

Analysis of Frailty Trajectories and Clinical Characteristics in Middle-Aged and Elderly Patients with Upper Gastrointestinal Bleeding

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Abstract

Frailty is a significant prognostic indicator for patients with upper gastrointestinal bleeding, yet the burden of frailty experienced varies among individuals, and the clinical characteristics of persistent frailty remain unclear. This prospective cohort study aimed to describe the changes in frailty among middle-aged and elderly patients with upper gastrointestinal bleeding over six months post-bleeding and to identify the clinical features of high-risk trajectory groups. We enrolled 319 hospitalized patients aged ≥ 50 years with upper gastrointestinal bleeding. Frailty levels were assessed using the Frailty Assessment Scale at admission (T1), 3 months (T2), and 6 months (T3). Group-based trajectory modeling was employed to identify distinct frailty trajectories, and multinomial logistic regression was used to explore the clinical characteristics associated with different trajectory categories. Our study identified four distinct trajectory subgroups of frailty: Trajectory 1 "Moderate-level group" with 76 cases (24.83%), Trajectory 2 "High-level group" with 99 cases (32.35%), Trajectory 3 "Low-level group" with 54 cases (18.30%), and Trajectory 4 "Very low-level group" with 77 cases (24.50%). Younger age, emergency admission, admission by walking with assistance/wheelchair/stretchers, complete dependence in self-care, gastric bleeding or cirrhosis as hemorrhage causes, higher NRS2002 scores, and higher BADL scores were clinical characteristics of Trajectory 2 group. Self-reported fatigue at admission was the clinical feature of Trajectory 3 group. Patients with intermediate-to-high risk AIMS65 scores were more likely to exhibit clinical characteristics of Trajectory 1 and Trajectory 4 groups. The burden of frailty experienced by middle-aged and elderly patients with upper gastrointestinal bleeding changes over time and follows distinct dynamic trajectories influenced by multiple factors. In future clinical practice, identifying and intervening in high-risk groups should be prioritized.

Introduction

Upper gastrointestinal bleeding (UGIB) is one of the most common gastrointestinal emergencies. Despite remarkable advancements in endoscopic treatments and substantial efforts in reducing mortality, the overall in-hospital mortality rate associated with UGIB is still estimated to be 10%^[1]. Frailty is an age-related medical syndrome with multiple causes and multifactorial origins, characterized by diminished strength, endurance, and physiological function, which increases an individual's risk of dependency and/or mortality^[2, 3]. UGIB patients typically present with melena and hematemesis, symptoms that often lead to decreased hemoglobin levels and even hemodynamic instability^[4, 5]. Secondly, UGIB patients are typically allowed only minimal food intake after bleeding cessation or when a physician assesses reduced bleeding risk. They are required to fast for at least 48 to 72 hours, with those needing endoscopic examination or treatment often subjected to even longer fasting periods, significantly increasing their risk of malnutrition^[6]. Additionally, UGIB caused by conditions such as cirrhotic esophagogastric varices or gastric ulcers often recurs, leading to prolonged nutritional deficiencies post-discharge due to patients' fear of rebleeding or lack of dietary guidance^[7, 8]. These factors make UGIB patients a high-risk group for frailty. A large retrospective cohort study reported that the prevalence of frailty among UGIB patients is as high as 45.69%^[9].

The potential harm of frailty in UGIB patients is not limited to the hospitalization period. Studies have shown that frailty has been proven to be an independent predictor of all-cause hospitalization and 30-day mortality in UGIB patients^[10]. Risk scores are often used to predict adverse outcomes in UGIB, particularly mortality, which typically plays a decisive role in subsequent patient treatment and management strategies^[11]. According to research from the United States, Europe, and Asia, UGIB patients exhibit excessively high long-term mortality rates, with 30-day mortality ranging between 5% and 12%. The elevated risk of death likely stems from multiple comorbidities involving the cardiovascular, cerebrovascular, and respiratory systems, rather than from recurrent peptic ulcer bleeding^[12]. Therefore, frailty plays a significant role in the long-term prognosis of this population. Meanwhile, frailty is a dynamic process, and studying its developmental trends and long-term patterns is crucial for early identification of modifiable risk factors and the formulation of effective prevention strategies^[13].

However, the long-term changes in frailty among UGIB patients remain unclear, which limits our understanding of its developmental trajectory. Group-based trajectory modeling (GBTM) is a trajectory analysis method capable of capturing individual variations and identifying distinct subgroups with different trajectories over time within a population^[14]. This approach facilitates the exploration of health status heterogeneity, aids in identifying vulnerable populations requiring targeted medical care, and clarifies trajectories leading to optimal health outcomes, thereby contributing to our understanding of health status development^[15]. Therefore, this study employs GBTM to investigate the trajectories of frailty and clinical characteristics in UGIB patients. The findings will assist clinicians in early identification of high-risk populations, determining optimal intervention timing, and providing insights for developing localized, dynamic, and personalized intervention strategies.

