Correlation between ankle–brachial index, wall motion score index, and SYNTAX score in acute coronary syndrome patients

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Abstract

Background: Ankle–brachial index (ABI) is a noninvasive and cheap measurement that is used to define peripheral arterial disease (PAD). It is used as a marker to predict coronary artery disease (CAD). The SYNTAX score was created to quantify the extent of CAD in patients with multivessel disease. Two-dimensional transthoracic echocardiography (TTE) is a useful method for evaluating left ventricular (LV) volumes and ejection fraction (EF) in CAD patients.

The aim of the study is to find the relationship between ABI and wall motion score index (WMSI) in order to better predict the severity of CAD.

Patients and Methods: One hundred and twenty-five CAD patients were evaluated by echocardiography to calculate WMSI before they underwent coronary angiography to assess the SYNTAX score. ABI measurement was done.

Results: The study included 54.4% males with a mean age of 55.11 years. Nearly half of them had ST-segment elevation myocardial infarction (STEMI). There was a negative correlation between the SYNTAX score and AKI, a positive correlation between the SYNTAX score and WMSI, and a negative correlation between WMSI and ABI. Predictors of high SYNTAX were ABI <0.9, low left ventricular ejection fraction (LVEF), high WMSI, and multivessel coronary artery affection.

Conclusion: ABI is a noninvasive test that could predict the severity of CAD. WMSI is an echocardiographic parameter that could be used as an indicator of CAD severity. Combining both ABI and WMSI could help in predicting complex CAD better.

Keywords

Ankle–brachial index, Wall motion score index, SYNTAX score, Acute coronary syndrome.

Introduction

Coronary artery disease (CAD) is one of the cardiac diseases that affect a wide section of our population. According to the latest World Health Organization (WHO) data published in 2018, coronary heart disease deaths in Egypt reached 163,171 (29.38%) of the total deaths. The age-adjusted death rate is 271.69 per 100,000 of the population, and Egypt ranks 15th in the world in CAD incidence [1]. So, every effort should be made to discover early, better risk stratify, and properly treat CAD patients. There are many invasive and noninvasive tests to diagnose and predict CAD severity. In 2006, the SYNTAX score was created to objectively assess the extension and severity of CAD in patients with multivessel disease. Further improvement in the accuracy of risk stratification was observed with detailed physiologic analysis recalculating the SYNTAX score based on the functional component of the lesions. The SYNTAX score is the most widely used angiographic score because it can guide the most appropriate type of revascularization (percutaneous or surgical) for each individual. Also, it provides prognostic information for follow-up after revascularization [2].

Peripheral arterial disease (PAD) affects more than 200 million patients worldwide. Data from the National Health and Nutrition Examination Survey found at least one traditional cardiovascular (CV) risk factor, such as smoking, diabetes mellitus, hypertension, and dyslipidemia, in more than 95% of patients with PAD, while more than 70% had two or more risk factors [3]. As atherosclerosis is a systemic disease and the most common underlying anatomic milieu for both CAD and PAD, it is not strange that many patients with CAD have PAD as well, with the prevalence being 22%–42% [4], whereas within the general population, the prevalence of PAD is much lower.

Ankle–brachial index (ABI) is a noninvasive and inexpensive measurement used to suspect PAD. Compared with invasive angiography, it has high sensitivity and specificity (>90% for each) [5]. ABI, as a marker of PAD, has been widely used to predict CAD. Moreover, obstructive coronary lesions in at least one artery have been reported in 60%–80% of patients with PAD who had undergone coronary angiography [5]. These patients had more extensive and calcified lesions, suggesting a more aggressive form of atherosclerosis [6]. Decreased ABI is associated with increased risk of congestive heart failure (CHF), CAD, and CV death [7,8] and confers increased morbidity and mortality for each category of the Framingham risk population [9]. It was previously shown that the ABI would reflect left ventricular (LV) systolic function, as well as atherosclerosis [10], as LV systolic function has been shown to influence arterial wave reflective properties [11].

