Evaluation of the relationship between nutritional status and 1-year mortality rate in patients with acute heart failure admitted at Vietnam National Heart Institute

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ABSTRACT

Background: Heart failure continues to be a leading cause of hospitalization worldwide, and acute heart failure (AHF) poses a significant risk of morbidity and mortality in the short term[1]. Acute heart failure (AHF) is a clinical syndrome with different triggering factors and manifests either as new onset or as an acute decompensation of chronic HF[5,6].

In Vietnam, heart failure also accounts for a considerable proportion. Hospitalized heart failure patients at the Vietnam National Heart Institute in 2007 were 1,962 patients, accounting for 19.8% of total admissions.[10] According to the 2010 statistics of the Ministry of Health, the incidence was 43.7%, of which the mortality rate was 1.2%. According to the 2015 statistical yearbook of the Department of medical service administration - Ministry of Health, the mortality rate from heart failure in 2013 accounted for 0.51% of total deaths from all causes, ranking 10th among the causes of death in Vietnam

Despite being actively treated and symptom improvement, patients hospitalized with AHF still have a considerable risk of mortality ranging from 10-20% within the next 6 months[2,7-9].

Subjects & methods: A total of 103 patients were successfully followed up in the first year. The mean follow-up time was 1 year.

Results: The main result of the study was the all-cause mortality rate within 1 year was 68%.

INTRODUCTION

Heart failure (HF) has become a global public health burden due to its high incidence and associated costs.[1] In the United States, there are over 1 million hospitalizations annually for acute heart failure (AHF). Combined in the US and Europe, there are about 1 million hospitalizations annually with a primary diagnosis of heart failure.[2] Although hospitalization rates in the US and Europe have declined, early post-discharge mortality and readmission rates have hardly changed over a long period. Recent data show that heart failure rates in Southeast Asian countries are similar to global figures, with heart failure accounting for up to 20% of hospital admissions and 30-day mortality of heart failure patients (HF pts) reaching 17% (around 10% in the Philippines, 17% in Indonesia).[3]

Malnutrition is a very common condition in HF patients and may be due to various mechanisms, such as low nutrition due to intestinal edema and anorexia,[4] hepatic dysfunction,[5] increased cytokine-induced catabolism,[6] insulin resistance, and other mechanisms.[7] Some studies suggest that malnutrition status, assessed by different clinical scoring systems, may also affect clinical outcomes in middle-aged and elderly patients hospitalized for acute HF.[8] According to Basta et al., nearly 55% of the study population with ST-segment elevation myocardial infarction (STEMI) were malnourished. Those individuals had a higher risk of death from any cause compared to those with normal nutritional status. It is important to accurately assess patients' nutritional status.[9]

Anker et al., Zapatero et al. have demonstrated that nutritional status is an independent prognostic factor in patients with acute or chronic heart failure.[10,11] Some nutritional screening tools such as the Mini Nutritional Assessment-Short Form (MNA-SF) and Nutritional Risk Screening (NRS-2002) have been developed to assess malnutrition risk in patients with HF.[12,13] Due to the complexity of calculating these indices and the subjectivity of questionnaires, the value and generalization of nutritional indices and questionnaires may vary according to examiners' experience and patients' recall. In contrast, some biochemical nutritional indices, including body mass index, total cholesterol, serum albumin and total lymphocyte count have been proposed to predict survival in HF patients.[14-16] There are many tools to assess nutritional status, however the NUTRIC score is recommended for use in the ICU.[17] Currently, there have been no studies at the Heart Institute investigating mortality of patients with acute heart failure and nutrition, therefore this study aims to assess the impact of nutritional status on in-hospital and 1-year mortality rates in patients with acute heart failure.

Objectives:

1. Determine nutritional status on admission and 1-year mortality rate of patients with acute heart failure.

2. The relationship between nutritional status and mortality in the first year of patients with acute heart failure.

SUBJECTS AND METHODS

Study design

A cross-sectional descriptive study was conducted on 103 patients diagnosed with acute heart failure or acute decompensated chronic heart failure from January 01st, 2019 to December, 2020 who had complete information on readmission or mortality within 1 year after discharge. Survey data was collected from medical records and telephone interviews.