Methods

2.1 Study design and participants

This prospective observational study was conducted at Deyang People's Hospital, where we enrolled patients with upper gastrointestinal bleeding who visited the hospital between April 2025 and November 2026 as study subjects. The inclusion criteria for participants included:

(1) individuals aged 50 and above; (2) The main symptoms were hematemesis, melena or hematochezia, with clinical and endoscopic diagnosis of upper gastrointestinal hemorrhage; (3) The diagnostic criteria were in accordance with the Expert Consensus on the Emergency Diagnosis and Treatment Process for Acute Upper Gastrointestinal Bleeding in China^[16]; (4) voluntary participation. The exclusion criteria included: (1) concurrent other cancers; (2) other serious diseases or complications; (3) cognitive impairment; (4) Loss to follow-up or death during follow-up.

We collected baseline data on frailty and clinical characteristics from patients 1-2 days after admission (T1), and assessed their frailty status at 3 months (T2) and 6 months (T3) respectively.

Our study was approved by the Ethics Committee of Deyang People's Hospital, with the ethical approval number 2025-04-034-K01. All patients agreed to participate in this study and signed the informed consent form. All methods in the present study were performed in accordance with the relevant guidelines and regulations of the Declaration of Helsinki.

2.2 Measures

2.2.1 General socio-demographic information

According to relevant research^[17-19], we made the general socio-demographic questionnaire, which included patients' socio-demographic information (age, gender, place of residence, education level, marital status, occupation type, types of medical insurance, professional, admission route, admission method, smoking, drinking and body mass index), clinical information (the score of nutritional risk screening 2002 and Barthel index for clinical formation system, self-reported symptoms upon admission, including syncope, fall, dizziness and fatigue, initial symptoms, time of onset, treatment methods, history of blood transfusion during hospitalization, presence of *Helicobacter pylori* infection, liver cirrhosis and viral hepatitis, cause of bleeding) and Laboratory test indicators (hemoglobin, red blood cell count, platelet count, albumin level).

2.2.2 Frailty

A Chinese version of the Frailty Screening Scale, shown to be moderately to substantially reliable in Chinese populations, was used to evaluate the degree of frailty^[20]. Participants were asked about the feeling fatigued most or all of the time over the past four weeks, difficulty climbing one flight of stairs without using any assistive devices or help from others and without resting midway, difficulty walking 100 meters without using any assistive devices or help from others, presence of five or more concurrent diseases and a weight loss of 5% or more within one year or less. The above items are scored as 1 point for "Yes" and 0 points for "No", with a total score of 5 points, a score of ≥ 5 indicates frailty.

2.2.3 Activities of Daily Living

The limitations of activities of daily living (ADL) were measured in terms of basic activities of daily living (BADL) and instrumental activities of daily living (IADL), which are based on the Katz Index of Independence in ADL and the Lawton IADL Scale^[21]. BADL includes eating, dressing, bathing, transferring from a chair to a bed using the toilet, and defecating. IADL includes doing housework, cooking, making phone calls, shopping, taking medicine, and managing finances. All items have four options: "do it without difficulty," "do it but with difficulty," "do it with difficulty and need help," and "cannot do it". This scale displayed a great internal consistency in BADL/IADL from the 2018 CHARLS sample, with Cronbach's α of 0.703 and 0.772, respectively. Validity analysis showed that the KMO values were 0.889 and 0.796 in BADL and IADL, respectively with great validity^[22, 23].

2.2.4 Evaluation of Upper Gastrointestinal Bleeding Condition

Glasgow-Blatchford Rating system (GBS) and AIMS65 were used to assess the need for clinical intervention in patients with gastrointestinal bleeding and the risk of rebleeding and mortality^[24]. The aim of GBS was to identify a patient's need for an intervention including eight clinical or laboratory variables: blood urea nitrogen; hemoglobin (adapted for sex); SBP; heart rate; presentation with melena; presentation with syncope; presence of a hepatic disease and cardiac disease^[25]. The minimum value of the score is 0 and the maximum is 23. According to the European Society of Gastrointestinal Endoscopy, patients with a GBS score of 0–1 are considered to be at very low risk and do not require early endoscopy or hospital admission. The AIMS65 includes five clinical or laboratory variables: age at presentation; albumin, international normalized ratio (INR); alteration in mental status and SBP. This score has a narrow score spectrum (minimum value: 0 and maximum: 5)^[26].

Statistical analysis

For the baseline description, we presented continuous variables with normally distributed as the mean $\pm$ standard deviation (SD), while categorical variables using counts and percentages (%). For multivariate analysis, binary logistic regression was used with the potential class as the dependent variable, and the variables with statistical significance in the univariate analysis were used as covariates to further analyze the influencing factors. A p-value of <0.05 was considered statistically significant.

