Unrecognized Arteriosclerosis Is Associated with Wound Complications after Below-Knee Amputation

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Background: Guillotine below-knee amputation (BKA) for wet gangrene is an unfortunate complication of poorly controlled diabetes. We examined risk factors associated with wound complications after amputation formalization in this patient population.

Methods: Retrospective data over a 4-year period were collected for patients undergoing guillotine BKA for wet gangrene followed by staged formalization. Patients with abnormal distal pulses underwent evaluation before formalization to stratify for peripheral arterial disease (PAD). Those patients with palpable pulses and no known PAD went to formalization without further investigation. Poor operative candidates underwent delayed formalization to allow for preoperative optimization. Patient history, interval between surgeries, pathology, and preformalization laboratories were tested for significance. Primary outcome was postformalization wound complication.

Results: Fifty-six amputations in 55 patients met inclusion criteria. Wound complications after formalization occurred in 18 cases, all BKAs (32%). A history of PAD was present in 19 patients (34.5%). On pathology, 23 patients (41%) had small-vessel atherosclerosis or arteriosclerosis. There was no association between wound complications and history of PAD ($P = 0.4$), preformalization albumin ($P = 0.09$), glucose ($P = 0.9$), white blood cell count ($P = 0.4$), or delayed versus expedited formalization ($P = 0.8$). Only the presence of microvascular disease on formal pathology was predictive of wound complications ($P = 0.03$). There was no association between microvascular disease on pathology and a history of PAD ($P = 0.07$).

Conclusions: After formalization of lower extremity amputation for wet gangrene, traditional markers of PAD were not predictive of wound complications. Although formalization of guillotine BKA can safely be performed without significant delay, more thorough assessment of microvascular disease in the perioperative period may be useful in identifying patients at risk for wound failure.

INTRODUCTION

Lower extremity amputation for wet gangrene continues to pose a significant problem for surgeons. Despite improvements in the treatment of diabetes, the incidence of lower extremity amputation has not changed significantly from 1990 to 2010 and persists at a rate of 3.0 per 10,000 US adults.[1] Lower extremity amputation carries significant risk, with the 5-year mortality after amputation ranging from 25% to as high as 50%.[1–3] In addition, while in 1 study survival was 86% at 6 months, only 51% of patients had successful wound healing and were able to use a prosthesis.[4]

Presented as an oral presentation at the Southern California Vascular Surgery Society Annual Meeting, May 4, 2014, Carlsbad, CA.

Conflict of Interest: None.

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Ann Vasc Surg 2015; 29: 266–271
http://dx.doi.org/10.1016/j.avsg.2014.10.021

Manuscript received: May 4, 2014; manuscript accepted: October 28, 2014; published online: November 26, 2014.

Although the risk factors for wound complications in major amputation for patients with peripheral arterial disease (PAD) often relate to the presence of macrovascular disease, wound complications after wet gangrene are less well defined.[5] In an effort to decrease the incidence of wound complications after formalization of lower extremity amputations, we reviewed our experience with patients undergoing guillotine below-knee amputation (BKA) for the indication of wet gangrene.

MATERIAL AND METHODS

This was a retrospective single institution study for procedures performed between July 2008 and August 2013. The study was approved by the Human Subjects Committee of the Los Angeles Biomedical Research Institute at Harbor-University of California at Los Angeles (UCLA) Medical Center, Torrance, California. Operative records were queried for the procedure of guillotine BKA. At our institution, most amputations are performed by the Trauma/Acute Care Surgery service, with major amputations performed by the Vascular Surgery service limited to patients with nonsalvageable critical limb ischemia or dry gangrene. Charts were reviewed to identify patients who presented with wet gangrene of the foot. This included chronic ulcers or wounds that progressed to fulminant infection and patients with necrotizing soft tissue infections. Patients who underwent BKA for traumatic injury, critical limb ischemia, or dry gangrene were excluded. Patients who were still awaiting a second-stage procedure were excluded from analysis.

Relevant demographic data were collected including age, gender, and ethnicity. Comorbid conditions included diabetes mellitus, hypertension, coronary artery disease, and chronic kidney disease. Markers of disease severity before guillotine amputation included serum chemistry and white blood count, as well as preoperative albumin. Patients were considered to have PAD if they had either a history of documented PAD or associated intervention, or if suspected based on nonpalpable distal pulses at the time of presentation. Those patients without palpable distal pulses on presentation were evaluated by the Vascular Surgery service before formalization and were assessed with noninvasive imaging (CT angiogram versus magnetic resonance angiogram where appropriate). Patients who were felt to have a significant lesion that was amenable to intervention underwent treatment by the Vascular Surgery service before guillotine amputation formalization. Ankle-brachial indices (ABIs) were not routinely measured as most patients had uncontrolled diabetes, and in our experience, such patients often have noncompressible ABIs, a notoriously inaccurate marker for severity of underlying PAD.[6] Pathology was examined from the first procedure and assigned to either gangrene or gangrene with evidence of arteriosclerosis. Patients were then followed to their second formalization procedure. Relevant information regarding the second procedure included preoperative glucose, hemoglobin A1C, white blood cell count, and albumin, as well as the timing between the 2 procedures and whether the formalization occurred during the index hospitalization. After formalization, patients were monitored for the development of wound complications. Wound complications were considered to have occurred within 90 days after formalization and included superficial infection, deep infection requiring incision and drainage, wound dehiscence without evidence of purulent drainage, and need for amputation at a higher level.

Statistical analysis was performed with SAS v.9.3 (Cary, NC) software. Patients with and without wound complications were compared. Descriptive statistics and univariate analysis given nonparametric data were performed using a Wilcoxon 2-sample test for continuous variables. Categorical variables were compared with Pearson chi-squared test and with Fisher's exact test when appropriate. Statistical significance was defined as a P value of less than 0.05. In addition, the mean difference and 95% confidence intervals (CIs) were calculated for continuous variables, and odds ratio (OR) and 95% CI was calculated specifically for specimen pathology from the first operation. Given the small sample size, multivariate analysis was not carried out.

Table I. Demographic and preoperative variables

Demographics	$n = 55$	%
Male	41	75
Ethnicity		
Latino	34	62
African American	5	9
Unknown	16	29
Comorbidity		
DM	52	95
HTN	27	49
CAD	14	25
CKD	10	18
PAD	19	35

DM, diabetes mellitus; HTN, hypertension; CAD, coronary artery disease; CKD, chronic kidney disease.