Characterizing the Chronic Limb-Threatening Ischemia Patient Journey

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INTRODUCTION

- Chronic limb-threatening ischemia (CLTI) is associated with significant morbidity and high mortality, analogous to an advanced stage cancer diagnosis.

- We sought to 1) characterize the CLTI journey using a conceptual framework and 2) test the feasibility of this framework in a cohort of patients with newly diagnosis CLTI undergoing revascularization within our health system.

METHODS

- Patients with new diagnosis of CLTI undergoing lower extremity revascularization between Jan 2021 - Sep 2022.
  - Excluded those who were lost to follow-up or dead within 30 days (n=85).

- At first follow-up, patients were grouped into those who achieved resolution of their CLTI-defining feature (A = remission) and those who did not (B = ongoing CLTI).

- Event rates for major amputation (MA), reintervention (R), and death (D) were estimated.

- A probabilistic Markov model was constructed to model CLTI-health state transitions and events (Figure 1).
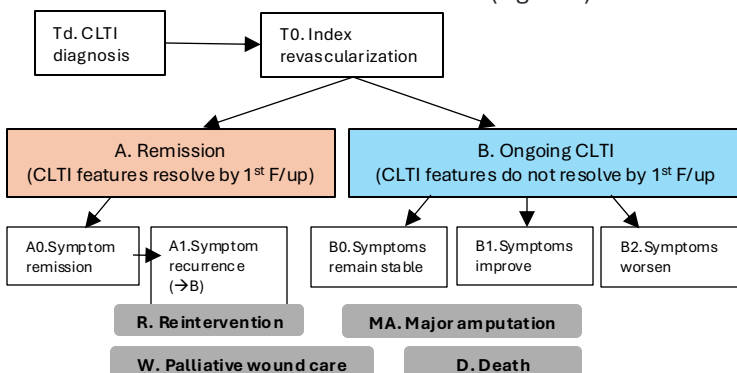

Figure 1: Proposed CLTI Journey conceptual framework for patients undergoing index revascularization.

RESULTS

Table 1. Baseline characteristics of patients newly diagnosed with CLTI.

Demographics		Total (n =344)	A (n =89)	B (n =255)	p-value
Age at procedure	Mean (SD)	69.9 (10.9)	69.1 (10.9)	70.2 (10.9)	0.56
Sex	Male	196 (57.0%)	49 (55.1%)	147 (57.6%)	0.67
	Female	148 (43.0%)	40 (44.9%)	108 (42.4%)	
Race/Ethnicity	Hispanic	8 (2.3%)	1 (1.1%)	7 (2.7%)	0.16
	African American	210 (61.1%)	50 (56.2%)	160 (62.8%)	0.62
	Unknown/Other	18 (5.2%)	6 (6.7%)	12 (4.7%)	
	White	116 (33.7%)	33 (37.1%)	83 (32.6%)	
Co-morbidities					
Diabetes		225 (65.4%)	45 (50.6%)	180 (70.6%)	0.001
	A1c ≥ 6.5%	122 (64.9%)	18 (52.9%)	104 (67.5%)	0.11
Hypertension		316 (91.7%)	79 (88.8%)	237 (92.9%)	0.22
Advanced Kidney Disease	CKD stage 3-5	197 (57.3%)	46 (51.7%)	151 (59.2%)	0.22
	ESRD on dialysis	59 (17.2%)	8 (9.0%)	51 (20.1%)	0.017
Coronary Artery Disease		148 (43.1%)	35 (39.3%)	114 (44.3%)	0.41
Congestive Heart Failure		99 (29.0%)	12 (13.6%)	87 (34.3%)	<0.001

Table 2. Clinical Presentation, Procedural Details, and Outcomes in Patients with CLTI.

At presentation		Total (n = 406)	A (n =107)	B (n =299)	P-value
CLTI symptoms	Ischemic rest pain	119 (29.3%)	71 (66.4%)	48 (16.1%)	
	Nonhealing wound	172 (42.4%)	23 (21.5%)	149 (49.8%)	<.001
	Gangrene	115 (28.2%)	13 (12.2%)	102 (34.1%)	
Baseline ABI	Median (IQR)	0.54 (0.39 - 0.73)	0.50 (0.37-0.63)	0.56 (0.41-0.76)	0.038
Baseline toe pressure	Median (IQR)	38 (18 - 57)	42 (22 - 64)	36 (15 - 55)	0.21
Wound, Ischemia, and foot Infection (WIfI) classification	WIfI score	3 (2 - 4)	2 (2 - 4)	3 (2 - 4)	<.001
	Wound grade	1 (0 - 2)	0 (0 - 1)	1 (1 - 2)	<.001
	Ischemia grade	2 (1 - 3)	2 (2 - 3)	2 (1 - 3)	0.06
	Foot Infection grade	0 (0 - 1)	0 (0 - 0)	0 (0 - 1)	<.001
At the time of revascularization					
Time to procedure	Median days (IQR)	13 (5 - 33.5)	22 (7 - 41)	9 (4 - 28)	<.001
Type of procedure	Open surgical	124 (30.5%)	48 (44.9%)	76 (25.4%)	
	Endovascular	257 (63.3%)	49 (45.8%)	208 (69.6%)	<.001
	Hybrid	25 (6.2%)	10 (9.4%)	15 (5.0%)	
At first follow-up					
WIfI score	Median (IQR)	1 (1 - 2)	1 (0 - 1)	2 (1 - 3)	<.001
Change in Wifi score	Score increased	14 (9.2%)	1 (2.2%)	13 (12.3%)	
	Score decreased	98 (64.5%)	36 (78.3%)	62 (58.5%)	0.036
	Score did not change	40 (26.3%)	9 (19.6%)	31 (29.3%)	
Outcomes					
Loss to follow-up	-	130/344 (37.8%)	42/89 (47.2%)	88/255 (34.5%)	0.34
Reintervention	-	128 (31.5%)	19 (17.8%)	109 (36.5%)	<.001
Major amputation	-	64 (15.8%)	2 (1.9%)	62 (20.7%)	<.001
Mortality	-	71/344 (20.6%)	8/89 (9.0%)	63/255 (24.7%)	0.002

RESULTS

Table 3. Probabilistic Markov model detailing CLTI Health States and Event Rates.

	Td	T0	A0	A1	B0	B1	B2	R	W	MA	D
Td		1	0.00	0.00	0.00	0.00	0.00				
T0			0.28	0.00	0.24	0.35	0.12				
A0								0.03	0.00	0.00	0.03
			0.24	0.02	0.00	0.00	0.00				
A1								0.04	0.00	0.03	0.00
			0.01	0.01	0.00	0.00	0.00				
B0								0.06	0.00	0.09	0.04
			0.02	0.00	0.10	0.07	0.04				
B1								0.01	0.00	0.00	0.10
			0.10	0.00	0.06	0.19	0.03				
B2								0.13	0.20	0.34	0.10
			0.01	0.00	0.03	0.04	0.03				

(Table 3 column groups: "Health States" = Td, T0, A0, A1, B0, B1, B2; "Events" = R, W, MA, D)

CONCLUSION

- The newly developed framework effectively maps the post-revascularization CLTI journey

- Patients with ongoing CLTI symptoms had a higher comorbidity burden (including diabetes, end-stage renal disease, and heart failure), worse baseline WIfI scores, and underwent endovascular procedures more often than open revascularization.

- This work provides a foundation for the use of deterministic modeling to guide shared decision-making and for use in future intervention trials.

- This model shows promise and could be further explored with longitudinal WIfI staging to create a comprehensive CLTI staging system, similar to those used in oncology.