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THE USE OF BASEL SCORE IN EARLY DETECTION OF CORONARY LESION SEVERITY IN NON-ST SEGMENT ELEVATION MYOCARDIAL INFARCTION AND UNSTABLE ANGINA PECTORIS

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ABSTRACT

Early diagnosis of cardiac ischemia is crucial for effective management of acute myocardial infarction. The BASEL (Better Analysis of ST-segment Elevations and Depressions in a 12-leads-ECG) score has been shown to provide additional diagnostic value to the established electrocardiographic (ECG) criteria. This study aimed to evaluate the use of BASEL score to determine the severity of coronary lesions in patients with non-ST segment elevation acute coronary syndrome. This study used a cross-sectional approach and was conducted from January 2021 to January 2022.

From a total of 90 subjects, more than three-quarters were male, while the mean age was 60.3 years. The median BASEL score was 2.3 (1–4.2). GRACE 2.0 score had a mean of 97.3±26. The SYNTAX I score had a mean of 25±15.6, the SYNTAX II – PCI median score was 34.5 (25.9-42.4), and the SYNTAX II-CABG mean score was 23.4±11.9. The BASEL score showed a significant association with the SYNTAX I score both in univariate 2.60 (2.60-3.59), p<0.001, and in multivariate model 2.16 (0.99-3.34), p=0.001. The BASEL score appeared superior to the GRACE 2.0 score for lesion classification prediction according to the SYNTAX I AUC Z=3.29; p<0.001 for SYNTAX score of ≥33 and AUC Z=3.72, p<0.001 for SYNTAX score of >22. However, the SYNTAX II-PCI score, the classification ability of BASEL and GRACE scores did not differ AUC Z=1.02, p=0.306 for SYNTAX scores ≥33, and AUC Z=0.85, p=0.393 for SYNTAX score of >22.

The BASEL score is significantly associated with the SYNTAX I score and provide better discrimination than the GRACE 2.0 score in determining the severity of coronary lesion.

Keywords: *BASEL Score, non-ST segment myocardial infarction, unstable angina pectoris, SYNTAX score, GRACE score.*

ABSTRAK

Diagnosis dini iskemia miokard sangat penting untuk manajemen yang efektif dari infark miokard akut. Skor BASEL (*Better Analysis of ST-segment Elevations and Depressions in a*

12-leads-ECG) telah terbukti memberikan nilai diagnostik tambahan untuk kriteria elektrokardiografi (EKG) yang ditetapkan.

Penelitian ini bertujuan untuk mengevaluasi penggunaan Skor Basel dalam menentukan tingkat keparahan lesi koroner pada pasien sindrom akut tanpa elevasi segmen ST. Penelitian ini menggunakan pendekatan potong lintang dan dilakukan dari bulan Januari 2021 hingga Januari 2022.Dari total 90 subjek, lebih dari tiga perempatnya adalah laki-laki, sedangkan usia rata-rata adalah 60,3 tahun. Median skor BASEL adalah 2,3 (1-4,2). Skor GRACE 2.0 memiliki rata-rata 97,3±26. Skor SYNTAX I memiliki rata-rata 25±15,6, skor median SYNTAX II - PCI adalah 34,5 (25,9-42,4) dan skor rata-rata SYNTAX II - CABG 23,4±11,9. Skor BASEL menunjukkan hubungan yang signifikan dengan skor SYNTAX – I baik pada model univariat 2,6 (2,60-3,59), $p < 0,001$ maupun pada model multivariat 2,16 (0,99-3,34), p=0,001. Skor BASEL lebih superior dari skor GRACE 2.0 untuk klasifikasi lesi menurut SYNTAX I AUC Z=3,29; $p <0,001$ untuk skor SYNTAX ≥33 dan AUC Z = 3,72, $p<0,001$ untuk skor SYNTAC >22. Namun pada klasifikasi menurut skor SYNTAC II-PCI, kemampuan klasifikasi skor BASEL dan GRACE tidak berbeda dengan AUC Z = 1,02, p=0,306 untuk skor SYNTAX ≥33 dan AUC Z = 0,85, p=0,393 untuk skor SYNTAX > 22.

