ORIGINAL ARTICLE

Mortality prediction in geriatric patients with multiple trauma presenting by ambulance

Aynur Yurtseven, Afşin Emre Kayıpmaz

Department of Emergency Medicine, Etlik State Hospital Faculty of Health Sciences, Ankara-*Türkiye*

ABSTRACT

BACKGROUND: The Modified 5-Factor Frailty Index (mFI-5) has been shown to predict complications following treatment in geriatric patients. However, few studies have compared the mFI-5 with other trauma scoring systems in cases involving multiple injuries. This study aimed to evaluate the Relationship Between mFI-5, Injury Severity Score (ISS), and Geriatric Trauma Outcome Score (GTOS) and their association with mortality in geriatric trauma patients.

METHODS: This retrospective cohort study included patients aged 65 and older who were admitted to the emergency trauma unit of a tertiary care hospital. Data collected included laboratory parameters, imaging results, blood transfusion requirements, hospitalization status, intensive care unit admission, surgical intervention, ISS, GTOS, mFI-5 scores, and mortality outcomes.

RESULTS: A total of 241 patients were included, with a mean age of 78.12 (±8.34) years. Falls were the most common cause of trauma (n=142, 58.9%). Thoracic injuries were the most frequently observed (n=86, 53.7%). Patients who died within the first 24 hours of admission had significantly higher ISS (14.1 vs. 26.33), GTOS (119.02 vs. 157.33), and mFI-5 (2.53 vs. 3.33) scores (p=0.001, p=0.001, and p=0.017, respectively). Similar trends were noted for one-month and three-month mortality (p=0.001 for all).

CONCLUSION: Scoring systems are essential for early mortality prediction in geriatric trauma patients. ISS, GTOS, and mFI-5 scores have shown similar effectiveness in predicting comorbidities, intensive care unit admission, and mortality in geriatric trauma patients. ISS involves a complex calculation, while GTOS, although specifically designed for geriatric patients, requires additional computations based on the ISS. In contrast, mFI-5 may be more practical in emergency settings because it is easy to calculate.

Keywords: Frailty; mortality; geriatric; trauma score; emergency.

INTRODUCTION

According to the U.S. Centers for Disease Control and Prevention, trauma-related injuries were the third leading cause of death in 2023, following heart disease and cancer.[1] The physiological and biological changes associated with aging significantly increase the risk of morbidity and mortality in geriatric individuals, particularly when complications arise after trauma. This trend suggests that, with the global increase in the elderly population, the healthcare burden related to trauma will continue to grow. Currently, the patient management guidelines used in emergency departments for the general adult population are limited in their ability to predict complications in geriatric patients.[2-3]

The Geriatric Trauma Outcome Score (GTOS) is a scoring system that incorporates clinical parameters such as age, Injury Severity Score (ISS), and early blood transfusion to estimate mortality risk in elderly trauma patients.[4] Both GTOS and ISS primarily evaluate the anatomical distribution and physiological effects of trauma, focusing mainly on injury severity. However, these systems do not adequately account for the physiological reserves, comorbidities, and post-trauma recovery capacity of elderly patients.[5-6]

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Address for correspondence: Aynur Yurtseven

Department of Emergency Medicine, Etlik State Hospital Faculty of Health Sciences, Ankara, Türkiye

E-mail: aynuryurt7@gmail.com

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Older adults with traumatic injuries should also be assessed for frailty during the initial examination. Frailty is a syndrome of physiological decline that can occur with aging, often leading to an impaired ability to adapt to acute illness or new stressors. This can result in complications such as the need for long-term care, disability, and even death.[7] The latest version of the frailty scale, the Modified 5-Factor Frailty Index (mFI-5), includes diabetes mellitus (DM), hypertension requiring treatment (HT), chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), and functional dependence.[8] The mFI-5 is a practical and rapid tool that can be used to predict clinical outcomes, particularly in elderly and comorbid patients. One of its key advantages, as noted in the literature, is that it can be calculated solely from patient history, without the need for laboratory tests or imaging, making it suitable even for prehospital assessment.[8] Furthermore, studies examining the relationship between mFI-5 and clinical outcomes, especially in elderly trauma patients, are increasing and have shown significant associations with complications, prolonged hospitalization, and mortality.[9] This study aimed to investigate the usability of the mFI-5 score in predicting early and long-term mortality and morbidity in geriatric trauma patients, using the GTOS and ISS scoring systems.

MATERIALS AND METHODS

This retrospective cohort study was conducted at a tertiary care hospital. After obtaining approval from the local ethics committee (Approval No: AEŞH-BADEK-2024-533), patients over the age of 65 who were brought to the emergency trauma unit by ambulance between 2022 and 2023 were evaluated. Only patients presenting with multiple trauma were included. Patients under 65 years of age and those with incomplete data were excluded. The study was designed and conducted in accordance with the ethical standards outlined in the Declaration of Helsinki for research involving human subjects.

Data collected from hospital records included presenting complaint, physical examination findings, imaging and laboratory results, erythrocyte suspension (ES) requirements, operative status, postoperative unit, length of hospital stay (LOS), postoperative follow-up, comorbidities, and outcomes (intensive care unit admission, discharge, or death). Only patients who received blood products within the first 24 hours were included in the scoring analysis. Mortality data (within the first 24 hours, 30 days, and 90 days) was obtained from the national healthcare database.

