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The value of malnutrition-inflammation-atherosclerosis (MIA) syndrome for predicting mortality in patients with end-stage renal disease at Hue Central Hospital

Thi Khanh Trang Ngo, Bui Bao Hoang*, Tam Vo

University of Medicine and Pharmacy - Hue University

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Abstract:

Background: the role of malnutrition, inflammation, atherosclerosis, and particularly the combination of these three factors were closely related to cardiovascular events, hospitalisation frequency, and death in end-stage renal disease (ESRD) patients. This study examines the relationship between malnutrition-inflammation-atherosclerosis (MIA) syndrome and mortality among these patients during an 18-month period.

Subjects and methods: in this prospective observational cohort study, all cause-mortality was evaluated during an 18-month follow-up period. A total of 174 patients with ESRD (including 57 non-dialysis patients, 56 peritoneal dialysis patients, and 61 hemodialysis patients) were enrolled. M (malnutrition) was assessed by the seven-point subjective global assessment (SGA), serum albumin. I (inflammation) was assessed by serum hs-CRP, serum IL-6. A (atherosclerosis) was defined as IMT ≥0.9 mm or the presence of plaque in the carotid artery. The patients are classified into four groups by number of components (MIA0, MIA1, MIA2, MIA3).

Results: 73.6% of patients had at least one component of MIA syndrome. The proportion of patients with malnutrition, inflammation, and atherosclerosis accounted for 36.8%, 21.3%, and 50.6%, respectively. The proportion of patients with 3, 2, 1 component accounted for 4.0, 27.0, and 42.5%. There was no difference between MIA groups based on age, sex, percentage suffering from dyslipidemia, anemia, or Hb levels. Relative to patients experiencing no elements of MIA syndrome, patients with three components experienced a 13.16 times higher risk of mortality. Only malnutrition was a strong predictor of mortality with HR (95% CI): 5.90 (2.46-14.14).

Conclusion: clinical physicians should attend more closely to and provide early assessments of MIA syndrome in patients with ESRD. They should care for nutrition conditions and thereby provide early and effective treatments. This can contribute to enhancements in quality of life, and decrease mortality rates in patients.

Keywords: **end-stage renal disease, malnutrition-inflammation-atherosclerosis syndrome, MIA syndrome.**

Classification number: **3.2**

Introduction

Chronic kidney disease (CKD) is a global health problem which has received substantial attention in medicine because it has become increasingly common. This has increased treatment costs and decreased quality of life. Patients with CKD have received improved care by many measures, which has advanced patients' lifespans and considerably enhanced disease prognoses. However, the mortality rate among patients with end-stage renal disease (ESRD) remains high, and deaths associated with cardiovascular events are the most concerning. Many researchers have demonstrated the role of malnutrition, inflammation, and atherosclerosis in these outcomes, and particularly the combination of the three factors was closely associated with cardiovascular events, hospitalisation frequency, and death among these patients [1-3]. Nephrologists are currently concerned about the treatment, quality of life advancement, and minimisation of mortality rates among patients with CKD. In Vietnam, although a complete study has not determined the number of CKD patients yet, it was estimated that 20,000 ESRD patients were under treatment with the renal replacement therapy. The mortality of this population has not been

*Corresponding author: Email: bsbao@yahoo.com

investigated yet. Therefore, this study was designed to examine the prognostic value of malnutrition-inflammation-atherosclerosis (MIA) syndrome regarding mortality during an 18-month follow-up with ESRD patients.

Methods

Ethics statement

This study was approved by the Research and Ethical Committees for the use of human subjects at Hue University of Medicine and Pharmacy; informed consent from the patients is required.

Study design and patients

This is a prospective observational cohort study with no treatment interventions; all cause-mortality was recorded during the 18-month follow-up period. Convenience sampling was used for the research, and all subjects eligible were invited to participate.

This research was performed at the department of Nephrology and the Department of Dialysis at Hue Central Hospital in Hue city, Vietnam, from 1/2014 to 2/2017. A total of 174 patients with ESRD (including 57 non-dialysis patients, 56 peritoneal dialysis patients, and 61 hemodialysis patients) were enrolled.

In terms of patient selection criteria patients with ESRD who were at least 18 years old, agreed to participate in the study. Non-dialysis patients with glomerular filtration <15 ml/min/1.73 m^2 (eGFR based on formula of CKD-EPI 2009) were enrolled. Additionally, continuous ambulatory peritoneal dialysis patients had been stable for at least two months (when the postoperative catheter placement was stable and the patient had mastered the procedure). Hemodialysis patients were treated three times weekly for at least three months.

