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X-Sizer for Thrombectomy in Acute Myocardial Infarction Improves ST-Segment Resolution

Results of the X-Sizer in AMI for Negligible Embolization and Optimal ST Resolution (X AMINE ST) Trial

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OBJECTIVES We sought to compare, in a prospective randomized multicenter study, the effect of adjunctive thrombectomy using X-Sizer (eV3, White Bear Lake, Minnesota) before percutaneous coronary intervention (PCI) versus conventional PCI in patients with acute myocardial infarction (AMI) for <12 h and Thrombolysis In Myocardial Infarction (TIMI) flow grade 0 to 1. The primary end point was the magnitude of ST-segment resolution after PCI.

BACKGROUND Despite a high rate of TIMI flow grade 3 achieved by PCI in patients with AMI, myocardial reperfusion remains relatively low. Distal embolization of thrombotic materials may play a major role in this setting.

METHODS We conducted a prospective, randomized, multicenter study in patients with AMI <12 h and initial TIMI flow grade 0 to 1 who were treated with primary PCI. The magnitude of ST-segment resolution 1 h after PCI was the primary end point.

RESULTS A total of 201 patients were included. Treatment groups were comparable by age (61 ± 13 years), diabetes (22%), previous MI (8%), anterior MI (52%), onset-to-angiogram (258 ± 173 min), and glycoprotein IIb/IIIa inhibitor use (59%). The magnitude of ST-segment resolution was greater in the X-Sizer group compared with the conventional group (7.5 vs. 4.9 mm, respectively; $p = 0.033$) as ST-segment resolution >50% (68% vs. 53%; $p = 0.037$). The occurrence of distal embolization was reduced (2% vs. 10%; $p = 0.033$) and TIMI flow grade 3 was obtained in 96% vs. 89%, respectively ($p = 0.105$). Myocardial blush grade 3 was similar (30% vs. 31%; p = NS). Six-month clinical outcome was comparable (death, 6% vs. 4% and major adverse cardiac and cerebral events, 13% vs. 13%, respectively). By multivariate analysis, independent predictors of ST-segment resolution >50% were: younger age, non-anterior MI, use of the X-Sizer, and a short time interval from symptom onset.

CONCLUSIONS Reducing thrombus burden with X-Sizer before stenting leads to better myocardial reperfusion, as illustrated by a reduced risk of distal embolization and better ST-segment resolution. (J Am Coll Cardiol 2005;46:246–52) © 2005 by the American College of Cardiology Foundation

Percutaneous coronary intervention (PCI) and stenting currently are considered the gold standard treatment (1) in patients with acute myocardial infarction (AMI). This treatment has been shown to increase the rate of acute Thrombolysis In Myocardial Infarction (TIMI) flow grade 3 of the infarct-related artery (IRA) (2,3), which is correlated with better mid- and long-term outcomes. However, TIMI flow grade 3 is only the tip of the iceberg, and a discrepancy between vessel patency and rescue of the jeopardized myocardium after interventional or pharmacologic treatment of AMI has been documented in at least one-third of patients (4–8). This discrepancy between angiographic epicardial flow and myocardial tissue reperfusion is multifactorial (9–13). However, the main issue is probably the occurrence of distal embolization of plaque and thrombus debris, either spontaneously or induced by percutaneous intervention, which may lead to obstruction in distal coronary branches or arterioles, limiting the efficacy and the extent of myocardial tissue reperfusion. In a recent work, Henriques et al. (14) showed that the occurrence of angiographically visible distal embolization during primary PCI was observed in 15% of cases and that it was significantly associated with a high rate of death at five-year follow-up compared with patients who had no distal embolization. New mechanical devices to remove thrombus and to prevent embolization of thrombus and plaque during PCI have become available (15–18), but few randomized studies have been performed in the setting of primary angioplasty (19,20). The present randomized study was designed to evaluate the effects of mechan-

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Abbreviations and Acronyms

AMI = acute myocardial infarction
CI = confidence interval
cTFC = corrected TIMI frame count
ECG = electrocardiogram/electrocardiographic
GP = glycoprotein
IRA = infarct-related artery
MACCE = major adverse cardiac and cerebral events
OR = odds ratio
PCI = percutaneous coronary intervention
TIMI = Thrombolysis In Myocardial Infarction

ical thrombus removal on myocardial tissue reperfusion in patients undergoing primary PCI. Because the mortality rate after primary PCI has become relatively low, we decided to use ST-segment resolution as a surrogate end point, given that it is one of the most sensitive and reliable markers of myocardial reperfusion (21) and has proved to be highly correlated with long-term outcome (22).

