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Original article

Relationship between yellow plaque grade and tissue protrusion after stent implantation: A coronary angioscopy study

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ABSTRACT

Background: Tissue protrusion detected with optical coherence tomography after percutaneous coronary intervention using stents is one of the risk factors for early stent thrombosis. However, tissue protrusion features have not been described. The aim of this study was to compare tissue morphology at stented sites with or without tissue protrusion by using coronary angioscopy.
Methods: Using optical coherence tomography and coronary angioscopy, we assessed 42 patients [31 men, 11 women; age, 70.7 ± 7.4 years; acute coronary syndrome (ACS), $n = 19$; effort angina pectoris (EAP), $n = 23$] after stenting.
Results: Twenty patients had tissue protrusion. ACS patients had a higher incidence of tissue protrusion than EAP patients (70.0% vs 29.4%; $p = 0.002$). The plaque at the protrusion site had higher-grade yellow plaque with thrombus than those without protrusion (2.35 ± 0.67 vs 1.40 ± 0.67; $p < 0.001$). The plaque at protrusion sites developed more thrombi (60.0% vs 22.7%; $p = 0.041$).
Conclusions: Tissue protrusion after stent implantation was associated with high-grade yellow plaque with thrombi.

Introduction

There has been an increase in the use of imaging modalities such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT) for percutaneous coronary intervention (PCI). Several modalities have frequently detected tissue protrusion after lesions have been stented. However, no study has assessed the nature of tissue protrusion using coronary angioscopy (CAS). Therefore, the aim of the present study was to compare tissue morphology at stented sites with and without tissue protrusion using CAS after detection with OCT.

Materials and methods

We retrospectively assessed 42 consecutive lesions after stent implantation using CAS for 42 patients who had undergone PCI from October 2013 to September 2015 at Ehime Prefectural Imabari Hospital. All patients received dual anti-platelet therapy with aspirin and clopidogrel or prasugrel before PCI and heparin injection with the goal of an activated coagulation time exceeding 300 s.

Tissue protrusion was defined when material was detected with OCT within the stent lumen immediately after PCI (Fig. 2). In the current study, we included tissue protrusion with a maximum height ≥100 μm for analysis. OCT was performed after intracoronary administration of 1–2 mg nitroglycerin. The ILUMIEN OPTIS (St. Jude Medical Inc., St. Paul, MN, USA) OCT system and the Dragonfly™ catheter (St. Jude Medical Inc.) were used.

The FT-203F (FiberTech Co. Ltd., Tokyo, Japan) non-obstructive coronary angioscope system and VISIBLE (FiberTech Co. Ltd.) optical fiber were used. Stented lesions were observed angioscopically while blood was cleared from the field of view with an injection of dextran, as previously reported [1]. Each modality analysis was performed with the agreement of two independent cardiologists.

After implantation, we examined the stent using OCT to confirm that it was adequately expanded. Then, we also determined whether there was tissue protrusion. We also assessed the presence of thrombus and the grade of yellow plaque at the stented site using CAS. The upper panel in Fig. 1 shows thrombus characteristics (red, mixed, and white) and the lower panel shows atherosclerotic plaque characteristics according to CAS. For example, Fig. 2 showed the relationship between OCT and CAS