The exclusion criteria applied included fever (defined as axillary temperature >37.5^{0}C), acute or chronic infection, and patients accompanied by one of the following diseases or conditions: cerebrovascular disease, coronary artery disease, peripheral vascular disease, congenital heart disease, heart valve disease, arthritis, malignant disease, chronic lung disease, cirrhosis, autoimmune disease, trauma, acute exacerbation of chronic kidney failure, complications related to peritoneal dialysis patients such as catheter issues, herniae, and hydrothorax, fistula vein stenosis, or renal transplantation.

Definition of MIA factors and grouping

M (malnutrition) was measured with the seven-point SGA (if items SGA ≤5 points with no manifestations of normal nutrition) combined with serum albumin levels <40 g/l [4]. I (inflammation) was defined as serum hs-CRP level >5 mg/l (upper reference values) combined with serum IL-6 level >5.53 pg/ml (upper reference values). A (atherosclerosis) was defined as IMT ≥0.9 mm or the presence of plaque in the carotid artery [5].

The patients were classified into for groups based on the number of the components: MIA0, MIA1, MIA2, MIA3.

Techniques applied in this research

Venous blood samples were taken in the morning after an overnight fast, and prior to dialysis. A machine of Cobas e 501 was used for quantifying chemo-biological indices (albumin, total cholesterol, triglyceride, HDL-C, LDL-C, hs-CRP), of IMMULITE 2000 XPI for quantifying plasma IL-6 levels.

An Acuson X500 Ultrasound Machine was used for the diagnosis of atherosclerosis of the carotid artery. 7-5 MHz linear transducers were used for the assessment of the intima-media thickness and plaque morphology. This technique was performed by an experienced radiologist.

Collecting information regarding mortality during the 18-month follow-up period

Non-dialysis patients: made contact with the patients by phone. They received reexamination once every month. This enabled us to collect important information regarding disease progress (including events, death), treatment compliance, and patients' and their families' thoughts and desires regarding treatment choices for kidney failure.

After monitoring for 18 months, we discovered the following change in the quantity in the non-dialysis group:

Firstly, 28 patients who had received renal replacement therapy with peritoneal dialysis and hemodialysis were excluded from the analysis because our aim is solely to conduct observational research, as opposed to treatment intervention.

Secondly, among the other 29 patients, 19 patients and their families initially refused renal replacement therapy and asked for dialysis delay. 18 months later, they also received dialysis. The other 10 patients had glomerular filtration rates at 10-15 ml/minute. Because there were not yet symptoms associated with uremia and events (volume overload, metabolic abnormalities...), there were no indications of dialysis. This group was periodically treated and monitored. Therefore, for 18 months, there had still been 29 patients who received medical treatment and then dialysis. Therefore, for the analysis of the prognostic value of MIA syndrome, only 146 patients remained.

Patients with peritoneal dialysis and hemodialysis were monitored through appointments each month (patients

with peritoneal dialysis) and through each dialysis session (patients with hemodialysis). Deaths were recorded based on outpatient medical records.

Our data only indicated the clinical value of MIA syndrome for predicting all-cause mortality in patients with ESRD.

Statistical analysis

All statistical analyses were performed using SPSS V22.0 (Statistical Package for Social Sciences). Quantitative variables were expressed as the mean ± standard deviation. Qualitative variables were expressed in terms of frequencies and percentages. Two ratios were compared using a Chi-squared test. An ANOVA test was used to compare means between groups. The COX model and the Kaplan-Meier method were used to investigate survival factors. The Kaplan-Meier method was used to analyse cumulative survival probability, and the COX model was applied to investigate the prognostic value of elements of MIA syndrome in relation to all-cause mortality. Differences with $p<0.05$ were considered statistically significant.

Results

Initially, the 174 patients (83 males and 91 females) included 57 non-dialysis patients, 56 peritoneal dialysis patients, and 61 hemodialysis patients. The average ages of these research subjects were 48.11±15.10, among whom non-dialysis patients were 50.83±16.67, peritoneal dialysis patients were 47.66±12.82; and hemodialysis patients were 45.98±15.36 (Tables 1, 2; Fig. 1).

Table 1. Percentage of patients who experienced at least one element of MIA.

