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High-Syntax Score: When PCI Is Still an Acceptable Option?

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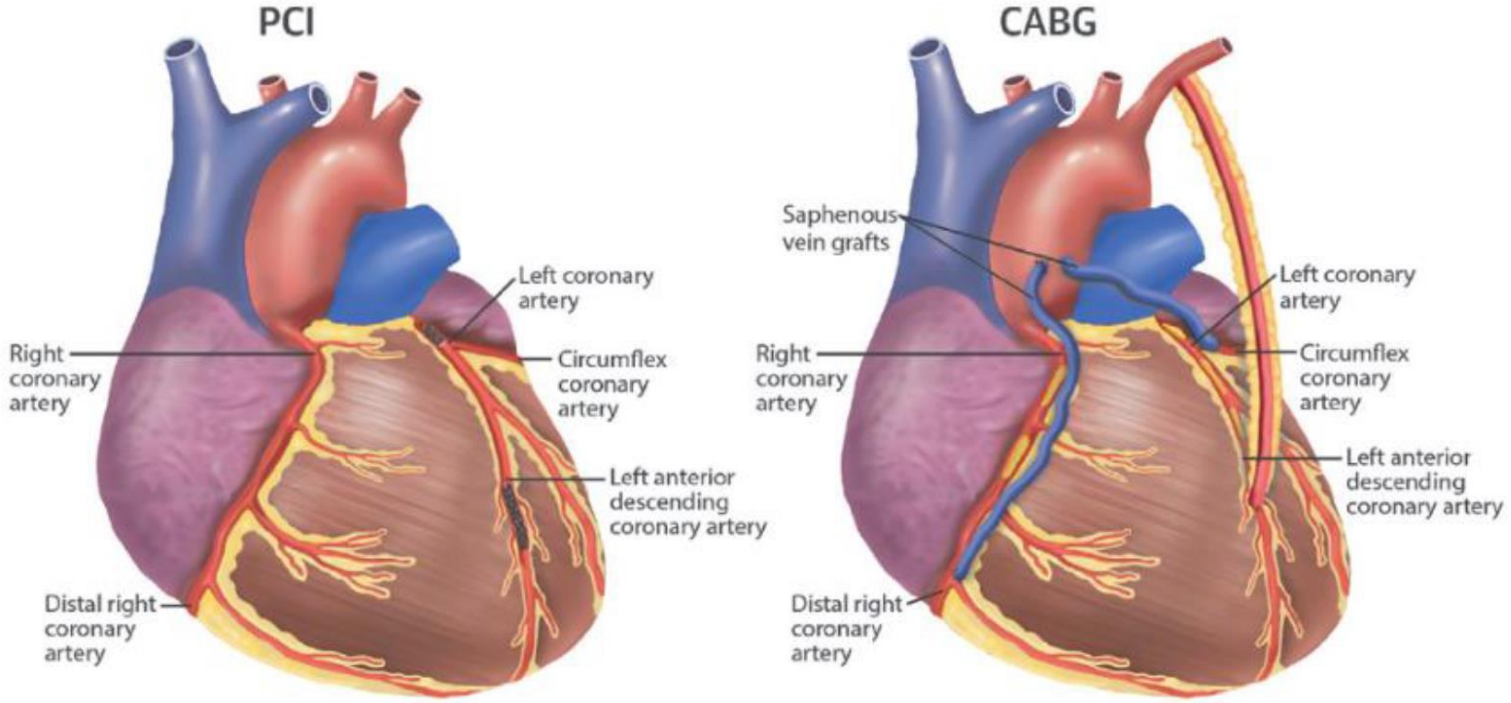
High Syntax Score: PCI Still an Acceptable Option ?

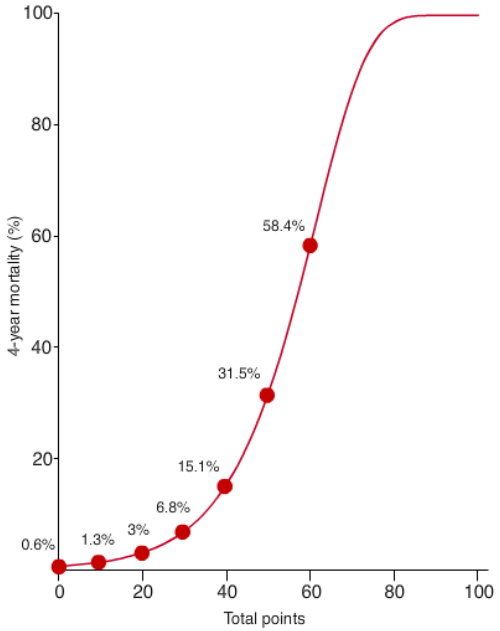


PCI	Less invasive and shorter hospitalization Lower risk of periprocedural adverse events Long-term durability due to low risk of disease progression
CABG	Lower risk of MACCE and repeat revascularization More complete revascularization Protection against events related to disease progression

WindeckerS, Piccolo R. JACC. 2016;68:1010-3

SYNTAX Score II

SYNTAX SCORE II 4-year mortality



Nomogram depicting predicted 4-year mortality as a function of the SYNTAX II Score for patients proposed to undergo myocardial revascularization (CABG or PCI).

Adapted from Farooq et al., The Lancet. 2013 Feb 23;381(9867):639-50

SYNTAX Score II questions

SYNTAX Score I

Age (years)

CrCl mL/min

LVEF (%)

Left Main ○ no ○ yes

Gender ○ male ○ female

COPD ○ no ○ yes

PVD ○ no ○ yes

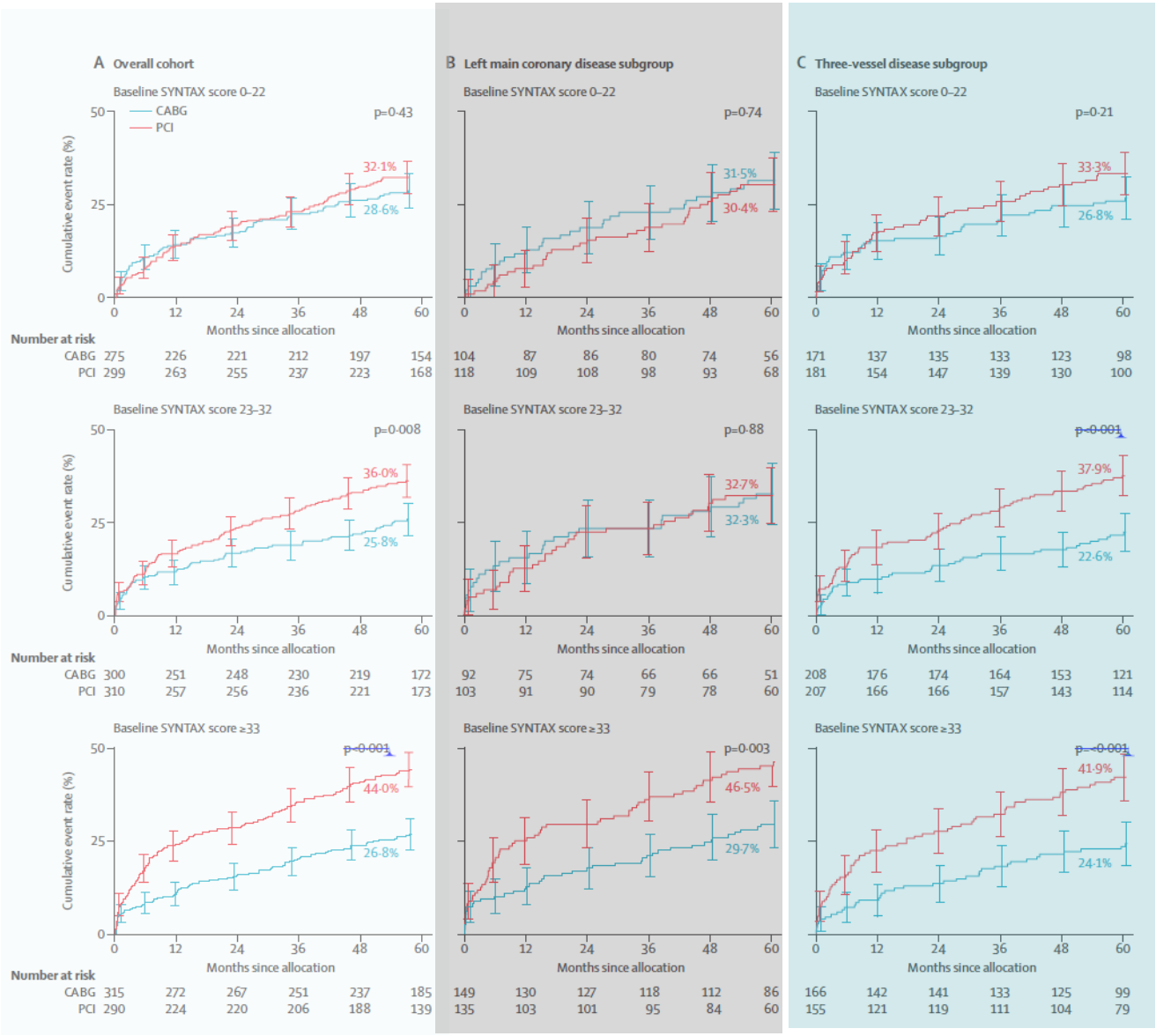
SYNTAX Score II [Calculate]

SYNTAX Trial 5-year FU : The outcome is also different ..

Low < 22

Intermediate 22-32

High ≥ 33



2014

Guidelines on myocardial revascularization

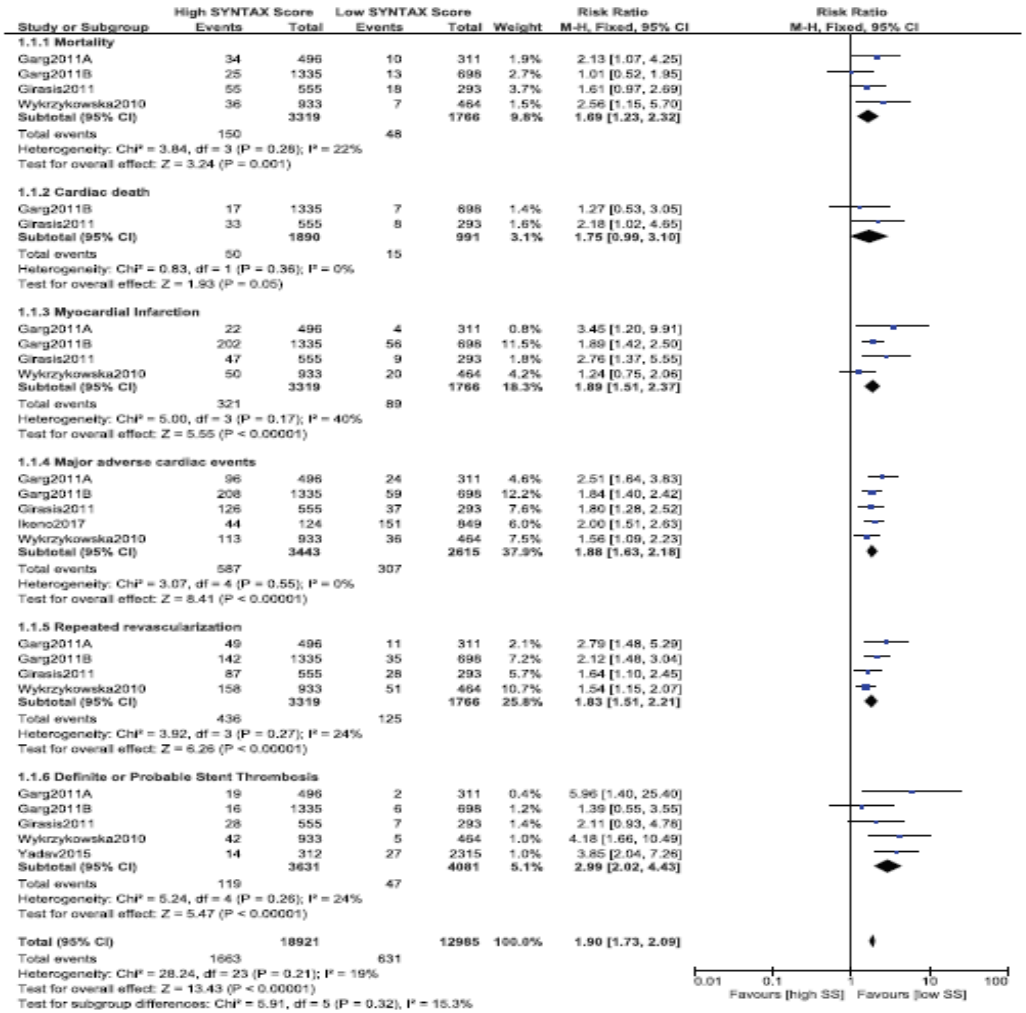
The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Bypass Surgery (CABG) versus in Patients with stable CAD