Statistical analyses were performed using R(version 2025.09.2). We used group-based trajectory modeling (GBTM), a semiparametric analytic technique that identifies individuals with similar patterns of change over time^[27]. We conducted all statistical analyses using R 4.4.0 software. We identified the frailty trajectory during 6 months by Group-Based Trajectory Model (GBTM)^[28]. The Akaike Information Criterion (AIC), adjusted Akaike Information Criterion (aAIC) and Bayesian Information Criterion (BIC) were adopted to assess the model fit^[29, 30]. Lower AIC and BIC values, higher entropy indicate a better fit and classification accuracy^[30]. Model adequacy was evaluated using three criteria. First, the average posterior probability of group membership, with a minimum threshold of 70 % for each group^[31]. Second, we assessed the percentage of the total sample assigned to each trajectory, applying a minimum threshold of 5 % to ensure interpretability given our sample size. Third, we calculated the odds of correct classification, with values greater than 5 considered indicative of strong assignment accuracy^[31]. To identify baseline characteristics associated with trajectory membership, we first conducted univariate comparisons across trajectory groups. We then performed a multinomial logistic regression to examine the adjusted association of each characteristic with trajectory membership. The reference group in the model was set to the trajectory with the group with the heaviest frailty burden.

Results

4.1 Patients characteristics

total of 319 participants were enrolled in the baseline survey. During the 6-month follow-up period, 3 participants were lost to follow-up at T2 (3 months later), 3 participants were lost to follow-up at T3 (6 months later), and 4 participants refused to participate in subsequent surveys. In total, 309 participants completed the entire follow-up, resulting in a loss-to-follow-up rate of 3.1%.

Table 1 presents the demographic and disease characteristics of the participants. The median age was 67.02 years (IQR 59 to 74.5), with males accounting for 64.1%. Clinically diagnosed cases of cirrhosis with esophagogastric variceal bleeding constituted 33.7%, and 85.4% of participants were classified as high-risk group according to the GBS score.

Variables	Total(n=306)	class1(n=76)	class2(n=99)	class3(n=54)	class4(n=77)	P
Age(year)	66.98 (10.26)	68.34 (10.10)	71.80 (9.97)	63.04 (7.80)	62.17 (9.26)	<0.001
Gender						0.271
male	110 (35.9)	33 (43.4)	36 (36.4)	20 (35.7)	21 (28.0)	
female	196 (64.1)	43 (56.6)	63 (63.6)	36 (64.3)	54 (72.0)	
Smoking						0.200
Yes	138 (45.1)	27 (35.5)	49 (49.5)	24 (42.9)	38 (50.7)	
No	168 (54.9)	49 (64.5)	50 (50.5)	32 (57.1)	37 (49.3)	
Drinking						0.613
Yes	145 (47.4)	32 (42.1)	51 (51.5)	25 (44.6)	37 (49.3)	
No	161 (52.6)	44 (57.9)	48 (48.5)	31 (55.4)	38 (50.7)	
Admission route						0.001
Outpatient	59 (19.3)	8 (10.5)	11 (11.1)	12 (21.4)	28 (37.3)	
Emergency	247 (80.7)	68 (89.5)	88 (88.9)	44 (78.6)	47 (62.7)	
Admission method						0.001
Walking	66 (21.6)	6 (7.9)	10 (10.1)	11 (19.6)	39 (52.0)	
assisted walking	20 (6.5)	4 (5.3)	8 (8.1)	5 (8.9)	3 (4.0)	
wheelchair	11 (3.6)	4 (5.3)	5 (5.1)	1 (1.8)	1 (1.3)	
stretcher	209 (68.3)	62 (81.6)	76 (76.8)	39 (69.6)	32 (42.7)	
Body mass index (Kg/m2)						0.220
18.5~23.9	175 (57.2)	47 (61.8)	51 (51.5)	36 (64.3)	41 (54.7)	
<18.5	25 (8.2)	7 (9.2)	11 (11.1)	0 (0.0)	7 (9.3)	
≥24	106 (34.6)	22 (28.9)	37 (37.4)	20 (35.7)	27 (36.0)	
Self-care ability						0.002
Completely independent	14 (4.6)	3 (3.9)	1 (1.0)	3 (5.4)	7 (9.3)	
requires partial assistance	126 (41.2)	25 (32.9)	38 (38.4)	23 (41.1)	40 (53.3)	
requires substantial assistance	124 (40.5)	37 (48.7)	39 (39.4)	28 (50.0)	20 (26.7)	
completely dependent	42 (13.7)	11 (14.5)	21 (21.2)	2 (3.6)	8 (10.7)	
Syncope						0.436
Yes	30 (9.8)	10 (13.2)	10 (10.1)	6 (10.7)	4 (5.3)	
No	276 (90.2)	66 (86.8)	89 (89.9)	50 (89.3)	71 (94.7)	
Fatigue						0.024
Yes	240 (78.4)	62 (81.6)	79 (79.8)	49 (87.5)	50 (66.7)	
No	66 (21.6)	14 (18.4)	20 (20.2)	7 (12.5)	25 (33.3)	
Dizziness						0.025
Yes	237 (77.5)	62 (81.6)	78 (78.8)	48 (85.7)	49 (65.3)	
No	69 (22.5)	14 (18.4)	21 (21.2)	8 (14.3)	26 (34.7)	
Fall						0.408
Yes	27 (8.8)	8 (10.5)	10 (10.1)	6 (10.7)	3 (4.0)	