Group	Experienced at least one factor of MIA		No factors of MIA	
	n	*%*	*n*	*%*
Non-dialysis (n=57)	42	73.7	15	26.3
Peritoneal dialysis (n=56)	41	73.2	15	26.8
Hemodialysis (n=61)	45	73.8	16	26.2
Total	128	73.6	46	26.4
p	>0.05			

Table 2. Percentage of patients by number of MIA elements.

Group	MIA3		MIA2		MIA1		MIA0	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Non-dialysis (n=57)	3	5.3	18	31.6	21	36.8	15	26.3
Peritoneal dialysis (n=56)	2	3.6	14	25.0	25	44.6	15	26.8
Hemodialysis (n=61)	2	3.3	15	24.6	28	45.9	16	26.2
Total	7	4.0	47	27.0	74	42.5	46	26.5
p	>0.05*		>0.05		>0.05		>0.05	

* Fisher test.

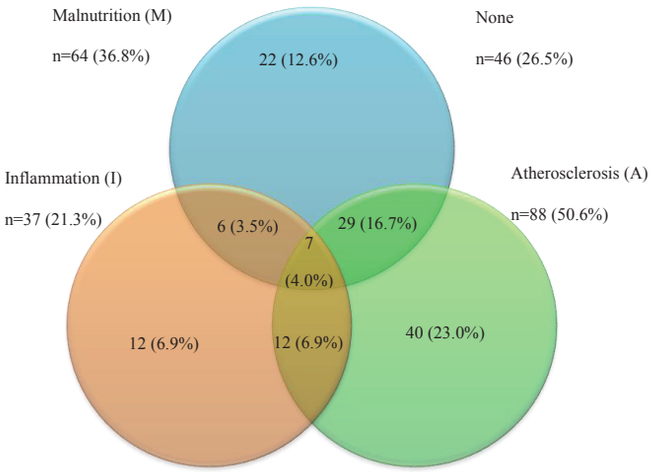

Fig. 1. Relationships between components of MIA syndrome among the patients.
Notably, 26.5% of the patients experienced no malnutrition, inflammation, or atherosclerosis.

During the 18-month follow-up period, 25 patients died from all causes. No differences were observed in terms of age, sex, percentage of patients with anemia, dyslipidemia, or treatment methods between the non-survival and survival groups (Table 3).

Table 3. Comparison between initial data among the non-survival group as opposed to the survival group.

Parameters		Non-survivals (n=25)		Survivals (n=121)		P-value
		n	*%*	*n*	*%*	
Age (years)	$\bar{X}$±SD	50.24±16.42		47.92±14.76		>0.05
Sex	Male	8	32.0	64	52.9	>0.05
	Female	17	68.0	57	47.1	
Patients with anemia	Yes	24	96.0	106	87.6	>0.05
	No	1	4.0	15	12.4	
Patients with dyslipidemia	Yes	19	76.0	87	71.9	>0.05
	No	6	24.0	34	28.1	
Treatment method	Non-dialysis	5	20.0	24	19.8	>0.05
	Peritoneal dialysis	10	40.0	46	38.0	
	Hemodialysis	10	40.0	51	42.2	

The probability of survival was diminished in malnourished patients (Table 4 and Fig. 2). Meanwhile, there was no significant difference in the probability of survival between patients with and without inflammation (Table 5 and Fig. 3). This was also noted between patients with and without atherosclerosis (Table 6 and Fig. 4).

Table 4. Probability of survival for patients with and without malnutrition.

Malnutrition	Group													
	Non-dialysis (n=29)				*Peritoneal dialysis (n=56)*				*Hemodialysis (n=61)*				*Total (n=146)*			
	Non-survivals (n=5)		*Survivals (n=24)*		*Non-survivals (n=10)*		*Survivals (n=46)*		*Non-survivals (n=10)*		*Survivals (n=51)*		*Non-survivals (n=25)*		*Survivals (n=121)*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Yes	5	41.7	7	58.3	7	35.0	13	65.0	6	33.3	12	66.7	18	36.0	32	64.0
No	0	0.0	17	100.0	3	8.3	33	91.7	4	9.3	39	90.7	7	7.3	89	92.7
p Log Rank	<0.05				<0.05				<0.05				<0.001			

