

# MIS (Malnutrition-Inflammation Score) is effective and crucial tool for prognostic prediction of peritoneal dialysis patients

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## INTRODUCTION

Malnutrition occurs in peritoneal dialysis (PD) patients commonly and may correlate with increased mortality. Several factors, such as protein loss into the peritoneal cavity, chronic inflammation, accumulation of uremic toxins, etc. could influence PD patients' nutritional status. Nutritional assessment of PD patients is a very important process to evaluate their nutritional condition. MIS is a useful tool to assess patients' nutritional status comprehensively. In this study, we validated the efficacy of MIS as a prognostic factor of PD patients.

## METHODS

40 patients (male 11, female 29) were enrolled into the study. A mean age of the onset of PD was  $78.5 \pm 7.4$  years. All patients had their nutritional status assessed with MIS and were classified into three subgroups corresponding to each MIS score, normal nutritional group (MIS 0-7), mildly impaired group (MIS 8-12), severely impaired group (MIS over 13) respectively. We analyzed patients' survival rates and compared it among three groups using the Kaplan-Meier analysis.

## RESULTS

Table 1.

Baseline characteristics of the peritoneal dialysis patients according to MIS

	all (40)	Normal (7)	impaired (16)	severe impaired (17)
Age(years)	78.85 ± 7.21	78.57 ± 2.82	77.00 ± 7.84	80.71 ± 7.67
Duration(months)	29.2 ± 20.2	35.7 ± 24.0	30.9 ± 18.8	24.9 ± 20.2
Gender(male/female)	11/29	3/4	5/11	3/14
Diabetes(Diabetes/non-Diabetes)	14/26	2/5	7/9	5/12
BMI (kg/m <sup>2</sup> )	20.83 ± 3.44	23.56 ± 2.20	21.27 ± 3.70	19.19 ± 2.80 <sup>a</sup>
eGFR at start (ml/min)	6.71 ± 2.03	6.52 ± 2.07	6.87 ± 2.18	6.63 ± 2.03
D/P	0.76 ± 0.13	0.72 ± 0.12	0.76 ± 0.14	0.79 ± 0.13
alb (g/dl)	2.96 ± 0.34	2.98 ± 0.34	2.90 ± 0.35	3.05 ± 0.32
CRP (mg/dl)	0.86 ± 1.18	0.63 ± 0.64	0.66 ± 0.75	1.15 ± 1.60
total Kt/V	2.59 ± 0.90	2.06 ± 0.71	2.40 ± 0.90	3.01 ± 0.84

Table 3.

Multivariate Cox proportional hazard analysis of independent predictor for patient's survival

	Hazard ratio	95% C.I.	p-value
BMI	0.969	0.760-1.234	0.797
total Kt/V	1.777	0.834-3.787	0.136
alb	0.162	0.035-0.759	0.021 *
MIS	1.169	1.005-1.360	0.043 *

Multivariate Cox proportional hazard analysis of independent predictor for technique survival

	Hazard ratio	95% C.I.	p-value
BMI	0.996	0.811-1.223	0.969
total Kt/V	1.583	0.793-3.161	0.193
alb	0.169	0.041-0.701	0.014 *
MIS	1.2	1.048-1.374	0.008 *

Table 2.

MIS sheet

ID	Name	Sex	Age	Date	Checked by
Height	cm	DW	kg	Date of birth	Starting date of dialysis
DM					

● Patients related medical history

1-Change in end dialysis dry weight(overall change in past 3-6 months)

0	1	2	3
No decrease in dry weight or weight loss <0.5kg	Minor weight loss (≥0.5kg but <1kg)	Weight loss more than 1kg but <5%	Weight loss >5%

2-Dietary intake

0	1	2	3
Good appetite and no deterioration of the dietary intake pattern	Somewhat sub-optimal solid diet intake	Moderate overall decrease to full liquid diet	Hypo-caloric liquid to starvation

3-Gastrointestinal(GI)symptoms

0	1	2	3
No symptoms with good appetite	Mild symptoms,poor appetite or nauseated occasionally	Occasional vomiting or moderate gastrointestinal symptoms	Frequent diarrhea or vomiting or severe anorexia

4-Functional capacity(nutritionally related functional impairment)

0	1	2	3
Normal to improved functional capacity,feeling fine	Occasional difficulty with baseline ambulation or feeling tired frequently	Difficulty with strenuous independent activities(e.g. going to bathroom)	Bed/chair-ridden or little to no physical activity

5-Co-morbidity including number of years on dialysis

0	1	2	3
On dialysis less than one year and healthy otherwise	Dialyzed for 1-4 years or mild co-morbidity(excluding MCO <sup>2</sup> )	Dialyzed 4 years or moderate co-morbidity(including one MCO <sup>2</sup> )	Any severe multiple co-morbidity(2 or more MCO <sup>2</sup> )

● Physical Exam(according to SGA criteria)

6-Loss of body fat(measurement) AC<sup>2</sup> cm, TSF<sup>3</sup> mm(%TSF<sup>3</sup>)

