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AORTIC STIFFNESS INDEXES AS A PREDICTOR FOR CHRONIC STABLE CORONARY ARTERY DISEASE IN TYPE 2 DIABETIC PATIENTS.

By

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ABSTRACT

Background: Type 2 diabetic patients have increased arterial stiffness and are at particular risk for augmented cardiovascular morbidity and mortality. As diabetes is a systemic disease and it has a higher incidence of having a greater extent of atherosclerosis, it can affect the coronary arteries as well as the aorta.

Objective: Assessment of the effect of diabetes mellitus on the aorta by calculating aortic stiffness parameters using echocardiography measurements, and using these parameters as a predictor for coronary artery disease (CAD) presence and severity.

Patients and Methods: This study was conducted within one year from October 2018 until October 2019. Fifty diabetic patients were enrolled, suspected to have chronic stable coronary artery disease by symptoms and risk factors, divided into two groups after coronary angiography: Group I included patients with coronary artery disease, and group II with normal coronaries. All patients were subjected to full history taking, general and local examination, echocardiography including calculation of aortic stiffness parameters, laboratory investigations and coronary angiography.

Results: Thirty-six per cent of the patients had normal coronaries, and sixty-four per cent had coronary lesions. Aortic systolic and diastolic diameters were significantly higher in group I compared to group II. Aortic stiffness index and elastic modulus were significantly higher in group I and aortic distensibility was significantly lower in group I compared to group II. Stiffness index and elastic modulus had a positive correlation with the complexity of CAD based on SYNTAX score and aortic distensibility had a negative correlation with it. Aortic stiffness index had the highest sensitivity and a cutoff value of > 17.4 to detect CAD.

Conclusion: Aortic stiffness index has the highest predictive power for CAD presence and severity meaning that the patients with higher aortic stiffness index most probably will have a higher chance of having a complex CAD.

Keywords: Aortic stiffness index, coronary artery disease, type2 diabetes mellitus.

INTRODUCTION

Aortic stiffness is a complication of a long process of arteriosclerosis which is a result of diabetes, along with other causes, as an important contributing factor *(Amraotkar et al., 2017).*

Type 2 diabetic patients have increased arterial stiffness and are at particular risk for augmented cardiovascular morbidity and mortality. This high cardiovascular risk is not completely explained by the clustering of traditional risk factors, and increased arterial stiffness may be one pathophysiological mechanism that links diabetes to increased cardiovascular morbidity and mortality *(Cardoso et al., 2013)*.

Aortic stiffness is an independent predictor of vascular morbidity and mortality as evidenced by studies performed in patients with diabetes as well as other risk factors and *Gale et al., 2019). And (Vlachopoulos et al., 2019*

The present study aimed to identify the power of aortic stiffness index, calculated using echocardiography measurements, to predict the presence of coronary artery disease in patients with type II DM, and its anticipation to have high-grade stenosis in the predicted group.

PATIENTS AND METHODS

This was a cohort study including a total of 50 diabetic patients admitted to the Cardiology Department, Al-Azhar University Hospitals within a year starting from October 2018 till October 2019. Patients were enrolled in the study after obtaining their written informed consents, and approval of the local ethics committee of the hospital. The patients included in the study were suspected to have chronic stable coronary artery disease by symptoms and risk factors. They were divided into two groups based on coronary angiography: Group I with coronary artery lesions and group II with normal coronaries. Group 1 was then divided into two subgroups according to the severity and complexity of CAD measured by SYNTAX score into low SYNTAX and intermediate to high SYNTAX where low syntax was lower than 22 and intermediate to high was higher than 22.

Exclusion Criteria: Patients with hypertension, previous CABG, structural heart disease and abnormal heart rhythm other than sinus rhythm.

All patients were subjected to a detailed history, including age, sex, history of CAD, medications and risk factors including smoking and dyslipidemia and physical examination including local and general examination. Random blood sugar was measured using a test strip. Echocardiographic images were obtained in the parasternal long-axis and short-axis and apical two-chamber and four-chamber views using standard transducer positions. Phillips IE33, General Electric Healthcare (GE Vingmed, Norway) equipped with a harmonic M5S variable-frequency (1.7-4 MHz) phased-array transducer was used to detect left ventricular end-diastolic diameter (LVEDD), left ventricular end-systolic diameter (LVESD), ejection fraction (EF), mitral inflow velocities and aortic stiffness index were measured and the results were done blindly by two echo experts for all subjects according to ASE recommendations.