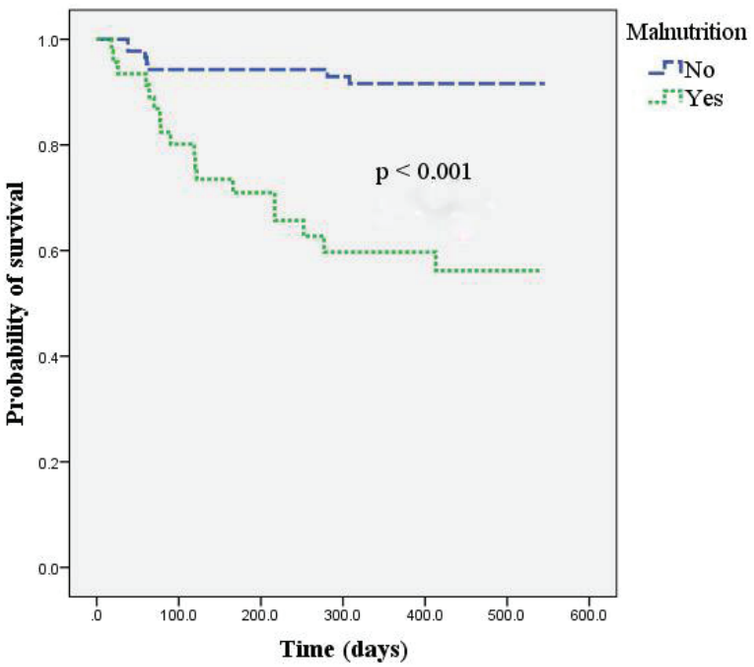

Fig. 2. Kaplan-Meier survival curves for patients with and without malnutrition.

Table 5. Probability of survival for patients with and without inflammation.

Inflammation	Group													
	Non-dialysis (n=29)				*Peritoneal dialysis (n=56)*				*Hemodialysis (n=61)*				*Total (n=146)*			
	Non-survivals (n=5)		*Survivals (n=24)*		*Non-survivals (n=10)*		*Survivals (n=46)*		*Non-survivals (n=10)*		*Survivals (n=51)*		*Non-survivals (n=25)*		*Survivals (n=121)*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Yes	3	42.9	4	57.1	2	15.4	11	84.6	1	7.1	13	92.9	6	17.6	28	82.4
No	2	9.1	20	90.9	8	18.6	35	81.4	9	19.1	38	80.9	19	17.0	93	83.0
p Log Rank	<0.05				>0.05				>0.05				>0.05			

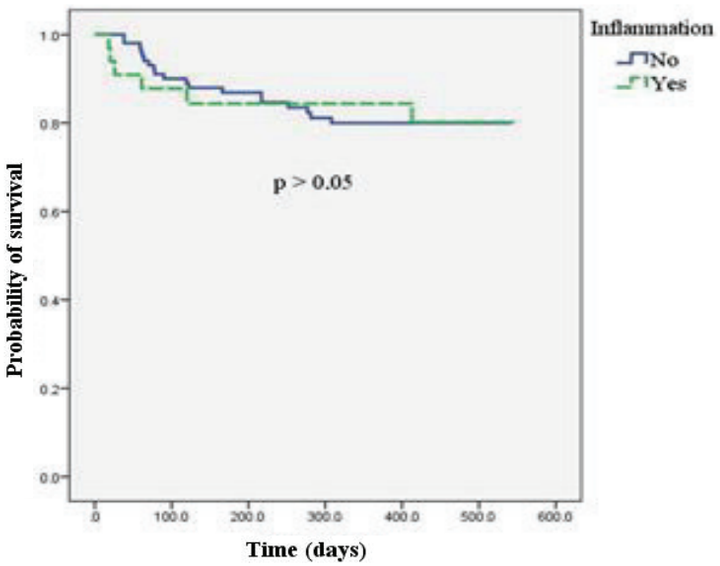

Fig. 3. Kaplan-Meier survival curves for patients with and without inflammation.

Table 6. Probability of survival for patients with and without atherosclerosis.

Atherosclerosis	Group															
	Non-dialysis (n=29)				*Peritoneal dialysis (n=56)*				*Hemodialysis (n=61)*				*Total (n=146)*			
	Non-survivals (n=5)		*Survivals (n=24)*		*Non-survivals (n=10)*		*Survivals (n=46)*		*Non-survivals (n=10)*		*Survivals (n=51)*		*Non-survivals (n=25)*		*Survivals (n=121)*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Yes	5	29.4	12	70.6	5	19.2	21	80.8	5	15.6	27	84.4	15	20.0	60	80.0
No	0	0.0	12	100.0	5	16.7	25	83.3	5	17.2	24	82.8	10	14.1	61	85.9
p Log Rank	>0.05				>0.05				>0.05				>0.05			