METHODS

Study population. Patients suffering an AMI who were amenable to PCI were included in 14 European centers with previous experience in the use of the X-Sizer device (X-Sizer catheter system; eV3, White Bear Lake, Minnesota). The inclusion criterion was AMI for <12 h (i.e., evidence of ischemic chest pain for >30 min and new ST-segment elevation for ≥2 mm in two or more contiguous electrocardiographic [ECG] leads, de novo lesion, single-vessel treatment in a native vessel ≥2.5 mm in diameter and occluded, thrombus-containing, TIMI flow grade 0 to 1 infarct-related artery). Main exclusion criteria were previous PCI in IRA, rescue PCI, Killip class ≥3, left or right bundle branch block, IRA with excessive proximal tortuosity or severe calcification, left ventricular ejection fraction <30%, contraindication to emergency coronary artery bypass grafting, and current participation in another study protocol.

After providing informed consent, patients fulfilling the inclusion and exclusion criteria were assigned randomly 1:1 to intracoronary thrombectomy, followed by PCI and stenting, or to PCI, excluding anything but balloon angioplasty and stent. Glycoprotein (GP) IIb/IIIa inhibitors were used according to the operator's judgment.

Procedure and device description. Thrombectomy was performed using the X-Sizer catheter system. This device is a two-lumen over-the-wire system (available diameters 1.5 and 2.0 mm) with a helical shape cutter at its distal tip. The cutter rotates at 2,100 rpm driven by a hand-held battery motor unit. One catheter lumen is connected to a 250-ml vacuum bottle, and aspirated debris is collected in an in-line filter. Two or more passages across the lesion from proximal to distal were performed by slowly advancing the activated catheter. Subsequently, additional balloon angioplasty or coronary stenting was performed. Before the intervention, all patients received aspirin. Heparin (70 U/kg) was given to maintain an activated clotting time of >250 s.

Angiographic analysis. The coronary angiograms were analyzed by an independent core laboratory (Dr. Glatt, Corisis, St. Denis, France) that was blinded to other data. In compliance with the protocol, the X-Sizer was systematically filmed with the purpose of measuring its effect on TIMI flow grade and thrombus burden and was, therefore, visible by the operator. Quantitative coronary analysis was performed before and after the procedure using the quantification system CMS-View (version 4.0; MEDIS, Leiden, the Netherlands). Angiographic TIMI flow grade was estimated visually, as previously described (23). The corrected TIMI frame count (cTFC) was measured with a frame counter on a digital film viewer analyzing the number of cine frames required for contrast to first reach a standardized distal coronary landmark (24). Recorded cine film speeds were 12.5, or 25 frames/s. All the results were corrected in 33 frames/s. In the presence of an occluded vessel (visual TIMI flow grade 0 to 1), cTFC was set to a value of 100 (25).

The incidence of distal embolization during the procedure also was assessed as previously described by Henriques et al. (14), as well as the occurrence of slow flow (TIMI flow grade decreasing from 3 to 2 during the procedure) or no reflow (TIMI flow grade decreasing from 2 or 3 to 0 or 1 during the procedure). The composite angiographic end point of slow-flow, no reflow, or distal embolization also was assessed. Thrombus burden at the lesion site was graded from 0 to 5 using the TIMI thrombus score (26). Partial thrombus removal after X-Sizer was defined by a reduction by at least one grade but remaining thrombus and complete removal by a reduction of more than one grade with no residual thrombus. All data were determined at baseline, after guidewire positioning, after thrombectomy, and at the end of the procedure. Myocardial blush grade was assessed before and after the procedure by a different independent core laboratory, which originally described the technique (Dr. Suryapranata, Zwolle, the Netherlands) (8).

ECG analysis. In each patient, a 12-lead ECG was recorded at admission, 60 min after the procedure, and at discharge. Electrocardiograms were analyzed by Corisis using the MPTronic ECG analyzer (MPTronic, Paris, France). The algebraic sum of ST-segment elevation and depression 20 ms from the J-point was assessed as previously described by Claeys et al. (22). Scanned images from original recording ECG were used. The image obtained was scaled on the squaring according to the speed and the amplitude of recording. For each lead, the baseline was automatically determined by the software (determination multipoints Iso segment between ST-T and P). For one QRS complex analyzed, the software determines automatically, after manual marking the end of the QRS complex, the time selected for the measurement of ST-segment elevation. The software identified for each derivation the point of intersection corresponding ST-segment and mea-