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Percutaneous Coronary Intervention of Chronic Total Occlusions in Patients With Low Left Ventricular Ejection Fraction

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ABSTRACT

OBJECTIVES The study sought to assess the outcome of percutaneous coronary intervention (PCI) of chronic total occlusions (CTOs) in patients with low left ventricular ejection fraction (LVEF) (≤35%).

BACKGROUND Data regarding the outcome of PCI in patients with low LVEF affected by CTO are scarcely reported.

METHODS The authors performed a prospective longitudinal multicenter study including consecutive patients undergoing elective PCI of CTOs. Patients were subdivided into 3 groups: group 1 (LVEF ≥50%), group 2 (LVEF 35% to 50%), and group 3 (LVEF ≤35%).

RESULTS A total of 839 patients (mean 64.6 ± 10.5 years of age, 87.7% men) underwent CTO PCI attempts. Baseline LVEF ≤35% was present in 72 (8.6%) patients. The angiographic success was high (overall 93.6%) and similar among the 3 groups (93.5% vs. 94.4% vs. 91.7%, respectively; all p = NS). In group 3, no periprocedural complications of CTO PCI were observed. Mean clinical follow-up of 16.3 ± 8.2 months duration was available in 781 (93.1%) patients including those with LVEF ≤35%. At 2 years, major cardiac and cerebrovascular events (MACCE) free survival was similar in the 3 groups (86% vs. 82.8% vs. 75.2%; all p = NS). In patients with LVEF ≤35%, LVEF improved significantly in the presence of a successful CTO PCI from 29.1 ± 3.4% to 41.6 ± 7.9% (p < 0.001).

CONCLUSIONS In CTO patients with low LVEF, PCI could represent a safe and effective revascularization strategy achieving good midterm outcome and LVEF improvement. (J Am Coll Cardiol Intv 2017;■:■–■) © 2017 by the American College of Cardiology Foundation.

Coronary chronic total occlusion (CTO) represents a frequent lesion subset observed in about 15% of patients undergoing coronary angiography (1-3), with a higher prevalence in those with previous coronary artery bypass grafting (CABG) (1,4). The presence of a CTO confers a negative impact on long-term outcome in different clinical situations. Indeed, in patients experiencing an acute coronary syndrome, a coexisting CTO is associated with increased early and late mortality (5,6). Similarly, in the setting of stable multivessel coronary artery disease, CTO was the strongest independent predictor of incomplete percutaneous revascularization, and associated with adverse clinical outcomes (7-9).

On the other hand, left ventricular ejection fraction (LVEF) represents one of the strongest predictors of cardiovascular events in patients with coronary artery disease (10). Very recently, it has been shown that in patients with ischemic heart failure (LVEF ≤35%), the presence of CTO was related to worse long-term outcome (11). Although PCI might

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ABBREVIATIONS AND ACRONYMS

bSS = baseline SYNTAX score

CABG = coronary artery bypass grafting

CTO = chronic total occlusion

HR = hazard ratio

LVEF = left ventricular ejection fraction

MACCE = major adverse cardiac and cerebrovascular events

MI = myocardial infarction

OR = odds ratio

PCI = percutaneous coronary intervention

rSS = residual SYNTAX score

SRI = SYNTAX Revascularization Index

TVR = target vessel revascularization

often remain the last available option to manage patients with low LVEF, outcome data of percutaneous recanalization of CTO subtending viable myocardium in this subset of patients are scarcely reported.

Accordingly, we aimed to assess the impact of LVEF on success rates and in-hospital outcome of CTO PCI, and to evaluate the midterm outcome of patients with low LVEF treated by PCI for a CTO.

METHODS

STUDY POPULATION. We performed a prospective multicenter study including consecutive patients undergoing elective PCI of CTO at 3 European centers from January 2013 to December 2015 (Online Figure 1). All procedures were scheduled (not ad hoc PCI), and performed by experienced CTO operators. Patients were selected on the basis of the presence of symptoms, viability, and inducible ischemia (>10%) in the CTO artery territory, as demonstrated by functional imaging tests. In presence of impaired LVEF, CTO revascularization was only considered for lesions subtending viable myocardial territory judged to be of hemodynamic importance. The decision of the revascularization strategy (PCI or CABG, and lesions to be revascularized) for each patient was left to the local heart team in the participating center. In case of surgical indication rejected by the patient, PCI was proposed if considered to be feasible by the local heart team.

According to the LVEF, our study population was subdivided into 3 groups: group 1 (LVEF ≥50%), group 2 (LVEF 35% to 50%), and group 3 (LVEF ≤35%).

The study was carried out in accordance to the Helsinki declaration; all patients provided written informed consent.

DEFINITIONS AND ENDPOINTS. Coronary CTOs were defined as angiographic evidence of total occlusions with Thrombolysis In Myocardial Infarction flow grade 0 within a major epicardial coronary artery of at least 2.5 mm, and estimated durations of at least 3 months (12).

The complexity of CTO lesion and the difficulty of CTO PCI attempt were assessed according to the J-CTO (Japanese multicenter registry) score and the ORA (O = ostial, R = filling < Rentrop 2, A = age ≥75 years) score, respectively (8,13). Angiographic success was defined as final residual stenosis <30% (by visual estimation) and TIMI flow grade 3 after CTO recanalization. Clinical success was defined as an angiographic success with no periprocedural complications including cardiac death, Q-wave and non-Q-wave myocardial infarction (MI), tamponade, stroke, and need for emergency CABG. Coronary perforations were defined and described as previously shown (14). In all patients, creatine kinase-myocardial band was evaluated 6 h after the procedure and until normalization if the levels were abnormal. Non-Q-wave MI was defined as creatine kinase-myocardial band enzyme elevation >3 times the upper limit of normal (9). Tamponade was defined as an epicardial effusion requiring pericardiocentesis. Major bleeding was defined according to Acuity criteria (15).

In patients with LVEF ≤35%, the baseline SYNTAX score (bSS) and the residual SYNTAX score (rSS) (after achieving the target level of revascularization) were determined. SYNTAX Revascularization Index (SRI) was then calculated using the following formula: $SRI = (bSS - rSS)/bSS \times 100$ (16).

At follow-up, major adverse cardiac and cerebrovascular events (MACCE) were defined as the composite of cardiac death, MI, stroke and further revascularization (CTO target vessel revascularization [TVR] or non-TVR).

INTERVENTIONAL PROCEDURES. Arterial access was usually established via right or left femoral arteries. The size of the guiding catheters used for the occluded artery was 7-F in the majority of cases. Dual injection was considered routinely if contralateral collaterals were present.

The sequence of use of wiring techniques, the guidewire selection and the primary CTO strategy (antegrade, retrograde, or hybrid) was completely left to the operator's discretion, as well as the use of percutaneous mechanical circulatory support.

Patients received an initial bolus of intravenous unfractionated heparin (100 IU/kg). The activated clotting time was monitored every 30 min to determine if an additional bolus of unfractionated heparin was necessary to maintain an activated clotting time >350 s. Upstream use of glycoprotein IIb or IIIa inhibitor therapy or bivalirudin was avoided.

In patients with LVEF ≤35%, we aimed to perform functional revascularization in 1 PCI procedure or in a staged manner during the same hospitalization, to achieve the lowest possible rSS.

Only drug-eluting stents were implanted. Antiplatelet therapy and heart failure medication (if necessary) were prescribed according to recognized standard of care (17,18).

BASELINE SYMPTOMS EVALUATION. Dyspnea and angina were assessed according to New York Heart Association functional class and Canadian