Skor BASEL secara signifikan berhubungan dengan Skor SYNTAX I dan memberikan diskriminasi yang lebih baik dibandingkan skor GRACE 2.0 dalam menentukan tingkat keparahan lesi koroner.

Kata kunci: Skor BASEL, infark miokard tanpa elevasi segmen ST, angka pektoris tidak stabil, Skor SYNTAX, skor GRACE

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INTRODUCTION

Cardiovascular disease is the leading cause of death globally each year.[1] In Indonesia, the incidence is estimated to be 200 per 100,000 individuals annually and was the second leading cause of death in 2012 with approximately 128.4 thousand mortality.[2] Acute coronary syndrome (ACS) as one of the most common cardiovascular diseases is classified as acute myocardial infarction and unstable angina pectoris.[3] Early diagnosis of cardiac ischemia is crucial for the effective management of acute myocardial infarction.[3,4]

The BASEL (Better Analysis of ST-segment Elevations and Depressions in a 12-Lead-ECG) Score provides independent information for the diagnosis of acute non-ST segment myocardial infarction

(NSTEMI) and unstable angina pectoris (UAP) based on ECG result which has been found to add diagnostic value to the established ECG criteria, hs-cTn, and full clinical assessment in emergency.[5]

Risk assessment in acute coronary syndrome includes the Global Registry of Acute Coronary Events (GRACE) and Synergy between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery (SYNTAX) scores. The GRACE score is a logistic predictive model to differentiate high- and low-risk acute coronary syndrome and the new GRACE 2.0 showed good predictive accuracy for 1-year and 3-year mortality rates of all spectrum of ACS.[7,8,9] While the SYNTAX score corresponds to the complexity of the lesion based on the characteristics of coronary branches, location, complexity, and the effect of the functional obstruction through angiography and has been updated to the new SYNTAX II score which predicts the 4-year mortality in patients with complex ACS.[10,11]

The BASEL score is thought to have diagnostic and prognostic value and is associated with the GRACE 2.0 and SYNTAX score to determine the choice of revascularization treatment. The authors aimed to evaluate the use of BASEL scores in NSTEMI and UAP patients to determine the severity of coronary lesions in association with GRACE 2.0 and SYNTAX scores.

METHODS

This is a hospital-based analytic observational study with a cross-sectional design. Data was collected retrospectively from the medical records of patients with acute non-ST segment elevation myocardial infarction and unstable angina pectoris admitted to Prof. Dr. RD Kandou Central General Hospital, Manado, between 1 January 2021 to 31 January 2022. Data collected includes demographic characteristics, medical history and risk factors, clinical examination, laboratory, radiology, ECG, echocardiography, and cardiac catheterization results. To avoid subjectivity and inter-observer variability, ECG interpretation was done by 2 different cardiologists.

The inclusion criteria were patients with APS and NSTEMI who underwent coronary angiography in our institution aged > 18 years old, who had no previous percutaneous coronary intervention or bypass surgery, in sinus rhythm, and with complete laboratory and cardiac catheterization results information.

The exclusion criteria were patients with secondary infection, HIV/AIDS, previous trauma, history of antipsychotic or antidepressant use, end-stage kidney disease with or without dialysis, had

anaphylactic or hypovolemic shock, history of malignancy, and history of digoxin or cardiac pacing use.