Selection criteria

- Patients admitted and diagnosed with acute heart failure according to 2016 ESC criteria with standards as outlined in the overview
- Patients 18 years and older
- Patients consented to participate in the study and provided sufficient information

The Nutrition Risk in Critically ill (NUTRIC) score

Age, comorbidities, number of days hospitalized before ICU admission, total APACHE II score assessing disease severity, and SOFA score assessing organ failure within 24 hours of admission.[18,19] A NUTRIC score ≥5 indicates higher malnutrition risk, while a score <5 indicates lower risk. APACHE II score: Assesses disease severity collected within 24 hours of admission. These signs are collected from medical records. APACHE II score is calculated according to Knaus.[18]

***Table 1**. NUTRIC score sheet (Heyland 2011)*

NUTRIC Score = Nutritional risk score in critically ill patients.

NUTRIC score without IL-6

Variables		Points
Age	<50	0
	50-74	1
	≥74	2
APACHE score	<15	0
	15-19	1
	20-27	2
	≥28	3

Variables		Points
SOFA score Organ failure assessment	<6	0
	6-9	1
	≥10	2
Number of comorbidities	0-1	0
	≥2	1
Days hospitalized before ICU admission	0-<1	0
	≥1	1
Total mNUTRIC score		

Sum points. If ≥ 5 points: High malnutrition risk. If <5 points: Low malnutrition risk.

Data analysis

- All data was processed using SPSS 20.0 and Excel software.

- 24-hour food survey: Recording food tracking sheets by asking patients, caregiver nurses, other trackers. Using the photo book for food surveys from the Institute of Nutrition in 2014. Nutritional values were calculated based on the Vietnamese Food Composition Table from the Institute of Nutrition in 2007. Dietary assessment was performed in Excel.

RESULTS

Nutritional status on admission

Table 3.1*. Nutritional assessment indices on admission*

Index	Overall	Male	Female	P
Weight (kg)	53.02 ± 10.75 Min: 33; Max: 94	56.2 ± 10.3	47.5 ± 9.2	p<0.05 (T-test)
Height (cm)	158.27 ± 7.84 Min: 140; Max: 177	162.5 ± 5.1	150.7 ± 5.9	p<0.05 (T-test)
Mid-arm circumference (cm)	25 Min: 17; Max: 36	25.0 ± 3.3	24.0 ± 2.8	p>0.05 Man-Whitney
Overall BMI (kg/m^2)	21.08 ± 3.45 Min: 15.1; Max: 34.5	21.2 ± 3.5	20.9 ± 3.4	p>0.05 Chi-square
BMI (kg/m^2) no edema group	21.07 Min: 15.6; Max: 30	21 Min: 15.6; Max: 30	20.9 Min: 15.6; Max: 28	p>0.05 Chi-square
mNUTRIC Score	4.0 Min: 1; Max: 8	3.8 ± 1.6	4.3 ± 1.4	p>0.05 Man-Whiney
Malnutrition by BMI (21 pts - 20.4%)		14 (21.2%)	7 (18.9%)	p>0.05 Fisher's Exact test

Comments: BMI: The malnutrition risk by Nutric score was lower in those with BMI <18.5 than those with BMI≥ 18.5, this difference was not statistically significant with p>0.05.

Age: There was a statistically significant difference in malnutrition risk by Nutric score between age groups with p<0.05.

Gender: Malnutrition risk was lower in males than females, this difference was not statistically significant with p>0.05.

Mechanical ventilation: Malnutrition risk was 5.1 times higher in the ventilation group than the non-ventilation group, this difference was statistically significant with p<0.05.

Number of comorbidities: The more diseases a patient had, the higher the malnutrition risk. Those with more than 2 diseases had a 12.1 times higher malnutrition risk than those with 2 or fewer diseases, this difference was statistically significant with p<0.05.

Infection: Malnutrition risk was 1.4 times higher in the infection group than the non-infection group, this difference was not statistically significant with p>0.05.

Vasopressors: Malnutrition risk was 2 times higher in the vasopressor group than the non-vasopressor group, this difference was not statistically significant p>0.05.

