Two-year Clinical Evaluation of the Zilver Vascular Stent for Symptomatic Iliac Artery Disease

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PURPOSE: To evaluate the 2-year outcomes of safety and effectiveness for iliac artery stent placement and examine the effects of placement in the common iliac artery (CIA) and external iliac artery (EIA), the degree of initial stenosis, and patient gender on success.

MATERIALS AND METHODS: Zilver vascular stents (Cook Inc., Bloomington, Indiana) were placed in 151 consecutive patients whose iliac arteries remained stenotic after percutaneous transluminal angioplasty (PTA). Success at 2 years was determined by patency, ankle-brachial index (ABI) scores, and Walking Impairment Questionnaire (WIQ) scores.

RESULTS: Patency, ABI measurements, and WIQ scores showed improvement at 2 years, compared with preprocedure measurements. Kaplan-Meier estimate of overall patency at 2 years was 90% ($n = 117$). Significant improvement in ABI and WIQ scores was seen at 2 years, compared with preprocedural values ($P < .01$). The 2-year overall success rate was 91%. The degree of initial stenosis, stent location, and patient gender did not affect the success of the Zilver stent ($P = .65$, $P = .58$, and $P = .77$). The Kaplan-Meier estimate of the probability of experiencing a major adverse event (MAE) related to the device or stent placement procedure by the 2-year follow-up was 2.7%.

CONCLUSIONS: The Zilver vascular stent remains durable at 2 years in regard to safety and clinical effectiveness, and is effective in the CIA and EIA both in male and female patients.

J Vasc Interv Radiol 2010; 21:1489–1494

Abbreviations: ABI = ankle-brachial index, ANOVA = analysis of variance, CIA = common iliac artery, EIA = external iliac artery, MAE = major adverse event, PAD = peripheral arterial disease, PTA = percutaneous transluminal angioplasty, WIQ = Walking Impairment Questionnaire

PERIPHERAL arterial disease (PAD) is a common disorder among adults older than 50 years in the United States (1). PAD is expected to become more prevalent as the population ages and as the incidence of obesity and diabetes continues to increase. In addition to reducing the cardiovascular morbidity and mortality of patients with PAD by aggressive risk factor intervention, the symptomatic goal of PAD therapy is to improve the quality of life of patients with intermittent claudication by increasing pain-free walking distance and preserving the affected limb among patients with critical limb ischemia. Before the advent of endovascular revascularization, surgical intervention had been considered the "gold standard" for treating PAD. Although not all surgical procedures require general anesthesia, these procedures may result in prolonged hospitalization, and there is an increased risk of incisional infection. These risks have continued to spark interest in alternative revascularization strategies over the past decade. In addition to pharmacotherapy and exercise for PAD, endovascular therapy (percutaneous transluminal angioplasty [PTA] and stent placement) is an important treatment option.

Supervised exercise therapy is an effective treatment for PAD. In a study of 151 patients by Spronk et al (2), results indicated that exercise therapy was as effective as stent placement for improvement of PAD. The MIMIC (Mild to Moderate Intermittent Claudication) studies showed greater improvement in walking distance among patients with intermittent claudication secondary to either iliac or femoropopliteal arterial disease treated by endovascular revascularization compared with exercise therapy (3). The CLEVER (Claudication: Exercise vs

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M.R.J. is a member of the Board of Directors of VIVA Physicians, a 501(c)3 not-for-profit education and research group. B.T.K. is an Endowed Chair for Cook Professor of Radiology.

DOI: 10.1016/j.jvir.2010.06.013

Endoluminal Revascularization) trial, which evaluates the combined effects of supervised exercise with medical therapy compared with stent placement, is currently in progress (4). Exercise therapy without supervision may not have the same results because patients may not comply as diligently as with supervision. Although supervised exercise therapy and stent placement have similar 1-year results, stent placement provides more immediate improvement than exercise (5).

Endovascular therapies, such as PTA and stent placement, are less invasive than surgery and have lower morbidity and mortality (6). In a metaanalysis conducted by Bosch and Hunink (7), stent placement was shown to provide better immediate results and higher long-term patency than PTA. Treatment of PAD with endovascular stents has become a mainstay of clinical practice. There are several advantages to this strategy, including the minimally invasive nature of the procedure, resulting in fewer major complications and shorter in-hospital stays.

