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Outcomes of major lower extremity amputations n dysvascular patients: Room for improvement

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ABSTRACT

Objectives: Dysvascular patients account for >80% of major amputations in the US. We sought to determine if early mobilization and discharge disposition decreased post-operative hospital length of stay (PO-LOS) and expedited independent ambulation.
Methods: A retrospective review of dysvascular patients undergoing major amputations was performed. Primary outcomes included PO-LOS, discharge disposition, and days to ambulation.
Results: 130 patients were included. Patients evaluated by Physical Therapy (PT) within 1 day of formal amputation had decreased PO-LOS (5.6 vs 6.5 days, $p = 0.029$). Patients discharged to rehab had a shorter PO-LOS (4 days) than those discharged to SNF or home (8 and 5 days, respectively; $p = 0.008$). Time to ambulation was shorter for patients discharged to rehab (109 days vs home = 153 days; SNF = 175 days; $p = 0.033$).
Conclusion: Modifiable factors, including early PT and rehab placement, decreased PO-LOS and expedited time to ambulation. A need exists for a standardized multidisciplinary team approach to improve outcomes.

Introduction

Over 1 million people in the United States are living with a major lower extremity amputation.[1] Dysvascular patients with peripheral arterial disease or diabetes mellitus account for >80% of all major (*trans*-tibial or *trans*-femoral) lower extremity amputations,[2,3] since over half of these patients will ultimately require a major amputation. Additionally, dysvascular patients undergoing major lower extremity amputation have a significantly higher mortality than comparably aged counterparts (69% and 34% at 1 and 5 years post-operatively). Patients with above knee amputations (AKA) have nearly a 25% increase in mortality compared to those with below knee amputations (BKA), likely due to the co-morbidities associated with advanced ischemic disease.[4]

Patients undergoing major lower extremity amputations due to dysvascular disease are generally older, with a higher number of medical co-morbidities, and are predisposed to deconditioning faster than the younger population with traumatic amputations.[3,5] Older patients with coronary artery disease and renal failure are less likely to be functionally ambulatory post amputation.[6] Prolonged immobility in this patient population can lead to early post-operative complications including deep venous thrombosis (DVT) and associated pulmonary embolus (PE), atelectasis and pneumonia, and urinary catheter associated complications (infection, retention).[7] Complications in this group of patients can be devastating due to their already deconditioned state. Avoidance of prolonged bed rest improves functionality, limits length of stay, and decreases overall mortality rates.[7]

This study examined outcomes in patients undergoing major lower extremity amputation for vascular causes and aimed to determine if modifiable factors existed that decreased post-operative hospital length of stay (PO-LOS) and expedited independent ambulation. We hypothesized early mobilization in combination with discharge to acute rehabilitation results in decreased post-operative length of stay and improved functional outcomes.

Methods

A retrospective review of all dysvascular patients undergoing *trans*-tibial or *trans*-femoral amputation from January 2016 through

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December 2018 at Community Regional Medical Center (CRMC) in Fresno, California, was performed. CRMC is a 680-bed regional referral center located in central California, serving a population of 2.2 million patients. Patients undergoing lower extremity amputation by the general or vascular surgery service were identified from the electronic medical record database. Patients greater than 18 years of age diagnosed with peripheral vascular disease and/or diabetes mellitus were included. Patients who underwent bilateral amputation, had amputations as a result of trauma, were not previously ambulatory, or were transferred to other hospitals or died prior to their formal amputation were excluded. Data included patient demographics, co-morbidities and anticoagulation status, time to physical therapy (PT) and discharge planning consultations, complications (30 day readmissions, surgical site infections, major adverse cardiac events, CAUTI, and DVT.), hospital length of stay, discharge disposition, and time to prosthesis and ambulation. Post-operative data was calculated from the date of formal amputation in patients who had an initial guillotine amputation.

Patients admitted with sepsis and/or a necrotizing infection of the lower extremity undergo a two stage amputation with initial guillotine amputation Patients then undergo formalization 72 h after a guillotine amputation if medically stable. This approach is uniform between our acute care surgical service and vascular service who collaborate in the care of these patients. Prosthetic and ambulation data was obtained from the prosthetists who delivered the prosthetic after discharge and determined when the patient was independently ambulatory. The primary outcome was post-operative hospital length of stay as determined from the time of formal amputation. Secondary outcomes included discharge disposition, receipt of prosthetic, and time to ambulation.