Aortic stiffness was assessed by calculating the following equations:

- Aortic distensibility (D): D = 2 (As - Ad)/ [Ad (Ps - Pd)]

Expressed as (10^-3 cm2/Dyn)

- Stiffness index (SI): SI = ln (Ps/Pd)/ [(As – Ad)/Ad]
- Pressure strain elastic modulus (Ep): Ep = (Ps – Pd)/ [(As – Ad)/Ad] expressed as (10^-2 kPa)

Where: **As** was the aortic diameter at end-systole, **Ad** is the aortic diameter at enddiastole, **Ps** is the systolic BP, **Pd** was the diastolic BP, and **ln** was the natural logarithm.

Tissue Doppler imaging: Aortic upper-wall velocities were measured by TDI at the same point as in the M-mode measurements. The TDI of expansion peak velocity during systole (Sao) and early (Eao) and late (Aao) contraction peak velocities during diastole were obtained with a 1-mm sample volume size.

Patients underwent coronary angiography (Performing on Philips Cath lab) (Retrograde coronary angiography using the Judkin's technique) to assess the ischemic profile of the patient which was performed and analyzed by an expert operator who was blinded to the clinical state of the patients. Local anaesthesia was administered, and femoral artery puncture was performed. Arterial sheath was inserted, then guidewire and needle were removed. A catheter was cannulated, then multiple standard views of coronary arteries were recorded.

Statistical analysis: Statistical presentation and analysis of the present study were conducted, using the range, median, IQR, frequency and percentage, correlation, Roc curve, Chi-square, and Mann-Whitney test by SPSS V20 for windows. (SPSS Inc., Chicago, Illinois, USA).

P-value ≤ 0.05 was considered significant. Correlation analysis assessed the strength of association between two variables.

RESULTS

Male percentages were higher in both groups. However, the Female percentage was higher in group I compared to group I with no statistically significant difference between the 2 groups. Also, there was no significant statistical difference between the two groups regarding smoking and family history of CAD **(Table 1)**.

Table (1): Demographic data and risk factors among the studied groups

Groups / Patients		Group I (N=32)		Group II (N=18)		Total		P-value
		N	%	N	%	N	%	
Males		18	56.25	11	61.11	29	58	0.738
Females		14	43.75	7	38.89	21	42	
Total		32	100	18	100	50	100	
Smoking	Yes	11	34.38	7	38.89	18	36	0.75
	No	21	65.63	11	61.11	32	64	
Family history of CAD	Yes	18	56.25	9	50	27	54	0.67
	No	14	43.75	9	50	23	46	

Chi²

There were statistically significant differences between the two groups regarding LVESD aortic systolic diameter and aortic diastolic diameter. Apart from those, there was no statistically significant difference between the two groups regarding other echocardiography findings. LVESD, aortic systolic and diastolic diameters were higher in group I compared to group II **(Table 2)**.

Table (2): Comparative analysis between Group I and Group II regarding echocardiography findings

Parameters \ Groups		Group I(N=32)			Group II(N=18)			P-value
Left ventricular diastolic diameter (LVDD) (mm)	**Range**	37.8	-	64	38.7	-	53.4	0.051
	Median (IQR)	50.15(8.55)			46.70(7.33)			
Left ventricular systolic diameter (LVSD) (mm)	**Range**	22.1	-	45.5	23.4	-	38.1	0.014
	Median (IQR)	34.05(7.18)			30.15(5.98)			
Ejection fraction (EF)	**Range**	47	-	71	56	-	72	0.073
	Median (IQR)	62.50(16.75)			65.50(9.25)			
E wave (cm/s)	**Range**	49.4	-	116.1	48.3	-	100.9	0.538
	Median (IQR)	84.40(26.05)			85.85(20.90)			
A wave (cm/s)	**Range**	33.1	-	94.4	24.9	-	80.5	0.442
	Median (IQR)	61.80(19.08)			60.65(20.15)			
Deceleration time (DT) (ms)	**Range**	147.3	-	265.4	126.1	-	245.9	0.968
	Median (IQR)	182.45(35.13)			185.10(49.38)			
Expansion peak velocity during systole (AO. S)	**Range**	6.8	-	14.5	6.5	-	15.5	0.517
	Median (IQR)	9.50(2.13)			9.05(1.90)			
Early contraction peak velocities during diastole (AO. E)	**Range**	4.4	-	19.6	7.1	-	20.8	0.122
	Median (IQR)	13.00(4.45)			14.00(3.88)			
Late contraction peak velocities during diastole (AO. A)	**Range**	3.6	-	14.6	4.1	-	12.4	0.701
	Median (IQR)	8.70(3.23)			8.85(3.23)			
Aortic Systolic Diameter	**Range**	24.8	-	37.6	25	-	34	0.004
	Median (IQR)	30.10(2.63)			27.95(2.78)			
Aortic diastolic Diameter	**Range**	22.2	-	34.4	23.2	-	30.1	0.014
	Median (IQR)	28.05(3.70)			26.00(3.63)			

Mann-Whitney Test

By comparing the aortic stiffness parameters between group I and group II, there was a statistically significant difference between the two groups in aortic stiffness index, aortic distensibility and elastic modulus. Both aortic stiffness index and elastic modulus were directly proportional to the presence of CAD while aortic distensibility was inversely proportional to the same event **(Table 3)**.

