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Analysis of Depression in Aged, Hospitalized Patients with Chronic Heart Failure

ABSTRACT

Objective: The objective is to investigate the situation and risk factors of depression in aged, hospitalized patients with chronic heart failure (CHF).

Methods: A total of 196 aged CHF patients admitted to Xuanwu Hospital from May 2022 to March 2024 were consecutively selected. Information such as demographics, comorbidities, old-age hospitalization assessment results, and admission test results was collected. Differences were found between the patients admitted with CHF and depression and those without depression. Independent predictors of depression in aged, hospitalized patients with CHF were identified using logistic regression analyses. The sensitivity and specificity of age, frailty score, and New York Heart Association (NYHA) classification to evaluate the occurrence of depression were examined by calculating the area under the curve (AUC) of the receiver operating characteristic (ROC) curve.

Results: Increased age [OR (Odds Ratio) = 1.132, (95% CI [Confidence Interval], 1.050-1.221), $P = .001$], higher frailty score [OR = 8.324, (95% CI, 4.233-16.368), $P < .001$], and higher NYHA classification [OR = 3.806, (95% CI, 1.864-7.773), $P < .001$] were independent predictors of depression in aged CHF hospitalized patients. The best indicators for the occurrence of depressive symptoms were age of 75 years, a score of 2 for frailty, and an NYHA classification of III. The AUCs for age, frailty score, and NYHA classification were 0.764, 0.876, and 0.707, respectively.

Conclusion: Clinical assessment of depression is necessary for aged, hospitalized CHF patients. Patients over 75 years old, with a frailty score of at least 2, and an NYHA classification of III or IV are more prone to depression, which requires attention.

Keywords: Depression, aged, hospitalization, chronic heart failure

Introduction

Depression is common in aged chronic heart failure (CHF) patients, which is under-recognized and linked to adverse outcomes.[1] According to research, depression is one of the most common complications in patients with CHF, with a prevalence ranging from 11% to 51%.[2] Depression is one of the strongest predictors for the long-term prognosis of CHF patients.[3,4] Therefore, for patients with CHF, psychological evaluation should be actively carried out to detect whether depression is present at an early stage.

According to the United States Preventive Services Task Force (USPSTF) guidelines,[5] patients with cardiovascular disease should be screened for depression using rational scales. The European Society of Cardiology recommends early screening for depression in CHF patients using a well-validated depression questionnaire. The Geriatric Depression Scale (GDS) is a tool for the evaluation and diagnosis of depression in aged patients. During the last Seminary of the Italian Geriatric Cardiology Society (SICGe), the faculty agreed that the Geriatric Depression Scale-15 items (GDS-15) could be the best choice for aged patients with CHF, considering its accuracy and simplicity in administration.[6]

However, in China, we rarely routinely assess depression in such patients, and only when the patient has obvious anxiety and delirium will we consider asking the corresponding

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department for consultation and intervention. In fact, many aged patients with CHF have depressive symptoms during hospitalization. A study conducted among Chinese CHF patients shows that the presence of depressive symptoms is a key determinant that influences their rehospitalization.[7] Identifying the independent factors for depression among CHF patients serves as the first step to understanding more about this condition. By doing this, early intervention can then be performed to improve the prognosis of CHF patients accompanied with depression. The purpose of this study is to determine the current landscape regarding depression during hospitalization in aged patients with CHF and examine the influencing factors. The results of this study might deepen our understanding of depression among aged CHF patients and provide useful data for the further management and control of this condition.

Material and Methods

Patients

This cross-sectional study included consecutively hospitalized, aged CHF patients. The procedures of this study were conducted in accordance with the Declaration of Helsinki (as revised in 2013) and approval was obtained from the Ethics Committee of the Xuanwu Hospital (No. 2021060). Written informed consent was obtained from all participants.

Study inclusion criteria: patients were at least 60 years old, diagnosed with CHF, admitted to the geriatrics and the emergency departments of Xuanwu Hospital, Capital Medical University, Beijing, from May 2022 to March 2024; CHF was diagnosed according to the American Heart Association Guideline;[8] and CHF was confirmed at the time of presentation by clinical specialist cardiologists. Study exclusion criteria: presence of acute heart failure, a complete inability to care for themselves, dependence on alcohol or other opioids, history of diagnosed depression, severe cognitive disorder, suicidal tendency, various end-stage diseases, end-stage malignant tumors, and vital signs that were unstable or required vasoactive drug maintenance.

