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Original/*Valoración nutricional*

High body mass index among patients undergoing hematopoietic stem cell transplantation: results of a cross-sectional evaluation of nutritional status in a private hospital

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Abstract

Background: **nutritional status before hematopoietic stem cell transplantation (HSCT) affects prognosis: better nourished patients have shorter time to engraftment, while malnutrition is associated with increase of mortality rates, complications, medical costs, poor quality of life and hospitalization stay. Furthermore, underweight patients have increased risk of death in the early post-HSCT period, and non-relapse mortality is greater for those who are extremely underweight, overweight and obese. Obesity is associated with treatment-related toxicity, higher incidence of grade II-IV acute graft-versus-host disease (GVHD), infections and mortality. The objective of this study was to investigate the nutritional status of patients undergoing HSCT between 2007-2013 in a private hospital, by calculating the body mass index (BMI), to verify the prevalence of any nutritional imbalances, especially obesity.**

Methods: **in this retrospective study, based on medical records, we analyzed data from all patients with malignant and nonmalignant diseases who underwent HSCT from January 2007 to February 2014 in the Hematology-Oncology and Bone Marrow Transplantation Center at a large, tertiary referral center in Brazil.**

Results: **a total of 257 cases were treated in the period and analyzed, of which 79% were aged up to 65 years old. Among these, 56% were overweight or obese. We observed a higher prevalence of obesity in elderly patients ($P < 0.001$). The mean BMI of the total sample was 26.4 kg/m^2. BMI was significantly different between genders, with higher prevalence of overweight among men ($P < 0.001$).**

Conclusion: **differently from other studies, our investigation has shown low rates of underweight and more**

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ÍNDICE DE MASA CORPORAL ELEVADO EN PACIENTES QUE SE SOMETEN A TRASPLANTE DE CÉLULAS MADRE HEMATOPOYÉTICAS: RESULTADOS DE UNA EVALUACIÓN INTERSECCIONAL DEL ESTADO NUTRICIONAL EN UN HOSPITAL PRIVADO

Resumen

Introducción: **el estado nutricional previo al trasplante de células madre hematopoyéticas (HSCT) afecta al pronóstico: los pacientes con una mejor nutrición necesitan un menor tiempo de injerto, mientras que una nutrición pobre estaría asociada a un aumento de la tasa de mortalidad, complicaciones, costes médicos, mala calidad de vida y hospitalización. Además, los pacientes con bajo peso presentan un mayor riesgo de muerte al principio del periodo post-HSCT, y la tasa de mortalidad sin recaída es mayor en aquellos con bajo peso extremo, sobrepeso y obesidad. La obesidad está relacionada con una toxicidad asociada al tratamiento, una incidencia más alta de enfermedad de injerto-huésped de grado II-IV (GVHD), infecciones y mortalidad. El objetivo de este estudio fue investigar el estado nutricional de pacientes que se sometieron a HSCT entre 2007 y 2013 en un hospital privado, calculando el índice de masa corporal (IMC), para comprobar la prevalencia de posibles desajustes nutricionales, especialmente obesidad.**

Métodos: **en este estudio retrospectivo, basado en informes médicos, analizamos datos de todos los pacientes con enfermedades tumorales y no tumorales que se sometieron a HSCT desde enero de 2007 hasta febrero de 2014 en el Centro de hematología-oncología y trasplante de médula ósea en un gran centro de especialidades médicas en Brasil.**

Resultados: **en el periodo se trató y analizó un total de 257 casos, de los cuales el 79% tenían edades de hasta 65 años. Entre estos, el 56% tenían sobrepeso u obesidad. Observamos una mayor prevalencia de obesidad en pacientes ancianos ($P < 0,001$). El IMC medio de la muestra total fue 26,4 kg/m^2. El IMC fue significativamente diferente entre géneros, con una prevalencia mayor de sobrepeso entre los hombres ($P < 0,001$).**

Conclusión: **a diferencia de otros estudios, nuestra investigación ha mostrado bajas tasas de tasas de bajo peso**

overweight and obesity rates in men and elderly patients undergoing HSCT.

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y altas tasas de sobrepeso y de obesidad en los hombres y pacientes ancianos sometidos a HSCT.

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Palabras clave: *IMC. Trasplante de células madre hematopoyéticas (HSCT). Nutrición. Hospitalización.*

Introduction

Hematopoietic stem cell transplantation (HSCT) is used to treat hematological and immune diseases, and some solid tumors[1-4]. Nutritional status before transplantation affects prognosis after HSCT[1-3]: time for engraftment is shorter in better nourished patients[1], while malnutrition is associated with increase of mortality rates, complications, medical costs, poor quality of life and hospitalization stay[1,2]. Furthermore, underweight patients have increased risk of death in the early post-HSCT period, and non-relapse mortality is greater for those who are extremely underweight, overweight and obese[5-7].

Obesity is associated with treatment-related toxicity, higher incidence of grade II-IV acute graft-versus-host disease (GVHD), infections and mortality[5,6,8]. Obesity can also affect cancer-treatment outcomes because of modification in chemotherapy dosing and pharmacokinetics, and obese patients have poorer response to chemotherapy[9]. Excess and deficiency nutritional imbalances of patients before HSCT, therefore, have impact in HSCT and, therefore, it is important to evaluate nutritional status for a successful transplantation[1]. The nutritional status can also be affected by duration of the last chemotherapy cycle, by infections and by anorexia that is common in cancer[2].

Weight increase is a prominent and challenging international public health issue, mostly in the developed world[7]. In Brazil, the last national survey on nutritional status, undertaken in 2009, revealed a prevalence of 2.7% of weight deficit in adults, 49% of overweight and 14.8% of obesity, with the excess weight prevalence being higher in urban than in rural areas. Compared to preceding years, there has been an increase of more than two-fold in the prevalence of obesity since 1974[10].