For each patient, the mFI-5 score was calculated based on the presence of diabetes mellitus, chronic obstructive pulmonary disease, congestive heart failure, hypertension requiring medication, and functional dependence. One point was assigned for each condition present, with a maximum possible score of 5. Comorbidity data were retrieved using International Classification of Diseases (ICD) codes from the national health system.

The Injury Severity Score is a trauma scoring system that evaluates six body regions (head or neck, face, chest, abdomen and pelvis, extremities and pelvic girdle, external/other trauma), and assigns points based on the three most severely injured regions.[10] It is also a component of GTOS, which combines age, ISS multiplied by 2.5, and an additional 25 points if blood transfusion was required, to calculate an overall score.[11]

Complications were recorded based on the Clavien-Dindo classification system.[12] According to this system, conditions are classified as grade 4 if they involve intensive care unit admission, myocardial infarction, pulmonary embolism, the need for postoperative dialysis, reintubation, or prolonged ventilation. In addition to these parameters, hospital-acquired or postoperative infections were also evaluated. Patients who were assessed by an infectious diseases physician and started on antibiotics based on laboratory and culture results were considered positive for infection.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 30.0 (IBM Corp., Armonk, NY, USA). Q-Q plots and Kolmogorov-Smirnov tests were used to evaluate the parametric distribution. Descriptive statistics were presented initially, followed by independent samples t-tests to compare scoring systems based on comorbidities and mortality. Correlations between scale parameters, including length of hospital stay, were analyzed using Spearman's correlation. Depending on the distribution pattern, comparisons between categorical variables were performed using either the Chi-square test or Fisher's exact test. P values less than or equal to 0.05 were considered statistically significant. No loss to follow-up was observed in the evaluation of comorbidities, complications, or mortality, as mortality data were later confirmed using the national healthcare database. Complications were assessed through the hospital's patient database. The study sample size was calculated using SPSS power analysis. To compare independent groups based on scoring systems, a minimum of 128 patients was required, assuming an effect size of 0.5, a Type I error rate of 0.05, and a power of 0.90, with equal distribution between groups.

RESULTS

A total of 241 patients were included in the study. The gender distribution was nearly equal, with 120 males and 121 females. The mean age was 78.12 (±8.34) years. The most common cause of trauma was falls (n=142, 58.9%), followed by motor vehicle collisions (MVCs) (n=96, 39.8%) and assault (n=3, 1.2%). The most frequent injury type was thoracic injury (n=86, 53.7%), followed by femur fractures (n=53, 22%) and lower extremity injuries (n=35, 14.5%). Subarachnoid hemorrhage occurred in 10.8% (n=26) of patients, followed by subdural hemorrhage (n=17, 7.1%) and other cranial injuries (n=8, 3.3%) (Table 1).

The majority of patients (n=106, 44%) were initially admitted to orthopedic services. This was followed by neurosurgical admissions (n=62, 25.7%) and thoracic surgical admissions (n=47, 19.5%). Fewer than half of the patients (n=102, 42.3%) required intensive care unit (ICU) admission, while the remaining patients (n=139, 57.7%) were admitted to general wards. No patients were discharged directly from the emergency department; all were admitted either to inpatient wards or the intensive care unit. Eighty-three patients (34.4%) required transfusion of blood and blood products within 24 hours of admission, 138 (57.3%) underwent surgical intervention, and 57 patients (23.7%) were intubated upon admission. Nearly all patients who required surgery were subsequently admitted to the ICU (n=132, 95.7%). Regarding the scoring systems, the average ISS, GTOS, and mFI-5 scores were 14.56 (±7.92), 120.45 (±25.79), and 2.56 (±1.12), respectively. The median length of stay was two days (range: 1-3) for ICU admissions and five days (range: 4-7) for ward admissions (Table 2).

Mortality evaluation was also conducted based on the localization of trauma. The origin of trauma did not differ be-

Table 1. Demographic characteristics and trauma evaluation

Parameter (n, %)	Total (n=241)
Sex	
Male	120 (49.8)
Female	121 (50.2)
Origin of Trauma	
Fall	142 (58.9)
Motor Vehicle Collision	96 (39.8)
Assault	3 (1.2)
Lower Extremity Injury	
None	153 (63.5)
Femur Fracture	53 (22)
Other Lower Extremity Injury	35 (14.5)
Upper Extremity Injury	
None	236 (97.9)
Present	5 (2.1)
Pelvic Fracture	
None	208 (86.3)
Present	33 (13.7)
Abdomen Injury	
None	219 (90.9)
Present	22 (9.1)
Thoracic Injury	
None	155 (64.3)
Present	86 (35.7)
Vertebral Fracture	
None	210 (87.1)
Present	31 (12.9)
Cranial Trauma	
None	184 (76.3)
Subdural Hemorrhage	25 (10.4)
Subarachnoid Hemorrhage	26 (10.8)
Other Cranial Injury	8 (3.3)
Total Cranial Injuries	57 (23.7)

