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Minor Amputation and Palliative Wound Care as a Strategy to Avoid Major Amputation in Patients With Foot Infections and Severe Peripheral Arterial Disease

Neal R. Barshes, MD, MPH[1], Benjamin Gold, BS[1], Aimee Garcia, MD[1], Carlos F. Bechara, MD, MS[1], George Pisimisis, MD[1], and Panos Kougias, MD[1]

Abstract

Foot infections occurring in patients with severe peripheral arterial disease (PAD) who are not considered candidates for revascularization and limb salvage efforts are generally treated with major amputations. Herein we describe our early experiences in managing foot infections with minor amputations and palliative wound care as a strategy to avoid the functional disability often associated with major amputations. Patients with severe PAD that underwent minor amputations and subsequent palliative wound care for moderate/severe infections were paired with age-matched controls with PAD that underwent primary major amputations for foot infections. Eleven patients who underwent minor amputations and palliative wound care of 13 limbs were compared to an age-matched cohort of 12 patients undergoing 13 major amputations. The median age was 80 years in both groups. Survival at 1 and 2 years did not differ significantly between groups. All patients who were ambulatory and/or independently living remained so following palliative management; in contrast, major amputation changed ambulatory status in 75% of patients and independent living status in 50%. Palliative management did not result in ascending/systemic sepsis or progressive necrosis. The need for reoperations was uncommon in both groups. In summary, minor amputations and operative drainage with subsequent palliative wound care appears to be a safe management option in patients with severe PAD and moderate or severe foot infections that are not candidates for revascularization. Palliative management may result in less functional impairment than major amputation.

Keywords

palliative care, diabetic foot infection

Patients with moderate or severe foot infections generally require operative drainage. If these foot infections are associated with severe peripheral arterial disease (PAD), revascularization through surgical bypass or endovascular intervention is generally offered. However, some patient characteristics—such as low baseline functional status, severe systemic comorbidities, or a history of previous revascularization that has failed—are thought to limit the likelihood of benefiting from (further) revascularization and limb preservation efforts. In these situations, major (ie, above-ankle) amputation is offered[1-3] and generally considered the only alternative to revascularization and limb preservation efforts.[4]

Recent cost-effectiveness analyses examining strategies for the management of foot wound associated with severe PAD have suggested that the strategy of local wound care and expectant management (including major amputation when needed) may provide more functional and health benefits at lower costs than a strategy of primary major amputation.[5] Although these studies considered uninfected foot wounds only, we hypothesized that the operative treatment of moderate or severe foot infections with minor amputations and subsequent palliative wound care might serve as a safe alternative to major amputation in patients with severe PAD. This study reports our center's experience with a cohort of patients receiving this strategy as well as a concurrent cohort receiving the conventional strategy of primary major amputation.

[1]Baylor College of Medicine, Houston, TX, USA

Corresponding Author:
Neal R. Barshes, MD, MPH, Division of Vascular and Endovascular Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Michael E. DeBakey Veterans Affairs Medical Center, 2002 Holcombe Boulevard (OCL 112), Houston, TX 77030, USA.
Email: nbarshes@bcm.tmc.edu

Methodology

Study Subjects

The study was reviewed and approved by the local review boards (Baylor College of Medicine Institutional Review Board Study H-32461, Veterans Affairs Research Identification Number 13F08.H). Patients who underwent operations at the Michael E. DeBakey Veterans Affairs Medical Center for foot infections between June 2009 and October 2013 were considered for inclusion in this study if the following characteristics were present: (*a*) moderate or severe (PEDIS grade 3 or 4)[6] foot infection, as corroborated by an operation done for infection with either positive microbiology from deep operative cultures or finding of purulent material at operation; (*b*) severe PAD (as corroborated by toe pressures <55 mm Hg and/or or ankle pressures <100 mm Hg)[7-9]; and (*c*) not offered or refused revascularization options.

