Comparsion between CT coronaries and Carotid dupplex in ischemic Patients

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Abstract

One of the leading causes of death in the globe is coronary artery disease (CAD). Patients at high risk for coronary artery disease will be included in this study to determine if carotid artery Doppler ultrasonography and computed tomography of coronary artery (CTA) findings are predictive of severe coronary artery disease (CAD). A prospective observational study was conducted on 70 patients who were admitted to the Nasr City Clinic and the Banha University Cardiology Clinic at the time of the study's completion. ECG abnormalities were found in 22 (31.4 percent) of patients, and the mean age of the patients studied was 51.9 years, with a standard deviation (SD) of 9.3 years. Each side had an average of 1.3 0.3 inches of intima media thickness. Atherosclerosis was seen in 39 (55.7 percent) of the patients with carotid artery damage. Carotid artery Doppler U/S results and CT angiography have a strong association. The conclusion is that carotid IMT can be a useful screening technique for CAD. The findings will provide light on the current clinical state of IMT in the detection of coronary artery disease.

Keywords: Carotid, Doppler, IHD, CAD.

1. Introduction

In the industrialised western world, cardiovascular disease is the leading cause of mortality, and it is expected to become the leading cause of death worldwide in the near future [1].

[2] Early identification of serious coronary and cerebrovascular diseases, as well as their quick intervention, are critical in the management [2] of diabetes.

There are several hereditary and environmental factors that play a role in atherosclerosis, and the development of atherosclerotic disease is influenced by these factors, which include high blood pressure, high cholesterol, and diabetes. According to testing, this method performed only somewhat well [2].

ECG, myocardial perfusion scintigraphy, coronary computed tomography angiography (coronary CT angiography), and conventional coronary angiography all have a high degree of sensitivity and specificity in determining disease severity.

It is impossible to screen all diabetes patients for silent myocardial ischemia with these technologies because of the possibility for major adverse effects, difficulty in performing, availability and high cost. In order to identify patients at high risk of cardiovascular disease, a non-invasive and affordable technique for predicting the likelihood of subclinical or silent atherosclerosis with more than moderate predictive performance is needed.

Recent investigations have demonstrated that carotid atherosclerosis and cerebrovascular or coronary artery disease are closely linked. Doctors have been able to see the carotid wall and lumen surfaces with ultrasound in order to determine the severity of atherosclerosis. A B-mode ultrasound assessment of carotid intima-media thickness (IMT) has been shown to correlate well with pathological measurements and to be a quantitative and reproducible measure of arteriosclerosis. [5]

Particularly in cardiovascular medicine, the selection of a non-invasive diagnostic technology that may be utilised as a screening tool that is both accurate and cost-effective is a primary goal.

The purpose of this study was to examine the correlation between carotid artery Doppler ultrasound (US) and the presence of substantial coronary artery disease (CAD) by computed tomography of coronary artery (CTA) as predictors of major CAD in high-risk patients of ischemic heart disease (IHD).

2. Patients and methods

This prospective observational study conducted at Police hospital Nasr city clinic and Banha University cardiology clinic and 70 patients were included in the study

Inclusion criteria

- ≥ 30 year old.
- Patients with At risk for Ischemic heart disease (Smoking, Hypertension , Dyslipidemic and +ve family history of IHD) presented with ischemic chest pain (retrosternal dull, pressure, heaviness, or squeezing associated symptoms may include pain in the shoulder, arm, upper abdomen, or jaw, or nausea, sweating, or shortness of breath).

