Ambulatory Status Is Associated With Successful Discharge Home in Survivors of Critical Illness

Dena H Tran, Parth Maheshwari, Zain Nagaria, Harsh Y Patel, and Avelino C Verceles

BACKGROUND: Survivors of prolonged ICU admissions are bedridden and immobilized for an extended period of time. These patients often are discharged to long-term acute care hospitals (LTACHs) for continued medical care and rehabilitation. Early ambulation has been associated with improved functional outcomes and lower readmission rates in hospitalized patients. The aim of this study was to determine the association between ambulatory status and discharge disposition in survivors of prolonged ICU stays who were admitted to an LTACH. METHODS: We performed a retrospective cohort study of 285 survivors of prolonged ICU stays who were admitted to a university-affiliated LTACH facility from 2010 to 2013. Outcomes of interest included comparing the relationship between ambulatory status and disposition status (ie, home vs acute rehabilitation facility, nursing home, readmission to an ICU, or death). RESULTS: The mean age of our cohort was 59.0 ± 15.3 y, with 129 (45%) males, 148 (52%) African-American, 123 (43%) white, and 14 (5%) of subjects other races. Most of these subjects were transferred from a medical ICU (68%). The median ICU and LTACH lengths of stay were 25.5 (13–38.8) d and 34.0 (14–64) d, respectively. Thirty-eight (13.3%) subjects were discharged home, 25 (8.7%) to an acute rehabilitation facility, 70 (24.6%) to a nursing home, 139 (48.8%) were readmitted to an ICU, and 13 (4.6%) died. Of 285 total subjects, 74 (26%) ambulated during physical therapy, while 211 (74%) subjects never ambulated. Of those who ambulated, 24 (32.4%) went home, whereas 14 of 211 (6.6%) subjects who did not ambulate went home ($P < .001$). CONCLUSIONS: The ability to ambulate was associated with a greater likelihood of being discharged home in survivors of prolonged ICU stays who were admitted to an LTACH. These results suggest that mobility training for survivors of prolonged ICU stays in LTACH facilities should be strongly emphasized to improve their likelihood of being discharged home. *Key words: early ambulation; physical therapy modalities; long-term care; critical illness; patient discharge.*
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Introduction

Survivors of prolonged ICU stays are bedbound for an extended period frequently resulting in ICU-acquired weakness, muscle wasting, and associated impairments in physical function.[1-5] These patients are often admitted to long-term acute care hospitals (LTACHs) for continued medical care and physical rehabilitation, and they commonly experience prolonged LTACH admissions and decreased quality of life.[6,7] In addition, loss of muscle mass occurs within hours of initiating bed rest, resulting in a decrease in lower extremity muscle mass by up to 16%

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within the first week of being bedbound.[8] Patients with decreased muscle mass as a result of immobility are also prone to reduced muscle protein synthesis, muscle efficiency, and overall strength.[9-12] Other associated complications include postural hypotension, contractures, bone demineralization, pneumonia, and skin breakdown.[13]

There have been numerous studies evaluating the effects of incorporating physical therapy as an early intervention in subjects weaning from mechanical ventilation directed toward improving long-term outcomes, including functional independence upon hospital discharge.[14-16] Although physical therapy mobilization strategies are initiated early, the clinical importance of patients who regained ambulatory capacity versus those who did not as a result of physical therapy during an LTACH admission remains unclear. To address this paucity of literature assessing the utility of ambulatory status as a predictor of discharge home in survivors of critical illness, we performed a retrospective cohort study to determine the relationship between ambulatory status and discharge disposition to home in survivors of critical illness treated at an LTACH.

QUICK LOOK

Current knowledge

Survivors of prolonged ICU admissions are bedridden and immobilized for an extended period of time. These subjects often are discharged to long-term acute care hospitals (LTACHs) for continued medical care and rehabilitation. Early ambulation has been associated with improved functional outcomes and lower readmission rates in hospitalized patients.

What this paper contributes to our knowledge

Subjects admitted to an LTACH after an ICU stay who were able to ambulate were more likely to go home than those who did not ambulate. Additionally, those who never ambulated were more likely to be readmitted to an ICU. Thus, walking is an important milestone that is associated with a greater likelihood of being discharged home and should be emphasized in the rehabilitation and medical care arena, not only for acutely ill ICU patients, but also for survivors of critical illness admitted to LTACHs.