Patients were compared by time to inpatient physical therapy consultation, as well as by discharge disposition. The timing of consultation for physical therapy placed by the primary or consulting teams was at the discretion of the attending physician. Patients seen by physical therapy on or before post-operative day 1 were defined as "Early PT" and those seen by physical therapy on post-operative day 2 or later were defined as "Late PT". The definition of "Early PT" was chosen based on the earliest PT consultation that could take place if the amputation was being performed electively. Patients at our institution cannot be discharged to acute rehab without a PT evaluation, therefore, a consultation occurring no later than POD1 ensures a patients ability to be discharged in a timely fashion once medically cleared (optimally on POD 2 or 3). Physical therapy is available seven days a week at our institution and therefore no delays occurred due to weekends. The goal for physical therapy activity at our institution aims to mobilize amputees out of bed on the first consultation visit (minimum of out of bed to chair with assistance). If consultation occurs prior to formal amputation, non-weight bearing exercises as well as upper extremity strengthening is provided. Once a physical therapy consultation is initiated, therapy occurs daily. If consultation occurs prior to formal amputation, non-weight bearing exercises as well as upper extremity strengthening is provided. Once a physical therapy consultation is initiated, therapy occurs daily. Consults placed prior to 3 p.m. are generally seen on the same day. Consults placed prior to 3 p.m. are generally seen on the same day. Patient follow up occurred in the general surgery and vascular clinics.

Continuous data are presented as mean ± standard deviation and categorical data are presented as percentages. Groups were compared using Mann Whitney U, Kruskall Wallis, and Chi Square with significance attributed to a p value < 0.05. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS 24.0, IBM). This study was approved by the Institutional Review Board at Community Medical Centers and UCSF Fresno.

Results

During the study period, 143 dysvascular patients underwent major lower extremity amputations; 13 were excluded, leaving a study cohort of 130 patients. All patients included in this study were functionally independent and ambulatory pre-operatively. The mean age was 57 ± 13 years and 73% were male with an average BMI of 29 ± 8. Common co-morbidities included coronary artery disease (30%), diabetes mellitus (91%), former or current smoker status (48%), and end stage renal disease on hemodialysis (17%). Prior procedures included lower extremity bypass or endovascular intervention (20%) and minor amputation or operative foot debridement (56%). Pre-operatively, 58 (45%) patients were on antiplatelet therapy and 12 (9%) patients were receiving anticoagulation. Sixty patients (46%) had guillotine amputations as their initial procedure. Of the study patients, 117 (90%) had a primary BKA and 13 (10%) had an AKA; only one patient required a revision from a BKA to an AKA during the study period (Table 1). Median follow up was 224 days [IQR: 95–567 days]. 7 patients were lost to follow up. Surgical site infections occurred in 15% of patients. The 30 day readmission rate was 15% and did not differ by discharge disposition; 11 readmissions were unrelated to the amputation and 8 were limb related, including 3 stump infections and 5 planned admissions for minor revision of the stump. The overall post-discharge mortality during the study period (patients last follow up) was 7% and there were no known deaths at 30 days.

All patients received consultations from physical therapy and social work during their index admission. The average time to physical therapy and discharge planning consults were 0 ± 4 and 1 ± 4 days post-operatively, respectively. Demographics were similar between those receiving early PT and late PT. Patients in the early PT group had their initial consult an average of one day prior to their formal amputation and were post-operatively mobilized out of bed sooner than the late PT group. Early PT patients also had a shorter PO-LOS [Table 2].

Of the 130 patients, 35 (27%) were discharged to an acute rehabilitation facility, 51 (39%) were discharged home, and 44 (23%) were discharged to a skilled nursing facility. Patients discharged to home were significantly younger and more likely to be male. Those discharged to a skilled nursing facility had a higher incidence of coronary artery disease and end stage renal disease on hemodialysis (Table 3). Additionally, of those discharged to a skilled nursing facility, 9 (20%) were AKA patients and never became functionally ambulatory. Patients who were discharged to an acute rehab facility

Table 1
Patient characteristics.

	No. (130)	%
Male gender	95	73
Race/Ethnicity		
White	41	32
Black	9	7
Hispanic	74	57
Asian	3	2
Comorbidities		
Coronary artery disease	39	30
Diabetes Mellitus	118	91
Smokers (former or current)	63	48
Hypertension	114	88
End stage renal disease	22	17
Initial Amputation		
Above Knee Amputation	13	10
Below Knee Amputation	117	90

Table 2
Demographics and outcomes by time to physical therapy.