Exclusion Criteria

- AF patients or frequent premature beats.
- High Calcium score.
- Estimated glomerular filtration rate (eGFR) <30 mL/min/1.73 m2.
- Previous ischemic events and evidence of revascularization either by stenting or by surgery.
- Age > 70 years old.
- Previous CABG and PCI.
- Known ischemic patient

Informed consent was obtained from all participants and The study approved by the ethics committee on research involving human subjects of Police hospital Nasr city clinic and all patients underwent the following diagnostic work up: Full

medical history including: Age, gender, cardiovascular risk factors e.g. hypertension, diabetes mellitus, smoking, symptoms suggestive of cardiac disease, current medications and family history. Full clinical examination including: Assessment of body weight, height, and vital signs including blood pressure, pulse and respiratory rate. Blood samples and chemistry of serum creatinine, blood urea, lipid profile, hemoglobin A1c. Twelve-lead surface ECG was done to all patients, All patients underwent trans-thoracic echocardiography in left lateral position

All patients underwent carotid Doppler U/S to detect maximum and overall IMT of the common carotid artery and presence of carotid plaques (defined as isolated and focal areas of abnormal intima protruding into the lumen more than 1.5 mm or at least 50% of the surrounding IMT value).IMT represents the thickness of the intima plus the media component of the vessel wall.

Statistical Analysis

The data were collected, tabulated and statistically analyzed using the suitable program. The collected data tabulated, and statistically analyzed using SPSS program (Statistical Package for Social Sciences) software version 26.0, Microsoft Excel 2016 and MedCalC program software version 19.1. Descriptive statistics were done for numerical parametric data as mean ± SD (standard deviation)

and minimum & maximum of the range and for numerical non parametric data as median and 1st & 3rd inter-quartile range, while they were done for categorical data as number and percentage.

3. Results

This prospective observational study was carried out on 70 patients that admitting to Police hospital Nasr city clinic and Banha University cardiology clinic. Table (1) shows demographic characteristics in the study group. The age of patients ranged from 36 to 68 years with mean age ±SD was 51.9± 9.3 years (table 1). Regarding gender, 41 (58.6%) patients were males while 29 (41.4%) patients were female (table 1) with male to female ratio was 1.41: 1. The weight of patients ranged from 69 to 115 kg with mean ±SD was 94.0± 13.5 kg. The height of patients ranged from 157 to 187 cm with mean ±SD was 171.4± 8.99 cm. The BMI of patients ranged from 20.68 to 43.75 kg/m^2 with mean ±SD was 32.20± 5.37 kg/m^2. (table 1). Twenty (28.6%) patients were smokers, 43 (61.4%) patients were non-smokers and 7 (10%) patients were x-smokers (table 1,). As regards to chronic diseases, 30 (42.9%) patients were hypertensive and 36 (51.4%) patients were diabetics. Regarding family history of ischemic heart diseases, 40 (57.1%) patients had family history of IHD.

Table (1) Distribution of socio-demographic characteristics among the studied patients.

Parameters		Study group (n=70)	
		n	%
Age (years)	Mean± SD	51.9± 9.3	
	Median (IQR)	53.0 (43.0- 58.0)	
	Range	36.0- 68.0	
Gender	Male	41	58.6%
	Female	29	41.4%
Weight (Kg)	Mean± SD	94.0± 13.5	
	Median (IQR)	95.0 (83.0- 105.0)	
	Range	69.0- 115.0	
Height (cm)	Mean± SD	171.4± 8.99	
	Median (IQR)	171.0 (164.0- 180.0)	
	Range	157.0- 187.0	
BMI (Kg/ m^2)	Mean± SD	32.20± 5.37	
	Median (IQR)	32.02 (27.94- 36.71)	
	Range	20.68- 43.75	
Smoking	No	43	61.4%
	Yes	20	28.6%
	X- smokers	7	10.0%
Hypertension	No	40	57.1%
	Yes	30	42.9%
Diabetes Mellitus	No	34	48.6%
	Yes	36	51.4%
Family history of IHD	No	30	42.9%
	Yes	40	57.1%

