RESEARCH ARTICLE

Coronary plaque morphology and characteristics in patients with raised haemoglobin A1c: an intravascular ultrasound Study

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Abstract

Objectives:To identify coronary plaque morphology using grey scale and virtual histology intravascular ultrasound in patients with and without elevated glycated haemoglobin.

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 admitted for catheterisation. 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. All patients were subjected to clinical examination, 12-lead electrocardiogram, coronary angiography and multimodality intravascular ultrasonography scan of proximal segments 3-6cmof non-culprit coronary arteries intra group differences were compared using the analysis of variance (ANOVA) test.

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-cap fibroatheroma was significantly higher in groups A and B compared to group C (p=0.045).

Conclusion: Patients with raised glycated haemoglobin presenting with acute coronary syndrome were found to have more vulnerable plaque types than those with normal levels.

Keywords: Coronary angiography, Artery, Glycated, Prediabetic, Electrocardiography, Catheterisation.

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Introduction

Diabetes mellitus (DM) and pre-diabetes mellitus (pre-DM) are common among patients with coronary artery disease (CAD)[1] Pre-DM is considered a risk factor for developing DM later in life and also heart disease, which is linked to an increased possibility of serious cardiac complications and a high risk for major adverse cardiovascular events (MACEs).[2]

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 (NC), and are reported as percentages of total plaque areas and volumes IVUS) and VH have good correlations with histopathology and may be able to classify plaques into various subtypes.[3]

A study found that thin-cap fibroatheroma (TCFA), detected by IVUS, and plaque burden >70% were found to be indicators of future cardiac events unrelated to the culprit lesion.[4]

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Plaque morphology in acute coronary syndrome (ACS) patients with and without DM has not been fully investigated. The current study was planned to fill the gap by evaluating the coronary plaque morphology in patients with and without raised glycated haemoglobin (HbA1c) using grey scale and VH-IVUS.

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 admitted for catheterisation. 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 complication with anti-platelet therapy. Patients with tortuous, severely calcified, or chronic complete occlusion of coronaries were also excluded because of the possible difficulty of doing IVUS in such conditions.

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 HbA1c5.7-6.4% in group B, and patients with normal HbA1c<5.7% in group C.

All patients were subjected to detailed, clinical examination, including testing for hypertension (HTN), DM and dyslipidaemia,12-lead electrocardiogram (ECG), coronary angiography and multimodality IUVS scan of proximal segments 3-6cm of non-culprit coronary arteries.

Plaque was classified as TCFA, thick-cap fibroatheroma, pathological intima thickening, fibrotic plaque, or fibrocalcific plaque.

Fibrotic plaque consisted of fibrotic tissue with <10% confluent necrosis, <10% dense calcification, and <15% fibrofatty plaque.

Echolucent (soft) plaques: The low echogenicity is attributed to high lipid content in a mostly cellular lesion. However, a necrotic zone within the plaque, an intramural haemorrhage is also Echolucent,[5] Echodense (fibrous) plaques: These represent the majority of atherosclerotic lesions. Their echogenicity is intermediate between echo lucent 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.[7]

Categorical data were presented as counts (proportions) and were compared using the (Chi square) test or (Fisher's exact) test if the expected cell value was <5.

Continuous variables are shown as the mean ± standard deviation (SD) for normally distributed data or as median for non-normally distributed data. Between group differences were tested using the analysis of variance (ANOVA) test. A two-tailed P value < 0.05 was considered significant.

Results

Of the52 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) There were 11(61.1%) smokers in group A, 6(35.3%) in group B and 9(53%)in group C (Table 1).

Mean low-density lipoprotein (LDL) level was 109.1±13.2mg/dl in group A, 112.9±12.9mg/dl in group B and 101.2±5.9 mg/dl in group C (p=0.013). Triglyceride (TG) level was 138.5±29 mg/dl in group A, 142.5±23.1 mg/dl in group B and 112.7±11.3mg/dl in group C (p≤0.004) (Table 2).

TCFA was significantly higher in groups A and B compared to group C (p=0.045) (Table 3).

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 (Ys)		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	

SD: Standard deviation, HbA1C: Glycated haemoglobin, HTN: Hypertension.

Table-2: Lipid profile.

Data	Group A (Diabetic) Mean ±SD	Group B (Raised HbA1C) Mean ±SD	Group C (Normal) Mean ±SD	*p-value*
LDL (mg/l)	109.1±13.2	112.9±12.9	101.2 ±5.9	0.013*
TG	138.5±29	142.5±23.1	112.7 ±11.3	0.004**

Statistically Significant **highly significant

SD: Standard deviation, HbA1C: Glycated haemoglobin, LDL: Low-density lipoprotien, TG: Triglyceride.

Table-3: Plaque types and coronary length.

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	

Data	Group A (Diabetic) Mean ±SD	Group B (Raised HbA1C) Mean ±SD	Group C (Normal) Mean ±SD	*p-value*
Non-Culprit Coronary Length scanned by IVUS (mm)	32.8±7.4	34.4±9.7	31.7 ±7.0	0.636

SD : standard deviation, HbA1C: Glycated haemoglobin, TCFA: Thin-cap fibroatheroma, IVUS: Intravascular ultrasound.

*** Statistically Significant**

Discussion

The current study evaluated coronary plaque morphology using grey scale and VH-IVUS in patients with ACS with and without elevated HbA1c levels.

Kurihara et al. assessed the impact of prediabetic status on CADand showed, like the current study, no significant difference related to age.[8]

Sánchez et al. evaluated the features of atheromasias in the prediabetes stage, and showed significant age-based differences, which is in disagreement with the current findings.[9]

A study found no significant difference in terms of smoking status and HTN[5], which was also noted by the current study.

In contrast to the current finding, Zhang et al. reported elevated blood pressure (BP)in DM than normoglycaemic individuals, and in the DM group than in the prediabetic group[7], but found no significant difference in relation to smoking status.[10]

TCFA were more frequently present in mixed plaques and the increased amount of necrotic core was shown to be a feature of increased risk to plaque rupture.[11]

TCGA was defined as a large lipid pool covered with thin fibrous cap and is considered a precursor lesion for plaque rupture.[12]

Sheng et al. used optical coherence tomography and reported an association of longer duration of DM and higher HbA1c with increased prevalence of lipid-rich plaques, TCFA, and plaque ruptures of culprit lesions in patients with acute myocardial infarction (AMI).[13]

The current study has limitations as the the sample size was not calculated which has affected the generalisabilityof the findings.

Conclusion

Patients with raised HbA1c presenting with ACE had more vulnerable plaque types than those with normal levels.

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Conflict of Interest: None.

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