Table (3): Aortic stiffness parameters in the studied groups

Parameters \ Groups		Group I			Group II			P-value
Stiffness index	**Range**	17.3	-	23.2	14.3	-	23.2	0.001
	Median (IQR)	19.80(2.18)			16.25(5.08)			
Aortic Distensibility	**Range**	1	-	5.3	1	-	6.6	0.009
	Median (IQR)	3.00(1.15)			4.55(3.18)			
Ep	**Range**	68	-	76.2	65.4	-	76.2	0.001
	Median (IQR)	70.90(5.85)			67.50(6.03)			

Mann-Whitney Test

Males were higher than females in patients diagnosed with CAD. Nevertheless, a higher number of females were diagnosed with intermediate and high SYNTAX score. However, the difference between groups was statistically insignificant. Also, there is no statistically significant difference between the patients' smoking, and family history of CAD & the degree of SYNTAX score **(Table 4)**.

Table (4): Relation between the complexity of CAD & demographic data and risk factors

Patients \ SYNTAX		Low		Intermediate and High		Total		P-value
		N	%	N	%	N	%	
Males		9	69.23	9	47.37	18	56.25	0.221
Females		4	30.77	10	52.63	14	43.75	
Total		13	100	19	100	32	100	
Smoking	**Yes**	5	38.46	6	31.58	11	34.38	0.687
	No	8	61.54	13	68.42	21	65.63	
Family history of CAD	**Yes**	8	61.54	10	52.63	18	56.25	0.618
	No	5	38.46	9	47.37	14	43.75	

Chi²

Apart from deceleration time (DT) which shows a statistical significance to the degree of SYNTAX score, it was found that all echocardiography findings were of no statistical significance to the SYNTAX score. DT is inversely proportionate to the degree of coronary artery disease complexity as it decreases by the increase of the SYNTAX **(Table 5)**.

Table (5): Relation between the complexity of CAD and Echocardiography findings

Parameters \ SYNTAX		Low			Intermediate and High			P-value
LVDD (mm)	**Range**	38.2	-	60	37.8	-	64	0.443
	Median (IQR)	48.10(8.60)			51.20(8.30)			
LVSD (mm)	**Range**	28	-	45.5	22.1	-	41.9	0.328
	Median (IQR)	31.50(6.90)			34.10(4.90)			
EF	**Range**	47	-	70	47	-	71	0.513
	Median (IQR)	65.00(16.50)			62.00(16.00)			
E wave (cm/s)	**Range**	49.4	-	111.1	65.8	-	116.1	0.111
	Median (IQR)	81.50(16.20)			93.00(27.40)			
A wave (cm/s)	**Range**	33.1	-	85.1	35.3	-	94.4	0.908
	Median (IQR)	60.80(15.15)			63.60(20.40)			
DT (ms)	**Range**	167.1	-	265.4	147.3	-	211.7	0.004
	Median (IQR)	202.50(58.00)			176.60(25.00)			
Ao. S wave (cm/s)	**Range**	6.8	-	14.5	7.3	-	12.2	0.219
	Median (IQR)	9.90(3.40)			9.20(1.20)			
Ao. E wave (cm/s)	**Range**	4.9	-	19.6	4.4	-	17.7	0.309
	Median (IQR)	13.80(6.35)			12.20(4.50)			
Ao. A wave(cm/s)	**Range**	4.9	-	10.5	3.6	-	14.6	0.145
	Median (IQR)	7.60(3.40)			8.90(4.00)			
Aortic Systolic Diameter	**Range**	24.8	-	37.6	26.8	-	32.3	0.171
	Median (IQR)	29.50(3.40)			30.20(2.30)			
Aortic diastolic Diameter	**Range**	22.2	-	34.4	22.2	-	31.1	0.526
	Median (IQR)	28.30(6.40)			28.00(2.80)			

Mann-Whitney Test

By comparing the patients of different degree of CAD, it has been shown that aortic stiffness parameters have a statistically significant difference with the degree of complexity of CAD measured by the SYNTAX score. While aortic stiffness index and Ep were directly proportionate to the higher CAD complexity, aortic distensibility was inversely proportionate to the same finding **(Table 6)**.

