Aortic knob calcification and coronary artery lesion complexity in non-ST-segment elevation acute coronary syndrome patients

ST-segment yükselmesi olmayan akut koroner sendromlu hastalarda aort topuzu kalsifikasyonu ile koroner lezyonunun kompleksliği arasında ilişki

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ABSTRACT

Objectives: Coronary artery lesion complexity is important for risk stratification of acute coronary syndrome (ACS) patients undergoing cardiac catheterization. SYNTAX score is a pure angiographic measure of anatomic coronary complexity. Chest radiography is a routine examination for evaluating patients with chest pain. There have been no studies to date exploring the relation between aortic knob calcification (AKC) and coronary lesion complexity assessed by SYNTAX score.

Study design: 135 consecutive patients with first time diagnosis of non-ST segment elevation ACS were enrolled. SYNTAX score was calculated by dedicated computer software. Aortic calcification was assessed visually.

Results: Patients with AKC had higher SYNTAX score compared to those without AKC (16±6 *vs.* 11±7, p=0.019). Also, patients with AKC had higher TIMI risk score and were more elderly. Linear regression analysis demonstrated AKC (95% confidence interval [CI] 1.7-6.9, p=0.002), diabetes (95% CI, 1.1-5.7, p=0.005), and smoking (95% CI, 1.2-13.5, p=0.004) as independent determinants of SYNTAX score.

Conclusion: Aortic calcification detected on chest X-ray is an independent predictor of complex coronary artery lesions in patients with ACS.

ÖZET

Amaç: Koroner arter lezyonunun kompleksliği akut koroner sendromlu (AKS) hastalarda risk katmanlaması için önemlidir. SYNTAX skoru koroner anatominin kompleksliğini gösteren bir parametredir. Akciğer grafisi göğüs ağrısı olan hastaların değerlendirilmesinde rutin olarak yapılan bir incelemedir. Teleradyografide aort topuzu kalsifikasyonu (ATK) ile koroner lezyon kompleksliği arasındaki ilişkiyi inceleyen herhangi bir SYNTAX skoru çalışması yoktur.

Çalışma planı: Çalışmaya ST-yükselmesi olmayan AKS tanısıyla başvuran ardışık 135 hasta alındı. SYNTAX skoru bilgisayar programı ile hesaplandı. ATK akciğer grafisinde değerlendirildi.

Bulgular: SYNTAX skoru ATK'si olanlarda olmayanlara göre daha yüksek idi (16±6 ve 11±7, p=0.019). Ayrıca ATK'si olan hastaların TIMI risk skoru daha yüksek ve yaşları daha ileri idi. Lineer regresyon analizinde ATK (%95 Güven Aralığı [GA] 1.7-6.9, p=0.002) diyabet (%95 GA, 1.1-5.7, p=0.005) ve sigara içimi (%95 GA, 1.2-13.5, p=0.004) SYNTAX skorunun bağımsız öngördürücüleri idi.

Sonuç: Akciğer grafisinde ATK'nin varlığı AKS'li hastalarda kompleks koroner lezyonlarının bağımsız bir öngördürücüsüdür.

Identification of acute coronary syndrome (ACS) patients with higher cardiovascular risk is important in estimating the prognosis and triage of these patients. Current risk scores are based on clinical, biochemical, and/or electrocardiographic variables.[1,2] Beyond the known clinical and laboratory predictors, baseline angiographic markers of disease burden, calcification, lesion severity and morphological characteristics have important independent predictive value for 30-day and 1-year ischemic outcomes in ACS patients.[3]

The SYNTAX score is a comprehensive angiographic scoring system that is derived entirely from the coronary anatomy and lesion characteristics.[4-6]

Chest radiography is routinely ordered during emergency evaluations of patients with suspected myocardial angina to screen for other causes of undifferentiated chest pain such as pneumothorax, aortic dissection, abdominal free air, or pneumonia. Recently, it has been shown that aortic knob calcification (AKC) assessed on chest radiography is closely related to significant coronary artery stenosis and is a reliable predictor of multivessel coronary artery disease in patients with unstable angina.[7] However, thus far, no study has examined the association between AKC and coronary lesion complexity determined by SYNTAX score. Therefore, the main purpose of the present study was to investigate the relationship between AKC and coronary artery lesions complexity in non-ST segment elevation acute coronary syndomes (NSTE-ACS).

PATIENTS AND METHODS

Patients

Consecutive patients with first time diagnosis of NSTE-ACS undergoing coronary angiography and intervention were enrolled into the study. NSTE-ACS was diagnosed when an elevation of troponin T level (>0.01 ng/mL in any sample during the admission) and/or a typical CKMB curve occurred, with or without ST/T changes in the ECG, in the absence of any other demonstrable cause for the chest pain. None of the patients had a history of cardiovascvular events or coronary revascularization. In our institute, chest X-ray is routinely ordered and SYNTAX score is calculated for every ACS patients undergoing coronary revascularization. Thus, we did not apply for a statement of patient consent or the approval of Internal Review Boards.