Categorical variables are presented as frequency and percentage while the concentration and distribution of numerical variables are presented according to the normality test as histogram, boxplot, density curve, or Shapiro Wilk normality test. Normally distributed data are presented as mean and standard deviation (SD) while abnormally distributed data are presented as median and interquartile range (IQR). The association between the BASEL score and SYNTAX score was analyzed using a logistic regression model or generalized linear model. The selection of variables for the final model using forward selection based on the Akaike's Information Criterion (AIC) and significance of each variable and the results are reported as estimates, 95% confidence interval (CI), and p-value. The discrimination rate for coronary lesion severity of BASEL score (compared to GRACE score) was determined using receiver operating characteristics (ROC) curve analysis, and the results are reported as sensitivity, specificity, and accuracy based on the optimal cut-off according to the J Youden Index. The area under the curve (AUC) of each predictor was compared using the DeLong method. Data analysis was done using the statistical software R version 4.0.5.

This study was conducted based on the Declaration of Helsinki 2008 and has received ethical clearance from the Ethical Committee of Prof. Dr. R. D. Kandou Central General Hospital, Manado.

RESULTS

A total of 90 patients with NSTEMI and UAP were included in the study. More than three-quarters of the patients were male (68 patients), while the mean age of patients was 60 years with a deviation of almost 10 years (Table 1). Mean body mass index (BMI) indicates overweight or obesity. The most common risk factor reported was hypertension (90%) which was confirmed by the median systolic blood pressure of 140 mmHg (median 50% distribution of 120-150 mmHg). One-fifth of the patients had previous heart failure and 10 (11%) had previous myocardial infarction episodes. The result of troponin-T, CK, and CK-MB were above the normal levels, as expected. The proportion of patients with NSTEMI was almost equal to those with UAP. Bypass surgery (CABG) was the preferred reperfusion therapy of most patients both standing alone or followed by PCI.

The median BASEL score was 2.3 with a median 50% distribution of between 1 to 4.2. GRACE score was distributed

symmetrically with a mean of 97.3 and 26 points variation. SYNTAX I score had a mean of 25, most patients had a score of >22 (moderate-severe coronary lesion) and 24 of them had a SYNTAX I score of ≥ 33. On SYNTAX II score – PCI analysis, the median score was higher which was 34.5, and more than half of the patients were with a score of ≥ 33. The mean of SYNTAX II score – CABG was almost equal to SYNTAX I which was 23.4 ± 11.9. More than half of the samples had a SYNTAX II score – CABG above 22, and 21 patients (24%) had a score of ≥33.

Figure 1 and Table 2 presented the visual evaluation and correlation analysis of the main variables of this study. Scatterplot and contour curve in general showed a relatively visual correlation between each pair, except for GRACE and SYNTAX I score, which is confirmed by the Pearson correlation coefficient for both variables in Table 2.

Table 3 presented the linear regression analysis of variables in the SYNTAX score. BASEL score was consistent in showing a positive correlation with SYNTAX score, except on the multivariate model of SYNTAX II – PCI. On the contrary, the GRACE score showed a positive correlation with all SYNTAX II scores but not with SYNTAX I. The second part of Table 3 presented the regression analysis with the SYNTAX score based on the severity of lesion or risk stratification. A SYNTAX score of >22 is categorized as a moderate-severe coronary lesion or risk, and a score of ≥33 as severe coronary lesion or high risk. BASEL score showed a significant correlation with the SYNTAX I score, both in univariate and multivariate analysis.

Figures 2, 3, and 4 presented the evaluation of the ability of BASEL and GRACE scores in the classification of coronary lesions according to SYNTAX score (SYNTAX I, SYNTAX II – PCI, and SYNTAX II – CABG). BASEL score appeared superior to the GRACE score for lesion classification based on SYNTAX I. However, for SYNTAX II – PCI, the discrimination rate of BASEL and GRACE scores was not dissimilar.