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Two-dimensional transthoracic echocardiography (TTE) is a useful routine method for estimating LV volumes and ejection fraction (EF) in CAD patients. The widely used Simpson biplane method of disks has its intrinsic limitations, such as its dependence on geometric assumptions and the limited number of views used to derive global left ventricular ejection fraction (LVEF). Using TTE, the wall motion score index (WMSI) can be calculated and used as an alternative for reliable evaluation of LVEF [12].

The aim of this study is to test if ABI and/or WMSI can be used as simple noninvasive parameters to predict the severity of CAD as assessed invasively using SYNTAX score during coronary angiography in patients who previously experienced acute coronary syndrome (ACS) and to build up a prediction model for those patients with high SYNTAX score.

Patients and methods

This prospective observational study was conducted at Assiut University Heart Hospital from November 2018 to November 2019. The study protocol was approved by the Ethical Committee of the Faculty of Medicine, Assiut University under Institutional Review Board (IRB) no. 17101565. The study was conducted in accordance with the Declaration of Helsinki. A written informed consent was obtained from every participant.

1. Patients

The study included 125 patients with CAD who experienced an ACS insult within the preceding month. Patients were excluded from the study for any of the following reasons: rheumatic heart disease, prior coronary intervention or coronary artery bypass, previous surgery or intervention for PAD, deformity in upper and lower limbs, and those with impaired renal function. Also, patients with heart rhythm other than normal sinus rhythm and those with bad echocardiographic windows were excluded.

2. Methods

All the studied patients were subjected to the following.

- Detailed history taking focusing on age and gender of the patients. Also, smoking history and history of hypertension, diabetes mellitus, and dyslipidemia were noted. Current cardiac medications were noted as well. The history of preceding ACS, whether ST-elevation myocardial infarction or non–ST-elevation myocardial infarction, or unstable angina (UA) was noted. Family history of ischemic heart disease (IHD) was assessed.
- Thorough clinical examination, especially cardiac examination, was conducted to find any of the exclusion criteria.
- Twelve-lead echocardiography (ECG) was performed to confirm normal sinus rhythm.
- Echocardiography using PHILIPS IE-33 device was performed to exclude the presence of rheumatic heart disease. We assessed the LV function by EF using Simpsons method, regional wall motion abnormalities (RWMA), and WMSI.
- WMSI: Using a standard TTE sequence, the 16-segment model of myocardial segmentation is recommended to assess RWMA, and hence calculate WMSI [12].
- Laboratory assessment was done including renal function and lipid profile.
- ABI measurement: After resting the patient in the supine position for at least 10 min, ABI measurement was carried out [13].
- Coronary angiography: The extent of CAD was evaluated using the SYNTAX score. Also, the number of affected vessels was classified as nonsignificant CAD, one-vessel, two-vessels, and three-vessels disease. The SYNTAX score was calculated by using SYNTAX score calculator software version 2.28.

3. Statistical analysis

Data were verified, coded by the researcher, and analyzed using IBM-SPSS 21.0 (IBM-SPSS Inc., Chicago, IL, USA). Data were expressed as mean value ± standard deviation (SD) or as median value with interquartile range. Differences in continuous variables were evaluated with Student *t*-test for normally distributed continuous variables, Mann–Whitney U-test for nonparametrically distributed continuous variables, and chi-square tests for categorical variables. For continuous variables with more than two categories, analysis of variance (ANOVA) test was used to calculate the mean differences of the data that followed normal distribution, and post-hoc test was performed using Bonferroni corrections. Correlation analysis was used to test the association between variables (Pearson's correlation). The clinical and demographic factors with proven statistical significance from the univariate analyses were further included in the multivariate logistic regression models. *P*-value was considered significant when it was equal to or less than 0.05.

Results

1. Patient characteristics

The study included 125 patients with ACS in the preceding month. Table 1 describes the sociodemographic, clinical, electrocardiographic, echocardiographic, lab, ABI, and angiographic data of the study population. The study included 54.4% (68 patients) males, with a mean age of 55.11 ± 9.25 years. Nearly half of the study population (47.2%, 59 patients) had ST-segment elevation myocardial infarction (STEMI). Approximately one-third of the study population (34.4%, 43 patients) were diabetics. Fifty-four patients (43.2%) had a history of hypertension, and more than half of the population (61.6%, 77 patients) were smokers.

