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BRIEF REPORT

OPEN

A novel method using the level of mobility to predict mortality in patients admitted for decompensated cirrhosis: A prospective study

To the editor,

Frailty is characterized by decreased physiologic reserve predisposing to adverse outcomes[1] and is a significant burden to patients with advanced chronic liver disease (AdvCLD) affecting approximately 25% of outpatients and about 60% of inpatients.[2,3] The assessment of frailty is crucial as it is associated with falls, hospitalization, waitlist dropout, posttransplantation complications, and mortality.[3,4] Recent research has focused on the validation of physical performance metrics to identify frailty and its response to rehabilitation in AdvCLD. Clinically available tools include the 6-minute walk test (6MWT) and the liver frailty index (LFI). Their use is recommended to standardize the diagnosis of frailty in outpatient/liver transplantation clinics. In the case of LFI, longitudinal changes carry significant prognostic implications.[5] Little attention has been paid to the study of frailty in hospitalized patients; however, LFI was recently shown to predict nonhome discharge and mortality among inpatients with AdvCLD.[3]

The Johns Hopkins Highest Level of Mobility (JH-HLM) is a simple and efficient method to measure physical activity in hospitalized patients. JH-HLM is an equipment-free tool allowing rapid mobility assessment (Figure 1) and can be performed by any member of the health care team. We conducted a prospective single-center cohort study to assess the ability of inpatient JH-HLM score to predict mortality in patients with decompensated AdvCLD.

PATIENTS AND METHODS

This study was conducted at an adult hepatology ward where the JH-HLM score is obtained routinely as part of physical therapy (PT) assessments. Hospitalized patients with AdvCLD complications (e.g., infection, ascites, acute kidney injury, bleeding, or encephalopathy) between September 2018 and December 2019 were enrolled and followed until June 2020. The study cohort was derived from a larger one described previously.[3] Patients' first admission during the aforesaid timeline was deemed as their index admission. Baseline characteristics including the Model for End-Stage Liver Disease–sodium (MELD-Na) and endpoints such as death and transplantation following discharge from index admission were recorded. The cirrhosis comorbidity index (CirCom), a validated scoring system for all-cause mortality in cirrhosis, and LFI were calculated.

JH-HLM was obtained both at admission and prior to discharge, whereas LFI was obtained only once. A minimum JH-HLM score of 1 was recorded when participants remained lying in bed. PT consultants provided daily consultation to patients with AdvCLD and remained masked to the aims of study. The University of Pittsburgh Institutional Review Board approved this study.

Statistical analysis

Descriptive statistics were calculated for all variables using mean ± standard deviation or median (25th–75th percentile), depending on data distribution. A JH-HLM score < 8 (per receiver operating characteristics analysis) or LFI ≥ 4.5 was used as a surrogate for frailty. Agreement was investigated with McNemar's test. The

Abbreviations: 6MWT, 6-minute walk test; AdvCLD, advanced chronic liver disease; CI, confidence interval; CirCom, cirrhosis comorbidity index; JH-HLM, Johns Hopkins Highest Level of Mobility; LFI, liver frailty index; MELD-Na, Model for End-Stage Liver Disease–sodium; PT, physical therapy; sHR, subdistribution hazard ratio.

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8	Walk 250 ft or more
7	Walk 25 ft or more
6	Walk 10 ft or more
5	Walk 10 steps or more
4	Stand for 1 min or more
3	Transfer independently to chair
2	Bed activities, transfer dependent
1	Lying in bed

FIGURE 1 Classification of the JH-HLM scores

Fine and Gray competing model for all-cause mortality (primary outcome) was calculated considering liver transplantation as the competing risk. Age, MELD-Na, and CirCom were used to adjust for hepatic/extra-hepatic morbidity. Statistical analyses were performed using Stata15 (StataCorp., College Station, TX).

