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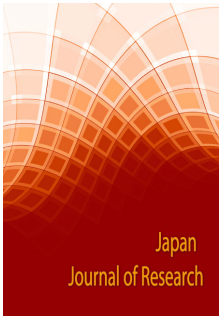

The effect of multidisciplinary teamwork on nutritional intervention in patients with pulmonary arterial hypertension

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Keywords

pulmonary arterial hypertension; multidisciplinary teamwork; nutritional risk; nursing

Abbreviations

6MWD: six-minute walk distance; BSA: body surface area; MDT: multidisciplinary team; mPAP: mean pulmonary artery pressure; NRS: nutritional risk screening; NT-proBNP: N-terminal pro-brain natriuretic peptide; ONS: oral nutritional supplements; PAH: pulmonary arterial hypertension; PAWP: pulmonary artery wedge pressure; PEM: protein-energy malnutrition; PPN: partial parenteral nutrition; RHC: right heart catheterization; SD: standard deviation; TEN: total enteral nutrition; TPN: total parenteral nutrition; WHO FC: World health organization functional class

Abstract

Objective: To explore the effect of multidisciplinary teamwork of nutritional intervention in patients with pulmonary arterial hypertension (PAH).

Methods: Multidisciplinary teamwork of nutrition management for patients with PAH was established. 100 patients with nutritional risk of PAH were randomly divided into control group and intervention group. The control group was given routine nutritional support, while the intervention group, was given the multi-team nutritional management scheme for nutritional intervention. After 4 weeks, the nutritional parameters, clinical symptoms, biochemical parameters and disease prognosis of the two groups were compared.

Results: Compared with the control group, the total score of nutritional risk screening was significantly reduced in the intervention group after 4 weeks. Serum albumin, the value of PaCO2 and the 6min walking distance were significantly increased, but the Brog dyspnea grade was significantly decreased ($P<0.05$).

Conclusion: The multidisciplinary teamwork applied to nutritional intervention in patients with PAH can effectively reduce the incidence of nutritional risk, improve the immunity of body, relieve clinical symptoms such as dyspnea, improve patient's endurance and reduce fatality rate.

Introduction

Pulmonary arterial hypertension (PAH) is a devastating, progressive and still not curable disease, characterized by structural changes of the small pulmonary arteries and subsequent increased pulmonary vascular resistance, ultimately leading to right heart failure and death [1]. Nutritional status has an important influence on the occurrence, development and prognosis of PAH. Recently, it has been reported that abnormal nutritional factors are largely more prevalent in PAH patients and animal models, which indicated that PAH patients may have different degrees of malnutrition or undernutrition [2].

It is important to evaluate the nutritional risk of patients and formulate appropriate nutritional intervention to help patients control disease progression in the process of treatment. Nutritional risk is defined as the risk of existing or potential nutritional factors leading to adverse clinical outcomes in patients [3]. Factors of nutritional risk refer to the three macro nutrients-carbohydrates, fats and proteins. The protein-energy malnutrition (PEM) is the common malnutrition or nutritional deficiencies. The latest definition of malnutrition no longer includes the original micronutrient abnormalities (insufficient or excess) and excess nutrition [4]. Malnutrition will increase the difficulty of diagnosis and treatment of PAH.

Multidisciplinary team (MDT), playing a key role in patient care, is a form of consultation made up of experts from different disciplines to jointly develop appropriate diagnosis and treatment plans for patients [5]. It can integrate the professional knowledge of various disciplines, break the boundaries of disciplines and improve the level of diagnosis and treatment. Therefore, the present study aimed to establish MDT model to carry out multiple-target nutritional intervention of patients with PAH by analyzing nutritional risk.