2. Determinants of ABI

We divided our study population according to their ABI into two groups as follows:

(1) Group I: It included 64 patients (51.2%) with ABI equal to or more than 0.9, indicating good peripheral vasculature.
(2) Group II: It included 61 patients (48.8%) with ABI less than 0.9, indicating diseased peripheral vasculature.

Table 1 - Sociodemographic, clinical, ECG, echocardiographic, laboratory, ABI, and angiographic characteristics of our study population

Parameters	*N* = 125
Age (mean ± SD) in years	55.11 ± 9.25
Sex, male (%)	68 (54.4)
Smoking (%)	77 (61.6)
Diabetes mellitus (%)	43 (34.4)
Hypertension (%)	54 (43.2)
Family history of IHD (%)	11 (8.8)
Dyslipidemia (%)	97 (77.6)
Diagnosis	
– **UA (%)**	46 (36.8)
– **STEMI (%)**	59 (47.2)
– **NSTEMI (%)**	20 (16.0)
Medications	
– **Beta blockers (%)**	123 (98.8)
– **ACE-inhibitors/ARBs (%)**	96 (76.8)
– **Calcium channel blockers (%)**	6 (4.8)
ECG, abnormal (%)	101 (80.8)
Ejection fraction (mean ± SD)	55.62 ± 10.56
Wall motion abnormalities (%)	77 (61.6)
WMSI (mean ± SD)	1.26 ± 0.28
Lipogram	
– **Total cholesterol (mean ± SD)**	203.10 ± 43.00
– **Triglycerides (mean ± SD)**	184.70 ± 47.65
– **LDL (mean ± SD)**	130.86 ± 27.12
– **HDL (mean ± SD)**	37.94 ± 7.09
ABI (mean ± SD)	0.95 ± 0.23
– **<0.9 (%)**	61 (48.8)
– **≥0.9 (%)**	64 (51.2)
SYNTAX score (mean ± SD)	18.55 ± 10.42
– **Low (0–22) (%)**	68 (54.4)
– **Moderate (23–32) (%)**	27 (21.6)
– **High (≥33) (%)**	30 (24)
Number of affected vessels (mean ± SD)	1.71 ± 1.08
– **Nonsignificant (%)**	17 (13.6)
– **One (%)**	44 (35.2)
– **Two (%)**	22 (17.6)
– **Three or more (%)**	42 (33.6)

IHD, ischemic heart disease; UA, unstable angina; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non–ST-segment elevation myocardial infarction; ACE, angiotensin-converting enzyme; ARBs, angiotensin receptor blockers; ABI, ankle–brachial index; WMSI, wall motion score index; SD, standard deviation; LDL, low-density lipoprotein; HDL, high-density lipoprotein; ECG, electrocardiogram.

Patients in group II were mostly smokers, diabetics, and had lower LV systolic function, higher WMSI, total cholesterol level, and SYNTAX score (Table 2).

3. Determinants of high SYNTAX score

We used the score 32 as a cutoff value to discriminate between those with low and high SYNTAX scores. Thus, we have two groups of patients according to their SYNTAX score (Table 3).

(1) Group A: It included 95 patients who had low SYNTAX score (0–32).

(2) Group B: It included 30 patients who had high SYNTAX score (≥33).

Table 2 - Sociodemographic, clinical, ECG, echocardiographic, laboratory, and angiographic characteristics of the two ABI groups

