Anatomic runoff score predicts cardiovascular outcomes in patients with lower extremity peripheral artery disease undergoing revascularization

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Background Although the presence, extent, and severity of obstruction in patients with lower extremity peripheral artery disease (LE PAD) affect their functional status, quality of life, and treatment, it is not known if these factors are associated with future cardiovascular events. We empirically created an anatomic runoff score (ARS) to approximate the burden of LE PAD and determined its association with clinical outcomes.

Methods We evaluated all patients with LE PAD and bilateral angiography undergoing revascularization in a community-based clinical study. Primary clinical outcomes of interest were (1) a composite of all-cause death, myocardial infarction (MI), and stroke and (2) amputation-free survival. Cox proportional hazards models were created to identify predictors of clinical outcomes.

Results We evaluated 908 patients undergoing angiography, and a total of 260 (28.0%) patients reached the composite end point (45 MI, 63 stroke, and 152 death) during the study period. Anatomic runoff score ranged from 0 to 15 (mean 4.7; SD 2.5) with higher scores indicating a higher burden of disease, and an optimal cutpoint analysis classified patients into low ARS (<5) and high ARS (≥5). The unadjusted rates of the primary composite end point and amputation-free survival were nearly 2-fold higher in patients with a high ARS when compared with patients with a low ARS. The most significant predictors of the composite end point (death/MI/stroke) were age (δ 10 years; hazard ratio [HR] 1.53; CI 1.32-1.78; $P < .001$), diabetes mellitus (HR 1.65; CI 1.26-2.18; $P < .001$), glomerular filtration rate <30 (HR 2.23; CI 1.44-3.44; $P < .001$), statin use (HR 0.66; CI 0.48-0.88; $P < .001$), and ARS (δ 2 points; HR 1.21; CI 1.08-1.35; $P < .001$).

Conclusions After adjustment for clinical factors, the LE PAD ARS was an independent predictor of future cardiovascular morbidity and mortality in a broadly representative patient population undergoing revascularization for symptomatic PAD. A clinically useful anatomic scoring system, if validated, may assist clinicians in risk stratification during the course of clinical decision making. (Am Heart J 2015;170:400-408.e1.)

Lower extremity peripheral artery disease (LE PAD) is associated with significantly worse clinical outcomes, including higher rates of mortality, major adverse cardiovascular events, and major adverse limb events.[1-5] Medical therapy for LE PAD, including antiplatelet and statin medications, has been associated with improved outcomes over the past few decades, but morbidity and mortality remain high.[6-11] Ankle brachial index (ABI) testing is the most frequent method of diagnosis of LE PAD, and low ABI values are associated with future cardiovascular events.[2,12-14] After diagnosis by ABI testing and initiation of medical therapy, symptomatic patients often undergo diagnostic testing (including noninvasive and invasive angiography) to define anatomy and determine whether surgical or endovascular intervention will improve symptoms.[15,16] Although the location and

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severity of obstructive arterial disease in patients with LE PAD routinely affect clinical decision making, the impact of these factors on treatment strategies (including revascularization) and future cardiovascular events is less clear.

Much like the treatment of symptomatic coronary artery disease (CAD), treatment of symptomatic LE PAD has evolved dramatically over the past 2 decades from a primarily surgical treatment to a primarily endovascular treatment.[17-20] With this change, more patients are eligible for revascularization; thus, the impetus to understand which patients are at higher risk for death and cardiovascular events after diagnosis and revascularization is magnified. In the coronary literature, a seminal article in 1994 described a hierarchical prognostic index called the Duke CAD index and reported the association between extent of CAD, treatment, and cardiovascular mortality.[21] Prior studies of the impact of the location and severity of LE PAD have generally been focused on patients with critical limb ischemia (CLI) and rates of limb salvage,[22,23] but there is nothing similar to the Duke CAD index for patients with LE PAD.

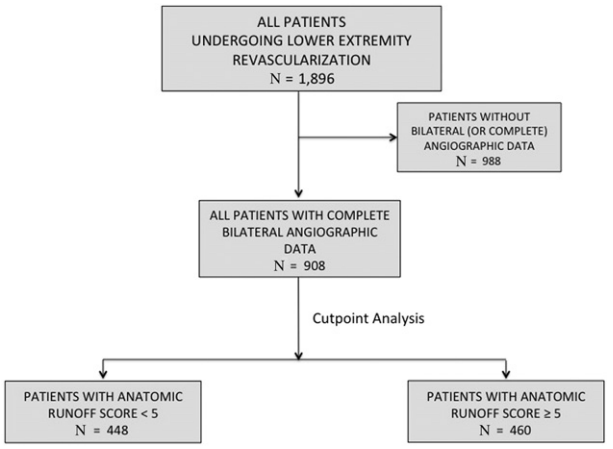
In the context of a comparative effectiveness study of revascularization techniques in the Kaiser Permanente health care system in Colorado and California, we abstracted all data from noninvasive and invasive angiographic studies that evaluated the presence and extent of peripheral atherosclerotic lesions. We subsequently and empirically created an anatomic runoff score (ARS) using these data from bilateral angiographic information. The main purpose of the current study is to determine the value of this new ARS for prognosis after diagnostic angiography and revascularization in patients with symptomatic LE PAD.

Methods

Study setting

The study was conducted in 2 large, integrated health care delivery systems: Kaiser Permanente Colorado and Kaiser Permanente Northern California. Kaiser Permanente Colorado has more than 600,000 enrollees in the Denver, CO, metropolitan area and contracts with more than 1,000 physicians to deliver care in 20 outpatient clinics. Kaiser Permanente Northern California provides care to more than 3.2 million members and contracts with a medical group of more than 6,000 physicians who treats patients at 39 clinics. Electronic data on vital signs, medication dispensings, laboratory test results, diagnoses, and health care utilization were available from electronic health records and administrative databases at both sites dating back to January 2000. Data from each of the health plans were restructured into a common, standardized format with identical variable names; formats; specifications; and identical variable definitions, labels, and coding.

Figure 1



Flow diagram of patients included in the current study.

Study population

The study population included patients aged ≥18 years undergoing lower extremity revascularization procedures from Kaiser Permanente Colorado or Kaiser Permanente Northern California between January 1, 2005, and December 31, 2011. We used a published algorithm of *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*), diagnosis codes and Current Procedural Terminology (CPT) codes to identify all patients undergoing lower extremity revascularization.[3,18,19] We identified 3,800 patients for preliminary chart review who met *ICD-9-CM* and CPT code eligibility. A panel of vascular experts reviewed all 3,800 charts; and procedures for non–lower extremity vessels (eg, subclavian, carotid, aortic, etc), acute limb ischemia, aneurysms, and venous procedures were removed. This process confirmed eligibility for 2,161 patients after detailed review, and 1,896 of these patients had either a lower extremity bypass (LEB) or lower extremity peripheral endovascular intervention (PVI). Patients treated with both LEB and PVI were excluded (n = 265). For the current analysis, only patients who had detailed, bilateral invasive, or noninvasive angiography information were included in the study cohort (n = 908). Figure 1 is a flow diagram that describes patient inclusion in the current analysis.

Peripheral artery disease registry development

We conducted a detailed chart review to gather additional data related to the index revascularization procedures. From the chart, study personnel collected a copy of the preprocedure history and physical, diagnostic testing reports, procedural report, discharge summary, and follow-up visits within 30 days of discharge. Preprocedure assessment and procedure notes were collected for all revascularization procedures through