Patients with these characteristics were generally offered primary major (above-ankle) amputation. The option of minor (toe or partial foot) amputation with palliative wound care (subsequently referred to as "wound palliation") was offered to selected patients at the discretion of a staff surgeon. Patients offered this wound palliation option were provided with a candid discussion of the expectations and the possible disadvantages of this approach including the possibility of ascending sepsis, progression to need for an above-knee amputation, and the indefinite need for long-term wound care. It was also made clear that there would be no expectation of wound healing and that local wound care would be needed indefinitely. Wound healing adjuncts such as with skin substitutes or growth factors were not used because of the advanced PAD present in this group.

All operations were done by or with the supervision of a board-certified vascular surgeon. Minor amputations were generally done with local or regional (ankle block) anesthesia and monitored anesthesia care. Deep operative cultures were obtained only after sterilization of the surgical site with an iodine-based preparation solution. Major amputations were done without a tourniquet. The decision for 1-stage (formal) amputation versus 2-stage (initial guillotine followed by formal amputation) was made by a staff surgeon based on the clinical context of the individual patient.

Case–Control Matching

All patients that underwent minor amputation and palliative wound care were included in the study. Age-matched controls were then selected in a 1:1 ratio from a registry of patients who also had the above-mentioned characteristics and had undergone primary major amputation at our medical center. These controls were selected based on presence and severity of the foot infection, PAD, and other comorbidities and baseline characteristics (including coronary artery disease and a history of previous major amputation of the contralateral limb) whenever possible. Matching was done blinded to clinical outcomes.

Baseline Variables and Outcome Data

The glycosylated hemoglobin (HgbA1C, recorded as a percentage) and serum albumin (recorded in gm/dL) values that preceded the initial operation were recorded. Estimated glomerular filtration rate was calculated using the Cockcroft–Gault formula. Ejection fraction was determined by cardiac imaging (echocardiography or coronary angiography with left ventriculogram). Left ventricular function that was reported to be "normal" was assumed to be 60% to 65%. The presence of any of the following within 48 hours prior to the initial operation (minor or major amputation) were considered signs of a systemic inflammatory response syndrome (SIRS): temperature ≥100.5°F; pulse rate >90/min; respiratory rate >20/min; arterial CO_2 <32 mm Hg or serum bicarbonate <22 mmol/L; white blood cell count >12 000/μL or <4000/μL; or neutrophil proportion >80%. We did not include temperature <96.8°F because many temperature recordings at our institution are axillary and frequently <98.6°F. Patients with 2 or more signs of the SIRS syndrome were classified according to the PEDIS classification as having a severe foot infection; those with less than 2 signs were classified as having a moderate foot infection.

Clinical outcomes were ascertained from prospective follow-up and detailed chart review. Outcomes of interest included survival, reoperations, wound healing, and intraoperative blood transfusions required. The date of last follow-up was the last time that the patient was seen at our medical center as an inpatient or outpatient.

Statistical Analysis

Intercooled Stata version 8.2 (StataCorp, College Station, TX) was used for all statistical analyses. A P value of <.05 was considered statistically significant. The Wilcoxon–Mann–Whitney rank-sum was used for the comparison of all ordinal or interval variables between groups. The Fisher exact test was used for all categorical or binary variables. Kaplan–Meier survival analyses were used for all time-to-event analyses, with the log-rank test being used to compare time-to-event outcomes between groups.

Results

Baseline Characteristics

Eleven patients received minor amputations and palliative wound care for moderate or severe infection in 13 limbs during the study period. These were matched to a control cohort of 12 patients who underwent primary amputation

Table 1. Demographics and Baseline Clinical Characteristics of Patients That Received a Primary Major Amputation (n = 12) or a Minor Amputation and Palliative Wound Care (n = 11) for Moderate or Severe Foot Infections and Peripheral Arterial Disease.

