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Coronary Artery Disease, Acute Coronary Syndromes, Acute Cardiac Care –
Coronary Artery Disease: Treatment, Revascularization

FREEDOM formula: external validation of diabetics treated by coronary artery bypass grafting in single large volume cardio-surgical center

N. Arnautovic[1], M. Ostojic[2], D. Nezic[2], M. Borzanovic[2], A. Nikolic[2], T. Ragus[2], S. Micovic[2], P. Otasevic[2], D. Djokic[2], I. Ivanovic[3], B. Stanetic[4], T. Kovacevic-Preradovic[4], V. Djajic[4], N. Tasic[2], M. Bojic[2]

[1]University Belgrade Medical School, Belgrade, Serbia; [2]Institute for Cardiovascular Diseases Dedinje, Belgrade, Serbia; [3]City Institute of Public Health, Institute of Public Health Republic of Serbia, Belgrade, Serbia; [4]University Clinical Centre of the Republic of Srpska, Faculty of Medicine Banja Luka, Banja Luka, Bosnia and Herzegovina

Background: Freedom formula (FF) was derived very recently to assist in decision making by Heart Team in patients (Pts) with diabetes (DM) who are in need for myocardial revascularization (Percutaneous Coronary Intervention or Coronary artery bypass grafting (CABG)) due to complex ischemic Heart disease (but without left main steam disease (LM)). In external validation moderate C statistics values were obtained.

Purpose: To validate FF predictive value in Pts with DM and more complex patients (three vessel (3VD) and/or LM as well lower left ventricular ejection fraction (LVEF)) than in FREEDOM population.
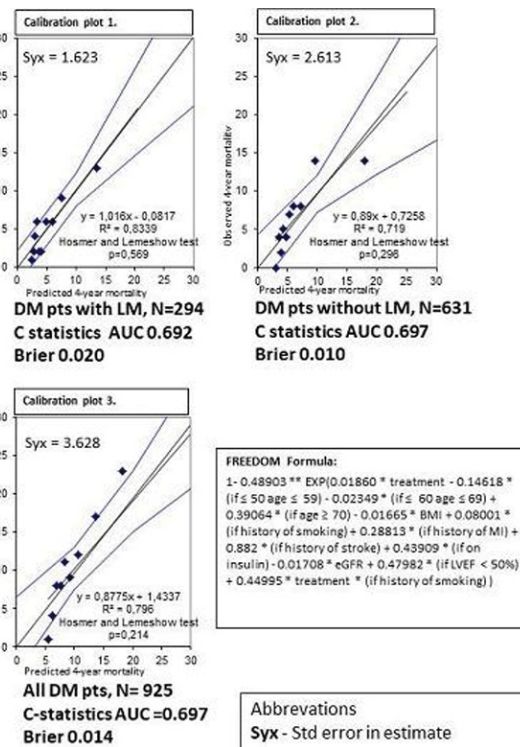
Methods: From our prospective data base of 2455 consecutive pts who had the first isolated CABG in the period 01/2012–12/2014 with 3VD and/or LM with 100% follow up of 4 years All-cause Mortality (Mt) we retrieved 925 pts with DM.

Results: DM was present in 925 Pts (Mt: 12.6%). On insulin were 318 (34.3%; Mt 14.5%). We analysed the predicative value of FF in the whole group (925) of pts with DM as well as in subgroups with LM (294) and without LM (631; most similar to original Freedom population), separately. Characteristics of pts, Freedom formula, predicating power by C Statistics, Calibration plots and Brier scores are presented in Picture 1.

Conclusions: Our external validation of FF was almost identical as previous published one. Furthermore, the FF may be of value even in pts with LM disease and other vessels involved. Of note our pts as seen by combined LVEF, ClCr and LM were sicker than pts in FREEDOM.

Table 1. Characteristics of 925 isolated CABG pts with DM with 4-year FUP

	DM + LM N= 294 pts	DM without LM: N = 631	P value
Age,years (IQR)	66 (61-72)	63 (59-69)	< 0.001
Sex / male n (%)	225 (76.5)	458 (72.6)	0.116
Diabetes Mellitus On-Insulin n (%)	94 (32.0)	224 (35.5)	0.164
Heredity n (%)	173 (58.8)	398 (63.1)	0.123
Smoker/smoking history (%)	148 (50.3)	325 (51.5)	0.398
Hyperlipidemia n (%)	249 (84.7)	550 (87.2)	0.179
Hypertension n (%)	274 (93.2)	593 (94.0)	0.373
Chronic obstructive pulmonary disease n (%)	7 (2.4)	29 (4.6)	0.071
Peripheral artery disease n (%)	68 (23.1)	117 (18.5)	0.063
Recent Myocardial Infarction n(%)	75 (25.5)	128 (20.3)	0.045
Neurological dysfunction n(%)	3 (1)	9 (1.4)	0.438
CCS class IV n (%)	46 (15.6)	44 (7.0)	< 0.001
NYHA Class			
I n (%)	34 (11.6)	82 (13.0)	0.549
II n (%)	153 (52.0)	376 (59.6)	0.029
III n (%)	103 (35.0)	169 (26.8)	0.010
IV n (%)	4 (1.4)	4 (0.6)	0.218
Left Ventricular Ejection Fraction % (mean±SD)	42.48 ± 12.57	43.59 ± 11.31	0.200
Body mass index (IQR)	27.4 (24.9-30.11)	27.8 (25.4-30.4)	0.130
Creatinine Clirens ml/min (CrCl) (IQR)	83.3 (59.7-102.1)	90.4 (70.4-113.1)	< 0.001
Urgence n (%)	142 (48.3)	116 (18.4)	<0.001
EuroSCORE II (mean±SD)	3.39 ± 3.92	2.33 ± 2.65	< 0.001
Four year mortality n(%)	51 (17.3)	66 (10.5)	0.003
FREEDOM score Mt % (mean±SD;IQR)	23.41 ±16.53; 17.77 (10.63-33.22)	18.55 ± 12.86; 15.04 (9.61-24.02)	< 0.001

Calibration plot 1.
Syx = 1.623
y = 1,016x – 0,0817
R² = 0,8339
Hosmer and Lemeshow test p=0,569
DM pts with LM, N=294
C statistics AUC 0.692
Brier 0.020

Calibration plot 2.
Syx = 2.613
y = 0,89x + 0,7258
R² = 0,719
Hosmer and Lemeshow test p=0,298
DM pts without LM, N=631
C statistics AUC 0.697
Brier 0.010

Calibration plot 3.
Syx = 3.628
y = 0,8775x + 1,4337
R² = 0,796
Hosmer and Lemeshow test p=0,214
All DM pts, N= 925
C-statistics AUC =0.697
Brier 0.014

FREEDOM Formula:
1- 0.48903 ** EXP(0.01860 * treatment - 0.14618 * (if ≤ 50 age ≤ 59) - 0.02349 * (if ≤ 60 age ≤ 69) + 0.39064 * (if age ≥ 70) - 0.01665 * BMI + 0.08001 * (if history of smoking) + 0.28813 * (if history of MI) + 0.882 * (if history of stroke) + 0.43909 * (if on insulin) - 0.01708 * eGFR + 0.47982 * (if LVEF < 50%) + 0.44995 * treatment * (if history of smoking))

Abbreviations
Syx - Std error in estimate

Picture 1