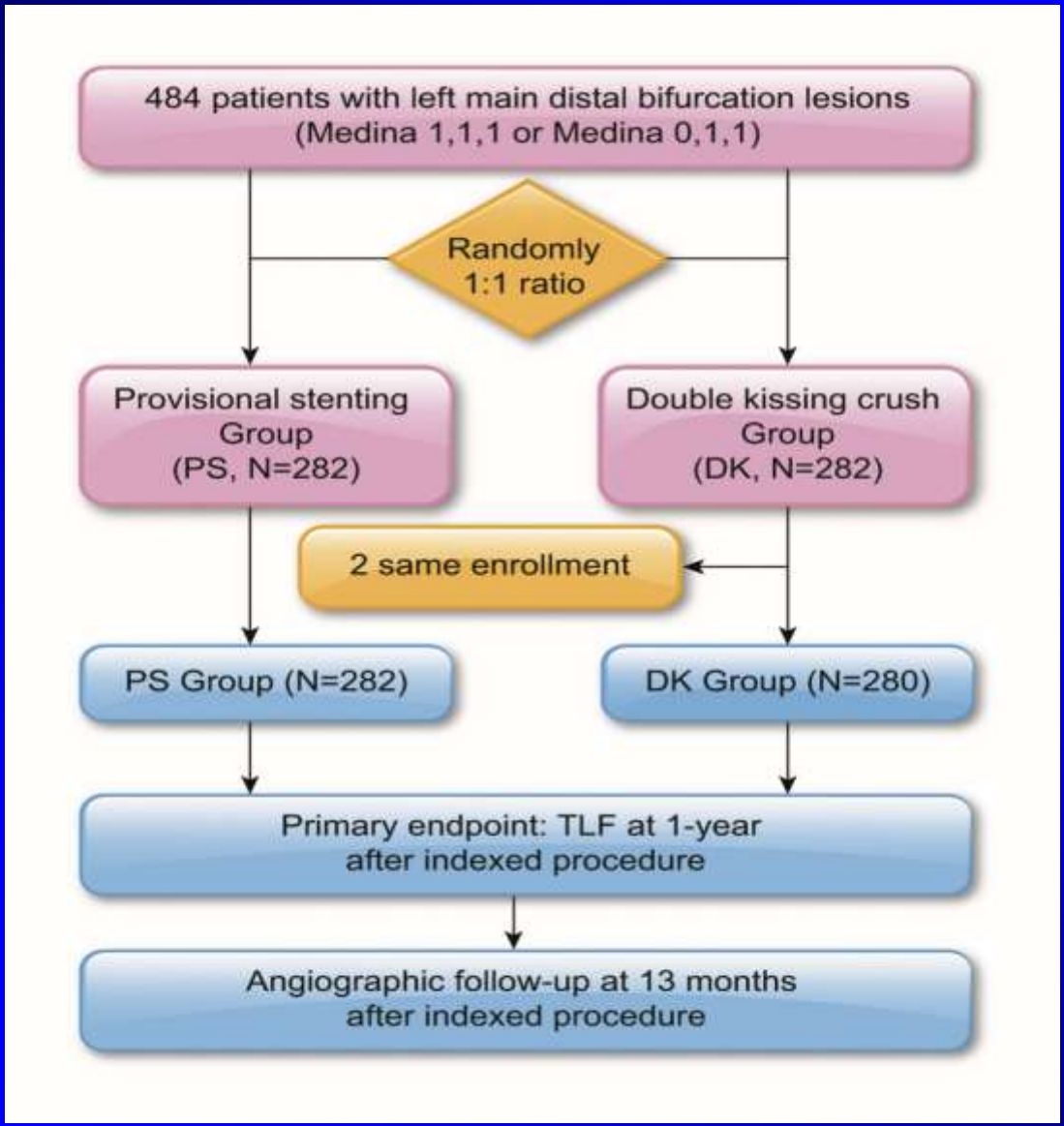




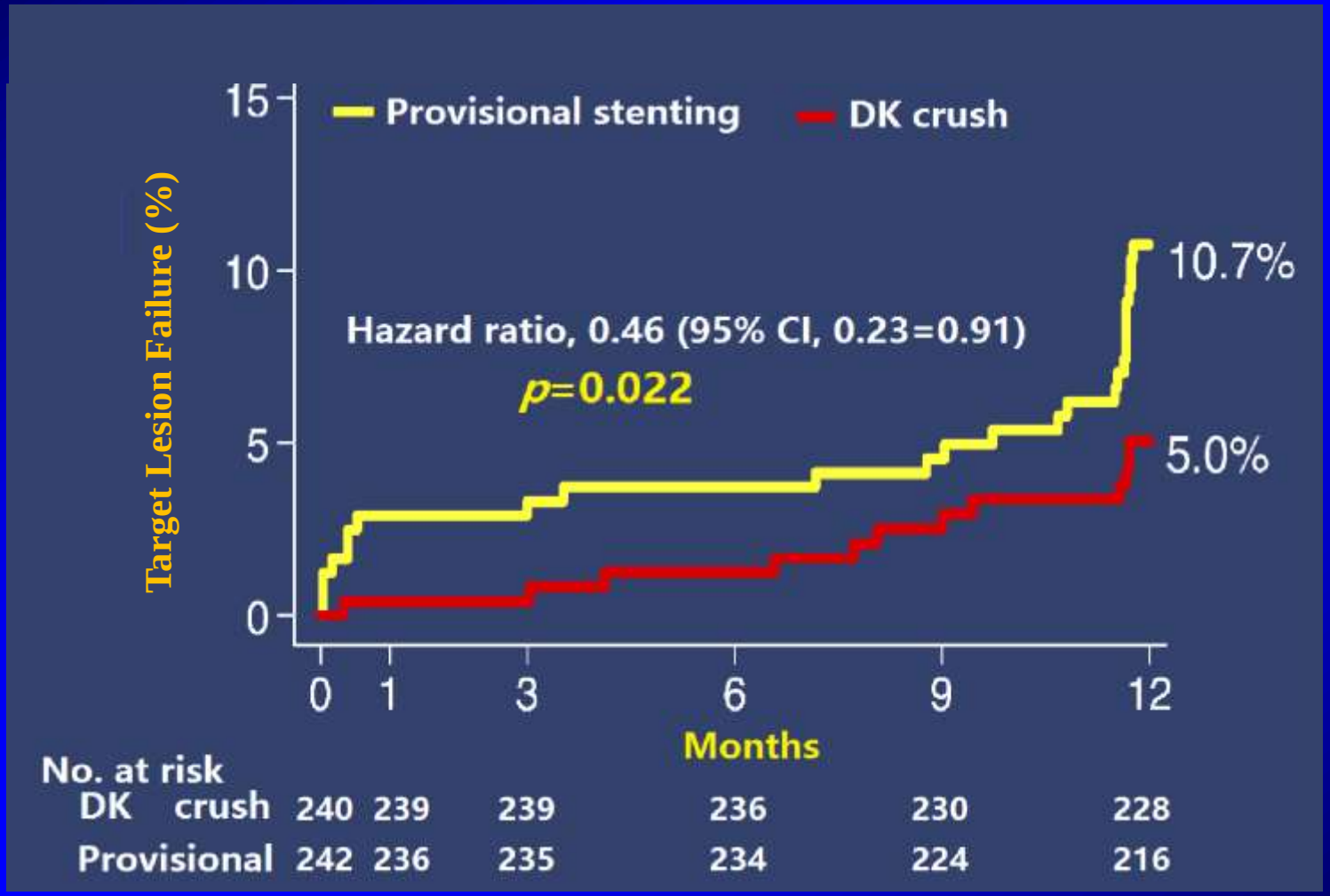
- Higher MACE driven mainly by increased MI (8.2% vs 3.4%, p = 0.037) and target-vessel revascularization (18.8% vs 5.8%, p < 0.001)
- Definite ST rate 3.4% in Culotte vs 0% in the DK Crush group (p = 0.007)

SL Chen et al J Am Coll Cardiol Intv 2015; 8: 1335–42

DKCRUSH V


484 patients with left main distal bifurcation lesions
(Medina 1,1,1 or Medina 0,1,1)
Randomly
1:1 ratio
Provisional stenting
Group
(PS, N=282)
Double kissing crush
Group
(DK, N=282)
2 same enrollment
PS Group (N=282)
DK Group (N=280)
Primary endpoint: TLF at 1-year
after indexed procedure
Angiographic follow-up at 13 months
after indexed procedure