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Material and Methods

Study population

One hundred incident patients with PAH were enrolled from April 2018 to February 2020 in Shanghai Pulmonary Hospital. All patients were confirmed by right heart catheterization (RHC). Patients were randomly divided into intervention group and control group. The diagnosis of IPAH in two groups was established according to the European Society of Cardiology and the European Respiratory Society guidelines from that time [6,7]. Patients with pulmonary hypertension due to left heart disease, pulmonary hypertension due to left heart disease and chronic thromboembolic pulmonary hypertension and other pulmonary artery obstructions were excluded. The study protocol was reviewed and approved by the ethics committee (number: K17-114) of Shanghai Pulmonary Hospital. Written informed consent was obtained from each patient prior to the performance of any study-related procedures.

Nutritional risk screening

The nurses screened the 100 patients for nutritional risk through the European nutritional risk screening evaluation form (NRS-2002) within 24 hours after admission.

MDT model of nutrition management program for PAH patient

The MDT model of "PAH patient nutrition intervention program" was developed according to the recommendation of nutrition guidelines and the actual clinical situation of PAH patients [8]. Consulting experts to establish the nutritional management scheme of PAH patients: consulting medical, nursing and nutrition experts engaged in the diagnosis and treatment of pulmonary vascular diseases to revise the expert consultation method and further improve the program.

The control group was given routine nutritional support and management for 4 weeks according to the doctor's orders and implemented dietary education and so on. The intervention group implemented nutrition intervention and management for 4 weeks according to the MDT model.

Measurements at baseline and during follow-ups

Demographics including sex, age, body surface area (BSA), six-minute walk distance (6MWD), N-terminal pro-brain natriuretic peptide (NT-proBNP), World health organization functional class (WHO FC), and hemodynamic parameters. Hemodynamic parameters were collected by RHC as described in previous study at baseline [9]. The 6MWD test was performed according to the guidelines of the American Thoracic Society [10].

Collected demographic information, biochemical parameters, food frequency questionnaires and other clinical parameters. After 4 weeks, the nutritional parameters, clinical symptoms, biochemical parameters, disease outcomes and other parameters of the two groups were compared.

Follow-up

Follow-up intervals were decided by physician according to individual's health-care needs. Patients were encouraged to follow-up every 3-6 months by outpatient or telephone according to ESC guideline. The primary outcome was all-cause mortality. Survival was estimated from the date of confirmation to August 23, 2020 in two groups.

Statistical Analysis

Results were expressed as mean with standard deviation (SD) or medians (and interquartile range) for continuous variables and number (%) for categorical variables. Comparisons of clinical characteristics between two groups were performed by chi-square tests for categorical data and the Student's t-test or Mann–Whitney U test for continuous data. The Kaplan-Meier method was carried out to generate survival curve and log-rank test was used to compare the difference of survival curve between different groups. A statistical significance level of <0.05 was used. Statistical analysis was performed using SPSS (Statistic Package for Social Science, Chicago, IL) version 20.0.

Results and Discussion

Characteristics of patients

Demographic and hemodynamic data is presented in Table 1. The mean age was 68 ± 18 years in control group and 56 ± 15 years in intervention group. The mean duration of follow-up was 24.60 ± 10.12 months in all patients. 100% of follow-up was achieved in the current study. Eleven patients and 2 patients passed away in control group and intervention group, respectively. There were no significant differences in demographic variables, laboratory, hemodynamic parameters and specific medication treatment between the two groups (all $P > 0.05$, Table 1).

The flow of MDT mode

The intervention group implemented nutrition intervention and management according to the MDT model (Figure 1). According to the patient's nutritional status, clinical symptoms, disease severity, nutritional parameters, etc., the physician gives parenteral nutrition or asks the deputy chief nutritionist of the nutrition department to consult for enteral nutrition support. Nutrition intervention therapy follows the five-step principle. First, nutrition education is selected, followed by oral nutritional supplements (ONS), total enteral nutrition (TEN), and partial parenteral nutrition (PPN) and total parenteral nutrition (TPN). When the next step cannot meet the 60% target energy requirement for 3 to 5 days, the previous step should be selected (Figure 1).