SD: standard deviation, IQR: interquartile range, IHD: ischemic heart diseases

Figure (1) illustrates distribution of ECG findings among the study group. 22 (31.4%) patients showed abnormal ECG findings.
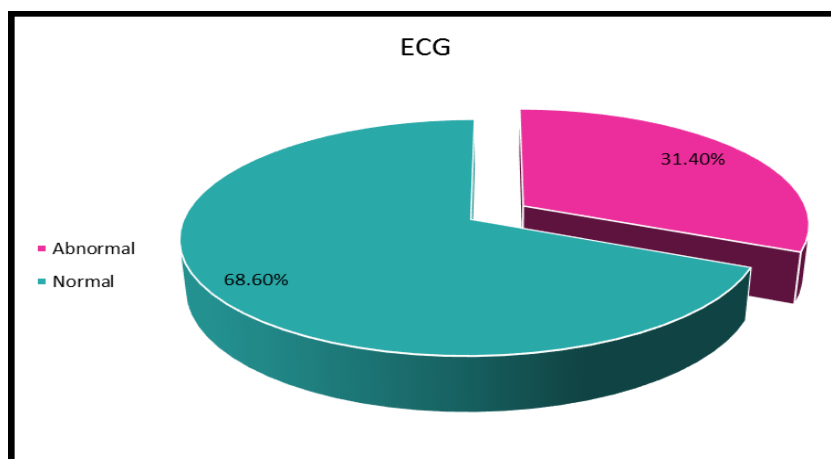
Fig. (1) Distribution of studied patients regarding ECG findings.

Table (2) shows echocardiography findings in the studied patients. It was revealed that the mean ± SD of LA, AO root and SWT were 39.1± 3.6 mm, 34.6± 1.7 mm and 10± 0.9 mm respectively. While the mean ± SD of LVEDD, PWT and LVEDD were 48.6± 1.9 mm, 8.7± 1.2 mm and 32.2± 2.1 respectively. The mean ejection fraction was 62.4± 4.1 and the mean FS was 33.2± 3.0 %. Regarding segmental wall motion abnormality, 10 (14.3%) patients had septal wall motion abnormality, 9 (12.9%) patients had anterior wall motion abnormality, 8 (11.4%) patients had lateral wall motion abnormality and 7 (10%) patients had posterior wall motion abnormality.

Table (2) Distribution of Echocardiography findings in the study group

Parameters		Study group (n=70)	
		n	%
LA (mm)	Mean± SD	39.1± 3.6	
	Median (IQR)	39.0 (36.0- 42.0)	
	Range	33.0- 46.0	
AO. Root (mm)	Mean± SD	34.6± 1.7	
	Median (IQR)	35.0 (33.0- 36.0)	
	Range	30.0- 37.0	
SWT (mm)	Mean± SD	10± 0.9	
	Median (IQR)	10.0 (9.0- 11.0)	
	Range	9.0- 11.0	
LVEDD (mm)	Mean± SD	48.6± 1.9	
	Median (IQR)	48.0 (47.0- 50.0)	
	Range	46.0- 52.0	
PWT (mm)	Mean± SD	8.7± 1.2	
	Median (IQR)	9.0 (8.0- 10.0)	
	Range	7.0- 10.0	
LVESD (mm)	Mean± SD	32.2± 2.1	
	Median (IQR)	32.0 (30.0- 34.0)	
	Range	29.0- 35.0	
EF (%)	Mean± SD	62.4± 4.1	
	Median (IQR)	63.0 (60.0- 65.0)	
	Range	45.0- 67.0	
FS (%)	Mean± SD	33.2± 3.0	
	Median (IQR)	33.0 (31.0- 36.0)	
	Range	29.0- 38.0	
Segmental wall motion abnormality	No	36	51.4%
	Anterior wall	9	12.9%
	Lateral wall	8	11.4%
	Posterior wall	7	10.0%
	Septal wall	10	14.3%

SD: standard deviation, IQR: interquartile range, EF: Fraction shorting

4. Discussion

The purpose of this study was to examine the correlation between carotid artery Doppler ultrasound (US) and the presence of substantial coronary artery disease (CAD) by computed tomography of coronary artery (CTA) as predictors of major CAD in high-risk patients of ischemic heart disease (IHD). The current results showed that 48 (68.6 percent) of the patients had normal ECG findings, while 22 (31.4 percent) had aberrant ECG findings.

