RESEARCH ARTICLE

Clinical presentation and outcome in Acute Coronary Syndrome patients in relation to plaque morphology identified by Intra Vascular Ultra Sound

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Abstract

Objective: To evaluate plaque morphology in non-culprit coronary arteries using intravascular ultrasound in patients with acute coronary syndrome with and without elevated glycated haemoglobin and its assocaition with patient outcome.

Methods: The cross-sectional study was conducted at the Cardiology Department of Kafrelsheikh University, Egypt, from November 2019 to January 2022, and comprised adult patients of either gender suffering from acute coronary syndrome. The patients were divided into three groups. Diabetic patients were in group A, prediabetic patients with elevated glycated haemoglobin in group B, and patients with normal glycated haemoglobin in group C. The patients were subjected to coronary angiography and percutaneous coronary intervention. Intravascular ultrasound scan was done after succcessful intervention. Lesions were classified according to ultrasound findings. Patients were followed up for one year to observe subsequent events to the morphology of the lesions detected at baseline. Data was analysed using SPSS 20.

Results: Of the 52 patients, 18(34.7%) were females and 34(65.3%) were males. Group A had 18(34.6%)patients; 13(72%) males and 5(28%) females with mean age 57.9±6.9 years. Group B had 17(32.7%) patients; 11(64.7%) males and 6(35.3%) females with mean age 56.5±5.5 years. Group C had 17(32.7%) patients; 10(59%) males and 7(41%) females with mean age 59.5±5.1 years (p>0.05). Thin-capped fibro-atheroma was significantly higher in groups A and B compared to group C (p=0.045). Significant direct correlation between major adverse cardiac events and prevalence of thin-capped fibro-atheroma was found between groups A and C (*p*=0.033), and between groups B and C (*p*=0.047) regarding prevalence of necrotic plaque and subsequent myocardial infarction.

Conclusion: Thin-capped fibro-atheroma was the more common plaque type in patients with raised glycated haemoglobin, and the subsequent rate of major adverse cardiac events was significantly higher in such patients compared to the non-diabetic population.

Keywords: Plaque, Atherosclerotic, Angiography, Vessels, Percutaneous, Prediabetic.

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Introduction

Acute coronary syndrome (ACE) can be evaluated through clinical characteristics, electrocardiogram (ECG)and cardiac biomarkers of myocardial necrosis.[1]

Despite the fact that ACS mortality has decreased, it is still believed that 40% of patients who have a coronary event will pass away within 5 years, with the risk of death being 5-6 times higher in individuals who experience a recurrent event.[2]

In a study[3], plaque burden >70%, and thin-capped fibro-atheroma (TCFA) detected by IVUS were predictors of non-culprit lesion-related major adverse cardiac events (MACEs).

On the basis of virtual histology-intravascular ultrasonography (VH-IVUS), plaque components can be categorised as dense calcium, fibrous tissue, fibrofatty plaque, or necrotic core, and reported as percentages of total plaque areas and volumes.[4]

The current study was planned to evaluate plaque morphology in non-culprit coronary arteries using IVUS in patients with ACE with and without elevated glycated haemoglobin (HbA1c), and its assocaition with patient outcome.

Patients and methods

The cross-sectional study was conducted at the Cardiology Department of Kafrelsheikh University, Egypt, from November 2019 to January 2022. After approval from the institutional ethics review committee, the sample was raised from among adult patients of either gender suffering from ACE. Those included were patients who underwent angiography and percutaneous coronary intervention (PCI). Those excluded were patients having cardiogenic shock, renal failure, severe liver disease, allergy to contrast media and or heavily calcified vessels.

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After taking written informed consent from all the patients, they were divided into three groups. Diabetic patients with HbA1c >6.4% were in group A, prediabetic patients with elevated HbA1c 5.7-6.4% in group B, and patients with normal HbA1c<5.7% in group C.

All patients were subjected to detailed, clinical examination, including testing for HbA1c, low-density lipoprotein (LDL) and triglycerides (TG), 12-lead ECG, coronary angiography and multimodality IUVS scan of non-culprit coronary arteries.

IVUS classified lesions as VH- TCFA, thick-TCFA (ThCFA), pathological intimal thickening, fibrotic plaque, or fibrocalcific plaque.The plaques were classified as follows:

Echolucent (soft) plaques: The low echogenicity is attributed to high lipid content in a mostly cellular lesion. However, a necrotic zone within the plaque is an intramural haemorrhage.[5] Echodense (fibrous) plaques: These represent the majority of atherosclerotic lesions. Their echogenicity is intermediate between echolucent and highly echogenic calcific plaques.[6] Calcific plaques: In IVUS, calcium is shown as hyperechoic plaque that is brighter than the reference adventitia with shadowing.[5-77]

Patients were then followed for one year from index intervention to observe subsequent events to the morphologies of the lesions detected at baseline. MACEs were defined as death from cardiac causes, cardiac arrest, MI or re-hospitalisation for unstable or progressive angina.

