

Non-Invasively Measured Augmentation Index in Relation To Severity of Coronary Artery Disease Evaluated by SYNTAX Score in Essential Hypertensive Patients with and Without Metabolic Syndrome

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ABSTRACT

Background: Cardiovascular risk is twice as high in patients with metabolic syndrome as compared to those without the syndrome. This prospective study aimed to correlate non-invasively measured augmentation index with severity of coronary artery disease evaluated by the SYNTAX score on coronary angiography in hypertensive patients with and without metabolic syndrome.

Methods: A prospective, cross-sectional, hospital-based study was conducted during December 2015 and December 2016 among 100 patients aged 18-69. Peripheral blood pressure was measured with a sphygmomanometer whereas central aortic blood pressure was measured using the Pulse Cor machine. All patients received appropriate medical treatment which included beta-blockers, angiotensin-converting-enzyme inhibitors, angiotensin II receptor blockers, or calcium channel blockers.

Results: A total of 100 patients participated in the study. Majority, 38 (38.0%) patients were between 60-69 years old. Males contributed 71 (71.0%) of the study population. Mean augmentation index was highest in non-smokers with metabolic syndrome (95.4 ± 72.4), whereas mean SYNTAX score was highest in smokers with metabolic syndrome (14.8 ± 7.0). Similarly, mean augmentation index was highest in the BB/BB ARB group (97.9 ± 55.6), whereas mean SYNTAX scores was highest in the ARB/ ARB DIURETIC group (15.0 ± 5.9).

Conclusion: In our study, augmentation index showed a weak positive correlation with severity of coronary artery disease. These findings may be justified by wide use of atenolol as the major antihypertensive drug used in our study.

Keywords: augmentation index, coronary artery disease, central aortic blood pressure, hypertension, metabolic syndrome, SYNTAX score

INTRODUCTION

Cardiovascular disease persists as the leading cause of mortality and morbidity worldwide. ^[1] Hypertension is a modifiable cardiovascular risk factor as well as an eminent feature of metabolic syndrome. This syndrome encompasses a cluster of cardiovascular risk factors such as obesity,

dyslipidemia, diabetes, and hypertension. Recently, the inclusion of hypertension as a component of the syndrome has enabled comprehensive insights into the condition, permitting prompt detection and treatment. ^[2] Metabolic syndrome prevalence amongst hypertensive patients as high as 44.5% has been previously reported. ^[3]

Augmentation index is a measure of arterial wall condition and stiffness. This clinical index serves as a predictive marker of coronary artery disease (CAD) due to the association between arterial stiffness and CAD. [1,4,5] Moreover, as arterial stiffness is increased in hypertensive patients, the augmentation index is especially useful as a determinant of cardiovascular outcomes in this specific subset of patients. The SYNTAX score is a well-established angiographic tool used to assess the extent and severity of CAD. Although originally developed to determine lesion complexity, application of this tool has been extended towards the prediction of subsequent adverse coronary events. [4] Thus, increased severity of CAD correlates with higher SYNTAX score. [6] Current literature correlating augmentation index with CAD severity measured by the SYNTAX is scarce. Against this background, we performed this prospective study to correlate non-invasively measured augmentation index with severity of CAD evaluated by the SYNTAX score on coronary angiography in hypertensive patients with and without metabolic syndrome.

MATERIALS AND METHODS

Study design and patient population

This was a prospective, cross-sectional, hospital-based study conducted from December 2015 to December 2016. Essential hypertensive patients (on or off treatment) with metabolic syndrome aged 18–69 years undergoing coronary angiography were included in the study. All patients were recruited from the out-patient department of our tertiary-care centre. Patients with known coronary artery disease on medications and acute coronary artery syndrome were excluded from the study. The study was approved by the Institutional Ethics Committee. All patients provided written informed consent for participation in the study.