Table 2. Admission status, scoring systems, and laboratory markers

Parameter (n, %)	Total (n=241)
Admission by Department	
General Surgery	16 (6.6)
Thoracic Surgery	47 (19.5)
Neurosurgery	62 (25.7)
Orthopedics	106 (44)
Anesthesia ICU	10 (4.1)
Admission Location	
Ward	139 (57.7)
ICU	102 (42.3)
Transfusion Within 24 Hours	
No	158 (65.6)
Yes	83 (34.4)
Surgical Intervention Required	
No	103 (42.7)
Yes	138 (57.3)
Intubation on Admission	
No	184 (76.3)
Yes	57 (23.7)
Postoperative ICU Admission	
No	6 (4.3)
Yes	132 (95.7)
Injury Severity Score (SD)	14.56 (7.92)
Geriatric Trauma Outcome Score (SD)	120.45 (25.79)
Modified 5-Item Frailty Index (SD)	2.56 (1.12)
White Blood Cell (x109/L, SD)	11.22 (3.55)
Hemoglobin (g/dL, SD)	12.29 (1.84)
Creatinine (mg/dL, median)	0.9 (0.71-1.00)
Lactate (mmol/L, median)	1.9 (1.4-2.70)
Base Deficit (mEq/L, median)	2 (1-3.2)
Length of Stay (days, median)	
ICU	2 (1-3)
Ward	5 (4-7)
Total	6 (5-9)

ICU: Intensive Care Unit; SD: Standard Deviation. Parameters presented as medians are accompanied by a range of the 25th to 75th percentiles.

Table 3. Complications, mortality, and scoring systems

Parameter (n, %)	Injury Severity Score		Geriatric Trauma Outcome Score		Modified 5-Item Frailty Index	
	(n, SD)	P Value	(n, SD)	P Value	(n, SD)	P Value
Complication						
None (202, 83.8)	13.81 (7.62)	0.001	117.83 (25.13)	0.001*	2.42 (1.05)	0.001
At Least One (39, 16.2)	18.46 (8.44)		134.01 (25.27)		3.28 (1.19)	
Pulmonary Embolism						
None (240, 99.6)	14.48 (7.83)	N/A	120.28 (25.73)	N/A	2.56 (1.12)	N/A
Present (1, 0.4)	35 (0)		159.5 (0)		2 (0)	
Reintubation						
No (233, 96.7)	14.28 (7.86)	0.003	119.59 (25.43)	0.005	2.52 (1.09)	0.006
Yes (8, 3.3)	22.63 (5.6)		145.5 (25.34)		3.63 (1.3)	
Extended Intubation						
No (223, 92.5)	14.15 (7.94)	0.005	119 (25.92)	0.001*	2.42 (1.01)	0.001
Yes (18, 7.5)	19.61 (5.8)		138.31 (15.94)		4.22 (1.06)	
ICU Readmission						
No (225, 93.4)	14 (7.78)	0.001	118.96 (25.51)	0.001	2.51 (1.11)	0.010
Yes (16, 6.6)	22.44 (5.61)		141.31 (20.85)		3.25 (1)	
Surgical Site Infection						
No (219, 90.9)	14.17 (7.57)	0.073	118.98 (24.77)	0.029*	2.56 (1.16)	0.963
Yes (22, 9.1)	18.41 (10.3)		135.02 (31.48)		2.55 (0.6)	
24-Hours Mortality						
Alive (232, 96.3)	14.1 (7.72)	0.001*	119.02 (25.22)	0.001*	2.53 (1.11)	0.017
Exitus (9, 3.7)	26.33 (1.12)		157.33 (3.78)		3.33 (1)	
One-Month Mortality						
Alive (198, 82.2)	12.25 (6.39)	0.001*	112.37 (20.56)	0.001*	2.38 (1.04)	0.001
Exitus (43, 17.8)	25.19 (5.21)		157.64 (9.8)		3.35 (1.13)	
Three-Month Mortality						
Alive (195, 80.9)	12.12 (6.3)	0.001	111.8 (20.17)	0.001*	2.37 (1.04)	0.001
Exitus (46, 19.1)	24.91 (5.34)		157.11 (9.86)		3.35 (1.1)	

SD: Standard Deviation; ICU: Intensive Care Unit. *Equal variances were not assumed for these comparisons.

tween survivor and non-survivor groups in terms of one-day, one-month, and three-month mortality. However, for deaths within the first 24 hours, mortality was higher among patients with cranial trauma (p=0.022). Other trauma types did not have sufficient sample sizes for analysis. One-month mortality was higher among patients with cranial trauma and abdominal injuries, and lower in those with extremity injuries (p=0.001, p=0.002, and p=0.004, respectively). At the three-month mark, mortality remained lower in patients with lower extremity, thoracic, and vertebral injuries (p=0.026, p=0.011, and p=0.013, respectively), while it was more prevalent in those with abdominal and cranial trauma (p=0.006 and p=0.001, respectively).

Scoring systems were then compared according to the presence of complications and mortality. Patients with at least one comorbidity had higher scores in all systems: ISS (13.81 vs. 18.46), GTOS (117.83 vs. 134.01), and mFI-5 (2.42 vs. 3.28) (p=0.001 for all comparisons). Similarly, patients requiring reintubation and extended intubation had elevated ISS, GTOS, and mFI-5 scores (p=0.003, p=0.005, and p=0.006 for reintubation; p=0.005, p=0.001, and p=0.001 for prolonged intubation, respectively) (Table 3).

