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CVN Interview

CLINICAL RESEARCH

Long-Term Outcome of Percutaneous Coronary Intervention for Chronic Total Occlusions

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Objectives The aim of this study was to evaluate long-term clinical outcomes after percutaneous coronary intervention (PCI) for chronic total occlusions (CTO).

Background Despite technical advancements, there is a paucity of data on long-term outcomes after PCI of CTO.

Methods We evaluated long-term clinical outcomes in 1,791 patients who underwent PCI of 1,852 CTO at 3 tertiary care centers in the United States, South Korea, and Italy between 1998 and 2007. Median follow-up was 2.9 years (interquartile range: 1.5 to 4.6 years).

Results Procedural success was obtained in 1,226 (68%) patients. Stents were implanted in 1,160 patients (95%); 396 patients (34%) received bare-metal stents (BMS), and 764 patients (66%) received drug-eluting stents (DES). After multivariable analysis, successful CTO PCI was an independent predictor of a lower cardiac mortality (hazard ratio [HR]: 0.40, 95% confidence interval [CI]: 0.21 to 0.75, $p < 0.01$) and reduced need for coronary artery bypass graft surgery (HR: 0.21, 95% CI: 0.13 to 0.40, $p < 0.01$); it also correlated with a strong trend toward lower all-cause mortality (HR: 0.63, 95% CI: 0.40 to 1.00, $p = 0.05$) at 5-year follow-up. Among patients who underwent stent implantation, treatment with DES rather than BMS resulted in less target vessel revascularization at long-term follow-up (17.2% vs. 31.1%, $p < 0.01$); definite/probable stent thrombosis rates were similar (DES 1.7%, BMS 2.3%, $p = 0.58$). Within the DES subgroup, patients treated with paclitaxel-eluting stents and sirolimus-eluting stents had similar clinical outcomes.

Conclusions Successful CTO PCI is associated with reduced long-term cardiac mortality and need for coronary artery bypass graft surgery. Treatment of CTO with DES rather than BMS is associated with a significant reduction in target vessel revascularization with similar rates of stent thrombosis. Paclitaxel-eluting stents and sirolimus-eluting stents had similar long-term safety and efficacy outcomes. (J Am Coll Cardiol Intv 2011;4: 952–61) © 2011 by the American College of Cardiology Foundation

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The percutaneous treatment of chronic total occlusions (CTO) is 1 of the major challenges in contemporary interventional cardiology. These complex lesions are identified in 15% to 30% of all patients referred for coronary angiography (1,2). Percutaneous coronary intervention (PCI) of CTOs is technically challenging and requires familiarity with advanced interventional techniques as well as specialty

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equipment. The complexity of percutaneous treatment of CTOs is illustrated by the relatively low procedural success rates (70% to 86%), compared with subtotal stenoses (98%) (3–6). Moreover, even in case of a successful procedure, PCI of a CTO is hampered by high restenosis rates. Nonetheless, successful PCI of a CTO can be associated with symptom relief, lower rate of subsequent myocardial infarction (MI), coronary artery bypass graft (CABG) surgery, and improved long-term survival, compared with unsuccessful PCI (7–11). Most of these studies, however, were not randomized, and many of them were performed with balloon-angioplasty or bare-metal stents (BMS), possibly explaining the relatively high re-occlusion rates.

The introduction of drug-eluting stents (DES) has dramatically reduced restenosis rates after PCI, compared with BMS, and might also have also impacted the percutaneous treatment of CTOs (12). A recent meta-analysis showed DES use in CTO recanalization is associated with lower target vessel revascularization (TVR) (13). However, there was also a statistical trend toward a higher risk of stent thrombosis with DES, compared with BMS. Currently, long-term data on clinical outcomes after CTO recanalization are scarce. Therefore, the aim of the current study was to identify the long-term clinical outcome of patients with successful versus failed CTO recanalization and the long-term safety and efficacy of DES versus BMS in CTOs.

Methods

All patients who underwent PCI for at least 1 CTO at 3 tertiary care hospitals between 1998 and 2007 were included in this study. A CTO was defined as a coronary artery obstruction with a Thrombolysis In Myocardial Infarction (TIMI) flow grade 0. All patients included had a native vessel occlusion estimated to be of at least 3-month duration on the basis of a history of sudden chest pain, a previous MI in the same target vessel territory, or the time between diagnosis made on coronary angiography and PCI. All patients had symptomatic angina and/or a positive functional ischemia study.

The PCI and stent implantation were performed in a standard manner. Heparin was administered to maintain an activated clotting time >250 s. The use of BMS or DES as well as the use of glycoprotein IIb/IIIa inhibitors was left to the discretion of the treating physician. The PCI of the CTO was performed with contemporary techniques such as bilateral injection; specialized hydrophilic, tapered tip, and stiff wires; parallel wires; microcatheters; and retrograde approach when they became available. After PCI, all patients were prescribed lifelong aspirin; in addition clopidogrel was prescribed for at least 3 months after DES implantation in Italy and South Korea and for at least 12 months in the United States and at least 1 month after BMS implantation in all participating sites.

Demographic and procedural data with regard to all patients undergoing PCI at the 3 participating centers were prospectively entered into a dedicated database. Angiographic analyses were performed by online QCA assessment by the operators. Patients were followed prospectively by telephone interview or outpatient visit after 30 days and yearly thereafter. The following endpoints were evaluated to compare patients with a failed versus a successful procedure: all-cause death, cardiac death, MI, and CABG. To compare patients treated with a DES versus BMS the following endpoints were evaluated: the composite clinical endpoint of major adverse cardiac events (MACE) (all-cause death, MI, or TVR), all-cause death, cardiac death, MI, TVR, and definite/probable stent thrombosis according to the Academic Research Consortium definitions (14). The following definitions were used: cardiac death was defined as death within 7 days after MI or stroke, death associated with cardiovascular interventions within 30 days after CABG or within 7 days after PCI, or unexpected death presumed to be due to ischemic cardiovascular disease and occurring within 24 h after the onset of symptoms without clinical or postmortem evidence of another cause. Death from uncertain causes was also classified as cardiac death. In-hospital MI was defined as a rise of creatine phosphokinase or creatine kinase-myocardial band isoenzyme >3× upper limit of normal. Multivessel disease was defined as the presence of at least 1 stenosis ≥70% by visual assessment in another major epicardial vessel or its sidebranches than that where the CTO was located. Procedural success was defined as successful recanalization and dilation of at least 1 CTO/

Abbreviations and Acronyms

BMS = bare-metal stent(s)
CABG = coronary artery bypass graft surgery
CI = confidence interval
CTO = chronic total occlusion
DES = drug-eluting stent(s)
HR = hazard ratio
LAD = left anterior descending coronary artery
LVEF = left ventricular ejection fraction
MACE = major adverse cardiac event(s)
MI = myocardial infarction
PCI = percutaneous coronary intervention
PES = paclitaxel-eluting stent(s)
SES = sirolimus-eluting stent(s)
TIMI = Thrombolysis In Myocardial Infarction
TVR = target vessel revascularization