

## Scientific letters

**Neoatherosclerosis as the Cause of Very Late Bare-metal Stent Restenosis: Optical Coherence Tomography Evaluation*****Neoaterosclerosis como causa de reestenosis muy tardía de un stent convencional: evaluación mediante tomografía de coherencia óptica*****To the Editor,**

A man aged 49 years, ex-smoker with a family history of premature ischemic heart disease, attended the emergency department after 1 month with clinical symptoms of progressive angina following even minimal exertion. In 2001, he had presented non-Q wave acute myocardial infarction and undergone conventional bare-metal stent (BMS) implantation in the mid left anterior descending artery. In 2007, a coronary angiogram for exertional angina showed no stent restenosis. Following a change in treatment, he remained asymptomatic and recorded negative exercise test results until this admission in 2012.

In view of symptoms of unstable angina, a fresh coronary angiography was requested and this showed substantial, focal intrastent restenosis (Fig. 1). An angioplasty guidewire was advanced through the stenosis without complications and a decision was made to use optical coherence tomography for the assessment. The optical coherence tomography showed correct expansion of the stent, absence of uncovered struts, and presence of intrastent neoatherosclerosis (Fig. 2) with lipid-laden intima, a cavity resulting from the rupture of the fibrous cap of a fine-cap fibroatheroma, and an apparently more fibrous proximal portion with images compatible with cholesterol crystal deposits. The intrastent restenosis was predilated with a delivery balloon and a drug-eluting stent implanted.

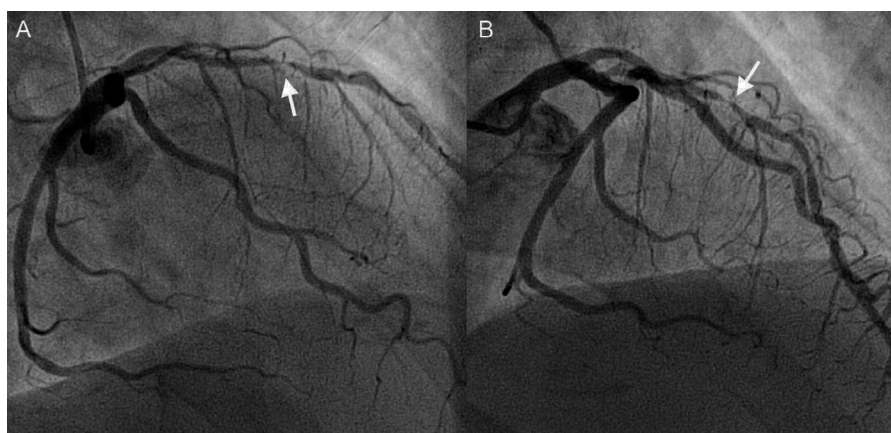
Bare-metal stent restenosis has traditionally been considered stable and benign, presenting neointimal growth in the first 6 to 12 months followed by a later quiescent period. However, the angiographic clinical course of our patient and optical coherence tomography images support the recent theory that

neoatherosclerosis is an active causal mechanism in many cases of restenosis and late stent thrombosis.<sup>1</sup> Moreover, symptoms of progressive angina and the discovery of ruptured plaque intrastent confirm that presentation is not consistently in the form of silent ischemia or stable angina and it has been estimated that  $\leq 9.5\%$  of BMS restenoses could present as acute coronary syndrome.<sup>2</sup>