Methods

Study Design and Subject Selection

We conducted a retrospective cohort study of 285 survivors of critical illnesses who were admitted to the LTACH at the University of Maryland Medical Center Midtown Campus from February 2010 to December 2013. During routine rehabilitation, subjects underwent standardized, mobility-based physical therapy at this university-affiliated hospital LTACH based in Baltimore, Maryland. Mobility-based physical therapy consisted of dynamic standing activities and pre-gait climbing, with additional emphasis on activities such as step-ups and standing hip extension/abduction maneuvers to strengthen the muscles used for walking. This study was approved by the institutional review board and the need for informed consent was waived.

Data Collection

Data were extracted from electronic medical records and included demographics, age, body mass index, prior location to LTACH admission, ICU and LTACH length of stay (LOS), ambulatory status, and discharge disposition. For each subject, data were collected and reviewed through electronic medical record. Mobility status was assessed on the basis of physical therapist and nursing documentation in each subject's chart, and disposition status was recorded (ie, home vs acute rehabilitation facility, nursing home, readmission to an care ICU, or death). Subjects were classified as being able to ambulate if they could walk or stand at any time during their LTACH stay, or as not ambulatory if they never walked or stood during their LTACH admission. We recorded comorbid illnesses for each subject using the Charlson comorbidity index score, which is a weighted scoring system that predicts the 1-y mortality based on various comorbidity disease burdens, with a higher Charlson comorbidity index score representing a greater comorbidity burden.[17]

Statistical Analysis

All subjects were included in the statistical analysis. Descriptive estimates of demographics and clinical characteristics are reported as mean ± SD, median (interquartile range), or count (percent) as appropriate. Comparison of means and proportions were performed using the *t* test and the chi-square test, respectively (SAS, SAS Institute, Cary, North Carolina). Multivariable logistic regression models were used to calculate odds ratios when appropriate. We used the traditional definition of a 2-tailed P value $\leq .05$ for statistical significance.

We performed additional analyses to determine whether increasing age and higher Charlson comorbidity index scores were predictive of discharge home when analyzed independently and collectively with the ability to ambulate. We designated a Charlson comorbidity index score of ≥ 6 as a discriminator value, as this score has been shown to reflect shorter overall survival and increased 1-y mortality rates in select cohorts age $\geq$ 65 y.[18,19] Univariate and

Table 1. Baseline Subject Characteristics

Characteristic	Total	Ambulated	Did Not Ambulate	*P*
Age, y	59.0 ± 15.3	58.3 ± 12.5	59.2 ± 16.2	.61
Gender				.08
Male	129 (45)	40 (54)	89 (42)	
Female	156 (55)	34 (46)	122 (58)	
Race				.67
African-American	148 (52)	38 (51)	110 (52)	
White	123 (43)	32 (43)	91 (43)	
Asian	7 (2.5)	1 (2)	6 (3)	
Other	7 (2.5)	3 (4)	4 (2)	
Body mass index, kg/m^2	29.5 (23.7–37.3)	28.3 (22.7–36.4)	30.0 (23.9–37.5)	.22
Location prior to LTACH				.09
Medical ICU	123 (43)	33 (44)	90 (43)	
Surgical ICU	16 (6)	9 (12)	7 (3)	
Trauma ICU	14 (5)	3 (4)	11(5)	
Other ICU	27 (9)	5 (7)	22 (10)	
Medical/surgical floor	17 (6)	5 (7)	12 (6)	
Other	88 (31)	19 (26)	69 (33)	

Data are presented as *n* (%), mean ± SD, or median (interquartile range). Total: $N = 285$ subjects; Ambulated: $n = 74$ subjects; Did Not Ambulate: $n = 211$ subjects.
LTACH = long-term acute care hospital

multivariable logistic regression analyses were performed using ambulation, age ≥ 65 y, and Charlson comorbidity index ≥ 6 as the independent variables to determine the odds of being discharged home.

Results

A total of 285 subject records were reviewed, of which 129 (45%) were male. The cohort had a mean age of 59.0 ± 15.3 y and a median (interquartile range) body mass index of 29.5 (23.7–37.3) kg/m^2 (Table 1). One hundred forty-eight (52%) subjects were African-American, 123 (43%) were white, and 14 (5%) were other races.

Using the electronic medical record, subject information was recorded based on their location prior to LTACH admission, ICU LOS, LTACH LOS, and disposition allocation. Most of these subjects were previously from an ICU (180, 63%), with 123 (68%) coming from a medical ICU. The median ICU and LTACH LOS were 25.5 (13–38.8) d and 34.0 (14–64) d, respectively. Thirty-eight (13.3%) subjects were discharged home, 25 (8.7%) to an acute rehabilitation facility, 70 (24.6%) to nursing home, and 139 (48.8%) were readmitted to an ICU; 13 (4.6%) subjects died (Table 2).

