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Prospective evaluation of health-related quality of life in geriatric trauma patients

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ABSTRACT

Background: Frailty is an established predictor of adverse outcomes in geriatric patients. Health-related quality of life (HRQoL) is an important outcome measure among trauma patients. This prospective observational study examined the impact of frailty on health-related quality of life in geriatric trauma patients.

Methods: We prospectively enrolled geriatric (age ≥65 years) trauma patients. We calculated the frailty index (FI) within 24 hours of admission using the trauma-specific frailty index. Patients were stratified into frail (frailty index ≥0.27) and nonfrail (frailty index <0.27). Health-related quality of life was calculated at discharge and at 30 days (day) after discharge using the RAND Short Form-36 (SF-36). Outcome measures were health-related quality of life at discharge, 30-days postdischarge, and delta health-related quality of life. Regression analysis was performed to control for demographic, vital signs, and injury parameters.

Results: We enrolled 296 patients. The mean age was 75.1 ± 9.8 years, 59% were male, and 81% were white. Frail patients accounted for 34%, and they had a lower health-related quality of life at discharge (366 vs 548, $P < .01$) and at 30-day postdischarge (393 vs 744, $P < .01$). Nonfrail patients scored higher in 6 out of 8 domains of health-related quality of life. Nonfrail patients had improved delta health-related quality of life ($P < .01$), unlike frail patients ($P = .11$). A linear regression model revealed an inverse relationship between frailty and improvement in health-related quality of life over 30-day postdischarge ($\beta = -0.689$, [confidence interval, −0.963 to −0.329] $P = .01$). This association remained statistically significant after controlling for potential confounding covariates, such as age, sex, race, and injury severity.

Conclusion: Compared with nonfrail geriatric trauma patients, those who were frail had poor health-related quality of life at discharge and at 30-day postdischarge. Frailty negatively affects the recovery of health-related quality of life after trauma. The use of frailty indices may help identify and develop targeted interventions to improve health-related quality of life among geriatric trauma patients.

Every day in the United States, 12,000 Americans reach the age of 65, making elderly people (age ≥65 years) the fastest growing subset of the population. Currently, there are >46.3 million (14.5%) geriatric Americans, and this figure is expected to grow to 98 million (24%) by 2060.[1] The rapidly increasing geriatric population is a major public health crisis. Furthermore, the greater number of older people making more active lifestyle choices puts this already at-risk population at an increased risk of trauma and its associated morbidity and mortality. Geriatric patients account for more than 20% of all hospital admissions,[2] and because of the presence of multiple comorbidities, decreased physiologic reserve, and complex geriatric syndromes, stress owing to trauma and hospitalization can be catastrophic and results in substantial morbidity and mortality.[3]

Assessing health-related quality of life (HRQoL) has become an important way to investigate patient outcomes. Although multiple tools exist to measure HRQoL, the RAND Short Form-36 (SF-36) has

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been validated clinically and is accepted widely as a suitable instrument for this task.[4,5] In recent years, an increasing number of health care providers understand that patients' subjective experiences influence patient outcomes, and they are integrating this information into their medical judgments. Multiple studies have shown how HRQoL is associated with increased health care utilization and poorer outcomes. This is especially relevant for the elderly population, which has a decreased physiologic reserve and functional status.[6]

Frailty, a common geriatric syndrome measured quantitatively with various indices, is a well-established measure of poor outcomes in elderly patients. Indeed, frailty has been shown to be superior to age in predicting outcomes after injury, and it is an impressive indicator of major adverse health outcomes.[7] The applicability of frailty assessment tools in trauma centers is still in its infancy, and each of the proposed instruments has relative pros and cons. These tools assess functional, locomotive, kinesthesiologic, and physiologic parameters.[8,9] At our institution, previously we developed and validated a 15-variable Trauma-Specific Frailty Index (TSFI) for short-term outcomes.[10] Although emerging literature addresses the association between frailty and in-hospital outcomes, its impact on HRQoL after hospital discharge in elderly trauma patients is still underexplored. Therefore, the aim of our study was to assess the impact of frailty on HRQoL at discharge and at 30 days postdischarge. We hypothesized that frail patients were at an increased risk for a decreased HRQoL.

Methods

After approval from the institutional review board at the University of Arizona, we performed a prospective, observational study of all trauma patients admitted to our Level I trauma center during a 1-year period (2016–2017). All eligible patients were approached for the consenting process, and those who agreed to participate in the study were included in the analysis. As the only level I trauma center in southern Arizona, Banner, University Medical Center Tucson covers a large area and provides care to a sizable population of Hispanic patients from both southern Arizona and Mexico.