Short-term results of clinical studies have shown the safety and efficacy of this treatment, and there have been published series on the long-term results designed to assess the long-term safety and efficacy of endovascular stent placement to determine the most appropriate treatment algorithms for patients with PAD. This article reports the 2-year results with the Zilver vascular stent (Cook Inc., Bloomington, Indiana) for treatment of symptomatic iliac artery disease. These results highlight the effects of the location of stent placement and gender on durability.

MATERIALS AND METHODS

Approval was obtained from the institutional review board at the investigative sites before the initiation of the study at each site. This study was registered at clinicaltrials.gov under NCT 00196066 and adhered to all components of good clinical practice. All major adverse events (MAEs) were adjudicated to determine their relationship to the study device or procedure by an independent clinical events committee (HCRI, Boston, Massachusetts). The first patients were enrolled in 2003.

A detailed description of the study protocol, including objective performance criterion, sample size determination, inclusion and exclusion criteria, study endpoints, definitions, study procedure, and 9-month results, was previously published (8). Patients with symptomatic iliac artery disease consented to iliac stent placement and follow-up visits at 1 month, 9 months, and 2 years after the procedure. A brief overview of the methods follows.

Definitions

MAEs were defined as death, myocardial infarction (non–Q-wave and Q-wave), target lesion revascularization, and limb loss ipsilateral to the treated lesion.

Patency was defined in the protocol as lack of occlusion of the treated segment determined by the presence of any one or more of the following criteria:

1. Lack of occlusion as identified with vascular imaging.
2. Maintenance of improvement in the ankle-brachial index (ABI) or thigh-brachial index, which must have increased by more than 0.10 initially and not deteriorated by more than 0.15 from the maximum early post-procedure level.
3. Pulse volume recording distal to the treated segment maintained at 5 mm above preoperative tracing (only for diabetic patients with non-compressible arteries).
4. Palpable pulse or biphasic or triphasic Doppler waveform measured at two points directly over a superficially placed graft.

The Walking Impairment Questionairre (WIQ), a validated measure of patient-perceived walking performance for patients with PAD (9), was used to assess disease-specific quality of life among patients in the study cohort. Distance and speed scores are calculated by expressing each patient's score as a percentage of the maximum score possible, with higher scores indicating a patient's perception of greater walking distance or speed.

Success at 2 years was defined as the combination of 2-year patency, improvement in 2-year WIQ scores, and improvement in the results of the 2-year ABI value. If patients failed to meet these criteria, the procedure was considered unsuccessful at 2 years.

Procedure

Iliac artery atherosclerotic lesions were classified by the TransAtlantic Inter-Society Consensus (TASC) lesion definitions (10). All patients underwent PTA before iliac artery stent placement. The appropriate stent length and diameter were determined according to the procedure outlined in the protocol. The protocol allowed placement of up to two stents per lesion in up to two lesions per patient. Stents could be placed in the common iliac artery (CIA), the external iliac artery (EIA), or both. After stent placement, dilation was performed at the discretion of the operator. Independent core laboratories analyzed duplex ultrasound (VasCore, Massachusetts General Hospital, Boston, Massachusetts) and angiographic (Cardiovascular Intervention Core Angiographic Analysis Laboratory, Houston, Texas) images. Relevant vessel measurements were obtained using angiography before stent placement and immediately after the procedure. Duplex ultrasonography was performed within 3 days of stent placement and during the 9-month and 2-year follow-up visits.

Statistical Analysis

The Kaplan-Meier analysis was used to evaluate MAEs, complications, and patency at 2 years. Patients who did not experience a related MAE, complication, or lack of patency were censored at their last date of follow-up or unrelated death. Log-rank tests were used to compare patency results between scores before the procedure and at the 2-year follow-up for the patency of the CIA, the EIA, or both. Paired *t* tests were used to compare the ABI and WIQ scores before the procedure and at the 2-year follow-up. Based on the results from these analyses, the difference between results for stents placed in the CIA and EIA is examined in this article. A one-way analysis of variance (ANOVA) test was used to compare reference vessel diameters of male versus female patients and to compare the amount of occlusion versus lesion locations and patient gender. Logistic regression was used to determine the effect of baseline percent diameter stenosis on the success of the procedure and