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Outcomes in Critical Limb Ischemia Compared by Distance from Referral Center

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Background: Little data exist regarding the effect of referral distance on outcomes after revascularization for critical limb ischemia (CLI). We tested the assumption that patients who travel longer distances for revascularization procedures have worse outcomes.

Methods: We identified a retrospective cohort of 300 CLI patients who underwent revascularization between January 1, 2000 and December 31, 2010 at a single academic medical center. Patients were stratified into 2 groups based on distance greater than or less than 100 miles from the referral center. The association between travel distance and outcome measures including length of stay (LOS), postoperative functional status, hospital disposition, patient follow-up, and amputation-free survival (AFS) were evaluated using Cox proportional hazard models controlling for patient comorbidities and type of revascularization procedure.

Results: One hundred eighteen (39%) patients travelled >100 miles for CLI revascularization. The 2 groups had similar baseline characteristics. Overall, 211 (70%) patients underwent an open revascularization, 60 (20%) an endovascular, and 29 (10%) a hybrid procedure. Those living >100 miles away less commonly underwent an endovascular procedure (14% vs. 24%, $P = 0.05$). LOS was similar between near and far groups (7.3 vs. 8.9 days, $P = 0.1$), as was postoperative functional status (ambulatory 73% vs. 68%, $P = 0.34$) and discharge to home (68% vs. 74%, $P = 0.34$). Long-term follow-up (mean 2.07 years) was similar between distance groups ($P = 0.6$). Five-year AFS (73% vs. 56%, $P = 0.02$) was superior in the distance >100 group. In the multivariate analysis, distance >100 miles (hazard ratio [HR] 0.6, $P = 0.05$), preoperative warfarin use (HR 0.5, $P = 0.02$), and independent ambulatory status (HR 0.5, $P = 0.002$) were associated with improved AFS.

Conclusions: Patient referral distance did not adversely affect AFS or long-term follow-up after revascularization for CLI. Patients traveling from rural settings for revascularization can expect similar outcomes as patients located near tertiary centers.

INTRODUCTION

Critical limb ischemia (CLI) is a major healthcare problem, with an estimated annual economic burden of 3.1 billion dollars from CLI, primarily due to limb loss and the need for assistive care.[1] Complicating matters is the significant regional variation in access to and provision of healthcare services in the United States. In particular, patients may need to travel far distances to receive emergency or elective vascular surgical care at tertiary or quaternary referral hospitals.

Factors affecting CLI postoperative outcomes are still being elucidated; however, there are minimal

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data on the effect of referral distance on CLI outcomes.

In other areas of surgery, the effect of referral distance on postoperative outcomes has been investigated, and outcome data are mixed.[2–6] In vascular surgery, the effect of distance on AAA outcomes has been described,[7–9] but data on the effect of distance on CLI outcomes are sparser. Only a single study suggests a link between longer distances and death or serious morbidity after lower extremity bypass in patients with CLI.[10]

Our hospital is an academic tertiary referral center that boasts a referral area that is inclusive of 5 states and more than 10% of the landmass of the contiguous United States (http://healthcare.utah.edu/about/). With such a large referral area at our disposal, we set out to assess whether longer referral distances were associated with poorer CLI outcomes.

MATERIALS AND METHODS

Data Sources and Study Population

We retrospectively reviewed all charts for patients who underwent procedures for peripheral vascular disease between January 1, 2000 and December 31, 2010 at the University of Utah using current procedural terminology codes for lower extremity amputation, bypass and endovascular revascularization, and International Classification of Diseases, Ninth Revision codes pertaining to peripheral arterial disease. Only procedures performed by the vascular surgery service were included. Under these criteria, 794 patients were deemed eligible for study. Next, we excluded patients with claudication, traumatic injury, cardiovascular access injuries, hypercoagulable states, and embolic phenomena. Also excluded were patients who underwent primary amputation on arrival to the referral center. This resulted in 300 patients with CLI who presented for revascularization procedures (Fig. 1). CLI was clinically defined as those patients with rest pain, tissue loss, or both. Noninvasive vascular testing (such as ankle brachial index) was not used to define CLI in this study, as results were inconsistent in the medical record.

Patient demographics and procedural data were abstracted. Revascularization procedures were divided into open, endovascular, or hybrid approaches. Open procedures included thrombectomy, endarterectomy, patch angioplasty, and bypass. Endovascular approaches included thrombolysis, angioplasty, angioplasty with stenting, and atherectomy. Hybrid approaches were defined as open procedures that included an endovascular component, typically to treat inflow lesions. Lesion location was not limited to a particular vascular distribution, with aortoiliac, femoral, popliteal, and tibial lesions included. Follow-up and mortality data were obtained through the electronic medical record, paper charts, and our hospital's medical records office.

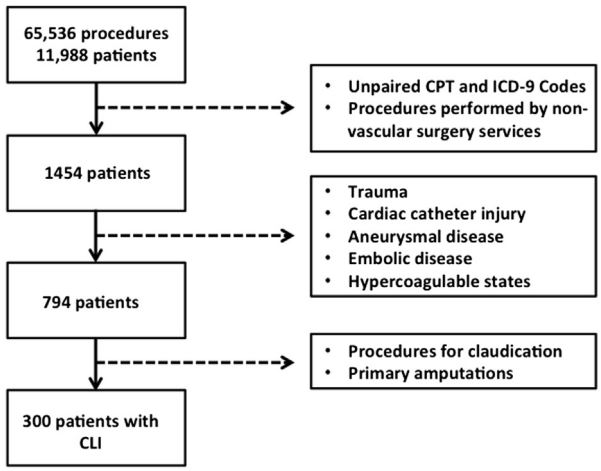

Fig. 1. Flow diagram showing the selection process.

Defining the Exposure Variable: Travel Distance to Hospital

Postal code (Zip code) data were obtained from the medical record, and straight-line distance from the patient home address to our referral center was calculated using an online calculator (http://www.zip-codes.com/distance_calculator.asp). Figure 2 shows the Zip code locations plotted on a map of the United States. Patients were stratified into 2 groups based on distance greater than or less than 100 miles from the referral center (Fig. 3). This distance has been used previously in other distance studies,[2,7] and was the nadir of a relatively bimodal distribution (Fig. 4).

Outcome Measures

The primary outcome measure for this study was amputation-free survival (AFS). This was defined as the absence of major lower extremity amputation of the index limb or death as described in the Society of Vascular Surgery (SVS) Objective Performance Goals.[11] Secondary outcome measures were hospital length of stay (LOS), postoperative functional status (ambulatory independently, ambulatory with assistive devices, wheelchair, bedbound, as defined by the SVS Vascular Quality Initiative [VQI]; http://www.vascularqualityinitiative.org),