No	279 (91.2)	68 (89.5)	89 (89.9)	50 (89.3)	72 (96.0)	
Initial symptoms						0.056
hematemesis	186 (60.8)	38 (50.0)	56 (56.6)	41 (73.2)	51 (68.0)	
melena	44 (14.4)	17 (22.4)	16 (16.2)	5 (8.9)	6 (8.0)	
hematemesis and melena	76 (24.8)	21 (27.6)	27 (27.3)	10 (17.9)	18 (24.0)	
Treatment methods						0.134
drug hemostasis	236 (77.1)	58 (76.3)	71 (71.7)	46 (82.1)	61 (81.3)	
drug hemostasis and endoscopic hemostasis	66 (21.6)	18 (23.7)	26 (26.3)	10 (17.9)	12 (16.0)	
drug hemostasis and interventional hemostasis	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.7)	
surgeries	2 (0.7)	0 (0.0)	2 (2.0)	0 (0.0)	0 (0.0)	
Charlson Comorbidity Index, CCI						0.001
None	2 (0.7)	0 (0.0)	1 (1.0)	1 (1.8)	0 (0.0)	
mild (1~2 points)	158 (51.6)	24 (31.6)	44 (44.4)	37 (66.1)	53 (70.7)	
moderate (3~4 points)	106 (34.6)	37 (48.7)	41 (41.4)	12 (21.4)	16 (21.3)	
severe ≥5 points	40 (13.1)	15 (19.7)	13 (13.1)	6 (10.7)	6 (8.0)	
AIMS65						0.001
Low-risk group	169 (55.2)	26 (34.2)	41 (41.4)	41 (73.2)	61 (81.3)	
Mild and high-risk group	37 (44.8)	50 (65.8)	58 (58.6)	15 (26.8)	14 (18.7)	
Causes of bleeding						0.032
compound ulcer	16 (5.2)	4 (5.3)	3 (3.0)	5 (8.9)	4 (5.3)	
ariceal upper gastrointestinal bleeding	102 (33.3)	35 (46.1)	37 (37.4)	16 (28.6)	14 (18.7)	
gastric ulcer	76 (24.8)	10 (13.2)	30 (30.3)	14 (25.0)	22 (29.3)	
duodenal bulb ulcer	34 (11.1)	9 (11.8)	6 (6.1)	7 (12.5)	12 (16.0)	
duodenal descending part ulcer	7 (2.3)	2 (2.6)	1 (1.0)	2 (3.6)	2 (2.7)	
acute gastric mucosal lesion	16 (5.2)	1 (1.3)	2 (2.0)	5 (8.9)	8 (10.7)	
mallory-weiss syndrome	3 (1.0)	0 (0.0)	1 (1.0)	1 (1.8)	1 (1.3)	
acute upper gastrointestinal bleeding	48 (15.7)	13 (17.1)	17 (17.2)	6 (10.7)	12 (16.0)	
other types	4 (1.3)	2 (2.6)	2 (2.0)	0 (0.0)	0 (0.0)	
Glasgow-Blatchford Rating system Ⅱ GBS						0.649
Low-risk group	45 (14.7)	8 (10.5)	16 (16.2)	8 (14.3)	13 (17.3)	
high-risk group	261 (85.3)	68 (89.5)	83 (83.8)	48 (85.7)	62 (82.7)	
AlbuminⅡALBⅡg/LⅡ						0.526
≤30	50 (16.3)	14 (18.4)	19 (19.2)	6 (10.7)	11 (14.7)	
Ⅱ30	256 (83.7)	62 (81.6)	80 (80.8)	50 (89.3)	64 (85.3)	
History of blood transfusion						0.001
Yes	156 (51.0)	46 (60.5)	62 (62.6)	23 (41.1)	25 (33.3)	
No	150 (49.0)	30 (39.5)	37 (37.4)	33 (58.9)	50 (66.7)	
viral hepatitis						0.269

