



2020

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Recommended Citation

Abdelnabi, Mahmoud; Almaghraby, Abdallah; Tok, Ozge O.; Oz, Tugba K.; Saleh, Yehia; Morsi, Ahmed; and Badran, Hiatham (2020) "A real-life correlation between clinical syntax score II and carotid intima-media thickness in patients with stable coronary artery disease," *Journal of the Saudi Heart Association*: Vol. 32 : Iss. 1 , Article 3.

Available at: <https://doi.org/10.37616/2212-5043.1002>

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A real-life correlation between clinical SYNTAX score II and carotid intima-media thickness in patients with stable coronary artery disease

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Abstract

Background: SYNTAX score II (SSII) is an update of the established SYNTAX score (SS) that uses clinical variables such as age, sex, creatinine clearance, left ventricular ejection fraction, chronic obstructive pulmonary disease, and peripheral arterial disease. Furthermore, SSII has been proven to be a more powerful predictive tool than SS in patients with complex coronary artery disease (CAD). Carotid intima-media thickness (CIMT) is a widely used noninvasive evidence for subclinical or early atherosclerosis, and it was proved to be an independent predictor for cardiovascular events. Most of the previously published articles studied the association between the CIMT with old cardiovascular scoring systems such as SSI and Gensini score with debatable data about their correlation.

Aim: To study the correlation between SSII and CIMT in stable CAD patients undergoing elective coronary angiography (CA).

Method and patients: A prospective study including 155 patients undergoing elective CA for stable CAD excluding patients with history of acute coronary syndrome, previous coronary revascularization either by percutaneous coronary intervention or coronary artery bypass grafting, and previous cerebrovascular stroke.

Results: The mean age of patients was 58.25 ± 16.46 years, and 79 patients (50.96%) were men. The mean SSII score was 10.23 ± 11.36 and mean CIMT was 0.85 ± 0.24 . The correlation between SSII and CIMT using Spearman correlation showed a strong correlation between SSII score and CIMT with correlation coefficient $r = 0.752$.

Conclusion: The study showed a strong positive correlation between SSII and CIMT in stable CAD patients undergoing elective CA.

Keywords: Carotid artery, Carotid intima-media thickness, Cardiovascular events, Coronary angiogram, Coronary artery disease, Correlation, SYNTAX score II, Ultrasound

1. Introduction

SYNTAX score II (SSII) is an update of the established SYNTAX score (SS) that uses clinical variables such as age, sex, creatinine

clearance, left ventricular ejection fraction, chronic obstructive pulmonary disease, and peripheral arterial disease. Additionally, it is now already proven that SSII is a more powerful predictive tool than SS. Carotid intima-media

Received 9 September 2019; revised 17 October 2019; accepted 20 October 2019.
Available online 17 April 2020

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thickness (CIMT) measurement via ultrasound is one of the most widely used and best validated atherosclerosis imaging techniques. It is very feasible, widely available, and highly reproducible. CIMT is also proven to be an independent predictor for cardiovascular events.

Most of the previously published articles studied the association between CIMT with old cardiovascular scoring systems such as SSI and Gensini score with debatable data about their correlation.

The study aimed to determine the correlation between the anatomical severity of coronary artery disease (CAD) and the patient's clinical factors using SSII and the carotid artery stenosis using CIMT measurement.

2. Methods

2.1. Patients

A prospective analysis of the data of 155 consecutive patients undergoing elective coronary angiography (CA) on top of chronic stable angina was performed. Patients with a history of acute coronary syndrome, previous coronary revascularization either by percutaneous coronary intervention or coronary artery bypass grafting, and previous cerebrovascular stroke were excluded from the study. Thoughtful history taking, clinical examination, electrocardiography, and transthoracic echocardiography were done.

This study was approved by our local ethical committee.

2.2. SSII score calculation

All CA data were analyzed by two cardiologists who were blinded to the patient's CIMT values. Based on the angiogram, each coronary lesion producing $\geq 50\%$ diameter stenosis was scored, and these scores were combined with patient's clinical data to provide the overall SSII score, which was calculated using the SSII score algorithm.

2.3. Carotid ultrasonography (CIMT measurement)

Carotid ultrasonography was performed with Philips CX50 machine linear probe. Patients were examined in the supine position with the head tilted backward. The maximum CIMT was measured manually at the near and far walls of the common carotid artery parallel to the transducer beam, and the lumen diameter was maximized in the longitudinal plane. In order to maximize reproducibility, both carotids were assessed as well as taking the

Abbreviations

SSII	Syntax Score II
CIMT	Carotid Intima-Media Thickness
CAD	coronary artery disease
CA	Coronary angiography
PCI	percutaneous coronary intervention
CABG	Coronary artery bypass grafting
CVS	Cerebrovascular stroke
ABI	Ankle brachial index

smallest and largest measurements. All measurements were performed by the same investigator who was blinded to clinical and angiographic data.