DISCUSSION

To our best knowledge, this study is the first one to evaluate the BASEL score and lesion severity using the SYNTAX II score. Of a total of 90 patients, 76% (68) were male with a mean age of 60 years. This result was similar to the data of coronary heart disease patients from the Ministry of Health of the Republic of Indonesia in 2015 which found that the majority were male and the most common age group was 45-64 years and second most was >65 years.[1] The most common risk factors reported were high BMI, hypertension, diabetes mellitus,

and smoking which is in accordance with the findings of the classic Framingham study as the risk factors for coronary heart disease.[2]

The median BASEL score was 2.3 with a median distribution of 50% between 1-4.2, in accordance with a study by Grim et al., which found a median BASEL score of 0.43 for those who survived and 2.23 for those who did not. The GRACE 2.0 score was distributed symmetrically with a mean of 97.3 and 26 points variation which is lower than in a study by Davidovic et al. The mean GRACE 2.0 score of NSTEMI and UAP patients in this study showed a higher score in more severe lesions.[11,12] GRACE 2.0 score was correlated with SYNTAX II score – CABG and SYNTAX II – PCI, but not with SYNTAX I, this result is in accordance with a study by Zafar et al., which found that GRACE 2.0 score was strongly correlated with SYNTAX score with an r-value of 0.8514.[9]

The SYNTAX I score had a mean of 25, with the majority of patients having a score of >22 (moderate-severe lesion) and 24 patients having a score of ≥33. SYNTAX II – PCI had a higher median score of 34.5 with more than half of the patients having a score ≥33. The mean SYNTAX II – CABG score was similar to those of SYNTAX I, which is 23.4 ± 11.9, and more than half of the patients had a SYNTAX II – CABG score >22, and 21 (24%) was ≥33, the proportion was similar to the distribution of SYNTAX I. This result was higher compared to a study by Escaned et al., which found the SYNTAX I score to be 22 ±8.7, SYNTAX II – PCI 30.6 ± 8.7, and SYNTAX – CABG 29.1 ± 9.6.[13]

A higher BASEL score in general increased the probability of a higher SYNTAX I score (more severe lesion or moderate-severe/severe lesion). Conversely, GRACE 2.0 score only showed a significant correlation in multivariate analysis for the outcome of SYNTAX II score – CABG. However, the OR was too close to 1, therefore it is hard to be extrapolated to the clinical context. In SYNTAX II score – CABG, BASEL score could only be used to predict a score of >22 but not for a score of ≥33. GRACE score could be used to predict both classifications but with a relatively low OR (1.08 and 1.09).

In the AUC, BASEL score appeared superior to GRACE 2.0 score for lesion classification according to SYNTAX I AUC Z 3.29, $p<0.001$ for SYNTAX ≥33 and AUC Z 3.72, $p<0.001$ for SYNTAX >22. However, for SYNTAX II – PCI, the classification ability of BASEL score and GRACE 2.0 score was not dissimilar with AUC Z 1.02, $p= 0.306$ for SYNTAX ≥33 and AUC Z 0.85, $p=0.393$ for SYNTAX

>22. It is expected that the BASEL score would be more correlated to the anatomical factor of the coronary lesion while the SYNTAX II score adds clinical factors in the calculation which made the discrimination rate of BASEL score not better than GRACE 2.0.

Prediction using machine learning and deep learning is a relatively new feature with increasing popularity BASEL score showed the best results regarding the anatomy of coronary artery in this study. Incorporating the BASEL score into prediction using machine learning is a promising system with a relatively low cost and can also be used to aid diagnosis in areas that did not have proper cardiac enzymes testing and aid the selection of puncture access for PCI and more aggressive treatment for patients with higher BASEL score (more severe lesion/ high risk).[5]

CONCLUSION

BASEL score showed a significant association with the SYNTAX I score. BASEL score has a better discrimination rate in determining the anatomical severity of lesion compared to the GRACE 2.0 score. A multicenter study is needed to further determine the discrimination rate of BASEL scores.