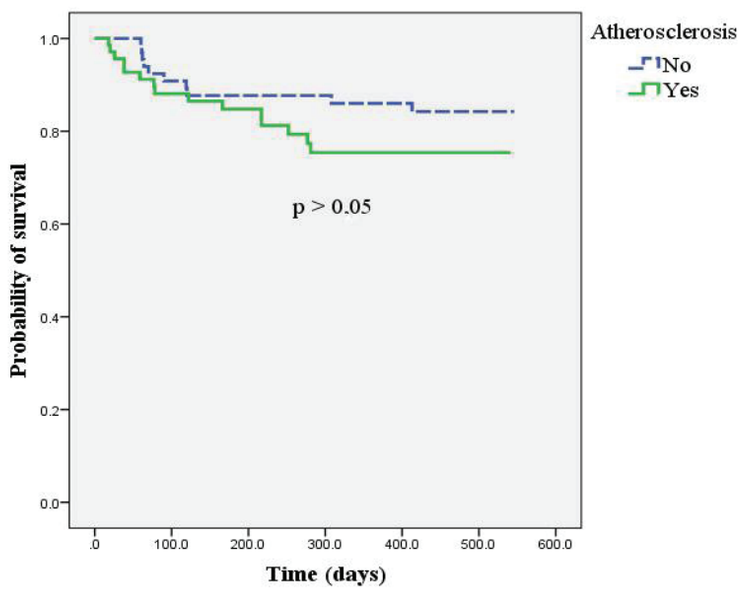

Fig. 4. Kaplan-Meier survival curves for patients with and without atherosclerosis.

Of all of the components of MIA, we discovered that only malnutrition was the independent predictor of mortality (Table 7).

Table 7. COX proportional hazards analysis for mortality in patients in relation to malnutrition.

Malnutrition	HR	95% CI	P-value
No	1	Reference	-
Yes	5.90	2.46-14.14	<0.001

The probability of mortality was significantly related to the presence and number of elements of MIA syndrome (Table 8 and Fig. 5). If the patient experienced all three components, the probability of mortality was 42.9%. Conversely, in patients without any components, this probably was 5.0%.

Table 8. Probability of survival for patients in relation to MIA groups.

MIA groups	Group														
	Non-dialysis (n=29)				*Peritoneal dialysis (n=56)*				*Hemodialysis (n=61)*				*Total (n=146)*			
	Non-survivals (n=5)		*Survivals (n=24)*		*Non-survivals (n=10)*		*Survivals (n=46)*		*Non-survivals (n=10)*		*Survivals (n=51)*		*Non-survivals (n=25)*		*Survivals (n=121)*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
MIA3	3	100.0	0	0.0	0	0.0	2	100.0	0	0.0	2	100.0	3	42.9	4	57.1
MIA2	2	20.0	8	80.0	5	35.7	9	64.3	3	20.0	12	80.0	10	25.6	29	74.4
MIA1	0	0.0	7	100.0	4	16.0	21	84.0	6	21.4	22	78.6	10	16.7	50	83.3
MIA0	0	0.0	9	100.0	1	6.7	14	93.3	1	6.2	15	93.8	2	5.0	38	95.0
p Log Rank	<0.001				>0.05				>0.05				<0.05			

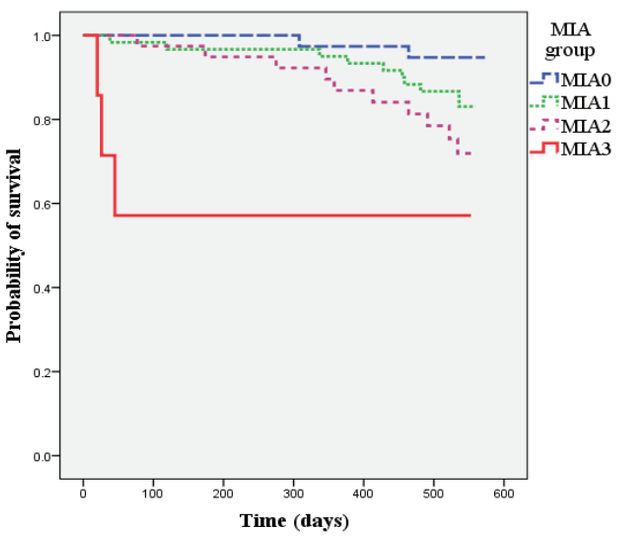

Fig. 5. Kaplan-Meier survival curves for patients in relation to MIA groups.