Patients requiring ICU readmission also had higher scores: ISS (14 vs. 22.44), GTOS (118.96 vs. 141.31), and mFI-5 (2.51 vs. 3.25) (p=0.001, p=0.001, and p=0.01, respectively). Regarding surgical site infection, only GTOS (118.98 vs. 135.02;

Table 4. Area under the curve (AUC) comparison of scoring systems for mortality prediction

Scoring System	AUC	95% Confidence Interval		Standard Error	P Value
		Lower	Upper		
24-Hour Mortality					
ISS	0.891	0.849	0.933	0.021	0.001
GTOS	0.907	0.868	0.945	0.02	0.001
mFI-5	0.727	0.56	0.893	0.085	0.001
One-Month Mortality					
ISS	0.92	0.884	0.955	0.018	0.001
GTOS	0.973	0.954	0.992	0.01	0.001
mFI-5	0.727	0.646	0.809	0.042	0.001
Three-Month Mortality					
ISS	0.922	0.888	0.956	0.017	0.001
GTOS	0.975	0.958	0.993	0.009	0.001
mFI-5	0.735	0.657	0.813	0.04	0.001

Test Pair	AUC Difference	95% Confidence Interval		Standard Score	Standard Error Difference[1]	P Value
		Lower	Upper			
24-Hour Mortality						
ISS vs. GTOS	-0.016	-0.059	0.028	-0.706	0.201	0.48
ISS vs. mFI-5	0.165	-0.011	0.34	1.833	0.33	0.067
GTOS vs. mFI-5	0.18	0.003	0.357	1.997	0.328	0.046
One-Month Mortality						
ISS vs. GTOS	-0.054	-0.08	-0.028	-4.031	0.166	0.001
ISS vs. mFI-5	0.192	0.103	0.281	4.219	0.241	0.001
GTOS vs. mFI-5	0.246	0.163	0.32 9	5.807	0.224	0.001
Three-Month Mortality						
ISS vs. GTOS	-0.053	-0.079	-0.028	-0.406	0.161	0.001
ISS vs. mFI-5	0.187	0.103	0.271	4.369	0.236	0.001
GTOS vs. mFI-5	0.24	0.162	0.319	6.019	0.217	0.001

AUC: Area under the curve; ISS: Injury Severity Score; GTOS: Geriatric Trauma Outcome Score; mFI-5: Modified 5-Item Frailty Index. 1Given for evaluation under non-parametric assumptions. All comparisons were made using DeLong's test.

p=0.029) was higher in affected patients compared to other scoring systems. There was no statistically significant difference for ISS (14.17 vs. 18.41; p=0.073) or mFI-5 (2.56 vs. 2.55; p=0.963). For mortality assessment, all three scoring systems showed higher scores among patients who died within one day of admission: ISS (14.1 vs. 26.33), GTOS (119.02 vs. 157.33), and mFI-5 (2.53 vs. 3.33) (p=0.001, p=0.001, and p=0.017, respectively). Similar trends were observed for one-month mortality: ISS (12.25 vs. 25.19), GTOS (112.37 vs. 157.64), and mFI-5 (2.38 vs. 3.35), and for three-month mortality: ISS (12.12 vs. 24.91), GTOS (111.8 vs. 157.11), and mFI-5 (2.37 vs. 3.35) (p=0.001 for all comparisons) (Table 3).

All scoring systems showed a statistically significant area under the curve (AUC) in the receiver operating characteristic (ROC) analysis for all three mortality time points (Fig. 1). When comparing the scoring systems using DeLong's test for AUC evaluation, no statistically significant difference was found between ISS and GTOS, or between ISS and mFI-5. However, a slight difference favoring GTOS was observed when compared with mFI-5 (AUC difference: 0.180, confidence interval [CI]: 0.003-0.357; p=0.046). For both one-month and three-month mortality, GTOS demonstrated the highest AUC with statistically significant results in pairwise comparisons, followed by ISS and then mFI-5 (all pairwise comparisons, p=0.001). Although these results were statistically significant, a regression model could not be performed to compare the scoring systems as independent predictors due to high multicollinearity and overall low model performance (Nagelkerke R values ≤0.3) (Table 4).

