

Balloon angioplasty results in increased segmental coronary distensibility: A likely mechanism of percutaneous transluminal coronary angioplasty

Journal of the American College of Cardiology, Volume 23, Issue 5, April 1994, Pages 1043-1052

Authors

Javier Botas MD, David A. Clark MD, FACC, Fausto Pinto MD, Adrian Chenzbraun MD, Tim A. Fischell MD, FACC

Abstract

Objectives

The purpose of this study was to evaluate the hypothesis that the increase in lumen area induced by percutaneous transluminal coronary angioplasty is secondary to a change in lesion (segmental) distensibility.

Background

Despite the widespread use of coronary angioplasty, the precise mechanism (or mechanisms) of lumen area improvement remains poorly understood.

Methods

Quantitative coronary angiography was used to measure the minimal (contrast agent filled) balloon diameters at 1 to 5 atm, inclusive, during the first and final balloon inflations in 24 lesions successfully treated with coronary angioplasty. To rule out possible confounding effects due to changes in balloon material distensibility during repeated inflations, five control balloons were studied ex vivo. In parallel, intravascular ultrasound imaging was utilized to compare the segmental distensibility (change in lumen area during the cardiac cycle) of eight disease-free and seven mildly diseased coronary segments and seven segments after successful balloon angioplasty.

Results

Minimal balloon diameters increased significantly between the first and final inflations (46%, 33%, 26%, 14% and 10% at 1, 2, 3, 4 and 5 atm, respectively, all $p < 0.0001$), demonstrating an increase in arterial distensibility after successful coronary angioplasty. No significant changes in balloon diameters were observed during sequential initial inflations at 1 and 2 atm ($n = 5$). Minimal increases in Balloon diameters were observed during repeated balloon inflations in the ex vivo studies ($4.9 \pm 1\%$ [mean \pm SEM]). A distensibility index, derived from the intravascular ultrasound data, was not different between the balloon-dilated and the normal segments but was significantly lower in mildly diseased sites (14.7 ± 2.2 vs. 12.9 ± 1.2 vs. 6.9 ± 1.9 , respectively, $p < 0.05$) despite a smaller plaque area (7.3 ± 1 vs. 11.3 ± 1 mm², proximal/nondilated vs. dilated segments, respectively, $p < 0.05$).

Conclusions

Coronary distensibility is significantly impaired in atherosclerotically diseased coronary segments and increases significantly after balloon angioplasty. This increase in segmental coronary compliance after coronary angioplasty may create a larger lumen area by allowing the vessel to distend in response to normal intraarterial pressure.