Subset of CAD by anatomy	Favours CABG	Favours PCI
1VD or 2VD - non-proximal LAD	IIb C	I C
1VD or 2VD - proximal LAD	I A	IIa B
3VD simple lesions, full functional revascularisation achievable with PCI, SYNTAX score ≤ 22	I A	IIa B
3VD complex lesions, incomplete revascularisation achievable with PCI, SYNTAX score > 22	I A	III A
Left main (isolated or 1VD, ostium/shaft)	I A	IIa B
Left main (isolated or 1VD, distal bifurcation)	I A	IIb B
Left main + 2VD or 3VD, SYNTAX score ≤ 32	I A	IIb B
Left main + 2VD or 3VD, SYNTAX score ≥ 33	I A	III B

Application of the SYNTAX score in interventional cardiology

A systematic review and meta-analysis



Study or Subgroup	High SYNTAX Score Events	Total	Low SYNTAX Score Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.1.1 Mortality						
Garg2011A	34	496	10	311	1.9%	2.13 [1.07, 4.25]
Garg2011B	25	1335	13	698	2.7%	1.01 [0.52, 1.95]
Girasis2011	55	555	18	293	3.7%	1.61 [0.97, 2.69]
Wykrzykowska2010	36	933	7	464	1.5%	2.56 [1.15, 5.70]
Subtotal (95% CI)		**3319**		**1766**	**9.8%**	**1.69 [1.23, 2.32]**
Total events	150		48			
Heterogeneity: Chi² = 3.84, df = 3 (P = 0.28); I² = 22%						
Test for overall effect: Z = 3.24 (P = 0.001)						
1.1.2 Cardiac death						
Garg2011B	17	1335	7	698	1.4%	1.27 [0.53, 3.05]
Girasis2011	33	555	8	293	1.6%	2.18 [1.02, 4.65]
Subtotal (95% CI)		**1890**		**991**	**3.1%**	**1.75 [0.99, 3.10]**
Total events	50		15			
Heterogeneity: Chi² = 0.83, df = 1 (P = 0.36); I² = 0%						
Test for overall effect: Z = 1.93 (P = 0.05)						
1.1.3 Myocardial Infarction						
Garg2011A	22	496	4	311	0.8%	3.45 [1.20, 9.91]
Garg2011B	202	1335	56	698	11.5%	1.89 [1.42, 2.50]
Girasis2011	47	555	9	293	1.8%	2.76 [1.37, 5.55]
Wykrzykowska2010	50	933	20	464	4.2%	1.24 [0.75, 2.06]
Subtotal (95% CI)		**3319**		**1766**	**18.3%**	**1.89 [1.51, 2.37]**
Total events	321		89			
Heterogeneity: Chi² = 5.00, df = 3 (P = 0.17); I² = 40%						
Test for overall effect: Z = 5.55 (P < 0.00001)						
1.1.4 Major adverse cardiac events						
Garg2011A	96	496	24	311	4.6%	2.51 [1.64, 3.83]
Garg2011B	208	1335	59	698	12.2%	1.84 [1.40, 2.42]
Girasis2011	126	555	37	293	7.6%	1.80 [1.28, 2.52]
Ikeno2017	44	124	151	849	6.0%	2.00 [1.51, 2.63]
Wykrzykowska2010	113	933	36	464	7.5%	1.56 [1.09, 2.23]
Subtotal (95% CI)		**3443**		**2615**	**37.9%**	**1.88 [1.63, 2.18]**
Total events	587		307			
Heterogeneity: Chi² = 3.07, df = 4 (P = 0.55); I² = 0%						
Test for overall effect: Z = 8.41 (P < 0.00001)						
1.1.5 Repeated revascularization						
Garg2011A	49	496	11	311	2.1%	2.79 [1.48, 5.29]
Garg2011B	142	1335	35	698	7.2%	2.12 [1.48, 3.04]
Girasis2011	87	555	28	293	5.7%	1.64 [1.10, 2.45]
Wykrzykowska2010	158	933	51	464	10.7%	1.54 [1.15, 2.07]
Subtotal (95% CI)		**3319**		**1766**	**25.8%**	**1.83 [1.51, 2.21]**
Total events	436		125			
Heterogeneity: Chi² = 3.92, df = 3 (P = 0.27); I² = 24%						
Test for overall effect: Z = 6.26 (P < 0.00001)						
1.1.6 Definite or Probable Stent Thrombosis						
Garg2011A	19	496	2	311	0.4%	5.96 [1.40, 25.40]
Garg2011B	16	1335	6	698	1.2%	1.39 [0.55, 3.55]
Girasis2011	28	555	7	293	1.4%	2.11 [0.93, 4.78]
Wykrzykowska2010	42	933	5	464	1.0%	4.18 [1.66, 10.49]
Yadav2015	14	312	27	2315	1.0%	3.85 [2.04, 7.26]
Subtotal (95% CI)		**3631**		**4081**	**5.1%**	**2.99 [2.02, 4.43]**
Total events	119		47			
Heterogeneity: Chi² = 5.24, df = 4 (P = 0.26); I² = 24%						
Test for overall effect: Z = 5.47 (P < 0.00001)						
Total (95% CI)		**18921**		**12985**	**100.0%**	**1.90 [1.73, 2.09]**
Total events	1663		631			
Heterogeneity: Chi² = 28.24, df = 23 (P = 0.21); I² = 19%						
Test for overall effect: Z = 13.43 (P < 0.00001)						
Test for subgroup differences: Chi² = 5.91, df = 5 (P = 0.32), I² = 15.3%						

Risk Ratio M-H, Fixed, 95% CI

0.01 0.1 1 10 100

Favours [high SS] Favours [low SS]

Figure 3. Postinterventional adverse cardiovascular outcomes which were observed between a low versus a higher (tertiles II and III) SYNTAX score using data which were obtained only from randomized controlled trials.

PK Bundhun et al. Medicine (2017) 96:28

High Syntax Score: PCI Still an Acceptable Option ?

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

2018

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)

Recommendations according to extent of CAD	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
One-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,101,139–144]	I	A	I	A
Two-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,70,73]	I	B	I	C
Left main CAD				
Left main disease with low SYNTAX score (0 - 22).[69,121,122,124,145–148]	I	A	I	A
Left main disease with intermediate SYNTAX score (23 - 32).[69,121,122,124,145–148]	I	A	IIa	A
Left main disease with high SYNTAX score (≥33).[c] [69,121,122,124,146–148]	I	A	III	B
Three-vessel CAD without diabetes mellitus				
Three-vessel disease with low SYNTAX score (0 - 22).[102,105,121,123,124,135,149]	I	A	I	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c] [102,105,121,123,124,135,149]	I	A	III	A
Three-vessel CAD with diabetes mellitus				
Three-vessel disease with low SYNTAX score 0–22.[102,105,121,123,124,135,150–157]	I	A	IIb	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c] [102,105,121,123,124,135,150–157]	I	A	III	A

High Syntax Score: PCI Still an Acceptable Option ?

Revascularization for Left Main and Multivessel Coronary Artery Disease: Current Status and Future Prospects after the EXCEL and NOBLE Trials

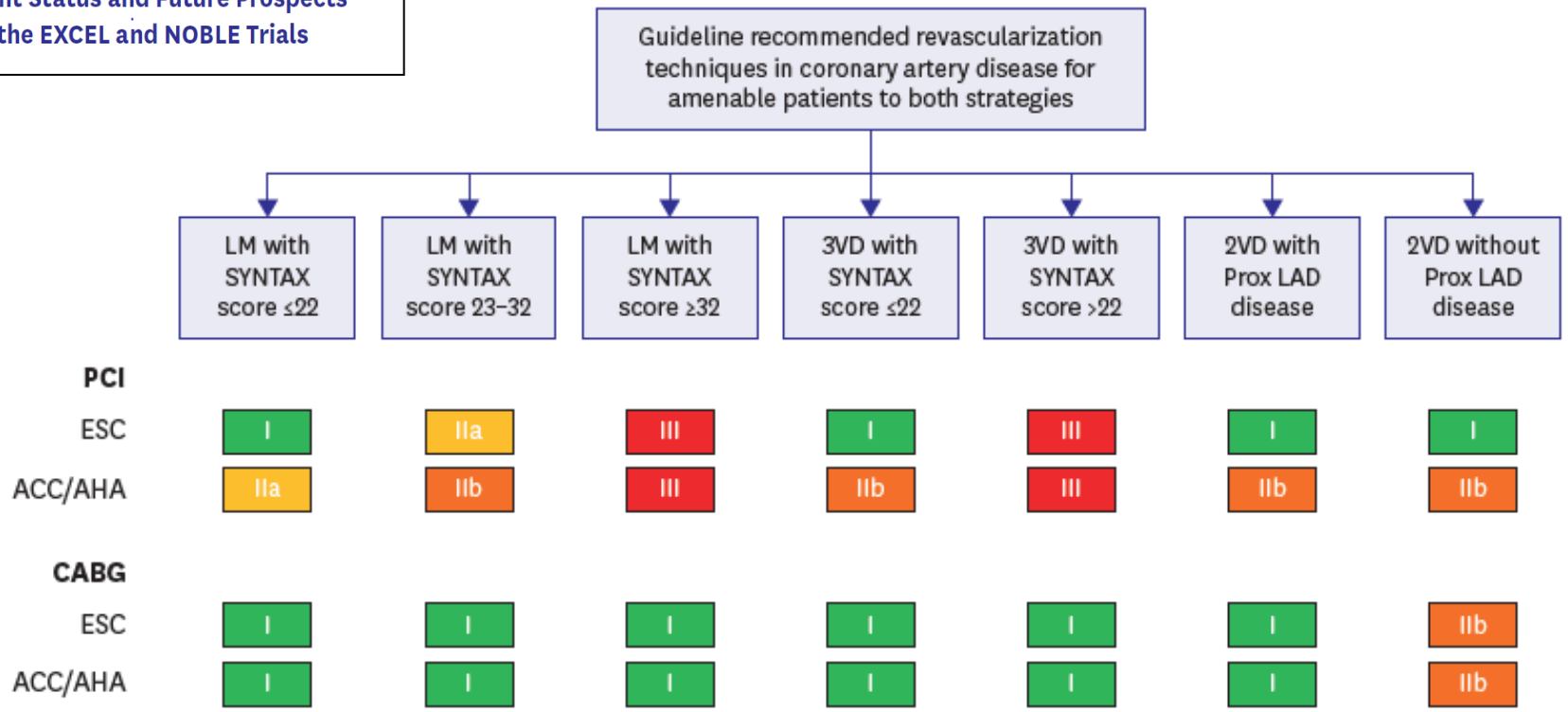


Figure 1. Comparison of ACC/AHA and ESC guidelines recommendations on LMD and MVD revascularizations. Class I: revascularization strategy is recommended or should be performed. Class IIa: revascularization strategy is reasonable and can be useful. Class IIb: revascularization strategy might be reasonable or considered. Class III: revascularization strategy is not recommended.
ACC/AHA – American College of Cardiology/American Heart Association; CABG – coronary artery bypass graft; ESC – European Society of Cardiology; LM – left main; LMD – left main disease; MVD – multivessel disease; PCI – percutaneous coronary intervention; SYNTAX – Synergy between PCI with TAXUS and Cardiac Surgery; 2VD – two vessel disease; 3VD – three vessel disease.