	Early PT (≤1 day post-op)	Late PT (>1 day post-op)	P value
N	81	49	–
Age	57 ± 12	56 ± 14	0.44
BMI	27 ± 5	30 ± 11	0.25
Male gender	61 (75%)	34 (69%)	0.46
Coronary artery disease	22 (27%)	17 (35%)	0.36
Diabetes Mellitus	74 (91%)	44 (90%)	0.77
End stage renal disease	14 (17%)	8 (16%)	0.89
Prior minor amputation	46 (57%)	27 (55%)	0.85
Prior vascular intervention	12 (15%)	14 (29%)	0.057
Post-op time to PT (days)	−1 ± 4	3 ± 1	<0.001
Post-op time to mobilization (days)	1 ± 2	3 ± 2	<0.001
Post-op LOS (days)	6 ± 6	7 ± 4	0.029
Discharge disposition			
Rehab	25 (31%)	10 (20%)	0.19
Home	28 (35%)	23 (47%)	0.16
SNF	28 (35%)	16 (33%)	0.82

had a significantly shorter post-operative length of stay (4 ± 3 days) compared to those who were discharged directly home (5 ± 3 days) or to a skilled nursing facility (8 ± 8 days) p = 0.008. In a multivariable logistic regression analysis accounting for CAD and ESRD, only discharge disposition was a significant predictor for post-operative LOS (p = 0.007).

Based on medical record review and data collected from prosthetists, only 58 patients (44%) received prosthetics. Of patients discharged to rehabilitation 54% received a prosthetic compared to only 45% that were discharged home and 36% discharged to skilled nursing facility. Only 2 of the 15 patients (13%) in the above knee amputation cohort went on to receive a prosthetic and ambulate and these were both discharged to acute rehab.

Detailed outcomes from prosthetists were available for 57 of 58 patients who went on to receive their prosthetic. Data was unavailable for 1 patient as the prosthesis was received directly from a company unaffiliated with our institution and the patient could not be contacted. Patients discharged to acute rehabilitation received prosthetics approximately 1 month earlier than those discharged to a skilled nursing facility or home; however, this difference was not significant (rehab = 109 ± 48 days, SNF = 144 ± 64 days, home = 153 ± 137 days; p = 0.24) (Fig. 1). Subsequently, those patients discharged to acute rehabilitation ambulated an average of 2 months sooner than those discharged to home or SNF (rehab = 109 ± 48 days, SNF = 175 ± 84 days, home = 153 ± 137 days; p = 0.033) (Fig. 2).

Discussion

Major lower extremity amputation remains a high volume procedure despite advances in medical care for diabetes mellitus and advanced limb salvage therapies. Chopra et al. recently reported a 46% post-amputation ambulatory rate in patients undergoing major lower extremity amputation which is consistent with our post-amputation ambulatory rate of 44%.[8] Historical evaluation comparing below knee amputees to above knee amputees demonstrates improved results with regards to ambulation with prosthetic as well as overall mortality in the below knee population.[9] Patients with an AKA are not only less likely to ambulate at a high functioning level, but also often fail to achieve even a basic level of independence (getting up from a chair, walking around the house to perform activities of daily living).[10] Rate of failure of a below knee amputation is historically reported in many large studies at approximately 80%.[11] All dysvascular patients undergo a complete vascular evaluation prior to amputation at our institution. In all ambulatory patients, if a femoral pulse is palpable with evidence of adequate ileofemoral/profunda flow via imaging and tissue below the knee is viable, we attempt a below knee amputation. Absence of a popliteal pulse does not exclude someone from a BKA. If there appears to be significant ileofemoral/profunda disease that would preclude BKA healing, we will often perform revascularization in an ambulatory patient in order to salvage a limb to a below knee amputation. At our institution a BKA was attempted in over 90% of all patients who presented with non-salvageable limbs and were previously ambulatory, with a 99% success rate. Gomero-Cure et al. reported in a large retrospective study of major amputations that inflow disease (common iliac artery or femoral artery significant stenosis/occlusion) as well as absence of tibial runoff were the most common anatomical reasons for failure of a BKA. Additionally females, those with dementia, or a history of recent cardiac intervention were more likely to fail.[12] We were able to demonstrate that with equivocal vascular supply (adequate inflow) we can be successful at achieving a healed and functional below knee amputation.

Table 3
Demographics and outcomes by discharge disposition.