Variable	Primary Major Amputation (n = 12)	Minor Amputation + Palliative Wound Care (n = 11)	*P* Value[a]
Age in years, n (%)			.94
<65	1 (8)	1 (9)	
65-69	1 (8)	2 (18)	
70-74	1 (8)	1 (9)	
75-79	3 (25)	1 (9)	
80-84	1 (8)	2 (18)	
85-89	3 (25)	3 (27)	
90+	2 (17)	1 (9)	
Diabetes mellitus, n (%)	10 (83)	9 (82)	1.0
Median hemoglobin A1C, %	7.1	7.6	.15
Chronic kidney disease, n (%)			.89
Stage 1 or less (eGFR ≥ 90)	4 (33)	3 (27)	
Stage 2 (eGFR 60-89)	1 (8)	3 (27)	
Stage 3 (eGFR 30-59)	5 (42)	3 (27)	
Stage 4 (eGFR 15-29)	1 (8)	1 (9)	
Stage 5 (eGFR<15 and/or ESRD)	1 (8)	1 (9)	
Cardiac ejection fraction, n (%)			1.0
Unknown	0 (0)	1 (9)	
55% or above	6 (50)	4 (45)	
35% to 54%	3 (25)	2 (18)	
<35%	3 (25)	3 (27)	
Median albumin, g/dL	2.4	2.9	.12
Median body mass index, kg/m^2	26.3	22.9	.23
Previous major amputation of contralateral limb, n (%)	4 (33)	2 (18)	.64
Previous stroke and/or dementia, n (%)	5 (42)	4 (36)	1.0
Lived independently prior to initial operation, n (%)	11 (92)	8 (73)	.32
Preserved ambulatory ability prior to initial operation, n (%)	8 (67)	5 (45)	.41

Abbreviations: eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease.
[a]Calculated using Fisher's exact test for categorical variables and the Wilcoxon–Mann–Whitney rank-sum test for ordinal variables.

for moderate or severe foot infections in 13 limbs. Both cohorts were comprised of elderly diabetics with a high prevalence of comorbidities and marginal baseline functional status (Table 1). The median age was 80 years in both groups. Most patients (19 of 23, or 83% overall) had diabetes mellitus with median glycosylated hemoglobin levels of 7.1% and 7.6% for the primary amputation and palliation groups, respectively (P = .15, Wilcoxon–Mann–Whitney rank-sum test). Chronic kidney disease was prevalent among this cohort. Twelve of the patients among the 2 cohorts (52% overall) had stage 3 or higher chronic kidney disease at the time of their initial operation. One patient in each group had end-stage renal disease. Six patients in the amputation group (50%) and 5 in the wound palliation group (45%) had chronic heart failure, with 3 patients in each cohort (25% and 27%, respectively) having an ejection fraction ≤30%. The median serum albumin at the time of the initial operation was low in both groups: 2.2 gm/dL in the primary amputation group and 2.9 gm/dL in the palliation group (P = .12, Wilcoxon–Mann–Whitney rank-sum test). As shown in Table 1, the baseline characteristics of these 2 groups did not differ significantly.

Baseline functional status was poor in both cohorts but did not differ significantly (Table 1). Most patients lived independently prior to their initial operation (11 [92%] in the primary amputation group and 8 [73%] in the palliation group). Five patients (42%) in the primary amputation group and 4 patients (36%) in the palliation group had a previous history of stroke and/or significant dementia. Four patients (33%) of the primary amputation group and 2 patients (18%) of the palliation group had a history of major amputation of their contralateral limb prior to the occurrence of a foot infection in their index limb.

Ankle-brachial indices were below 0.9 in only 16 of the 24 patients (67%) in whom ankle pressures could be obtained. All 13 limbs in the palliative care group and 12 of the 13 limbs (92%) in the primary amputation group had toe pressure of <55 mm Hg. One patient (8%) in the primary amputation

Table 2. Characteristics of the Foot Infections Managed With Primary Amputation (n = 13) or Minor Amputation and Palliative Wound Care (n = 13).

