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A Prospective Randomized Trial of Thrombectomy Versus No Thrombectomy in Patients With ST-Segment Elevation Myocardial Infarction and Thrombus-Rich Lesions

MUSTELA (MUltidevice Thrombectomy in Acute ST-Segment ELevation Acute Myocardial Infarction) Trial

Marco De Carlo, MD, PHD,* Giovanni D. Aquaro, MD,† Cataldo Palmieri, MD,‡ Elena Guerra, MD,* Leonardo Misuraca, MD,* Cristina Giannini, MD, PHD,* Massimo Lombardi, MD,† Sergio Berti, MD,‡ A. Sonia Petronio, MD*

Pisa and Massa, Italy

Objectives The aim of this study was to evaluate whether thrombectomy during primary percutaneous coronary intervention (pPCI) in patients with high thrombus burden improves myocardial reperfusion and reduces infarct size.

Background Thrombectomy aims at reducing distal thrombotic embolization during pPCI, improving myocardial reperfusion and clinical outcome.

Methods We randomized 208 patients with high thrombus burden in a 1:1 ratio to either pPCI with thrombectomy (Group T) or standard pPCI (Group S). Thrombectomy was performed with either rheolytic or manual aspiration catheters. Three-month magnetic resonance imaging was performed to assess infarct size and transmurality and microvascular obstruction (MVO). The primary endpoints were ST-segment elevation resolution (STR) >70% at 60 min and 3-month infarct size.

Results The baseline profile was similar between groups, except for a higher rate of initial Thrombolysis In Myocardial Infarction flow grade 3 in Group S ($p = 0.002$). Group T showed a significantly higher rate of STR (57.4% vs. 37.3%; $p = 0.004$) and of final myocardial blush 3 (68.3% vs. 52.9%; $p = 0.03$). Group T and Group S did not differ with regard to infarct size (20.4 ± 10.5% vs. 19.3 ± 10.6%; $p = 0.54$) and transmurality (11.9 ± 12.0% vs. 11.6 ± 12.7%; $p = 0.92$), but Group T showed significantly less MVO (11.4% vs. 26.7%; $p = 0.02$) and a higher prevalence of inhomogeneous scar ($p < 0.0001$). One-year freedom from major adverse cardiac events was similar between groups.

Conclusions Thrombectomy as an adjunct to pPCI in patients with high thrombus load yielded better post-procedural STR and reduced MVO at 3 months but was not associated with a reduction in infarct size and transmurality. Thromboaspiration in Patients With High Thrombotic Burden Undergoing Primary Percutaneous (Coronary Intervention; NCT01472718) (J Am Coll Cardiol Intv 2012;5: 1223–30) © 2012 by the American College of Cardiology Foundation

From the *Cardiac Catheterization Laboratory, Cardiothoracic and Vascular Department, Azienda Ospedaliero-Universitaria Pisana, Pisa, Italy; †Institute of Clinical Physiology C.N.R./G. Monasterio Foundation, Pisa, Italy; and the ‡Institute of Clinical Physiology C.N.R./G. Monasterio Foundation, Massa, Italy. Dr. Petronio has served as a clinical proctor for Medtronic. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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Primary percutaneous coronary intervention (pPCI) is highly effective in restoring a normal Thrombolysis In Myocardial Infarction (TIMI) flow in patients with ST-segment elevation acute myocardial infarction (STEMI), but a relevant proportion of patients shows a poor myocardial reperfusion, which strongly correlates with larger infarct size and worse clinical outcome (1). Thrombectomy devices aim at improving myocardial reperfusion by preventing distal thrombus embolization during pPCI. After controversial results of the initial studies, 2 recent randomized single-center studies (2,3) demonstrated a significant benefit of thrombus aspiration on clinical outcome although not on infarct size. Currently, magnetic resonance imaging (MRI) with late gadolinium enhancement (LGE) is the best method to assess infarct size (4) but was used only in a substudy of a single-center randomized trial on thrombectomy (5). Moreover, all thrombectomy studies until now included patients with variable degrees of thrombus load, leaving open the question of whether the benefits of routine thrombus aspiration could be obtained also with a strategy of selective thrombectomy in patients with large thrombus burden.