Study Design

A cross-sectional research design was adopted for this study. All participants were screened for depression using the GDS-15 scale.[9] Participants were grouped into the depressed group or the non-depressed group according to GDS-15 scores. Group information was compared with depression as the dependent variable, and influencing factors for depression were analyzed.

MAIN POINTS

- *Depression is common in aged CHF patients and is under-recognized.*
- *Depression and CHF have several similar pathophysiological mechanisms.*
- *Clinical assessment of depression is necessary for aged, hospitalized CHF patients.*
- *Old age, higher frailty score, and higher NYHA classification were independent predictors in aged, hospitalized CHF patients with depression.*

Data Collection

Demographic Characteristics: Demographic data included age, sex, body mass index (BMI), education level (3 levels: lower education, illiteracy, or primary school; moderate level, middle school or technical secondary school; higher education, university or above), marital status (married and living alone, including divorced, widowed, and unmarried), smoking status, and alcohol consumption.

Comorbidities: Conditions that reflected the patient's comorbidities included hypertension (HT), hyperlipidemia (HLP), diabetes mellitus (DM), atrial fibrillation (Afib), coronary heart disease (CHD), peripheral artery disease (PAD), chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), cerebrovascular disease (CVD), connective tissue disease (CTD), and malignancy. The number of complications was also counted.

Old-age Hospitalization Assessments: Assessments included nutrition score, fall risk score, cognitive score, activities of daily living (ADL) score, and frailty index score.

Nutritional risk screening (NRS) was performed within 48 hours after admission using the NRS 2002, which conforms to the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines.[10] All patients were evaluated at the time of admission. An NRS 2002 score ≥3 indicated a nutritional risk (a nutritional support program would be developed based on clinical practice for these patients), while a score <3 indicated no nutritional risk.

Fall risk assessment was carried out using the Johns Hopkins Fall Risk Assessment scale,[11] and the criteria were as follows: scores of 0-5 indicated a low risk, scores of 6-13 indicated a moderate risk, and a score >13 indicated a high risk.

For cognition assessment, the Mini-Mental State Examination (MMSE)[12] was used. Scores were assigned within a range of 0-30. The lower the score, the more severe the cognitive impairment.

Activities of daily living was assessed with the Barthel index scale,[13] with scores ranging from 0 to 100.

A frailty scale[14] was used to evaluate the presence of fatigue, muscle resistance, aerobic capacity, weight loss, and disease burden. The frailty index consists of 5 simple questions, which require a "Yes" or "No" answer, with 1 point assigned to any affirmative response. The scores range from 0 to 5 points, and individuals are classified as robust (0 points), prefrail (1-2 points), or frail (>3 points).

Laboratory Tests and Cardiac Function: These indicators included systolic blood pressure (SBP), heart rate (HR), hemoglobin, albumin, total cholesterol, triglycerides, N-terminal pro-brain natriuretic peptide (NT-proBNP) tests, New York Heart Association (NYHA) classification, and left ventricular ejection fraction (LVEF), which reflected the patient's laboratory test outcomes and cardiac function.

Depression Screening: All patients were screened for depression using the GDS-15, with scores ranging from 0 to 15. The higher the score, the more obvious the depressive symptoms. Scores of 0-4, 5-8, 9-11, and 12-15 indicate no depressive symptoms, mild depressive symptoms, moderate depressive symptoms, and severe depressive symptoms, respectively.[15]

Treatment: All hospitalized CHF patients received routine treatment in accordance with the American Heart Association Guideline.[8] Intravenous medications included nitrates, diuretics, and β-blockers, while oral medications included ACEIs/ARBs/ARNIs, β-blockers, diuretics, and SGLT-2is.

Statistical Analysis

SPSS 22.0 statistical software was used for data analysis. Measurement data were expressed as the mean ± SD ($\bar{X} \pm SD$). Independent sample *T*-tests were used for comparison between groups. The χ^2 test was used for categorical data. Multivariate logistic regression was used to identify independent predictors for depression, with depression as the dependent variable and all observation indicators with $P < 0.2$ between the 2 groups as the independent variables. The sensitivity and specificity of influential factors for depression were examined by calculating the Area under the curve (AUC) of the receiver operating characteristic (ROC) curve. Points under the ROC curve were considered the most critical. A *P*-value of less than .05 was considered to indicate statistical significance.