A research by Vaidya et al. [7] found that all 36 Rose angina patients had their resting ECGs recorded and evaluated, and 24 of those patients had ECGs that indicated myocardial ischemia.

At least one ECG anomaly was seen in 85.4 percent of patients, according to Adeoye et al. [8]. Atrial fibrillation and/or left ventricular hypertrophy with or without strain pattern were substantially more common in women.

The mean SD of LA, AO root, and SWT were found to be 39.1 3.6 mm, 34.6 1.7 mm, and 10 0.9 mm, respectively, on echocardiography. However, the mean SD of LVEDD, PWT, and LVEDD were all 48.6 1.9% higher than the national average of 8.7 1.2 mm. The mean ejection percentage was 62.4 4.1 percent and the mean fractional shortening (FS) was 33.2 3.0 percent. When it comes to segmental high wall abnormality, we observed that 10 (14.3%), 9 (12.9%), 8 (11.4%), and 7 (10%) of the patients had septal wall motion abnormality, respectively, as well as anterior, lateral, and posterior motion abnormalities.

According to Mohammadzad et al., [9], LVEF, IVSD, and E wave were considerably lower in the study group than the control group.

Regarding the results of Carotid artery Doppler US in our patients investigated. The mean intima media thickness was found to be 1.3 0.3 on the left and 1.3 0.3 on the right. Carotid artery disease was found in 74.3 percent of patients, a larger percentage than Fernandes et al., [10], who found atherosclerotic plaques in 39 of their subjects (53 percent).

IMT of the common carotid artery (CCA) has recently been proposed as a fast, noninvasive, and reproducible marker of CAD. B-mode ultrasound pictures can be used to measure the distance between the media-adventitia layer and the echogenic lumen-intima layer. Predictors of atherosclerotic disease and cardiovascular events and outcomes are linked to the presence of this marker in patients. Furthermore, it has been found to be linked to a number of cardiovascular risk factors, including smoking, sex, diabetes, hypertension, and cholesterol. Aside from that, it is possible to use IMT to forecast the severity of coronary artery disease (CAD). Patients with coronary artery disease (CAD) have higher IMT than healthy controls, according to a prior study. The IMT was also higher in patients with more advanced CAD. The exact role of IMT in the clinical screening of CAD has not yet been determined, despite the fact that multiple studies have shown a strong correlation between IMT and the development of CAD.

Carotid artery Doppler U/S findings were found to correlate strongly with CT angiography results in this investigation. Multivariate regression analysis with IMT assessed by Carotid artery Doppler U/S as a dependent variable, LCx and total measurement emerged as the independent conditions linked with inducible ischemia in the studied population.

For coronary heart disease, stroke, and cardiovascular disease (CVD), the adjusted hazard ratios associated with per standard deviation increase in intima-media thickness in Zhang et al. [11] were 1.10, 1.08, and 1.14 for each standard deviation increase. Using proton-density–weighted MRI, the equivalent relationships for mean wall thickness were: 1.32; 1.48; 1.37; and 1.27; 1.58; 1.38 for gadolinium-enhanced MRI. While intima-media thickness remained a significant predictor of outcomes, MRI wall thickness was not.

IMT's sensitivity and specificity were found to be 31.91% and 90.52 percent, respectively, in research conducted by Zhang et al. [12]. They observed that carotid IMT 0.9-mm had 50% and 96% sensitivity and specificity, respectively. The diagnostic sensitivity and specificity were shown to be 68% and 70%, respectively, by Liu et al. [14]. The AUC for this study was 0.74. In addition, a subgroup analysis based on IMT threshold values was conducted. A threshold value of IMT 0.8 mm had a sensitivity of 66% and a specificity of 66%, respectively. More than 70% sensitivity and 67% specificity may be achieved by using an IMT cutoff value of 0.08-1mm. Sensitivity and specificity were increased by 66% and 79%, respectively, when IMT > 1 mm was used as the cutoff value.