Procedure

Peripheral blood pressure was measured with a sphygmomanometer. Central aortic blood pressure was measured using PulseCor machine by tying the cuff at the brachial area. CAD was assessed by performing coronary angiography. All patients received appropriate medical treatment which included beta-blockers (BB), angiotensin-converting-enzyme inhibitors (ACEI), angiotensin II receptor blockers (ARB), or calcium channel blockers (CCB) and if required aspirin and statins according to relevant guidelines. Severity of CAD was assessed using the SYNTAX score.

Data collection

Detailed history was taken from all study participants. Cardiovascular and other relevant systemic examinations were performed on all patients. SYNTAX score was calculated using a SYNTAX score calculator and has been previously described in literature. [7]

Statistical Analysis

Continuous variables were presented as mean and standard deviation, whereas categorical variables were represented as percentages. Karl Pearson's correlation coefficient was used to study the relationship between augmentation index and SYNTAX score in essential hypertensive patients and metabolic syndrome patients. The statistical evaluation of data was done using the Statistical Package for Social Sciences (SPSS; Chicago, IL, USA) program, version 15. A p-value <0.05 was considered statistically significant.

RESULTS

Demographics of study population

Of the 100 patients, 38(38.0%) patients belonged to the age group of 60–69 years, indicating higher proportion of patients in this age group. Males contributed 71 (71.0%) of the study population. Smokers, diabetics, and patients with dyslipidemia represented 66 (66.0%), 38 (38.0%), and 34 (34.0%) of the study population. The distribution of patients

according to age group is detailed in **Table 1**.

according to hypertension and metabolic syndrome profiles are delineated in **Table 1**.

Augmentation index and SYNTAX scores according to hypertension and metabolic syndrome profiles

Mean augmentation index was highest in non-smokers with metabolic syndrome (95.4±72.4) followed by non-smokers with hypertension (91.8±623.4). Mean SYNTAX score was highest in smokers with metabolic syndrome (14.8±7.0). The mean augmentation index and SYNTAX score

Table 1: Baseline demographics of study population

Variable	n= 100 Patients
Age	
30–39 years, n (%)	4 (4.0%)
40–49 years, n (%)	21 (21.0%)
50–59 years, n (%)	37 (37.0%)
60–69 years, n (%)	38 (38.0%)
Males, n (%)	71 (71.0%)
Cardiovascular risk factors	
Hypertension, n (%)	100 (100%)
Smoker, n (%)	66 (66.0%)
Diabetes, n (%)	38 (38.0%)
Dyslipidemia, n (%)	34 (34.0%)

Table 2: Mean augmentation index and mean SYNTAX score according to hypertension and metabolic syndrome profiles

Group	Mean Augmentation Index	Mean SYNTAX Score
Only hypertension (n=24)	89.5±59.1	12.3±5.8
Smokers with hypertension (n=50)	74.3±36.3	14.2±6.3
Non-smokers with hypertension (n=25)	91.8±63.4	12.4±5.6
Hypertension with metabolic syndrome (n=8)	75.9±49.9	14.1±6.3
Smokers with metabolic syndrome (n=16)	68.9±37.8	14.8±7.0
Non-smokers with metabolic syndrome (n=9)	95.4±72.4	12.5±3.5

Table 3: Mean augmentation index and SYNTAX score according to various drug groups

Type of drug	Mean Augmentation Index (n=100)	Mean SYNTAX Score (n=100)
ACEI (n=12)	70.9±35.9	12.4±4.7
ARB /ARB DIURETIC (n=24)	76.9±51.5	15.0±5.9
BB/ BB ARB (n=12)	97.9±55.6	14.8±5.5
CCB (n=8)	70.6±36.3	12.0±6.0
CCB ARB/CCB BB (n=7)	87.7±57.9	13.9±9.0

ACEI-angiotensin-converting-enzyme inhibitor, ARB-angiotensin II receptor blockers, BB-beta-blocker, CCB-calcium channel blocker

Table 4: Correlations of augmentation index and SYNTAX scores between hypertension and metabolic syndrome profile

Correlation	r value	p value	Correlation
Overall correlation between augmentation index and SYNTAX score	0.0552	0.620	Weak correlation
Augmentation index between hypertension and metabolic syndrome	0.0520	0.950*	No correlation
SYNTAX score between hypertension and metabolic syndrome	0.9165	0.359	No correlation

(Kindly provide the 'r' values)

Augmentation index and SYNTAX score according to various drug groups

Mean augmentation index was highest in the BB/BB ARB group (97.9±55.6). Mean SYNTAX scores was ARB /ARB DIURETIC group (15.0±5.9). The mean augmentation index and SYNTAX score according to various drugs are demonstrated in **Table 2**.