2.4. Statistical analysis

Statistical analyses were performed with SPSS version 15 (SPSS Inc., Chicago, IL, USA). Data were expressed as mean values \pm standard deviation or n (%). Linear correlations between different quantitative variables were evaluated by Spearman correlation coefficient. A p value < 0.05 was considered significant.

3. Results

3.1. Baseline clinical and demographic data

A total number of 155 patients with stable CAD undergoing elective CA were studied. The baseline demographic, clinical, laboratory, and SSII/CIMT score are shown in Table 1. The mean age of the

Table 1. Baseline demographic, clinical, laboratory and SYNTAX II/CIMT data ($n = 155$).

		$n = 155$
Total eligible		$n = 155$
Age (yr)		58.25 (± 16.46)
Sex (male)		79 (50.96)
Risk factors	Hypertension	108 (69.68)
	Diabetes mellitus	52 (33.55)
	Smoking	67 (43.23)
	Dyslipidemia	10 (6.45)
	Chronic kidney disease	9 (5.81)
	Family history	4 (2.58)
	Peripheral arterial disease	1 (0.65)
	Thrombophilia	0 (0)
Laboratory data	Hemoglobin (g/dL)	11.7 (± 1.83)
	White cell count ($10^9/L$)	8.5 (± 2.2)
	Platelet count ($10^3/L$)	264 (± 43)
	Creatinine (mg/dL)	1.05 (± 0.23)
	INR	1.03 (± 0.1)
SYNTAX & CIMT	SYNTAX II	10.23 (± 11.36)
	CIMT	0.85 (± 0.24)

Data is presented as n (%) or mean (\pm standard deviation). CIMT = carotid intima-media thickness; INR = international normalized ratio.

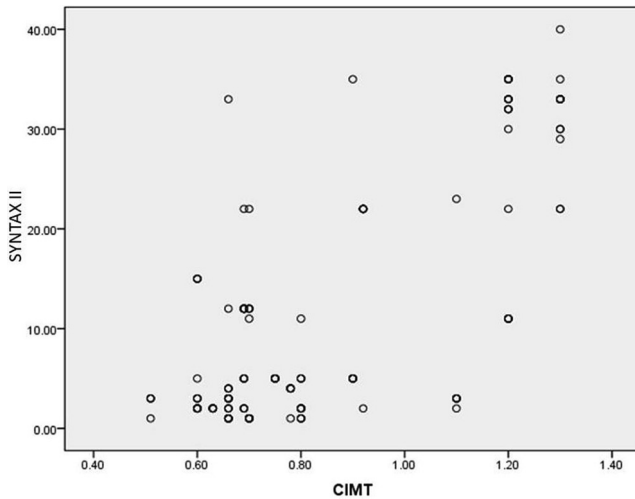


Fig. 1. Correlation between the SSII and CIMT ($r=0.752$). CIMT = carotid intima-media thickness; SSII = SYNTAX score II.

studied population was 58.25 ± 16.46 years and 79 patients (50.96%) were men. The mean SSII score was 10.23 ± 11.36 and mean CIMT was 0.85 ± 0.24 .

3.2. Correlation between SSII and CIMT

The correlation between SS, SSII and CIMT using Pearson correlation showed a strong positive correlation coefficient of $r=0.646$ and $r=0.752$ (Fig. 1), respectively. In addition, there was no significant difference in the correlation coefficient of SSII and CIMT between both sexes (males $r=0.788$, females $r=0.728$; Figs. 2 and 3).

4. Discussion

The correlation between CAD risk factors (age, hypertension, diabetes, dyslipidemia, and smoking)

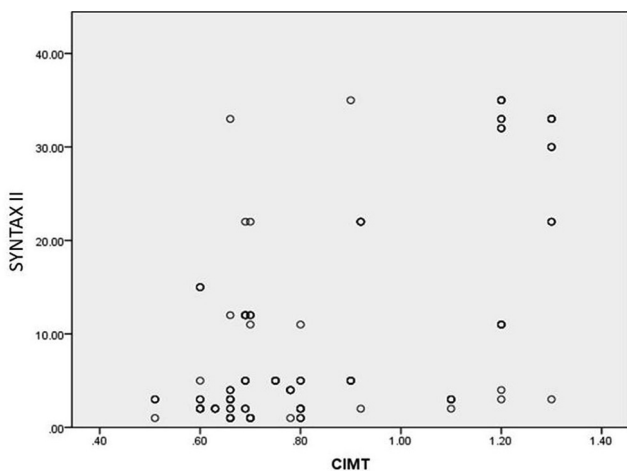


Fig. 2. Correlation between the SSII and CIMT in males ($r=0.788$). CIMT = carotid intima-media thickness; SSII = SYNTAX score II.