Table (6): Relation between the complexity of CAD and Aortic stiffness parameters

Parameters \ SYNTAX		Low			Intermediate and High			P-value
Stiffness index	**Range**	17.7	-	22.4	17.3	-	23.2	0.002
	Median (IQR)	18.70(1.45)			20.50(1.70)			
Aortic distensibility	**Range**	2.7	-	4.3	1	-	5.3	0.012
	Median (IQR)	3.40(1.20)			2.80(0.80)			
Ep	**Range**	68.8	-	76.1	68	-	76.2	0.060
	Median (IQR)	70.00(3.25)			74.30(5.70)			

Mann-Whitney Test

By studying the correlation between all the previous findings and the SYNTAX score, it was found that the degree of the SYNTAX score was directly correlated to the aortic stiffness index and EP, and inversely correlated to the aortic distensibility. There was also a direct correlation between aortic stiffness index and EP while it was inversely correlated to aortic distensibility. Finally, there was an inverse correlation between the aortic distensibility and EP. There was a statistically significant difference between SYNTAX score and aortic stiffness index and between SYNTAX score and aortic distensibility and SYNTAX score and EP. Also, there was a statistical significance between stiffness index and aortic distensibility and between stiffness index and EP. Finally, there was a statistical significance between aortic distensibility and EP **(Table 7)**.

Table (7): Correlation between SYNTAX score, aortic stiffness parameters, risk factors, clinical examinations and echocardiography findings

Correlations / Parameters	SYNTAX score		Stiffness index		Aortic distensibility		Ep	
	r	P-value	r	P-value	r	P-value	r	P-value
Stiffness index	0.603	<0.001						
Aortic distensibility	-0.552	0.001	-0.820	<0.001				
Ep	0.420	0.017	0.694	<0.001	-0.680	<0.001		
Age	0.104	0.572	-0.127	0.488	0.119	0.518	-0.008	0.966
FBS	0.164	0.368	-0.028	0.879	0.047	0.800	-0.052	0.779
SBP	0.285	0.114	0.097	0.599	-0.066	0.722	0.207	0.255
DBP	-0.277	0.125	-0.218	0.230	0.276	0.127	0.041	0.825
LVDD (mm)	0.022	0.904	0.142	0.439	-0.129	0.481	0.087	0.636
LVSD (mm)	-0.114	0.534	0.051	0.782	-0.260	0.150	0.098	0.592
EF	-0.060	0.746	-0.017	0.925	0.149	0.417	0.085	0.645
E wave (cm/s)	0.285	0.114	0.110	0.549	0.022	0.903	-0.128	0.484
A wave (cm/s)	0.009	0.961	0.094	0.609	-0.139	0.449	-0.027	0.884
DT (ms)	-0.196	0.283	-0.278	0.124	0.155	0.396	-0.233	0.200
Ao. S wave (cm/s)	-0.023	0.902	-0.087	0.636	-0.102	0.579	-0.032	0.863
Ao. E wave (cm/s)	-0.180	0.325	-0.211	0.246	0.206	0.258	-0.189	0.299
Ao. A wave(cm/s)	0.109	0.552	-0.010	0.958	-0.115	0.530	0.055	0.764
Aortic Systolic Diameter	0.120	0.512	0.140	0.444	-0.077	0.676	0.145	0.429
Aortic diastolic Diameter	0.044	0.812	-0.045	0.807	0.069	0.708	-0.129	0.480

All of the aortic stiffness parameters were sensitive to detect CAD in the studied population with the aortic stiffness index has the highest sensitivity with a cutoff value of > 17.4. Aortic distensibility and EP also have slightly lower sensitivity with a cutoff value of ≤4.2 and >68.6 **(Table 8** and **Figure 1)**.

Table (8): Roc curve between Group I and II regarding aortic stiffness parameters

ROC curve between Group I and Group II						
	Cutoff	**Sens.**	**Spec.**	**PPV**	**NPV**	**Accuracy**
Stiffness index	>17.4	96.87	72.22	86.1	92.9	77.4%
Aortic distensibility	≤4.2	93.75	61.11	81.1	84.6	72.4%
Ep	>68.6	94.77	70.14	84.2	90.7	75.4%

