Original Article

Evaluation of the Efficacy of Using Gnri and Mis as a Predictor of Mortality in Elderly Hemodialysis Patients

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Received: 04-Oct-2022;
Revision: 27-Oct-2022;
Accepted: 08-Dec-2022;
Published: 27-Feb-2023

Abstract

Background: Malnutrition is one of the most common geriatric syndromes in hemodialysis (HD) patients. Although there is no gold standard for evaluating nutritional status in HD patients, the Subjective Global Assessment (SGA), Geriatric Nutritional Risk Index (GNRI), and Malnutrition-Inflammation Score (MIS) are widely used in clinical settings. **Aim:** To examine the efficacy of using Geriatric Nutritional Risk Index (GNRI) and Malnutrition-Inflammation Score (MIS) as a predictor of mortality in elderly hemodialysis patients. **Subjects and Methods:** A retrospective cohort study was carried out in Malatya Training and Research Hospital's Hemodialysis Unit between July 2018 and August 2022. Two hundred seventy-four elderly hemodialysis patients were included in the study. Demographic characteristics, laboratory parameters, and anthropometric measurements of the patients were reviewed. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 16.0 software (SPSS Inc., Chicago, IL, USA). Logistic regression analysis was performed to identify independent predictors of mortality. **Results:** The mean age of 83 patients who died was 70.00 ± 8.39 years and 47 (56.6%) of these patients were male. All-cause death occurred in 69 (71.1%) of 97 patients with an MIS of ≥6. All-cause death occurred in 24 (54.5%) of 44 patients with a GNRI score of <91.2. Accordingly, MIS ($P < 0.001$, OR = 1.376 [0.163–0.392]), GNRI ($P = 0.001$, OR = −0.431 [1.189–1.990]), and age ($P = 0.021$, OR = 0.109 [0.818–0.984]) were found to be independent predictors of all-cause mortality. **Conclusions:** GNRI and MIS are important predictors of increased risk of mortality from all causes in elderly HD patients.

Keywords: *Elderly, GNRI, hemodialysis, MIS, mortality*

Introduction

Malnutrition is one of the most common geriatric syndromes in hemodialysis (HD) patients. Approximately 28%–54% of patients have malnutrition. Since malnutrition has significant effects on both quality of life and disease progression, it is very important to detect it easily and accurately. Therefore, approved screening measures are used in establishing patients under risk.[1,2]

Although there is no gold standard for evaluating nutritional status in HD patients, the Subjective Global Assessment (SGA), Geriatric Nutritional Risk Index (GNRI), and Malnutrition-Inflammation Score (MIS) are widely used in clinics. The MIS, used to evaluate both malnutrition and inflammation, has been shown to be a strong predictor of mortality.[3] However, the MIS is time-consuming and has subjective evaluation parameters as a screening test. Because of these features of MIS, it is necessary to develop alternative tests to determine nutritional risk in HD patients. GNRI is one of these tests and was developed by Bouillanne *et al*.[4] to evaluate the nutritional status of elderly

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_672_22

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How to cite this article: Pembegul I, Yakaryilmaz FD. Evaluation of the efficacy of using gnri and mis as a predictor of mortality in elderly hemodialysis patients. Niger J Clin Pract 2023;26:240-5.

patients. Although some subsequent studies showed that GNRI is also effective in predicting mortality, this effect is unclear.[5,6] In a recent study, it was reported that MIS is more powerful than GNRI in predicting mortality.[7]

In Turkey, the effect of MIS and GNRI on predicting mortality in elderly HD patients has not been investigated before. Therefore, we aimed to investigate the importance of MIS and GNRI in predicting all-cause mortality.

Material and Method

Study design and topics

This study was a retrospective cohort study. The files of 328 patients who received hemodialysis treatment at Malatya Training and Research Hospital between July 2018 and August 2022 were analyzed after approval by the Malatya Turgut Ozal University Non-Invasive Clinical Research Ethics Committee (2022/137). Among the files examined, 34 patients were excluded from the study because they were transferred to another dialysis center, 6 patients were diagnosed with liver cirrhosis, and 14 patients had malignant tumors. A total of 274 patients aged 65 years and older who received HD treatment for at least three months were included in the study. All patients received sessions on standard bicarbonate dialysis using a standard biocompatible HD membrane three times a week for a duration of about 3.5–4 h per session. Blood flow rates were 250–300 ml/min and dialysate flow rates were 500 ml/min. Ultrafiltration varied according to the patients' actual weight. Patients with a history of acute infection, liver cirrhosis, active autoimmune disease, multiple organ failure, cognitive impairment, serum parathyroid hormone (PTH) levels >800 pg/mL and advanced malignant tumor were excluded.

