The influence of gender on functional outcomes of lower extremity bypass

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Objective: **Our aim was to evaluate the effect of gender on early and late procedural and functional outcomes of lower extremity bypass (LEB).**

Methods: **We reviewed the records of 2576 patients (828 women; 32%) who underwent LEB for claudication or critical limb ischemia (CLI) in the Vascular Study Group of New England from 2003 to 2010. Logistic regression and proportional hazards models were used to adjust for potential confounding differences between genders. Morbidity, mortality, graft patency, freedom from major amputation, ambulation, and living status were analyzed postoperatively and over 1 year.**

Results: **Women were older (70 vs 68 years; $P < .001$), had more hypertension (89% vs 85%; $P = .006$), less coronary artery disease (35% vs 39%; $P = .03$), smoking (73% vs 88%; $P < .001$), and preoperative statin use (60% vs 64%; $P = .04$). Women were more likely to have CLI (76% vs 71%; $P = .003$), and ambulate with assistance at presentation (19% vs 16%; $P = .02$). Morbidity was similar except women had higher rates of reoperation for thrombosis (4% vs 2%; $P < .001$) without differences in major amputation (2% vs 1%; $P = .13$) or in-hospital mortality (1.7% vs 1.7%; $P = .96$). Women and men with claudication had similar 1-year graft patency rates. Women with CLI had lower rates of primary (hazard ratio [HR], 1.24; 95% confidence interval [CI], 1.03-1.48; $P = .02$), assisted primary (HR, 1.42; 95% CI, 1.15-1.76; $P = .001$) and secondary patency (HR, 1.40; 95% CI, 1.10-1.77; $P = .006$) during the first year compared with men. Freedom from amputation was similar for men and women with CLI (HR, 1.17; 95% CI, 0.84-1.63; $P = .36$). There were no differences in late survival between women and men with claudication (HR, 0.89; 95% CI, 0.60-1.31; $P = .36$) or CLI (HR, 0.94; 95% CI, 0.81-1.09; $P = .39$). More female claudicants were not independently ambulatory at discharge (30% vs 19%; $P = .002$) and were discharged to a nursing home (15% vs 5%; $P < .001$) but these differences did not persist at 1 year. Women with CLI were more likely to be nonambulatory at discharge (13% vs 9%; $P = .006$) and at 1 year (13% vs 8%; $P < .001$). More women with CLI were discharged to a nursing home (44% vs 35%; $P = .01$) and resided there at 1 year (11% vs 7%; $P = .02$).**

Conclusions: **Women have complication rates similar to men with inferior early and late functional outcomes after LEB. The reduced patency rates in women with CLI did not translate into differences in limb salvage. These findings might help define physician and patient expectations for women before revascularization. (J Vasc Surg 2014;60:1282-90.)**

Historically, traditional outcomes such as graft patency, limb salvage, and mortality have been used to define the success of infrainguinal lower extremity bypass (LEB) with relatively less emphasis placed on functional outcomes. However, functional long-term outcomes, specifically maintenance of ambulation and preservation of independence, ultimately correlate with improved patient quality of life.

Several studies have reported predictors of successful ambulation after LEB.[1-5] Although female gender has been identified in some studies as an independent risk factor for inferior outcomes such as patency, infection, and mortality after LEB, few studies have specifically evaluated the association between gender and functional outcomes.[6-11] The primary aim of this study was to elucidate gender differences in functional outcomes including 1-year ambulation and living status among patients undergoing LEB for claudication or critical limb ischemia (CLI). A secondary aim was to compare rates of early and late morbidity, mortality, graft patency, and freedom from amputation according to gender.

METHODS

Patients and databases. We reviewed prospectively collected data on 2576 patients (828 women; 32%) who underwent infrainguinal LEB in the Vascular Study Group of New England (VSGNE), a cooperative quality improvement initiative developed in 2002 to study and improve regional outcomes in vascular surgery.[12]

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Further details on the VSGNE registry have been published and are available at https://www.vascularweb.org/regionalgroups/vsgne/Pages/home.aspx.

Consecutive infrainguinal bypasses for CLI (n = 1864) and claudication (n = 712), from January 2003 to June 2010 were included. Percutaneous vascular interventions and patients with aneurysmal disease were excluded. Patients who underwent multiple bypasses were included based on their initial intervention so that the number of patients and bypass grafts was equivalent.

Definitions and outcome measures. As previously described, data on >100 clinical and demographic variables were collected for each patient and prospectively entered into the VSGNE registry.[12] Our primary outcome measures were ambulatory status and living status at discharge and at 1-year follow-up.

