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Markers for predicting Coronary Artery Disease in Patients undergoing Coronary Angiography - by use of Ankle-Brachial Index - adescriptive study in rural tertiary care centre (Rajarajeswari Heart Centre)

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Abstract
Objectives: *The Ankle-Brachial index (ABI) is a highly effective tool for diagnosing peripheral artery disease. Peripheral arterial disease (PAD) is frequently under-diagnosed condition in the clinical setup which leads to a lack of opportunity in detection of subjects at a high risk for cardiovascular (CV) death. But use of the Ankle-Brachial index (ABI) till date has not been validated for the diagnosis of coronary artery disease.*
Aim of this Study: *To evaluate the ability of the ankle-brachial index in prediction of coronary artery disease in patients undergoing coronary angiography.*
Methods: *Patients with clinical suspicion of coronary artery disease and indication for coronary angiography were prospectively evaluated. Significant coronary artery disease was defined as the presence of stenosis >70% of at least one of the major epicardial coronary artery or any of their major branches. A ROC curve was developed to define the ankle-brachial index cutoff that best predicts coronary artery disease.*
Results: *A total of 51 patients were evaluated: mean age was 56 ± 12 years and 55% of them were males. Ninteen (37.2%) patients had significant coronary disease. Ankle-brachial index measurement in these patients was significantly lower than in those without coronary artery disease (0.78 ± 0.14 vs. 0.86 ± 0.87; p <0 .01). Ankle-brachial index <0.87 showed a sensitivity of 31%, specificity of 96.4%, positive predictive value of 76.9% and negative predictive value of 71.6%. The area under the receiver operating characteristic (ROC) curve was 0.73 (95% confidence interval of 0.67-0.79).*
Conclusions: *ABI values ≤ 0.87 showed high specificity to predict significant coronary artery disease.*
Keywords: *Atherosclerosis. Cardiovascular diseases. Ankle brachial index. Risk factors. Coronary angiography, receiver operating characteristic (ROC) curve.*

Introduction

Atherosclerosis is a systemic disease, which is not restricted only to a vascular territory. Coronary artery disease (CAD) and peripheral arterial disease (PAD) are commonly found in the same patient,[1] and this condition is associated with high risk of cardiovascular events.[2,3.]

Ankle Brachial Index (ABI) is a ratio of Systolic blood pressure at ankle and in the arm.[4] The ankle-brachial index (ABI) is a simple and effective tool for PAD screening.[5] ABI <0.90 is considered as altered, and has a 95% sensitivity for predicting peripheral vascular disease with significant stenosis on angiography.[6] In addition.

ABI <0.90 is associated with a worse cardiovascular prognosis and increased all-cause mortality.[7-9] Although ABI is useful for detecting PAD, its validity in predicting CAD is not well established.

Aim of this Study

To evaluate the ability of the ankle-brachial index in prediction of coronary artery disease in patients undergoing coronary angiography

Material and Method

Study Design: This descriptive study was carried out from 1st August 2018 to 31st November 2019 in Rajarajeswari Medical College & Hospital, Bangalore.

Inclusion Criteria: Suspected CAD patients who were referred for coronary angiography in our centre were selected.

Exclusion Criteria: Patients with previous coronary angiography, ABI > 1.0, severe valve disease, acute coronary syndrome, and those who did not agree to sign the informed consent were excluded from this analysis.

Clinical evaluation and measurement of ankle-brachial index: Patients were clinically evaluated before their coronary angiography through physical examination and medical history; information on the classic risk factors for ischemic heart disease was collected.

ABI was measured as recommended by current guidelines.5 Systolic pressure was measured in upper and lower limbs with a portable vascular Doppler device. In calculation of ABI, the ratio between anterior and/or posterior tibial artery pressure (the highest value was considered) and brachial systolic pressure was used. In the case of differing values between left and right side, the lowest value was used in this analysis.

Coronary Angiography: Quantitative coronary angiography was the parameter used for diagnosis of coronary stenosis. After clinical evaluation, the patients underwent coronary angiography through the femoral artery. Quantitative coronary angiography was performed by an independent investigator. Coronary disease was considered significant in the presence of a stenosis ≥70% in at least one coronary segment.