***Table 3.2**. Nutritional status on admission according to criteria*

Criteria		On admission	Total
By BMI	Malnutrition	21 (20.4%)	103 (100%)
	No malnutrition	82 (79.6%)	
By GLIM ASPEN 2015	Malnutrition	35 (34%)	103 (100%)
	No malnutrition	68 (66%)	
By mNUTRIC score	High risk mNUTRIC ≥5	37 (35.9%)	103 (100%)
	Low risk mNUTRIC <5	66 (64.1%)	

Comments: On the first day of admission, BMI assessment showed 20.4% were malnourished. Assessment by GLIM criteria of ASPEN 2015 showed 34% were malnourished. Assessment by mNUTRIC score showed 35% were at high malnutrition risk, 65% were at low risk.

***Table 3.3**. Relationship between nutritional status by mNUTRIC score and related factors*

Criteria		High risk NUTRIC ≥5	Low risk NUTRIC <5	OR (95% CL)	P
BMI	BMI<18.5	6	15	0.7(0.2-1.9)	p>0.05*
	BMI≥18.5	31	51	1	
Age	<60 years	1	20		**p<0.05****
	60-74 years	9	30		
	≥ 75 years	27	16		
Giới	Male	20	46	0.5(0.2-1.2)	p>0.05**
	Female	17	20	1	
Ventilation	Yes	28	25	5.1 (2.1-12.6)	**p<0.05****
	No	9	41	1	
Number of comorbidities	>2 diseases	35	39	12.1 (2.7-54.7)	**p<0.05****
	≤ 2 diseases	2	27	1	
Infection	Yes	25	40	1.4(0.6-3.2)	p>0.05**
	No	12	26	1	
Vasopressors	Yes	19	23	2 (0.9-4.5)	p>0.05**
	No	18	43	1	

** Chi square test, * Fisher's Exact test

Comments: Age: There was a statistically significant difference in malnutrition risk by Nutric score between age groups, p<0.05. Mechanical ventilation: Malnutrition risk was 5.1 times higher in the ventilation group than the non-ventilation group, this difference was statistically significant, p<0.05. Vasopressors: Malnutrition risk was 2 times higher in the vasopressor group than the non-vasopressor group, this difference was not statistically significant, p>0.05.

Relationship between nutritional status and mortality in the first year

Table 3.4. *Mortality rate in the first year*

	Died		Survived		Total	
	N	%	n	%	N	%
After 1 year	70	68	33	32	103	100%

Comments: In the first year there were 70 patient deaths, accounting for 68%.

Table 3.5. *Comparison of nutritional status between surviving and deceased patients*

Index	Total		Survived		Died		P
	N	%	n	%	N	%	
BMI <18.5	21	100%	8	38.1	13	61.9	P=0.5 Chi-square
BMI ≥ 18.5	82	100%	25	30.5	57	69.5	
mNutric: 0-4 (Low malnutrition risk)	67	100	29	43.3%	38	56.7%	P=0.01 Chi-square
mNutric ≥ 5 (High malnutrition risk)	36	100%	4	11.1%	32	88.9%	

Comments: The malnutrition group had a 61.9% mortality rate while the non-malnutrition group had a 69.5% mortality rate, the difference was not statistically significant with p>0.05.

In the high malnutrition risk group the mortality rate was 88.9%, higher than the 56.7% mortality rate in the low risk group, the difference was statistically significant with p<0.05.

Table 3.6. *Relationship between mNutric score and mortality*

Factor	OR	95% CI	P
mNutric score	1.655	1.196 - 2.291	0.002

Comments: For every 1 point increase in mNutric score, the risk of mortality increases by 1.65 times.