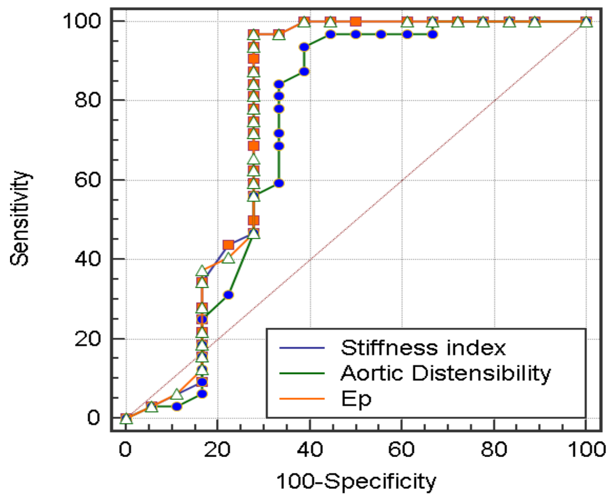

Figure (1): Roc curve between group I and II regarding aortic stiffness parameters

All of the aortic stiffness parameters were sensitive to anticipate the severity of CAD. The aortic stiffness index was the highest sensitive with a cutoff value of>19.2. Aortic distensibility and EP were less sensitive to detect the severity of CAD with a cutoff value of ≤ 3.1 and > 73.2 respectively **(Table 9** and **Figure 2)**.

Table (9): Roc curve between Low and intermediate to high SYNTAX score and aortic stiffness parameters

ROC curve between Low and Intermediate and High SYNTAX score						
	Cutoff	**Sens.**	**Spec.**	**PPV**	**NPV**	**Accuracy**
Stiffness index	>19.2	89.47	76.92	85.0	83.3	82.6%
Aortic distensibility	≤3.1	78.95	69.23	78.9	69.2	76.3%
Ep	>73.2	57.89	92.31	91.7	60.0	69.8%

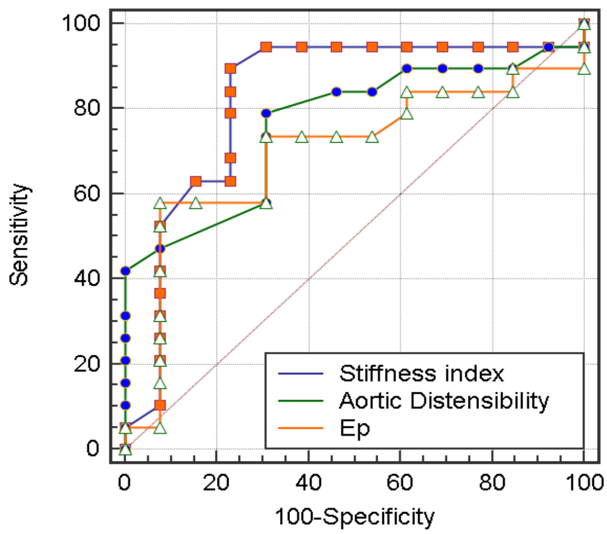

Figure (2): Roc curve between low and intermediate to high SYNTAX score and aortic stiffness parameters

DISCUSSION

Noninvasive echocardiographic measurement of aortic stiffness entails the measurement of parameters that are intrinsically associated with stiffness. This involves three main parameters: aortic stiffness index, aortic distensibility, and pressure-strain elastic modulus *(Güngör et al., 2014)*.

A previous study demonstrated that the noninvasively evaluated aortic stiffness index is comparable with invasive methods with a high degree of accuracy. Also, it was proven that increased aortic stiffness has recently been recognized as a predictor of cardiovascular events *(Güngör et al., 2014)*.

Therefore, the study was designed to assess the aortic stiffness parameter as a predictor and prognostic factor for the presence and complexity of CAD. The study included 50 diabetic patients who presented with Stable CAD at the diabetes clinic of Al-Azhar University Hospitals and was divided into two groups according to the presence of CAD, 32 patients with CAD detected by CA (group I), and 18 patients with normal coronaries (group II). The presence of CAD was correlated directly to LVSD, aortic systolic diameter, and aortic diastolic diameter.

This agreed with another study which stated that when systolic aortic diameter was compared in control and CAD patients, cases with CAD had significantly larger systolic aortic diameter. Also, the same was true for the aortic diastolic diameters measured 3 cm above the aortic valve with a significantly bigger aortic diameter for the CAD patients compared to patients without CAD *(Ozturk and Durmus, 2019)*.

A previous study by *Sen et al. (2013)* showed similar results. Aortic systolic and aortic diastolic diameters were significantly different between the groups. That was also supported by another study that proved that LV systolic diameter was significantly higher *(Güngör et al., 2014)*.