Statistical Analysis

Quantitative variables were expressed as means ± standard deviations and compared using Student's t-test. Qualitative variables were presented as absolute numbers and percentages and compared using the chi-squared test or Fisher's exact test, as appropriate. The determination of the cutoff for ABI was performed by receiver operating characteristic (ROC) curve. This statistical analysis was performed with SPSS version 15.0

Results

From August 2018 to November of 2019, 51 patients were included in this study. The mean age was 57 ± 11 years, 55% were male, and 24.4% were diabetic (Table 1). Nineteen patients (37.2%) were diagnosed with significant CAD. In these individuals, ABI was significantly lower than in those patients without significant CAD (0.78 ± 0.14 vs. 0.86 ± 0.87; p<0.01).

The specificity of ABI for predicting significant CAD in patients with ABI ≤ 0.87 was 96.4% (95% confidence interval – 95% CI, 91.7-97.7), with a sensitivity of 31% (95% CI, 23.1-39.9) (Figure); the positive predictive value was 75.9% and the negative predictive value was 71.6%.

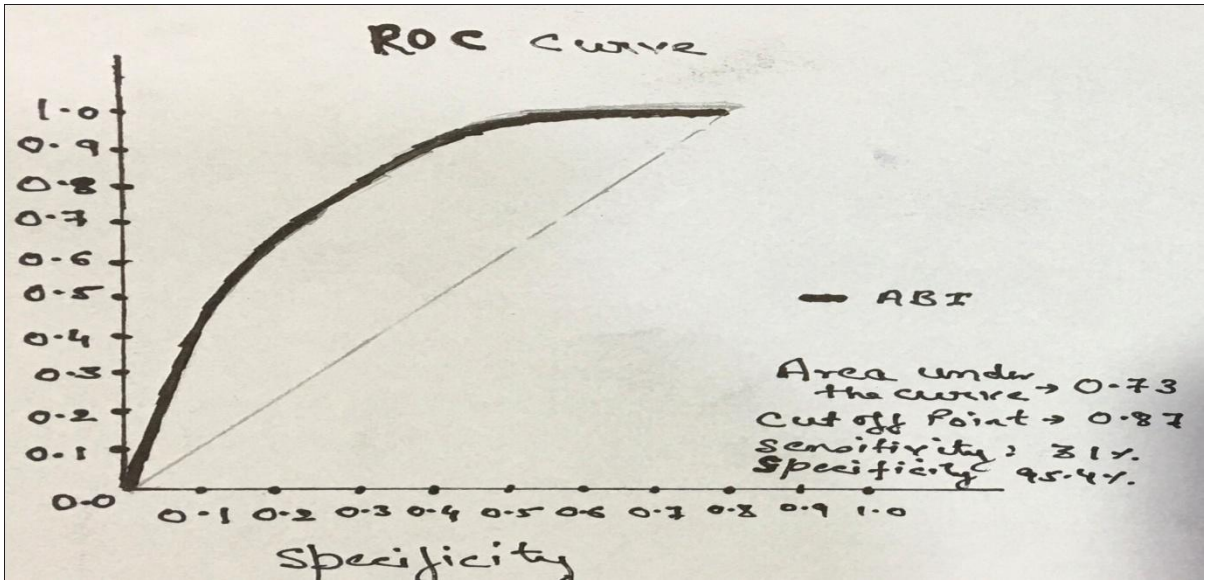

Figure: Receiver operating characteristic curve of ankle-brachial index (ABI) determination, related to the presence of stenosis ≥ 70% in a coronary artery or in a main coronary branch in angiography.

The probability of a significant coronary lesion presentation for patients undergoing coronary angiography can also be predicted by ABI. With an ABI ≤ 0.87, the probability of significant CAD was 77.2%. As shown in Table 2, it was observed that the lower the ABI, the greater the likelihood of a significant CAD.

To predict the occurrence of significant CAD associated with risk factors for this disease with ABI. For example, patients with ABI ≤ 0.87 and four risk factors had a 90.5% probability of significant CAD (Table 3).