Responsible nurses implement nutrition education, intervention measures and management. The enteral nutrition solution is kept in a refrigerator at 4°C. Each shift of the nurses will be transferred. Enteral and parenteral nutrition measures will be implemented according to the doctor's advice and the nutritionist's consultation. The amount of inhaled and excreted fluids for 24 hours will be recorded. Nurses issued "Patient-specific Nutrition Knowledge Manual", nutrition education manual and education pictures to strengthen nutrition education and diet guidance.

The responsible nurse assessed nutritional risk score every week for 4 weeks, collected laboratory parameters. And the physician timely and dynamically adjusted the nutritional support approach and dose according to the scoring results, the patient's clinical symptoms, nutritional indicators, and requested a nutritionist for consultation if necessary (Figure 1).

After 4 weeks, the nurse again collected the patient's nutrition, biochemical parameters and other clinical parameters, and follow-up. Patients hospitalized for less than 4 weeks, ONS will be supervised by the patients and their families after discharge. Enteral and parenteral nutrition support will be implemented by nurses in local community hospitals. Chronic disease managers are responsible for the supervision and education of nutrition intervention (Figure 1).

Table 1. Comparison of baseline clinical characteristics between intervention and control group.

Characteristics	Control group (n=50)	Intervention group (n=50)	P- value
Age, years	60 ±18	56 ±15	0.207
Male, n	22	14	0.096
BMI, mmHg	116.86 ± 10.47	120.74 ± 16.34	0.161
HR, bpm	116.86 ± 10.47	120.74 ±16.34	0.161
SBP, mmHg	116.86 ± 10.47	120.74 ±16.34	0.161
DBP, mmHg	69.98 ± 9.39	68.88 ±10.92	0.590
WHO-FC(I/II/III/IV), n	2/7/36/5	2/9/37/2	0.671
Laboratory			
Precursor Protein (mg/L)	163.37 ± 71.97	179.29 ± 63.03	0.286
transferrin (g/L)	47.22 ±78.35	2.48 ± 0.69	0.027
glucose (mmol/L)	7.74 ± 11.26	5.63 ± 2.40	0.206
Urea nitrogen (mmol/L)	6.65(5.37, 9.80)	6.05(5.08, 7.75)	0.146
creatinine (umol/L)	74.44 ± 25.96	69.41 ± 24.70	0.323
glycated hemoglobin (%)	7.49 ± 8.97	6.22 ± 1.17	0.371
Hemodynamics			
mRAP, mmHg	3.52 ± 3.48	4.87 ± 3.58	0.175
mPAP, mmHg	56.49 ± 39.68	54.97 ± 23.80	0.851
mPCWP, mmHg	9.06 ± 7.42	7.26 ± 4.95	0.268
PVR, Wood units	7.91 ± 5.18	9.00 ± 6.20	0.483
CO, L/min	4.73 ± 1.18	5.26 ± 1.50	0.150
CI	2.98 ± 0.77	3.15 ± 0.82	0.432
Therapy			0.235
Specific therapy, n (%)	45 (0.90)	46 (0.92)	
Nonspecific therapy, n (%)	5 (0.10)	4 (0.08)	

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure; WHO-FC, World Health Organization fictional classification.