Patient assessments and medical and nutritional histories were obtained from hospital records. Serum creatinine, albumin, C-reactive protein, urea, electrolytes and hemoglobin, total iron binding capacity (TIBC), and iron and transferrin were obtained from the laboratory data recorded during the routine examinations of the patients. Dialysis adequacy was evaluated with Kt/V. Anthropometric measurements such as weight, height, and calf circumference (CC) were performed within 10–30 minutes after HD treatment by the clinician.

Malnutrition-inflammation score (MIS)

The MIS consists of 4 parts (medical history, physical examination, body mass index, and laboratory values) and 10 components in total. Each component is scored according to four severity levels, from 0 (normal) to 3 (severely abnormal). The sum of these 10 MIS components can range from 0 (normal) to 30 (severely malnourished). A higher score reflects a more severe degree of malnutrition and inflammation. It is calculated using data including two physical examination findings and body mass index (BMI), serum albumin, and serum transferrin, in addition to five components questioning the dry weight change, appetite status, gastrointestinal symptoms, functional capacity, and dialysis vintage of HD patients in the last three months. An MIS ≥6 was determined as the cut-off value in predicting mortality.[8,9]

Geriatric nutrition risk index (GNRI)

The GNRI was calculated from baseline albumin level and body weight using the formula below. Body weight was calculated as the average weight after the previous three dialysis sessions in kilograms. Ideal body weight was calculated by multiplying 22 by the square of height in meters, based on the BMI. Patients were divided into two groups according to the previously reported GNRI score of 91.2, a threshold value for mortality.[10] The following formula was used for GNRI calculation.

GNRI = [14.89 × albumin (g/dL) + [41.7 × (body weight/ideal body weight)]

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 16.0 software (SPSS Inc., Chicago, IL, USA). The normality of the data was analyzed using the Kolmogorov–Smirnov test. All numerical variables with normal distribution were expressed as mean ± standard deviation (SD). Categorical variables were compared using the Chi-squared test. Normally distributed numerical variables were analyzed using independent sample tests according to the normality of distribution, or one-way ANOVA (*post hoc* Tukey) tests. The relationship between numerical variables was evaluated with the Pearson correlation coefficient. Logistic regression analysis was performed to identify independent predictors of mortality.

Results

A total of 274 elderly HD patients, consisting of 143 (52.2%) women, were included in the study. The mean age of the patients was 67.59 ± 6.51. Hospital records showed that 83 patients died of any cause during a median observation period of 2.3 years. Demographic and laboratory data of deceased and surviving patients are given in Table 1. In a mean follow-up period of 2.3 years, 36 patients (43.4%) had cardiovascular disease (CVD), 29 (34.9%) had infections, 5 (6.0%)

Table 1: Demographic Characteristics, Laboratory Parameters, and Anthropometric Measurements of the Patients

	Exitus (*n*=83)	Alive (*n*=191)	Total (*n*=274)	*P*
Age (year)	70.00±8.39	66.54±5.18	67.59±6.51	<0.001*
Gender				
Male	47 (35.9%)	84 (64.1%)	131 (100.0%)	0.851
Female	36 (25.2%)	107 (74.8%)	143 (100.0%)	
Marital status				
Married	72 (29.6%)	171 (70.4%)	243 (100.0%)	0.105
Single	4 (17.4%)	19 (82.6%)	23 (100.0%)	
Education status				
Illiterate	44 (52.4%)	40 (47.6%)	84 (100.0%)	0.264
Elementary school	30 (24.6%)	92 (75.4%)	122 (100.0%)	
High school	8 (12.1%)	58 (87.9%)	66 (100.0%)	
Social status				
Alone	1 (50.0%)	1 (50.0%)	2 (100.0%)	0.226
With family	82 (30.1%)	190 (69.9%)	272 (100.0%)	
Smoking				
Yes	8 (14.5%)	47 (85.5%)	55 (100.0%)	<0.001*
Alcohol consumption				
Yes	12 (60.0%)	8 (40.0%)	20 (100.0%)	0.568
Comorbidity				
Diabetes mellitus	32 (35.6%)	58 (64.4%)	90 (100.0%)	0.384
Hypertension	38 (38.8%)	60 (61.2%)	98 (100.0%)	
Cardiovascular disease	27 (36.0%)	48 (64.0%)	75 (100.0%)	
Others	30 (24.2%)	94 (75.8%)	124 (100.0%)	
Dialysis vintage (month)	64.47±46.13	66.31±42.83	65.75±43.77	0.742
MIS	8.81±2.83	4.21±1.16	5.63±2.79	<0.001*
GNRI	95.23±8.31	102.52±9.98	100.31±10.07	<0.001*
Number of drugs	4.65±0.76	4.70±0.85	4.68±0.82	0.845
Body mass index (kg/m^2)	25.43±5.32	26.80±5.40	25.44±5.41	0.108
Calf circumference (cm)	28.56±6.54	31.48±7.81	30.58±7.36	0.035*
Hemoglobin (g/dl)	10.90±1.38	10.25±1.89	10.45±1.77	0.001*
Kt/V	1.69±0.36	1.79±0.33	1.76±0.34	0.565
Creatinine (mg/dl)	8.45±2.87	9.25±3.25	9.01±3.16	0.244
Urea (mg/dl)	124.45±31.09	122.10±47.32	122.81±43.01	0.785
Calcium (mg/dl)	8.95±0.94	9.25±0.74	9.16±0.82	0.036*
Potassium (mmol/l)	5.13±0.80	5.20±0.96	5.18±0.92	0.032*
Albumin (g/dl)	3.55±0.35	3.66±0.27	3.62±0.30	0.056
C-reactive protein (g/dl)	0.78±0.02	0.58±0.01	0.64±0.2	0.045*