M. Al-Hijji , A. El Sabbagh and DR. Holmes ; **Korean Circ J. 2018 ;48:447-62**

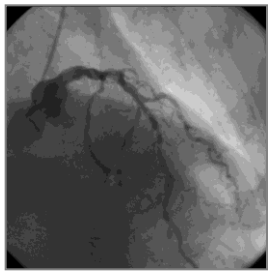
Multivessel Disease PCI : Variables Affecting the Outcome

Patient-related Factors :

- ✓Age
- ✓Patients Symptoms
- ✓ACS Presenting Symptoms :STEMI
- ✓Depressed Left Ventricular function
- ✓Impaired Renal Function
- ✓Hemodynamic instability
- ✓Patient Reliability
- ✓Patient Comorbidities (Diabetes, …)

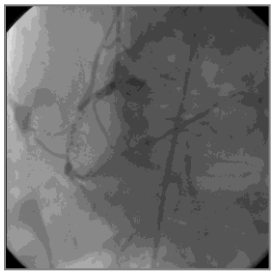
Procedural Factors :

- ✓Contrast media use
- ✓Radiation dose
- ✓Unexpected complication during the first lesion PCI
- ✓Undilatable lesion with no availability of Rotablator
- ✓Unplanned ‘ Full Metal Jacket ’ in first vessel treated



Angio- related Factors :

- ✓Lesion Complexity
- ✓Calcified lesion
- ✓‘True’ CTO
- ✓Extreme tortuosity
- ✓Diffuse disease
- ✓Complex Bifurcation lesions



Age-dependent impact of the SYNTAX-score on longer-term mortality after percutaneous coronary intervention in an all-comer population

Table 3. Predictors for two-year mortality in patients < 75 years and ≥ 75 years old.

	< 75 years old, *n* = 868				≥ 75 years old, *n* = 463			
	Univariable analysis		Multivariable analysis		Univariable analysis		Multivariable analysis	
	Hazard ratio	*P*	Hazard ratio	*P*	Hazard ratio	*P*	Hazard ratio	*P*
SYNTAX-score	1.90 (1.46–2.47)	< 0.001	1.33 (1.01–1.76)	0.041	1.28 (1.03–1.60)	0.027	1.11 (0.87–1.41)	0.394
Age, yrs	1.90 (1.24–2.90)	0.003	1.59 (1.03–2.45)	0.038	3.06 (1.73–5.41)	< 0.001	2.18 (1.19–4.02)	0.012
Body mass index, kg/m^2	0.87 (0.68–1.11)	0.260			0.64 (0.48–0.85)	0.002	0.68 (0.51–0.92)	0.012
Chronic kidney disease	5.47 (3.57–8.37)	< 0.001	3.36 (2.11–5.34)	< 0.001	1.65 (1.15–2.39)	0.007	1.54 (1.04–2.26)	0.031
Diabetes mellitus	1.85 (1.19–2.89)	0.007	1.45 (0.89–2.34)	0.132	1.72 (1.16–2.55)	0.007	1.50 (1.00–2.26)	0.048
Arterial hypertension	0.61 (0.38–0.96)	0.032	0.60 (0.37–0.96)	0.035	0.93 (0.53–1.62)	0.785		
ACS at presentation	1.74 (1.11–2.73)	0.017	1.39 (0.87–2.21)	0.168	1.41 (0.97–2.06)	0.074	1.31 (0.87–1.96)	0.193
Malignancy	3.47 (1.99–6.06)	< 0.001	2.81 (1.56–5.07)	< 0.001	3.01 (1.92–4.73)	< 0.001	3.39 (2.11–5.43)	< 0.001
LVEF < 50%	4.46 (2.51–7.91)	< 0.001	2.68 (1.46–4.93)	0.002	2.47 (1.58–3.84)	< 0.001	2.19 (1.36–3.52)	0.001

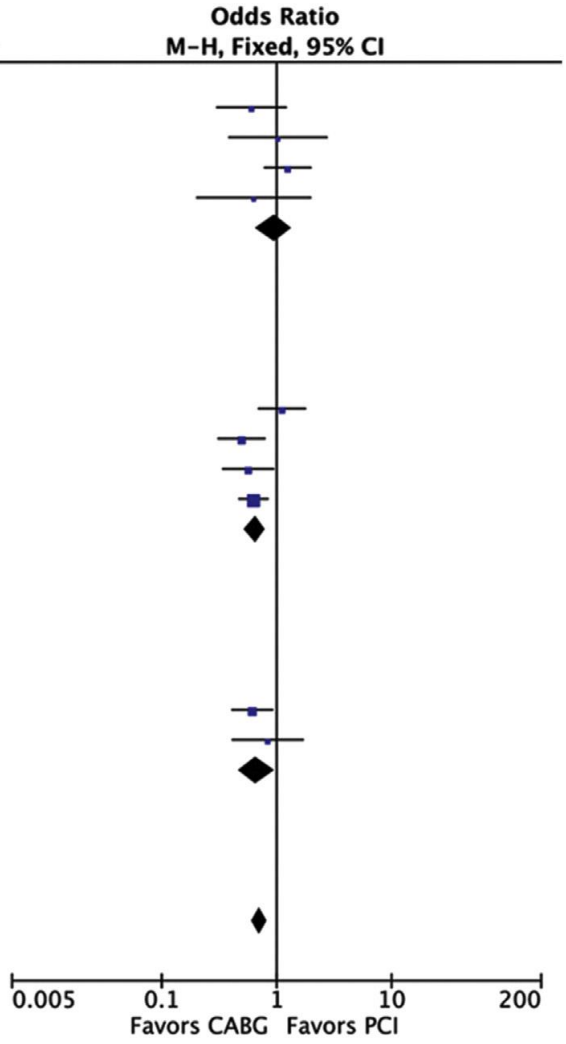
Data are presented as Hazard Ratio (95% CI). ACS: acute coronary syndrome; LVEF: left ventricular ejection fraction; SYNTAX: Synergy between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery.

M Eickhoff et al ; Journal of Geriatric Cardiology (2018) 15: 559–66

High Syntax Score: PCI Still an Acceptable Option ?

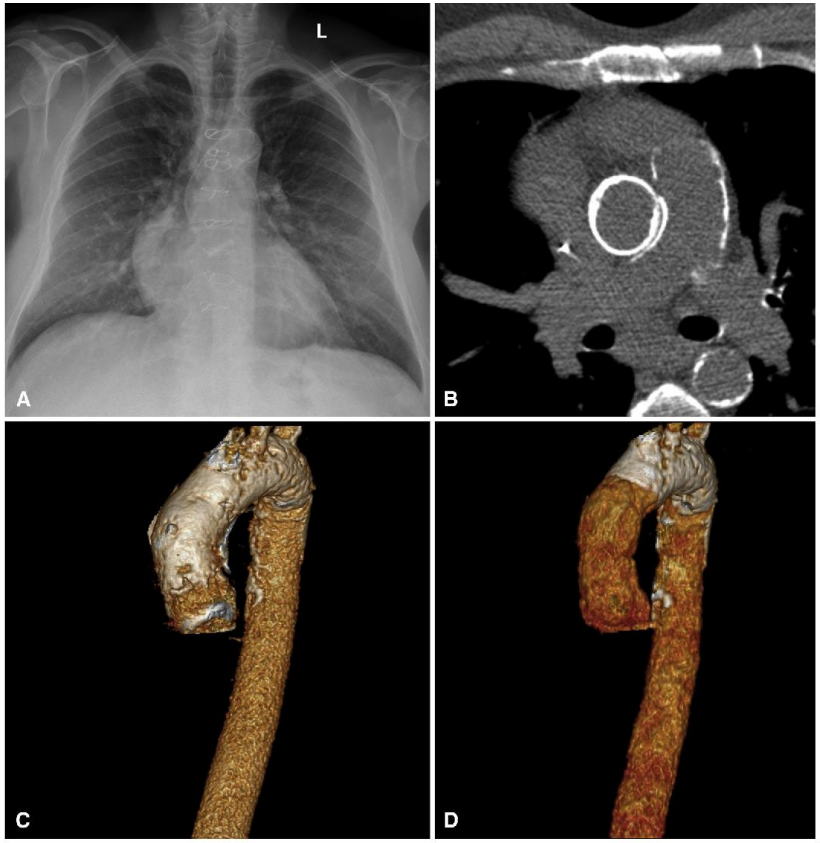
Systematic Review of Therapies for Stable Coronary Artery Disease in Diabetic Patients