A comparison of admission laboratory values with mortality

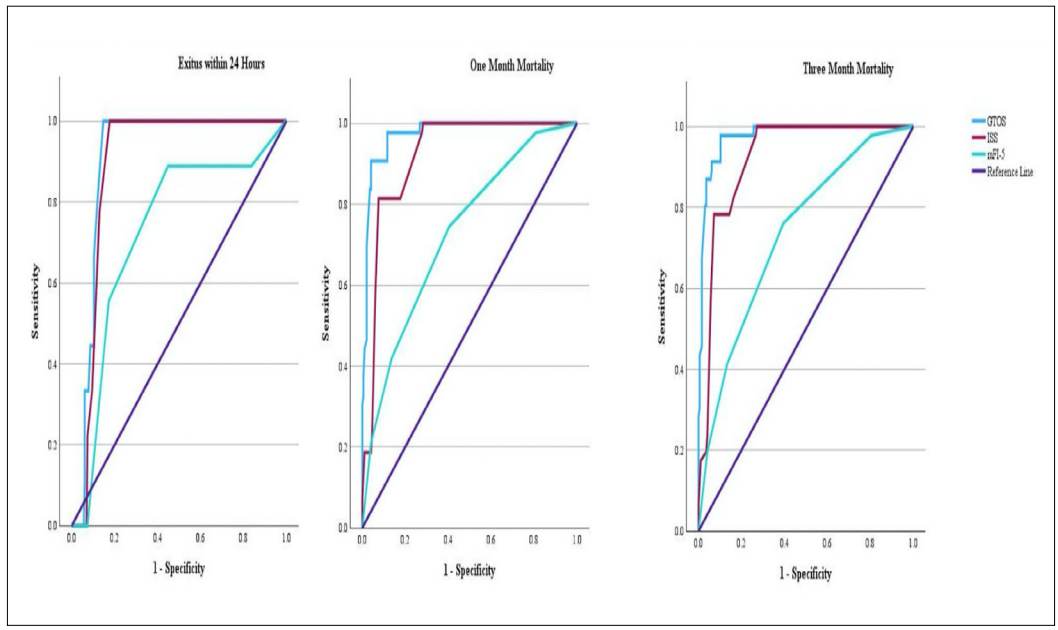

Figure 1. Area under the curve (AUC) for mortality prediction according to scoring systems.

outcomes revealed that only hemoglobin levels were lower in patients who died (12.38 g/dL vs. 9.73 g/dL). For one-month mortality, hemoglobin levels did not differ significantly between groups (12.32 g/dL vs. 12.06 g/dL). However, white blood cell (WBC) count (10.88×109/L vs 13.34×109/L), creatinine, lactate, and base deficit values were higher in the mortality group (p=0.001, p=0.034, p=0.001, and p=0.001, respectively). Three-month mortality was higher in the group with elevated lactate, base deficit, and WBC values (p=0.001, p=0.001, and p=0.016, respectively). Hemoglobin levels (12.43 g/dL vs. 11.66 g/dL; p=0.010) were also lower in the mortality group, while creatinine levels showed no statistically significant difference between groups (p=0.23) (Table 5).

A moderate correlation was observed between ISS and mFI-5 (correlation coefficient=0.447, p=0.001), and between GTOS and mFI-5 (correlation coefficient=0.57, p=0.001). All scoring systems demonstrated moderate correlations with ICU admission duration (correlation coefficients: ISS=0.468, GTOS=0.379, and mFI-5=0.318; all p=0.001). While ISS was not correlated with ward admission duration, GTOS and mFI-5 showed weak correlations with admission duration (cor-

Table 5. Comparison of admission parameters and mortality

Parameter (n, %) (x10⁹/L, SD)	White Blood Cell (g/dL, SD)		Hemoglobin (mg/dL, median)		Creatinine[2]		Lactate[2] (mmol/L, median)		Base Deficit[2] (mEq/L, median)	
	Mean±SD	P Value	Mean±SD	P Value	Mean Rank	P Value	Mean Rank	P Value	Mean Rank	P Value
C4-Hour Mortality										
Alive	11.28 (3.55)	0.180	12.38 (1.69)	0.001*	121.66	0.452	121.92	0.298	121.3	0.364
Exitus	9.66 (3.08)		9.73 (3.33)		103.94		97.28		99.89	
One-Month Mortality										
Alive	10.88 (3.44)	0.001	12.32 (1.78)	0.451	117.17	0.034	112.83	0.001	111.14	0.001
Exitus	13.24 (3.55)		12.06 (2.14)		144.32		170.76		177.24	
Three-Month Mortality										
Alive	10.95 (3.48)	0.016	12.43 (1.61)	0.0101	118.39	0.23	112.51	0.001	112.87	0.001
Exitus	12.34 (3.65)		11.66 (2.51)		132.05		157		152.66	

SD: Standard Deviation; ICU: Intensive Care Unit. 1Equal variances were not assumed for these comparisons. 2Analyses were performed using the Mann-Whitney U test due to nonparametric distribution.

relation coefficients: 0.237, p=0.001, p=0.199, and p=0.004, respectively).

DISCUSSION

Patients with higher ISS, GTOS, and mFI-5 scores had more comorbidities, required more frequent reintubations and longer intubation durations, and experienced more ICU readmissions. Surgical site infections were more common only in patients with higher GTOS scores. Among trauma localizations, cranial trauma was the most significant predictor of mortality across all time points, followed by abdominal injury for both one-month and three-month mortality. There was a moderately strong correlation between ICU admission and length of stay and all scoring systems; however, only GTOS and mFI-5 showed a weak correlation with ward admission duration. All scoring systems had higher scores in the mortality group, with statistical significance observed across comparisons. Although statistically significant differences were found in AUC values, the superiority of any single scoring system could not be confirmed due to the absence of a regression analysis.

The aging population is a driving force behind the development of new clinical algorithms for elderly patients requiring chronic and complex care.[13] Increased comorbidities, frequent polypharmacy, and altered physiological responses can mask the clinical presentation in geriatric patients. Older adults often present with non-specific complaints but have higher mortality rates.[14]

In our study, which included 241 trauma patients aged 65 years and older, the most common cause of injury was falls (58.9%), followed by motor vehicle collision (39.8%), and assault (1.2%). These findings are consistent with previous studies in the literature.[15,16] However, the proportion of admissions due to traffic accidents was higher than reported in other studies. This difference may be attributed to the inclusion criteria, as only trauma patients transported by ambulance were included, while those evaluated in outpatient settings were excluded.

