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Original Article

Frailty as a predictor of discharge destination and long-term function in older adults with burn injury

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Abstract: Background: Elderly patients are at increased risk of burn injury due to the biological, psychological, and social changes associated with aging. This population experiences higher rates of morbidity, mortality, and an increased length of stay compared to younger patients. This study examines frailty as a predictor of discharge disposition and long-term functional outcomes after burn injury. Methods: A prospective study was performed at a single U.S. ABA-verified burn center. Patients > 55 years old admitted from September 2019 to 2021 were screened for enrollment. Patient demographics, the pre-morbid Clinical Frailty Scale (CFS), Barthel Index (BI), and discharge disposition were recorded. Long-term functional status was assessed using the follow up Barthel Index and a functional questionnaire completed at 6 months to 1.5 years post-discharge. Results: Fifty patients were enrolled, with an average age of 71 (SD 10.4) years and a median percentage Total Body Surface Area of Burn Injury (TBSA) of 4 (IQR 5). The mean CFS score was 3.4 (SD 1.7). Patients discharged to a Skilled Nursing Facility (SNF) had significantly higher mean CFS scores (5.0, SD 0.9) compared to those discharged home (2.2, SD 1.2) or to an Inpatient Rehabilitation Facility (IRF) (3.0, SD 1.3), with a statistically significant difference across groups ($F = 15.97$; $P < 0.0001$). At follow-up, 50% (n = 25) of patients reported a return to baseline. Conclusions: Frailty score as assessed by the CFS is associated with disposition destination after burn injury. A higher CFS was associated with discharge to a higher level of care. The CFS may be useful after burn injury in predicting disposition and assisting with early conversations with patients and their families related to longitudinal care.

Keywords: Frailty, burn injury, elderly, clinical frailty scale, discharge disposition

Introduction

The population of the United States (U.S.) is older today than it has ever been and the number of Americans aged 65 and older is projected to increase 42% over the next 30 years [1]. The American Burn Association (ABA) national burn repository reported that adults aged 60 years and older represent more than 14% of patients admitted to U.S. burn centers [2]. Older adults are at increased risk for burn injuries due to normal age-related physiological changes, including impairments in global sensory function, decreased executive function, decreased reaction time, alterations in co-ordination and progressive age-related atrophy of the skin and subcutaneous tissue [3-5].

Beyond the increased susceptibility to burn injury, older patients, particularly those older than 75, have higher rates of mortality, more in-hospital complications, loss of independence, and decreased post-injury quality of life. They are also more likely to be discharged to a Skilled Nursing Facility (SNF), an Inpatient Rehabilitation Facility (IRF) or to hospice [6-8].

Furthermore, the physiologic stress associated with burn injury in combination with multiple operations requiring general anesthesia, is poorly tolerated by the elderly patient, and can lead to an accelerated decline in executive function commensurate with a decline in independence during their admission [9].

Frailty is widely recognized as a clinical syndrome reflecting age-related vulnerability and diminished physiological reserve, resulting in an increased risk of adverse health outcomes

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when exposed to stressors such as illness, injury, or surgery [10, 11].

Frailty becomes more common as populations age and the prevalence of frailty in community-dwelling persons ranged from 11% in those aged 50-59 years to 51% in those aged 90 years or older [12].

Although chronological age has been associated with worse outcomes, individuals physiologically age at different rates [7, 13]. Therefore, a measure of frailty is considered a more accurate index of physiologic reserve [14].

Frailty is not an inevitable consequence of aging, nor does old age alone define frailty [15-18].

Frailty is increasingly recognized as an important surrogate for health-related outcomes in older adults irrespective of chronological age and because of decreased resilience, there is a commensurate increase in vulnerability to stressors including illness, surgery and trauma [19, 20].

Specifically, frailty has been linked to an increased risk of post-operative complications, falls, fractures, unplanned hospital admissions, progression of chronic disease, and increased mortality [21-25].

Similarly, in burn injury, assessments of frailty using multiple frailty measures have been associated with unfavorable outcomes and increased mortality [26, 27].

There is a wide array of measurement tools available for the assessment of frailty which have been validated in various clinical domains and show fair inter-scale agreement [28, 29].

The Clinical Frailty Scale (CFS) which was developed from the Canadian Study of Health of Aging has been shown to have short administration times and correlates strongly with mortality and non-favorable discharge [29-31]. Furthermore, it has been found reliable and its use has been validated in a retrospective cohort study of patients with burn injury [32].