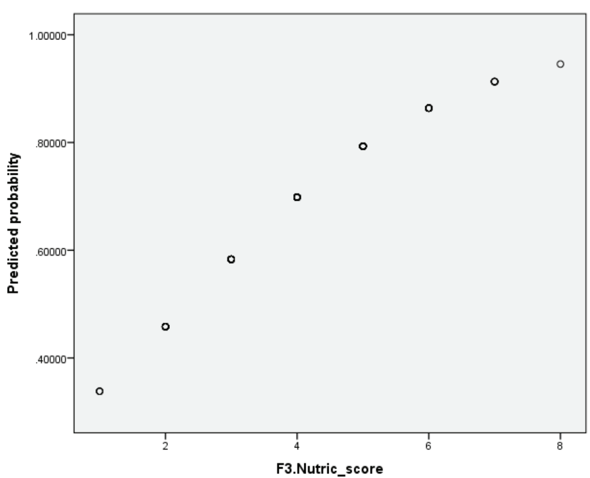

Figure 1. *Relationship between malnutrition risk mNutric score and predicted probability of mortality*

Comments: So there is a linear relationship between malnutrition risk score and predicted probability of mortality according to the chart.

***Table 3.7**. Relationship between factors and mortality in the first year*

Factor	Odd ratino	95% confidence interval	Statistical significance
Age	1.07	1.03-1.11	0.01
BMI	1.11	0.97-1.3	0.14
Malnutrition risk	0.3	0.04-1.8	0.2
mNutric score	1	0.6-1.7	0.9

Comments: In this study, only age was an independent factor leading to mortality with OR=1.07, 95% CI: 1.03-1.11, p=0.01<0.05.

DISCUSSION

Nutritional status on admission

Assessment by BMI showed the malnutrition rate was 20.4%, obesity rate 11.6%. The malnutrition rate was higher than in the study by Miró Ò (2017) on AHF patients with a malnutrition rate of 1.3%, while the obesity rate was lower than Miró Ò (72.6%).[21] This difference is because the author studied a large sample size in Spain over 1 year. The malnutrition rate was also higher than in the study by Cox ZL (2020) in admitted AHF patients with a malnutrition rate of 3%, and the obesity rate in our study was lower than Cox ZL's study with an obesity rate of 69%. [22] Our malnutrition rate was fairly similar to the study by Seko Y (2020) in ADHF patients with a malnutrition rate of 24.8%, the obesity rate was also lower than Seko Y (16.4%).

Assessment of malnutrition by GLIM criteria of ESPEN 2015 showed 35% of ICU patients had malnutrition by BMI at admission. Assessment by mNUTRIC score also showed 35.9% of ICU patients had high malnutrition risk (NUTRIC score ≥5) at admission.

This result was lower than the study by Lee Z-Y et al. on ICU patients with 56% having high malnutrition risk by NUTRIC score, Rosa M et al. on ICU patients with 50% having high risk by NUTRIC score. [23,24] The difference may be because the study population of Lee Z-Y comprised only mechanically ventilated patients on admission, while ours included both ventilated and non-ventilated patients. This result was higher than the study by Coltman et al. in the US (26%), Nguyen Huu Hoan et al. in the ICU of Bach Mai hospital (2016) which was 27%. [25,26] The explanation for this could be that the subjects in this study had acute heart failure, mostly on pre-existing chronic heart failure, along with other conditions like kidney failure, diabetes, hypertension, arrhythmias - an elderly population with accompanying age-related digestive and absorptive impairments. The difference with Nguyen Huu Hoan's results is that most ICU patients in that study were first-time admissions, with previously normal nutritional status.

In this study, when applying the ESPEN diagnostic criteria for malnutrition, i.e. combining additional criteria of unintentional weight loss and decreased fat-free mass with raising the BMI limit between normal and malnutrition to <20 kg/m^2 for subjects <70 years old and <22 kg/m^2 for subjects ≥70 years old, the malnutrition rate of hospitalized patients increased. This is appropriate when considering the physiological changes of the elderly. Height decreases with age, thus increasing the normal BMI limit in the elderly, and raising the limit between normal and malnourished to 20 kg/m^2 for those <70 years old and 22 kg/m^2 for those ≥70 years old.[27] The presence of fluid-electrolyte resuscitation, enteral and parenteral nutrition, localized or generalized edema, dialysis, gastric tube placement, abdominal paracentesis, or conditions like kidney failure, liver failure, etc. in ICU patients causes pseudo weight gain, affecting BMI results. Therefore, if only the BMI index is used to assess the nutritional status of these subjects, it would lead to missed cases.