Yes	59 (19.3)	18 (23.7)	13 (13.1)	13 (23.2)	15 (20.0)	
No	247 (80.7)	58 (76.3)	86 (86.9)	43 (76.8)	60 (80.0)	
Liver cirrhosis						0.001
Yes	118 (38.6)	40 (52.6)	45 (45.5)	17 (30.4)	16 (21.3)	
No	188 (61.4)	36 (47.4)	54 (54.5)	39 (69.6)	59 (78.7)	
Helicobacter pylori infection						0.067
Yes	36 (11.8)	4 (5.3)	10 (10.1)	8 (14.3)	14 (18.7)	
No/Not detected	270 (88.2)	72 (94.7)	89 (89.9)	48 (85.7)	61 (81.3)	
Nutritional Risk Screening 2002 NRS2002	0.93 (0.85)	0.97 (0.82)	1.29 (0.77)	0.59 (0.68)	0.65 (0.92)	<0.001
HospitalStay (day)	9.07 (4.01)	9.71 (4.06)	9.74 (3.76)	7.32 (2.60)	8.85 (4.73)	0.001
Hb α g/L α	83.17 (29.19)	80.92 (27.11)	79.83(29.96)	82.25 (26.85)	90.56 (31.08)	0.085
PLT(109/L)	159.21 (94.38)	138.97 (90.73)	155.04(85.09)	172.64(97.64)	175.20(104.20)	0.072
RBC(109/L)	2.99 (1.57)	3.11 (2.67)	2.84 (0.93)	2.91 (0.91)	3.14 (1.07)	0.536
IADL	15.00 (6.29)	17.41 (4.59)	17.48 (4.71)	14.09 (4.87)	9.95 (7.34)	<0.001
BADL	10.59 (4.83)	12.33 (3.58)	12.19 (3.94)	11.00 (4.24)	6.40 (4.97)	<0.001

4.2 Prevalence of frailty

Our study found that the incidence of frailty showed a declining trend during the follow-up period, with the highest rate observed at baseline (80.6%). Among the three dimensions of frailty - physical function, psychological function, and social function - the burden of physical frailty was the most severe, and its peak severity occurred at baseline.

Table2. The prevalence and severity of frailty

Demension	Baseline	3 months	6 months
Physical function	5.45 $\pm$ 1.80	3.99 $\pm$ 1.11	2.01 $\pm$ 0.87
Psychological function	2.09 $\pm$ 1.19	2.21 $\pm$ 1.07	1.98 $\pm$ 0.44
Social function	0.26 $\pm$ 0.52	0.31 $\pm$ 0.52	0.26 $\pm$ 0.52
Total frailty level	7.24 $\pm$ 2.84	5.28 $\pm$ 2.76	3.66 $\pm$ 2.27
prevalence, n(%)	249(80.6)	191(61.6)	114(36.9)

4.3 Trajectory of frailty

Table 3 reports the fit indices of Five models of trajectories of frailty. The 4-group model had the lowest BIC and aAIC when compared with other models. Additionally, the AvePP values were all exceeding 0.80, the proportion of each group was more than 5%, making it the best fit model.

Table3.AvePP of group assignment and statistics of model fit

class	AIC	BIC	CAIC	SSBIC	HQIC	Proportion(%)	AvePP(%)
1	4547.999	4562.466	4565.466	4552.938	4553.52	100	100
2	4045.358	4083.936	4091.936	4058.528	4060.081	64.05/35.94	97.69/97.82
3	3838.303	3905.814	3919.814	3861.352	3864.069	33.00/31.04/35.94	92.75/99.20/99.58
4	3468.271	3545.427	3561.427	3494.612	3497.717	24.83/32.35/18.30/24.50	97.41/99.94/98.84/99.97
5	3540.165	3651.076	3674.076	3578.031	3582.494	34.64/18.62/17.97/25.81/2.9	94.69/98.93/96.37/99.99/99.97

The frailty trajectory groups are shown in Figure 2. Trajectory 1 (moderate-level group) comprised 76 patients (24.83%), with an initial frailty score of 8.74 points showing a declining trend at approximately -1.55 points/month. Trajectory 2 (high-level group) included 99 patients

(32.35%), representing the largest proportion, with an initial frailty score of 10.56 points. Although demonstrating a declining trend at -1.63 points/month, the overall scores remained at moderate-to-high levels. Trajectory 3 (low-level group) consisted of 54 patients (18.30%), the smallest subgroup, with an initial frailty score of 6.33 points showing a declining trend at approximately -1.29 points/month. Trajectory 4 (very low-level group) included 77 patients (24.50%), with an initial frailty level of 3.45 points showing a downward trend, approaching -1.01 points/month. The baseline characteristics of each trajectory group are presented in Table 1. Statistically significant differences were observed among the four groups in terms of age, admission method, admission route, self-care ability, self-reported fatigue and dizziness symptoms at admission, CCI, AIMS65, cause of bleeding, transfusion history, cirrhosis, NRS2002, length of hospital stay, IADL, and BADL.