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0914-5087/

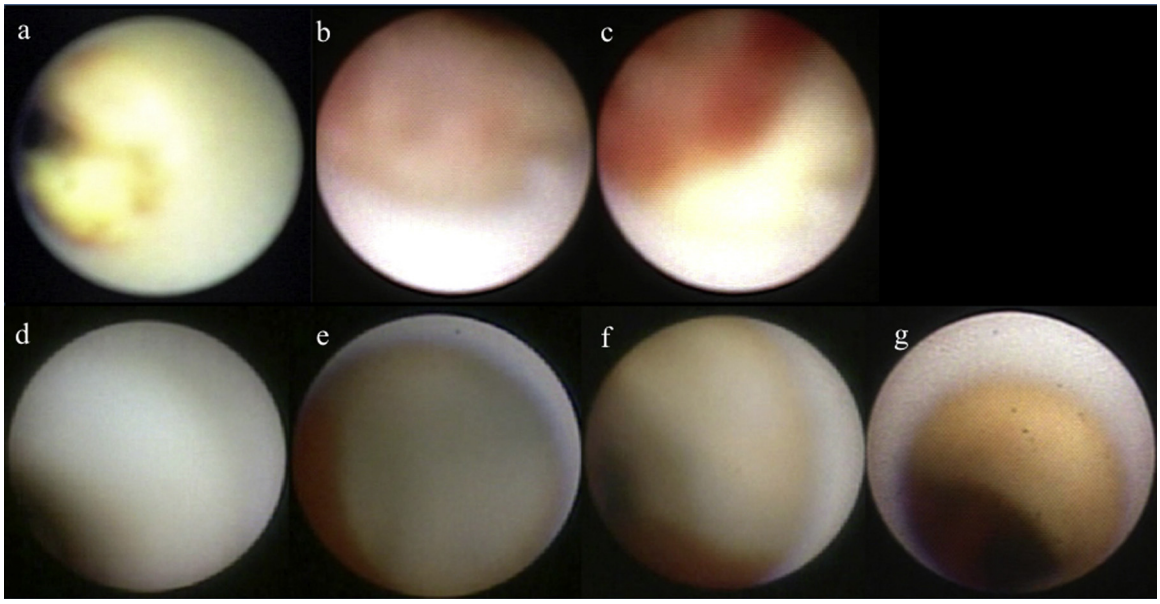

Fig. 1. Definitions of thrombus and color grade of yellow plaque by coronary angioscopy. The upper panel shows thrombus characteristics: (a) white thrombus; (b) mixed thrombus; and (c) red thrombus. The lower panel shows atherosclerotic plaque characteristics: (d) white (grade 0); (e) light yellow (grade1); (f) yellow (grade 2); and (g) bright yellow (grade 3).

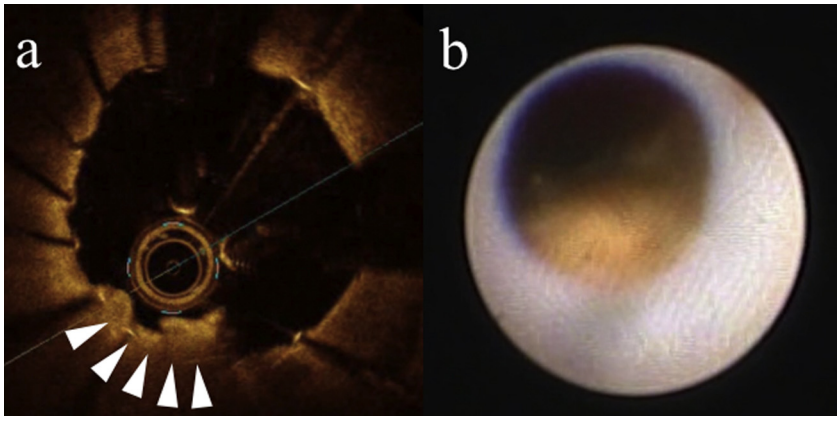

Fig. 2. Relationship between optical coherence tomography (OCT) and coronary angioscopy (CAS) after stenting. OCT disclosed high-grade tissue protrusion between stent struts. CAS demonstrated high-grade yellow plaque at the protrusion site.

after stenting. OCT disclosed high-grade tissue protrusion between stent struts. CAS demonstrated high-grade yellow plaque at the protrusion site.

In this study, we performed OCT after stenting and defined the protrusion site. Then, we performed CAS to assess the protrusion site. Tissue protrusion detected by CAS was defined as not being able to see through the struts or struts covered with yellow plaque or various thrombi despite being able to see through them. Using CAS, the tissue protrusion grade was defined by yellow color-grade characteristics. This study was approved by the institutional review committee of our hospital. All patients provided written informed consent.

Data are presented as mean ± standard deviation. Statistical analyses of the results of the tissue protrusion and non-tissue protrusion groups were performed using Student's t test, χ^2 test, or Mann–Whitney's U-test; $p < 0.05$ was regarded as statistically significant. Statistical analyses were performed using EZR [2].

Results

We retrospectively assessed 42 cases during 2 years. Twenty patients had protrusion and 22 patients had no protrusion on OCT. Sex, body mass index, hypertension, diabetes mellitus, dyslipidemia, and smoking status showed no significant differences between the two groups. However, there were significant differences in low-density lipoprotein (LDL) cholesterol and statin use between these groups. ACS patients had a higher incidence of tissue protrusion than EAP patients (70.0% vs 29.4%; $p = 0.002$). There were no significant differences between the groups regarding stent length, stent diameter, number of stents, or stent type (Table 1).

CAS findings showed that protrusion sites after stenting had more yellow plaque with thrombus than sites without protrusion (2.35 ± 0.37 vs 1.40 ± 0.67; $p < 0.001$). Additionally, the stent struts at the protrusion sites had more thrombus formations (60.0% vs 22.7%; $p = 0.041$) (Table 2).

Discussion

This is the first report to analyze plaque morphology using CAS and OCT at the tissue protrusion site after stenting. We found that tissue protrusion after stent implantation was associated with more yellow plaque with thrombus.

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