Within the VSGNE database, ambulatory status was classified preoperatively, at discharge, and at 1-year follow-up in four ways: (1) independent, (2) with assistance including use of a cane or walker, (3) wheelchair, or (4) bedridden. Because the number of patients in the wheelchair and bedridden categories was small we combined them into one group called nonambulatory. Therefore, our analysis of ambulation was based on three categories: nonambulatory, ambulatory with assistance, and independent. Living status was categorized as living at home or in a nursing home and was evaluated preoperatively, at discharge, and at 1-year follow-up. Analysis of ambulatory and living status was based on indication for bypass of claudication or CLI.

Secondary outcome measures included in-hospital mortality and morbidity including wound or graft infection, cardiac and pulmonary complications, renal insufficiency, and reoperation for bleeding, thrombosis, infection, or graft revision. These outcomes were defined using previously described definitions available at: http://www.vascularqualityinitiative.org/about/procedures-collected. Mortality, bypass patency, and freedom from major amputation (below or above the knee) were analyzed at discharge and at long-term follow-up. Graft surveillance was performed according to individual surgeon practice and method of determining patency was coded as Doppler only, palpable graft pulse, palpable distal pulse, ankle-brachial index increase >0.15, or using duplex. Data analysis for discharge and follow-up was restricted only to patients who survived and had long-term data. Across the study group, 5.4% of women and 6.3% of men were lost to follow-up. Follow-up for ambulation and living status was at a mean of 347 days and median of 335 days after LEB. Follow-up data for survival analysis was calculated at a mean of 1441 days and a median of 1330 days using the Social Security Death Index.

Statistical analysis. Univariate analysis was performed to compare preoperative, operative, and postoperative characteristics between genders. Risk factors found to differ significantly between genders were then included in a multivariable logistic regression model to adjust for baseline differences between genders. Potential confounders included age, race, smoking, coronary artery disease, hypertension, indication (claudication, rest pain, tissue loss), preoperative ambulation, statin use, graft origin and recipient, conduit type, and length of follow-up. Logistic regression was used to analyze differences in ambulation and living status at discharge and long-term follow-up based on indication and gender. Kaplan-Meier analysis was used to compare long-term mortality, bypass patency, and freedom from amputation during the first year, using proportional hazards regression to adjust for potentially confounding differences between genders, which was stratified by indication. Statistical significance was designated by a P-value $< .05$. Data were analyzed using SAS version 9.3 (SAS Institure, Cary, NC). The Committee for the Protection of Human Subjects at Dartmouth College and the Institutional Review Board of the University of Vermont College of Medicine has approved research analyses based on deidentified data from the VSGNE without requiring consent.

RESULTS

Preoperative and operative characteristics according to gender. Most revascularizations were performed for CLI in women and men (76% vs 71%; $P = .003$) (Table I). At baseline, women were older with higher rates of hypertension but a lower prevalence of smoking and coronary artery disease. Women were less likely to be using a statin perioperatively. Preoperatively, women were more likely to be nonambulatory (6% vs 5%; $P = .05$) or ambulating with assistance (19% vs 16%; $P = .02$). There were no differences in preoperative living status among men and women. Tibial (31% vs 26%; $P = .04$) and pedal targets (11% vs 8%; $P = .006$) were used more often in men compared with women. Prosthetic infrainguinal grafts were used more frequently in women (30%) compared with men (23%). A small number (n = 21; 1%) of bypasses were performed for patients reported to be bedridden. Although further detail was not available, the indication might have been to preserve transfer ability in these patients.

Early postoperative outcomes. Postoperative complications were similar among genders except women had a higher rate of reoperation for graft thrombosis (4% vs 2%; $P < .001$) (Table II). There was no difference in in-hospital superficial wound infections for women vs men (6% vs 5%; $P = .07$). At discharge, primary patency was 94.3% vs 95.9% ($P = .07$) and assisted primary patency was 95.8% vs 97.6% ($P = .23$) in women and men, respectively. When combining primary and assisted primary patency rates together there was a significant difference between genders compared with secondary patency and occluded graft ($P = .02$). Graft occlusion was greater in women (2.5% vs 1.3%; $P = .03$). There were statistical differences in overall amputation rates across genders ($P = .03$). Major ipsilateral amputation rates in-hospital were comparable between genders (2% vs 1%; $P = .13$), although women had fewer minor amputations (7% vs 10%; $P = .03$). In-hospital mortality was equal at 1.7% for both genders. The mean length of stay was 8.5 days for women and 7.7 days for men ($P = .06$).