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Table 1. Characteristics of NSTEMI and UAP Patients in the Study (N=90)

Characteristics	n (%)	Mean ± SD	Med (Q_1-Q_3)
Gender			
Male	68 (76)	-	-
Female	22 (24)	-	-
Age	-	60.3 ± 9.8	-
BMI (kg/m^2)	-	25.6 ± 3.0	-
History of Risk Factors			
Smoking	54 (60)	-	-
Alcohol	18 (20)	-	-
DM- II	40 (44)	-	-
Hypertension	81 (90)	-	-
Dyslipidemia	53 (59)	-	-
Previous Heart Failure	19 (21)	-	-
Previous Myocardial Infarction	10 (11)	-	-
Heart rate	-	-	74.0 (68.0-88.0)
Systolic BP (mmHg)	-	-	136.5 (120.0-150.0)
Diastolic BP (mmHg)	-	78.2 ± 13.1	-
Hemoglobin (g/dL)	-	13.2 ± 2.0	-
Leukocyte (x10^3/µL)	-	9.3 ± 3.0	-
Platelet (x10^3/µL)	-	-	234.0 (193.2-281.8)
Urea (mg/dL)	-	-	32.0 (24.0-48.8)
Creatinine (mg/dL)	-	-	1.2 (0.9-1.6)
RBG (mg/dL)	-	-	125.5 (105.2-173.0)
FBG (mg/dL)	-	-	96.0 (81.2-120.0)
Uric acid (mg/dL)	-	7.3 ± 2.1	-
A1c (%)	-	-	6.3 (5.8-7.7)
LDL (mg/dL)	-	-	110.5 (87.0-139.8)
HDL (mg/dL)	-	-	38.0 (32.0-44.0)
Total Cholesterol (mg/dL)	-	184.0 ± 47.9	-
Triglyceride (mg/dL)	-	-	137.0 (107.5-176.5)
Albumin (mg/dL)	-	-	4.0 (3.7-4.2)
ALT (mg/dL)	-	-	25.0 (16.0-34.8)
AST (mg/dL)	-	-	28.0 (21.0-49.5)
Troponin-T (pg/mL)	-	-	80.5 (36.2-530.5)
CK	-	-	146.0 (85.0-276.5)
CKMB	-	-	25.5 (18.0-41.5)
Sodium (mmol/L)	-	-	137.0 (133.0-141.0)
Potassium (mmol/L)	-	-	4.2 (3.8-4.5)
Chloride (mmol/L)	-	100.0 ± 5.7	-
Chest X-ray			
Normal	54 (60)	-	-
Abnormal	36 (40)	-	-
Ejection Fraction	-	51.5 ± 12.6	-
Treatment Preference			
None	6 (7)	-	-
CABG	46 (52)	-	-
CABG/PCI	33 (38)	-	-
PCI	1 (1)	-	-
PCI/CABG	2 (2)	-	-

Diagnosis			
NSTEMI	52 (58)	-	-
UAP	38 (42)	-	-
BASEL	-	-	2.3 (1.0-4.2)
GRACE	-	97.3 ± 26.0	-
SYNTAX I	-	25.0 ± 15.6	-
>22	51 (58)	-	-
≥33	24 (27)	-	-
SYNTAX II – PCI	-	-	34.5 (25.9-42.4)
>22	74 (84)	-	-
≥33	45 (51)	-	-
SYNTAX II – CABG	-	23.4 ± 11.9	-
>22	48 (55)	-	-
≥33	21 (24)	-	-

Note: SD, standard deviation; Q_1, quartile I; Q_3, quartile III, BMI, body mass index; ALT, alanine aminotransferase; AST, aspartate aminotransferase; RBG, random blood glucose; FBG, fasting blood glucose; LDL, low-density lipoprotein; HDL, high-density lipoprotein.