Patients with a history of myocardial infarction, valvular disease, acute or chronic heart failure, cardiomyopathy, systolic dysfunction, ejection fraction <50%, known or suspected infectious or inflammatory conditions, need of urgent coronary angiography and intervention, renal, hepatic, or neoplastic diseases were excluded. Patients with ST-elevations on admission ECG, new left bundle branch block or new Q waves on the evolution of ECG were also excluded from the study. Moreover, we excluded patients whose chest X-ray was not properly centered, if there was any deviation of the trachea or shift of the mediastinum, and if there was any known disease in the aorta such as aortitis.

Coronary angiography and SYNTAX score

Coronary angiography was performed by the Judkins technique and analyzed by two experienced observers. Each angiogram was analyzed independently by two experienced interventional cardiologists who were blinded to the patients clinical data. In cases of disagreement, the decision of a third observer was obtained and the final decision was made by consensus. Each coronary lesion producing 50% diameter stenosis in vessels greater than 1.5 mm was scored separately and added together to provide the overall SYNTAX score, which was calculated prospectively using the SYNTAX score algorithm.[6]

Assessment of aortic knob calcification

All patients underwent a chest radiography in the posteroanterior (PA) view. An examiner who was unaware of the clinical and angiographic data reviewed the chest radiography. Patients with small spots or a single thin area of calcification are considered to have AKC (Fig. 1).
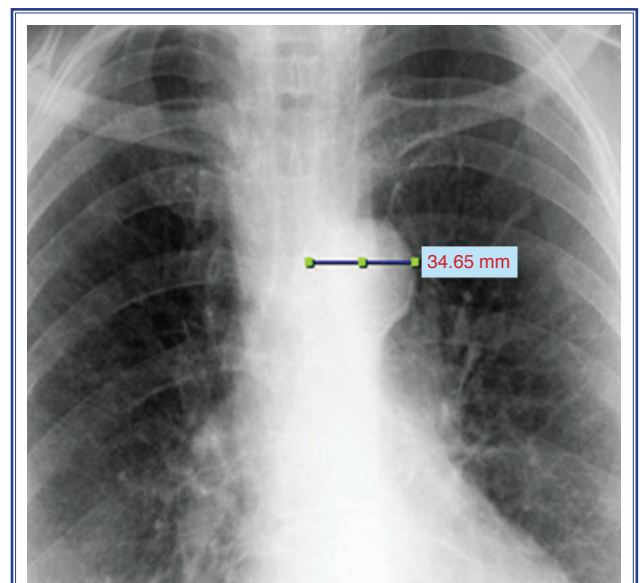

Figure 1. Measurement of aortic knob.

Table 1. Baseline charactheristics of study population

	n	%	Mean±SD
Age (years)			62±11
Gender (male)	95	70	
BMI (kg/m²)			27±3.3
Dyslipidemia	78	57	
Diabetes mellitus	56	41	
Smoking	64	47	
Hypertension	73	54	
Presence of AKC	74	55	
SYNTAX Score			14±7
TIMI risk score			3.6±0.9
TIMI (0-2)	16	12	
TIMI (3-4)	74	55	
TIMI (5-7)	45	33	
Number of diseased vessel			
One vessel	54	40	
Two vessels	46	34	
Three vessels	35	26	

BMI: Body mass index; AKC: Aortic knob calcification;
TIMI: Thrombolysis in myocardial infarction.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables were expressed as a percentage. An analysis of normality of the continuous variables was performed with the Kolmogorov-Smirnov test. Student's t-test and the Mann-Whitney U-test were used in order to compare continuous variables between groups. Categorical variables were compared by chi-square test. Linear regression analysis was done to determine independent predictors of AKC. Variables with a *p* value <0.1 for correlation with AKC were added to the multiple linear regression analysis. Statistical analysis was performed using SPSS for Windows 14.0 and a *p* value ≤0.05 was considered statistically significant.

RESULTS

Clinical and laboratory characteristics of the study population are reported in Table 1. AKC was detected in 74 patients (55%). Patients with AKC had higher SYNTAX score compared to those without AKC (16±6 *vs.* 11±7, p=0.019) (Table 2). Also, patients with AKC had higher TIMI risk score and were older.

There was a statistically significant correlation between SYNTAX score and age (r=0.35, p<0.001), diabetes (r=0.24, p=0.005), smoking (r=0.31, p<0.001), and AKC (r=0.36, p<0.001) (Table 3). Linear regression analysis demonstrated AKC (95% confidence interval [CI] 1.7-6.9, p=0.002), diabetes (95% CI, 1.1-5.7, p=0.005) and smoking (95% CI, 1.2-13.5, p=0.004) as independent determinants of SYNTAX score (Table 3).