Variable	Primary Major Amputation (n = 13)	Minor Amputation + Palliative Wound Care (n = 13)	*P* Value
Median toe pressure, mmHg	33	31	.28
Proximal-distal location of instigating ulcer			.003*
Toes	5 (38)	13 (100)	
Proximal forefoot	1 (24)	0 (0)	
Midfoot	0 (0)	0 (0)	
Heel	5 (38)	0 (0)	
Location of forefoot wounds			.26
Medial	1 (13)	3 (23)	
Central compartment	6 (75)	5 (38)	
Lateral compartment	1 (13)	5 (30)	
PEDIS severity of foot infection			1.0
Moderate	5 (38.5)	6 (46.2)	
Severe	8 (61.5)	7 (53.9)	
Median white blood cell count at presentation, 1000 per μL	14.5	10.7	.12
Median serum glucose on presentation, mg/dL	136	120	.43
Median number of unique microorganism species identified	3.0	3.5	.50

group that had a heel wound had a previous history of transmetatarsal amputation, and thus toe pressures could not be obtained; the pressure at the ankle was 108 mm Hg, consistent with moderate-severity PAD. The median toe pressures of 33 mm Hg (median digital-brachial index of 0.12) in the primary amputation group and 31 mm Hg (median digital-brachial index of 0.16) in the palliative care group did not differ significantly (Table 2). All instigating foot wounds in the palliative care group were located in the toes. This differed from the instigating foot wounds in the primary amputation group, which had nearly equal numbers in the forefoot (toes and region of the distal metatarsals) as the heel ($P = .003$ between groups, Fisher exact test). Among the subset of limbs with forefoot wounds (n = 21), wound laterality (medial vs central vs lateral compartment) did not differ significantly between the 2 groups. There were no limbs with midfoot ulcers that met inclusion criteria during this study period.

The severity of acute illness appeared to be comparable in the 2 groups. Eight (61.5%) of the foot infections in the primary amputation group and 7 (53.9%) of the foot infections in the palliative care group were classified as severe at the time of presentation ($P = 1.0$, Fisher's exact test). The median white blood cell count and median glucose levels at admission did not differ significantly between the 2 groups. The median number of unique microorganisms obtained from operative fluid and/or tissue cultures was also similar among the 2 groups.

Limb Outcomes and Characteristics of Operations Performed

The 11 patients in the primary amputation group underwent primary amputation of 13 infected limbs. The major amputations included 7 transtibial (below-knee) amputations and 6 transfemoral (above-knee) amputations. Two of the below-knee amputations were performed in a 2-stage fashion (ie, proceeded by a guillotine [open] transtibial amputation). Six (46%) of these amputations were done under general anesthesia and 7 (54%) were done with regional anesthesia. Blood transfusions were given during 7 (46%) of these operations—1 unit in 4 cases (31%) and 2 units in 3 cases (23%). Three limbs (23%) required a total of 6 reoperations after the formal amputation was done for various wound healing problems such as wound dehiscence and superficial surgical site infections. Of these, one limb required 3 reoperations, one limb required 2 reoperations, and one limb required 1 reoperation. Ten of these limbs (77%) healed or remained closed (intact) during a median follow-up time of 357 days (range = 42-1328 days).

All 13 limbs in the minor amputation and wound palliation group underwent an initial operative drainage of infection. In all cases, this included amputation of at least one toe and variable degrees of operative drainage of abscess extending into the proximal forefoot. Three limbs (23%) required a total of 3 additional reoperations below the ankle (ie, one reoperation per limb).

Four of the 13 limbs (31%) in the wound palliation group have undergone major amputation over a median follow-up time of 139 days (range=33-660 days) for a 1- and 2-year limb salvage rate of 65.9% (see Figure 1). Three of these major amputations occurred at approximately 1 month (viz, 32, 34, and 38 days) following the initial operation, and the fourth occurred at 139 days after the initial operation. In 2 of these cases the decision to proceed to amputation was made because of the recurrence of local sepsis with some vague but persistent systemic symptoms including malaise and anorexia. The other 2 cases were both nonambulatory patients with advanced dementia who developed leukocytosis

