Journal of the American College of Cardiology
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Published by Elsevier Inc.

Vol. 58, No. 15, 2011
ISSN 0735-1097/$36.00
doi:10.1016/j.jacc.2011.05.054

CLINICAL RESEARCH | Clinical Trial

Health-Related Quality of Life After Carotid Stenting Versus Carotid Endarterectomy

Results From CREST (Carotid Revascularization Endarterectomy Versus Stenting Trial)

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Objectives The purpose of this study was to compare health-related quality of life (HRQOL) outcomes in patients treated with carotid artery stenting (CAS) versus carotid endarterectomy (CEA).

Background In CREST (Carotid Revascularization Endarterectomy versus Stenting Trial), the largest randomized trial of carotid revascularization to date, there was no significant difference in the primary composite endpoint, but rates of stroke and myocardial infarction (MI) differed between CAS and CEA. To help guide individualized clinical decision making, we compared HRQOL among patients enrolled in the CREST study. We also performed exploratory analyses to evaluate the association between periprocedural complications and HRQOL.

Methods We measured HRQOL at baseline, and after 2 weeks, 1 month, and 1 year among 2,502 patients randomly assigned to either CAS or CEA in the CREST study. The HRQOL was assessed using the Medical Outcomes Study Short-Form 36 (SF-36) and 6 disease-specific scales designed to study HRQOL in patients undergoing carotid revascularization.

Results At both 2 weeks and 1 month, CAS patients had better outcomes for multiple components of the SF-36, with large differences for role physical function, pain, and the physical component summary scale (all $p < 0.01$). On the disease-specific scales, CAS patients reported less difficulty with driving, eating/swallowing, neck pain, and headaches but more difficulty with walking and leg pain (all $p < 0.05$). However, by 1 year, there were no differences in any HRQOL measure between CAS and CEA. In the exploratory analyses, periprocedural stroke was associated with poorer 1-year HRQOL across all SF-36 domains, but periprocedural MI or cranial nerve palsy were not.

Conclusions Among patients undergoing carotid revascularization, CAS is associated with better HRQOL during the early recovery period as compared with CEA—particularly with regard to physical limitations and pain—but these differences diminish over time and are not evident after 1 year. Although CAS and CEA are associated with similar overall HRQOL at 1 year, event-specific analyses confirm that stroke has a greater and more sustained impact on HRQOL than MI. (Carotid Revascularization Endarterectomy versus Stenting Trial [CREST]; NCT00004732) (J Am Coll Cardiol 2011; 58:1557–65) © 2011 by the American College of Cardiology Foundation

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JACC Vol. 58, No. 15, 2011
October 4, 2011:1557–65

Abbreviations and Acronyms

CAS = carotid artery stenting

CEA = carotid endarterectomy

CI = confidence interval

HRQOL = health-related quality of life

MI = myocardial infarction

OR = odds ratio

SF-36 = Medical Outcomes Study Short-Form 36

Carotid endarterectomy (CEA) plus medical management of modifiable risk factors is an established approach for primary and secondary stroke prevention for patients with significant carotid atherosclerosis (1–4). Some patients, however, are considered poor candidates for surgical revascularization because of anatomic complexity or medical comorbidities, and adverse outcomes occur more frequently in these patients (5). Carotid artery stenting (CAS) was developed as a less invasive option for carotid revascularization. The results of clinical trials of CAS have varied, with several finding acceptable rates of safety and efficacy (6–11), but others reporting higher rates of adverse events as compared with CEA (12–14).

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The CREST (Carotid Revascularization Endarterectomy versus Stenting Trial) recently compared CAS and CEA in patients at low risk of surgical complications and found no difference in the primary composite endpoint of stroke, myocardial infarction (MI), or death during the periprocedural period, or ipsilateral stroke within 4 years (15). Individual endpoints, however, varied between treatment groups, with patients assigned to CAS having higher rates of stroke and patients assigned to CEA having higher rates of MI. These differences in risk of periprocedural stroke and MI between the 2 treatment groups in the CREST study have led to considerable debate regarding the optimal treatment strategy for patients undergoing carotid revascularization (16–19).