Data was analysed using SPSS 20. Categorical data was presented as frequencies and percentages, and was compared using chi-squareor Fisher's exact test, as appropriate. Continuous variables were expressed as mean ± standard deviation (SD) for normally distributed data, or as median and range for non-normally distributed data. Intergroup differences were tested using analysis of variance (ANOVA). Two-tailed $p<0.05$ was considered statistically significant.

Results

Of the 52 patients, 18(34.7%) were females and 34(65.3%) were males. Group A had 18(34.6%) patients; 13(72%) males and 5(28%) females with mean age 57.9±6.9 years. Group B had 17(32.7%) patients; 11(64.7%) males and 6(35.3%) females with mean age 56.5±5.5 years. Group C had 17(32.7%) patients; 10(59%) males and 7(41%) females with mean age 59.5±5.1 years. HTN was not significantly different among the groups ($p=0.674$) (Table 1, Figure 1). There were 11(61.1%) smokers in group A, 6(35.3%) in group B and 9(53%) in group C ($p=0.298$). There were 9(50%) hypertensive patients in group A, 11(64.7%) in group B and 10(58.8%) in group C ($p=0.674$). (Figure 2).

Clinical presentation with STEMI, NSTEMI and unstable angina (UA) was not significantly different among the groups (Table 2).

Regarding plaque type, significant difference were noted between groups A and C, and between groups B and C with ($p<0.05$), while there was no significant difference between groups A and B ($p=0.236$)

With regard to calcific plaque, there was significant difference between groups A and C ($p=0.042$), while there was no significant differences between groups A and B ($p=0.351$) and between groups B and C ($p=0.062$).

Regarding fibrotic plaque: there was no significant difference among the groups (Table 3, Figure 3).

Significant direct correlation between MACE and TCFA prevalence was found between groups A and C ($p=0.033$), and between groups B and C ($p=0.047$) regarding prevalence of necrotic plaque and subsequent myocardial infarction. With regard to progressive angina, significant difference was noted between groups A and C ($p=0.044$), while there was no significant differences between groups A and group B, and between groups B and C (Figure 4).

Table-1: Demographic characteristics and risk factors.

Demographic Data		Group A (Diabetic) Mean ±SD	Group B (Raised HbA1C) Mean ±SD	Group C (Normal) Mean ±SD	*p-value*
Age (years)		57.9 ±6.9	56.5 ±5.5	59.5 ±5.1	0.358
Gender	Male	13	11	10	
	Female	5	6	7	0.705
Risk factors		**Group A (Diabetic)**	**Group B (Raised HbA1C)**	**Group C (Normal)**	***p-value***
HTN	Yes	9	11	10	0.674
	No	9	6	7	
Smoking	Yes	11	6	9	0.298
	No	7	11	8	

D: Standard deviation, HTN: Hypertension, HbA1c: Glycated haemoglobin.

Table-2: Clinical presentation in the studied groups.

Clinical Data	Group A (Diabetic)	Group B (Raised HbA1C)	Group C (Normal)	*p-value*
STEMI	5	7	9	0.634
NSTEMI	6	5	3	
UA	7	5	5	

HbA1c: Glycated haemoglobin,STEMI: ST elevation myocardial infarction, NSTEMI:Non-ST elevation myocardial infarction, UA: Unstable angina.

Table-3: Plaque types and major adverse cardiac events(MACEs) in the studied groups.

Plaque Type	Group A (Diabetic)	Group B (Raised HbA1C)	Group C (Normal)	*p-value* A,B&C	B&C	A&C	A&B
TCFA	7	3	2	0.236	0.031*	0.047*	0.045*
Calcific	9	4	1	0.351	0.042*	0.062	
Fibrotic	4	6	9	0.363	0.061	0.0712	
MACE	**Group A (Diabetic)**	**Group B (Raised HbA1C)**	**Group C (Normal)**	***p-value*** **A,B&C**	**B&C**	**A&C**	**A&B**
TCFA	8	1	0	0.336	0.033*	0.047*	0.047*
Calcific	9	3	1	0.251	0.044*	0.052	
Fibrotic	1	2	3	0.263	0.041	0.071	

HbA1c: Glycated haemoglobin, TCFA: Thin-capped fibroatheroma, MI: Myocardial infarction.

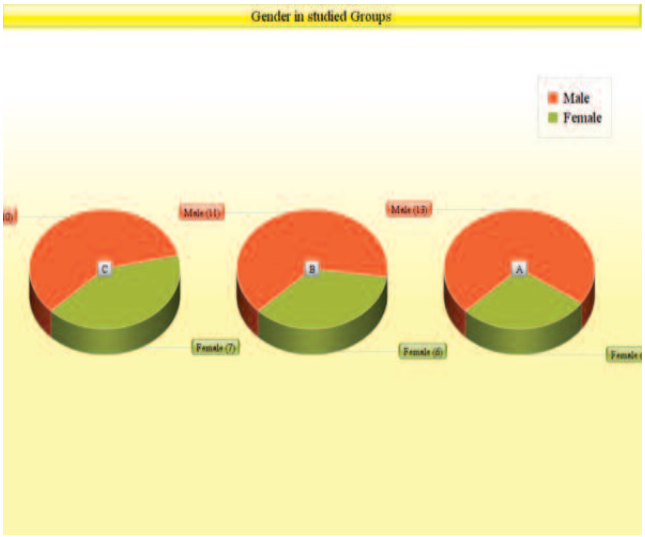

Figure 1: Gender distribution in the studied groups.