An accurate, reproducible and easily administered assessment of frailty would then allow clinicians who are entrusted with the care of those with burn injury to better predict outcomes and disposition. In this study, we examined the impact of frailty, as measured by the CFS, on discharge disposition following the completion of the acute-care phase of the burn injury and described longitudinal trends in function following burn injury with the hope that our findings may help to inform both the healthcare team, the patient and their family and assist in conceptualizing the discharge plan in the early stages of the injury.

Materials and methods

Study design and patient selection

This prospective cohort study was conducted at a single U.S. ABA-verified burn center from September 2019 to September 2021 under Institutional Review Board (IRB) approval, protocol number 2019P001699.

All patients older than 55 years old who were admitted to the inpatient burn unit with a burn injury were prospectively screened. Burn injury was defined as traumatic injury to the skin and subcutaneous tissues by heat, electrical discharge, friction or caustic chemical exposure. Potential subjects were provided with a description of the study as well as expectations after enrollment. Verbal consent was obtained prior to participation.

Exclusion criteria included those with progressive neurologic disease, known terminal illness, and a non-survivable burn injury as determined by the consensus of the burn service.

A total of 65 patients older than 55 years old were screened during the study period of which 50 patients met criteria for enrollment (**Figure 1**).

Data collection and outcome measures

Patient and injury demographics were collected via the electronic medical record, including age, gender, percent total body surface area of the burn injury (TBSA), and need for surgical intervention. The primary independent variable was frailty, assessed using the CFS [14].

This was assessed after admission and was focused on determining the pre-morbid frailty of the patient before the burn injury was sustained.

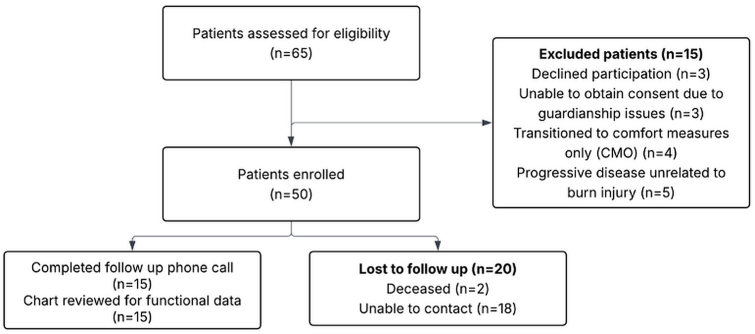

Figure 1. CONSORT diagram.

The primary outcome measure was disposition after discharge following the acute hospitalization, namely, Home, SNF, or IRF.

Secondary outcome measures focused on longitudinal function and were collected using paired Barthel Index scores, (calculated both on admission and at follow up) and a questionnaire administered via follow-up phone calls conducted from 6 months to 1.5 years following discharge.

We utilized the Barthel Index (BI) a widely used measure of basic activities of daily living (ADL) because of its simplicity, communicability, and ease of scoring [33, 34]. Patients were interviewed directly for data collection to complete the BI and information was corroborated with their caregivers to ensure accurate completion.

The questionnaire was a four-question, researcher-administered questionnaire, developed for the study including questions regarding: (1) use of an assistive device, (2) community access, (3) current living environment, and (4) the nature of social support.

When patients or their caregivers were unable to be contacted for data acquisition, a chart review was conducted to obtain the relevant information, and the most recent notes were utilized to furnish the data collection.

Statistical analysis

Data were analyzed using descriptive statistics. Continuous variables are presented as means with standard deviations (SD) and medians with the interquartile range (IQR) as appropriate. Categorical variables are presented as counts and percentages. A one-way Analysis of Variance (ANOVA) was used to assess the difference in CFS scores across the three discharge disposition groups. Predictors of discharge location were assessed using a regression model, including CFS, BI, Age, and social/functional factors. A *P*-value < 0.05 was considered statistically significant. The data analysis for this paper was generated using SAS software (Version 9.4). Copyright © (2023) SAS Institute Inc.

Results

Patient and injury demographics

Of the 50 patients enrolled in the study, the average age was 71 (SD 10.4) years. The median percentage TBSA of the burn injury was 4% (IQR 5). The mean Clinical Frailty Scale (CFS) score was 3.4 (SD 1.7) with a median Length of Stay (LOS) of 13 days (IQR 10). All patients included in the analysis underwent excisional debridement and autografting of their burns. Complete demographics are summarized in **Table 1**.

Disposition after discharge

Discharge disposition after the acute-care phase of the burn injury was categorized as Home (n = 27), Inpatient Rehabilitation Facility (IRF) (n = 13), or Skilled Nursing Facility (SNF) (n = 10). There was an association with CFS scores and age with disposition (**Table 2**).