Table I. Preoperative and operative characteristics according to gender

	Women, mean (SD) or No. (%) (n = 828)	*Men, mean (SD) or No. (%) (n =1748)*	P[a]
Age, years	70 (12)	68 (11)	<.001
Nonwhite race	10 (1)	42 (2)	.04
Not living at home	35 (4)	63 (4)	.45
Ambulatory status			
Ambulatory	615 (74)	1383 (79)	.04 (across groups)
Ambulatory with assist	161 (19)	281 (16)	
Nonambulatory	52 (6)	82 (5)	
Wheelchair	45 (5)	68 (4)	
Bedridden	7 (1)	14 (1)	
Smoking current/past	607 (73)	1541 (88)	<.001
COPD	223 (27)	519 (30)	.15
Diabetes	438 (53)	900 (51)	.50
CAD	289 (35)	689 (39)	.03
CHF	147 (18)	289 (17)	.43
Hypertension	736 (89)	1483 (85)	.006
Dialysis	56 (7)	124 (7)	.76
Previous bypass	179 (22)	434 (25)	.08
Indication			
Claudication	197 (24)	515 (29)	.003 (across groups)
CLI	631 (76)	1233 (71)	
Anti-platelet	615 (74)	1301 (74)	.92
Statin	497 (60)	1121 (64)	.04
β-blocker			
None	168 (20)	301 (17)	.02 (across groups)
Perioperative	166 (20)	424 (24)	
Chronic	489 (59)	1008 (58)	
Graft origin			
CFA	590 (71)	1213 (70)	<.001 (across groups)
External iliac	25 (3)	24 (1)	
Superficial femoral	141 (17)	301 (17)	
Profunda	28 (3)	43 (2)	
Popliteal	42 (5)	158 (9)	
Tibial	2 (<1)	6 (<1)	
Graft recipient			
Below-knee popliteal	276 (33)	545 (31)	<.001 (across groups)
Above-knee popliteal	250 (30)	444 (25)	
SFA/profunda	20 (2)	23 (1)	
Tibial	216 (26)	535 (31)	
Pedal/crural	65 (8)	199 (11)	
Conduit			
Vein	552 (67)	1293 (74)	<.001 (across groups)
Dacron	26 (3)	26 (1)	
PTFE	225 (27)	383 (22)	
Nonautologous	20 (2)	38 (2)	
Composite with vein	5 (1)	8 (<1)	

CAD, Coronary artery disease; *CFA,* common femoral artery; *CHF,* congestive heart failure; *CLI,* critical limb ischemia; *COPD,* chronic obstructive pulmonary disease; *PTFE,* polytetrafluoroethylene; *SD,* standard deviation; *SFA,* superficial femoral artery.
[a] *t*-test for age, χ^2 test for categorical variables.

Graft patency, freedom from major amputation, and overall survival. For patients with CLI, primary patency during the first year was less in women compared with men (hazard ratio [HR], 1.24; 95% confidence interval [CI], 1.03-1.48; *P* = .02). Assisted primary patency (HR, 1.42; 95% CI, 1.15-1.76; *P* = .001) and secondary patency (HR, 1.40; 95% CI, 1.10-1.77; *P* = .006) were also less in women with CLI. There were no statistically significant differences in patency in comparison of female and male claudicants (primary: HR, 1.36; 95% CI, 0.95-1.97; *P* = .10; assisted primary: HR, 1.45; 95% CI, 0.87-2.41; *P* = .15; secondary: HR, 1.51; 95% CI, 0.82-2.79; *P* = .18, respectively; Fig 1).

Freedom from major amputation during 1-year follow-up was similar for men and women with claudication (HR, 0.85; 95% CI, 0.06-12.49; *P* = .91) or CLI (HR, 1.17; 95% CI, 0.84-1.63; *P* = .36; Fig 2). Rates for freedom from amputation at 1 year for women and men were 98% vs 99% for claudicants and 88% vs 87% for CLI, respectively. There were no differences in long-term survival (mean follow-up, 1441 days) between men and women with claudication (HR, 0.89; 95% CI, 0.60-1.31; *P* = .36) or CLI (HR, 0.94; 95% CI, 0.81-1.09; *P* = .39; Fig 3). One-year survival was 98% for women compared with 96% for men with claudication and 82% for women compared with 84% for men with CLI.

Table II. Postoperative characteristics according to gender

	Women, No. (%)	*Men, No. (%)*	P[a]
Surgical site infection	53 (6)	82 (5)	.07
Graft infection	4 (<1)	5 (<1)	.43
POMI	43 (5)	66 (4)	.09
Respiratory			.57 (across groups)
None	812 (98)	1707 (98)	
Pneumonia	5 (1)	15 (1)	
Ventilator dependence	9 (1)	26 (1)	
Change in renal function	36 (5)	78 (5)	.93
Reason for repeat surgery			
Bleeding	11 (1)	29 (2)	.53
Thrombosis	35 (4)	33 (2)	<.001
Infection	10 (1)	12 (1)	.18
Revision	24 (3)	39 (2)	.30
Ipsilateral amputation			
None	753 (91)	1560 (89)	.03 (across groups)
Minor	57 (7)	166 (10)	
Major	16 (2)	20 (1)	
Discharge patency			
Primary	775 (94)	1668 (96)	.11 (across groups)
Primary-assisted	13 (1.5)	29 (1.7)	
Secondary	13 (1.5)	18 (1.0)	
Occluded	21 (2.5)	24 (1.3)	
Discharge medications			
Antiplatelet	676 (83)	1429 (83)	.79
Statin	379 (70)	875 (75)	.01
β-blocker	429 (79)	943 (81)	.27
Warfarin	191 (23)	395 (23)	.83
Mean LOS ± SD, days	8.5 ± 9.8	7.7 ± 11.2	.06
Death (in-hospital)	14 (1.7)	30 (1.7)	.96

LOS, Length of stay; *POMI,* postoperative myocardial infarction; *SD,* standard deviation.
[a]*t*-test for age, χ^2 test for categorical variables.