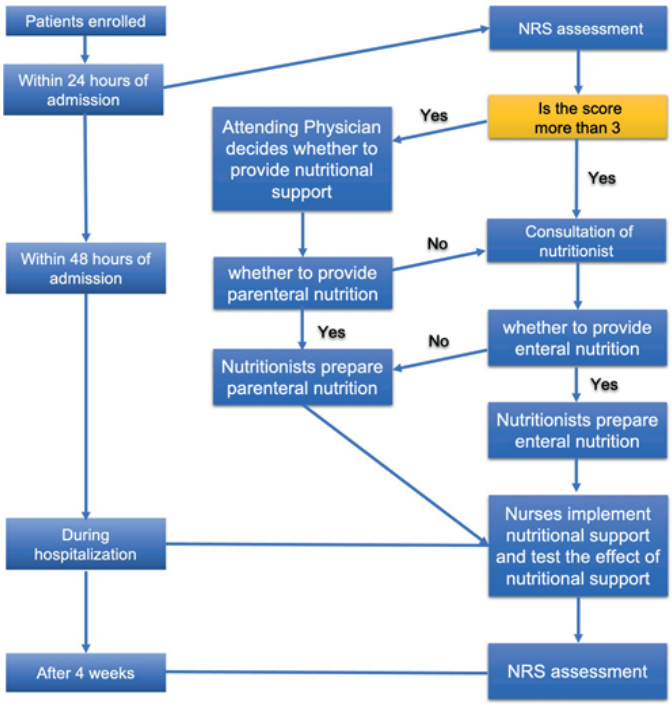

Figure 1. The flow of MDT.

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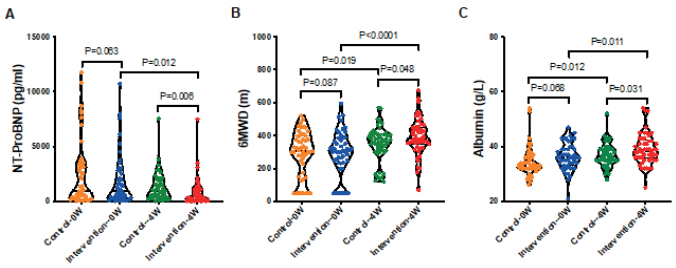


Figure 2. The comparison of NT-proBNP, 6MWD and albumin in before and after intervention.

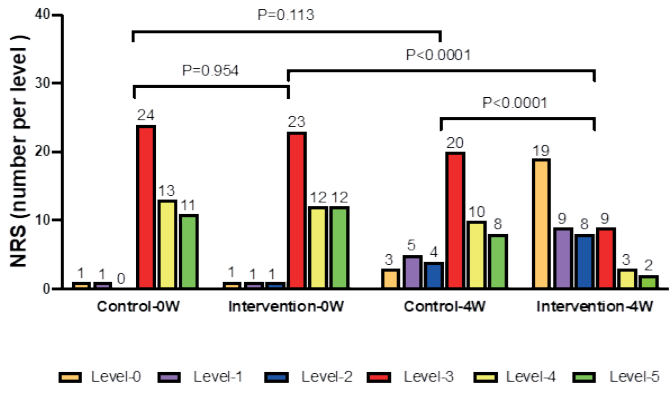
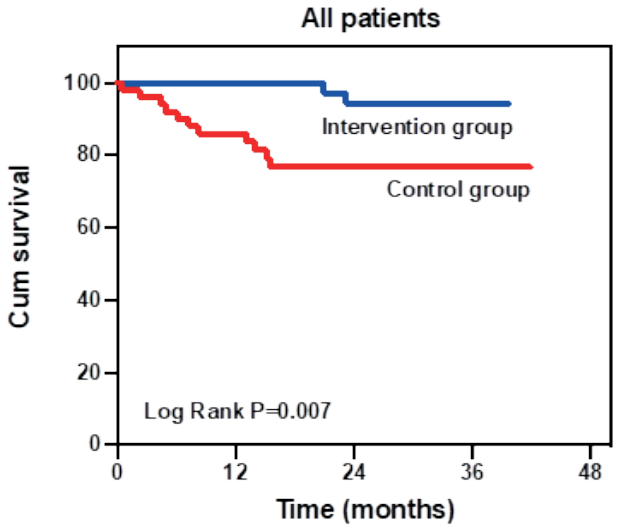


Figure 3. The comparison of NRS in before and after intervention.



Number at risk (months)	0	12	24	36
Control group	50	43	39	39
Intervention group	50	50	48	48

Figure 4. Kaplan-Meier survival analysis.

