Original Article

NRS2002 assesses nutritional status of leukemia patients undergoing hematopoietic stem cell transplantation

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Objective: To discuss whether nutritional risk screening 2002 (NRS2002) is appropriate for nutritional risk screening for leukemia patients before and after hematopoietic stem cell transplantation (HSCT), and whether there are risk differences in other conditions, such as age, gender and matching degree; to find the methods and indicators of nutritional risk screening for these patients before and after HSCT, in order to give timely intervention to guarantee the successful completion of the entire transplantation process.
Methods: Nutritional risk of 99 leukemia patients was screened with NRS2002 before and after HSCT. The χ^2 test was applied to compare the risk differences between groups such as age, gender and matching degree, while the differences of other enumeration data, such as recent (1-3 months) weight loss, reduced food intake within one week and BMI, were compared by continuity correction.
Results: Of the 99 leukemia patients, 22 cases (22.2%) had nutritional risk before HSCT, while all patients had nutritional risk after HSCT; there is no significant difference in nutritional risk between male and female, and patients of less than 30 years old, not-full matched, recent (1-3 months) weight loss, reduced food intake within a week or BMI <18.5 were more likely to have nutritional risk; and 77 cases (77.8%) had weight loss, among which 49 patients (63.6%) had more than 5% weight loss within one month.
Conclusions: This study showed that leukemia patients should receive the nutritional risk screening conventionally before and after HSCT, and NRS2002 was only appropriate for nutritional risk screening before HSCT. More attention should be paid to the patients less than 30 years old or not-full matched. Weight change was one of the important nutritional indicators for patients after HSCT.

Key Words: Hematopoietic stem cell transplantation; leukemia; nutrition; nutrition screening

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Introduction

Hematopoietic stem cell transplantation (HSCT) is widely used in the treatment of hematological malignancies and some solid tumors (1,2). Patients with hematological malignancies are frequently accompanied with malnutrition (3). Prior to the transplantation, patients usually receive high-dose chemotherapy and/or general radiotherapy, which make their nutrition status injured in different extents (4,5). Nutritional status is an important variable for prognosis of diseases (6). Malnutrition patients have high incidence of complications and mortality (7), prolonged hospitalization days, increased medical costs (8), and poor quality of life (9). Malnutrition will influence the treatment effect of HSCT and the reconstitution of hematopoietic and immune functions (10). Therefore, correctly assessing the nutritional status of patients before and after HSCT is important for a successful transplantation and improving the quality of life after transplantation (11). Nutritional risk screening 2002 (NRS2002) is the first nutrition risk screening tool

Table1 Basic information of patients (*N*=99)

	Gender		Age (year)		Matching degree		Leukemia type			
	Male	Female	<30	≥30	Not full	Full	ALL	AML	CML	MDS
n	69	30	49	50	62	37	59	12	11	17

developed on the basis of evidence-based medicine, and the selected core indicators reflecting nutritional risk are derived from 128 randomized controlled trials (RCT), suitable for nutrition risk screening for inpatients and easy to use (12,13). This study intended to investigate whether NRS2002 is suitable for nutritional risk screening for leukemia patients with HSCT, and whether there are risk differences in other conditions, such as age and gender differences; and to find the methods and indicators of nutritional risk screening and assessment for these patients before and after transplantation, in order to give them timely intervention to guarantee the successful completion of the entire transplantation process.

Materials and methods

Subjects

A total of 99 leukemia patients receiving HSCT were sampled from Peking University People's Hospital. The mean age of these patients was (32.45±11.26) years (range, 18-56 years), and the mean time in laminar air flow room (LAFR) was (30±4) d (range, 23-39 d). All 99 patients were told the fact, and written informed consent was obtained. The study was approved by the Ethic Committee of Peking University People's Hospital. The basic information of these patients is showed in *Table 1*.

Assessment methods

After continuously sampling in the designated sites, two trained nutritionists used NRS2002 to screen the nutritional risk of leukemia patients on the enrollment day (before HSCT) and the HSCT completion day (after HSCT).

NRS2002 was developed by the Danish Association of Parenteral and Enteral Nutrition (DAPEN) and recommended by the European Society for Parenteral and Enteral Nutrition (ESPEN). Nutritional risk judgment criteria included: (I) severity of impact of the primary disease on nutritional status, (II) recent (1-3 months) weight change, (III) change of food intake within a week, (IV) body mass index (BMI), and (V) over the age of 70, scored 1. Scoring method was applied to measure the risk, and NRS score ≥3 was defined as nutritional risk (14).

The application of NRS2002 with BMI of Chinese population to screen the nutrition risk of inpatients and to determine whether nutritional support should be given had been shown to be feasible (15). Therefore, in this study, the assessment standard of BMI was Chen's standard (16), and BMI <18.5 kg/m^2 is defined as undernutrition {BMI = weight (kg)/[height (m)]^2}.

Quality control

Investigators must be trained before the survey; unified nutritional assessment questionnaire was adopted for screening and assessment; height and weight of patients with ward clothes were measured without shoes at fasting.

Statistical analysis

SPSS statistical software version 16.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Measurement data were expressed as $\bar{x}\pm s$. Enumeration data were expressed as percentage. The differences of enumeration data, such as gender, age and matching degree, were compared by χ^2 test, while the differences of enumeration data, such as recent (1-3 months) weight loss, reduced food intake within one week and BMI, were compared by continuity correction. $P<0.05$ was considered statistically significant.