Functional outcomes: Ambulation and living status. We found a transient loss in independent ambulation postoperatively among claudicants in men and women (Fig 4, *A*). More female claudicants (30%) were able to ambulate with assistance compared with only 19% of men at discharge ($P = .003$). Despite this decrease in early postoperative ambulation, most female claudicants regained independent ambulation by 1-year follow-up with only 3% requiring assistance compared with 1% of men ($P = .20$).

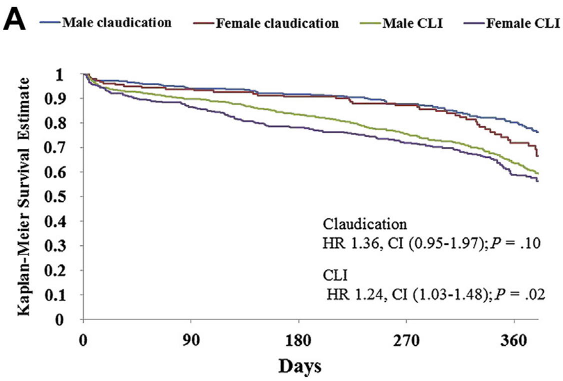
Among patients with CLI, nearly half of men and women were able to ambulate with assistance at discharge (Fig 4, *B*). Women were more likely to be completely nonambulatory at discharge compared with men (13% vs 9%; $P = .002$). This ambulation gap persisted at 1-year follow-up with more women wheelchair-bound or bedridden compared with men (13% vs 8%; $P < .001$). When compared with their preoperative ambulatory status an additional 5% of women became nonambulatory at 1 year compared with an additional 2% of men ($P = .007$).

In multivariate analysis, women with CLI were more likely to ambulate with assistance (odds ratio [OR], 1.3; 95% CI, 1.0-1.6; $P = .02$) or be nonambulatory (OR, 2.0; 95% CI, 1.3-3.0; $P < .001$) at discharge (Supplementary Table, online only). This association persisted at the 1-year follow-up with more women having a greater likelihood of ambulating with assistance (OR, 1.4; 95% CI, 1.0-2.0; $P = .08$) or being nonambulatory (OR, 2.4; 95% CI, 1.6-3.7; $P < .001$) compared with men with CLI.

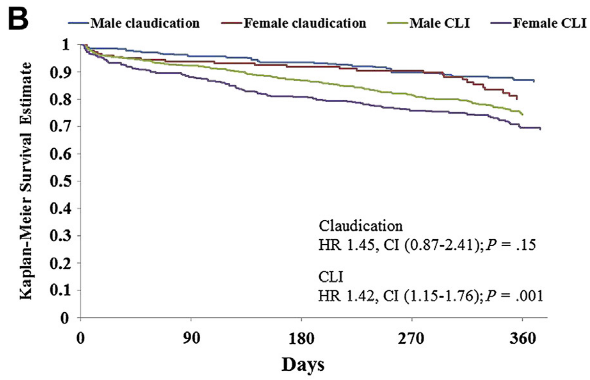
Although most patients were living at home before surgical intervention, a significant proportion of patients were discharged to a nursing facility. Women with claudication were three times more likely to be discharged to a nursing home postoperatively in contrast to men (15% vs 5%; $P < .001$; Fig 5, *A*). However, at the 1-year follow-up, only 1% of female and male claudicants were not living at home. A significant percentage of women with CLI were discharged to a nursing home compared with men (44% vs 35%; $P = .01$; Fig 5, *B*). We found a persistent loss in independent living at 1 year among women with CLI (11% vs 7%; $P = .02$). Furthermore, more women with CLI who were initially discharged to home were living in a nursing home at the 1-year follow-up (5% vs 2%; OR, 2.5; 95% CI, 1.2-5.2; $P = .01$).

In multivariate analysis, female gender was associated with discharge to a nursing home in claudicants (OR, 4.3; 95% CI, 2.2-8.1; $P < .001$; Supplementary Table, online only). Female gender was also associated with nursing home residence at discharge (OR, 1.3; 95% CI, 1.1-1.7; $P = .01$) and at 1 year (OR, 1.7; 95% CI, 1.1-2.8; $P = .02$) in patients with CLI.