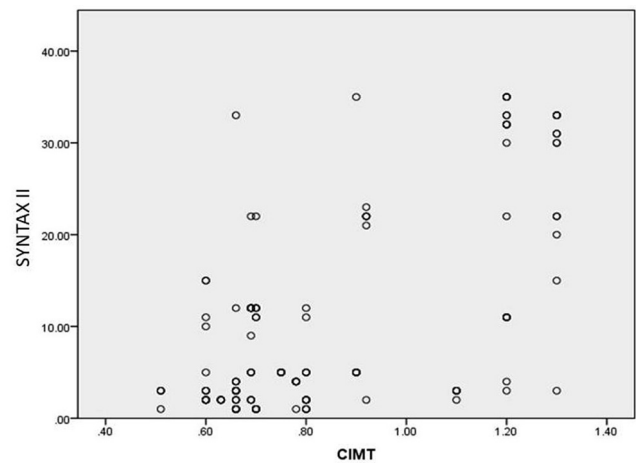


Fig. 3. Correlation between the SSII and CIMT in females ($r=0.728$). CIMT = carotid intima-media thickness; SSII = SYNTAX score II.

and CIMT has been well established in several trials. However, the correlation between CAD complexity and CIMT is not well established. Various studies looked into the association between CIMT and traditional risk scoring systems such as “Gensini” or “SSI”; there has been always an ongoing debate about this relationship though. In this prospective study, we studied the correlation between the anatomical severity of CAD and patient’s clinical factors using SSII and the carotid artery stenosis using CIMT measurement in stable CAD patients who underwent elective CA. This was the first study in the literature to elucidate this association clearly using SSII score.

The main finding of our study was that it showed a strong positive correlation between SSII score which reflects the complexity of CAD as well as patient’s clinical factors with CIMT, which is a noninvasive and trustworthy parameter proven to be closely related to carotid atherosclerosis. The relationship between complex CAD and carotid artery disease has been suggested and investigated in many studies previously. Comparison between the results indicates some similarities and differences as well.

In accordance with our study, Bryniarski et al [1] have shown that CIMT is positively correlated with SS. Additionally, they investigated the relationship of ankle-brachial index (ABI) with SS and found a negative correlation between ABI and SS. They found that combining both CIMT and ABI in patients with myocardial infarction is also feasible to predict the SS, and CIMT is a better predictor of the SS than ABI [1].

In a similar study, Saito et al. [2] have demonstrated a significant relationship between complex carotid plaques and complex CAD in a relatively small number of patients. There was a statistically significant association between CIMT and SS indicating that CIMT may be considered a reliable parameter for prediction of the SS in CAD patients [2].

Ikeda et al [3] have depicted overall SS as 8.1 ± 14.4 and CIMT as 0.86 ± 0.23 . Although their SS is lower than the SS that we reported, they found a significant relationship between SS and CIMT in line with our study with Spearman's rank correlation coefficient of 0.442 [3].

By contrast, there are some contrary studies in the literature. Costanzo et al [4] have shown the high prevalence of carotid lesions in patients with complex CAD; whilst SS did not seem to correlate with carotid atherosclerosis, they established their work on 204 consecutive patients with established multivessel CAD and divided them into three groups according to SYNTAX: < 14 , from 15 to 24, and ≥ 25 ; then, they found nonsignificant difference of the three groups in correlation with CIMT, $p = 0.38$ [4].

As a completely different result from our study, Saedi et al. [5] conducted their work on 100 consecutive patients with CAD and found no relationship between CIMT and SS in patients who underwent CA ($r = 0.103$, $p = 0.3$), but diabetes mellitus and hypertension were found to be related to increased CIMT [5]. Overall, there are various studies with different results in the literature investigating the relationship between carotid stenosis and the old SS. Many of them have shown that carotid ultrasound may predict prognosis and the risk of cardiovascular events [6,7].

In our study, we showed positive correlation of CIMT with SS and SSII. We specifically added SSII in our study to take patient factors into consideration as SSII takes into account not only the coronary anatomy like SSI but also the cardiovascular risk factors. The positive correlation with SSII makes the CIMT a more reliable and predictive test of CAD since SSII is more validated than the anatomical SS. Given the positive correlation in our study, CIMT is a simple, noninvasive test with a good potential of becoming a good indicator of the complexity of CAD in selected patients. Therefore, further research on the topic will be meaningful.

Nonetheless, these results must be interpreted with caution and a number of limitations should be borne in mind. First, this study regrettably consisted of a relatively small sample size. Second, the

average SSII of the included patients was relatively low. Further studies with a larger number of patients having a higher SSII score on average will be definitely supportive to this study to enlighten our hypothesis. Third, as the patients recruited in our study were likely to have ischemic heart disease, these patients have a relatively higher risk than the normal healthy population; thus, it is not clear whether our results will be useful in screening the general asymptomatic population.

5. Conclusion

In conclusion, the current study showed that the combination of the anatomical complexity of CAD and patient's clinical factors using SSII score has a strong correlation with carotid stenosis assessed by CIMT. It can be presumed that increased CIMT might reflect the complexity of CAD. Given the negative impact of atherosclerosis and coronary artery complexity on cardiovascular events, further studies are needed to confirm that CIMT can be used as a screening test for complex CAD.

Conflict of interest

The authors declare no conflict of interest.

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