	Rehab (n = 35)	Home (n = 51)	SNF (n = 44)	P value
Age	58 ± 13	52 ± 10	60 ± 14	0.017
BMI	28 ± 6	28 ± 5	30 ± 12	0.62
Male gender	25 (71%)	43 (84%)	27 (61%)	0.041
Coronary artery disease	7 (20%)	12 (24%)	20 (45%)	0.021
Diabetes Mellitus	32 (91%)	47 (92%)	39 (89%)	0.83
End stage renal disease	6 (17%)	4 (8%)	12 (27%)	0.042
Prior minor amputation	18 (51%)	32 (63%)	23 (52%)	0.48
Prior vascular intervention	8 (32%)	7 (14%)	11 (25%)	0.35
Post-op LOS (days)	4 ± 3	5 ± 3	8 ± 8	0.008
Prosthesis received	19 (54%)	23 (45%)	16 (36%)	0.28

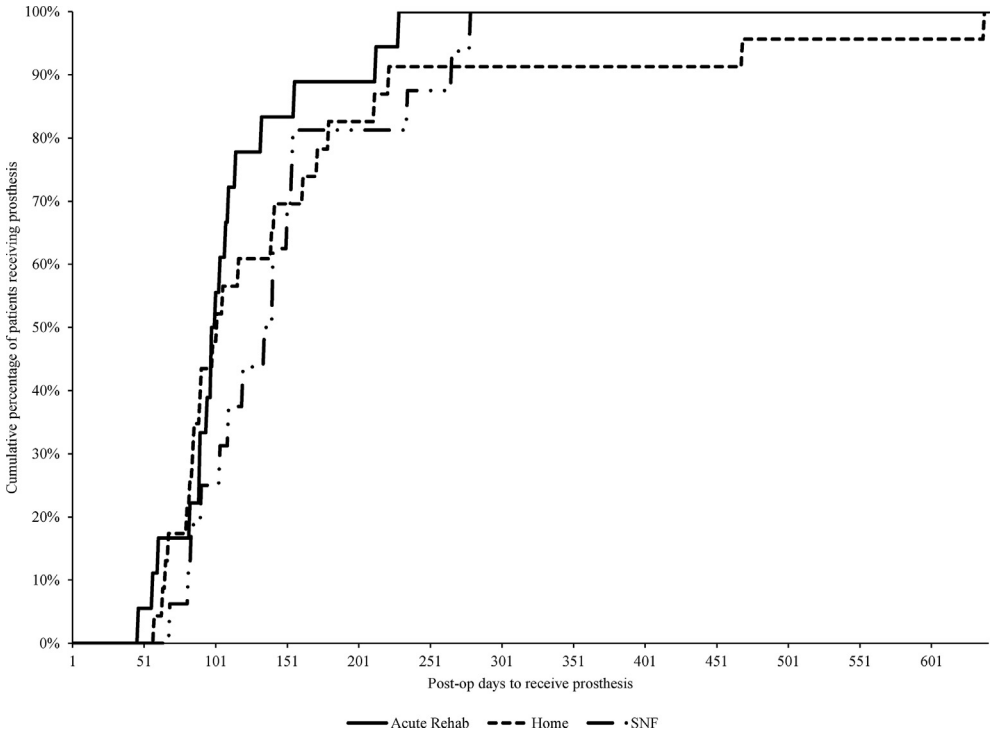

Fig. 1. Post-operative days to receive prosthesis by discharge disposition.

Physical therapy and post-operative mobilization should be prioritized in the dysvascular amputee. Data suggests that once an amputee is safe to transfer they avoid the potential complications of prolonged immobility, have shorter PO-LOS, and are able to transition to functional ambulation faster.[13–15] Historical studies report that patients often remain on bed rest anywhere from 3 to 5 days to avoid presumed complications of dependent swelling and wound dehiscence, as well as improved pain control.[16] We demonstrated that patients with early physical therapy were actually discharged sooner than those receiving physical therapy later in their post-operative course.