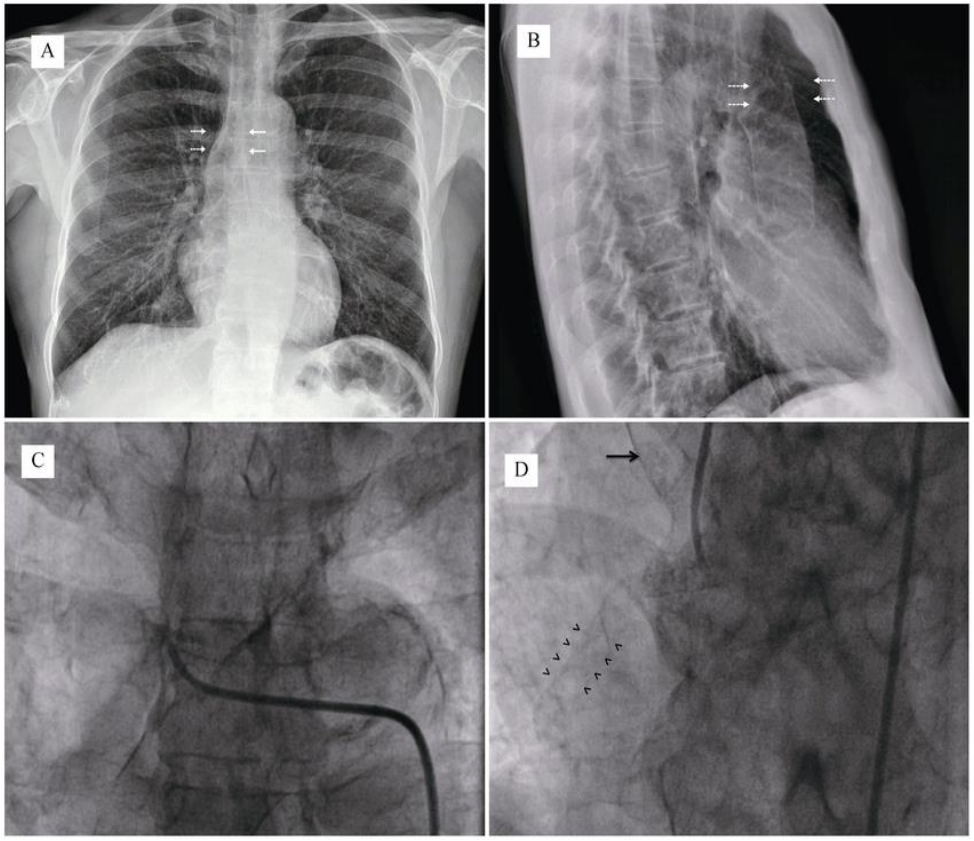
Study or Subgroup	CABG Events	CABG Total	PCI Events	PCI Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Year
1.2.1 1-year							
SYNTAX	13	204	23	227	5.7%	0.60 [0.30, 1.23]	2009
CARDiA	8	248	8	254	2.1%	1.02 [0.38, 2.78]	2009
FREEDOM	38	904	32	941	8.4%	1.25 [0.77, 2.01]	2012
VA CARDS	5	97	8	101	2.1%	0.63 [0.20, 2.00]	2013
Subtotal (95% CI)		**1453**		**1523**	**18.2%**	**0.95 [0.67, 1.35]**	
Total events	64		71				
Heterogeneity: $Chi^2 = 3.31$, df = 3 (P = 0.35); $I^2 = 9\%$							
Test for overall effect: Z = 0.28 (P = 0.78)							
1.2.2 5-year							
ARTS	38	509	33	488	8.7%	1.11 [0.69, 1.80]	2005
BARI	36	180	58	173	13.2%	0.50 [0.31, 0.80]	2007
SYNTAX	26	221	44	231	10.6%	0.57 [0.34, 0.96]	2009
FREEDOM	83	761	114	699	29.5%	0.63 [0.46, 0.85]	2012
Subtotal (95% CI)		**1671**		**1591**	**61.9%**	**0.66 [0.53, 0.81]**	
Total events	183		249				
Heterogeneity: $Chi^2 = 6.25$, df = 3 (P = 0.10); $I^2 = 52\%$							
Test for overall effect: Z = 3.97 (P < 0.0001)							
1.2.3 10-year							
BARI	76	180	94	173	15.4%	0.61 [0.40, 0.94]	2007
MASS II	22	80	20	64	4.5%	0.83 [0.41, 1.72]	2013
Subtotal (95% CI)		**260**		**237**	**19.9%**	**0.66 [0.46, 0.95]**	
Total events	98		114				
Heterogeneity: $Chi^2 = 0.52$, df = 1 (P = 0.47); $I^2 = 0\%$							
Test for overall effect: Z = 2.21 (P = 0.03)							
Total (95% CI)		**3384**		**3351**	**100.0%**	**0.71 [0.61, 0.84]**	
Total events	345		434				
Heterogeneity: $Chi^2 = 13.48$, df = 9 (P = 0.14); $I^2 = 33\%$							
Test for overall effect: Z = 4.17 (P < 0.0001)							
Test for subgroup differences: $Chi^2 = 3.38$, df = 2 (P = 0.18), $I^2 = 40.9\%$							



S. Luthra et al , Ann Thorac Surg 2015;100:2383–97

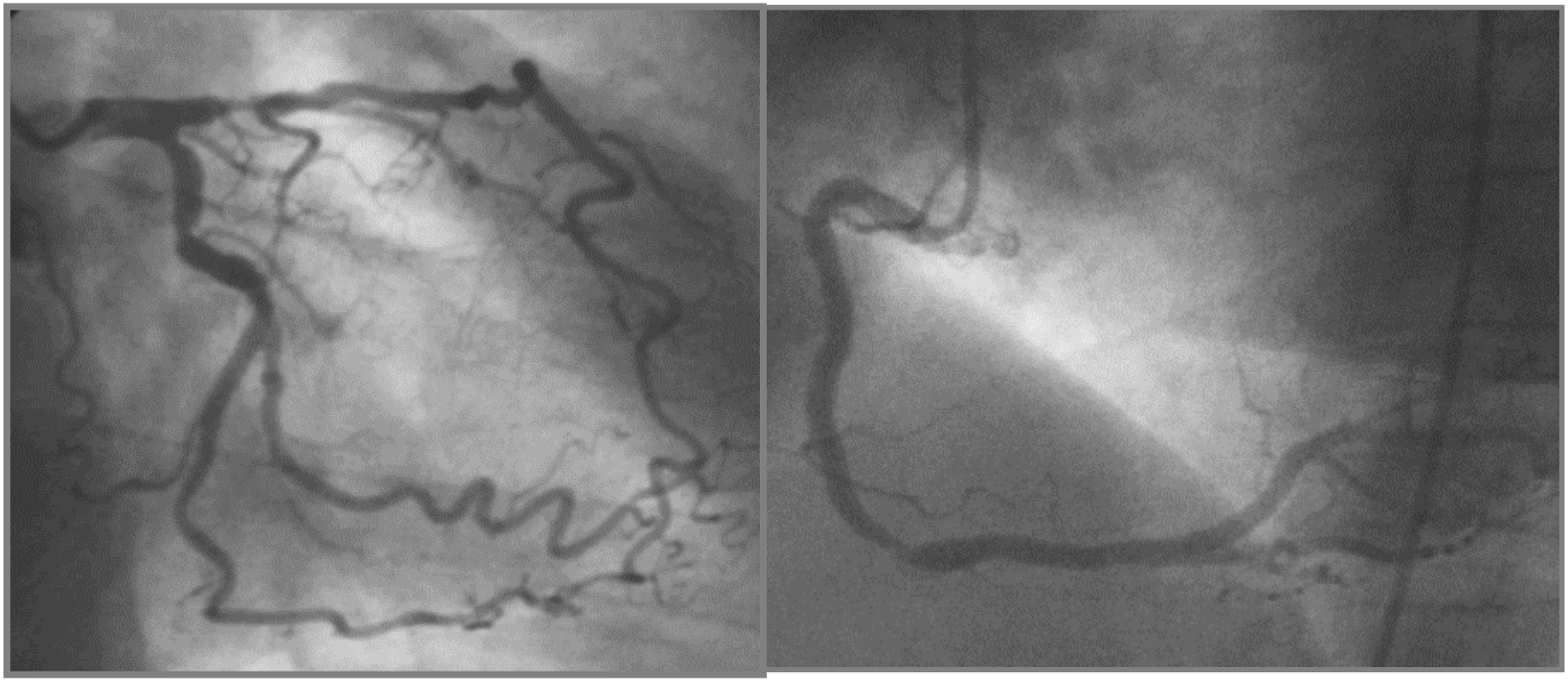
Porcelain Aorta





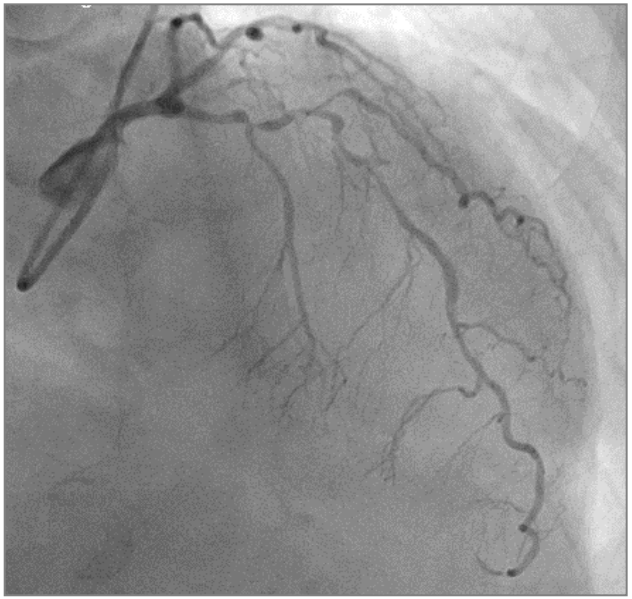
A, Preoperative chest radiography showed a hyperdense aspect of the ascending aorta and aortic wall. B, Computed tomogra

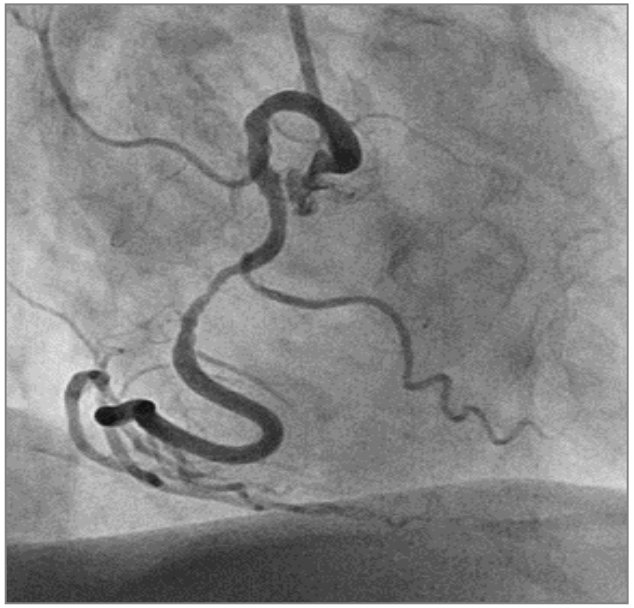
Multivessel Disease : Focal lesions



Low Syntax Score (10), not complex
PCI is a good option with excellent clinical outcome