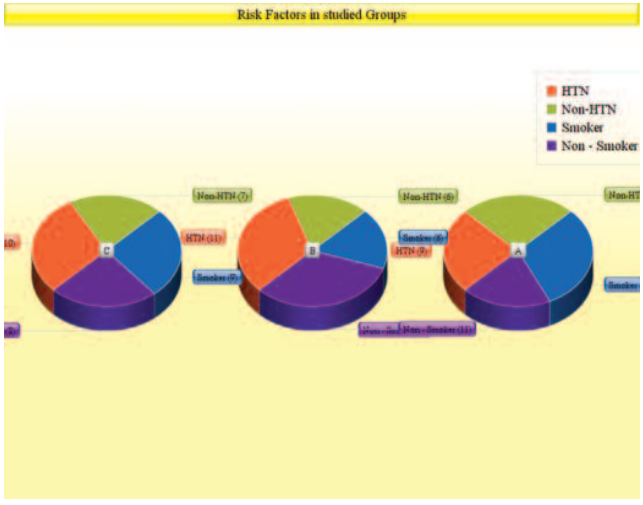

Figure 2: Risk factors in the studied groups.

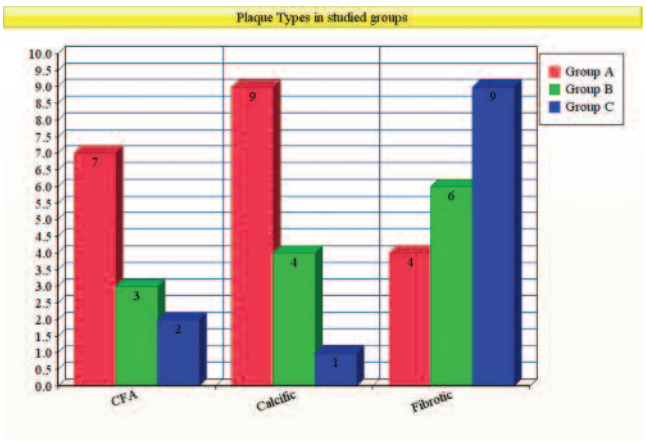

Figure 3: Plaque types in the studied groups.

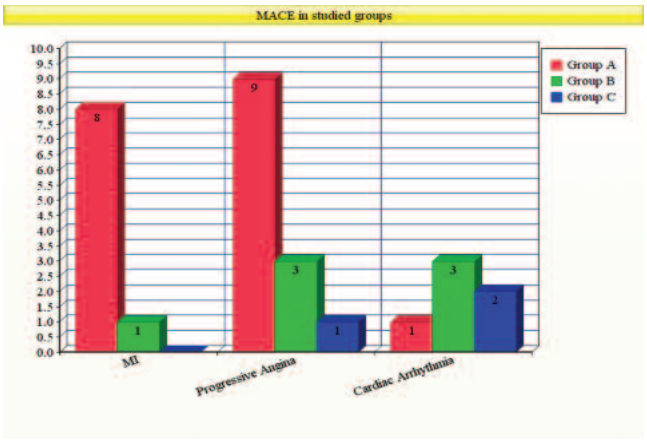

Figure 3: Major adverse cardiac event (MACEs) in the studied groups.

Discussion

Diabetes is a chronic disease responsible for a high rate of morbidity and mortality which can be attributed to atherosclerosis and cardiovascular disease. Diabetes is preceded by prediabetes. Type 2 diabetes mellitus (T2DM) is a proinflammatory process and a known risk factor for MACE. The same inflammatory markers may be present in prediabetes (pDM), but the relationship between pDM and MACE is not well studied.

The current findings were concordant with earlier studies which assessed the impact of pDMstatus on coronary disease.[8]

Plaque rupture is mostly preceded by the development of aTCFA, the most common type of vulnerable plaque.[9]

TCFAs have been defined as a large lipid core covered with thin fibrous cap and is the precursor lesion for plaque rupture.[10]

Sheng et al. using optical coherence tomography found the association of long DM duration with increased lipid-rich

plaques, TCFA, and plaque ruptures in patients with MI.[11]

In contrast to current results, a study showed significant difference regarding clinical presentation[12]

Another study showed no difference between diabetic and non-diabetic groups regarding clinical presentation with STEMI and NSTEMI, while there was difference in terms of UA.[13]

One study showed that the rate of adverse events was higher in diabetic patients.[14]

Comparable with the current results, a study showed that elevated HbA1c was a significant and independent predictor of MACE after PCI.[15]

Similar to the current results, a study showed no significant difference regarding MACE.[16]

The current study has limitations as the sample size was not calculated, which may have affected the power of the study. Also, the sample size ws too small to allow for generalisation of the findings.

Conclusion

TCFAI was the more common plaque type in patients with raised HbA1c,and the subsequent MACE rate was significantly higher in those patients compared to the non-diabetic population.

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Conflict of Interest: None.

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