Parameters	Group I (*n* = 64)	Group II (*n* = 61)	*P*-value
Age (mean ± SD) in years	55.33 ± 8.9	54.89 ± 9.7	0.79
Sex, male (%)	37 (57.8)	31 (50.8)	0.43
Smoking (%)	32 (50)	45 (73.8)	0.006
Diabetes mellitus (%)	14 (21.9)	29 (47.5)	0.003
Hypertension (%)	25 (39.1)	29 (47.5)	0.33
Family history of IHD (%)	6 (9.4)	5 (8.2)	0.82
Dyslipidemia (%)	49 (76.6)	48 (78.7)	0.78
Diagnosis			
– **UA and NSTEMI (%)**	38 (59.4)	28 (45.9)	0.13
– **STEMI (%)**	26 (40.6)	33 (54.1)	
Medications			
– **Beta-blockers (%)**	63 (98.4)	60 (98.4)	0.97
– **ACE-inhibitors/ ARBs (%)**	48 (75)	48 (78.7)	0.63
– **Calcium channel blockers (%)**	2 (3.1)	4 (6.6)	0.37
ECG, abnormal (%)	50 (78.1)	51 (83.6)	0.44
EF (mean ± SD)	57.16 ± 9.9	54.00 ± 11.1	0.095
RWMA (%)	31 (48.4)	46 (75.4)	0.002
WMSI (mean ± SD)	1.14 ± 0.21	1.37 ± 0.29	0.001
Lipogram			
– **Total cholesterol (mean ± SD)**	184.88 ± 40.3	222.23 ± 37.3	0.001
– **Triglycerides (mean ± SD)**	177.80 ± 56.8	191.95 ± 34.6	0.097
– **LDL (mean ± SD)**	121.91 ± 25.4	140.26 ± 25.8	0.001
– **HDL (mean ± SD)**	38.05 ± 8.4	37.84 ± 5.5	0.87
SYNTAX score (mean ± SD)	11.11 ± 7.0	20.21 ± 11.4	0.001
– **Low (0–32) (%)**	61 (95.3)	34 (55.7)	0.001
– **High (≥33) (%)**	3 (4.7)	27 (44.3)	
Number of affected vessels (mean ± SD)	1.25 ± 0.9	2.20 ± 1.0	0.001
– **Nonsignificant or one vessel (%)**	45 (70.3)	16 (26.2)	0.001
– **Two or more vessels (%)**	19 (29.7)	45 (73.8)	

IHD, ischemic heart disease; UA, unstable angina; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non–ST-segment elevation myocardial infarction; ACE, angiotensin-converting enzyme; ARBs, angiotensin receptor blockers; ABI, ankle–brachial index; EF, ejection fraction; RWMA, regional wall motion abnormalities; WMSI, wall motion score index; SD, standard deviation; LDL, low-density lipoprotein; HDL, high-density lipoprotein; ECG, electrocardiogram.

4. Correlations between WMSI, ABI, and SYNTAX score

Using Pearson's correlation coefficient, we found a negative correlation between SYNTAX score and AKI (r = -0.40, P-value 0.001; Figure 1), a positive correlation between SYNTAX score and WMSI (r = 0.30, P-value 0.001; Figure 2), and a negative correlation between WMSI and ABI (r = -0.36, P-value 0.001; Figure 3).

Table 3 - Sociodemographic, clinical, ECG, echocardiographic, laboratory, ABI, and angiographic characteristics of the two SYNTAX groups

Parameters	Group A (*n* = 95)	Group B (*n* = 30)	*P*-value
Age (mean ± SD) in years	54.79 ± 8.7	56.13 ± 10.8	0.49
Sex, male (%)	49 (51.6)	19 (63.3)	0.26
Smoking (%)	56 (58.9)	21 (70)	0.28
Diabetes mellitus (%)	22 (23.2)	21 (70)	0.001
Hypertension (%)	38 (40)	16 (53.3)	0.19
Family history of IHD (%)	8 (8.4)	3 (10)	0.79
Dyslipidemia (%)	71 (74.7)	26 (86.7)	0.17
Diagnosis			
– **UA and NSTEMI (%)**	52 (54.7)	14 (46.7)	0.44
– **STEMI (%)**	43 (45.3)	16 (53.3)	
Medications			
– **Beta blockers (%)**	94 (98.9)	29 (96.7)	0.39
– **ACE-inhibitors/ARBs (%)**	73 (76.8)	23 (76.7)	0.98
– **Calcium channel blockers (%)**	4 (4.2)	2 (6.7)	0.58
ECG, abnormal (%)	74 (77.9)	27 (90)	0.14
EF (mean ± SD)	56.91 ± 9.9	51.53 ± 11.7	0.02
RWMA (%)	51 (53.7)	26 (86.7)	0.001
WMSI (mean ± SD)	1.20 ± 0.26	1.44 ± 0.27	0.001
Lipogram			
– **Total cholesterol (mean ± SD)**	192.63 ± 41.9	236.27 ± 26.7	0.001
– **Triglycerides (mean ± SD)**	178.06 ± 49.4	205.73 ± 34.6	0.02
– **LDL (mean ± SD)**	123.00 ± 23.7	155.77 ± 21.9	0.001
– **HDL (mean ± SD)**	37.47 ± 7.1	39.43 ± 6.9	0.19
ABI (mean ± SD)	0.99 ± 0.2	0.81 ± 0.3	0.001
– **<0.9 (%)**	34 (35.8)	27 (90)	0.001
– **≥0.9 (%)**	61 (64.2)	3 (10)	
Number of affected vessels (mean ± SD)	1.31 ± 0.9	3.0 ± 0.5	0.001
– **Nonsignificant or one vessel (%)**	61 (64.2)	0 (0)	0.001
– **Two or more vessels (%)**	34 (35.8)	30 (100)	