Results

Nutritional risk screening in patients before HSCT

Among 99 leukemia patients, 22 (22.2%) had nutritional risk, whose NRS2002 score ≥3, and nutritional support should be needed (*Table 2*).

Nutritional risk screening in different groups before HSCT

The patients were grouped according to gender, age and

other conditions, and the incidence of nutritional risk was compared. The results showed that there was no significant difference in the nutritional risk incidence according to gender (P>0.05), while there were significant differences according to age, matching degree, weight loss, reduced intake or BMI (P<0.01) (*Table 3*).

Nutritional risk screening in patients after HSCT

All patients had nutritional risk after HSCT (*Table 4*).

Discussion

HSCT is an important treatment method for leukemia. The nutritional status is very important for patients after HSCT. Malnutrition can affect the results of HSCT, which is related to patient's prognosis and quality of life.

In this study, 99 patients received the nutritional risk screening by NRS2002, and the results showed that 22.2% of patients had nutritional risk, at the same time, 15.4% of patients with BMI ≥18.5 had nutritional risk, suggesting that the patients before HSCT had high incidence rates of nutritional risk, and BMI alone could not accurately reflect whether there was a nutritional risk. Furthermore, after HSCT, the patients had much higher incidence rates of nutritional risk and higher NRS scores. Therefore, leukemia patients are required to receive nutritional risk screening before and after HSCT for timely detection of their nutritional problems and early intervention to avoid malnutrition occurrence. This is very important for guaranteeing patients a successful completion of treatment and improving their quality of life.

NRS grades consist of disease state grade, nutritional status grade and age grade. The subjects of this study were patients with leukemia and less than 70 years old, so the scores of disease state and age were 2 and 0, respectively.

Table 2 Nutritional risk screening before HSCT (*N*=99)

NRS2002 score	*n*	Percentage (%)
2	77	77.8
3	9	9.1
4	2	2.0
5	11	11.1

Table 3 Nutritional risk screening in different groups before HSCT (*N*=99)

	Nutritional risk [*n* (%)]		P
	No risk	Have risk	
Gender			
Male	55 (79.7%)	14 (20.3%)	>0.05
Female	22 (26.7%)	8 (73.3%)	
Age (year)			
<30	31 (63.3%)	18 (36.7%)	<0.01
≥30	46 (92.0%)	4 (8.0%)	
Matching degree			
Not full	16 (25.8%)	46 (74.2%)	<0.01
Full	31 (83.8%)	6 (16.2%)	
Recent (1-3 months) weight loss			
No	77 (81.9%)	17 (18.1%)	<0.01
Yes	0 (0%)	5 (100%)	
Reduced food intake within 1 week			
No	77 (84.6%)	14 (15.4%)	<0.01
Yes	0 (0%)	8 (100%)	
BMI			
<18.5	0 (0%)	8 (100%)	<0.01
≥18.5	77 (84.6%)	14 (15.4%)	

Table 4 Nutritional risk screening after HSCT (*N*=99)

NRS2002 score	*n*	Percentage (%)
3	25	25.3
4	8	8.1
5	3	3.0
6	63	63.6

Therefore, this study compared the nutritional risk in three aspects: BMI, recent (1-3 months) weight loss, and reduced food intake within a week, and the results showed a significant difference in each aspect, which further explained the results of our previous study (17) showing NRS2002 was appropriate for nutritional risk screening of leukemia patients before HSCT. The result that BMI should be concerned about before HSCT was also consistent with other report (18).

Furthermore, this study also compared the risk incidence of different gender, age and matching degree, and the results showed that there was no significant difference between male and female, while there were higher incidence rates of nutritional risk in patients less than 30 years old and not-full matched, suggesting that these patients should be paid more attention to.

This study showed that all the patients after HSCT had nutritional risk, because their diagnosis was all "HSCT", which made all the patients receive 3 score in the aspect of disease state grade, and the total scores were all equal to or greater than 3. Therefore, NRS2002 may not be appropriate for the nutritional risk screening of the patients after HSCT. But we should notice that there were 63.6% of patients after HSCT having 6 score which meant that although NRS2002 could not distinguish nutritional risk status of patients after HSCT well, the nutritional risk of patients after HSCT was higher than before, and a more accurate method was needed for assessment and distinguishing.

There were 77 cases (77.8%) with weight loss after HSCT, of which 49 (63.6%) had weight loss more than 5% in one month. Weight change during the transplantation can indirectly reflect the changes of patient's condition and heat supply. Excessive weight loss will seriously affect various systems of patients, resulting in a decline in disease resistance, even the success of the transplantation (19). It was reported that the measurement of body weight could be useful for the nutritional assessment (20), and underweight might reduce the ability to mobilize peripheral blood stem cells which is associated with a poorer outcome after HSCT (21). It was also reported that body weight loss > 10% of the initial value within a week is an indication to start nutritional support with total parenteral nutrition (TPN) (22). Therefore, for the nutritional risk screening and assessment of patients after HSCT, body weight is an important indicator.

In conclusion, leukemia patients should receive the nutritional risk screening conventionally before and after HSCT. NRS2002 is appropriate for nutritional risk screening before HSCT. At the same time, more attention should be paid to the patients less than 30 years old or not-full matched. But the methods of nutritional risk screening and assessment for patients after HSCT remain to be further explored. Moreover, it should be noticed that the weight loss is an important problem for patients after HSCT, and is one of the innegligible indicators of nutritional risk screening and assessment. Ensuring relatively stable weight would have a positive effect for the patients to overcome the stress response and improve the prognosis.

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