Relative to patients without any components of MIA, patients with all three components experienced an increased risk of death by a factor of 13.16 (Table 9).

Table 9. COX proportional hazards analysis for mortality in relation to MIA groups.

MIA group	HR	95% CI	P-value
MIA0	1	Reference	-
MIA3	13.16	2.20-78.86	<0.05
MIA2	5.58	1.22-25.48	<0.05
MIA1	3.39	0.74-15.50	>0.05

Discussion

Malnutrition, inflammation, and atherosclerosis are all common causes of morbidity and mortality in ESRD patients. In addition, each component is predictive of cardiovascular events in these subjects [1, 6-8]. The strong association between inflammation, malnutrition, and atherosclerosis has been demonstrated in several studies and was summarised in a syndrome called MIA syndrome [9-11].

Our results demonstrated that 73.6% of patients in the study group experienced at least one component of MIA syndrome; the proportion of these patients experiencing three components was 4.0%. This was 22.0% lower than that in a study by P. Stenvinkel, et al. (Sweden) which examined 109 predialysis patients [11]; 23.44% in A.R. Qureshi, et al. (Sweden) on over 128 patients with maintenance haemodialysis [6]; 11.0% in K. Turkmen, et al. (Turkey) on over 80 patients with maintenance haemodialysis and peritoneal dialysis [9]. In another study by A.Y. Wang, et al. (China) on 238 patients with peritoneal dialysis, the researchers identified MIA3 among 36 patients (15.1%), MIA2 among 62 patients (26.1%), MIA1 among 81 patients (34.0%), and MIA0 among 59 patients (24.8%) [8].

We discovered a difference in the distribution of the number of components between the results of our study and those of the researchers'. The causes of the difference may be related to the criteria for the diagnosis of MIA syndrome and the research subjects. In foreign countries, the causes of diabetes mellitus and hypertension accounted for a significant proportion while chronic glomerulonephritis and chronic pyelonephritis were the primary causes in our country. In addition, race is also related to inflammation and atherosclerosis rates.

H.Z. Tonbul, et al. (Turkey) conducted a study which examined 30 patients with peritoneal dialysis and 30 patients with maintenance haemodialysis. The results demonstrated that the MIA3 rate in the group with peritoneal dialysis was 3.33% and 0.0% in the group with maintenance haemodialysis [12].

Another study by Renée de Mutsert, et al. (Netherlands) which involved 815 patients with maintenance haemodialysis demonstrated that the MIA3 rate was 6% [2]. Therefore, our results are similar to those.

The association between malnutrition, inflammation and atherosclerosis was further confirmed by the overlap in the presence of these components in MIA syndrome (see Fig. 1). This result was identified by studies performed across the world:

A study by P. Stenvinkel, et al. examined the association between malnutrition, inflammation and atherosclerosis in 109 non-dialysis ESRD patients. It demonstrated that a significant proportion of patients with atherosclerosis also experienced malnutrition (24.0%), inflammation (13.0%) or both (30.0%). The majority of patients experienced inflammation (97.0%) and malnutrition (89.0%) with plaque in the carotid artery [11].

Similarly, the association between malnutrition, inflammation and atherosclerosis was also confirmed in diabetic patients with peritoneal dialysis [13] or ESRD patients (patients with maintenance haemodialysis and peritoneal dialysis) [7].

Our results and those of other researchers have identified the overlap between malnutrition, inflammation and atherosclerosis in ESRD patients. In addition, we discovered no difference in the number of components of MIA in all three groups (Tables 1, 2). This suggests that one, two, or all three components of MIA may be present among non-dialysis CKD patients as well as in patients who have received renal replacement therapy (with peritoneal dialysis and hemodialysis). This resulted in increased hospitalisations, morbidity and mortality from cardiovascular diseases, as well as quality of life decreases among those with many risks [14, 15].

In terms of the predictive value of MIA syndrome in ESRD patients, studies performed across the world have indicated that each component has an independent predictive value [1, 6-8]. However, we only demonstrated that malnutrition is an independent predictor of mortality in the study population. Our findings were consistent with other studies conducted around the world which illustrated that malnutrition is a risk factor for increases in morbidity and mortality in ESRD patients [16-18].