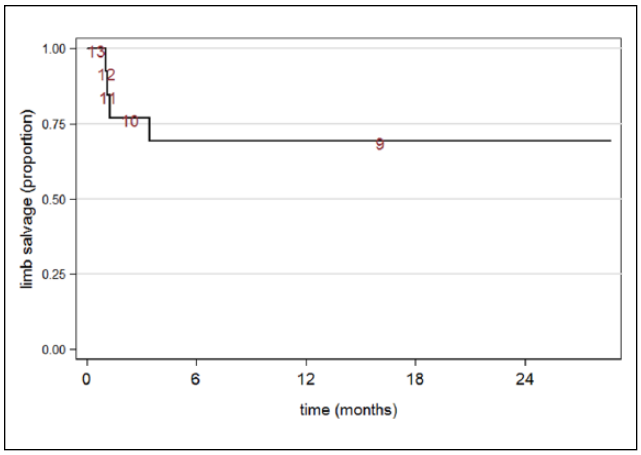

Figure 1. Limb salvage over the 24 months following minor amputation and palliative wound care in patients with moderate or severe foot infections and severe PAD.

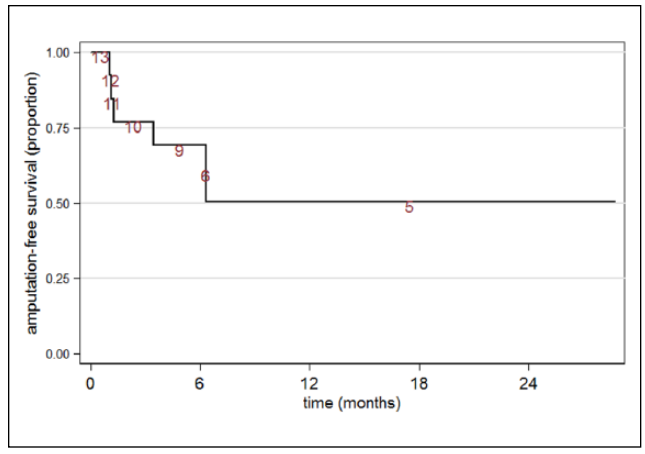

Figure 2. Amputation-free survival over the 24 months following minor amputation and palliative wound care in patients with moderate or severe foot infections and severe PAD.

and recurrent signs of local infection in the foot approximately 1 month after minor amputation. No patient developed signs or symptoms of sepsis extending to the leg. Aside from the above-mentioned patient with leukocytosis, no other patient subsequently developed any signs of the systemic inflammatory syndrome. Three of the 4 amputations (75%) done among this group were transfemoral (above-knee) amputations and one (25%) was a transtibial (below-knee) amputation. Two transfemoral amputation were done in 2 stages (ie, preceded by an open [guillotine] transtibial amputation), while one transfemoral and the single transtibial amputation was done in a single stage. Two of these major amputations (67%) were done under general anesthesia and one (33%) was done under regional anesthesia. Two of these major amputations (50%) have had a total of 3 reoperations for wound healing problems: one transfemoral amputation requiring 2 revisions and another transfemoral amputation requiring 1 revision.

Patient Survival and Functional Outcomes

The overall survival for the 26 patients included in the study at 1 and 2 years was 83.3% and 70.4%, respectively. The survival rates at 1 and 2 years were 84.6% and 67.7% for the primary major amputation group and 75.0% and 75.5% for the palliative wound care group, a difference that did not reach statistical significance ($P = .86$, log-rank test). One perioperative death occurred at postoperative day 42 in a patient in the primary amputation group—a 93-year-old man who developed acute renal failure and progressive respiratory failure. The earliest death among patients in the palliative care group occurred at 192 days following initial operative debridement and appeared to be due to a sudden cardiac cause. One other late death was due to aspiration pneumonia and another was presumably an acute intra-abdominal pathology that had presented with projectile emesis. The cause of death in the other 2 cases is unknown and occurred in the outpatient setting. Together with the amputation data, this resulted in 1- and 2-year amputation-free survival rates of 36.0% in the palliative wound care group (see Figure 2).