Patients who were discharged to a SNF and an IRF had a significantly higher mean CFS score (5.0, SD 0.9 and 3.0, SD 1.3) compared to patients discharged home (2.2, SD 1.2).

The ANOVA test demonstrated a statistically significant difference in mean frailty scores among the three discharge disposition groups ($F = 15.97$; $P < 0.0001$) (**Figure 2**). A multivariate analysis was used to predict discharge disposition, and the CFS was found to be a significant predictor (t-value = -3.51; $P = 0.0005$) (**Figure 3**). Other factors that were significant predictors included the Barthel Activity Index

Table 1. Patient and injury demographics

Demographic	Mean, Standard deviation (SD)
Age	71, 10.4
Clinical Frailty Score (CFS)	3.4, 1.7
Demographic	Median, Interquartile range (IQR)
Total Body Surface Area % (TBSA)	4, 5
Length of Stay (LOS)	13, 10
Functional and Social Questions (N = 50)	
Barthel Index Activity Score	95/100, Range 50-100
Device used	Walker: 6, 12% Cane: 8, 16% None: 36, 72%
Able to go into community 3x/week (Y/N)	Yes: 41 (82%) No: 9 (18%)
Living Environment	House/Apartment: 47, 94% Other: 3, 6%
Social Support	Family (significant other, spouse, children): 31, 62% None: 19, 38%

Table 2. Discharge location in relation to age on admission and clinical frailty scores

Discharge Location	N = 50	Age on Admission	CFS Score
Inpatient Rehab Hospital	13	77 (9)	3 (1.3)
Home	27	67.9 (9.3)	2.2 (1.2)
Skilled Nursing Facility	10	72.3 (11)	5 (0.9)

Data are presented as Mean (SD); CFS, Clinical Frailty Scale.

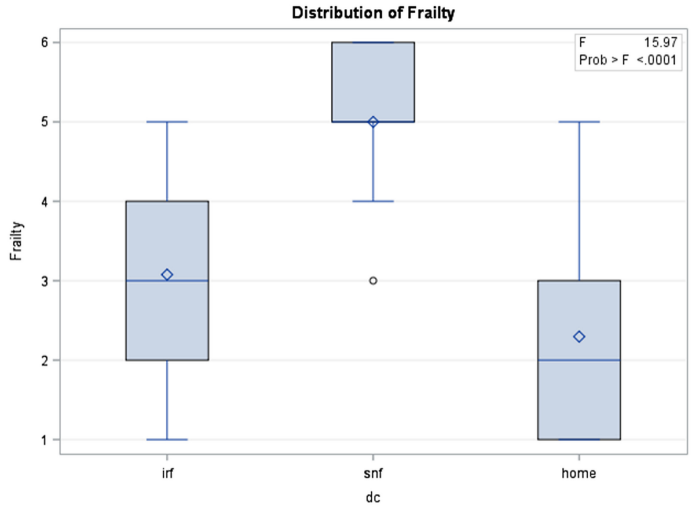

Figure 2. Distribution of frailty scores by discharge disposition. Box-and-whisker plots show frailty scores across three discharge destinations (dc): inpatient rehabilitation facility (irf), skilled nursing facility (snf), and home. The box represents the interquartile range (25th to 75th percentile), with the horizontal line indicating the median. The diamond symbol indicates the mean frailty score, and circles represent statistical outliers. An ANOVA test demonstrated a statistically significant difference in frailty scores among the groups ($F = 15.97$; $P < 0.0001$).

(t-value = 7.22; $P < 0.0001$), Age (t-value = -2.93; $P = 0.0065$), and the need for a device (t-value = -3.29; $P = 0.0026$). Follow-up data obtained via phone-call and additional chart review was collected to determine if a patient returned to their baseline ($n = 30$). The average Barthel Activity Index Score at the time of follow-up for those who returned to baseline was 96.2 vs 71.7 for those who did not return to baseline.

We performed a simple descriptive comparison between this group and those patients who reported not returning to the pre-morbid baseline. Those who reported not returning to baseline were older, had higher CFS scores and lower Barthel scores at baseline (**Table 4**).

Discussion

The results of this prospective study support that pre-morbid frailty in burn injury using the CFS serves as a predictor of discharge disposition and longitudinal return to baseline. The assessment of frailty using validated measurement tools has been supported over the use of chronological age alone, and in this study, CFS scores demonstrate prognostic value [35, 36].