IHD, ischemic heart disease; UA, unstable angina; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non–ST-segment elevation myocardial infarction; ACE, angiotensin-converting enzyme; ARBs, angiotensin receptor blockers; ABI, ankle–brachial index; EF, ejection fraction; RWMA, regional wall motion abnormalities; WMSI, wall motion score index; SD, standard deviation; LDL, low-density lipoprotein; HDL, high-density lipoprotein; ECG, electrocardiogram.

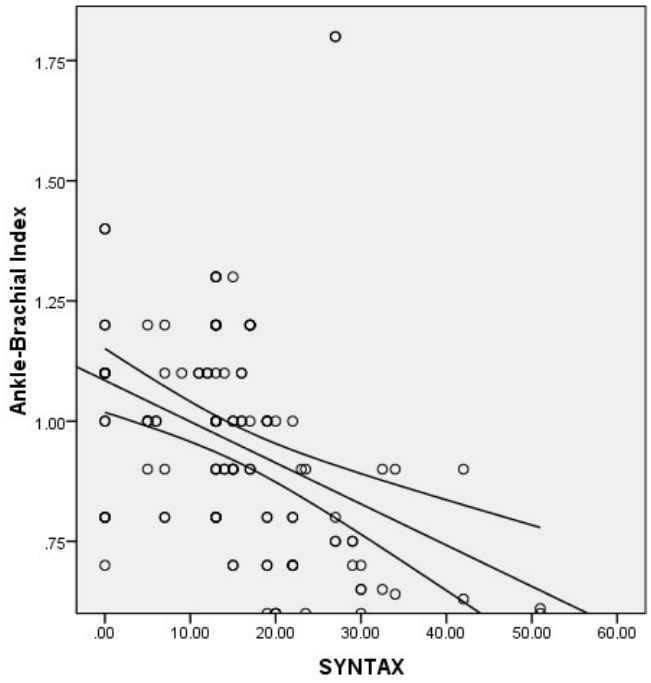


Figure 1 - Correlation between ABI and the SYNTAX score (*r* = -0.40, *P*-value 0.001). ABI, ankle–brachial index.

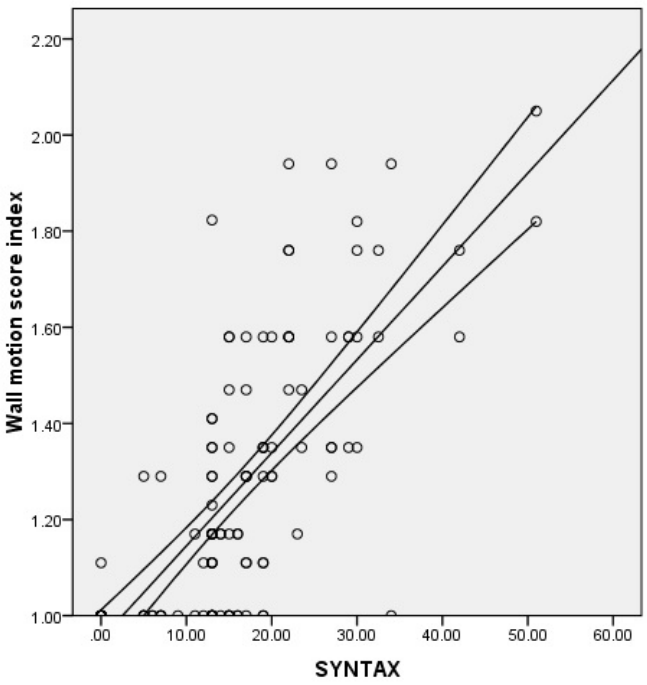


Figure 2 - Correlation between WMSI and the SYNTAX score (*r* = 0.30, *P*-value 0.001). WMSI, wall motion score index.