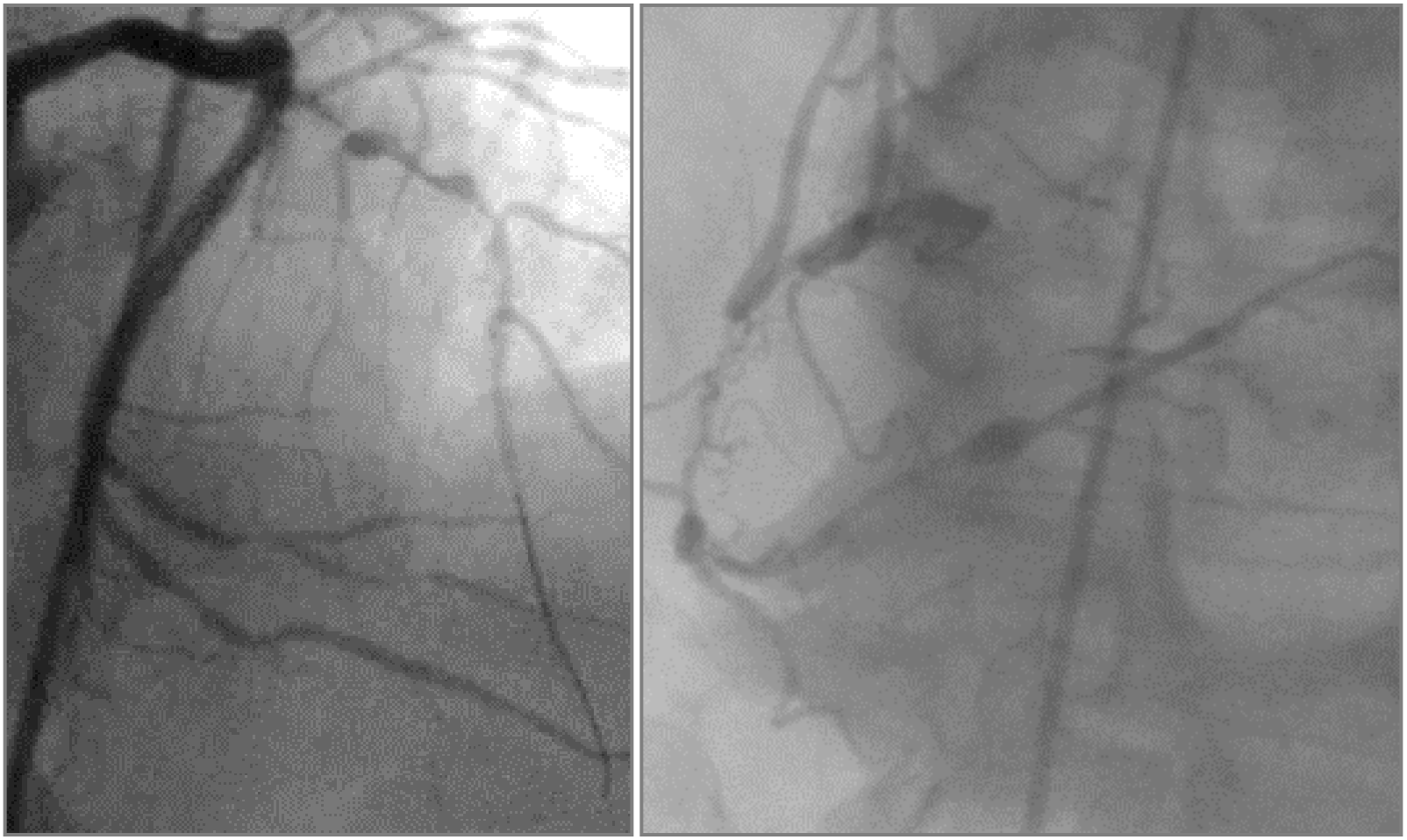
Multivessel Disease : Diffuse lesions





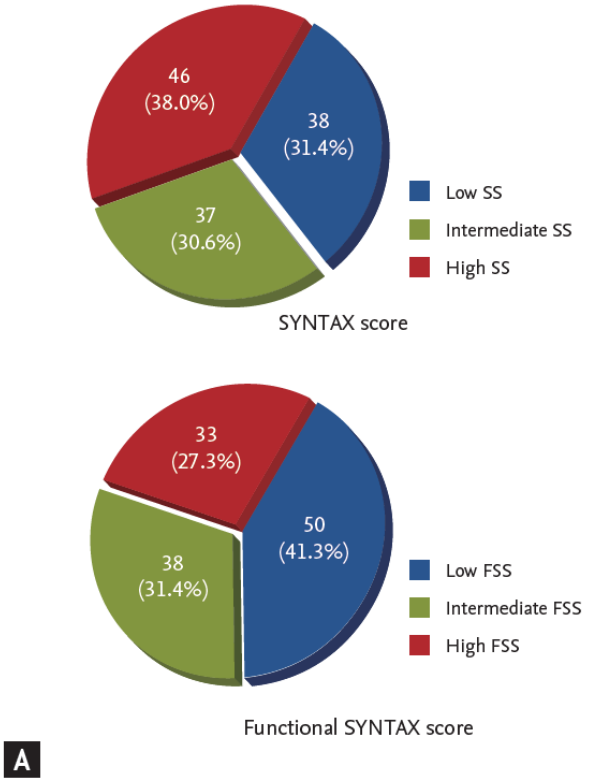
Complex anatomy , diffuse disease , Hig Syntax Score (34):
CABG is the most appropriate option

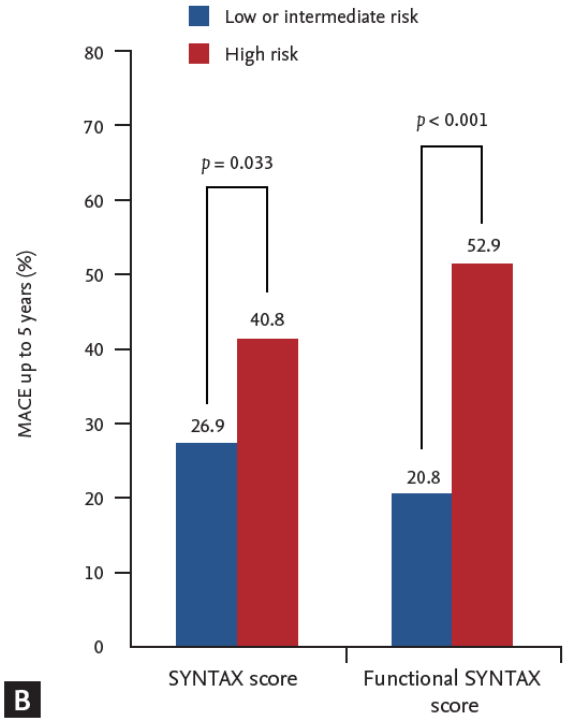
MVD & High SYNTAX Score



SYNTAX Score = 38 : **Is this patient a good candidate for CABG ?**

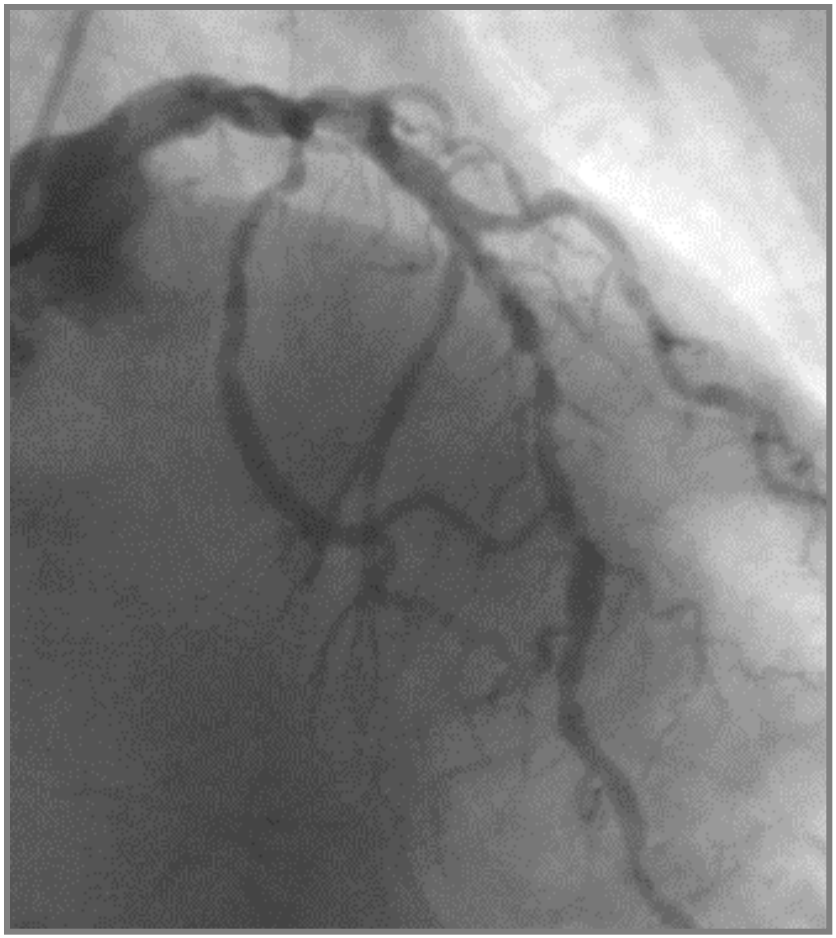
Physiology Guided Revascularization in MVD patients



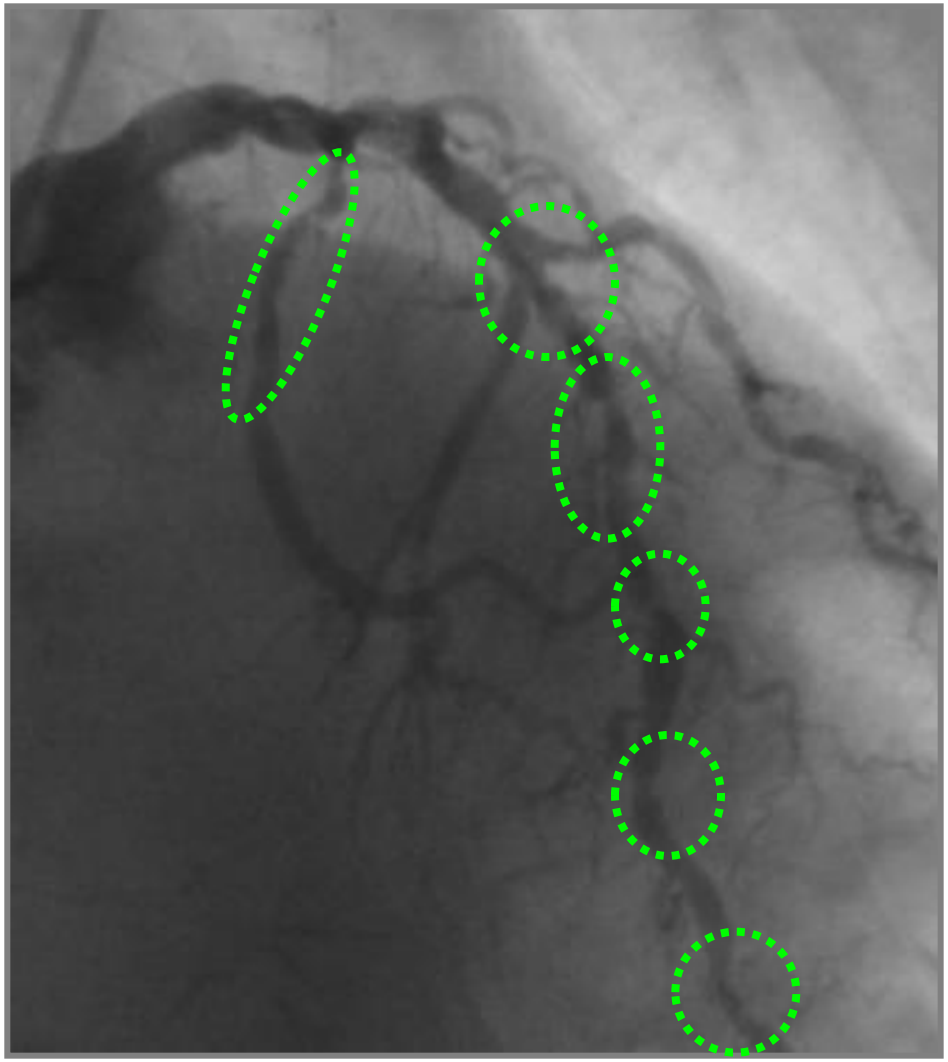


YK Cho and ChW Nam, Korean J Intern Med 2018;33(5):851-859.