Regarding the TDI of the upper aortic wall in parasternal long-axis and TDI of the mitral annulus, our study showed that there was no significant relationship between those variables and CAD. This was unlike the study by *Cavalcante et al. (2011)* who showed that Ao.S and Ao.E velocities of ascending aorta were significantly low in individuals with CAD and diabetes mellitus by using pulsed wave velocity to measure the aortic stiffness.

Our study showed that by comparing the aortic stiffness parameters between group I and group II, there was a statistically significant difference between the two groups in aortic stiffness index, aortic distensibility, and elastic modulus. Both aortic stiffness index and elastic modulus directly proportional to the presence of CAD, while aortic distensibility is inversely proportional to the same event.

The study of *Sen et al. (2013)* showed that aortic stiffness index and aortic distensibility were significantly different between the groups. This was in line with *El-Naggar et al. (2020)* who showed that patients with CAD had significantly higher aortic stiffness and elastic modulus and significantly lower aortic distensibility.

SYNTAX score was calculated for the group of patients with CAD. This divided the patients with CAD into 2 groups according to the SYNTAX score into low and intermediate to high SYNTAX score.

Based on our study, deceleration time (DT) showed a statistically significant difference with the degree of SYNTAX score being lower in patients with high SYNTAX score. This was seconded by a study by *Elshafey et al. (2020)* who stated that DT was found to be significantly lower in the obstructive CAD group.

As regards the correlation between aortic stiffness parameters and CAD severity based on SYNTAX score, our study stated that there was a direct correlation between aortic stiffness index and elastic modulus and SYNTAX score and there was an inverse correlation between aortic distensibility and SYNTAX score.

This was unlike the result found by *Gaszner et al. (2012)* who stated that there was no significant correlation between the SYNTAX score and regional arterial stiffness parameters using a different technique to measure aortic stiffness called regional velocity of the aortic pulse wave.

Kilic et al. (2013) used Gensini score as a scoring system for CAD and found out that both aortic distensibility and aortic stiffness were independently correlated with Gensini score in the CAD group.

As regards aortic strain elastic modulus, *Karakurt et al. (2016)* stated that the aortic strain elastic modulus in the intermediate and high-SYNTAX score group was significantly higher than in Low- SYNTAX score group.

El-Naggar et al. (2020) studied aortic stiffness and stated that univariate and multivariate logistic regression analysis showed that decreased aortic distensibility and increased elastic modulus and aortic stiffness index were predictors for the severity and complexity of CAD.

By studying Roc curve between group I and II regarding aortic stiffness parameters, aortic stiffness index was the only independent predictor of CAD presence with a cutoff value of aortic stiffness was >17.4, followed by aortic distensibility and elastic modulus.

Kilic et al. (2013), who used Gensini score as a scoring system for CAD, have shown that aortic stiffness index along with aortic distensibility were good predictors for CAD. The aortic distensibility values of ≥1.24 predict the presence of a low Gensini score (≤26 for the study) with a sensitivity of 88.2% and specificity of 84.6% with an area under the curve of 0.94; whereas the aortic stiffness values of ≥3.36 predict the presence of low Gensini score with a sensitivity of 82.4% and specificity of 87.2% with area under the curve of 0.873 unlike our study, aortic stiffness index cutoff was >17.4 and aortic distensibility cut off ≤4.2 to predict high SYNTAX score in CA.

As regards the aortic stiffness parameters to predict the complexity of CAD, it was found that all of the aortic stiffness parameters were sensitive to anticipate the severity of CAD. The aortic stiffness index was the highest sensitive (98.47) with a cutoff value of >19.2 and accuracy of 82.6%. Aortic distensibility and EP were less sensitive to detect the severity of CAD as they record sensitivity of 78.95 and 57.89 with a cutoff value of ≤ 3.1 and > 73.2 respectively.

This was in agreement with *El-Naggar et al. (2020)*, who showed that aortic stiffness parameters are predictors for the severity and complexity of CAD. However, along with diabetes, increased aortic stiffness index (> 17.7) was the only independent predictor of CAD severity, carrying twice the odds of having moderate-high SYNTAX score.

Limitations: The small size of the study population may have biased the statistical results. Other studies with a larger population are needed to confirm our results.

CONCLUSION

Aortic stiffness parameters have a good predictive power concerning coronary artery disease in patients suspected of having ischemic heart disease or more severe coronary involvement. Aortic stiffness index (ASI) in particular has the highest predictive power for the presence and severity of CAD.