5. Predictors of high SYNTAX score

Table 4 shows the multivariate regression analysis of independent correlates of high SYNTAX score. After adjusting for age and sex, the final logistic regression model contained four predictors: ABI <0.9, LVEF, WMSI, and number of affected coronary vessels.

In other words, patients with ABI <0.9 were 11 times more likely to have high SYNTAX score (AOR = 10.95, 95% CI: 1.87–24.18), and this was statistically significant (*P* = 0.008). Conversely, with 1% increase in EF, there was 6.2% decrease in the probability of having high SYNTAX score among cases (AOR = 0.938, 95% CI: 0.86–0.98, *P* = 0.041). Also, with 0.1 increase in WMSI, there will be 7.6 times increase in the probability of having a high SYNTAX score (AOR = 7.63, 95% CI: 5.65–9.23, *P* = 0.004). Regarding the number of affected vessels, one vessel increase in the number of affected vessels was associated with a 2.4 times increase in the probability

Table 4 - Logistic regression model for the predictors of high SYNTAX score

Factor	Bivariate		Multivariable	
	OR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Age/years	1.016 (0.971–1.064)	=0.487	1.011 (0.919–1.080)	=0.928
Sex (male)	1.622 (0.697–3.773)	=0.262	2.208 (0.828–5.889)	=0.114
ABI (<0.9)	16.15 (4.65–57.18)	<0.001	10.95 (1.87–24.18)	=0.008
EF%	0.953 (0.916–0.992)	=0.018	0.938 (0.861–0.984)	=0.041
WMSI	10.71 (9.75–11.92)	<0.001	7.63 (5.65–9.23)	=0.004
No. of affected vessels	3.242 (0.024–12.03)	<0.001	2.413 (1.033–6.118)	0.044

EF, ejection fraction; OR, odds ratio; CI, confidence interval; WMSI, wall motion score index; ABI, ankle–brachial index.

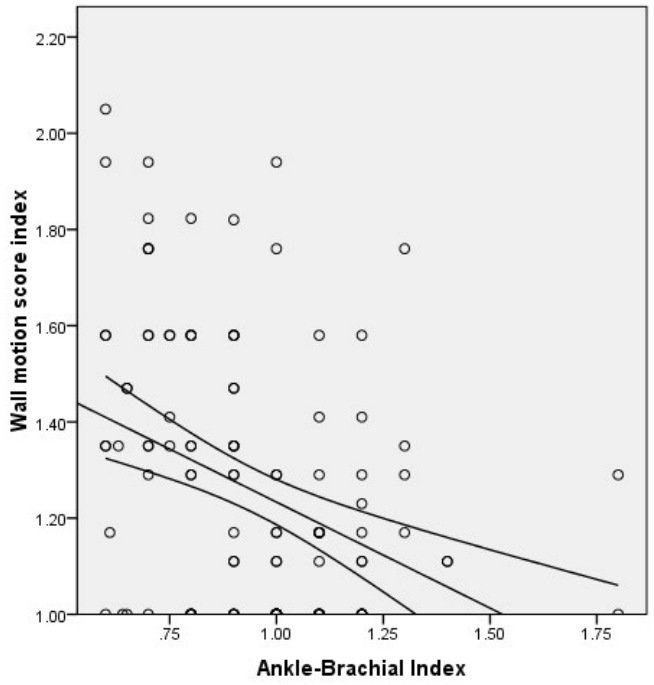


Figure 3: Correlation between WMSI and ABI (*r* = 0.36, *P*-value 0.001). ABI, ankle–brachial index; WMSI, wall motion score index.

of having high SYNTAX score among cases (AOR = 2.413, 95% CI: 0.1.033–6.118, *P* = 0.044).