Two separate studies conducted in Japan and Iran at different times reported that the most common site of injury was the extremities, which aligns with findings from other studies in the literature.[15,17] In our study, however, the most common injury site was the thorax (53.7%), followed by femur fractures (22%) and other lower extremity injuries (14.5%). We believe this difference is due to the fact that the majority of patients included in our study presented with multiple trauma, often involving thoracic injuries accompanied by damage to other organs. This findings supports previous research showing that pulmonary contusion, rib fractures, and resulting complications (such as atelectasis and pneumonia) occur at higher rates in the elderly compared to younger adults, largely due to a more fragile chest wall and pre-existing lung disease associated with aging.[18]

It has been shown that base excess and lactate levels can serve as early markers for mortality prediction in geriatric trauma patients.[19] In our study, we found that only low hemoglobin levels were significantly associated with mortality within the first 24 hours. In contrast, elevated blood lactate, WBC levels, and base deficit were more predictive of one-month and three-month mortality. Creatinine levels were only significantly associated with one-month mortality and showed no difference in early or long-term mortality evaluations. The significance of low hemoglobin levels within the first 24 hours may be related to the patients' susceptibility to hemorrhagic shock following trauma. These findings suggest that blood gas analysis can serve as a rapidly assessable marker for mortality prediction.

Ahl et al. demonstrated that GTOS was effective in predicting 24-hour mortality in geriatric trauma patients.[20] In contrast, a study by Tejiram et al. found no significant difference in mortality between frail and non-frail groups.[21] Our study incorporated parameters from both studies and compared their effects on mortality in geriatric trauma patients. We found no statistically significant difference between ISS, GTOS, and mFI-5 in predicting mortality. However, all three scoring systems were elevated in all cases classified as Grade 4 according to the Clavien-Dindo Classification System. GTOS was the only score that was significantly higher among patients diagnosed with surgical site infections.

The main limitations of this study are its single-center design and retrospective nature. Additionally, patients who presented as outpatients or who did not have multiple organ injuries were excluded to maintain transparency of the study. Although a statistically significant difference was observed in the DeLong analysis, a definitive conclusion regarding the superiority of one scoring system over another could not be made due to the absence of a regression analysis, which was another limitation of the study. Despite the sample size being considered adequate for statistical analysis, this limitation persisted, primarily due to the inherent collinearity among the scoring systems, as many of their parameters are similar.

CONCLUSION

With the growing elderly population, there is a need for effective scoring systems that can be applied from the triage stage to help identify risk factors for complications following treatment in emergency departments. The mFI-5 scoring system, which can be easily calculated from anamnesis alone, produced results comparable to those of more complex trauma scoring systems in predicting mortality and morbidity, making it a valuable tool for prognostic assessment in emergency departments.

Ethics Committee Approval: This study was approved by the Ankara Etlik City Hosital Ethics Committee (Date: 12.06.2024, Decision No: AEŞH-BADEK-2024-533).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: A.Y.; Design: A.Y.; Supervision: A.Y.; Resource: A.Y.; Materials: A.Y.; Data collection and/or processing: A.Y.; Analysis and/or interpretation:

A.Y., A.E.K.; Literature review: A.Y., A.E.K.; Writing: A.Y., A.E.K.; Critical review: A.Y., A.E.K.

Conflict of Interest: None declared.