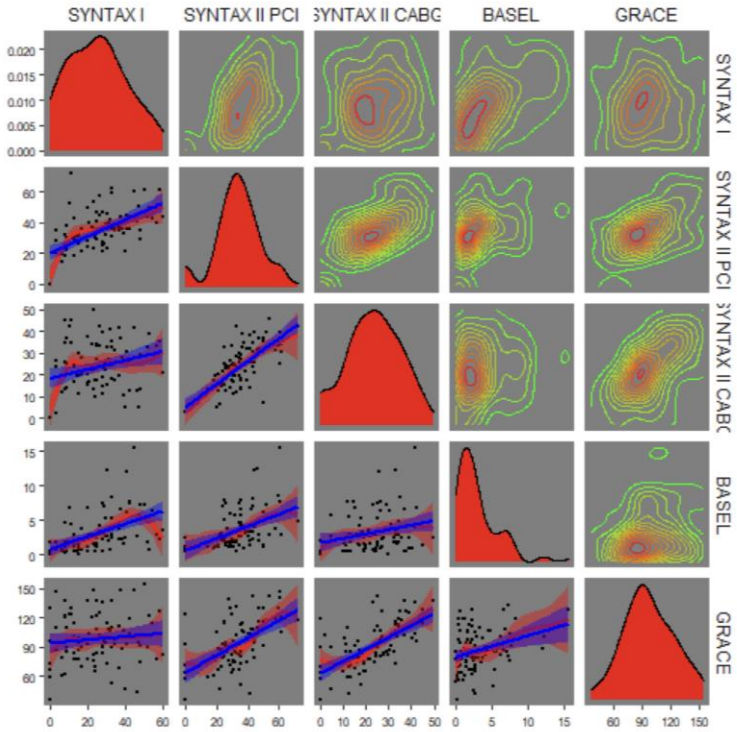


Figure 1. Scatterplot Matrix and Contour Curve between SYNTAX, BASEL, and GRACE Scores

Table 2. Matrix of Pearson Correlation Coefficient between SYNTAX, BASEL, and GRACE Scores. Numbers in **Bold** indicate p< 0.05

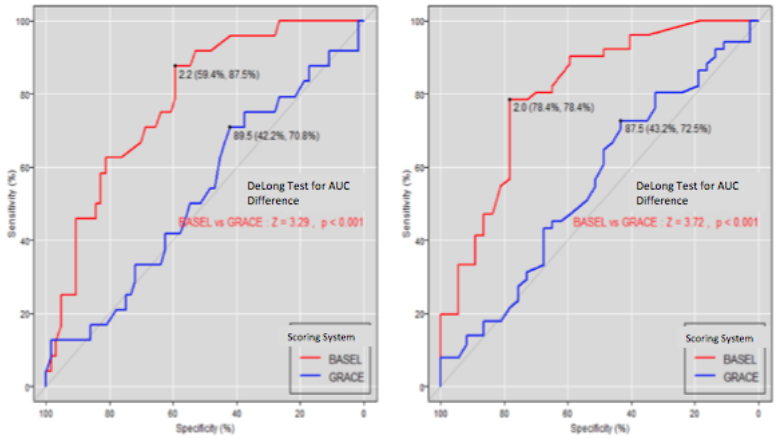
	SYNTAX II – PCI	SYNTAX II – CABG	BASEL	GRACE
SYNTAX I	**0.580**	**0.272**	**0.488**	0.099
SYNTAX II-PCI		**0.736**	**0.451**	**0.541**
SYNTAX II-CABG			**0.260**	**0.629**
BASEL				**0.292**

Table 3. Linear and Logistic Regression Model of The Correlation Between SYNTAX Score (Outcome) with BASEL and GRACE Scores (Predictor)