To account for the possible effect of repeat surgery on ambulatory and living status we examined the group exclusive of those who received repeat surgery. When we

A


N					
Male IC	444	400	357	307	172
SE	-	0 .011	0.013	0.016	0.022
Female IC	176	156	139	117	61
SE	-	0.018	0.023	0.026	0.041
Male CLI	966	807	706	577	329
SE	-	0.01	0.012	0.015	0.018
Female CLI	490	399	344	276	149
SE	-	0.016	0.019	0.021	0.026

B


N					
Male IC	441	405	360	312	175
SE	-	0.01	0.012	0.015	0.018
Female IC	176	156	141	121	63
SE	-	0.018	0.021	0.023	0.036
Male CLI	959	821	725	601	340
SE	-	0.009	0.011	0.013	0.016
Female CLI	488	405	351	285	157
SE	-	0.015	0.018	0.02	0.024

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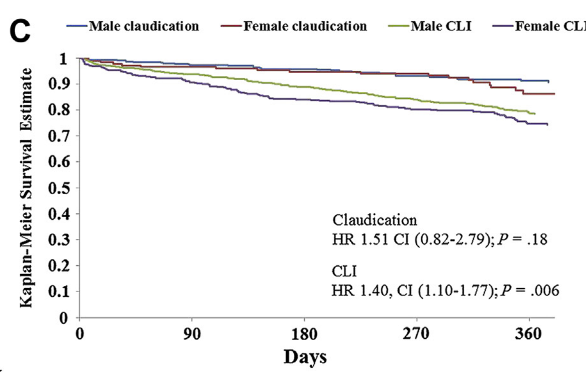


N					
Male IC	440	411	369	321	178
SE	-	0.008	0.01	0.013	0.015
Female IC	175	159	144	126	67
SE	-	0.014	0.018	0.019	0.031
Male CLI	952	829	736	612	346
SE	-	0.008	0.011	0.013	0.015
Female CLI	480	409	359	295	163
SE	-	0.013	0.017	0.019	0.023

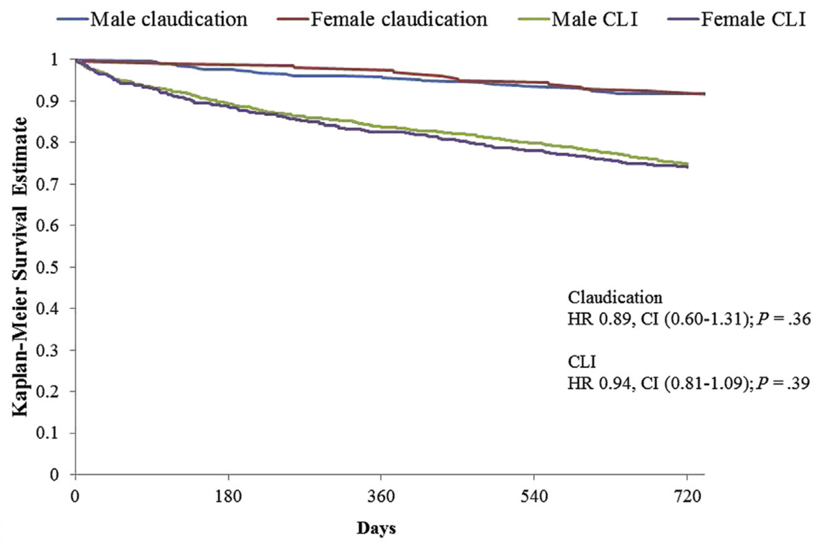
Fig 1. Kaplan Meier curve of **(A)** primary, **(B)** assisted primary, and **(C)** secondary for male and female patients with claudication and critical limb ischemia (*CLI*). *CI,* Confidence interval; *HR,* hazard ratio; *IC,* intermittent claudication; *SE,* standard error.

compared all patients in the study with a group excluding patients who underwent repeat surgery for bleeding, infection, or thrombosis we found no change in our overall results for ambulatory or living status.