had cerebrovascular events, and 13 (15.7%) died from other causes. The mean age of 83 patients who died was 70.00 ± 8.39 years and 47 (56.6%) were male. While the mean age, MIS, and CRP levels of the patients who died were significantly higher, the GNRI scores of patients were low.

All-cause death occurred in 69 (71.1%) of 97 patients with an MIS of ≥6. All-cause death occurred in 24 (54.5%) of 44 patients with a GNRI score of <91.2. In the analysis of anthropometric measurements, the CC of the deceased group was found to be significantly lower (P = 0.035). Among laboratory tests, CRP level was significantly higher in HD patients who died (P = 0.045).

In the correlation analysis, a negative correlation was found between MIS and GNRI (r = −0.264, P < 0.001) [Table 2]. There was a negative correlation between GNRI and age, whereas there was a positive correlation between GNRI and BMI, dialysis vintage, and albumin levels.

Logistic regression analysis was performed to determine the parameters that affected the risk of death from all causes in the participants. Accordingly, MIS (P < 0.001, OR = 1.376 [0.163–0.392]), GNRI (P = 0.001, OR = −0.431 [1.189–1.990]), and age (P = 0.021, OR = 0.109 [0.818–0.984]) were found to be independent predictors of all-cause mortality [Table 3].

Table 2: Correlation Analysis between MIS, GNRI, Age, BMI, Dialysis Vintage, and Albumin

	MIS	GNRI	Age	BMI	Dialysis vintage	Albumin
MIS						
r	1	−0.264**	0.107	0.084	−0.035	−0.062
P		0.000	0.077	0.165	0.565	0.309
GNRI						
r		1	−0.177**	0.508**	0.145*	0.286**
P			0.003	0.000	0.016	0.000
Age						
r			1	−0.068	−0.045	−0.052
P				0.260	0.453	0.391
BMI						
r				1	−0.128*	0.284**
P					0.035	0.000
Dialysis vintage						
r					1	−0.254**
P						0.000
Albumin						
r						1
P						

MIS: Maltutrion-Inflamation score; GNRI: Geriatric Nutrition Risk Index; BMI: Body Mass Index; m: Month. **Correlation is significant at the 0.01 level (two-tailed). *Correlation is significant at the 0.05 level (two-tailed)

Table 3: Logistic regression analysis to determine the parameters that affect the risk of death from all causes

	P	OR	95% CI	
MIS	<0.001	1.38	0.163	0.392
GNRI	0.001	−0.431	1.189	1.990
Dialysis vintage (month)	0.266	0.007	0.980	1.006
Albumin (g/dl)	0.975	0.062	0.020	44.667
Age (year)	0.021	0.109	0.818	0.984

Discussion

The MIS is a comprehensive test on nutrition, inflammation and anemia parameters that correlate with hospitalization and mortality. GNRI, on the other hand, is another tool that has been developed for elderly patients and is used to evaluate nutritional status and mortality in a practical and rapid manner. In this retrospective study, we investigated the relationship between nutritional status and all-cause mortality in elderly HD patients. Accordingly, it predicted mortality in two out of three HD patients with an MIS of ≥6 and in one out of two HD patients with a GNRI score of <91.2 during a mean follow-up of 2.3 years. Additionally, we found that advanced age was a predictive value of mortality. We found that MIS was more effective than GNRI in reliably assessing the nutritional and inflammatory status of HD patients, as well as identifying individuals at high risk for mortality.