4. Discussion

In our study, we were concerned about two simple noninvasive parameters and studied their relationship and interaction with severity of CADs as assessed invasively by coronary angiography. The ABI, defined as the ratio of ankle and brachial systolic blood pressure [14], is a widely accepted method for the diagnosis of PAD [15]. Moreover, the ABI is a parameter of diffuse atherosclerosis [7]. The American Heart Association recommends that the value of ABI ≤0.90 defines PAD [13]. The existence of PAD in patients with CAD remarkably increases the risk of CV morbidity and mortality [16]. Patients with ABI below 0.90 have been observed to have higher all-cause mortality when compared with patients with a normal ABI [17]. A meta-analysis published in 2015 stated that low ABI (<0.9) was an independent predictor of CV or all-cause mortality in the general population [18]. In a large survey conducted in the USA, it was found that abnormal ABI values were linked to CV events including myocardial infarction, stroke, and mortality [19]. So, the ABI may help improve risk stratification in patients with CAD.

The SYNTAX scoring system was developed to define coronary anatomy in patients who underwent coronary revascularization in the SYNTAX trial [20]. This score has been used to help in choosing the optimal revascularization strategy in patients with complex CAD. Furthermore, such a score can predict the clinical outcome in patients who underwent percutaneous coronary intervention (PCI) [21]. Moreover, in patients treated with drug-eluting stents, the SYNTAX score enabled prospective risk stratification [22]. However, the SYNTAX score reflects only coronary complexity and has a limited ability to predict the prognosis of PCI patients.

Our study emphasized the relationship between PAD and CAD through the definite close relationship between ABI and SYNTAX score. We detected a negative correlation between the SYNTAX score and AKI (*r* = -0.40, *P*-value 0.001). The association between ABI and the SYNTAX score has been confirmed in many previous studies [7,8,23,24]. Our results were in agreement with those of Korkmaz et al., who investigated the relationship between PAD and CAD complexity in 150 patients with ACS. They demonstrated that the SYNTAX score was higher in patients with overt and borderline PAD (ABI ≤0.99) than in normal participants (ABI 1–1.29). In addition, they reported a strong negative correlation between ABI and the SYNTAX score (*r* = -0.46, *P* < 0.001) [25]. As a mirror effect of the relationship between the SYNTAX score and ABI, we found a statistically significant relationship between low ABI and the number of affected coronary vessels. This was previously reported by Chen et al., who studied 58 patients undergoing coronary angiography. They found an independent negative correlation for ABI and the number of vessels obstructed in patients with CAD [26]. In contrast to our result, Puspitasari et al. found that low ABI values (<0.9) were not associated with CAD. A major limitation of their study was that only a very small percentage of the studied population had a low ABI (only 2.9%) [27]. Also, Petracco et al. studied 101 patients with ACS and found that patients with ABI <0.9 showed no association with higher disease complexity determined as high SYNTAX score in patients with ACS. However, they found a significant association of intermediate SYNTAX score values with non–ST-segment elevation myocardial infarction (NSTEMI), and of low SYNTAX score values

with unstable angina (UA) (odds ratio [OR], 95% confidence interval [CI]: 1.11 [1.03–1.20]; *P* = 0.004) [28].

Also, we reported that patients with low ABI were diabetics, smokers, and showed high cholesterol levels, and all of them are risk factors for atherosclerosis. Again, this has been confirmed in many antecedent studies and reviews [29,30].

