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Successful Recanalization of Native Coronary Chronic Total Occlusion Is Not Associated With Improved Long-Term Survival

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ABSTRACT

OBJECTIVES The purpose of this study was to evaluate long-term clinical outcomes after drug-eluting stent-supported percutaneous coronary intervention (PCI) for native coronary total occlusion (CTO).

BACKGROUND The benefit of successful recanalization of CTO on prognosis remains uncertain.

METHODS Between March 2003 and May 2014, 1,173 consecutive patients with CTO of native coronary vessels requiring PCI were enrolled. Drug-eluting stent implantation was performed in all successful procedures (1,004 patients, 85.6%).

RESULTS During a median follow-up of 4.6 years, the adjusted risks of all-cause mortality (hazard ratio [HR]: 1.04; 95% confidence interval [CI]: 0.53 to 2.04; $p = 0.92$) and the composite of death or myocardial infarction (HR: 1.05; 95% CI: 0.56 to 1.94; $p = 0.89$) were found to be comparable between patients with successful and failed CTO-PCI, whereas the adjusted risk of target vessel revascularization (HR: 0.15; 95% CI: 0.10 to 0.25; $p < 0.001$) and coronary artery bypass grafting (HR: 0.02; 95% CI: 0.006 to 0.06, $p < 0.001$) was significantly higher in patients with failed CTO-PCI. Among patients ($n = 879$) in whom complete revascularization for non-CTO vessels was performed, the risk of death or the composite of death or myocardial infarction were not found to differ between patients who underwent successful recanalization of the remaining CTO and patients who did not. This finding was consistent regardless of whether the patient had a multivessel disease including CTO or only had a single CTO disease.

CONCLUSIONS Successful CTO-PCI compared with failed PCI was not associated with a lesser risk for mortality. However, successful CTO-PCI was associated with significantly less subsequent coronary artery bypass grafting. (J Am Coll Cardiol Intv 2016;9:530–8) © 2016 by the American College of Cardiology Foundation.

Recanalization of chronic total occlusion (CTO) continues to be 1 of the most challenging procedures in coronary intervention. Despite safety concerns associated with high doses of radiation exposure or contrast use and the possibility of disastrous complications associated with the procedure, percutaneous coronary intervention (PCI) of coronary CTO accounts for more than 10% of all PCI procedures on the basis of national registry data (1,2). The procedural success rates of CTO-PCI have dramatically improved in recent years due to improved operator experience and the development of dedicated devices and techniques (3,4). Moreover, the introduction of drug-eluting stents (DES) has resulted in a marked

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reduction in restenosis or repeated revascularization procedures compared with bare-metal stents and has consequently provided interventional cardiologists with the advantage of performing PCI for more complex coronary CTOs (5).

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Successful reopening of CTO has been reported to alleviate symptoms, improve left ventricular function, and reduce the need for coronary artery bypass graft surgery (CABG) (6–9). Results from previous cohort studies have been inconsistent with regard to the potential survival benefit of successful versus failed CTO-PCI, although many of these studies were conducted before the widespread use of dedicated devices or techniques, DES, and current standards of medical management (10–13). Following the continuous improvement in procedural techniques, coronary stent systems, and optimal medical therapy in coronary artery disease, reassessment of the effect of the success or failure of CTO-PCI in a population with a relatively high success rate of contemporary stent treatment is essential. The aim of our study was to evaluate the effect of successful recanalization of native coronary CTOs using DES on long-term clinical outcomes compared with failed CTO-PCI.

METHODS

PATIENT POPULATION AND PROCEDURE. The CTO registry database, involving the prospective recruitment of consecutive patients undergoing PCI for CTO at the Asan Medical Center, Seoul, South Korea, was used for the current study. The CTO was defined as a coronary artery obstruction with a Thrombolysis In Myocardial Infarction flow grade of 0 within the occluded segment. The duration of the occlusion was estimated to be ≥3 months based on previous coronary angiogram or clinical features. In patients in whom there was no clinical evidence of the duration of the occlusion, a CTO was diagnosed based on angiographic anatomy suggestive of long-standing occlusion (degree of calcification, collateral developments, and nontapered stump) (14). From March 2003 to May 2014, 1,287 patients in whom PCI for CTO lesions was attempted were included in the study. The patients had either symptomatic angina or a positive functional stress test, such as a treadmill test or a myocardial perfusion imaging study. The decision to perform PCI of a CTO was based on multiple factors including the probability of achieving technical success, the extent of other coronary artery diseases, and the amount of viable myocardium supplied by the CTO vessel (15).

PCI and stent implantation were performed in a standard manner. The use of specialized devices or techniques and the choice of type of DES were left to the operator's discretion. Periprocedural anticoagulation was administered according to the standard regimens. All patients were prescribed aspirin (loading dose, 200 mg) and clopidogrel (loading dose, 300 or 600 mg) before the coronary intervention. Following the procedure, aspirin was continued indefinitely, and patients treated with a DES were prescribed clopidogrel for at least 12 months. Further cilostazol use or the duration of antiplatelet therapy in patients who underwent failed PCI was left to the discretion of each attending physician. Procedural success was defined as successful recanalization of the intended CTO lesion with DES implantation, restoration of Thrombolysis In Myocardial Infarction flow grade 3, and residual diameter stenosis <30% on visual assessment.

ABBREVIATIONS AND ACRONYMS

CABG = coronary artery bypass graft surgery
CI = confidence interval
CTO = chronic total occlusion
DES = drug-eluting stent(s)
HR = hazard ratio
MI = myocardial infarction
PCI = percutaneous coronary intervention
TVR = target vessel revascularization

ENDPOINTS AND DEFINITIONS. The primary safety endpoints between patients with successful and failed PCI were all-cause mortality and a composite of all-cause death or Q-wave myocardial infarction (MI). The primary efficacy endpoint was target vessel revascularization (TVR) and CABG. Cardiac death, Q-wave MI, stroke, stent thrombosis, any repeat revascularization, and changes in angina severity were also assessed as secondary endpoints. All events were based on clinical diagnoses by each patient's physician and were adjudicated by an independent group of clinicians. Causes of death were considered as cardiac unless an unequivocal noncardiac cause could be established. Q-wave MI was defined as documentation of a new, pathological Q-wave in 2 contiguous leads and an increase in creatine kinase-MB concentration to greater than the upper limit of the normal range with ischemic symptoms or signs after index treatment. Stroke, which was detected by the occurrence of a new neurological deficit, was confirmed by a neurologist on the basis of imaging modalities. TVR was defined as any percutaneous or surgical revascularization procedure of an index vessel. Stent thrombosis was defined according to the Academic Research Consortium definitions (16), and definite or probable stent thrombosis was used as the endpoint for stent thrombosis in the present study. Severity of angina was assessed according to the Canadian Cardiovascular Society functional classification.

DATA COLLECTION AND FOLLOW-UP. Clinical, procedural or operative, and outcome data were recorded in the dedicated database by independent research personnel. Clinical follow-up was performed