Of the 285 subjects, 74 (26%) ambulated during physical therapy, whereas 211 (74%) never ambulated. All of the subjects in the study, including those who never ambulated, were able to ambulate prior to critical illness. Over the course of their illness, they became too debilitated or developed profound weakness or contractures that prevented them from standing and eventually from ambulating within the time frame noted during their LTACH admission. Of subjects who ambulated, 32.4% went home, whereas only 6.6% of subjects who did not ambulate went home ($P < .001$). In addition, 55% of subjects who did not ambulate were readmitted to an ICU ($P < .001$) (Fig. 1). Furthermore, there was a 32% sensitivity and a 93% specificity in predicting the ability to be discharged home for those who ambulated.

Table 2. Discharge Disposition

Discharge Disposition	Ambulated	Did Not Ambulate	Odds Ratio (95% CI)	*P*
Home	24 (32.4)	14 (6.6)	0.15 (0.71–0.31)	< .001
Acute rehabilitation	8 (10.8)	17 (8.1)	0.72 (0.30–1.75)	.47
Nursing home	18 (24.3)	52 (24.6)	1.02 (0.55–1.89)	.96
Readmitted	23 (31.1)	116 (55.0)	2.71 (1.54–4.75)	< .001
Death	1 (1.4)	12 (5.7)	4.40 (0.56–34.45)	.16

Data are presented as *n* (%). Ambulated: $n = 74$ subjects; Did Not Ambulate: $n = 211$ subjects.

In our study population, the mean age of those who never ambulated was greater than those who ambulated, although this difference was not statistically significant (Table 1). Additionally, univariate analyses demonstrated that those who could ambulate were more likely to go home (odds ratio = 6.75, 95% CI 3.26–14.0, $P < .001$). Subjects age ≥ 65 y were more likely to not go home (odds ratio = 0.34, 95% CI 0.14–0.80, $P = .01$). Charlson comorbidity index ≥ 6 did not demonstrate significance (odds ratio = 0.76, 95% CI 0.36–1.61, $P = .48$) (Table 3). There was no significant difference in ambulation status (36% who never ambulated

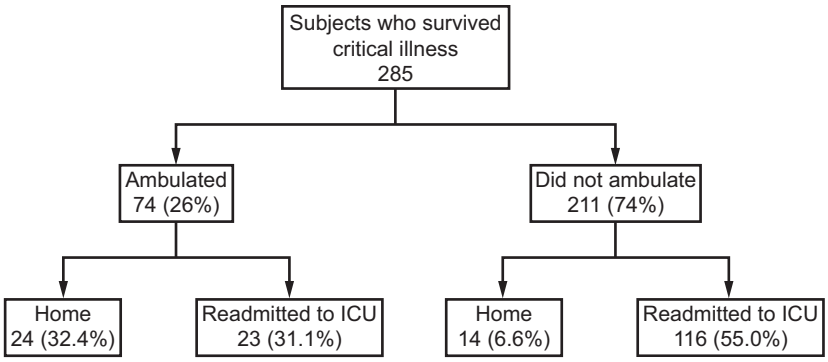

Fig. 1. Flow chart.

Table 3. Univariate Logistic Regression Analysis Assessing Ambulatory Status, Age, and Charlson Comorbidity Index in Predicting Discharge Home

	Odds Ratio (95% CI)	*P*
Ambulate*	6.75 (3.26–14.0)	< .001
Age ≥ 65 y	0.34 (0.14–0.80)	.01
Charlson comorbidity index ≥ 6	0.76 (0.36–1.61)	.48

* Ambulate = ability to stand or ambulate during admission to long-term acute care hospital.

vs 28.4% who ambulated) among the 97 subjects who had a Charlson comorbidity index ≥ 6. Analyzing these data incorporating all 3 independent variables in a multivariable model did not change the results.

Discussion

Our study indicates that subjects admitted to an LTACH after an ICU stay who were able to ambulate were more likely to go home. Our analysis also shows that subjects who had never ambulated were more likely to be readmitted to an care ICU than those who ambulated. These results are consistent with prior studies focused on mobility in ICU survivors.[20,21] Additionally, those who ambulated were more likely to be discharged to other locations, including acute rehabilitation facilities, which may improve functional outcomes versus those who never ambulated. Collectively, these findings further support the importance of ambulation in critically ill patients as a means of improving the likelihood of being discharged out of the hospital and the ability to go home.