Results

A total of 196 patients were involved in the study and completed the questionnaires. Ages of the enrolled patients ranged from 60 years to

Table 1. Comparison of Characteristics in the Depressed Group (GDS ≥ 5) and the Non-depressed Group (GDS ≤ 4) on Admission

	Total (n = 196)	GDS ≥5 (n = 107)	GDS ≤4 (n = 89)	*P*
Demographic Data				
Age (years)	76.63 ± 8.69	80.21 ± 7.14	72.31 ± 8.45	**<.001***
Sex (M/F)	132/64	74/33	58/31	.553
BMI	23.94 ± 3.90	23.94 ± 3.67	23.93 ± 4.18	.993
Married (Y/N)	117/79	57/50	60/29	**.044***
Education (L/M/H)	79/84/33	53/43/11	26/41/22	**.003***
Smoking (Y/N)	51/145	31/76	20/69	.302
Drinking (Y/N)	39/157	20/87	19/70	.643
Comorbid Chronic Diseases				
HT (Y/N)	145/51	82/25	63/26	.353
HLP (Y/N)	150/46	82/25	68/21	.970
DM (Y/N)	90/106	54/53	36/53	.161
A-fib (Y/N)	38/158	20/87	18/71	.787
CHD (Y/N)	169/27	95/12	74/15	.254
PAD (Y/N)	44/152	25/82	19/70	.736
COPD (Y/N)	56/140	35/72	21/68	.160
CKD (Y/N)	102/94	61/46	41/48	.127
CVD (Y/N)	85/111	56/51	29/60	**.005***
CTD (Y/N)	17/179	11/96	6/83	.381
Malignancy (Y/N)	19/177	13/94	6/83	.203
Complications	4.67 ± 1.65	4.99 ± 1.47	4.28 ± 1.77	**.003***
Old-age Hospitalization Assessment Items				
NRS 2002	1.62 ± 1.16	1.85 ± 1.27	1.34 ± 0.97	**.002***
Fall risk score	12.44 ± 4.78	13.35 ± 5.13	11.35 ± 4.09	**.003**
MMSE	23.31 ± 4.00	22.94 ± 4.09	23.75 ± 3.86	.159
ADL	73.01 ± 16.18	69.81 ± 17.64	76.85 ± 13.32	**.002***
Frailty scale	2.06 ± 1.29	2.82 ± 1.03	1.13 ± 0.92	**<.001***
Admission Tests				
SBP (mmHg)	142.14 ± 17.25	141.50 ± 18.53	142.92 ± 15.63	.566
HR (bpm)	77.02 ± 14.89	76.32 ± 14.49	77.85 ± 15.39	.473
Hemoglobin (g/L)	122.98 ± 20.04	120.56 ± 19.56	125.90 ± 20.33	.063
Albumin (g/L)	36.29 ± 4.87	35.70 ± 4.33	36.99 ± 5.39	.071
Cholesterol (mmol/L)	3.54 ± 0.99	3.42 ± 0.90	3.69 ± 1.07	.060
Triglycerides (mmol/L)	1.31 ± 0.75	1.34 ± 0.77	1.29 ± 0.72	.676
NT-proBNP (pg/mL)	5527.68 ± 4458.63	6237.31 ± 5192.52	4674.53 ± 3197.70	**.011***
LVEF (%)	42.44 ± 3.45	41.98 ± 3.25	43.00 ± 3.61	**.039***
NYHA (I/II/III/IV)	41/58/68/29	13/25/43/26	28/33/25/3	**<.001***

Data are expressed as the mean ± SD, or n (%).
A-fib, atrial fibrillation; ADL, activities of daily living; BMI, body mass index; CHD, coronary heart disease; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CTD, connective tissue disease; CVD, cerebrovascular disease; DM, diabetes mellitus; GDS, Geriatric Depression Scale; HLP, hyperlipidemia; HR, heart rate; HT, hypertension; L/M/H, lower/moderate/higher education; LVEF, left ventricular ejection fraction; MMSE, mini-mental state examination; M/F, male/female; NRS, nutritional risk screening; NYHA, New York Heart Association; PAD, peripheral artery disease; SBP, systolic blood pressure; SD, standard deviation; Y/N, yes/no.
**P* < .05. the P-value < 0.05 was written in the bold form which means significant different.

97 years, with a mean age of 76.63 ± 8.69 years. There were 132 males and 64 females.

