

**Creation of Risk Stratification Model Using
Predictors of Adverse Outcomes in
Unprotected LMCA Revascularization
Update of LM-Score**

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Usefulness of Risk Scoring System

- To predict outcomes of patients
- To select a appropriate treatment strategy for each patient
- To predict a need of adjunctive resources
- To compare outcomes of revascularization treatment in different hospitals and populations

Multivariate Predictors of Death/MI

324 PCI Pts with LMCA Stenosis in AMC

Variables	Hazard ratio	95% CI	P value
High EuroSCORE (≥ 6)	3.362	1.181 – 9.574	0.023
Number of total used stents	1.792	1.021 – 3.146	0.042
Use of glycoprotein IIb/IIIa inhibitor	8.640	2.722 – 27.418	<0.001

Kim YH et al. Am J Cardiol. 2006;98:1567

Component of Euro SCORE

Parameters Based on Clinical Situations

Risk factors	Score	Risk factors	Score
Cardiac-related factors		Patient-related factors	1
Unstable angina	2	Age	1
Left ventricular dysfunction	1	Sex	1
Left ventricular dysfunction	3	Chronic pulmonary disease	2
Recent myocardial infarction	2	Extracardiac arteriopathy	2
Pulmonary hypertension	2	Neurologic dysfunction	3
Operation-related factors		Previous cardiac surgery	2
Emergent operation	2	Serum creatinine	3
Other than isolated CABG	2	Active endocarditis	3
Surgery on thoracic aorta	3	Critical preoperative state	
Postinfarct septal rupture	4		

The SYNTAX score algorithm

1. Dominance
2. Number of lesions
3. Segments involved per lesion
- Lesion Characteristics*
4. Total occlusion
 - i. Number of segments involved
 - ii. Age of the total occlusion (>3 months)
 - iii. Blunt Stump
 - iv. Bridging collaterals
 - v. First segment beyond the occlusion visible by antegrade or retrograde filling
 - vi. Side branch involvement
5. Trifurcation
 - i. Number of segments diseased
6. Bifurcation
 - i. Type
 - ii. Angulation between the distal main vessel and the side branch $<70^\circ$
7. Aorto-ostial lesion
8. Severe tortuosity
9. Length >20mm
10. Heavy calcification
11. Thrombus
12. Diffuse disease/small vessels
 - i. Number of segments with diffuse disease/small vessels

SYNTAX Score

The Syntax score was proposed to take into account the heterogeneity in the lesion anatomy and complexity.

Sianos G EuroInterv.2005;1:219

Background of LM-Score

- We are trying to create a new scoring system integrating clinical and angiographic parameters for LM revascularization with either PCI or CABG,

The First Creation of LM-Risk Score



Development of LM Risk Score

Investigator Group

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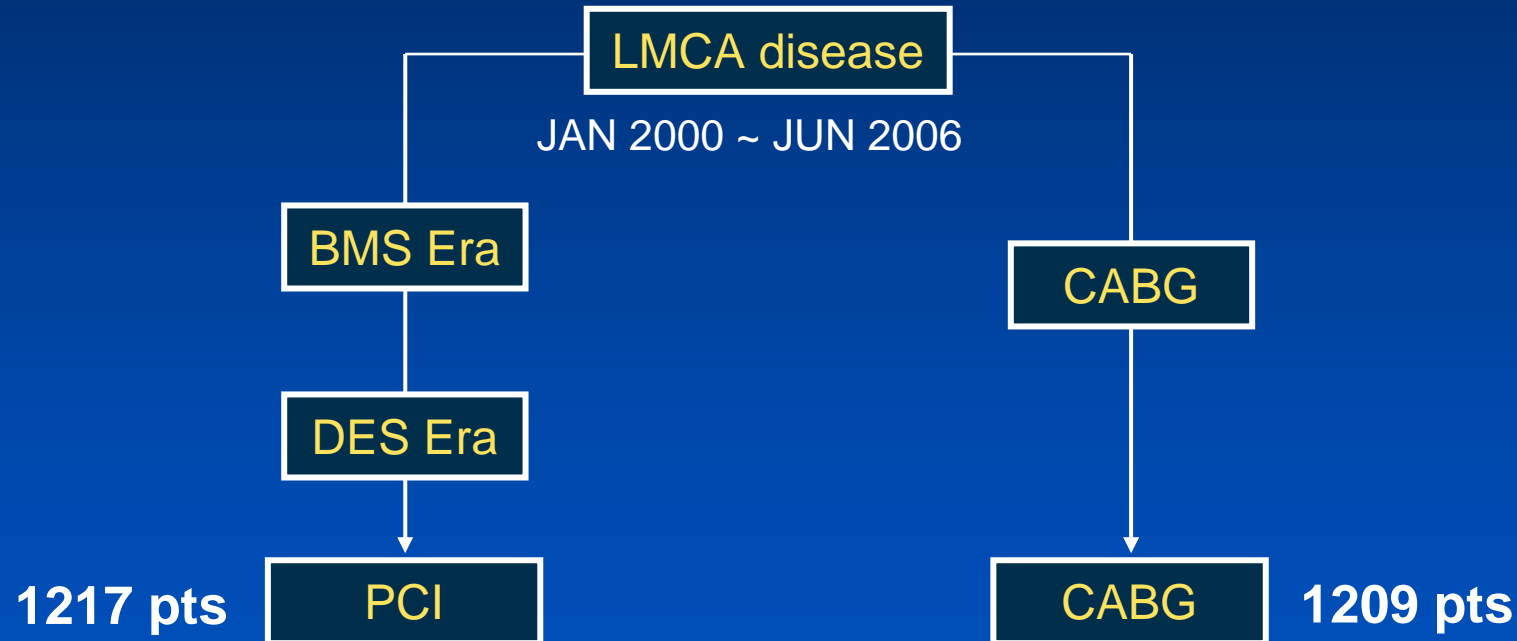
Columbia University,
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Discrimination of Risk Factors Population at Risk