Our study confirmed that patients with low ABI had a lower LVEF. Many previous studies described the direct relationship between ABI and EF. ABI values were found to be related to LVEF in a variety of patients, including elderly with IHD, diabetes, atrial fibrillation, and hemodialysis [31-35]. The mechanism(s) underlying this relation remains unknown [36]. It is needless to say that the common predisposing factor for both low ABI and low EF is atherosclerosis. This could explain the relationship between ABI and EF. Low ABI values may reflect the LV function in diabetic patients with LV systolic dysfunction [37]. Many epidemiologic studies have shown that CHF is common in patients with established PAD. In a meta-analysis of more than 11,000 patients with PAD, Anand et al. found that the prevalence of heart failure was 7.9%, which was greater than the 4.1% expected from NHANES data [38]. Conversely, the prevalence of PAD also appears to be higher in patients with heart failure. In a multicenter study of 794 patients with reduced LVEF, the overall prevalence of PAD determined by ABI <0.9 was unexpectedly high (17.1%) [39]. Another explanation for such a link was hypothesized by Rizivi et al. They stated that LV systolic dysfunction attenuates blood pressure amplification and found the ABI values to be directly correlated with LVEF in patients suspected of having PAD [40]. This assumption was further strengthened by the results of Nunes et al. who supported the link between ABI and LVEF in patients without CAD [36]. Our results not only confirmed the aforementioned link between ABI and LVEF, but they also extended such a relationship to the level of RWMA. Simpson biplane method for assessment of LVEF has some limitations such as its dependence on geometric assumptions, ventricular filling state, and plausibility of obtaining LV views, besides the limited number of views. WMSI can be derived and used as an alternative for the assessment of LV systolic function. Moreover, through a regression equation, LVEF could be obtained from WMSI [12]. To the best of our knowledge, our results are the first to establish a link between ABI and WMSI. We have reported a negative correlation between ABI and WMSI (r = 0.36, P-value 0.001).

The extent and severity of CAD are mirrored by the degree of LV systolic dysfunction during echocardiographic examination, especially stress modality [41,42] and represent critically important information for risk stratification and revascularization [43]. The WMSI is by far the most used and validated index in echocardiography [44,45]. Few, if any, studies have reported the relationship between WMSI and the severity of coronary artery stenosis. Zainal Abidin et al., in an abstract presented in EuroEcho 2016, reported their work on more than 100 CAD patients. They stated that there was a definite correlation between WMSI and the SYNTAX score. WMSI obtained during stress echocardiography can be a useful tool to predict the severity of CAD assessed by SYNTAX [46]. In a study enrolling more than 200 patients, Wierzbowska-Drabik et al. reported that during peak stress echocardiographic examination, WMSI was well correlated with both SYNTAX and Gensini scores. WMSI was a better predictor of severe CAD than LVEF [47]. However, in contrast to all these studies, in which WMSI was obtained during stress echocardiographic examination, we obtained WMSI at rest. The rationale for such an aspect was that all our patients were proved to have CAD and had already survived acute coronary insult within this month, so there was no need for stress echocardiographic examination. Moreover, resting RWMA were present in more than 60% of our study population.

Finally, using multivariate logistic regression analysis, our results built up a model for prediction of high SYNTAX score. This model contains, after adjusting for age and sex, three independent predictors. These are low LVEF, high WMSI, and low ABI. This could help better predict those patients who are badly in need of coronary intervention because of a high likelihood of having high SYNTAX score that carries unfavorable prognosis. We combined a simple bedside noninvasive atherosclerosis parameter (ABI) with an easily obtained simple echo parameter (WMSI) to help in predicting those patients with a high SYNTAX score.

1. Limitations

It would be great to increase our sample size; however, the use of appropriate statistical tests would overcome such a limitation. Our population consisted of those surviving an ACS within the last month. It would be better to expand the study group to include some patients with chronic coronary syndrome in order to get sound widely applicable results.

Conclusions

ABI is a simple bedside noninvasive test that could help in predicting the severity of CAD lesion. WMSI is an easily obtained simple echocardiographic parameter that could be used as an indicator of CAD severity. Still, prediction of CAD in patients with complex coronary lesions and high SYNTAX score is of great importance in our daily practice.

Funding and conflict of interest

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List of abbreviations

ABI: Ankle–brachial index
PAD: Peripheral arterial disease
CAD: Coronary artery disease
TTE: Two-dimensional transthoracic echocardiography
LV: Left ventricle
EF: Ejection fraction
WMSI: Wall motion score index
LVEF: Left ventricular ejection fraction
WHO: World Health Organization
CHF: Congestive heart failure
CV: Cardiovascular
ACS: Acute coronary syndrome
IHD: Ischemic heart disease
RWMA: Regional wall motion abnormalities
STEMI: ST-segment elevation myocardial infarction
UA: Unstable angina
NSTEMI: Non–ST-segment elevation myocardial infarction
ACE: Angiotensin-converting enzyme
ARBs: Angiotensin receptor blockers
PCI: Percutaneous coronary intervention

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