General Patient Characteristics

The characteristics of the depressed group and the non-depressed group were compared, and there were significant differences in age (80.21 ± 7.14 years vs. 72.31 ± 8.45 years, $t = 7.094$, $P < .001$), marital status (married/living alone: 57/50 vs. 60/29, respectively, $\chi^2 = 4.040$, $P = .044$), educational level (lower education/moderate education/higher education: 53/43/11 vs. 26/41/22, respectively, $\chi^2 = 11.385$, $P = .003$), complicated with cerebrovascular disease (with/without: 56/51 vs. 29/62, $t = 2.836$, $P = .005$), amount of complications (4.99 ± 1.47 vs. 4.28 ± 1.77, $t = 3.008$, $P = .003$), NRS 2002 score (1.85 ± 1.27 vs. 1.34 ± 0.97, $t = 3.143$, $P = .002$), fall risk score (13.35 ± 5.13 vs. 11.35 ± 4.09, $t = 3.031$, $P = .003$), ADL score (69.81 ± 17.64 vs. 76.85 ± 13.32, $t = -3.180$, $P = .002$), frailty score (2.82 ± 1.03 vs. 1.13 ± 0.92, $t = 12.013$, $P < .001$), NT-proBNP (6237.31 ± 5192.52 vs. 4674.53 ± 3197.70, $t = 2.580$, $P = .011$), LVEF (%) (41.98 ± 3.25 vs. 43.00 ± 3.61, $t = -2.077$, $P = .039$), and NYHA (I/II/III/IV: 13/25/43/26 vs. 28/33/25/3, $\chi^2 = 28.182$, $P < .001$) (Table 1).

Patient Geriatric Depression Scale-15 Scores

The mean patient GDS-15 scores were 5.67 ± 3.091, among which 89 patients (45.4%) had no depressive symptoms (GDS-15 score: 0-4 points), 64 patients (32.7%) had mild depressive symptoms (GDS-15 score: 5-8 points), 34 patients (17.3%) had moderate depressive symptoms (GDS-15 score: 9-11 points), and 9 patients (4.6%) had severe depressive symptoms (GDS-15 score: 12-15 points) (Figure 1).

Independent Predictors of Depression

Advanced age [OR = 1.132, (95% CI, 1.050-1.221), $P = .001$], a high frailty index score [OR = 8.324, (95% CI, 4.233-16.3684), $P < .001$], and a higher level of NYHA [OR = 3.806, (95% CI, 1.864-7.773), $P < .001$] were independent predictors for depression in aged CHF hospitalized patients (Table 2).

Receiver Operating Characteristic Curve

Analysis of the specificity and sensitivity of age, frailty, and NYHA classification to evaluate the occurrence of depression was performed by calculating the AUC of the ROC curve (Figure 2). The AUCs for age, frailty, and NYHA classification were 0.764, 0.876, and 0.707, respectively. The AUC for their combined prediction ability is 0.952. The best critical points under the ROC curve for age, frailty score, and NYHA classification to indicate the occurrence of depressive symptoms in the patients were 75 years, 2, and III, respectively (Table 3).

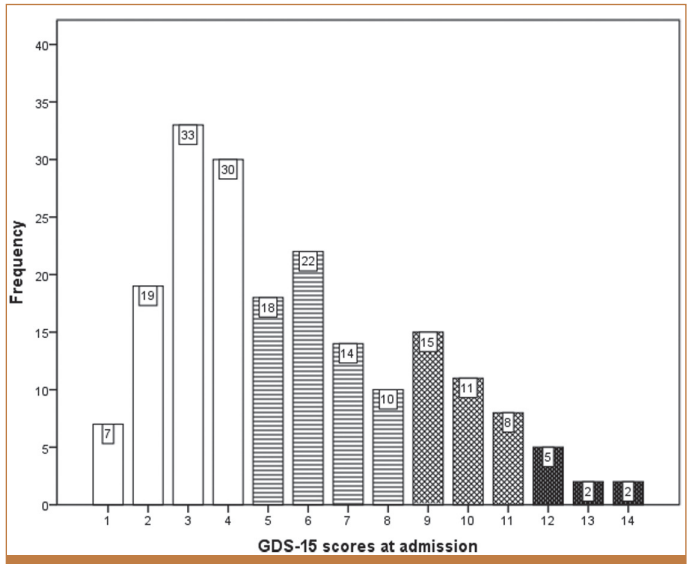

Figure 1. Distribution of geriatric depression scale-15 scores at admission.

Discussion

In summary, we found that increased age, higher frailty score, and higher level of NYHA classification were independent predictors of depression in aged, hospitalized CHF patients. Patients over the age of 75 years, with frailty scale scores of 2 and above, and NYHA classifications of III or IV were more prone to depression, a finding which deserves attention.