Study population (inclusion and exclusion criteria)

We approached all geriatric (≥65 years) trauma patients admitted to our level I trauma center for at least 1 day. We excluded patients who were dead on arrival, transferred from other institutions, unwilling to consent, or unable to complete the survey owing to an altered mental status or unavailability of family historians.

Study protocol

Patients were screened during the morning trauma sign-outs. All eligible trauma patients were identified and approached by the investigators. The study protocol along with the benefits and risks were explained to every eligible patient. After obtaining written informed consent, we administered surveys that measured frailty and HRQoL. Data points regarding demographics and the hospital course were collected through a review of electronic medical records. After discharge, we conducted a phone survey with each patient to measure HRQoL at 30-days postdischarge.

Measurements and data points

Frailty

Frailty was measured at admission using the previously validated TSFI questionnaire (derived from the Rockwood frailty survey).[10] The TSFI follows the deficit accumulation model of frailty and covers the patient's overall health, including comorbidities (cancer history, coronary artery disease, and dementia), activities of daily living (grooming, money management, housework, toileting, and walking), sexual activity, nutritional status, and general health attitude (patient's own perspective on energy, loneliness, mood, and falls).[10] Most of the 15 variables included in the TSFI are dichotomized variables (the answers are either yes or no), whereas a few others have multiple categories. Each variable is given a score, and individual scores are then added up and divided by the maximum score (ie, 15) to calculate the TSFI. The TSFI score ranges from 0 to 1 with higher scores indicating a frail status. Patients were then stratified into two groups based on their TSFI: nonfrail (TSFI <0.27) and frail (TSFI ≥0.27).

Health-related quality of life

HRQoL was assessed using the previously validated SF-36 survey, which has 8 domains including physical functioning, role limitations owing to physical health, role limitations owing to emotional problems, energy and fatigue, emotional well-being, social functioning, pain, and general health. The SF-36 has 36 variables, each answer is given a preset value on a scale of 0 to 100, and every question corresponds to a specific domain. Questions within each domain are averaged to get the specific domain score. Scores closer to 100 indicate a higher level of HRQoL; scores closer to 0 indicate a lower HRQoL. We measured HRQoL at discharge ($HRQoL_{Dis}$) and at 30 days after discharge from the hospital ($HRQoL_{30}$).

Demographics and clinical characteristics

The electronic medical record of each patient was queried to extract data regarding demographics (age, sex, and race), vital signs on presentation (systolic blood pressure, heart rate, temperature, and Glasgow coma scale score), and hospital and intensive care unit (ICU) duration of stay. Data about injury characteristics, including the global injury severity score (ISS), the different body region abbreviated injury scale (AIS), and the mechanism of injury, were obtained from the trauma registry.

Outcome measures

The primary outcome measure was HRQoL at discharge and 30-day postdischarge. Our secondary outcome measure was delta HRQoL (ΔHRQoL), which was defined as a change in the HRQoL over 30 days after discharge. ΔHRQoL was calculated as the difference in the HRQoL at 30-days postdischarge and discharge, that is, ($\Delta HRQoL = HRQoL_{30} - HRQoL_{Dis}$).

Statistical analysis

Data are reported as proportions for categorical variables, as a mean with standard deviation for continuous parametric variables, and as a median with interquartile range for continuous nonparametric variables. We performed the Student *t* test and the Mann-Whitney *U*-test to explore the differences between parametric and non-parametric continuous variables in the 2 patient cohorts. The Pearson χ^2 test was used to compare the categorical variables between the 2 groups. Alpha was set at 5%.

We performed a univariate linear regression analysis to assess the association between each variable and the outcomes. Variables with an association on univariate analysis (ie, *P* value <0.2) were then used in a multivariate regression model.

Table I
Patient demographics

Variables	Nonfrail (n = 196)	Frail (n = 100)	*P* value
Age, mean ± SD	74.3 ± 10.3	78.8 ± 9.1	.28
Male, %	60%	57%	.12
White, %	84%	79%	.03
BMI, mean ± SD	25.1 ± 7.4	23.4 ± 8.3	.04
Injury parameters			
ISS, median (IQR)	14 (9–18)	11 (8–20)	.03
Mechanism of injury			
Fall, %	43%	58%	.01
MVC, %	49%	36%	
Other, %	8%	6%	
Hospital course			
Hospital duration of stay, d, median (IQR)	4 (2–6)	5 (3–7)	.03
ICU duration of stay, d, median (IQR)	1 (0–2)	2 (0–4)	.04
TSFI, mean ± SD	0.09 ± 0.04	0.40 ± 0.12	.01
Preinjury medications			
Antiplatelet, %	28%	32%	.04
Anticoagulants, %	11%	13%	.09

BMI, body mass index; *IQR*, interquartile range; *MVC*, motor vehicle collision; *SD*, standard deviation.