It has been recommended that all patients should be nutritionally screened within 48 hours of hospital admission.[28] Patients at risk of malnutrition should then undergo a full nutritional assessment. An international consensus on changing the definition of malnutrition has emphasized the role of inflammation.[27] The American Society for Parenteral and Enteral Nutrition (ASPEN) has recognized the importance of the inflammatory factor in the characteristics of malnutrition and recommended criteria-based classifications of patients. The presence of two or more criteria determines the presence of malnutrition,[29,30] including insufficient energy intake compared to estimated energy requirements, weight loss including unintentional weight loss occurring at any body mass index, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid accumulation, reduced functional activity with acute illness or injury, chronic illness and starvation-induced malnutrition.

For ICU patients, collecting information encounters many obstacles such as mechanical ventilation, impaired consciousness, long hospital stays, and frequent caregiver changes, so the pre-admission diet history and gastrointestinal symptoms are difficult to gather. Weight can be affected by fluid balance status, as HF patients use diuretics, or poor heart function causes fluid retention and edema, or fluid infusion is required to maintain hemodynamics, and the above-mentioned factors influencing fluid status. Physical examination - muscle mass can be used as a more objective tool since it does not require asking the patient, but assessing decreased muscle mass and fat mass may be obscured by symptoms of edema or ascites. Of all the tools, only NRS 2002 and NUTRIC score include both nutritional status and disease severity. Therefore, the American Society of Parenteral and Enteral Nutrition and American Society of Critical Care Medicine guidelines have clearly stated that the recommended nutritional screening tools for ICU patients are NRS 2002 and NUTRIC score.[18,19] The NRS 2002 score requires determining weight loss and dietary changes for nutritional assessment, which poses some difficulties in severely ill patients where this information is hard to gather. The NUTRIC score does not depend on these criteria as it collects clinical and test parameters of the patient, hence it is recommended for use in ICUs.[28] According to our study, the mean mNutric score was 4.0 (Min 1, Max 8), mean APACHE II score was 16.52±2.85 (Min 8, Max 27). This result was lower than the study by Heyland et al. (2011), which had a mean APACHE II score of 23±4.5[31].

The rate of patients at high malnutrition risk at admission was 35.9%, higher than Nguyen Huu Hoan's study (2016) in the ICU which was 27%,[26] lower than Kalaiselvan et al.'s study (2017) on mechanically ventilated patients where 42.5% were at high risk,[32] according to Mendes et al. (2017) in an ICU in Portugal 48.6% were at high malnutrition risk by NUTRIC score.[33] The difference could be because our study subjects had acute heart failure, while Nguyen Huu Hoan's study was on ICU patients with other diseases who may have had normal nutritional status before admission. Compared to Kalaiselvan, their study population was mechanically ventilated ICU patients for over 48h, while ours included both ventilated and non-invasively ventilated or oxygen supported patients. As for Mendes et al., that was a national, multicenter, observational study conducted in 15 multidisciplinary intensive care units (ICUs) across Portugal over 6 months with diverse and multi-departmental patients, while we only conducted the study in a single cardiovascular ICU.

Mortality in the first year

The 1-year mortality rate of 68% was higher than Krista Siirilä-Waris et al. [34] in their study on characteristics, outcomes and 1-year mortality prognosis in 620 acute heart failure patients hospitalized at 14 hospitals in Finland. The cumulative mortality at 3 and 6 months was 15.0 and 20.0%. After 1 year, there were 171 (27.4%) deaths. This difference could be because our study sample size was smaller at around 103 patients, focused on a severely ill group with the majority being in intensive care on mechanical ventilation, and our unit is the final stage of cardiovascular care. In a study on acute heart failure by Ovidiu Chioncel et al.[35] collecting data from the ESC Long-Term HF Registry with follow-up from admission to 1 year on 6,629 AHF patients, the all-cause 1-year mortality rate was 26.7% and 1-year hospitalization for HF was 25.9%. Cardiovascular deaths accounted for 57.2% of all deaths in the overall study sample. Similar to in-hospital mortality rates, the highest 1-year mortality rates were observed in patients with cardiovascular disease (54.0%), low admission systolic blood pressure (34.8%), and in congested patients with impaired perfusion (29.8%).