In light of this ongoing controversy, evaluation of health-related quality of life (HRQOL) may help further inform individualized clinical decision making for patients undergoing carotid revascularization. Prior studies have suggested less impairment during the early recovery period after CAS as compared with CEA, but these differences were brief and limited to highly sensitive, disease-specific outcomes and physical role limitations (20,21). Moreover, these findings were based on nonrandomized studies or small randomized trials that enrolled highly selected patients. To address these gaps in knowledge, we performed a prospectively planned analysis of HRQOL among patients randomly assigned to CAS or CEA in the CREST study. In addition, we performed exploratory analyses to evaluate the association between periprocedural complications and HRQOL during 1 year of follow-up.

Methods

Trial design. Details of the CREST study design and primary outcomes have been described previously (15,22). In brief, the CREST study was a randomized trial of CAS versus CEA in both symptomatic and asymptomatic adult patients with significant carotid stenosis by ultrasonography, computed tomography, magnetic resonance imaging, or conventional angiography. Exclusion criteria were prior severe stroke, atrial fibrillation, unstable angina, or acute MI within the past 30 days. Clinical and anatomical suitability for either revascularization approach was required, after which patients were enrolled and treated by certified operators (based on adequate procedural volume and low complication rates) at 117 centers in the United States and Canada (23).

Risk factor modification and aspirin were recommended for all patients, and CEA was performed according to published guidelines. Patients undergoing CAS received the Rx Acculink stent and Rx Accunet embolic protection device (Abbott Vascular Solutions, Santa Clara, California) whenever feasible. Anticoagulation therapy was administered according to local practice, and thienopyridine therapy was recommended for a minimum of 4 weeks after the procedure. Neurologic evaluation at scheduled intervals, including the use of standardized stroke assessment measures, was performed in all patients. Cardiac biomarkers and electrocardiograms were obtained in all patients before and after the index procedure and after signs or symptoms of cardiac ischemia. Approval was obtained from the Human Studies Committee at each enrolling site, and all patients provided written informed consent before participation.

Data definitions. The periprocedural period was defined as the time from randomization through 30 days after revascularization (or 36 days after randomization when the procedure was not performed within 30 days of randomization). Stroke was defined as an acute neurologic event with focal findings consistent with cerebral ischemia that lasted for 24 h or more. MI was defined as the presence of elevated cardiac biomarkers at least twice the upper limit of normal at the site's hospital laboratory, plus either: 1) electrocardio-

038384), with supplemental funding from Abbott Vascular Solutions (formerly Guidant), including donations of Accunet and Acculink systems equivalent to ~15% of the total study cost for the CREST study centers in Canada and to the CREST study centers in the U.S. that were at Veterans Affairs sites. Dr. Cohen has received research support from Boston Scientific, Abbott Vascular, Medtronic, Edwards Lifesciences, MedRad, Merck/Schering-Plough, and Eli Lilly-Daiichi Sankyo; is a consultant to Merck/Schering-Plough, Eli Lilly, Medtronic, and Cordis; and has served on the Speakers' Bureau for Eli Lilly and The Medicines Company. Dr. Stolker has served on the Speakers' Bureau for AstraZeneca. Dr. Magnuson has received research support from Eli Lilly-Daiichi Sankyo, Sanofi-Aventis, and Bristol-Myers Squibb; and has received honoraria from Sanofi-Aventis. Dr. Aronow has served on the Speakers' Bureau/Advisory Board for Medtronic. Dr. Goldstein has served as consultant and Advisory Board member for Abbott and ACT-1 Trial Clinical Oversight Committee. Dr. Roubin has received royalties from Abbott Vascular, Inc. and Cook, Inc. Dr. Howard has served as consultant and Advisory Board member for Bayer Healthcare and is a member of the ARRIVE Executive Committee. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received March 11, 2011; revised manuscript received May 6, 2011, accepted May 24, 2011.