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REFERENCES

1. Murphy SL, Kochanek KD, Xu J, Arias E. Mortality in the United States, 2023. NCHS Data Brief 2024;521:CS356116. [CrossRef]
2. Panossian VS, Lagazzi E, Rafaqat W, Abiad M, Nzenwa IC, Arnold S, et al. Outcomes of severe isolated blunt chest trauma in young and geriatric patients. Eur J Trauma Emerg Surg 2024;50:2471-80. [CrossRef]
3. Elliott A, Taub N, Banerjee J, Aijaz F, Jones W, Teece L, et al. Does the clinical frailty scale at triage predict outcomes from emergency care for older people? Ann Emerg Med 2021;77:620-7. [CrossRef]
4. Maxwell, C. A., Mion, L. C., Mukherjee, K., Dietrich, M. S., Minnick, A. F., May, A. K., et al. Development of a geriatric trauma outcome score. Journal of Trauma and Acute Care Surgery, 2012; 72(6), 1649–1655.
5. Bergeron E, Lavoie A, Clas D, Moore L, Ratte S, Tetreault S, et al. Elderly trauma patients with rib fractures are at greater risk of death and pneumonia. J Trauma 2003;54:478-85. [CrossRef]
6. Hashmi, A., Ibrahim-Zada, I., Rhee, P., Nathens, A. B., Haut, E. R., O'Keeffe, T., et al. Predictors of mortality in geriatric trauma patients: A retrospective analysis of 9,539 patients. J Trauma Acute Care Surg, 2014; 76(4), 1184–1188.
7. Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G. Untangling the concepts of disability, frailty, and comorbidity: Implications for improved targeting and care. J Gerontol A Biol Sci Med Sci 2004;59:255-63. [CrossRef]
8. Subramaniam S, Aalberg JJ, Soriano RP, Divino CM. New 5-factor modified frailty index using American College of Surgeons NSQIP Data. J Am Coll Surg 2018;226:173-81.e8. [CrossRef]
9. Cooper Z, Rogers SO Jr, Ngo L, Guess J, Schmitt E, Jones RN, et al. Comparison of frailty measures as predictors of outcomes after orthopedic surgery. J Am Geriatr Soc 2016;64:2464–71. [CrossRef]
10. Reynolds P, Scattoloni JA, Gadepalli SK, Ehrlich P, Cladis FP, Davis PJ. Anesthesia for the pediatric trauma patient. In: Davis PJ, Cladis FP, Motoyama EK, editors. Smith's Anesthesia for Infants and Children. Philadelphia: Elsevier; 2017. p. 969–99. [CrossRef]
11. Zhao FZ, Wolf SE, Nakonezny PA, Minhajuddin A, Rhodes RL, Paulk ME, et al. Estimating geriatric mortality after injury using age, injury severity, and performance of a transfusion: The Geriatric Trauma Outcome Score. J Palliat Med 2015;18:677-81. [CrossRef]
12. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205-13. [CrossRef]
13. Blomaard LC, Speksnijder C, Lucke JA, de Gelder J, Anten S, Schuit SCE, et al. Geriatric screening, triage urgency, and 30-day mortality in older emergency department patients. J Am Geriatr Soc 2020;68:1755-62. [CrossRef]
14. Bullard MJ, Melady D, Emond M, Musgrave E, Unger B, van der Linde E, et al. Guidance when applying the Canadian Triage and Acuity Scale (CTAS) to the geriatric patient: Executive summary. CJEM 2017;19:S28-37. Erratum in: CJEM 2017;19:415. [CrossRef]
15. Miyoshi Y, Kondo Y, Hirano Y, Ishihara T, Sueyoshi K, Okamoto K, et al. Characteristics, injuries, and clinical outcomes of geriatric trauma patients in Japan: An analysis of the nationwide trauma registry database. Sci Rep 2020;10:19148. [CrossRef]
16. Söz G, Karakaya Z. The evaluation of geriatric patients who presented with trauma to the emergency department. Arch Med Sci 2019;15:1261-8. [CrossRef]
17. Yousefzadeh-Chabok S, Hosseinpour M, Kouchakinejad-Eramsadati L, Ranjbar F, Malekpouri R, Razzaghi A, et al. Comparison of revised trauma score, injury severity score and trauma and injury severity score for mortality prediction in elderly trauma patients. Ulus Travma Acil Cerrahi Derg 2016;22:536-40. [CrossRef]
18. Joyce MF, Gupta A, Azocar RJ. Acute trauma and multiple injuries in the elderly population. Curr Opin Anaesthesiol 2015;28:145-50. [CrossRef]
19. Siegel JH, Rivkind AI, Dalal S, Goodarzi S. Early physiologic predictors of injury severity and death in blunt multiple trauma. Arch Surg 1990;125:498-508. [CrossRef]
20. Ahl R, Phelan HA, Dogan S, Cao Y, Cook AC, Mohseni S. Predicting in-hospital and 1-year mortality in geriatric trauma patients using geriatric trauma outcome score. J Am Coll Surg 2017;224:264-9. [CrossRef]
21. Tejiram S, Cartwright J, Taylor SL, Hatcher VH, Galet C, Skeete DA, et al. A Prospective comparison of frailty scores and fall prediction in acutely injured older adults. J Surg Res 2021;257:326-32. [CrossRef]

ORİJİNAL ÇALIŞMA - *ÖZ*

Geriatrik travma hastalarında mortalite tahmini

AMAÇ: Modifiye 5 faktörlü kırılganlık indeksinin (mFI-5) geriatrik hastalarda tedavi sonrası gelişebilecek komplikasyonları öngörmede kullanılabileceği gösterilmiştir. Ancak çoklu travmalarda mFI-5'i diğer travma skorlama sistemleri ile karşılaştıran yeterli çalışma bulunmamaktadır. Bu çalışmanın amacı, geriatrik travma hastalarında mFI-5, yaralanma şiddeti skoru (ISS) ve geriatrik travma sonuç skorunun (GTO) mortalite ile ilişkisini belirlemektir.

GEREÇ VE YÖNTEM: Bu retrospektif gözlemsel çalışmada, üçüncü basamak bir hastanenin acil travma alanına başvuran 65 yaş ve üzeri hastalar değerlendirildi. Laboratuvar parametreleri, görüntüleme sonuçları, kan replasmanı, hastanede yatış durumu, yoğun bakım takibi, ameliyat durumu, ISS, GTOS, mFI-5 skorları ve mortalite sonuçları kaydedildi.

BULGULAR: Çalışmaya toplam 241 hasta dahil edildi. Ortalama yaş 78.12 (±8.34) yıldı. Travma kaynağı çoğunlukla düşmeye bağlıydı (n=142, %58.9). En sık torasik yaralanma gözlendi (n=86, %53.7). Kabulden sonraki ilk 24 saat içindeki mortalite için ISS (14.1 ila 26.33), GTOS (119.02 ila 157.33) ve mFI-5 (2.53 ila 3.33) skorları anlamlı derecede yüksekti (p değeri sırasıyla, 0.001, 0.001 ve 0.017). Benzer sonuçlar bir aylık ve üç aylık mortalite için de gözlendi (tüm analizler için p değeri 0.001'di).