0	1	2	3
%TSF ≥ 91	%TSF 81-90	%TSF 61-80	%TSF ≤ 60

7-Loss of muscle(measurement) AMC<sup>4</sup> cm(%AMC<sup>4</sup>)

0	1	2	3
%AMC ≥ 91	%AMC 81-90	%AMC 61-80	%AMC ≤ 60

● BMI

8-BMI<sup>5</sup> (kg/m<sup>2</sup>)

0	1	2	3
BMI(kg/m <sup>2</sup> ) ≥ 20	BMI(kg/m <sup>2</sup> ) ≥ 18	BMI(kg/m <sup>2</sup> ) ≥ 16	BMI(kg/m <sup>2</sup> ) < 16

● Laboratory parameters

9-ALB<sup>6</sup> (g/dl)

0	1	2	3
ALB(g/dl) ≥ 4.0	ALB(g/dl) ≥ 3.5	ALB(g/dl) ≥ 3.0	ALB(g/dl) < 3.0

10-TIBC<sup>7</sup> (μg/dl)

0	1	2	3
TIBC(μg/dl) ≥ 250	TIBC(μg/dl) ≥ 200	TIBC(μg/dl) ≥ 150	TIBC(μg/dl) < 150

Total Score(sum of above 10 components)

other CRP (mg/dl) nPCR(g/kg/day) diagram riser dialysis HD/HDF (before/after)

last time MIS Comment

(This sheet is a quotation from Kalamat Zadeh, et al. Am J Kidney Dis. 2001;38:1251-1263)

● 1 MCO: Major Comorbid Conditions include CHF, dialysis, II or IV myocardial infarction, moderate to severe COPD, cerebral hemorrhage and metastatic malignancies  
 ● 2 TSF: TSF: serial survey value/median of Japanese physical measurement standard value  
 ● 3 DM: dry weight ● 4 AC: arm circumference ● 5 TSF: triceps skin fold thickness ● 6 AMC: arm muscle circumference ● 7 BMI: body mass index(DW/kg)<sup>2</sup> (m)<sup>2</sup>  
 ● 8 ALB: serum albumin ● 9 TIBC: serum TIBC(total iron binding capacity)