Our aim was to assess the impact of thrombectomy, either manual or rheolytic, on myocardial reperfusion and infarct size in patients with high thrombotic burden.

Abbreviations and Acronyms

cTFC = corrected TIMI frame count

LGE = late gadolinium enhancement

LV = left ventricular

MACE = major adverse cardiac events

MBG = myocardial blush grade

MRI = magnetic resonance imaging

MT = manual thrombectomy

MVO = microvascular obstructionp

pPCI = primary percutaneous coronary intervention

RT = rheolytic thrombectomy

STEMI = ST-segment elevation myocardial infarction

STR = ST-segment elevation resolution

TIMI = Thrombolysis In Myocardial Infarction

Methods

Study design and patients. The MUSTELA (MUltidevice thrombectomy in acute ST ELevation Acute myocardial infarction) trial was a multicenter prospective randomized study that assigned patients in a 1:1 ratio to either thrombectomy as an adjunct to pPCI (Group T) or standard pPCI without thrombectomy (Group S). Inclusion criteria were age ≥18 years; STEMI (new ST-segment elevation of >1 mm in at least 2 contiguous leads or new left bundle branch block) within 12 h of symptom onset; TIMI thrombus grade >3 after reclassification of initial grade 5 after coronary recanalization with a guidewire or small balloon according to Sianos et al. (6); and reference diameter of the infarct-related artery ≥3.0 mm at visual estimate. Exclusion criteria were previous infarct in the same ventricular wall; cardiogenic shock; severe liver/renal failure; contraindications to abciximab; and contraindications to MRI. Patients showing a TIMI thrombus grade >3 at diagnostic angiography underwent stratification for infarct location on the anterior versus non-anterior left ventricular (LV) wall and were randomized on the basis of computer-generated random sequence through a dedicated website.

The study was approved by the local Ethics Committee, and written informed consent was obtained from all patients before diagnostic angiography (clinical trial unique identifier: NCT01472718; see note after abstract).

PCI procedure. The PCI was performed with standard technique, with the radial approach as first choice. Thrombectomy was performed with either the manual aspiration Export catheter (Medtronic CardioVascular, Santa Rosa, California) or the RT AngioJet Ultra catheter (Possis Medical, Inc., Minneapolis, Minnesota) in a sequential alternating fashion. The thrombectomy catheter was activated just proximal to the culprit lesion and was slowly pushed across the lesion for at least 2 passages; additional passages were performed until no further reduction in thrombus load could be obtained. Pre-dilation with small balloons was performed only if the thrombectomy catheter failed to cross the lesion. Direct stenting was recommended, whereas choice of coronary stents was left at the discretion of the physician. Use of embolic protection devices was not allowed.

All patients received IV aspirin 250 mg and clopidogrel 600 mg oral load at time of STEMI diagnosis. In the catheterization laboratory, IV boluses of unfractionated heparin (60 U/kg body weight) and abciximab (0.25 mg/kg) were administered, followed by a12-h abciximab infusion at 0.125 μg/kg/min. The activated clotting time was kept in the 200- to 250-s range during pPCI.

Angiographic and electrocardiographic analysis. All angiograms were analyzed by 2 experienced investigators in our core laboratory in Pisa University Hospital. We assessed the initial and post-procedural TIMI flow grade, corrected TIMI frame count (cTFC), and myocardial blush grade (MBG) (7–8). Thrombotic burden was graded according to the TIMI thrombus classification modified according to Sianos et al. (6). Complete thrombus removal by thrombectomy was defined by a reduction in thrombus grade from grade 4 to grade 0 to 1. Procedural success was defined as a final TIMI flow grade 3 with a residual stenosis ≤20%.

The ST-segment elevation was measured 40 ms after the J point, and the sum of ST-segment deviations was determined on a 12-lead electrocardiogram before and 60 min after intervention. The ST-segment elevation resolution (STR) was categorized as complete (>70%), partial (30% to 70%), or absent (<30%) (9).

MRI protocol. Three months after PCI, MRI was performed with a 1.5-T scanner with an 8-element cardiac phased array receiver surface coil (CVi, HD release; GE Healthcare, Milwaukee, Wisconsin). Left ventricular functional parameters were obtained from short-axis cine images from mitral valve plane to the apex, with a steady-state free