Eight of the 11 patients (73%) in the primary amputation group had some ambulatory ability prior to their foot infection. Of these, 6 (75%) lost their ability to ambulate after the primary amputation. Five of the 11 patients (45%) in the palliative care group were ambulatory prior to the onset of foot infection; all 5 (100%) remained ambulatory after minor amputation. This difference reached statistical significance ($P = .02$, Fisher's exact test). Similarly, 10 patients (91%) in the primary amputation group lived independently prior to major amputation, but only 5 (45%) remained so after primary amputation. In contrast, of the 8 patients in the palliative care group (73%) that lived independently prior to their foot infection and minor amputation, all 8 (100%) remained independent afterwards ($P = .02$, Fisher's exact test).

Discussion

Traditionally, advanced foot infections in patients with severe PAD that were not considered candidates for revascularization (most often because of poor baseline functional status or severe medical comorbidities) were treated with major amputation as a means of achieving control of the source of the infection and a healed wound.[1,2,4] Anecdotally, wound palliation—local wound care that provides symptomatic relief without the expectation of wound healing—is not infrequently used as a management strategy for uninfected foot or leg wounds in patients in patients with advanced terminal illnesses. The little literature that exists on palliative wound care is exclusive to wounds without significant infection and is essentially advisory.[10-12] There

does not appear to be any literature—anecdotal, advisory, or otherwise—describing the outcome of such management and none describing the concept of minor amputation or operative drainage with subsequent palliative wound care as an alternative to major amputations for patients with severe PAD and foot infections.

Herein we have described our group's experience with an approach for the palliation of wounds that would traditionally be treated with major amputation. These early experiences with minor amputations and palliative wound care have demonstrated several points. First, this strategy does effectively avoid the need for major amputation in most patients. Furthermore, the avoidance of major amputation appears durable, with rates of "limb salvage" (more major amputation-avoidance in this context) of 66% at 1 year following the initial operation. A second potential benefit of minor amputation with palliative wound care is minimizing the need for general anesthesia, blood transfusions, and the perioperative mortality associated with major amputation—which has been estimated to be as high as 9% in a high-risk patient population such as this.[13]

Perhaps the most important potential benefit of the strategy of minor amputation and palliative wound care, however, is the potential to preserve the low baseline level of function of these patients and prevent decline that might result in loss of the ability to live in the community. In our series, all patients who had some ambulatory ability and lived independently at baseline remained so after minor amputation and palliative wound care. In contrast, most patients (75%) undergoing primary amputation lost ambulatory ability, and half (50%) were no longer able to live independently in the community and required nursing home care. These are outcomes similar to those of other reports that have demonstrated that patients with functional that is poor at baseline seem to be at highest risk for significant decline.[14,15] Nursing home care is costly, and discharge to a nursing home appears to be a significant cost driver in the setting of limb preservation efforts, and it was previous work focused on costs and cost-effectiveness that initiated our group's interest in investigating palliative wound care as an appealing alternative to major amputation. Indeed, a strong argument for avoiding major amputation in frail, elderly patients can be made on an economic basis alone,[5] and this argument is more compelling still when the psychological and functional impact of limb loss is considered.

Several outcomes were notably absent from our findings. We did not see any cases of ascending infection or systemic sepsis. The need for reoperations—either further drainage/minor amputations or major amputations—was infrequent. Although none of the minor amputation site wounds healed, we did not see progressive dry gangrene of the soft tissue surrounding the minor amputation sites (see example in Figure 3). Lastly, it did not appear that failure of minor amputation and palliative wound care altered the final level of amputation that was required.

Figure 3. The right foot of an 80-year-old man with diabetes mellitus, advanced lymphedema, severe peripheral arterial disease (first toe pressure 20 mm Hg), and stage II chronic kidney disease. He initially presented with purulent drainage from a necrotic third toe (panel A) that was treated with toe amputation. The wound was not healed 8 months later (panel B) but had remained without infection.