Diffuse MVD

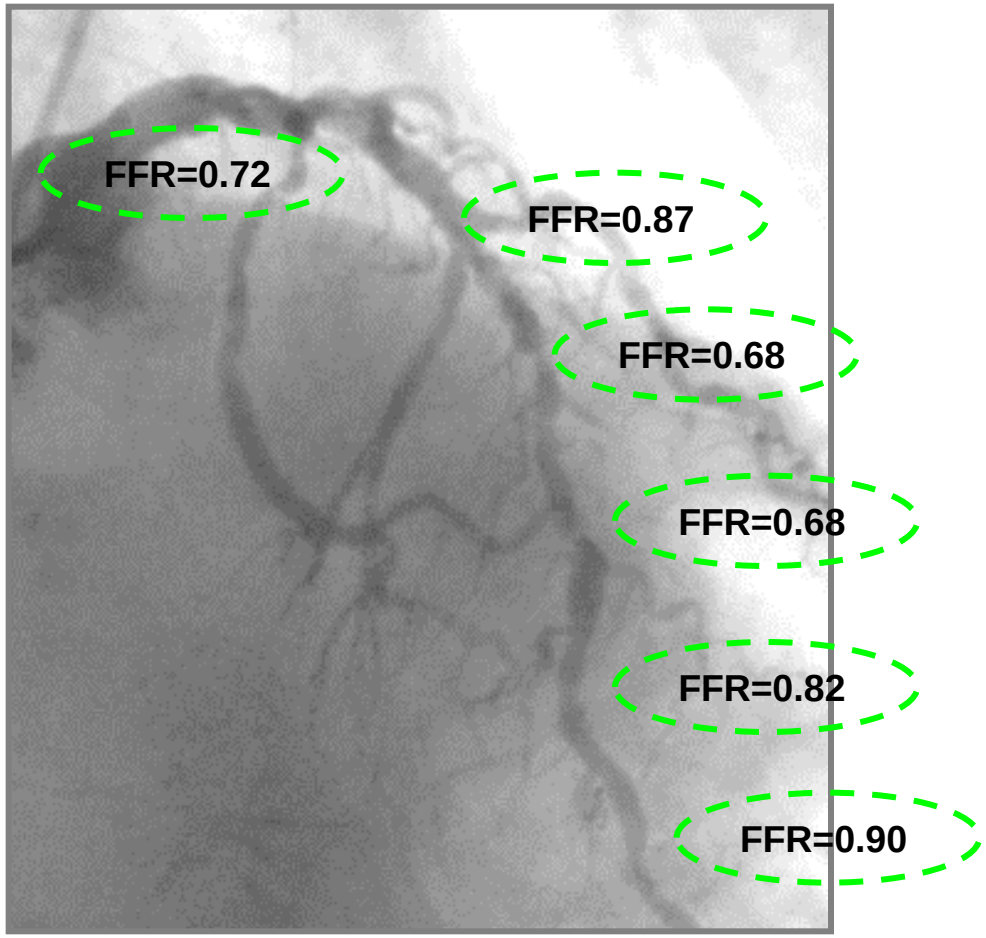


What is the optimal approach ?



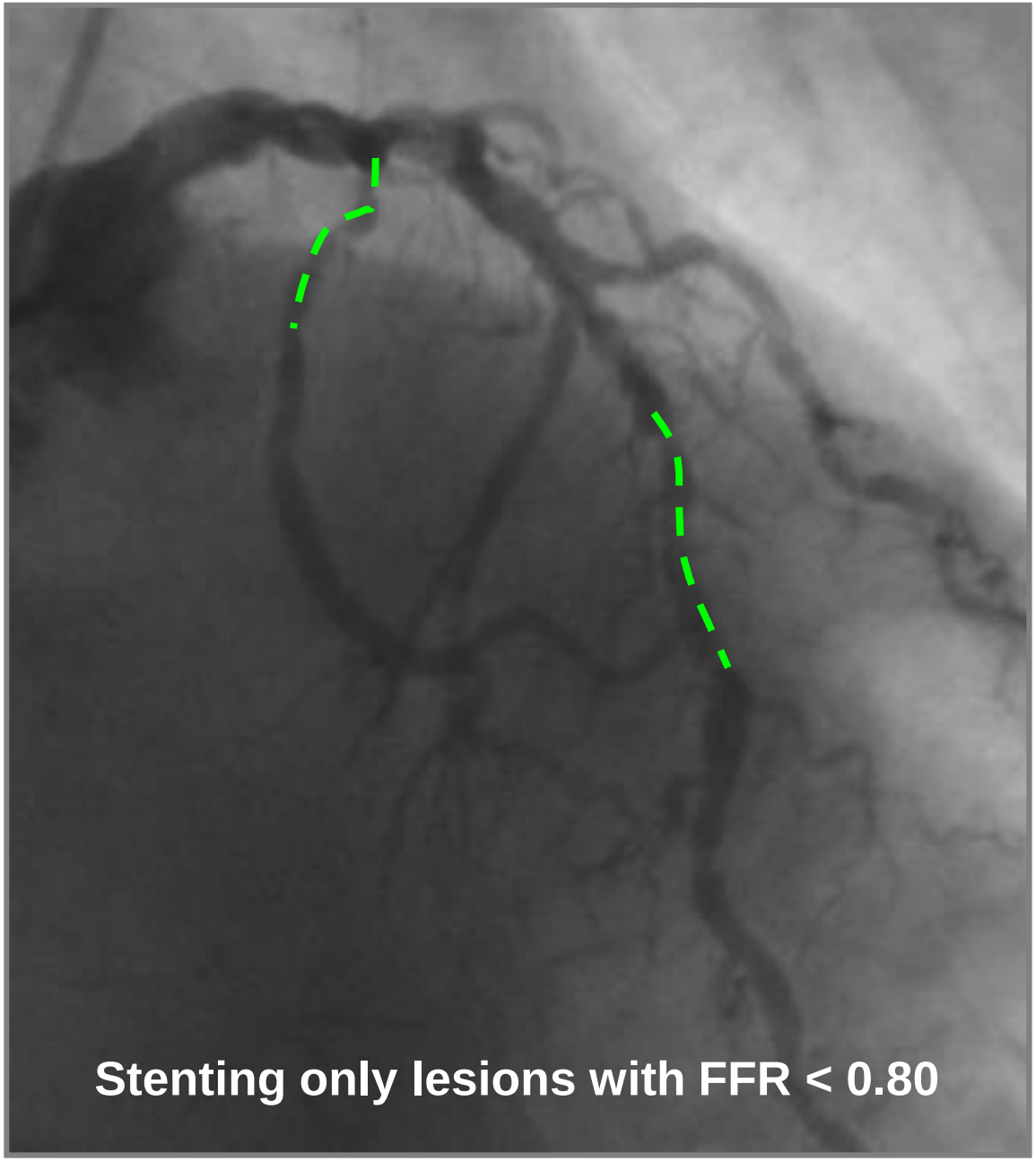
SYNTAX SCORE = 35

Diffuse MVD : Should all lesions be treated ?



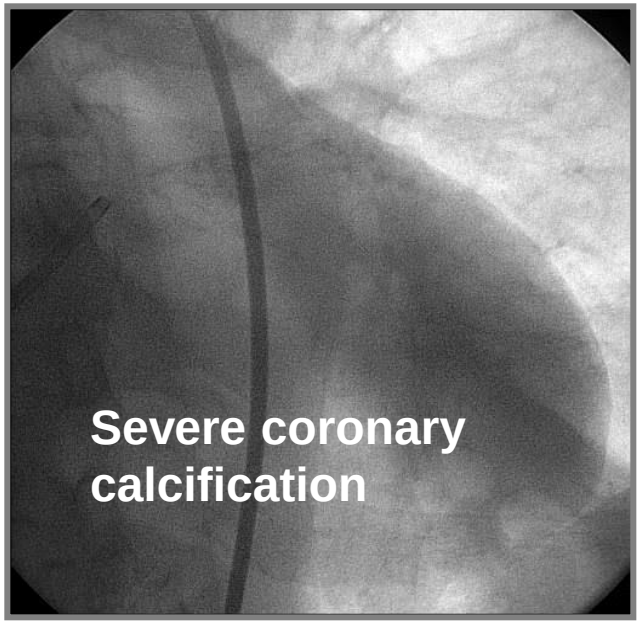
FFR-Guided procedure will avoid unnecessary stenting
Stent only for functionally ischemic lesions

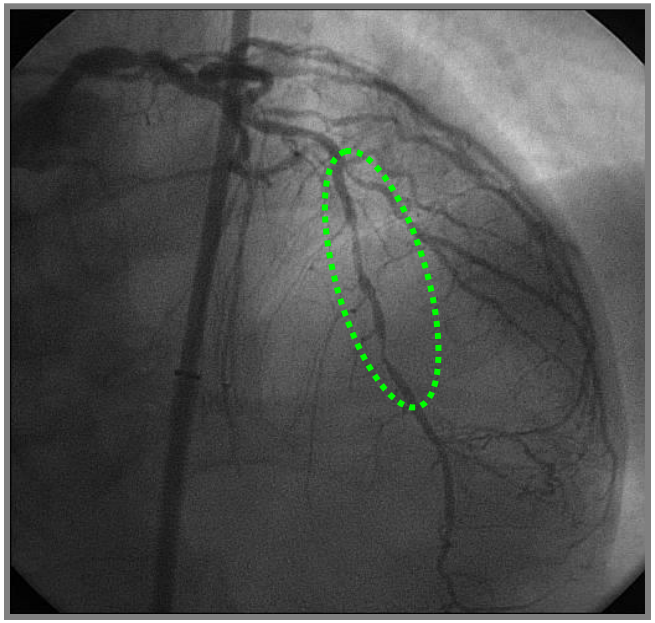
High Syntax Score: PCI Still an Acceptable Option ?

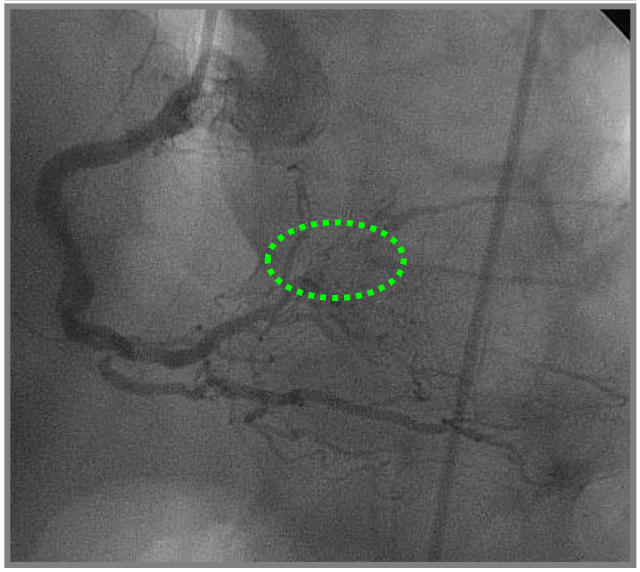


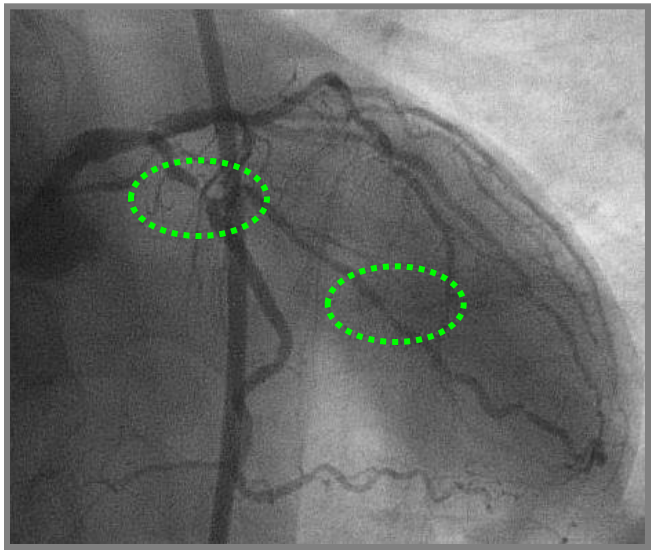
High Syntax Score: PCI Still an Acceptable Option ?