Various exercise assessments have been created and tested in the critically ill population with the objective of predicting physical function and clinical outcomes. Although these assessments were not performed on our cohort, these measures have been used in similar populations to predict physical function and outcomes. One such assessment, the Functional Status Score for the Intensive Care Unit (FSS-ICU), was designed to measure physical function in the ICU population. Validation testing on the FSS-ICU indicated that subjects who were admitted to an LTACH and had a higher FSS-ICU score were more likely to be discharged home.[22] There have been other mobility exercise tests, including the Functional Independence Measure (FIM), the Johns Hopkins Hospital Function Acute Care Score (JHH-FACS), and the University of Rochester Acute Care Evaluation (URACE). The FIM was created to address one's level of independence and how much assistance is needed to carry out activities of daily living. However, the FIM is multidisciplinary and requires performance on stairs, which may be challenging for chronic critically ill subjects.[22,23] The JHH-FACS and URACE have been used to assess functional abilities and individual function in the ICU. However, these assessments may have a floor effect when performed on bed-bound subjects and thus may not necessarily reflect one's ability to be discharged home.[24,25] Despite the flaws that may be inherent to each of these assessment methods, the data provided by each one reflect basic functional mobility, with each providing useful information on functional status and independence.

There are several other mobility and exercise tests that may be prognostic of strength and ambulation, including the short physical performance battery, the sit-to-stand test, the 6-min-walk test, the timed up and go test, and physical function outcome measure. Although these maneuvers have been validated as functional measures, these tests may have a floor effect and may be difficult for chronic critically ill subjects to perform, including those who are intubated and cannot get up and out of bed.[21,26-28] In addition, these tests are time-consuming, and these maneuvers may test individual capabilities, which do not necessarily test for actual ambulatory function. Despite these maneuvers being tested within the ICU population, they have not been tested in an LTACH population, nor have these tests been validated in their ability to predict discharge disposition.

Our results indicate that ambulation is an important step in improving physical and clinical outcomes such as being discharged home. Those who have not ambulated are more

prone to muscle wasting and muscle loss, hence they are less likely to be physically and functionally fit enough to be discharged home. When caring for the chronically critically ill population, providers are constantly searching for markers that can predict favorable clinical outcomes. Examples of such characteristics include gait speed in older subjects with hematologic malignancies, being predictive of mortality;[29] the timed up and go test in Parkinson's disease and poststroke subjects, demonstrating higher fall risk and disability;[30] and grip strength in older community-dwelling subjects, reflective of upper extremity strength and function.[31] In our study population, we noted that age $\geq$ 65 y was a negative predictor of discharge home and was reflective of greater odds of postdischarge mortality. Thus, when caring for subjects in LTACHs who are older, have a greater comorbidity burden, and are nonambulatory, clinicians should be aware of the higher likelihood of worse outcomes. This may raise the question as to whether the incorporation of physical therapy specifically aimed at increasing ambulatory status – the only modifiable of the 3 incorporated into our regression model – may be of benefit with respect to improving clinical outcomes in this post-ICU population. Studies using the mobility protocols have reported that early physical therapy is safe and feasible in ICU subjects[20,32-37] and results in decreased mechanical ventilation duration, decreased ICU and hospital LOS, and improved clinical and functional outcomes.[16,38,39] However, there have been conflicting studies suggesting that mobility may not have an impact on clinical and functional outcomes.[40,41] Moss et al[42] reported that an intensive physical therapy program did not improve physical functional performance nor was there a difference in ICU and hospital LOS or discharge disposition to home. Although this study was performed on acutely ill subjects in the ICU, the negative results cast some uncertainty as to the efficacy of physical and mobility training in various debilitated ICU and post-ICU populations.

There are several limitations to our study. First, this was a retrospective study rather than a prospective randomized controlled trial, which limits its generalizability. Second, this study was performed at a single center with a limited sample size; therefore, the study may have lacked power to determine other significant findings. Future research would benefit from assessing the relationship of mobility status and being discharged home in a multicenter, prospective, randomized controlled trial across multiple LTACHs and post-acute care settings, which would allow for a larger sample size.

Conclusions

Walking is an important milestone that is associated with a greater likelihood of being discharged home, and therefore it should be emphasized in the rehabilitation and medical care not only of acutely ill subjects in the ICU, but also that of survivors of critical illness admitted to LTACHs. Thus, initiating mobility-targeted physical therapy early into the care plan of these subjects is not only important to prevent muscle loss and subsequent immobility, but it is also a critical aspect of physical therapy necessary to improve outcomes and overall quality of life.

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