REFERENCES

1. **Amraotkar, R.A. Ghafghazi, S. Trainor, PJ. Hargis, C.W. Irfan, B. Rai, S. Bhatnagar, N.A and Defilippis, A.P. (2017):** Presence of Multiple Coronary Angiographic Characteristics for the Diagnosis of Acute Coronary Thrombus. HHS Public Access, 24 (1): 25–34.
2. **Cardoso, C.R.L. Ferreira, M.T., Leite, N.C. and Salles, G.F. (2013):** Prognostic Impact of Aortic Stiffness in High-Risk Type 2 Diabetic Patients: The Rio de Janeiro Type 2 Diabetes Cohort Study. Diabetes Care 36 (11): 3772–37\78.
3. **Cavalcante, J.L. João, A.C. Lima, A.R. and Mouaz, H.A. (2011):** Aortic Stiffness: Current Understanding and Future Directions. Journal of the American College of Cardiology, 5 (14): 71511-71522.
4. **El-Naggar, H M. Anwar, H S. Helmy, H A. and Demitry, S R. (2020):** Aortic Root Distensibility and Stiffness Assessed by Echocardiography as Predictors of Coronary Artery Lesion Severity in Patients Undergoing Coronary Angiography.European Heart Journal - Cardiovascular Imaging, 21 (1): 1503-1505.
5. **Elshafey, W.E. Abdelaziz, W.F. Mohamed, M.S. Omar, O. M (2020):** Severity of Coronary Artery Disease by Coronary CT Angiography in Relation to Left Ventricular Diastolic Function. World Journal of Cardiovascular Diseases, 10 (04): 235–245.
6. **Gale, N.S. Albarrati, A.M. Munnery, M.M. McDonnell, B.J. Benson, V.S. Singer, R.M. Cockcroft, J.R. Shale, D.J. (2019):** Aortic Pulse Wave Velocity as a Measure of Cardiovascular Risk in Chronic Obstructive Pulmonary Disease: Two-Year Follow-up Data from the ARCADE Study. Medicina (Lithuania), 55 (4): 89-95
7. **Gaszner, B. Lenkey, Z. Illyés, M. Sárszegi, Z. Horváth, I.G. Magyari, B. Molnár, F. Kõnyi, A. Cziráki, A. (2012):** Comparison of Aortic and

Carotid Arterial Stiffness Parameters in Patients with Verified Coronary Artery Disease. Clinical Cardiology, 35 (1): 26–31.

8. **Güngör, B. Yilmaz, H. Ekmekçi, A. Özcan, K.S. Tijani, M. Osmonov, D. Karataş, B. Taha, A. Mutluer, F.O. Gürkan, U. Bolca, O. (2014):** Aortic Stiffness Is Increased in Patients with Premature Coronary Artery Disease: A Tissue Doppler Imaging Study. Journal of Cardiology, 63 (3): 223–229.

9. **Karakurt, A. Yildiz, C. Yildiz, A. Başbuğ, H. S. (2016):** Assessment of Relation between Aortic Elastic Properties and the Complexity of Coronary Artery Disease. Acta Cardiologica, 71 (3): 267–273.

10. **Kilic, H. Salih, O. Akdemir, R. Karakurt, O. Cagirci, G. Yeter, E. Acikel, S. Dogan, M. Arslantas, U. Baha, R.M (2013):** An Invasive but Simple and Accurate Method for Ascending Aorta-Femoral Artery Pulse Wave Velocity Measurement. Blood Pressure, 22 (1): 45–50.

11. **Ozturk, S. Durmus, G. (2019):** Aortic Knob Width and Calcification Is Associated with the Extensivity of Lower Extremity Arterial Disease. Annals of Medical Research, 26 (9): 2026.-2030

12. **Sen, T. Tufekcioglu, O. Ozdemir, M. Tuncez, A. Uygur, B. Golbasi, Z. Kisacik, H. (2013):** A New Echocardiographic Parameter of Aortic Stiffness and Atherosclerosis in Patients with Coronary Artery Disease: Aortic Propagation Velocity. Journal of Cardiology, 62 (4): 236–240.

13. **Vlachopoulos, C. Terentes-Printzios, D. Laurent, S. Nilsson, P. M. Protogerou, A. D. Aznaouridis, K. Xaplanteris, P. Koutagiar, I. Tomiyama, H. Yamashina, A. Sfikakis, P. Tousoulis, D. (2019):** Association of Estimated Pulse Wave Velocity With Survival: A Secondary Analysis of SPRINT. JAMA Network Open, 2 (10): 158-163.