2426 Patients in MAIN-COMPARE Registry

Revascularization for Unprotected Left **MAIN** Coronary Artery Stenosis: **COM**parison of **P**ercutaneous Coronary **A**ngioplasty versus Surgical **RE**vascularization from Multi-Center Registry



12 major academic institutions in Korea

Statistical Analysis

- A multivariable Cox model was used to assess the statistical significance of each candidate prognostic variable.
- After each factor was tested independently in a univariate Cox model, those that achieved a significance level with $p < 0.05$ were selected for testing in a multivariate stepwise selection.
- Interaction test was performed according to the procedure types.
- The ROC curves were used to test the accuracy of the risk score.

Outcomes of Interest

Death or Q-MI at 2 Years

	PCI (N=1217)	CABG (N=1209)	Total (N=2426)
F/U duration (days) Median [IQR]	707.00 [399.00, 1121.00]	909.00 [478.50, 1501.50]	797.50 [438.00, 1313.00]

Binary Outcomes

Death	6.7%	7.4%	7.0%
Q-wave MI	0.6%	0.8%	0.7%
Death/Q-MI	6.9%	7.8%	7.3%

K-M Estimates

Death	7.9%	8.1%	8.0%
Q-wave MI	0.6%	0.9%	0.7%
Death/Q-MI	8.0%	8.5%	8.2%

Candidate Predictors of Death/MI

37 Variables

DES (vs. BMS)

Age

Obesity (BMI > 30)

Female

Previous PCI

Previous MI

Previous CHF

Diabetes mellitus

Hypertension

Hyperlipidemia

Previous CVA

Chronic renal failure

Peripheral vascular
disease

Smoking

Chronic lung disease

Significant valve disease

Acute coronary syndrome

Myocardial infarction

Atrial fibrillation

TIMI flow

LV EF (%)

Cardiogenic shock

Indication of procedure

Multivessel disease

Extra-LM vascular involvement

RCA disease

Lesion location

Bifurcation type

ACC/AHA type

In-stent restenosis

Infarct-related artery

Restenotic lesions

Lesion length

Total occlusion

calcification

Thrombus

Ulceration

Multivariate Interaction Model

Combined Group

Predictors	Coefficient	SE	p value	Hazard Ratio [95% C.I.]	Risk Score
DES	-0.4410	0.2857	0.1227	0.64 [0.37, 1.13]	0
PCI	0.0674	0.3138	0.8299	1.07 [0.58, 1.98]	0
65 <= Age < 75	0.3190	0.1839	0.0828	1.38 [0.96, 1.97]	2
Age >= 75	1.0866	0.1971	0.0000	2.96 [2.01, 4.36]	6
EF < 30%	1.7152	0.2656	0.0000	5.56 [3.30, 9.36]	7
STEMI	0.7855	0.2235	0.0004	2.19 [1.42, 3.40]	4

Multivariate Interaction Model

Interaction Terms (1)