DISCUSSION

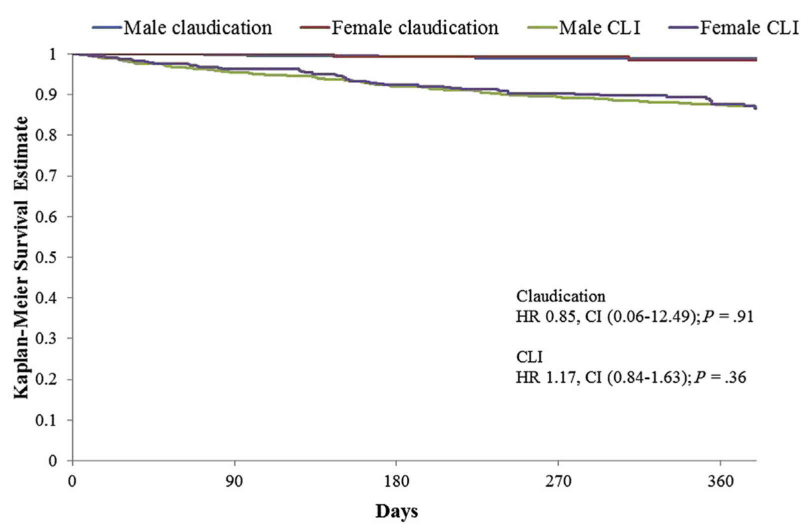
Despite a number of studies that examined the association of gender on conventional outcomes such as patency, morbidity, and mortality after LEB, few have focused on functional outcomes according to gender.[13-17] Clearly, claudicants and CLI patients have differing patency and survival rates with some reports suggesting inferior outcomes in women.[6-9,17] Although female gender has been associated with inferior technical outcomes and postoperative complications, there is a lack of consistency in these findings with some reporting no difference between genders. This association has been attributed to a variety of factors including delayed presentation, smaller vessel diameter, advanced age, and increased propensity of postmenopausal atherosclerosis.[18]

The primary clinical goals of LEB are to maintain function and preserve independence. Studies that only investigate graft patency and limb salvage might fail to discover an important loss of functional status or independence. Several studies have identified predictors that negatively influence functional outcomes after LEB. Abou-Zamzam



N	0	180	360	540	720
Male IC	515	503	494	482	469
SE	-	0.007	0.009	0.011	0.012
Female IC	197	195	193	187	179
SE	-	0.007	0.01	0.016	0.019
Male CLI	1232	1100	1031	984	917
SE	-	0.009	0.011	0.001	0.012
Female CLI	631	559	520	492	464
SE	-	0.013	0.015	0.016	0.018

Fig 2. Kaplan-Meier curve of freedom from amputation for male and female patients with claudication and critical limb ischemia (*CLI*). *CI,* Confidence interval; *HR,* hazard ratio; *IC,* intermittent claudication; *SE,* standard error.



N	0	90	180	270	360
Male IC.	467	423	382	337	189
SE	-	0.002	0.004	0.005	0.005
Female IC	182	165	150	130	70
SE	-	0.006	0.01	0.01	0.023
Male CLI	1048	849	764	644	374
SE	-	0.007	0.009	0.01	0.012
Female CLI	529	438	395	329	189
SE	-	0.009	0.013	0.014	0.017

Fig 3. Kaplan-Meier curve of survival for male and female patients with claudication and critical limb ischemia (*CLI*). *CI,* Confidence interval; *HR,* hazard ratio; *IC,* intermittent claudication; *SE,* standard error.

et al found that preoperative living situation and ambulation status were predictors of 6-month functional outcomes for patients with CLI.[1] In an analysis of VSGNE data, Goodney et al found that age, preoperative ambulatory status, independent living status, CLI, and amputation predicted 1-year ambulatory status among claudicants and CLI patients.[3] Female gender was significant in univariate analysis but gender was not an independent predictor of

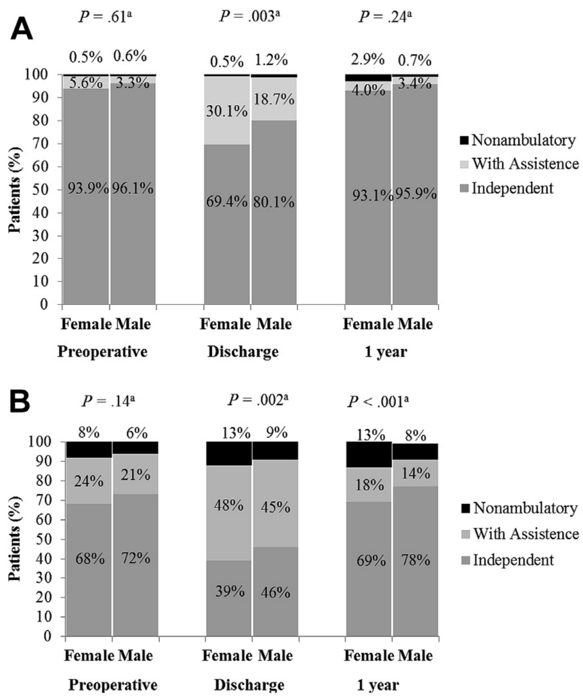


Fig 4. Ambulatory status of patients with claudication **(A)** and critical limb ischemia (CLI) **(B)** preoperatively, at discharge, and at 1-year follow-up according to gender. [a]*P* value adjusted for age, race, smoking, preoperative ambulatory status, preoperative statin, coronary artery disease, hypertension, conduit, graft origin, graft recipient, and length of follow-up using logistic regression; adjusted for indication using stratification.