Therefore, it was an issue that we demonstrated that only malnutrition was an independent predictor of mortality in this study. This may be because serum hs-CRP and IL-6 levels were only assessed once. This could not be a representative of chronic inflammation; the follow-up duration in the study may not have been sufficiently lengthy (18 months); the cause of CKD of our subjects is chronic glomerulonephritis and chronic pyelonephritis. Meanwhile, research subjects in foreign countries are primarily patients with CKD due to diabetes and hypertension.

Although inflammation has been demonstrated to be an independent predictor of death from cardiovascular disease in many studies, the risk of cardiovascular events in inflammatory patients in our study did not depend significantly on serum hs-CRP and IL-6 levels. The current perception held that malnutrition is a risk factor for cardiovascular disease in uremic environments and that this is the cause of increased mortality in malnutrition patients. The exact mechanism of malnutrition that possibly increased the risk of cardiovascular disease remained unclear. It has recently been proven that malnutrition combined with an increase in oxidative stress can weaken the inner lining of the blood vessels, which may reduce the biological benefits of nitric oxide; this can precipitate immune system disorders which render the body susceptible to inflammation, infection and cardiovascular disease through the following hypothesis. This finding suggests that malnutrition exacerbated outcomes in CKD patient by contributing to present inflammation and atherosclerosis.

The strengths of this study, however, were that we investigated the role of compound elements believed to exert synergistic effects in relation to MIA syndrome. The results illustrated that the risk of mortality during the 18-month follow-up period would increase along with the number of components in MIA syndrome as follows: the risk of increased mortality in patients with two or more components. It was remarkable that the MIA3 group faced the risk of death increasing 13.16 times more relative to patients without component of MIA syndrome.

Studies performed around the world have also demonstrated an increased risk of mortality associated with MIA syndrome [2, 3, 6].

Therefore, it is necessary to proactively attend to and evaluate MIA syndrome; nutritional status should receive special attention for timely intervention to reduce the risk of death in these patients. However, this also presented a major challenge in clinical practice because many factors exerted effects on the assessment of nutritional status and inflammation in CKD patients. Malnutrition and inflammation tended to occur simultaneously and coexisted in ESRD patients. Some causes of malnutrition were also factors that promoted inflammation and vice versa. Therefore, MIA syndrome was proposed to emphasise the association of these two conditions in ESRD patients.

In summary, similarly to worldwide studies, we also discovered an interaction between malnutrition, inflammation, and atherosclerosis in ESRD patients. In the circle of this pathology, inflammation was mediated by inflammatory cytokines that caused malnutrition through the mechanism of energy consumption increases at rest, muscle protein breakdown increases, appetite suppression, and anorexia. Moreover, inflammation was also the cause of atherosclerosis; conversely,

atherosclerosis caused inflammatory pathology. Finally, malnutrition contributed to developing chronic inflammation and atherosclerosis, which increased morbidity and mortality from cardiovascular disease in ESRD patients [11, 13].

Limitations of the study

The data only indicated the clinical value of MIA syndrome for predicting all-cause mortality in patients with ESRD. The study did not analyse the association between MIA syndrome and death from cardiovascular disease.

Conclusions

Studying 174 patients (including 57 non-dialysis patients, 56 peritoneal dialysis patients, and 61 hemodialysis patients) during the 18-month follow-up period has yielded the following conclusions:

- 73.6% of patients had at least one component of MIA syndrome. The proportion of patients with malnutrition, inflammation, and atherosclerosis accounted for 36.8%, 21.3%, and 50.6%, respectively. The proportion of patients with 3, 2, and 1 components accounted for 4.0%, 27.0%, and 42.5%, respectively.

- There is no difference between MIA groups in terms of age, sex, percentage of dyslipidemia, anemia, and Hb levels.

- Relative to patients experiencing no elements of MIA syndrome, patients with three components had an increased risk of mortality by a factor of 13.16. Only malnutrition was a strong predictor of mortality with HR (95% CI): 5.90 (2.46-14.14).

Recommendation

The findings of the research indicate the following recommendations: clinical physicians should attend more closely to and provide an early assessment of malnutrition-inflammation-atherosclerosis syndrome in patients with ESRD. They should care for nutrition conditions, based on which they can provide an early and positive treatment. This can advance quality of life and decrease mortality rates in ESRD patients.

The authors declare that there is no conflict of interest regarding the publication of this article.

REFERENCES

[1] I. Akdag, Y. Yilmaz, S. Kahvecioglu, et al. (2008), "Clinical value of the malnutrition-inflammation-atherosclerosis syndrome for long-term prediction of cardiovascular mortality in patients with end-stage renal disease: a 5-year prospective study", *Nephron Clinical Practice*, **108**, pp.99-105.