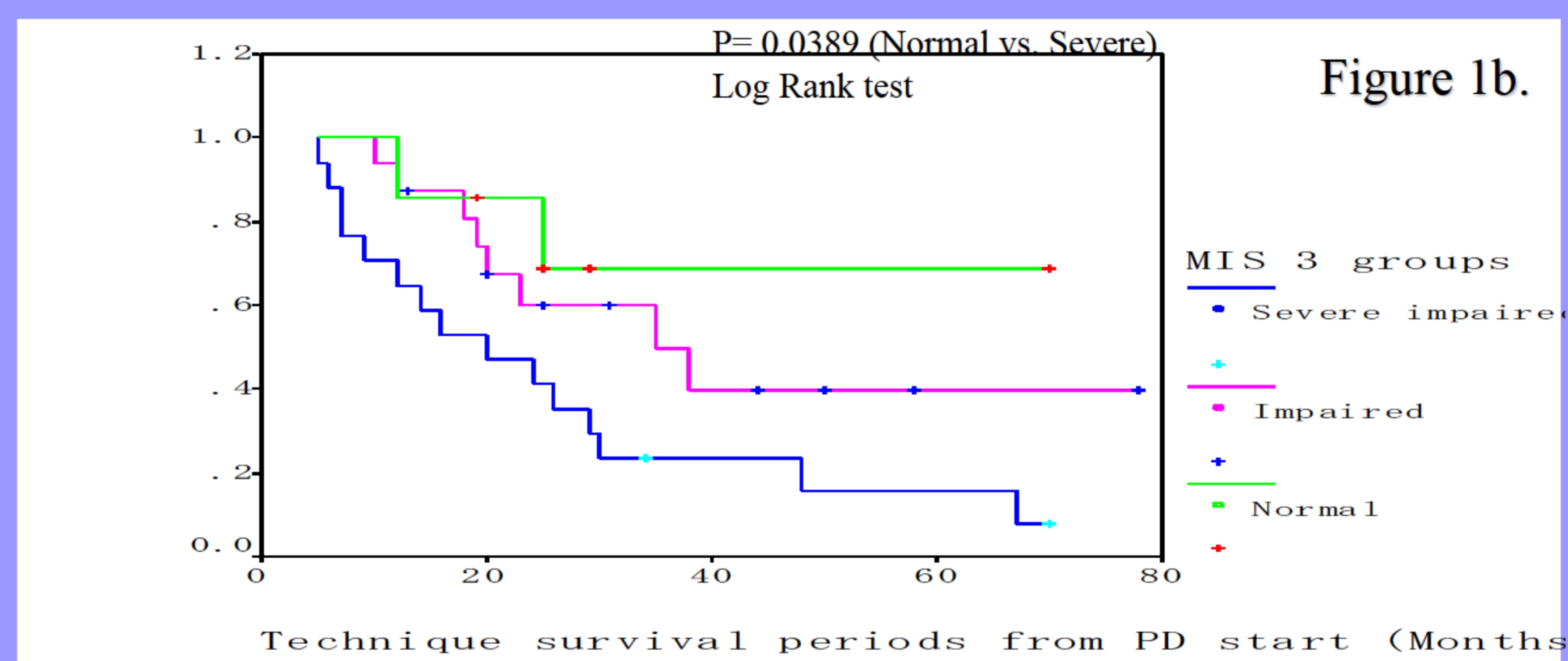
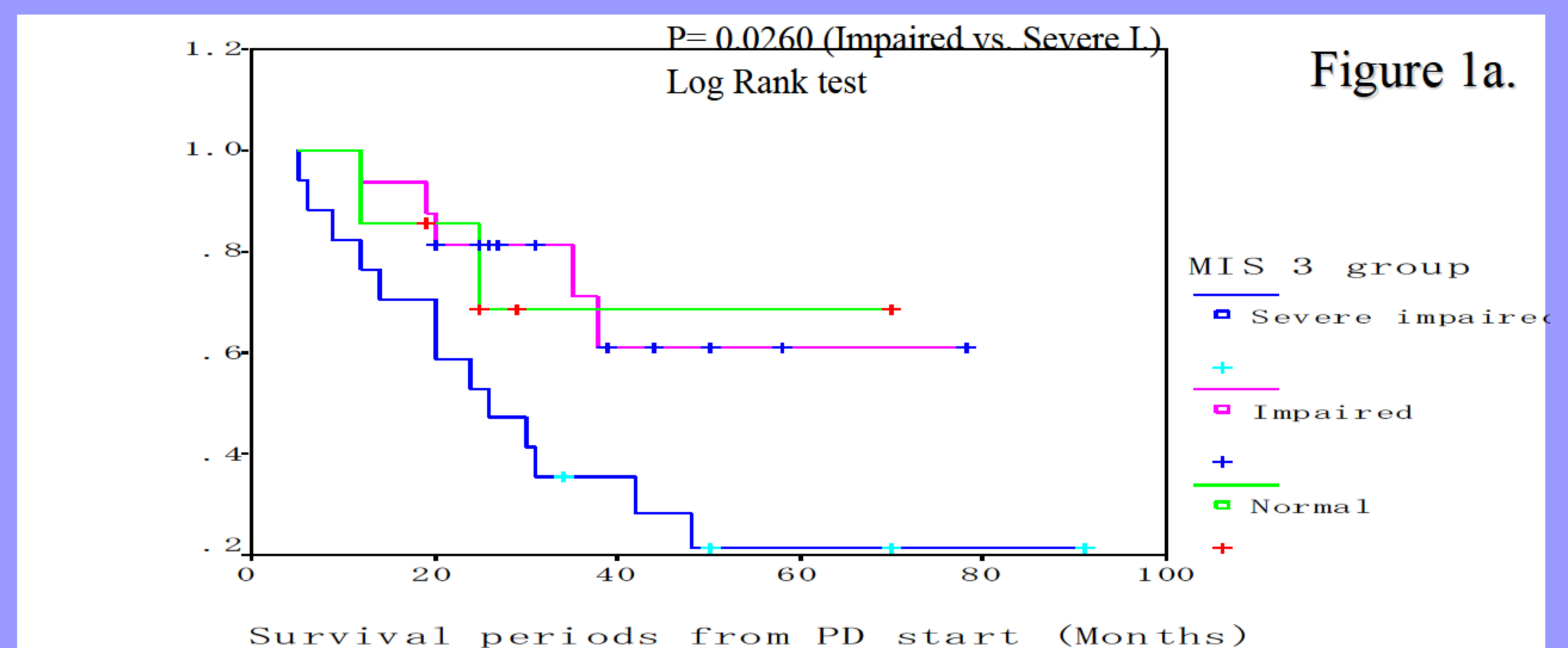


Figure 1a and 1b shows the Kaplan-Meier curves for cumulative patient and technique survival in three subgroups corresponding to MIS score. Three year survival rates of the normal group, the mildly impaired group and severely impaired group were 72.9%, 71.0% and 35.2% respectively. We found statistically significant difference between the normal and severe impaired group in both outcomes. The Cox regression analysis showed that patients with lower serum albumin and the patients with worse MIS results had an increased risk for mortality and dropout from PD therapy (table 3).

## DISCUSSION

The results of this study indicated that the MIS is an independent prognostic factor for patient and technique survival in PD patients. MIS is a comprehensive and quantitative nutritional assessment and consists of several components (medical history, physical examination, body mass index and laboratory parameters), but is very simple and easy to use. According to the scores of each component, we can design therapeutic interventions for patients with malnutrition. MIS is a powerful predictor for PD patients. Attempts to improve MIS could be a great help to reduce the mortality of PD patients.