Table 2. Comparison of study population

	AKC (−) (n=61)			AKC (+) (n=74)			p
	n	%	Mean±SD	n	%	Mean±SD	
Age (years)			56±10			66±9	**<0.001**
Gender (male)	43	71		52	70		0.37
BMI (kg/m²)			27±4.1			27±3.7	0.42
Dyslipidemia	38	62		40	54		0.33
Diabetes mellitus	21	34		35	47		0.13
Smoking	30	49		34	46		0.08
Hypertension	31	51		42	57		0.72
SYNTAX score			11±7			16±7	**0.01**
TIMI risk score			3.3±0.9			3.9±0.8	**0.02**
Number of diseased vessel			1.7±0.8			2±0.8	0.26

AKC: Aortic knob calcification; BMI: Body mass index; TIMI: Thrombolysis in myocardial infarction.

Table 3. Correlation and linear regression analysis of variables and SYNTAX score

	r	*p*	β	*p*	95% CI
Age	0.35	<0.001	0.11	0.08	-0.1–0.23
Gender (male)	0.09	0.11	–	–	–
Dyslipidemia	0.1	0.24	–	–	–
Diabetes mellitus	0.24	0.005	0.23	0.005	1.1–5.7
Smoking	0.31	<0.001	0.22	0.004	1.2–13.5
Hypertension	0.07	0.4	–	–	–
TIMI risk score	0.04	0.7	–	–	–
AKC	0.36	<0.001	0.28	0.002	1.7–6.9

CI: Confidence interval; AKC: Aortic knob calcification.

DISCUSSION

In the present study, we have demonstrated an independent and significant association between AKC and coronary artery lesion complexity. Another important finding is that a well known risk stratification marker, TIMI risk score, could not provide predictive information on coronary lesion complexity in our analysis.

The SYNTAX score is widely accepted as a CAD complexity marker and its prognostic value has been demonstrated in a variety of different clinical situations. Patients with the highest tertile SYNTAX score experience significantly more major adverse cardiac events (MACEs).[8-10] Wykrzykowska et al.[11] demonstrated the independent predictive value of SYNTAX score for MACEs and mortality not only in selected patient groups, but also in all CAD treated by percutaneous coronary intervention (PCI). Moreover, SYNTAX score has a role in the risk stratification of patients with STEMI having primary PCI and is a useful tool that provides additional risk stratification according to known risk factors of long-term mortality and MACEs.[11,12] The clinical significance of SYNTAX score also has been shown in NSTE patients with ACS.[13] Patients with higher SYNTAX score had increased rates of all-cause mortality, cardiac mortality, and myocardial infarction both within the first 30 days after PCI and between 30 days and 1 year. These early and late MACEs in patients with higher SYNTAX score may be due to the increased periprocedural risks associated with complex lesions and diffuse atherosclerosis.

The aortic knob is a radiographic structure that is formed by the foreshortened aortic arch and a portion of the descending aorta. Aortic calcification has an underlying atherosclerosis process and calcification in extracoronary arterial beds indicates the extent of atherosclerotic lesions.[14-17] Also, extracoronary calcification is associated with increased risk of cardiovascular events.[18-20] AKC is one form of extracoronary arterial calcification and its detection on chest X-ray increases risk for CAD.[21] Also, AKC is an independent predictor of cardiovascular events beyond traditional cardiovascular risk factors.[22] Yun et al.[7] demonstrated the positive predictive value of AKC as a marker of significant and multi-vessel coronary artery stenosis in unstable angina pectoris patients. Although there have been no studies comparing different scores in terms of coronary lesion complexity that take into account lesion properties such as bifurcation or trifucation, lesion length, severe angulation and calcification, thrombus, or vessel diameter, some previously used classification systems may be too simplistic in comparison to the detailed analysis summarized by the SYNTAX score.

Limitations

Our study has several limitations. First of all, the study population is relatively small. Also, we excluded patients with previous CAD or having any coronary revascularization. Moreover, we included only those who underwent coronary catheterization and subsequent revascularisation. Therefore, our study cannot represent the entire ACS population. Another important limitation is the cross-sectional study design, which prevents us from determining whether patients with higher SYNTAX score face increased MACE incidence in short and long term of follow-up. Moreover, we did not quantify AKC, not only because

of the small size of study population and its dependence on the operator, but also with the aim of simple and easy evaluation of the aortic knob.

In conclusion, evaluation of chest radiographs for AKC adds no cost and is exceptionally simple. Our preliminary findings may give further utility to the chest radiograph as a screening examination and, if confirmed, could assist risk stratification in patients with ACS.

Conflict-of-interest issues regarding the authorship or article: None declared

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