

Original Article

Study of the features of coronary artery atheromatous plaque using intravascular ultrasound in patients with impaired glucose tolerance

Jin-Ming Cen^a, Xi-Li Yang^{a,*}, Qing-Yuan Xiong^b, Zhao-Yan Xu^a, Ri-Ming Liang^a

^a Cardiology Department, First People's Hospital of Foshan, Foshan, Guangdong 528000, China

^b Department of Clinical and Laboratory Medicine, Chancheng District Central Hospital of Foshan, Foshan, Guangdong 528000, China

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Abstract

Objective: We used intravascular ultrasound (IVUS) to analyze the features of coronary artery atheromatous plaque in patients with impaired glucose tolerance and mild-to-moderate angiographic coronary stenosis. The aim was to determine the clinical significance of plaque characteristics as well as the relationship between hemoglobin A1c (HbA1c) levels and coronary artery lesions.

Methods: HbA1c levels were evaluated in 85 patients (96 lesions), of whom 46 had impaired glucose tolerance (IGT Group) and 39 had normal blood glucose (NBG Group). IVUS was used to analyze the lesion vessel of both groups qualitatively and quantitatively. The external elastic membrane area (EEMA), minimal lumen area (MLA), plaque area (PA), and plaque burden (PB) were measured for both the target lesion and the reference segments (reference external elastic membrane area (REEMA), reference minimal lumen area (RMLA), reference plaque area (RPA), and reference plaque burden (RPB), respectively).

Results: HbA1c levels were significantly higher in the IGT Group than in the NBG Group ($P < 0.05$). In the IGT Group there was more soft plaque, eccentric plaque, and positive remodeling, and less calcification, while in the NBG Group there was much harder plaque and calcification, no reconstruction, and negative remodeling ($P < 0.05$). MLA was smaller in the IGT Group than in the NBG Group, while EEMA, PA, and PB were clearly greater ($P < 0.05$). In the meantime, RMLA was clearly smaller in the IGT Group than in the NBG Group, while RPA and RPB were greater ($P < 0.05$). HbA1c levels were positively correlated with PA and PB, and negatively correlated with MLA.

Conclusion: IVUS is very valuable for the evaluation of mild-to-moderate coronary lesions. The coronary artery lesions in patients with IGT are more serious and widespread than those in patients with NBG. HbA1c levels might be of some value in assessing the severity of coronary artery lesions.

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* Corresponding author.

E-mail address: 289124834@qq.com (X.-L. Yang).

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Introduction

Impaired glucose tolerance is a transitional phase between normal glucose tolerance and diabetes. It is associated with a significantly increased risk of microvascular and macrovascular complications. The risk of serious adverse cardiovascular events increases further when impaired glucose tolerance coexists with coronary atherosclerosis.¹

In recent years, research has shown that the severity of an atherosclerotic lesion has only a weak correlation with its clinical sequelae, the majority (60%–70%) of which are caused by the rupture of the atherosclerotic plaque and the secondary thrombus. Traditional coronary angiography (CAG) has demonstrated that most clinical events were associated with mild-to-moderate stenosis.^{2–4}

In the present study, CAG was used to evaluate patients who had both coronary artery disease and impaired glucose tolerance. In those cases that showed mild-to-moderate stenosis on CAG, intravascular ultrasound (IVUS) was used to classify the pathological changes in coronary plaque and assess their clinical significance.

Methods

Subjects

Between July 2009 and December 2010, we evaluated 85 patients with stable or unstable angina, of whom 46 had impaired glucose tolerance (IGT Group) and 39 had normal blood glucose (NBG Group). All patients had at least one 50–70% vessel diameter stenosis in an epicardial coronary artery or its main branch, as confirmed by CAG. No patients in either group were taking hypoglycemic drugs.

Coronary angiography

The normal reference segments and the lesion segment were identified for each coronary vessel. A “normal” reference segment was defined as a 5–10 mm segment without pathological changes in the proximal or distal part of the target lesion vessel. The lesion segment was the one with the most severe stenosis, according to images from different angiographic projections, and as assessed by quantitative coronary angiography (QCA).

IVUS images

Quantitative indicators: All data for analysis were collected from the segment with the worst stenosis

according to IVUS. The external elastic membrane area (EEMA), minimal lumen area (MLA), plaque area (PA), and plaque burden (PB) were measured for both the target lesions and the reference segments (reference external elastic membrane area (REEMA), reference minimal lumen area (RMLA), reference plaque area (RPA), and reference plaque burden (RPB), respectively), together with any vascular calcification.

Qualitative indicators: Based on the ultrasonic echo, plaque can be divided into four types: soft plaque, fibrous plaque, calcific plaque, and mixed plaque. Eccentric plaque refers to plaque that builds up unevenly on the wall of the arteries, so that its maximum thickness is more than twice the minimum.

Statistical methods

SPSS 14.0 statistical software (SPSS Inc. Chicago, IL, USA) was employed. The Chi-square test was used to compare numerical data, which were expressed as mean values. The *t*-test was used for between-group comparisons and Pearson analysis was used to test correlations between two factors. A *P*-value < 0.05 represented the level of statistical significance.

Results

The clinical data showed that the IGT Group had significantly higher levels of hemoglobin A1c (HbA1c) than the NBG Group (*P* < 0.05) (Table 1).

In this study, 96 pathological lesions were evaluated and found to have a mean area stenosis of $53.68 \pm 2.58\%$ by CAG and $59.66 \pm 4.66\%$ by IVUS (*P* < 0.05); Angiography identified a total of 96 lesions in the 85 patients. According to the IVUS data for these lesions, MLA was less in the IGT Group than in the NBG Group, while EEMA, PA, and PB were clearly greater in the IGT Group (*P* < 0.05). However, RMLA was clearly less in the IGT Group than in the NBG Group, while RPA and RPB were higher (*P* < 0.05) (Table 2).

In the IGT Group, there were 52 plaques, including 36 eccentric plaques, while in the NBG Group, there were 44 plaques of which 20 were eccentric. The difference was statistically significant (*P* = 0.019). The IGT Group showed more soft plaque, eccentric plaque, and positive remodeling of the coronary artery, but less calcification, while the NBG Group showed more fibrous plaque, calcification, and either no remodeling or negative remodeling (*P* < 0.05) (Table 3).

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