Variables	Univariate		Multivariate	
	β (95% CI)	p	β (95% CI)	p
Outcome: SYNTAX I				
BASEL	2.60 (1.60-3.59)	<0.001	2.16 (0.99-3.34)	0.001
GRACE	0.06 (-0.07-0.19)	0.359	-0.11 (-0.23-0.01)	0.083
Outcome: SYNTAX II-PCI				
BASEL	2.24 (1.29-3.19)	<0.001	0.72 (-0.08-1.53)	0.083
GRACE	0.30 (0.20-0.41)	<0.001	0.14 (0.02-0.26)	0.027
Outcome: SYNTAX II-CABG				
BASEL	1.06 (0.22-1.90)	0.014	0.88 (0.42-1.34)	<0.001
GRACE	0.29 (0.21-0.37)	<0.001	0.16 (0.08-0.25)	<0.001
	Univariate		Multivariate	
	OR (95% CI)	p	OR (95% CI)	p
Outcome: SYNTAX I > 22				
BASEL	1.74 (1.29-2.34)	<0.001	1.73 (1.28-2.34)	<0.001
GRACE	1.01 (0.99-1.02)	0.378	-	
Outcome: SYNTAX I ≥ 33				
BASEL	1.40 (1.15-1.70)	0.001	1.38 (1.13-1.69)	0.002
GRACE	1.00 (0.98-1.02)	0.719	-	
Outcome: SYNTAX II-PCI >22				
BASEL	3.79 (1.62-8.86)	0.002	5.72 (0.90-36.12)	0.064
GRACE	1.05 (1.02-1.08)	0.002	-	
	Univariate		Multivariate	
	β (95% CI)	p	β (95% CI)	p
Outcome: SYNTAX II-PCI ≥33				
BASEL	1.53 (1.20-1.95)	0.001	-	
GRACE	1.03 (1.01-1.05)	0.003	0.90 (0.84-0.98)	0.015
Outcome: SYNTAX II-CABG >22				
BASEL	1.22 (1.02-1.46)	0.031	-	
GRACE	1.09 (1.05-1.12)	<0.001	-	

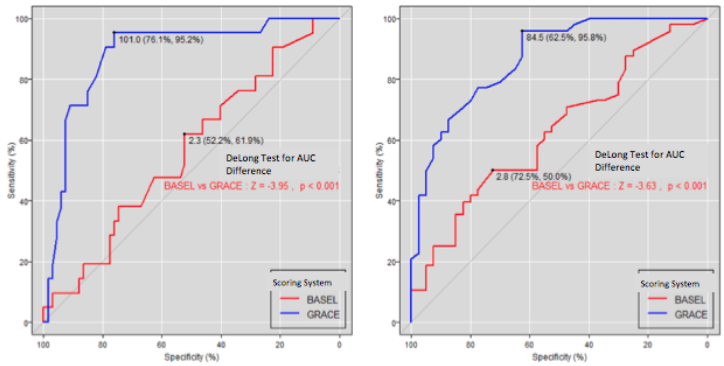
Outcome: SYNTAX II-CABG ≥33			
BASEL	1.07 (0.92-1.26)	0.377	-
GRACE	1.08 (1.04-1.11)	<0.001	-

Note: OR, odds ratio; CI, confidence interval.



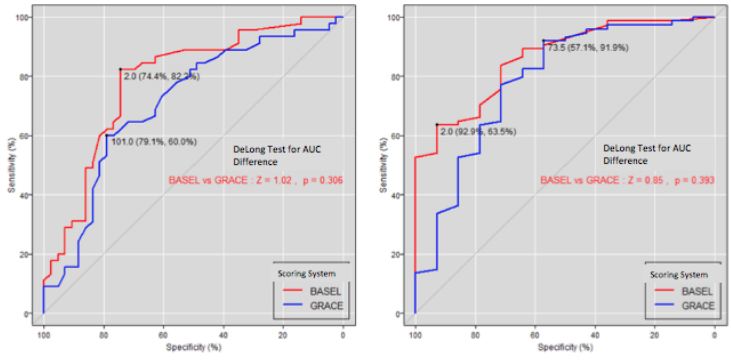
(I) SYNTAX ≥ 33 (II) SYNTAX > 22

Figure 2. Receiver Operating Characteristics Curve for The Discrimination Rate of Coronary Lesion Severity According to SYNTAX I Score



(I) SYNTAX ≥ 33 (II) SYNTAX > 22

Figure 3. Receiver Operating Characteristics Curve for The Discrimination Rate of Coronary Lesion Severity According to SYNTAX II – CABG



(I) SYNTAX ≥ 33 (II) SYNTAX > 22

Figure 4. Receiver Operating Characteristics Curve for The Discrimination Rate of Coronary Lesion Severity According to SYNTAX II – PCI