4.5 Analysis of characteristics among different frailty groups

Table 1 presents the adjusted odds ratios (OR) and 95% confidence intervals (CI) from the multinomial logistic regression analysis of frailty trajectories. These results indicate that Patients who were younger, admitted through the emergency department (OR=0.17, 95%CI:0.03~0.86, P<0.001), with walking assistance (OR=0.05, 95%CI:0.007~0.46, P<0.001), wheelchair use (OR=0.01, 95%CI:0.004~0.23, P=0.003), stretcher use (OR=0.06, 95%CI:0.01~0.35, P=0.001), complete dependence for self-care (OR=0.03, 95%CI:0.001~0.75, P=0.032), bleeding causes such as gastric hemorrhage or cirrhosis (OR=0.13, 95%CI:0.01~0.94, P=0.044), higher NRS2002 scores, and higher BADL scores (OR=0.73, 95%CI:0.61~0.87, P<0.001) were more likely to be in the high frailty group. Patients who self-reported fatigue as their admission symptom were more likely to be in the very low frailty group (OR=18.63, 95%CI:10.08-34.33, P=0.049). Patients in the intermediate-to-high risk group of AIMS65 score were more likely to be in the moderate frailty group (OR=9.99, 95%CI:2.98-33.94, P<0.001) and the very low frailty group (OR=4.23, 95%CI:1.06-16.88, P=0.041).

Table 1. Polynomial Logistic Regression Analysis of Frailty Trajectories in Middle-Aged and Elderly Patients with Upper Gastrointestinal Bleeding

Variables	class1(n=79)		class3(n=54)		class4(n=77)	
	OR(95%CI)	P	OR(95%CI)	P	OR(95%CI)	P
Age(year)	0.89(0.84, 0.94)	0.001	0.88(0.82, 0.95)	0.001	0.83(0.77, 0.89)	0.001
Admission route						
Outpatient	--	--	--	--	--	--
Emergency	0.17(0.03, 0.86)	0.032	0.25(0.04, 1.38)	0.114	0.37(0.06, 2.03)	0.256
Admission method						
Walking	--	--	--	--	--	--
assisted walking	0.59(0.09, 3.90)	0.592	0.36(0.05, 2.33)	0.287	0.05(0.007, 0.46)	0.001
wheelchair	0.26(0.02, 2.49)	0.243	0.02(0.001, 0.70)	0.025	0.01(0.004, 0.23)	0.003
stretcher	0.51(0.09, 2.95)	0.459	0.34(0.06, 1.92)	0.224	0.06(0.01, 0.35)	0.001
Self-care ability						
Completely independent	--	--	--	--	--	--
requires partial assistance	0.15(0.01, 2.05)	0.156	0.08(0.005, 1.41)	0.085	0.09(0.005, 1.47)	0.091
requires substantial assistance	0.31(0.02, 4.10)	0.380	0.24(0.01, 4.04)	0.328	0.15(0.009, 2.51)	0.190
completely dependent	0.12(0.008, 1.90)	0.135	0.03(0.001, 0.75)	0.032	0.26(0.01, 5.04)	0.377
Fatigue						
Yes	3.28(0.22, 4.71)	0.381	20.41(8.83, 47.17)	0.059	18.63(10.08, 34.44)	0.049
No	--	--	--	--	--	--
Dizziness						
Yes	0.78(0.05, 10.33)	0.852	0.19(0.009, 3.91)	0.287	0.07(0.004, 1.34)	0.079
No	--	--	--	--	--	--
AIMS65						
Low-risk group	--	--	--	--	--	--
Mild and high-risk group	9.99(2.98, 33.94)	0.001	3.04(0.80, 11.54)	0.101	4.23(1.06, 16.88)	0.041
Causes of bleeding						
compound ulcer	--	--	--	--	--	--
ariceal upper gastrointestinal bleeding	0.53(0.06, 4.12)	0.548	0.83(0.06, 1.02)	0.890	0.75(0.04, 11.89)	0.840
gastric ulcer	0.11(0.01, 0.76)	0.025	0.08(0.01, 0.61)	0.014	0.13(0.01, 1.55)	0.067
duodenal bulb ulcer	0.92(0.12, 6.97)	0.942	0.42(0.04, 3.84)	0.448	0.55(0.05, 5.89)	0.627
duodenal descending part ulcer	2.01(0.09, 43.32)	0.655	1.77(0.06, 49.60)	0.734	0.29(0.004, 18.42)	0.559
acute gastric mucosal lesion	0.32(0.01, 8.31)	0.494	1.68(0.08, 33.94)	0.732	2.81(0.11, 66.55)	0.520
mallory-weiss syndrome	--	--	0.09(0.001, 5.75)	0.261	0.67(0.006, 71.13)	0.869
acute upper gastrointestinal bleeding	0.74(0.11, 4.78)	0.760	0.45(0.05, 3.64)	0.458	0.89(0.09, 8.48)	0.922
other types	0.88(0.05, 1.31)	0.929	--	--	--	--
History of blood transfusion						
Yes	0.60(0.28, 1.30)	0.199	0.53(0.22, 1.27)	0.159	0.47(0.19, 1.19)	0.112
No	--	--	--	--	--	--