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Comparison of biochemical parameters, clinical symptoms and nutritional parameters between the two groups

At baseline, there were no significant difference of NT-proBNP, 6MWD and albumin in the two groups. After 4 weeks, compared with the control group, the levels of NT-proBNP in the intervention group were significantly reduce ($P = 0.006$, Figure 2A); The 6MWD and serum albumin increased significantly (both $P < 0.05$, Figure 2B and C). Interesting, there was also significant decrease of NT-proBNP levels and increases of 6MWD and serum albumin after 4 weeks compared with at 0 week in intervention group (all $P < 0.05$, Figure 2A-C). In control group, 6MWD and serum albumin after 4 weeks were also significant increased compared with at 0 week (both $P < 0.05$, Figure 2B and C), but no significant change of NT-proBNP levels was shown after 4 weeks compared with 0 week (Figure 2A).

Comparison of NRS between the two groups

At baseline, there were no significant different numbers of every level of NRS in the two groups (Figure 3). After 4 weeks, compared with the control group, the numbers of every level of NRS in the intervention group were significantly different ($P < 0.0001$, Figure 3). Especially, the numbers of lower level 0 to 2 after 4 weeks were more than at 0 week in intervention group (Figure 3). And the numbers of higher level 3 to 5 after 4 weeks were less than at 0 week in intervention group (Figure 3). Although there were similar trends, no significant changes in control group (Figure 3).

Comparison of survival analysis between the two groups

After follow-up, there were 11 deaths in the control group and 2 deaths in the intervention group. Intervention group had higher survival rate than the control group (1-year survival, 100% vs. 86%; 2-year survival, 96% vs. 78%; respectively; $P = 0.007$, Figure 4)

Authors' Contributions

The present study indicated that the application of MDT model in nutritional intervention for PAH patients can effectively reduce the incidence of nutritional risks in patients, improve the clinical symptoms and reduce the fatality rate.

Patients with PAH have the presence of shortness of breath, chest tightness, hypoxemia, right ventricular insufficiency and other symptoms. The body is in a state of high catabolism, the increasing demand for energy and protein, and susceptible to severe malnutrition, malnutrition of patients well systolic function, pulmonary function, immune function, such as severely damaged, causing infection is aggravating, is the important reason for PAH refractory and aggravating. Therefore, the enrolled patients had different degree nutritional risk.

Based on the assessment of nutritional risk, MDT model for nutrition management scheme were constructed. Four weeks after the intervention, patients in the intervention group had significantly lower nutritional risks and higher albumin than those in the control group, which was directly related to the provision of standardized and effective nutrition intervention; and the symptoms of NT-proBNP, 6MWD and albumin were significantly changed, which may be related to the improvement of activity endurance and cardio-pulmonary function after the patients received nutritional support;

In the past ten years or so, with the targeted drug treatment of pulmonary vasodilation in three ways, Zhang Rui et al. [11] research on the survival of PAH patients in China showed that the 1-year, 2-year, and 3-year survival rates for patients with idiopathic PAH were 92%, 85%, and 75%, respectively. Therefore, the prognosis of patients with PAH is still poor, and how to extend the survival time of patients is the most important problem to be solved urgently. Nutritional health has a great influence on the occurrence and development of diseases. Patients with PAH have an increased risk of malnutrition due to long-term chronic disease consumption and metabolic disorders. Insufficient nutrition damages respiratory muscle function, aggravates respiratory muscle fatigue, reduces body immune function, increases the chance of infection, accelerates tissue and organ atrophy, increases the incidence of complications and mortality. Active and effective nutritional support is particularly important for patients with PAH. Therefore, our data indicated the improvement of survival rate may benefit from nutritional support.

Some limitations of present study were important to be noticed. Firstly, due to the small sample size, the generalizability of our findings should be further confirmed in a larger population. Secondly, these clinical findings still need a long-term nutrition intervention to give an proper program of nutritional support and proper diet. Thirdly, we should add more outcomes of patients but not only get the information of survival in follow-up.

Conclusion

The results of this study indicate that the application of MDT model in nutritional intervention for PAH patients can effectively reduce the incidence of nutritional risks in patients, improve the clinical symptoms and reduce the fatality rate.

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Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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