Results

During the study period, we approached 496 geriatric patients admitted to our trauma center, 362 of whom consented to participate in the study. The 36 patients (18%) who did not respond to phone calls for completion of the 30-day postdischarge HRQoL survey were excluded. A total of 296 patients were included in the final analysis. The mean age was 75.1 ± 9.8 years, 59% were male, and 81% were white. The most common mechanisms of injury were falls (48%) followed by motor vehicle collisions (44%). Overall, 100 (34%) patients were frail. The demographics and admission vitals of the study cohorts are given in Table I. Frail patients were less likely to be white ($P = .03$), had a lesser body mass index ($P = .04$), and were more likely to present after falls ($P = .01$) compared with nonfrail patients. In addition, frail patients had a lesser ISS ($P = .03$), but a prolonged hospital ($P = .03$) and ICU duration of stay ($P = .04$). There was no difference between the 2 groups regarding age ($P = .28$), sex ($P = .12$), admission vitals, or h-AIS ($P = .24$).

Table II represents the results of the HRQoL questionnaire at discharge and at 30 days postdischarge. At discharge, frail patients had a lower HRQoL in physical functioning (35 vs 85, $P < .01$), role limitations owing to physical health (25 vs 100, $P < .01$), energy or fatigue (30 vs 55, $P = .04$), social functioning (75 vs 87, $P = .03$), pain (22 vs 58, $P < .01$), and general health (45 vs 75, $P = .01$) compared with nonfrail patients. There was no difference in HRQoL between the 2 groups regarding emotional well-being or role limitations owing to emotional problems. At 30 days after discharge from the hospital in comparison with nonfrail patients, frail patients also had lower HRQoL in physical functioning, role limitation owing to physical health, energy or fatigue, social functioning, pain, and general health perception (Table II).

The frail patients had a lower overall discharge HRQoL (366 vs 548, $P < .01$) and 30-day postdischarge HRQoL (393 vs 744, $P < .01$) compared with nonfrail patients. Analysis of the frail group showed no difference between the discharge and 30-day postdischarge HRQoL (366 vs 393 vs, $P = .11$). In contrast, in the nonfrail group, the 30-day postdischarge HRQoL was higher than the discharge HRQoL (744 vs 558, $P < .01$). In addition, frail patients had a lower delta HRQoL compared with nonfrail patients (27 vs 196, $P < .01$).

Table III shows the results of the multivariate analyses. A multivariate linear regression analysis was performed controlling for patient demographics (age, sex, race), admission vital signs (systolic blood pressure, heart rate, Glasgow coma scale score), injury parameters (ISS, h-AIS), mechanism of injury, and HRQoL at discharge. Motor vehicle collision ($P = .04$) and ISS ($P = .03$) were negatively associated, whereas $HRQoL_{Dis}$ ($P = .02$) was positively associated with improvement of HRQoL at 30 days after discharge. Moreover, frailty was negatively associated with improvement in the HRQoL over 30 days after hospital discharge ($\beta = -0.689$, 95% CI $= -0.963$ to -0.329, $P = .01$).

Discussion

The results of our study show that frail patients had a decreased HRQoL at discharge and at 30 days postdischarge. Furthermore, the presence of frailty was negatively associated with improvement in HRQoL after discharge from the hospital.

HRQoL represents the perceived physical and mental health of an individual as described by the patient. A decreased HRQoL is associated with increased healthcare utilization and mortality.[6,11] Our study is one of the earliest to analyze the impact of frailty on HRQoL in geriatric trauma patients, demonstrating that frail patients had worse HRQoL. Similarly, Bilotta et al reported that frail patients were 10 times more likely to have a lower quality of life using the SF-36 measurement tool.[12] Wynne et al reported that frail status was independently associated with impairment of HRQoL in critically ill geriatric patients.[13]

Frailty is a multidimensional construct that includes physical, cognitive, social, psychologic, and biologic functions.[8] We showed that frail patients had a lower score in the general health domain and the physical component of HRQoL. For instance, frail geriatric patients have decreased physiologic reserves and are prone to dysregulation of biologic pathways, which manifest as weakness, loss of lean body mass, poor gait and balance, and lower physical activity.[11] All these characteristics result in impairment of physical functioning and role limitations.