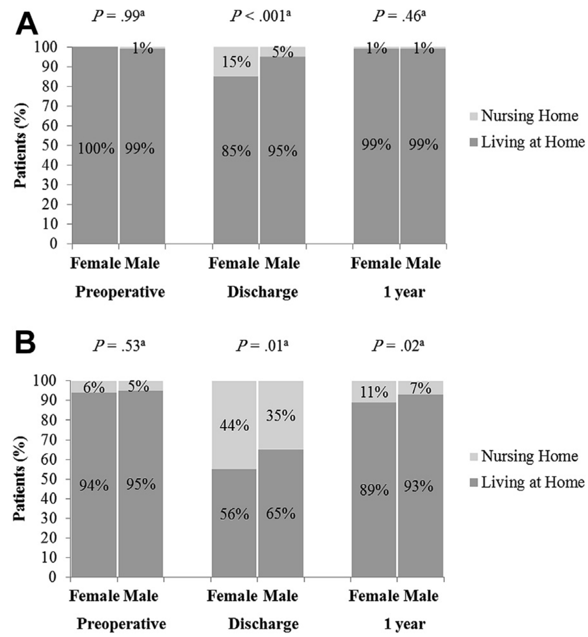


Fig 5. Living status of patients with claudication **(A)** and critical limb ischemia (CLI) **(B)** preoperatively, at discharge, and at 1-year follow-up according to gender. [a]*P* value adjusted for age, race, smoking, preoperative ambulatory status, preoperative statin, coronary artery disease, hypertension, conduit, graft origin, graft recipient, and length of follow-up using logistic regression; adjusted for indication using stratification.

ambulation in the multivariate model. Others have confirmed the importance of preoperative ambulatory status among patients with CLI and found that infrainguinal disease, end-stage renal disease, presence of gangrene, and hyperlipidemia are independent risk factors for achieving clinical success including ambulation after LEB.[19] Limb loss in less than 1 year, homebound ambulation, dementia, end-stage renal disease, diabetes, and female gender have also been categorized as risk factors for deterioration of ambulation among CLI patients at 1 year after LEB.[5] Taylor et al evaluated 1000 limbs of patients who underwent open and endovascular revascularization for CLI and found that female gender was an independent risk factor associated with deterioration of ambulation at 1 year, with no effect on independent living status or mortality.[5] Pulli et al specifically investigated outcomes after percutaneous vascular intervention of femoropopliteal disease among men and women and found that both genders had similar rates of technical success with a trend toward inferior primary and assisted primary patency among women.[20] Comparison between these studies is difficult because of varying combinations of open vs percutaneous revascularization and differing definitions of ambulation and living status.

In this study, we found that women with CLI had lower rates of primary, assisted primary, and secondary patency at 1 year, however there were no gender differences in in-hospital or long-term mortality, and amputation rates. Women with claudication had patency and survival rates similar to men. Overall in-hospital morbidity was similar between genders except for a 2% higher rate of reoperation for graft thrombosis in women. When we examined the entire spectrum of postoperative complications this was the only statistically significant difference. Taken together, the results bolster the evidence that, except for reduced patency in patients with CLI, women have outcomes that are very comparable to men with regard to these standard end points.

Our study provides new insight into the functional outcomes of women with claudication and CLI. Although we found few differences between men and women in many of the more traditional end points, we observed important differences in functional outcomes between genders. Within our study, female claudicants were less likely to ambulate independently at discharge. Surprisingly, women with claudication were three times more likely to be discharged to a nursing home at a rate of 15%. Ultimately, however, female claudicants showed no difference in ambulation or living status at 1 year. In contrast, women with CLI showed inferior outcomes for ambulation and independent living status at discharge which persisted at the 1-year follow-up. Although the absolute gender differences were small, results of this study suggest that there is a subset of women at risk for unfavorable functional outcomes.

Our study is unique in that we assessed functional outcomes of patients with claudication and CLI. We found that more female claudicants required assistance with ambulation and were admitted to a nursing home at discharge. These gender differences for claudicants did not persist at 1 year, suggesting women regained functional status over time. We observed significant differences in ambulatory and living status among women with CLI that persisted at 1 year.

Why do women have inferior functional outcomes compared with men? Women have a longer life expectancy, and it could be hypothesized that our results were because of age discrepancies within the study cohort. Our analysis was adjusted for age, and the differences seen in functional outcomes are more likely multifactorial. Social reasons might account for the early difference in fewer women returning home after LEB. More women tend to live alone and nursing home populations are >70% women.[21-23] Many women might be widowed and living alone or have a partner who is unable to perform a caregiver function. Moreover, women are more likely to serve as the dominant caregivers of their male spouses despite having similar functional impairment.[20] The historical social role of women as the caregiver might also account for these discrepancies. Women might not have the social support or extended family to provide the necessary care. A social support network might be invaluable in the maintenance of function and independence for women in particular.