Liver cirrhosis						
Yes	0.45(0.11, 0.73)	0.247	0.33(0.05, 2.10)	0.243	0.13(0.01, 0.94)	0.044
No	--	--	--	--	--	--
Nutritional Risk Screening 2002	0.52(0.31, 0.86)	0.012	0.47(0.02, 0.89)	0.021	0.81(0.45, 1.44)	0.478
BADL	0.93(0.80, 1.08)	0.389	0.99(0.84, 1.17)	0.979	0.73(0.61, 0.87)	0.001
IADL	1.07(0.95, 1.20)	0.207	0.96(0.84, 1.09)	0.561	1.08(0.95, 1.24)	0.209

Discussion

- Our study collected the clinical characteristics of middle-aged and elderly patients with upper gastrointestinal bleeding (UGIB) and assessed the degree of frailty within six months post-bleeding. Using Latent Class Growth Modeling (LCGM), we identified four distinct frailty trajectory categories: high-level group, moderate-level group, low-level group, and very low-level group, while recognizing the unique clinical features associated with each trajectory. These findings provide critical evidence for identifying high-risk populations and developing targeted strategies to mitigate frailty.
- Frailty has been demonstrated as a key factor influencing the prognosis of UGIB patients, independently predicting all-cause hospitalization, mortality, and the incidence of perioperative adverse events in this population^[10, 32]. Currently, most existing studies focus on the relationship between baseline frailty and mortality in UGIB patients, with limited attention paid to the dynamic progression of frailty in this population^[9, 10, 32]. In our study, the frailty burden was most severe at baseline (T1), reaching a prevalence as high as 80.6%, indicating that this is the optimal time point for implementing frailty interventions. Among the four frailty trajectories we identified, the majority of patients (57.18%) belonged to the moderate-to-high frailty level group. Although the frailty burden showed a declining trend, patients still exhibited varying degrees of frailty at 6 months post-bleeding, maintaining moderate-to-high levels. This suggests that frailty continues to play a significant role in the long-term physical functional recovery of patients after bleeding. Current research suggests that frailty may be associated with gastrointestinal bleeding through mechanisms such as dysregulated neuroendocrine modulation and epithelial barrier dysfunction^[33], chronic inflammation and immune dysregulation^[34], as well as metabolic dysregulation and impaired hemostasis^[35, 36]. Monitoring and intervention for frailty may improve outcomes in UGIB patients.
- Notably, the high-level frailty group accounted for the highest proportion (32.35%). These patients are at high risk of frailty and represent a key population requiring clinical attention. Frailty often indicates reduced physiological reserves and diminished stress response capacity. Multiple studies have demonstrated that frailty increases both the incidence of bleeding and patient mortality. As reported by Lian He et al^[37], frailty increases the all-cause mortality risk in atrial fibrillation patients by 2.77 times and raises the major bleeding risk by 1.83 times. Chenao Zhang et al^[35] found that frailty significantly elevates the risk of gastrointestinal bleeding, with the risk increasing proportionally to the severity of frailty. We recommend incorporating frailty assessment into routine screening for UGIB patients, with particular focus on high-risk individuals. Our findings indicate that younger patients are more likely to be in the high-level frailty group. This observation is not entirely consistent with the conclusion reported by Chenao Zhang et al, which suggested that the association between frailty and gastrointestinal bleeding risk was more pronounced in participants aged ≥ 65 years than in younger individuals^[35]. The reason is that among the population we included, the causes of bleeding were mainly due to esophageal and gastric variceal rupture bleeding caused by liver cirrhosis and gastric ulcer bleeding, with a higher proportion of young patients in these two diseases. In addition, patients in the high-level frailty group also exhibited characteristics such as emergency admission, being admitted by walking with assistance, wheelchair, or being pushed on a stretcher, complete dependence for self-care, bleeding causes including gastric bleeding and liver cirrhosis, high NRS2002 scores, and high BADL scores. These features reflect that this group has severe conditions, poor self-care ability, and nutritional deficiencies. We believe that, first, UGIB is characterized by acute onset and severe conditions^[38]. Second, most studies clearly demonstrate an association between malnutrition and frailty^[39, 40]. In energy metabolism, impaired protein metabolism is a significant factor contributing to frailty^[41]. Finally, frailty is a common complication in patients with liver cirrhosis, with a prevalence as high as 18% to 43%^[42]. In our study, liver cirrhosis leading to gastroesophageal variceal bleeding accounted for the highest proportion at 33.3%.