RESULTS

A total of 98 inpatients with LFI assessment (92% of original cohort) had available admission/discharge JH-HLM and were included (mean age ± SD 57 ± 11 years, 53% male, mean MELD-Na ± SD 20 ± 9). Based on JH-HLM, 77% were frail on admission with a significant improvement during hospitalization (median [25th–75th percentile] 7 [3–8] on admission vs. 7 [5–8] at discharge; $p < 0.001$), such that at discharge only 62% were considered frail. Full baseline characteristics according to frailty per JH-HLM score are shown in Table S1. In comparison, frailty per LFI was observed in 60% at discharge with a 63% agreement with JH-HLM ($p = 0.73$), and LFI (mean ± SD) was significantly higher in patients with frailty by JH-HLM versus those without it (4.90 ± 0.80 and 4.27 ± 0.73; $p < 0.001$). Frailty on admission by JH-HLM (Figure 2) was associated with increased mortality (subdistribution hazard ratio [sHR] 5.70, 95% confidence interval [CI] 1.44–22.4) in a multivariable model adjusted for age (sHR 1.03, 95% CI 0.99–1.07), MELD-Na (sHR 1.03, 95% CI 0.99–1.07), and CirCom (sHR 0.75, 95% CI 0.31–1.78). Frailty by LFI yielded similar results to HLM (sHR 2.42, 1.13–5.16). Frailty by JH-HLM at discharge showed a trend, although the inpatient change in JH-HLM was not associated with mortality risk (data not shown).

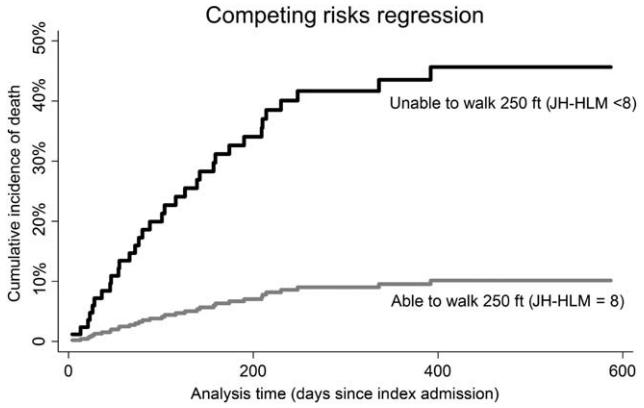

FIGURE 2 Adjusted competing risk survival analysis graph for mortality according to the JH-HLM scores (frail [JH-HLM = 8] vs. nonfrail [JH-HLM < 8] categories). Liver transplantation was used as the competing risk

DISCUSSION

Our study found that JH-HLM score, a practical method to assess reduced mobility (i.e., a key component of frailty), is associated with overall mortality in inpatients with AdvCLD. The potential advantage of JH-HLM over LFI is that it does not require a dynamometer and can be performed by any hospital staff without specialized training.

Interestingly, the prevalence of frailty assessed using the JH-HLM score decreased from admission to discharge by 15% following coordinated PT care and overall convalescence from inpatient care. This suggests that JH-HLM is sensitive to change as a result of interventions impacting an individual's mobility. We did not observe differences in the prevalence of frailty at discharge when JH-HLM was compared with LFI, which providers further cross-validation evidence on JH-HLM as an inpatient frailty tool.

We found that JH-HLM scores <8 on admission were associated with higher risk of mortality compared with those with a JH-HLM score of 8. The effect was independent of age, MELD-Na, and comorbidities, which emphasized the value of JH-HLM as an accessible frailty tool to prognosticate inpatients with AdvCLD. Although the association between JH-HLM score and mortality was attenuated at discharge, our study was not designed to assess trajectories. Being a more time-consuming metric, LFI was collected only once during hospitalization; however, because JH-HLM is embedded in our daily workflow, we could have multiple timepoints of assessment.

There are a few limitations to our study. First, this study was conducted at a specialized hepatology ward in a patient population that is 99% White, which limits its generalizability to settings including more diverse populations. Further, the number of PT sessions and the engagement of patients in those sessions were not considered when assessing change in JH-HLM

scores. Finally, LFI was assessed at a single timepoint that did not necessarily coincide with the discharge JH-HLM (i.e., 1 [range 0–5] days prior to discharge). Future multicenter studies with a more diverse population addressing both inpatient mobility trajectories for JH-HLM/LFI and fidelity of PT interventions are warranted.

In conclusion, a JH-HLM score < 8 on admission provides an early indicator of frailty in inpatients with AdvCLD and is independently associated with increased mortality. Apart from being easy to use and interpret, JH-HLM offers minimal barriers for implementation with great potential for scalability and could effectively emphasize the need for outpatient rehabilitation in AdvCLD.

CONFLICT OF INTEREST

Andres Duarte-Rojo received grants from and consults for Axcella Health Inc. Marina Serper is employed by Gilead, Inc.

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