SONUÇ: Skorlama sistemleri erken mortalite tahmini için hayati öneme sahiptir. ISS, GTOS ve mFI-5 skorlamaları, geriatrik travma hastalarında komorbiditeleri, yoğun bakım ünitesine yatışı ve mortalite oranını tahmin etmede benzer sonuçlar göstermiştir. ISS puanlaması karmaşık bir formülasyonla hesaplanır. Aynı şekilde, GTOS özellikle geriatrik hastalar için tasarlanmıştır ancak ISS üzerinde yeni ek hesaplamalar gerektirir. mFI-5, hesaplanması kolay olduğu için acil servislerde kullanımı faydalı olabilir.

Anahtar sözcükler: Acil; kırılganlık; mortalite geriatri; travma skoru.

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Supplementary Table 1. Correlation between admission durations and scoring systems

Parameter	Injury Severity Score	Geriatric Trauma Outcome Score	Modified 5-Item Frailty Index	ICU Admission Duration	Ward Admission Duration
Injury Severity Score					
CC		0.852	0.447	0.468	0.042
P-Value		0.001	0.001	0.001	0.543
N		241	241	186	212
Geriatric Trauma Outcome Score					
CC	0.852		0.57	0.379	0.237
P-Value	0.001		0.001	0.001	0.001
N	241		241	186	212
Modified 5-Item Frailty Index					
CC	0.447	0.57		0.318	0.199
P-Value	0.001	0.001		0.001	0.004
N	241	241		186	212
ICU Admission Duration					
CC	0.468	0.379	0.318		-0.055
P-Value	0.001	0.001	0.001		0.495
N	186	186	186		157
Ward Admission Duration					
CC	0.042	0.237	0.199	-0.055	
P-Value	0.543	0.001	0.004	0.495	
N	212	212	212	157	

CC: Correlation Coefficient; ICU: Intensive Care Unit. Spearman correlation was used for all analyses.

Supplementary Table 2. Comparison of mortality and trauma localization

Parameter (n, %)	24-Hour Mortality		One-Month Mortality		Three-Month Mortality	
	Alive (232, 96.3)	Exitus (9, 3.7)	Alive (198, 82.2)	Exitus (43, 17.8)	Alive (195, 80.9)	Exitus (46, 19.1)
Origin of Trauma						
Fall	136 (58.6)	6 (66.7)	126 (60.9)	16 (47.1)	118 (60.5)	24 (52.2)
MVC	93 (40.1)	3 (33.3)	80 (38.6)	16 (47.1)	76 (39)	20 (43.5)
Assault	3 (1.3)	0 (0)	1 (0.5)	2 (5.9)	1 (0.5)	2 (4.3)
P-Value	N/A	0.231	0.443			
Lower Extremity Injury						
None	147 (63.4)	6 (66.7)	124 (59.9)	29 (85.3)	117 (60)	36 (78.3)
Present	85 (36.6)	3 (33.3)	83 (40.1)	5 (14.7)	78 (40)	10 (21.7)
P-Value	0.571	0.0041	0.0261			
Upper Extremity Injury						
None	227 (97.8)	9 (100)	202 (97.6)	34 (100)	190 (97.4)	46 (100)
Present	5 (2.2)	0 (0)	5 (2.4)	0 (0)	5 (2.6)	0 (0)
P-Value	N/A	N/A	N/A			
Pelvic Fracture						
None	199 (85.8)	9 (100)	178 (86)	30 (88.2)	166 (85.1)	42 (91.3)
Present	33 (14.2)	0 (0)	29 (14)	4 (11.8)	29 (14.9)	4 (8.7)
P-Value	N/A	0.4861	0.3461			
Abdominal Injury						
None	211 (90.9)	8 (88.9)	193 (93.2)	26 (76.5)	182 (93.3)	37 (80.4)
Present	21 (9.1)	1 (11.1)	14 (6.8)	8 (23.5)	13 (6.7)	9 (19.6)
P-Value	0.5841	0.002	0.006			
Thoracic Injury						
None	146 (62.9)	9 (100)	130 (62.8)	25 (73.5)	118 (60.5)	37 (80.4)
Present	86 (37.1)	0 (0)	77 (37.2)	9 (26.5)	77 (39.5)	9 (19.6)
P-Value	N/A	0.252	0.0111			
Vertebral Fracture						
None	201 (86.6)	9 (100)	177 (85.5)	33 (97.1)	165 (84.6)	45 (97.8)
Present	31 (13.4)	0 (0)	30 (14.5)	1 (2.9)	30 (15.4)	1 (2.2)
P-Value	N/A	0.093	0.0131			
Cranial Trauma						
None	180 (77.6)	4 (44.4)	167 (80.7)	17 (50)	161 (82.6)	23 (50)
Present	52 (22.4)	5 (55.6)	40 (19.3)	17 (50)	34 (17.4)	23 (50)
P-Value	0.022	0.001	0.001			

MVC: Motor Vehicle Collision. Assault was not included in the analysis, as only fall and motor vehicle collision (MVC) cases were compared. 1Fisher's Exact T test was used for the comparison of parameters.