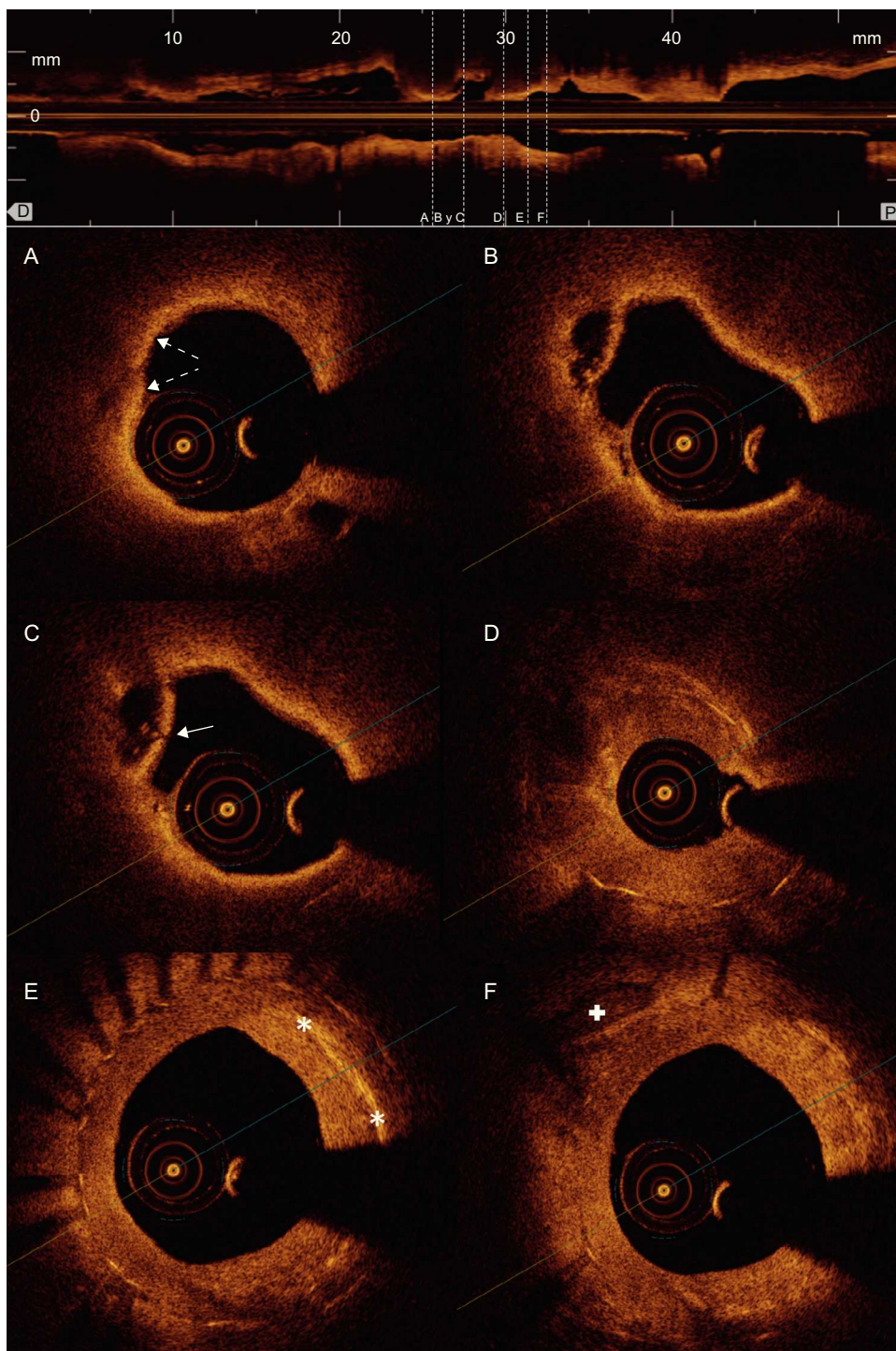
Histopathologic studies have shown that, while neoatherosclerosis is a common process in BMS and drug-eluting stent, its occurrence is neither homogeneous nor simultaneous.<sup>3</sup> In drug-eluting stent, incidence is more frequent and it appears early; in BMS, it is quite exceptional at  $<2$  years.<sup>3,4</sup> Nonetheless, at-risk lesions (fine-cap fibroatheroma and ruptured plaque) are more frequently detected in BMS restenosis, even though—as in our patient (Figs. 2A–C)—they mostly appear at  $>5$  years post-implantation.<sup>3–5</sup>

Very little data exist on optical coherence tomography evaluation of late restenosis in BMS. Takano et al.<sup>4</sup> studied initial behavior ( $<6$  months) and course ( $>5$  years) of coronary segments with BMS revascularization and found homogeneous neointimal coating in the first phase, but only in the second phase established the presence of calcium deposits, lipid nuclei, or cholesterol crystals accompanied by significant reduction of lumen. Habara et al.<sup>5</sup> compared findings on early ( $<1$  year) and late ( $>5$  years) BMS restenosis and described significant differences in neointimal structure, which was more heterogeneous in appearance and much like typical atherosclerotic plaque. Finally, Yonetsu et al.<sup>6</sup> also reported greater attenuation and lipid content in late ( $>48$  months) BMS restenosis neointima by comparison with early BMS restenoses.

Given known morbidity and mortality associated with restenosis and stent thrombosis, it is essential we study the pathologic mechanism in greater depth. The rupture and exposure to the circulating blood of prothrombotic lipid material contained in the neointima may be the cause of many thromboses. The present case shows how optical coherence tomography can contribute to our understanding of these mechanisms.



**Figure 1.** A and B: Substantial focal stent restenosis (arrows) in the middle segment of the left anterior descending artery.



**Figure 2.** Optical coherence tomography: intrastent restenosis. A: Lipid-laden neointima (low intensity tissue, badly defined borders, and high attenuation that causes a shadow limiting visualization of the stent struts); presents points, superficial, hyperintense areas compatible with macrophage infiltration (broken arrows). B: Cavity caused by the rupture of a neointimal plaque with the remains of its fibrous capsule. C: Ruptured fibrous cap of the same plaque (arrow). D: Heterogeneous neointimal proliferation causing substantial arterial lumen stenosis. E: Very hyperintense linear areas compatible with cholesterol deposits (asterisks) in the neointima. F: Diffuse neointimal and more homogeneous proliferation indicating greater fibrous content, with calcium plaque (cross) outside of the stent.

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## Myocardial Infarction in South Asian Immigrants in Catalonia. Results From the ASIAM Study

### Infarto de miocardio en inmigrantes del sur de Asia en Cataluña. Resultados del Estudio ASIAM

#### To the Editor,

In recent years, Catalonia has experienced a considerable increase in immigration from South Asia.<sup>1</sup> This trend has been associated with a rise in hospital admissions for acute myocardial infarction (AMI) in South Asian patients, whose demographic characteristics, risk profile, and the extent of coronary disease seem to differ from that of individuals of European origin.