Multivessel Disease

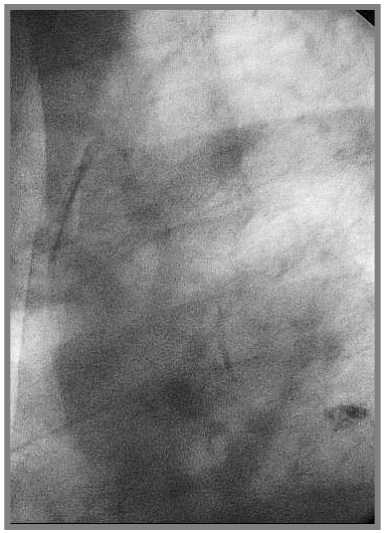








SYNTAX SCORE = 46



Severe aortic calcification

CABG ? Or PCI LCX and med LAD ?

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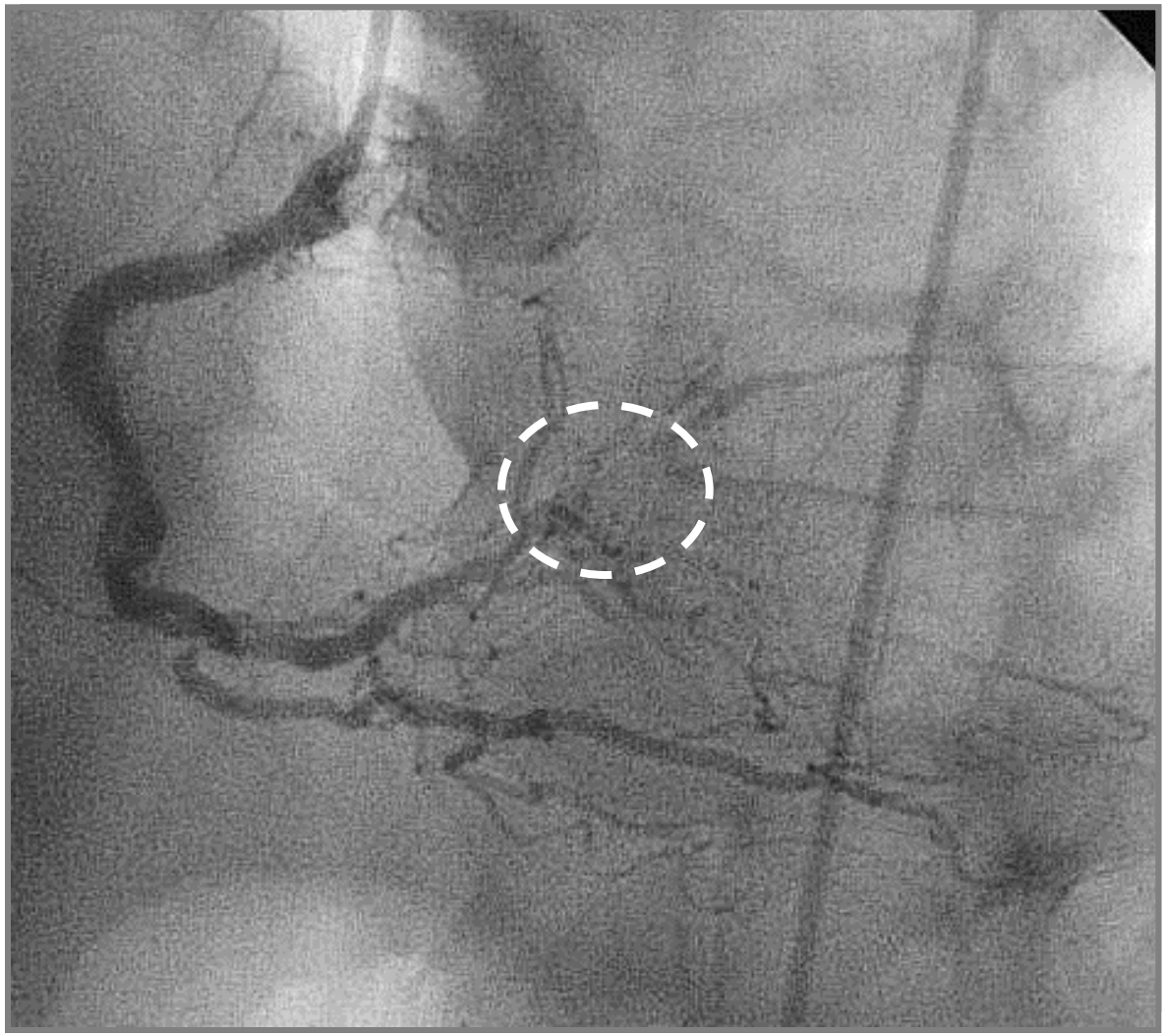


Distal CTO : Would PCI at this level impact patient's outcome ?

SYNTAX II Trial

- SYNTAX Score II (incorporating clinical and anatomical variables) to guide Heart Team decisions on myocardial revascularisa6on.
- Physiology-based revascularisation (hybrid use of iFR and FFR).
- Second generation DES (thin strut, biodegradable polymer, everolimus- eluting Synergy™ stent [EES]).
- IVUS-guided optmisation of stent deployment (modified MUSIC criteria).
- Contemporary CTO revascularization techniques.
- Guideline-directed medical therapy.

Escaned J et al. EuroIntervен6on. 2016 Jun 12;12(2):e224-34

- **Primary endpoint:** Composite of major adverse cardiac and cerebrovascular events (MACCE) at one-year follow-up.

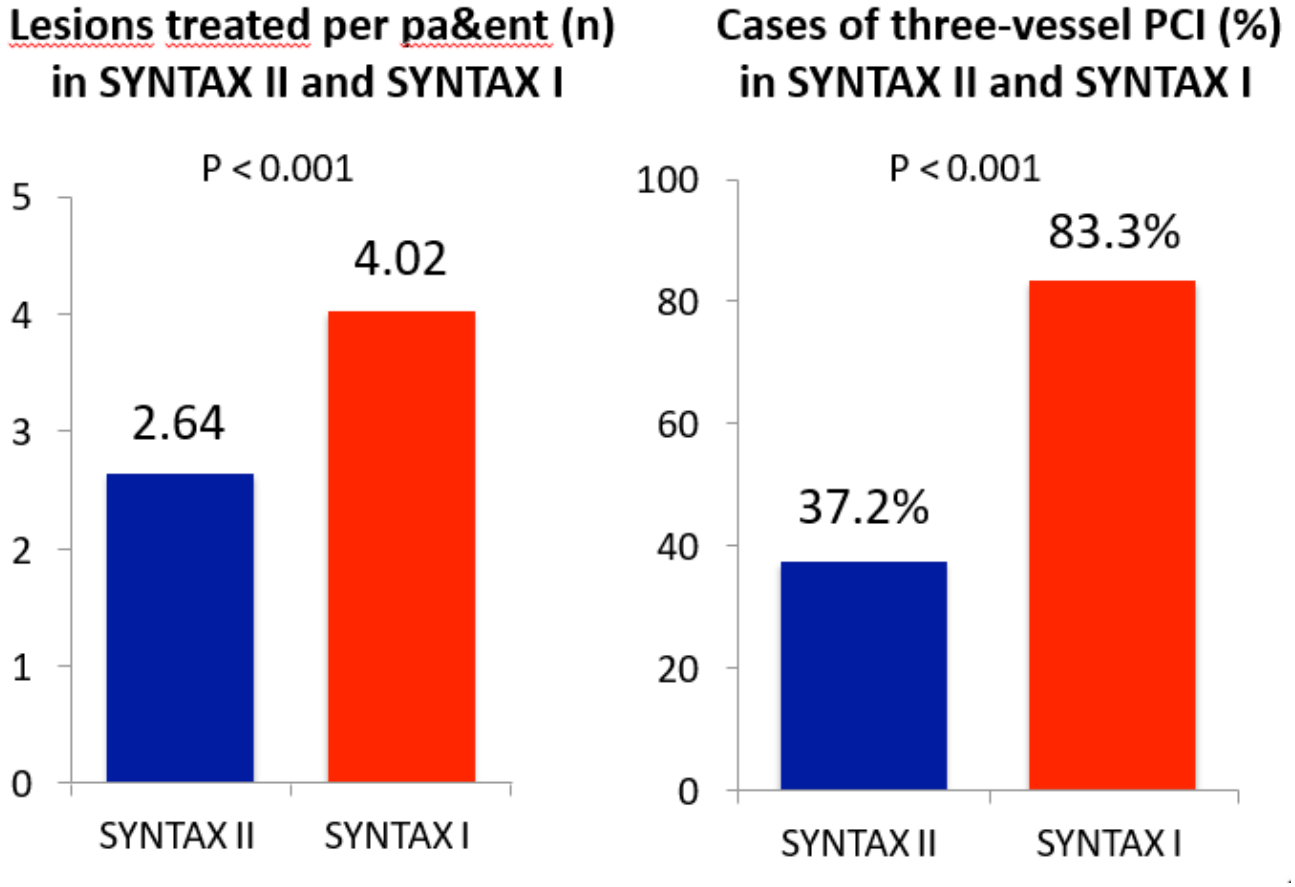
- **Comparator:** Predefined PCI cohort (n=315) from the original SYNTAX-I trial selected on the basis of equipoise 4-year mortality between CABG and PCI

SYNTAX II Trial

Baseline Characteristics

	SYNTAX II (n=454)	SYNTAX I PCI arm (n=315)	P value
Age (years)	66.7 ± 9.7	66.7 ± 9.1	0.99
Male	93.2%	93.0%	0.93
BMI (kg/m²)	28.9 ± 4.7	28.2 ± 4.4	0.032
DM	30.3%	29.2%	0.75
Current Smoker	14.7%	17.8%	0.26
Previous MI	12.5%	28.7%	<0.001
Previous Stroke	5.6%	1.9%	0.010
Hypertension	77.0%	73.4%	0.26
Hyperlipidemia	77.3%	74.4%	0.35
Clinical Presenta&on			<0.001
Silent Ischemia	5.5%	13.3%	
Stable angina	68.8%	61.6%	
Unstable angina	25.6%	25.1%	

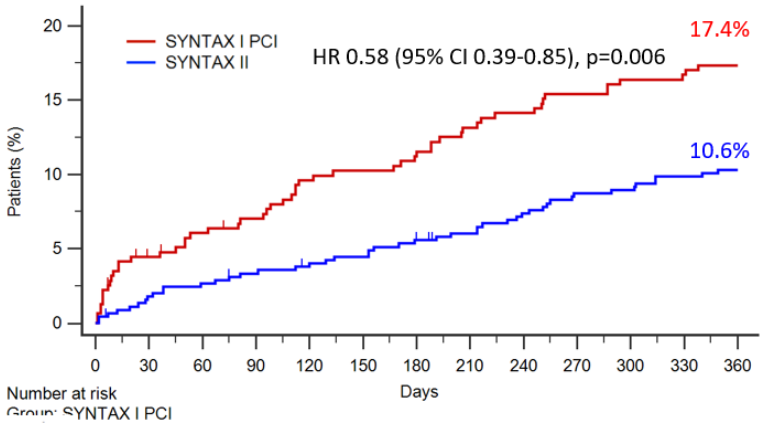
SYNTAX II Trial



IVUS Guidance :	84.1 % (Syntax II) vs 4.8% (Syntax I)
CTO procedures	87% (Syntax II) vs 53% (Syntax I)