It is worth emphasizing that this study focused on a very specific and relatively homogenous patient population: those with severe PAD (toe pressures of <55 mm Hg and/or ankle pressures <100 mm Hg) *and* moderate or severe foot infections requiring operative drainage. Similar to practices at other medical centers, clinicians at our center have offered palliative wound care to patients with less severe PAD and/or uninfected foot wounds that were either uninterested in more aggressive limb preservation efforts or were thought to have limited potential for benefit from these efforts. We chose, however, to focus this study only on those meeting the aforementioned criteria to determine the upper limit to which the strategy of palliative wound care might be applied and to allow generalizability of these findings to similar patients. The tradeoff of such selective inclusion criteria, however, is a smaller study sample size. While we feel the results of this study are encouraging, we acknowledge the need for other groups to report their

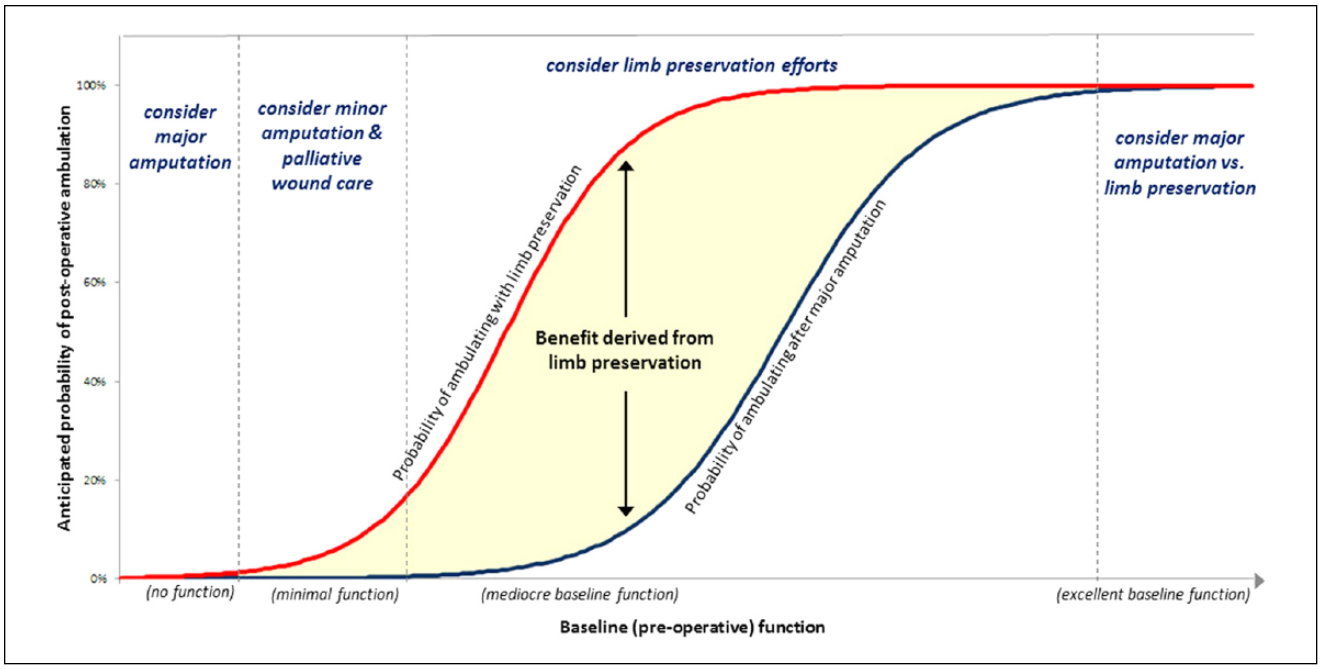

Figure 4. The relationship between preoperative and postoperative function and the health benefits that may be provided by limb preservation efforts.

experiences with minor amputations and palliative wound care in this patient population.