Frequently, due to sepsis, requirement of a staged amputation,

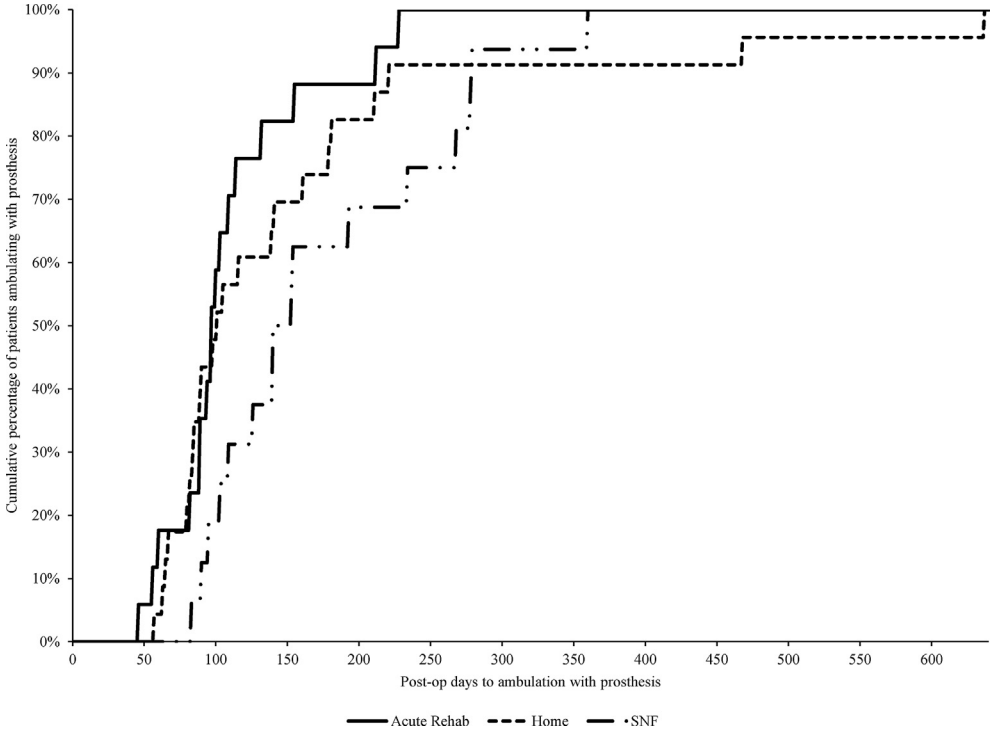

Fig. 2. Post-operative days to ambulation with prosthesis by discharge disposition.

or other medical co-morbidities, patients are admitted several days to weeks prior to receiving a definitive amputation. Therefore, there is often ample opportunity for early involvement of physical therapy and discharge planning. At our institution, if the consultation to the discharge planner or physical therapy team was not directly communicated via phone or face to face encounter, there was a potential delay in the patient being seen by the consultant. If a mindful approach is taken to employment of this multidisciplinary team (physical therapy and discharge planning), patients can benefit from "early PT", avoidance of prolonged bed rest, and a decreased post-operative length of stay. Data from previous studies suggests that discharge disposition is largely driven by clinical factors (mental capacity and functional ability) and availability of family support rather than socio-economic characteristics (insurance coverage).[17] Early evaluation by physical therapy allows for the determination of a patient's potential functional ability before they undergo a major amputation. Additionally, early involvement with discharge planning allows patients time to organize family support that will be required after discharge from acute rehabilitation.

Care provided to patients varies based on discharge disposition. Acute rehabilitation facilities are hospitals providing 24 h inpatient care by a team of clinicians in which patients receive medical care as well as three or more hours of core therapies per day. Skilled nursing facilities, however, only provide 1 h of core therapies per day and a provider (MD/NP/PA) is only required to visit the patient once every 30 days per Medicare guidelines. Finally, discharge to home with physical therapy often results in patients receiving in home PT or outpatient PT which may be less than three times a week. Medicare data for all patients discharged to SNF vs acute rehab demonstrate an average length of stay of 28 days vs 16 days.[18] This prolonged stay not only increases overall cost to the patient and healthcare system, but has been shown in studies, including ours, to worsen outcomes. It has been demonstrated that dysvascular amputees discharged to acute rehabilitation facilities vs SNF have better outcomes (improved 1 year mortality, higher likelihood of receiving a prosthetic, and decreased morbidity overall). Home discharge after amputation should be a last resort as major amputees require specialized rehabilitation to be able to safely exist independently at home.[19–21] In our study cohort, patients discharged to acute rehab not only had a shorter post-operative length of stay, but also ambulated sooner than those discharged to a skilled nursing facility or home. These findings highlight the importance of a multidisciplinary approach with physical therapy and discharge planning to place the patient in the most appropriate facility that will maximize their outcomes.

This study has several limitations. This was a retrospective, non-randomized study. All peri-operative care, surgical procedures, and post-operative follow up were left to the discretion of the surgical and medical teams and not according to standardized protocol. Discharge disposition to acute rehabilitation was not enforced by the physicians and ultimately left to the discretion of the physical therapists and discharge planner. No patients were excluded from discharge to acute rehabilitation based on type of insurance. Dysvascular patients requiring major amputation presenting to the hospital with no insurance typically qualify for presumptive Medi-Cal and can be placed at an acute rehab facility. No patients are denied prosthetics based on insurance or lack thereof.

Conclusions

This study demonstrates that modifiable factors, including early physical therapy evaluation and acute rehabilitation facility placement, decrease post-operative length of stay and expedite time to ambulation, and thus functional independence. Every attempt should be made at providing the patient with a below knee amputation when feasible to improve post-operative ambulation rates. A need exists for a standardized protocol employed by a multidisciplinary team to optimize the perioperative course in dysvascular patients undergoing major lower extremity amputations to improve outcomes.

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