In our study, we found that MIS was effective in the evaluation of mortality compared to other malnutrition or inflammation markers, in line with the literature.[11,12] The CC, which was used in the evaluation of nutritional status, was also found to be significantly lower in the deceased group. When patients who followed up for chronic renal failure (CRF) were evaluated with anthropometric measurements and nutritional biomarkers, it was determined that the MIS was associated with an increased risk of mortality in CRF. From this point of view, in addition to the anthropometric measurements made at regular intervals in elderly HD patients, the MIS also must be calculated and evaluated together in the prevention of possible mortality and hospitalization risk.

In studies evaluating survival in HD patients, it has been shown that BMI is paradoxically associated with survival among anthropometric parameters.[13,14] Although BMI was not found to be one of the predictive parameters of mortality in our study, the BMI of the patients who died due to all causes was found to be lower. We also found a negative correlation between BMI and the MIS, and a positive correlation with the GNRI score. This can be explained by the fact that BMI is affected by many factors associated with survival, such as muscle mass, hydration, nutrition, and visceral adipose tissue. However, since our study population was based on data from a single center, the effect of BMI on mortality should be supported by studies with a higher number of participants.

We showed that MIS was superior to CRP, one of the inflammatory markers used in mortality estimation, in line with the literature.[15] In the one-year follow-up of

69 HD patients in Turkey, CRP levels were also found to be predictor of mortality in addition to age and the MIS.[16] Rambod *et al*.[17] published similar results for hemodialysis patients, indicating that the MIS is more comprehensive than other inflammation parameters.

Malnutrition and inflammation are often seen together in HD patients. The MIS is associated with worse clinical conditions and worse outcomes in this group of patients. However, another tool frequently used to evaluate the nutritional and inflammatory status of dialysis patients is the GNRI.[18] Although the GNRI is a prospectively validated, and easy and reliable tool for determining nutritional status and estimating degree of disease, it is a more quantitative scale. Studies have shown that GNRI is a predictor of morbidity and mortality, as well as a determiner of nutritional status in HD patients.[19,20] A recently published meta-analysis showed that low GNRI scores is an important predictor of cardiovascular and all-cause mortality in HD patients.[5] The fact that the studies included in this meta-analysis belong to Asian, Middle Eastern, and European countries shows that GNRI can also be applied to individuals with different lifestyles, ethnic origins, and racial characteristics. All of these data show that the GNRI is a universal nutritional assessment tool for evaluating HD patients. However, multiple thresholds for the GNRI have been reported to predict mortality in HD patients. In the prediction of mortality in HD patients, the GNRI cut-off value determined by Yamada *et al*. was recommended as 91.2.[3] When the threshold value of 91.2 was used in our study, we found that one out of every two patients with a GNRI <91.2 developed all-cause death. Mortality rates of the group with a GNRI ≥91.2 were significantly lower. Many studies in the literature have reported that GNRI is a strong predictor of all-cause mortality.[7,10,21] We found that, in line with the literature, the GNRI had high sensitivity in predicting mortality.[21,22] On the other hand, in our study, compared to the GNRI, the MIS was better in predicting mortality. Some studies showed that the predictive value of the GNRI for cardiovascular and all-cause mortality was similar to that of the MIS.[23,24] In light of all this information, the GNRI is a tool that can be calculated more easily compared to the MIS. Therefore, the GNRI may be more useful for repeated nutritional assessments.

There were some limitations to our study. The first of these was the small sample size. Since it was designed as a retrospective study, it is insufficient to evaluate the direct cause-and-effect relationship. As the study was performed during the COVID-19 pandemic, mortality results may have been affected by this issue. However, despite these limitations and to our knowledge, this is the first study evaluating mortality in elderly HD patients using the MIS and GNRI.

Our study showed that the MIS and GNRI are important predictors of increased risk of mortality from all causes in elderly HD patients. Although previous studies reported that the MIS and GNRI had a high level of reliability in health care institution evaluation, mortality predictability of the MIS was higher than that of the GNRI.[24] However, an important disadvantage is that it requires the use of professional and trained personnel in calculating the MIS. In this respect, tools such as the GNRI that can be implemented more easily and faster should be validated with more comprehensive studies.

Consequently, the MIS and GNRI may guide physicians to identify high-risk patients in early stages and to reduce the risk by appropriate interventions.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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