[2] Renée de Mutsert, D.C. Grootendorst, J. Axelsson, et al. (2008), "Excess mortality due to interaction between protein-energy wasting, inflammation and cardiovascular disease in chronic dialysis patients", *Nephrology Dialysis Transplantation*, **23**, pp.2957-2964.

[3] D. Sueta, S. Hokimoto, K. Sakamoto, et al. (2016), "Validation of the high mortality rate of malnutrition - inflammation - atherosclerosis syndrome - community - based observational study", *International Journal of Cardiology*, **30**, pp.1-6.

[4] National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF KDOQI) (2000), "Clinical practice guidelines for nutrition in chronic renal failure", *American Journal of Kidney Diseases*, **35(6)**, pp.1-140.

[5] A. Zachetti (2003), "2003 European society of hypertension European society of cardiology guidelines for the management of arterial hypertension", *Jounal of Hypertension*, **21**, pp.1011-1053.

[6] A.R. Qureshi, A. Alvestrand, J.C. Divino-Filho, et al. (2002), "Inflammation, malnutrition, and cardiac disease as predictors of mortality in hemodialysis patients", *Journal of the American Society of Nephrology*, **13**, pp.28-36.

[7] K. Turkmen, H.Z. Tonbul, F.M. Erdur, et al. (2013), "Peri-aortic fat tissue and malnutrition-inflammation-atherosclerosis/calcification syndrome in end-stage renal disease patients", *International Urology and Nephrology*, **45**, pp.857-867.

[8] A.Y. Wang, J. Woo, C.W. Lam, et al. (2005), "Associations of serum fetuin-A with malnutrition, inflammation, atherosclerosis and valvular calcification syndrome and outcome in peritoneal dialysis patients", *Nephrology Dialysis Transplantation*, **20(8)**, pp.1676-1685.

[9] K. Turkmen, H. Kayikcioglu, O. Ozbek, et al. (2011), "The relationship between epicardial adipose tissue and Malnutrition, Inflammation, Atherosclerosis/Calcification syndrome in ESRD patients", *Clinical Journal of the American Society* of *Nephrology*, **6**, pp.1920-1925.

[10] Y.Y. Hyun, K.B. Lee, S.H. Hanson, et al. (2017), "Nutritional status in adults with predialysis chronic kidney disease: KNOW-CKD study", *Journal of Korean Medical Science*, **32**, pp.257-263.

[11] P. Stenvinkel, O. Heimburger, F. Paultre, et al. (1999), "Strong association between malnutrition, inflammation, and atherosclerosis in chronic renal failure", *Kidney International*, **55**, pp.1899-1911.

[12] H.Z. Tonbul, M. Demir, L. Altintepe, et al. (2006), "Malnutrition-inflammation-atherosclerosis (MIA) syndrome components in hemodialysis and peritoneal dialysis patients", *Renal Failure*, **28**, pp.287-294.

[13] R. Pecoits-Filho (2002), "The malnutrition, inflammation, and atherosclerosis (MIA) syndrome-the heart of the matter", *Nephrology Dialysis Transplantation*, **17(11)**, pp.28-31.

[14] I. Shahab, K.D. Nolph (2006), "MIA syndrome in peritoneal dialysis: prevention and treatment", *Peritoneal Dialysis: A Clinical Update*, **150**, pp.135-143.

[15] S. Zyga, G. Christopoulou, M. Malliarou, et al. (2011), "Malnutrition-inflammation-atherosclerosis syndrome in patients with end-stage renal disease", *Journal of Renal Care,* **37(1)**, pp.12-15.

[16] D. Churchill, D.W. Taylor, P.R. Keshaviah, et al. (1996), "Adequacy of dialysis and nutrition in continuous peritoneal dialysis; association with clinical outcomes", *Journal of the American Society of Nephrology*, **7**, pp.198-207.

[17] L. Foucan, H. Merault, F.L. Velayoudom-Cephise (2015), "Impact of protein energy wasting status on survival among Afro-Caribbean hemodialysis patients: a 3-year prospective study", *Springer Plus,* **4(452)**, pp.1-10.

[18] Renée de Mutsert, D.C. Grootendorst, E.W. Boeschoten, et al. (2009), "Subjective global assessment of nutritional status is strongly associated with mortality in chronic dialysis patients", *American Journal of Clinical Nutrition*, **89**, pp.787-793.