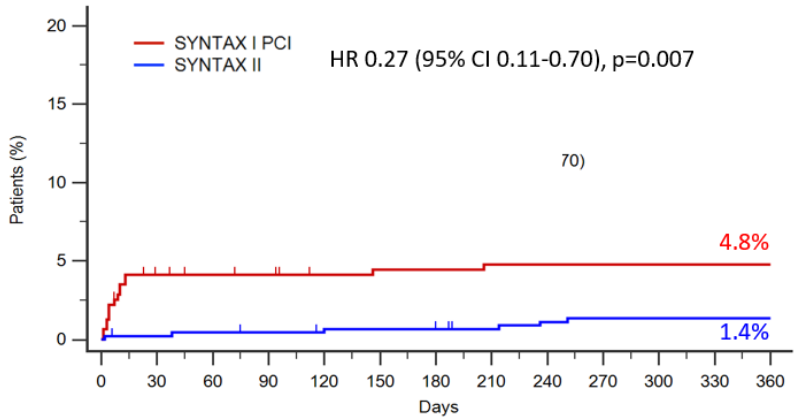
SYNTAX II Trial

Primary Endpoints



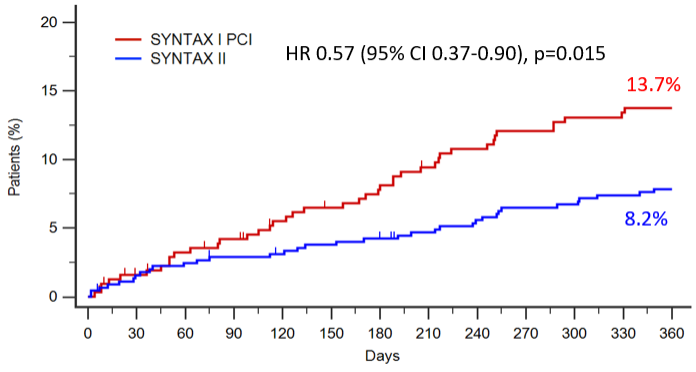
SYNTAX I PCI	315	298	292	288	280	278	274	269	266	262	259	258	256
SYNTAX II	450	441	437	433	429	427	421	417	411	405	404	400	398

MI



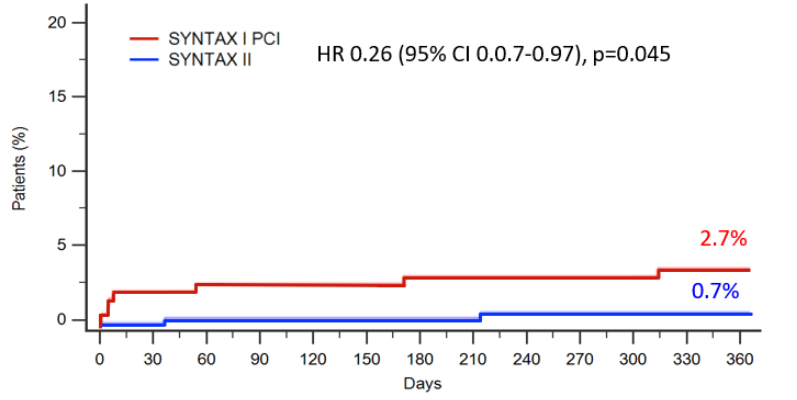
SYNTAX I PCI	315	299	297	296	293	292	292	291	291	291	291	291	291
SYNTAX II	450	448	447	446	444	444	443	441	439	438	438	438	438

TLR



SYNTAX I PCI	315	305	299	295	288	284	279	274	270	266	263	262	261
SYNTAX II	450	442	438	435	433	430	427	423	419	415	414	411	409

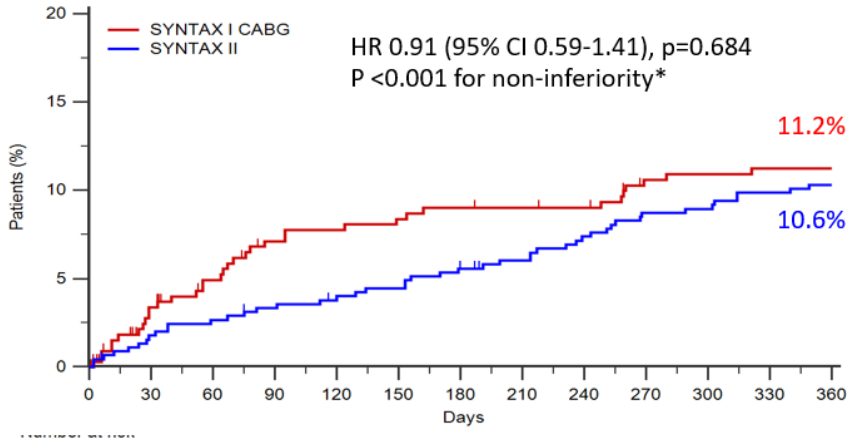
Definite ST



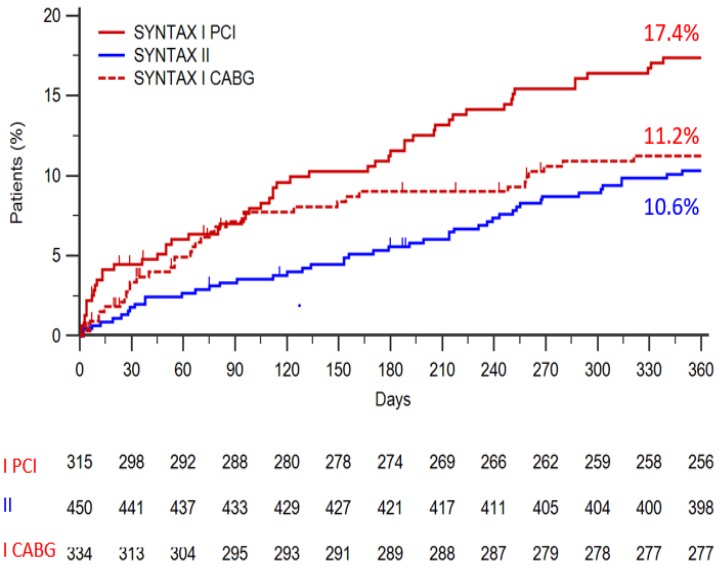
SYNTAX I PCI	315	299	297	296	292	292	292	291	291	291	291	291	290
SYNTAX II	450	447	446	444	441	441	437	435	431	428	428	427	427

SYNTAX II Trial

Exploratory End-Point: MACCE PCI vs. CABG



MACCE SYNTAX II and SYNTAX I PCI / CABG



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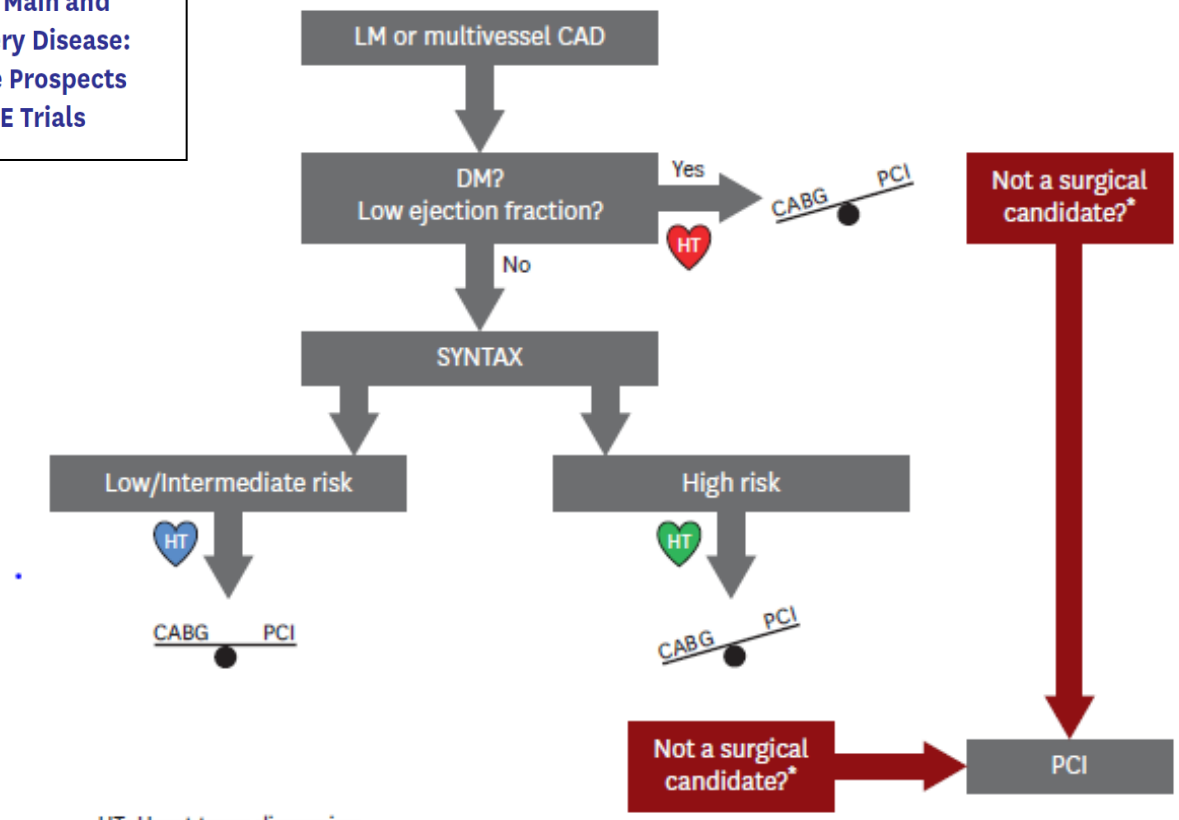
Revascularization for Left Main and Multivessel Coronary Artery Disease: Current Status and Future Prospects after the EXCEL and NOBLE Trials



HT: Heart team discussion

HT CABG has clear survival benefit with slight increased risk of stroke in diabetes. Low EF-CABG showed improved survival- never studied in PCI

HT Similar composite endpoint of death, MI and stroke between CABG and PCI

HT CABG has potential survival benefit, lower repeat revascularization, MI at the expense of longer perioperative recovery time and stroke

*Not a surgical candidate due to high risk of surgery using conventional scores, comorbidities that portend >5% risk of operative mortality, frailty, or patient refusing surgery

M. Al-Hijji , A. El Sabbagh and DR. Holmes ; **Korean Circ J. 2018 ;48:447-62**

PRACTICAL CONCLUSIONS

In MVD with high SYNTAX Score CABG is the first choice paricularly when :

- **Diabetic Patients with diffuse disease**
- **> 1 clinically relevant CTO**
- **Inexperienced operator (<1000 PCI)**
- **Other cardiac surgery indications**

In MVD with high SYNTAX Score unelegible for CABG PCI is an acceptable alternative particularly if guided by Functional Evaluation and appropriately performed (lesion preparation, optimization ,,,)

A " functional SYNTAX Score " (FFR) can be more appropriate to select patients with MVD and further improve clinical outcome

THANK YOU FOR YOUR ATTENTION