Predictors	Coeff.	SE	p value	Hazard Ratio [95% C.I.]	Risk Score
Only add if CABG					
MEDINA 1.1.1 or 1.1.0 (ostial LAD +)	0.6383	0.2202	0.0038	1.89 [1.23, 2.92]	3
Only add if any PCI					
Chronic renal failure	1.7885	0.2831	0.0000	5.98 [3.43, 10.42]	6
Infarction Related	0.6735	0.2365	0.0044	1.96 [1.23, 3.12]	3

Multivariate Interaction Model

Interaction Terms (2)

Multivariate Predictors	Coeff.	SE	p value	Hazard Ratio [95% C.I.]	Risk Score
Only add if PCI with DES					
Significant valve disease	1.1136	0.5492	0.0427	3.05 [1.04, 8.94]	2
Low EF (30%-40%)	1.2647	0.3833	0.0010	3.54 [1.67, 7.51]	3
Total Occlusion	1.2899	0.4208	0.0022	3.63 [1.59, 8.29]	3
Only add if PCI with BMS					
Hyperlipidemia	-0.6378	0.2420	0.0084	0.53 [0.33, 0.85]	-3
Atrial fibrillation	1.4030	0.2910	0.0000	4.07 [2.30, 7.19]	5
RCA disease	0.5285	0.2344	0.0241	1.70 [1.07, 2.69]	2

Range of Possible Scores

CABG 0 ~ 22

PCI with DES 0 ~ 36

PCI with BMS 0 ~ 35

Incidence of 2-Year Death / Q-MI According to the Risk Score

N=2248	PCI		CABG	
	No.	%	No.	%
0 (Very Low)	9	1.75	14	3.53
1-5 (Low)	19	4.42	42	6.62
6-9 (Moderate)	19	9.74	33	19.88
≥ 10 (High)	37	46.84	5	41.67

Under the ROC Curve for 100 randomly selected samples

Mean	SD	Median	IQR
0.6173	0.0263	0.6173	0.6003 – 0.6323

**69 Y Male,
EF 42%,
CRF,
Stable Angina,
LM extended to LAD by angiography**

Which treatment ?

**69 Y Male, EF 42%, CRF, SA, LM extended to LAD,
Going to PCI with DES**

	Patients	Risk Score	Patient risk
Overall			
DES	Yes	0	0
PCI	Yes	0	0
65 <= Age < 75	Yes	2	2
Age >= 75	No	6	0
EF < 30%	No	7	0
STEMI	No	4	0
Any PCI			
CRF	Yes	6	6
Infarct related	No	3	0
DES only			
Significant valve disease	No	2	0
EF 30-40%	No	3	0
Total occlusion	No	3	0
Total score			8

Expected 2-Year Events (Death/Q-MI) According to the Risk Score

	PCI		CABG	
	No.	%	No.	%
0 (Very Low)	9	1.75	14	3.53
1-5 (Low)	19	4.42	42	6.62
6-9 (Moderate)	19	9.74	33	19.88
≥ 10 (High)	37	46.84	5	41.67

69 Y Male, EF 42%, CRF, SA, LM extended to LAD, Going to CABG

	Patients	Risk Score	Patient risk
Overall			
DES	Yes	0	0
PCI	Yes	0	0
65 <= Age < 75	Yes	2	2
Age >= 75	No	6	0
EF < 30%	No	7	0
STEMI	No	4	0
CABG			
MEDINA 1.1.1 or 1.0.1 (ostial LAD involvement)	Yes	6	6
Total score			8

Expected 2-Year Events (Death/Q-MI) According to the Risk Score

	PCI		CABG	
	No.	%	No.	%
0 (Very Low)	9	1.75	14	3.53
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**69 Y Male,
EF 42%,
CRF,
Stable Angina,
LM extended to LAD**

We may recommend PCI with DES

- Expected risk of Death/QMI in PCI with DES
~ 10 %
- Expected risk of Death/QMI in CABG
~ 20 %

Limitation

- Absence of detailed angiographic parameters
- Lack of diverse study population across countries
- Absence of external validation of LM-Score

Modification

- Absence of detailed angiographic parameters
- Lack of diverse study population across countries
- Absence of external validation of LM-Score

- ✓ **Angiographic analysis**
- ✓ **Merge with patients in other registries at different risk profiles**
- ✓ **Application of this score to other database**

Conclusion

- In this preliminary analysis, the 'LM-Score' appears to be effective to stratify the risk of patients treated with either PCI or CABG for unprotected LMCA stenosis.
- Combination of new database and analysis of angiographic characteristics will create a more relevant risk model to predict the outcomes of revascularization.
- The predictability of final statistical model will be additionally ascertained by the process of external validation using the separated large database.