Chronic heart failure, particularly in NYHA III and IV, often causes a poor quality of life because of troublesome somatic symptoms (e.g., fatigue, dyspnea, and sleeping disorders), poor functional status, and unplanned hospitalizations.[1,6] Previous studies have found significant associations between depression and poor quality of life, increased re-hospitalization for CHF, and increased mortality.[16,17] Therefore, it is important to identify depressive symptoms in CHF patients earlier. In this study, we investigated independent predictors of depression in aged CHF hospitalized patients, which have been rarely reported in this country.

An epidemiological study on the prevalence of depression in hospitalized aged Chinese CHF patients showed that 53.57% of the investigated patients had no depressive symptoms, 35.36% had mild depressive symptoms, and 11.07% had moderate/severe depressive symptoms.[18] Geriatric Depression Scale is a tool for the evaluation

Table 2. Independent Predictors for Depression in Aged, Hospitalized Chronic Heart Failure Patients

	B	S.E.	Walds	Sig	Exp(*B*)	95% CI
Age	0.124	0.039	10.408	0.001	1.132	1.050-1.221
Frailty	2.119	0.345	37.730	<0.001	8.324	4.233-16.368
NYHA	1.337	0.364	13.458	<0.001	3.806	1.864-7.773

Multivariable logistic regression was used to analyze the independent predictors for depression in aged CHF patients, with depression as the dependent variable and all observation indicators with $P < .2$ between the 2 groups as the independent variables (age, marital status, education, DM, COPD, CKD, CVD, complications, NRS, fall risk score, MMSE, ADL, frailty scale score, hemoglobin, albumin, cholesterol, NT-proBNP, LVEF, NYHA). Increased age, higher frailty scale score, and higher NYHA classification were independent predictors for depression in aged, hospitalized CHF patients. ADL, activities of daily living; CHF, chronic heart failure; CKD, chronic kidney disease; CI, Confidence Interval; COPD, chronic obstructive pulmonary disease; CVD, cerebrovascular disease; DM, diabetes mellitus; LVEF, left ventricular ejection fraction; NRS, nutritional risk screening; NYHA, New York Heart Association.

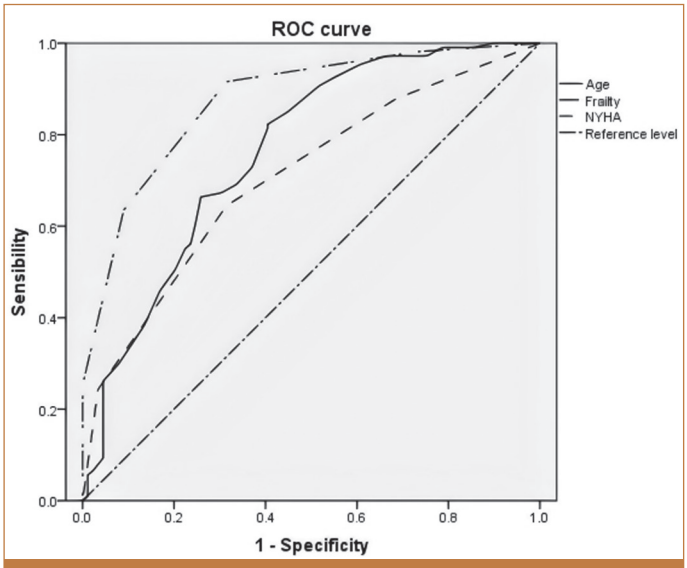

Figure 2. Age, frailty score, and NYHA classification for the evaluation of depressive symptoms in CHF hospitalized patients. The AUCs for age, frailty score, and NYHA classification were 0.764, 0.876, and 0.707, respectively. AUC, area under curve; CHF, chronic heart failure; NYHA, New York Heart Association.

and diagnosis of depression in aged patients.[19] The subsequently developed GDS-15 reduces the administration time of the survey, which makes it easier to use. A study showed that the GDS-15 scale was effective for the screening of major depressive episodes according to DSM-IV criteria.[20] We therefore chose the GDS-15 scale to examine the presence of depressive symptoms in our study population. Among all enrolled 196 patients, 89 patients (45.4%) had no depressive symptoms, 64 patients (32.7%) had mild depressive symptoms, 34 patients (17.3%) had moderate depressive symptoms, and 9 patients (4.6%) had severe depressive symptoms. The prevalence of depression was generally consistent with that reported in the literature. Minor disparities may be due to the use of different scales. Apart from the variability of different scales, differences in individual subjectivity, inclusion and exclusion criteria, and racial and regional differences of the patients also contribute to the different rates of depression in CHF patients reported in studies.

