Effect of shear stress on plaque rupture

Pablo Garcia-Pavia MD, Pablo Aguiar-Souto MD, Raymundo Ocaranza MD

A previously asymptomatic 40-year-old woman was admitted to the emergency department with acute onset of left-sided chest pain on exertion. The initial electrocardiogram showed ST-segment elevation in the anterior leads, suggesting an anterior ST-segment elevation myocardial infarction. Symptoms improved after treatment with oxygen, acetylsalicylic acid and oral nitroglycerin, although the ST-segment elevation persisted.

Emergency cardiac catheterization demonstrated an ulcerated culprit lesion just at the entrance of an intramyocardial coronary segment (Figure 1). No other coronary lesions were documented. The disruption of the normal left coronary artery anatomy created by the presence of the intramyocardial segment may have induced changes in vessel wall shear stress at this point, and may have prompted plaque rupture. An intra-coronary 3 mm × 24 mm paclitaxel-eluting stent was successfully implanted; this modified the left anterior descending

artery architecture by correcting the angle of the intramyocardial segment entrance (Figure 2). No incidents occurred during admission, and the patient was discharged on day 4, with treatment with acetylsalicylic acid, clopidogrel, enalapril, atenolol and atorvastatin.

DISCUSSION

Vulnerable plaques with a lipid core covered by a fibrous cap develop at locations of eccentric low shear stress at the outer edges of vessel bifurcations or, as shown here, in the transitional angle between epicardial and intramyocardial segments. When these plaques grow and start projecting into the lumen, the shear stress over the plaque changes. This increases tensile stress at the plaque shoulders, promoting its fissuring and leading to an acute myocardial infarction, even in a patient such as the one described in the present report, who was at very low atherosclerotic risk.

Figure 1) Coronary angiogram showing an ulcerated plaque (arrow) at the entrance of an intramyocardial segment in the left anterior descending artery. **Inset:** Area in detail

Figure 2) Coronary angiogram after stent implantation at the entrance of the intramyocardial segment (arrow). The angle of the intramyocardial segment entrance has been successfully corrected

Department of Cardiology, Puerta de Hierro University Hospital, Madrid, Spain

Correspondence: Dr Pablo Garcia-Pavia, Department of Cardiology, Puerta de Hierro University Hospital, San Martín de Porres, 4, 28035

Madrid, Spain. Telephone 34-91-7342775, fax 34-91-7352902, e-mail pablogpavia@yahoo.es

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