Table 1 Patients' characteristics and risk factors for coronary arterial disease (CAD)

Characteristics	Without significant CAD n=32)	With significant CAD n=19)	p-value
Age,year	56 ± 12	62 ± 10	<0.01
Male gender ,n (%)	**12(37.5)**	**13(68.4)**	<0.01
Risk factor for CAD n(%)			
Hypertension	**23(71.8)**	**16(84.2)**	<0.01
Diabetes	**5(15.6)**	**7(36.8)**	<0.01
Hyperlipidemia	**11(34.3)**	**13(68.4)**	<0.01
Current smoking	**11(34.3)**	**12(63.1)**	<0.01
Family history of CAD	**13(40.6)**	**8(42.1)**	0.63
ABI ≤ 0.87,n(%)	**2(6.2)**	**7(36.8)**	<0.01

Note: *Presence of stenosis ≥ 70% in a coronary artery or main coronary branch. ABI: ankle-brachial index.

Table 2 Probability of significant coronary artery disease (CAD) in relation to the ankle-brachial index (ABI)

ABI	Without significant CAD n=32)	Chance of significant CAD * n=19) (%)	**Odds Ratio**
≤ 0.87	**2**	**77.2**	**5.66**
0.88-0.92	**5**	**48.4**	**1.58**
0.93-0.96	**2**	**33.3**	**0.84**
≤ 0.97	**23**	**20.9**	**0.44**

Note:-*Presence of stenosis ≥ 70% in a coronary or main coronary branch

Table 3 Probability of significant coronary artery disease (CAD) in relation to ankle-brachial index (ABI) and coronary risk factors*

Number of risk factor	ABI ≤ 0.87	ABI- 0.88-0.92	ABI- 0.93-0.96	ABI ≤ 0.97
≤ 1	50%(n=9)	0%(n=0)	0%(n=0)	3.6%(n=1)
2-3	70.6%(n=13)	47.1%(n=8)	36.4%(n=6)	22.2%(n=4)
≥ 4	90.5%(n=17)	87.5%(n=16)	25%(n=4)	56.5%(n=10)

Note:-*Presence of stenosis ≥ 70% in a coronary artery or main coronary branch; coronary risk factors were hypertension, current smoking, dyslipidemia, diabetes mellitus, and family history of coronary artery disease.

Discussion

This study evaluated the sensitivity and specificity of ABI for predicting significant CAD in patients undergoing coronary angiography. CAD may be present in 58% of patients with PAD,[10] and such an association is related to a worse prognosis. The diagnosis and early treatment are critical in order to minimize cardiovascular events.

Lee et al.[11] have previously proved an association between low ABI with high risk of cardiovascular and cerebrovascular events and death. Additionally, ABI increased significantly ($p < 0.01$) the predictive value for fatal myocardial infarction, when compared with a model considering only risk factors for CAD. However, ABI is not fully validated for detecting CAD. The present study demonstrated the usefulness of this index in predicting significant coronary lesions.

ABI is a useful tool for diagnosing PAD, and ABI <0.5 is associated with claudication when walking 100 m.18 ABI does not have good sensitivity for predicting CAD. However, when indexes **≤0.87**were considered, the specificity was 96.4%. Otah et al.12 demonstrated that three-vessel arterial disease or left main coronary artery disease can be predicted by the ITB, with sensitivity and specificity of 85% and 77%, respectively. In the present study, the sensitivity was low, but with higher specificity. Probably the main reason for this finding was the criterion used for CAD. In the present study, only cases of CAD with ≥ 70% stenosis were considered as significant, while Otah et al.[12] considered all coronary injuries that were diagnosed. Perhaps these different criteria have contributed to these differences in results. Although ABI per se does not have a high sensitivity to detect CAD, with an index **≤0.87** the probability of the patient having a significant CAD is estimated in 77.2%. When associating ABI with risk factors for CAD, the probability of lesions ≥70% in coronary angiography increases. Considering patients with four or more risk factors and an ABI **≤0.87**, approximately 90% have a significant CAD.

The result of our present study is almost at par with the study done by Sabedotti et al[13].

Study Limitations

The present study had some limitations that should be mentioned. This was a descriptive study with a small number of patients. Perhaps this sample represents a high-risk population with a high prevalence of CAD, and may have overestimated the predictive values of ABI. To established the risk factors for ischemic heart disease and were referred for coronary angiography for suspected CAD.

Conclusions

Ankle-brachial index≤ 0.87 had a high specificity to predict significant coronary disease. Considering its low cost and ease of use, measurement of ankle-brachial index may be incorporated to daily clinical practice to help diagnose significant coronary artery disease.

Conflict of Interests: The authors declare no conflicts of interest.

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