Depression has a co-relationship with increased all-cause mortality risk, which is stronger in shorter follow-up periods and aged adults.

Table 3. Best Cut-off for Age, Frailty Score, and New York Heart Association Classification

	Age (years)	Frailty Score	NYHA Classification
Cut-off	74.5	1.5	2.5
Sensitivity	0.729	0.916	0.645
Specificity	0.629	0.685	0.685
Youden's index	0.358	0.601	0.330

According to the ROC curve and clinical conditions, the best critical point for age, frailty score, and NYHA classification to indicate the occurrence of depressive symptoms in CHF hospitalized patients was 74.5 years, 1.5, and 2.5, respectively. This means that CHF hospitalized patients of at least 75 years, with a frailty score of at least 2, and an NYHA classification of III or IV is more prone to depressive symptoms. NYHA, New York Heart Association.

Depression may serve as a marker of more severe conditions in aged CHF patients.[21] Severe physical impairments and accompanying frailty, cognitive impairment, and depression are associated with adverse clinical outcomes in aged patients.[22,23] It is easy to understand that heart function in CHF patients gradually declines, physical skills gradually decline, and various comorbidities increase with age, making them more prone to depressive symptoms. In our study, increased age was considered an independent predictor for depression in aged, hospitalized CHF patients, and from the ROC curve, we calculated that those aged 75 years and above are more prone to depression.

Frailty is a geriatric syndrome, caused by age-related cumulative decline, which could be influenced by weakness, pain, mobility, and balance problems. These risk factors may also cause functional decline or disability and thus cause depressive symptoms.[24] Conversely, depression may be a predictor of frailty due to decreases in gait speed, physical activity, and social ties, or as the result of an increase in a sedentary lifestyle.[25] A systematical review of patients with cardiovascular disease reported that frailty in CHF patients of all ages is correlated with worse functional outcomes, a poor response to treatment, and increased mortality.[26,27] Our study shows that frailty scale score is an independent predictor of depression in aged, hospitalized CHF patients. Receiver operating characteristic curve analysis indicated that patients with frailty scores of 2 and above, and other clinical conditions, were prone to depression.

Depression and CHF have several similar pathophysiological mechanisms, such as oxidative stress, chronic inflammation, and dysregulation of the hypothalamic-pituitary-adrenal axis.[28] Moreover, this association works both ways. CHF, especially in NYHA III-IV classification, often causes a poor quality of life because of troublesome physical symptoms, unplanned hospitalizations, and poor functional status.[6] NYHA classification III or IV ($P = .001$) has previously been shown to be a predictor of depression in patients with CHF,[29] which is in line with the results of our study. In addition, higher NYHA classification was also an independent predictor of depression in our study.

Conclusion

Depression is common in aged CHF patients and under-recognized. Clinical assessment of depression is necessary for aged, hospitalized CHF patients. Advanced age, a high frailty index score, and a higher level of NYHA were independent predictors for depression in aged CHF hospitalized patients. Patients over 75 years old, with a frailty score of at least 2, and an NYHA classification of III or IV are more prone to depression, which requires attention.

Limitation

This study has some limitations. First, this study was a single-center study, and all patients were from a tertiary hospital, so there is a certain selection bias. Second, in terms of depression screening, the GDS was selected in this study, without a specific assessment of the degree of depression, and without a clear diagnosis. In addition, a number of domestic and foreign studies have found that depression are also related to a variety of factors, such as income, race, and quality of life, which were not assessed in this study.

For CHF patients complicated with depression, there is no consensus, as yet, regarding effective methods to significantly improve prognosis. Identifying independent factors for depression among CHF patients

serves as the first step to understanding more about this condition. By doing this, early intervention can be performed to improve the prognosis of CHF patients accompanied with depression. This study has some limitations. First, it is a single-center study, and all patients were collected from a tertiary hospital, so there could be a selection bias. Second, we used the GDS-15 as a screening tool to evaluate depressive symptoms, although this was not used for diagnosis, so this could have caused another bias. Third, other factors such as income, race, quality of life, and social support were not considered.

Availability of Data and Materials: *The data that support the findings of this study are available from the corresponding author, upon reasonable request.*

Ethics Committee Approval: *This study was approved by the Ethics Committee of Xuanwu Hospital (No. 2021060, Date: 2021.06).*

Informed Consent: *Written informed consent was obtained from the patients/patient who agreed to take part in the study.*

Peer-review: *Externally peer-reviewed.*

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