The aim of our study was to analyze the differences between South Asian and white Spanish patients admitted for a first AMI in a Catalanian reference hospital. This is a retrospective study including all South Asian patients (n=76) and white Spanish patients (n=1253) consecutively hospitalized for a first AMI in our coronary unit between 2002 and 2011. The demographic characteristics of the two groups were compared. South Asian and Spanish patient pairs were then matched for age ( $\pm 2$  years), sex, and year of presentation ( $\pm 2$  years), and comparisons were performed for coronary risk factors, clinical presentation, coronary anatomy, and in-hospital clinical course. Because of difficulties in matching South Asians and Spanish patients by age, the ratio ultimately defined was 1:1.6 (76 South Asian patients:127 Spanish patients). Data on the variables studied were obtained from the hospital admission records. Comparisons between the two groups were performed with the chi-square test for categorical variables and the Student *t* test or Mann Whitney *U* test for continuous variables, depending on whether or not they followed a normal distribution.

The majority of patients in the South Asian group were from Pakistan (78.9%), followed by India and Bangladesh (10.5%, respectively). As compared to the white Spanish population, South Asians were younger ( $47.5 \pm 8.7$  vs  $65.1 \pm 12.7$  years;  $P < .001$ ) and there was a higher percentage of men (92.1% vs 72.1%;  $P < .001$ ). The prevalence of risk factors, comorbidities, and previous treatments in the two groups is shown in Table 1. The clinical presentation, results of angiography study, treatments, and in-hospital clinical course are summarized in Table 2.

**Table 1**

Differences in Coronary Risk Factors, Biochemical Parameters, Associated Comorbidity, and Pharmacological Treatment Before Hospitalization Between Age- and Sex-Matched South Asian and White Spanish Patients.

|                                   | South Asian<br>(n=76) | White Spanish<br>(n=127) | P     |
|-----------------------------------|-----------------------|--------------------------|-------|
| <i>Age and sex after matching</i> |                       |                          |       |
| Age, years                        | 47.5 $\pm$ 8.7        | 48.6 $\pm$ 8.1           | .400  |
| Men                               | 70 (92.1)             | 117 (92.1)               | .792  |
| <i>Coronary risk factors</i>      |                       |                          |       |
| Diabetes mellitus                 | 22 (28.9)             | 25 (19.7)                | .180  |
| Hypertension                      | 21 (27.6)             | 54 (42.5)                | .048  |
| Active smoker/ex-smoker           | 49 (64.5)             | 106 (83.5)               | .002  |
| Smokers, cigarettes/day           | 20.8 $\pm$ 9.8        | 26.6 $\pm$ 11.0          | .011  |
| Cocaine use                       | 1 (1.3)               | 12 (9.4)                 | .034  |
| <i>Biochemical parameters</i>     |                       |                          |       |
| Total cholesterol, mg/dL          | 181 $\pm$ 46.9        | 196 $\pm$ 46.3           | .032  |
| HDL-C, mg/dL                      | 35.5 $\pm$ 8.9        | 42.3 $\pm$ 10.8          | <.001 |
| LDL-C, mg/dL                      | 115 $\pm$ 34.2        | 124 $\pm$ 38.3           | .097  |
| Triglycerides, mg/dL              | 171 [129–234]         | 158 [124–233]            | .454  |
| HbA <sub>1c</sub> , %             | 5.6 [5.0–8.3]         | 5.2 [4.8–5.8]            | .003  |
| <i>Other comorbidities</i>        |                       |                          |       |
| Peripheral vasculopathy           | 1 (1.3)               | 5 (3.9)                  | .414  |
| Chronic renal failure             | 0 (0.0)               | 4 (3.1)                  | .299  |
| Thrombophilia                     | 0 (0.0)               | 1 (0.7)                  | 1.000 |
| HIV infection                     | 0 (0.0)               | 4 (3.1)                  | .299  |
| <i>Previous treatments</i>        |                       |                          |       |
| ASA                               | 3 (3.9)               | 6 (4.7)                  | 1.000 |
| Clopidogrel                       | 0 (0.0)               | 2 (1.6)                  | .529  |
| Beta blockers                     | 3 (3.9)               | 10 (7.9)                 | .378  |
| ACEI/ARB                          | 4 (5.3)               | 23 (18.1)                | .010  |
| Statins                           | 5 (6.5)               | 31 (24.4)                | .001  |
| Insulin/oral lipid lowering drugs | 15 (19.7)             | 11 (8.7)                 | .039  |

ACEI, angiotensin-converting enzyme inhibitors; ARB, angiotensin receptor blocker; ASA, acetylsalicylic acid; HbA<sub>1c</sub>, glycohemoglobin; HDL-C, high-density lipoprotein cholesterol; HIV, human immunodeficiency virus; LDL-C, low-density lipoprotein cholesterol.

Data are expressed as n (%), mean $\pm$  standard deviation, or median [interquartile range].