Table 3. Predictors of discharge location

Parameter	t-Value	*p-value*
Pre-morbid Barthel Activity Index	7.22	< 0.0001
Age	-2.93	0.0065
CFS	-3.51	0.0005
Device used	-3.29	0.0026
Community	4.6	0.0001
Social Support	-0.43	0.6674
Surgery	-0.71	0.4838

The primary finding of our study is the predictive value of the CFS score on discharge disposition with those being discharged home having lower CFS scores compared to those being discharged to a higher level of care. This is in keeping with the established literature in geriatric trauma which demonstrates that frailty is a superior metric for predicting non-favorable outcomes and institutionalization that chronological age alone [37, 38].

Echoing these findings, the SNF group and the IRF group had higher CFS scores highlighting the emphasis on frailty on predicting disposition.

Regarding longitudinal follow-up, most of the cohort surveyed reported a return to their pre-morbid baseline.

This longitudinal data is encouraging and supports a positive prognosis for older, frail patients who sustain burn injury. Patients who did not return to their baseline, however, had a higher average CFS (4.3 vs 2.6) again identifying frailty as a useful measure in predicting return to pre-morbid baseline (**Table 4**).

The post-admission assessment of pre-morbid frailty is an important component in assessing the morbidity and mortality associated with burn injuries [26]. Though many measurement tools are available, the CFS has been found to be reliable and has been validated in those with burn injuries with respect to morbidity, mortality, disposition, functional outcome and the commencement of goals of care conversations [9, 27, 39-42]. Coupled with this, in a systematic review of frailty as a measure of outcomes in those with burn injury, the CFS was also the most used frailty measure [26]. The support for the CFS in the burn literature informed our decision to use the tool in our study.

To some, frailty may seem intuitively associated with an increase in morbidity and mortality. We support this view but maintain the opinion that the use of a standardized measurement tool like the CFS is an important part of the care of the patient with burn injury. By stratifying patients early in their hospital course, a standardized assessment of frailty serves to inform the patient and their families about the expected hospital course and discharge plan, well in advance of their expected discharge date. This serves to enhance the rapport between the patient and the healthcare team and helps patients and their families plan for the post-injury period. It also allows the healthcare team to identify the subset of vulnerable patients who may need early aggressive multidisciplinary care and a comprehensive geriatric assessment which may assist with resource utilization [43, 44].

Furthermore, by using these standardized tools and reporting on the outcomes, the reproducibility and validity of the frailty assessment may serve as a reference for other clinicians and researchers who care for the burn-injured frail patient.

There are important limitations of this study that mandate discussion. Firstly, it is a single center study which limits the ability to generalize the findings. Secondly, despite the prospective design, the sample size was small (n = 50) with a proportionately high drop-out rate. This loss to follow up may have added significant selection bias.

We also acknowledge that chart review was used to supplement longitudinal data collection. This variability in collection methodology may have also introduced bias.

Regarding longitudinal function, our questionnaire asked about self-reported return to baseline, which comes with inherent subjective bias. Also, our questionnaire was not a validated tool like the CFS and the BI and the results from this may therefore be less reproducible across studies.

Notably, our regression model did not account for several possible confounding factors such as the topographic location of the burn injury, underlying chronic illness, number of operations required during the index hospitalization

Table 4. Comparison of patients who returned to their baseline and patients who did not return to their baseline

	Age	CFS Score	Barthel score baseline	Barthel score Follow-up	Entered Community Post-Burn (Y)
Total n = 30	71.7 (11.3)	3 (1.5)	94.8 (13.1)	91.5 (17.7)	23/30 (77%)
Returned to Baseline n = 25	70 (9.9)	2.6 (1.4)	96.5 (12.6)	96.2 (12.1)	22/25 (88%)
Did Not Return to Baseline n = 5	80.1 (12.7)	4.3 (1.0)	88.3 (13)	71.7 (20.7)	1/5 (20%)

Data are presented as Mean (SD); CFS, Clinical Frailty Scale.

and willingness and involvement of family support post discharge.

Regarding the comparison between those patients who returned to baseline and those who did not as illustrated in **Table 4**, the absence of statistical hypothesis testing weakens the observations reported on the descriptive statistics.

Conclusion

Frailty, as measured by the Clinical Frailty Scale, is a significant and superior predictor of both discharge disposition and longitudinal functional recovery in the burn-injured adult patient. Those with higher pre-morbid frailty scores were less likely to be discharged home after the index hospitalization and were also less likely to report a return to their pre-morbid baseline. These findings were independent of chronologic age.

As a result of our findings, coupled with the established literature, we suggest the integration of a validated, reliable measure of frailty such as the CFS in the early phase of assessment of the burn-injured patient to aid prognostication, enhance evidence-based communication between the patient, their family and the healthcare team and help them conceptualize the disposition plan and long term outcomes well in advance of their discharge.

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Disclosure of conflict of interest

None.

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