Nutritional status and mortality in the first year

Recent data from the ESC-HF pilot study shows that all-cause mortality and hospitalization rates within 1 year for hospitalized HF patients are very high (17% and 44% respectively).[36] Increased risk of malnutrition is quite common in cardiovascular patients. At the same time, malnutrition is associated with longer hospital stays, more frequent hospitalizations and readmissions, increased risk of treatment-related complications, and even increased risk of death. Therefore, this is a public health issue because it increases treatment costs for patients.[37-39] In our study, the high malnutrition risk group accounted for 31.1% of total patient deaths.

The mortality rate was 88.9% in the high malnutrition risk group, higher than the 56.7% mortality rate in the low risk group, with statistically significant difference at $p<0.05$.

In the study by Antonio Zapatero[11] et al. on the impact of obesity and malnutrition in patients with acute heart failure in Spain from 2006-2008, a total of 370,983 heart failure admissions were analyzed, with 41,127 (11.1%) diagnosed with obesity and 4,105 (1.1%) malnourished. The overall in-hospital mortality rate was 12.9% and the risk of readmission was 16.4%. Obese patients had lower risk of in-hospital mortality (odds ratio [OR]: 0.65, 95% confidence interval [95% CI]: 0.62-0.68) and early readmission (OR: 0.81, 95% CI: 0.78-0.83) than non-obese patients. Malnourished patients had a much higher risk of in-hospital mortality (OR: 1.83 95%CI: 1.69-1.97) or readmission within 30 days after discharge (OR: 1.39, 95%CI: 1.29-1.51), even after adjusting for possible confounding factors.

The prevalence of malnutrition increased with age and number of comorbidities.[40] For HF disease, a recent meta-analysis showed the prevalence of malnutrition risk ranged from 16% to 90%, particularly high in patients with acute HF (AHF) (75–90%).[41] Thus in our study, the 1-year mortality rate of 68% was also similar to this study. Moreover, malnutrition was significantly associated with higher morbidity and mortality rates in heart failure patients,[41] and described as a short-term[42] and long-term[43-45] prognostic factor in patients hospitalized for acute heart failure. Additionally, a recent trial demonstrated that nutritional intervention in malnourished patients hospitalized for heart failure reduced long-term all-cause mortality and heart failure rehospitalization.[46]

Currently, malnutrition screening is recommended on hospital admission in elderly patients[40] and is often overlooked in emergency care. In addition, little is known about the prevalence and impact of malnutrition risk on short-term mortality rates in elderly patients presenting to emergency departments with AHF. Therefore, malnutrition risk needs to be explored as a modifiable prognostic factor to establish routine screening of malnutrition status in emergency situations in elderly AHF patients.

The PICNIC study (Nutritional Condition Intervention Program in Malnourished Patients With Heart Failure) results showed that nutritional intervention in malnourished patients with acute heart failure reduced all-cause mortality and risk of heart failure rehospitalization.[47] Guidelines from the European Society of Cardiology for treatment of acute heart failure recommend monitoring body weight and preventing malnutrition in heart failure patients.[48] However, there are no specific nutritional recommendations for elderly patients at risk of AHF.

Regarding AHF, a randomized, multicenter, controlled clinical trial conducted on 120 malnourished patients hospitalized for heart failure demonstrated that 6 months of personalized nutritional intervention helped reduce the risk of mortality from any cause and the risk of heart failure rehospitalization after 1 year.[47] The efficacy of this nutritional intervention did not differ between patients with or without decreased blood albumin,[49] and was maintained at 2 years.[50]

CONCLUSION

Nutritional status correlated with increased risk of in-hospital mortality. The malnutrition risk assessment score mNutric was correlated with predicted mortality probability. For every 1 point increase in mNutric score, the mortality rate increased by 1.65 times (95% CI: 1.03-1.11) p=0.01. Patients with high malnutrition risk had higher 1-year mortality rates than patients with low malnutrition risk according to the mNutric score.

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