Conclusion

- Middle-aged and elderly patients with upper gastrointestinal bleeding exhibit heterogeneous frailty trajectories within six months after bleeding. Early assessment to predict the occurrence of heterogeneous frailty trajectories is crucial for improving outcomes in these

patients. Future research should further explore scientific and effective frailty interventions to enhance the prognosis of this patient population.

Declarations

Competing interests

there is no conflict of interest in our study

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Author Contribution

C.X.Y. was responsible for the overall manuscript structure, writing, and revisions. F.W. and X.Q.R. contributed to the conceptual development and structural design of the paper, and helped refine key expressions. J.R.W. and Y.Y. collected, organized, and analyzed the data and prepared the figures and tables. G.Q.X. and N.Z. supervised the study design, proposed the research topic, and revised the manuscript in detail.

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Data Availability

The datasets used during the current study are available from the corresponding author on reasonable request.

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Figures

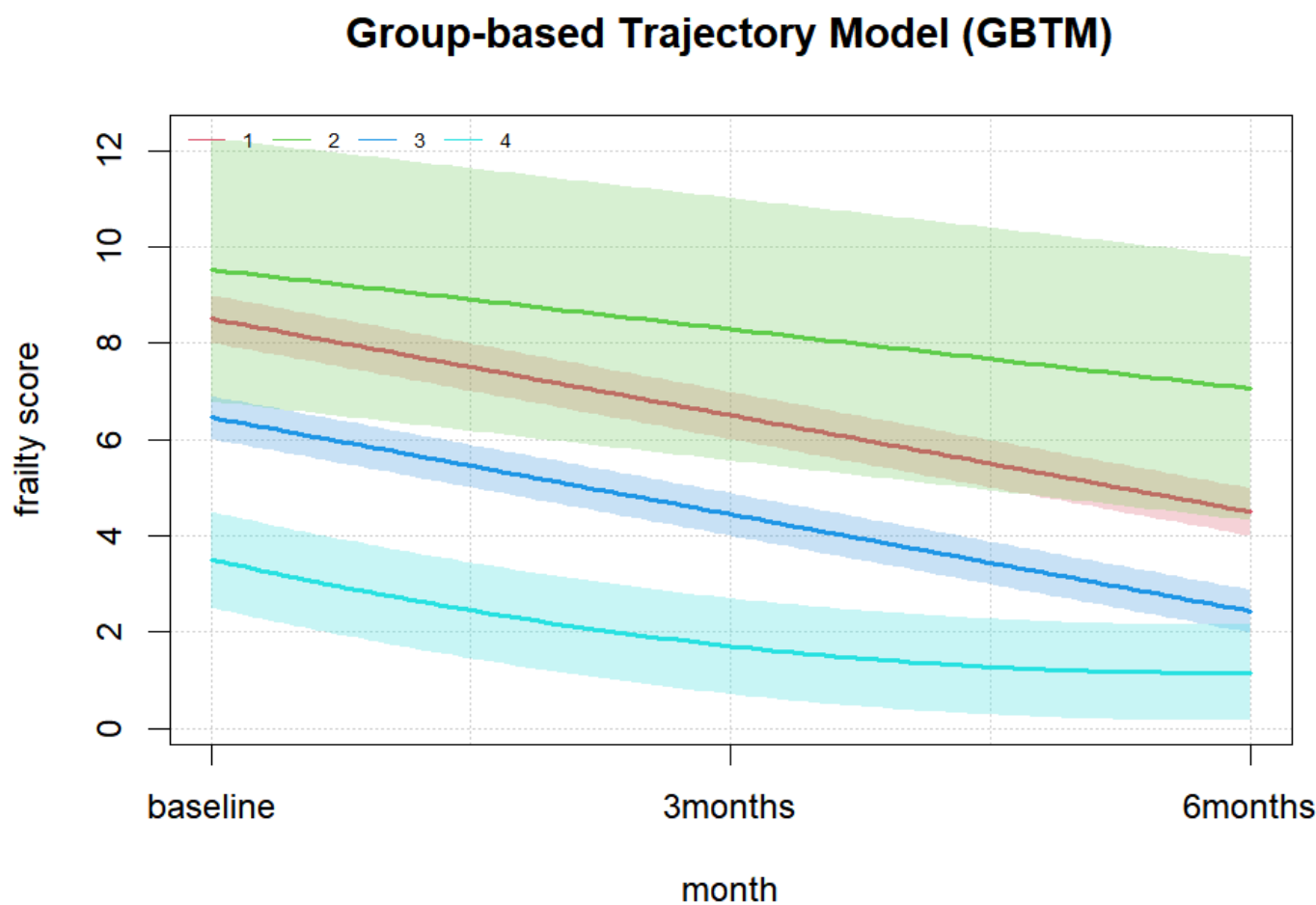


Figure 1

The trajectory of frailty