DK CRUSH V Primary Endpoint: Target Lesion Failure



Chen SL et al J Am Coll Cardiol 2017;70: 2605-2617

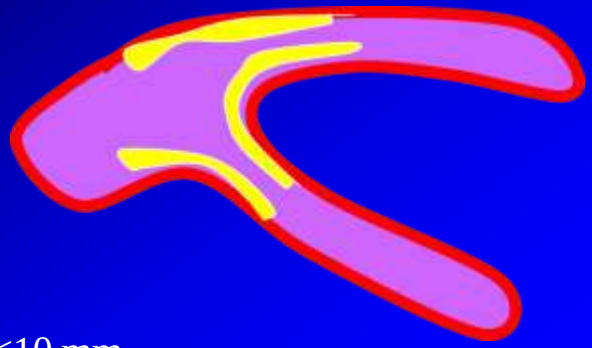
DKCRUSH V: Primary and Secondary Endpoints

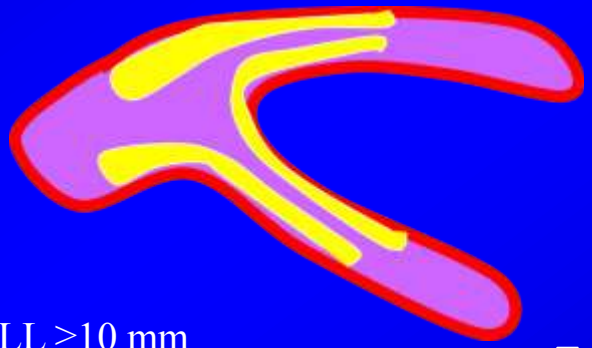
	DK crush (N=240)	Provisional (N=242)	*P* value
Primary endpoint components at 30 days			
- Cardiac death	0	1.7	0.046
- Target vessel MI	0.4	1.7	0.10
- TLR	0.4	0.4	1.00
Primary endpoint components at 1 year			
- Cardiac death	1.2	2.1	0.48
- Target vessel MI	0.4	2.9	0.03
- TLR	3.8	7.9	0.06
Secondary endpoints at 1 year			
- All-cause death	2.9	2.1	0.58
- Any revascularization	5.4	7.9	0.32
- Angina	4.5	9.3	0.06
Stent thrombosis (def/prob)			
- 30 days	0.4	2.5	0.06
- 1 year	0.4	3.3	0.02

Chen SL et al J Am Coll Cardiol 2017;70: 2605-2617

DKCRUSH V: Target Lesion Failure at 1-Year

Simplex vs Complex Bifurcation Lesions





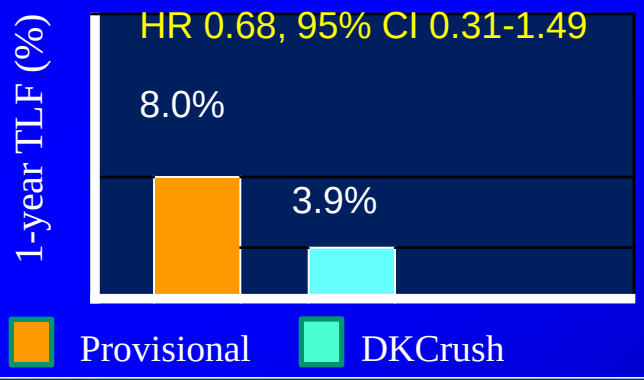
LCX-LL<10 mm
and/or os LCX DS <70%

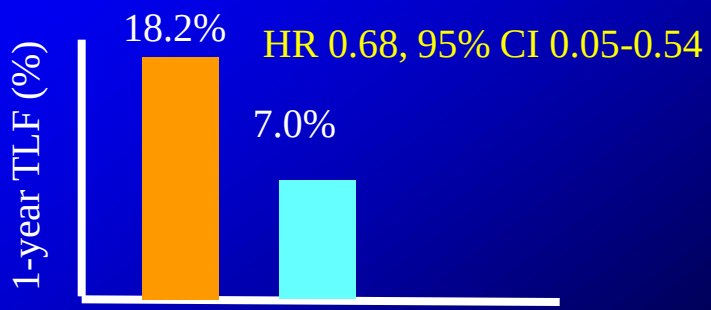
LCX-LL ≥10 mm
and os LCX DS ≥70%

Plus ≥2 of 6
minor criteria

Simple Lesions

Complex Lesions





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Conclusions

- PCI with DES for UPLM is safe and effective in appropriately selected patients
- 2nd generation EES provides the current best data for left main PCI
- Uncertain if any specific 2-stent strategy is superior
- Discussion among cardiologists and surgeons in a 'heart team' of a patient's optimal revascularisation strategy remains the best approach

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