دور معامل تصلب الشريان الأورطي في توقع قصور الشريان التاجي المزمن المستقر في مرضي السكري من النوع الثاني

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خلفيـــة البحـــث: ان مرضـــي الســـكري النـــوع الثـــاني لـــديهم معـــدل اصـــابة اعلـــي بالتصـــالب الشـــرياني و عرضـــة اكثـــر للاصـــابة بـــامراض القلـــب والأوعيـــة الدمويـــة او الوفـــاة بســـببها. و بمـــا ان المـــرض الســـكري مـــرض جهـــازي و الـــذي يســـبب بنســـبة اكبـــر فـــي حـــدوث التصـــالب الشـــرياني, فانـــه يـــؤثر علـــي الشـــرايين التاجيـــة كمـــايؤثر علـــي الشريان الاورطي.

الهـدف مـن البحـث: تقيـيم اثـر المـرض السـكري النـوع الثـاني علـي الشـريان الأورطـي باســـتخدام الموجـــات فـــوق الصـــوتية علـــي القلـــب لقيـــاس نســـبة معـــاملات تصـــالب الشـــريان الاورطـــي و اســـتخدام ذلـــك كمؤشـــر لتوقـــع حـــدوث امـــراض الشـــرايين التاجيـــة و مقدار الخطورة كذلك.

المرضـــي و طـــرق البحـــث: تـــم اجـــراء الدراســـة علـــي مـــدار ســـنة ابتـــداءا مـــن اكتـــوبر 2018 الـــي اكتـــوبر 2019 تـــم دراســـة 50 حالـــة مـــن مرضـــي الســـكري النـــوع الثـــاني المتوقـــع وجـــود ذبحـــات صـــدريه مســـتقرة بالشـــكاوي المرضـــية و تواجـــد معـــاملات الخطـــورة لـــديهم. تـــم تقســـيم الحـــالات الـــي مجمـــوعتين تبعـــا لنتيجـــة القســـطرة التشخيصـــيه للشـــراين التاجيـــة .المجموعـــة الأولـــي تـــم اكتشـــاف وجـــود تضـــيقات بالشـــرايين التاجيـــة امـــا المجوعـــة الثانيـــة كـــان لـــديهم شـــرايين تاجيـــة ســـليمة. تـــم اخـــذ تـــاريخ مرضـــي لجميـــع الحـــالات و عمـــل الفحـــص الســـريري. كمـــا تـــم عمـــل موجـــات فـــوق صـــوتية علـــي القلـــب وتـــم حســـاب معـــاملات تصـــالب الشـــريان الاورطـــي و عمـــل تحاليـــل و اخيـــرا تـــم عمـــل قسطرة تشخيصية لتصوير الشرايين التاجية.

نتــائج البحــث: ســت ثلاثــون بالمائــة مــن الحــالات كانــت لــديهم شــرايين تاجيــة طبيعيــة بينمــا اربــع و ســتون بالمائــة مــن الحــالات كــان لــديهم تضــيقات بالشــرايين التاجيــة وتــم اســتخدام معامــل ســنتاكس لتحديــد شــدة التضــيقات . قياســات الشــريان الاورطــي فــي الانقبــاض والانبســاط كانــت اعلــي بشــكل ملحــوظ فــي المجموعــة الاولــي بالمقارنــه بالمجموعــة الثانيــة. معامــل تصــالب الشــريان الاورطــي و معامــل المرونــة كانــت اعلــي بشــكل ملحــوظ فــي المجموعــة الاولــي ايضــا و لكــن كــان معامــل تمــدد الشــريان الاورطــي اعلــي فــي المجموعــة الثانيــة بالمقارنــه بالمجموعــة الاولــى. معامــل تصــالب الشــريان الاورطــي و معامــل مرونــة الشــريان الاورطــي لــديهم علاقــة ايجابيــه بوجــود تضــيقات بالشــرايين التاجيــة و بمقــدار حــدة الاصــابة كــذلك بينمــا معامــل تمــدد الشــريان الاورطــي لديــه علاقــة عكســية مــع نفــس المعــايير. و مــن بــين الــثلاث معــاملات كــان مؤشــر تصــالب الشــريان الاورطــي صــاحب اعلــي حساســية تجــاه تحديــد وجــود تضيقات بالشريان الاورطي و كذلك تحديد مقدار حدة الاصابة.

الاســتنتاج: مؤشــر تصــالب الشــريان الاورطــي لديــه اعلــي مقــدار توقــع لوجــود تضــيقات بالشــرايين التاجيــة و كــذلك تحديــد حــدة الاصــابه حيــث ان المــريض صــاحب مؤشــر اعلــي لتصــالب الشــريان الاورطــي لديــه احتمــال اعلــي بوجــود تضــيقات بالشراين الاورطي و غالبا ما تكون اكثر حده بازدياد رقم المؤشر.

الكلمــات الدالــة: معامــل تصــالب الشــريان الاورطــي, مــرض الشــرايين التاجيــة, المرض السكري النوع الثاني.