A decrease in physical strength could also contribute to inferior functional outcomes in women after LEB. Women have a greater prevalence of disabling conditions such as osteoporosis, osteoarthritis, and back problems, which might further place them at risk for poorer postoperative functional outcomes and loss of independent ambulation.[23,24] Early and consistent physical therapy could benefit women after LEB who might have pre-existing conditions that might hinder baseline physical activity and impair their postoperative recovery.

How can these data be helpful in clinical practice? First, patients, families, and surgeons should take comfort in the fact that the overall differences are fairly small. Second, the informed consent process should reflect these small but significant differences. This will help set appropriate patient and family expectations. Third, instituting a multidisciplinary care team including social workers, case managers, visiting nurses, physical therapists, and rehabilitation specialists early in anticipation of more intense posthospital care might lead to increased patient satisfaction and shorten hospital length of stay. Further work is necessary to identify the subset of women who are in greater need of social support after surgery.

Limitations to this work include the baseline differences between men and women, which we accounted for in the analysis. A small number in both groups were lost to long-term follow-up. Body mass index data were not collected during all years, so could not be analyzed, and might have had an effect on functional status independent of gender. Although previous peripheral vascular intervention was recorded in the database, information on laterality and type of intervention were not captured. Certain variables such as social support, history of dementia, primary caregiver status, and the specific reason requiring a nursing home are not captured in the VSGNE database and could have provided insight into the underlying cause for loss of independent ambulation and living among women. The specific reasons for admission to a nursing home might vary based on factors such as other comorbidities and social support and were not available in the data set. Although we recorded ambulation and living status, we did not directly measure quality of life using survey methods. Furthermore, we did not record the extent of tissue loss for patients with CLI, which could have influenced ambulation status. Because readmission rates (not available in this data set) are coming under increased scrutiny it would be of interest to determine if there are differences between genders in this metric. Our data mainly included Caucasian women in New England and therefore our findings might not be generalizable to all ethnic populations. Finally, we limited our analysis to patients undergoing infrainguinal bypass. In the future, we plan to investigate gender disparities including technical and functional outcomes in patients undergoing percutaneous vascular interventions to improve patient and procedural selection for men and women requiring treatment for peripheral arterial disease.

CONCLUSIONS

Women have similar postoperative outcomes, but reduced patency rates and worse functional outcomes at 1 year after infrainguinal bypass predominantly in patients with CLI. These findings might help define physician and patient expectations for women before revascularization and identify a group a patients in need of more intense services after discharge from the hospital.

AUTHOR CONTRIBUTIONS

Conception and design: JA, DB
Analysis and interpretation: RD, JA, PC, AS, PG, MR, JC, DB
Data collection: RD, PC
Writing the article: RD, DB, JC
Critical revision of the article: RD, JA, PC, AS, PG, MR, JC, DB
Final approval of the article: RD, JA, PC, AS, PG, MR, JC, DB
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Supplementary Table (online only). Multivariate analysis of ambulatory and living status

	OR[a]	*95% CI*	P
Ambulatory status			
Claudicants			
Preoperative			
With assistance vs independent	1.4	0.6-3.2	.40
Nonambulatory vs independent	0.6	0.05-5.7	.62
Discharge			
With assistance vs independent	2.0	1.3-3.0	<.001
Nonambulatory vs independent	0.5	0.05-4.5	.51
One-year follow-up			
With assistance vs independent	1.3	0.5-3.8	.59
Nonambulatory vs independent	4.9	0.7-33	.10
CLI			
Preoperative			
With assistance vs independent	1.2	0.9-1.6	.13
Nonambulatory vs independent	1.4	0.9-2.0	.13
Discharge			
With assistance vs independent	1.3	1.0-1.6	.02
Nonambulatory vs independent	2.0	1.3-3.0	<.001
One-year follow-up			
With assistance vs independent	1.4	1.0-2.0	.08
Nonambulatory vs independent	2.4	1.6-3.7	<.001
Living status, nursing home vs home			
Claudicants			
Preoperative	0	0-undefined	.99
Discharge	4.3	2.2-8.1	<.001
One-year follow-up	2.6	0.2-32	.46
CLI			
Preoperative	0.9	0.5-1.4	.53
Discharge	1.3	1.1-1.7	.01
One year follow-up	1.7	1.1-2.8	.02

CI, Confidence interval; *CLI,* critical limb ischemia; *OR,* odds ratio.
Nonambulatory includes wheelchair or bedridden.
[a]ORs are for women vs men adjusting for covariates including age, race, smoking, preoperative ambulatory status, preoperative statin, CAD, HTN, conduit, graft origin, graft recipient, and length of follow-up using logistic regression; adjusted for indication using stratification.