5. Conclusion

Carotid IMT has been proposed as a useful method for the early detection of CAD. The findings will provide light on the current clinical state of IMT in the detection of coronary artery disease.

References

[1] A. Becker, "Predictive value of coronary calcifications for future cardiac events in asymptomatic patients with diabetes mellitus: a prospective study in 716 patients over 8 years," BMC Cardiovasc. Disord.vol.8, pp.1–8,2008.

[2] S. Van Dieren, "External validation of the UK Prospective Diabetes Study (UKPDS) risk engine in patients with type 2 diabetes," Diabetologia.vol. 54,pp.264–270,2011.

[3] R. K. Simmons, "Performance of the UK prospective diabetes study risk engine and the Framingham risk equations in estimating cardiovascular disease in the EPIC-Norfolk cohort," Diabetes Care.vol.32, pp.708–713, 2009.

[4] J. W. Stephens, G. Ambler, P. Vallance, D. J.

Betteridge, S. E. Humphries, and S. J. Hurel, "Cardiovascular risk and diabetes. Are the methods of risk prediction satisfactory?," Eur. J. Cardiovasc. Prev.Rehabil.vol.11,pp.521–528, 2004.

[5] N. Katakami, T. Matsuoka, and I. Shimomura, "Clinical utility of carotid ultrasonography: Application for the management of patients with diabetes," J. Diabetes Investig.vol.10, pp.883–898,2019.

[6] C. Gottfried, V. Bambini-Junior, F. Francis, R. Riesgo, and W. Savino, "The impact of neuroimmune alterations in autism spectrum disorder,"Front.psychiatry.vol.6,pp.121, 2015.

[7] A. Vaidya, P. K. Pokharel, S. Nagesh, P. Karki, S. Kumar, and S. Majhi, "Prevalence of coronary heart disease in the urban adult males of eastern Nepal: a population-based analytical cross-sectional study," Dharan BP Koirala Inst. Heal. Sci.vol.5,pp.14-23, 2009.

[8] A. M. Adeoye, "Prevalence and prognostic features of ECG abnormalities in acute stroke: findings from the SIREN study among Africans," Glob. Heart.vol.12,pp.99–105,2017.

[9] M. H. S. Mohammadzad, K. Khademvatani, S. Gardeshkhah, and A. Sedokani, "Echocardiographic and laboratory findings in coronary slow flow phenomenon: cross-sectional study and review," BMC Cardiovasc. Disord.vol.21,pp.1–8,2021.

[10] M. Fernandes, B. Keerthiraj, A. R. Mahale, A. Kumar, and A. Dudekula, "Evaluation of carotid arteries in stroke patients using color Doppler sonography: A prospective study conducted in a tertiary care hospital in South India," Int. J. Appl. Basic Med. Res.vol.6,pp.38,2016.

[11] D. Liu, C. Du, W. Shao, and G. Ma, "Diagnostic role of carotid intima-media thickness for coronary artery disease: A meta-analysis," Biomed Res. Int.vol.2,pp.44-53,2020.

[12] Y. Zhang, "Carotid artery wall thickness and incident cardiovascular events: a comparison between US and MRI in the Multi-Ethnic Study of Atherosclerosis(MESA),"Radiology.vol.289,pp.649–657,2018.

[13] Y. Zhang, E. Guallar, Y. Qiao, and B. A. Wasserman, "Is carotid intima-media thickness as predictive as other noninvasive techniques for the detection of coronary artery disease?," Arterioscler. Thromb. Vasc. Biol.vol.34,pp.1341–1345,2014.

[14] D. J. Murphy, "Diagnostic accuracy of carotid intima media thickness in predicting coronary plaque burden on coronary computed tomography angiography in patients with obstructivesleepapnoea,"J.Cardiovasc. Comput.Tomogr.vol.11,pp.227-233,2017.