Correlations of augmentation index and SYNTAX scores between hypertension and metabolic syndrome profile

Overall correlation between augmentation index and SYNTAX score (p=0.62) was not statistically significant. Similarly the correlation for augmentation index between hypertension and metabolic syndrome (p=0.950) and for SYNTAX

score between hypertension and metabolic syndrome (p=0.359) were also not statistically significant. Correlations between hypertension and metabolic syndrome profiles are given in **Table 3**.

DISCUSSION

In the present study we aimed to correlate non-invasively measured augmentation index with severity of CAD evaluated by the SYNTAX score in hypertensive patients with or without metabolic syndrome. Zrinko et al. [4] found strong correlation between CAD and arterial stiffness, but no association between degrees of the CAD with parameters of arterial stiffness. However, Durmus et al. [6] showed patients with higher SYNTAX

score were more likely to have CAD as compared to patients with lower SYNTAX score. Similarly, El Kersh et al. [8] and Arya et al. [9] documented higher SYNTAX score in hypertensive patients as compared to non-hypertensive patients. Vascular remodelling is a sequela of age [5] and age may account for up to 40% variation in SYNTAX score, hence the significant correlation between age and SYNTAX score. [8] This correlation may justify the weak correlation observed in our study as three-quarters of our study population were above the age of 50 years.

Prevalence of metabolic syndrome in a Chinese study observed metabolic syndrome prevalence higher in women than men (10.4% versus 5.4%, 13.6% versus 8.1% and 17.4% versus 12.8%, according to Adults Treatment Panel II, International Diabetes Federation (IDF) and modified ATP III criteria, respectively. [10] Similarly. An Indian study documented prevalence of 58.1% and 50.0% in males and 86.3% and 86.3% in females by ATP III and IDF criteria, respectively. [11] Although women are prone to experience fewer coronary events, population-attributable risk for hypertension is higher for women than men owing to longer life expectancy and increased incidence of hypertension with age. Thus, advanced age accounts for increased prevalence of metabolic syndrome in women. [12]

The landmark CAFÉ [13] study proved that different blood pressure-lowering drugs confer different reductions in central aortic pressures and thus cardiovascular outcome despite similar effects on brachial blood pressure. In the present study, the ACEI group resulted in lower augmentation index and relatively low SYNTAX score. This implies great effect of this treatment in lowering central blood pressure. Patients in this group had less severe CAD as compared to patients of the beta-blocker group. Our study shows weak correlation between central aortic blood pressure and severity of CAD, despite strong correlation between SYTNAX score and central aortic blood pressure in the

ACEI group. However, atenolol was the most widely used beta-blocker in our study. Other studies have reported inferior outcomes with atenolol. [13,14] This finding may provide justification for outcomes in the present study and may also throw light on other studies with the hypothesis of drugs lowering central blood pressure being more effective.

Study limitations

The study had a few limitations. Firstly, the small study sample size. Secondly, the SYNTAX score, can calculate CAD of >50 % stenosis only. Thus, the role of augmentation index in mild CAD cannot be defined. Thirdly, possible associated confounding risk factors such as smoking were not excluded from our study. Finally, beta-blockers were not studied individually, in relation to augmentation index and SYNTAX score.

CONCLUSION

In our study, augmentation index showed a weak positive correlation with severity of CAD. Despite having a strong positive correlation of augmentation index with severity of CAD in ARB or ACEI group, we got a weak positive correlation on mean augmentation index and mean syntax score. These findings may be justified by wide use of atenolol as the major antihypertensive drug used in our study.

Conflict of Interest: The authors declare no conflict of interest.

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