In our study, frail patients also scored lower on the mental components, including pain. Frailty, through psychoneuroimmunologic pathways, such as increased production of inflammatory cytokines, causes a state of impaired cognition and mental processes.[12] Moreover, frailty acts synergistically with the comorbid burden to increase the experience of intrusive pain.[14] Frailty has been reported to dysregulate the hypothalamic-pituitary-adrenal axis, resulting in chronic pain.[14] In addition, multiple studies have shown that frailty alters the metabolic pathways and the pharmacokinetics of multiple drugs, including paracetamol (acetaminophen).[13,14]

Frail patients have a generalized decline in their physiologic reserve and physical fitness that renders them more prone to injuries such as falls in particular.[15] In our analysis, we found that falls

Table II
HRQoL at discharge and at 30 d postdischarge

Variable	At discharge			30 d postdischarge		
	Nonfrail	Frail	*P* value	Nonfrail	Frail	*P* value
General health	75 (57.5–80)	75 (57.5–80)	.001	81 (63–87)	51 (35–67)	.01
Physical component						
Physical functioning	85 (56.2–95)	35 (15–67.5)	<.01	90 (60–98)	37 (17–69)	<.01
Role limitations owing to physical Health	100 (50–100)	25 (0–25)	<.01	100 (72–100)	30 (5–35)	<.01
Energy/fatigue	55 (26.25–75)	30 (17.5–52.5)	.041	68 (38–79)	34 (20–55)	.03
Mental component						
Emotional well-being	88 (68–96)	68 (52–92)	.104	90 (70–96)	71 (53–93)	.13
Role limitations owing to emotional problems	100 (66.6–100)	66.6 (33.3–100)	.071	100 (73–100)	70 (37–100)	.09
Social functioning	87 (62.5–87.5)	75 (37.5–81.25)	.035	89 (67–93)	76 (36–82)	.04
Pain	57.5 (45–90)	22 (12.5–68.7)	.007	79 (61–92)	37 (16–70)	.01

Table III
Multivariave linear regrssion for increase in quality of life over 30 d

Covariates	β	95% CI	*P* value
Age	−0.124	(−0.025 to 0.002)	.40
MVCs	−0.421	(−0.618 to −0.092)	.04
ISS	−0.343	(−0.483 to −0.173)	.03
$HRQoL_{Dis}$	0.613	(0.379–0.816)	.02
TSFI	−0.689	(−0.963 to −0.329)	.01

MVC, motor vehicle collision.

are more prevalent among frail patients. In addition, there was a noticeable difference between frail and non-frail patients in terms of HRQoL at discharge and at 30 days postdischarge. Moreover, nonfrail patients have better improvement in their 30-day HRQoL. Nonfrail trauma patients are more resilient to recapture their pre-injury functional status and HRQoL.[16]

On multivariate regression analysis after controlling for confounding factors, we also found that frailty was negatively associated with improvement in HRQoL over 30 days after discharge. In addition, we found a negative association between severe injuries secondary to a motor vehicle crash with recovery of HRQoL. Similarly, Dimopoulou et al reported that 74% of poly-trauma survivors had a low score in at least one domain of the HRQoL,[17] whereas Thiagarajan et al showed that poly-trauma patients had lower scores in the somatic dimensions of the quality of life assessment, such as energy and emotional well-being.[18]

Targeting the functional status of patients during their in-hospital stay and after discharge is vital to improve long-term outcomes.[19–21] For instance, Yümin et al concluded that functional mobility in the elderly improves HRQoL.[19] Moreover, Zidén et al showed that home rehabilitation and focusing on functional independence is associated with improved HRQoL.[20] At our institution, we have started early mobilization in the ICU and provide early exercise regimens in addition to discharge to a dedicated rehabilitation center to enhance functional independence. All patients review a workout plan with a physical therapist before discharge that suggests programs such as tai chi, yoga, and pure barre. Nonetheless, we need more efforts to generate protocols and guidelines that target improving HRQoL in elderly trauma patients.

Our study has limitations. First, as a single-center study, our results may not be generalizable. Second, we did not have preadmission HRQoL, and we calculated the HRQoL after patients were admitted after a trauma. Sustaining a trauma can alter the perceived quality of life; however, this study is unique because it analyzes the effect of frailty on HRQoL in trauma patients. Our study is strengthened by being a prospective observational design and capturing comprehensive baseline and outcome data with a small attrition rate.

In conclusion, compared with nonfrail geriatric trauma patients, those who were frail had poor HRQoL at discharge and at 30-days postdischarge. HRQoL did not improve after discharge for frail patients. Frailty negatively affects the recovery of HRQoL after trauma. The use of frailty indices may help identify and develop targeted interventions to improve HRQoL among geriatric trauma patients.

Conflict of interest

The authors have no financial or proprietary interest in the subject matter or materials discussed in the manuscript.

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