We would urge clinicians considering the strategy of minor amputations and subsequent palliative wound care to be mindful of appropriate patient selection. Formal cost-effectiveness analyses have suggested that, in general, limb preservation efforts are a cost-effective alternative to wound care for maintaining ambulatory ability and independence in patients with critical limb ischemia and nonhealing foot wounds. The relative cost-effectiveness of these efforts seems to improve and even reach cost savings (improved health benefits at lower total costs) for frail and/or elderly patients, probably because although the functional outcomes in this patient population are somewhat poorer, they are poorer still after major amputation (see Figure 4). Indeed, primary major amputation does not seem to be a good option for patients that are ambulatory and independent at baseline, as it associated with poorer health outcomes and higher costs than either revascularization and limb preservation efforts or local wound care alone.

The strategy of minor amputation and palliative wound care seems most appropriate for those patients that live in the community and do have some limited ambulatory ability but would be expected to have limited benefits from limb preservation (Figure 4). In this series, this included patients with forefoot or midfoot infections, severe medical comorbidities, and poor baseline function who live in the community. None of the patients in this series had heel wounds. These wounds are generally decubitus in nature, occurring often in patients who are completely bedridden and/or live in a nursing home environment. Although the presence of a heel ulcer with infection need not be a contraindication to operative drainage and palliative wound care, the lack of independence and ambulatory ability characteristic of most patients with heel wounds would curtail or eliminate much of the benefit this strategy might provide over major amputation (Figure 4). This strategy should probably be reserved for patients with minimal pain (because of associated peripheral neuropathy) or mild pain that can be managed effectively with oral analgesic medications. Minor amputations and palliative wound care can be effective for severe foot infections (ie, patients with 2+ signs of SIRS), but we might caution against applying this strategy toward patients presenting with septic shock (ie, hypotension that is refractory to resuscitation), especially in elderly patients with poor physiological reserves.

Clinicians who offer the option of minor amputation and palliative wound care should generally also at least discuss if not offer both conventional limb preservation efforts (revascularization, offloading, and wound care with the intent to achieve wound healing) as well as primary major amputation. This discussion should include a candid description of the morbidity, mortality, and outcomes expected with each of these options. If palliative management is undertaken, the patient and all providers involved in his or her care should be clear on expected outcomes.

Specifically, it should be emphasized that the wound is not expected to heal and that palliative wound care is being done only with the goal of avoiding a major amputation. Being clear on this point may avoid the application of expensive wound healing adjuncts such as skin substitutes or growth factors. Like other authors, we agree that surgical management of foot infections is most effective when performed by experienced surgeons that are familiar with the anatomy of the foot, as foot infections do typically track along compartments of the foot and other tissue planes.[16-18]

Finally, we encourage other surgeons to actively participate in the innovation of other palliative management options for elderly patients with significant medical comorbidities. As advocated by the American College of Surgeon Committee on Ethics,[19] palliative management options should seek to optimize person-centered outcomes in ways that are consistent with each patient's particular preferences for health-related outcomes. There is a growing body of literature describing palliative management from the surgeon's perspective with a focus mainly on surgical oncology.[20-24] Given that the annual mortality rates of patients with PAD and foot wounds is typically at generally 12% and nearer to 20% for those that are elderly, palliative options may be as applicable to patients with PAD as to patients with terminal cancers. It should be emphasized that palliative management should be used only selectively and as an alternative to major amputation in the context of limb-threatening foot infections. Aggressive limb salvage efforts (including revascularization and wound care with intent to achieve a healed wound) to do appear cost-effective—especially in elderly patients with marginal functional status—and should remain the recommended management option for most patients with PAD that present with foot infection.

In summary, minor amputations and/or operative drainage with subsequent palliative wound care appears to be a safe alternative to primary major amputations for patients with severe PAD and moderate or severe foot infections that are not considered candidates for revascularization. Patients that may benefit most from palliation are those with some limb function that would be likely to have a change in ambulatory status or living situation if a major amputation is performed.

Declaration of Conflicting Interests

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