Objective

Following the national trend of increase of body mass index (BMI) in the Brazilian population, we hypothesized that the prevalence of overweight could be even higher in patients undergoing HSCT in a private hospital. The objective of this study was, therefore, to investigate the nutritional status of patients undergoing HSCT between 2007-2013 in a private hospital of the largest city in Brazil, by calculating the BMI, to verify the prevalence of any nutritional imbalances, especially obesity.

Method

Patients

In this cross-sectional study, based on medical records, we analyzed data from all the patients with malignant and nonmalignant diseases who underwent HSCT from January 2007 to February 2014 in the Hematology-Oncology and Bone Marrow Transplantation Center at Albert Einstein Hospital in São Paulo, Brazil. Patients aging less than 18 years old were excluded from the study. The study was approved by the institutional ethics committee.

In the first day of hospitalization, all patients underwent routine nutritional evaluation: they were weighted to the nearest 0,05 kg by calibrated digital scales, and measured for height in the nearest 0,1 cm using a stadiometer. Body mass index (BMI) was calculated as body weight (kg) divided by squared height (m^2). These data were available in the medical charts. We retrieved this data and classified patients according to the BMI (kg/m^2). We classified patients younger than 65 years old as malnourished if they had BMI < 18.4 kg/m^2; normal, if between 18.5 and 24.9 kg/m^2; patients with overweight if the BMI was 25-29.9 kg/m^2; and as obese if BMI > 30 kg/m^2. Patients aged 65 years-old or older were considered as having malnutrition if BMI was under 21.9 kg/m^2 and as eutrophic if BMI was 22-26.9 kg/m^2; patients were obese if BMI > 27 kg/m^2 [11].

Data analysis

We performed a descriptive analysis by registering absolute frequencies and percentages for the categorical variables and means, standard deviations, and minimum and maximum values in the case of numerical variables. For the inferential analysis, including the classification of BMI, we excluded malnourished patients. For the comparison of BMI and age over the years, we used normal models with mixed effects, considering the correlation between measurements taken in the same year under the autoregressive structure of order 1. To compare the categories of BMI interest groups, we used Pearson and chi-square tests. We used SPSS (SPSS Inc. Released 2008. SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc.) software, considering a level of significance of 5%.

Results

Between 2007 and February 2014, 257 adults received HSCT in our hospital and were included in this study. All these patients had available information on the nutritional status. The characteristics of the patients are shown in table I. Of the total sample, 57.6% were male and 21.0% were elderly. The table shows that 56% of the patients were overweight or obese.

Table II shows the main diagnosis, for indication of HSCT. The year with the highest number of transplantations in adults was 2013 (56 cases). The most common type of transplant was the autologous (53.3%), followed by allogeneic (39.7%) and haploidentical (7.0%).

The mean BMI of the total sample was 26.4 kg/m^2, varying from 25.6 in 2007 and 2012 to 27.9 kg/m^2 in 2009. No evidence of an increase or decrease in BMI over the years was found (P=0.411) (Table III and Figure 1).

The mean age ranged from 28 years (in 2014) and 52.6 years (2009), also without evidence of increased or decreased age of patients undergoing HSCT over the years (Figure 2).

We observed a higher prevalence of obesity in elderly patients (P<0.001; Table IV), and a higher prevalence of overweight and obesity among men (P<0.001; Table IV).

Table I
Demographic and clinical characteristics of the patients included in the study and who underwent hematopoietic stem cell transplantation (HSCT)

	n	%
Gender		
Female	109	42.4%
Male	148	57.6%
Elderly		
<65	203	79.0%
≥65	54	21.0%
Year of HSCT		
2007	21	8.2%
2008	26	10.1%
2009	31	12.1%
2010	35	13.6%
2011	38	14.8%
2012	48	18.7%
2013	56	21.8%
2014	2	0.8%
Type of HSCT		
Autologous	137	53.3%
Allogeneic	102	39.7%
Haploidentical	18	7.0%
Body mass index (BMI) category (<65 years old)		
Malnourished	9	3.5%
Normal	104	40.5%
Overweight	80	31.1%
Obesity	64	24.9%
Total	**257**	**100.0%**

Discussion

HSCT is a highly stressful condition, requiring high amounts of energy, resulting from a hypermetabolic state, in which increased catabolism and anabolism are consequences of cytoreductive therapy, and of complications such as infections, multiple organ failure and tissue repairing[1]. Furthermore, the high-dose conditioning, an accepted method for the treatment of hematological malignancies, can bring severe gastrotoxicity and nutrition impact symptoms[12]. Weight loss is commonly reported post-transplantation[12].

There are many studies about the increase of complications in underweight patients undergoing HSCT[1,2,8]. In our sample, the prevalence of obesity and overweight was much higher than the prevalence of underweight, in patients undergoing HSCT, in comparison to other studies in other countries. Our results were obtained in a sample of patients that were examined between 2007 and 2014, and it is possible that this higher prevalence is already seen in the whole population in our country (but no recent survey is available). The increase in the number of people with obesity and overweight in the last years reveals a world epidemic[13]. In 2003, a study about the nutritional status of Brazilian hospitalized patients showed 70% of underweight individuals, but that survey evaluated patients admitted in private and public hospitals[14]. The finding of a high prevalence of obesity among our patients can be explained by their high economic level, since ours is a private setting, reflecting

Table II
Primary diagnosis of patients undergoing hematopoietic stem cell transplantation and included in the study

Diagnosis	*n*	%
Multiple myeloma	65	25.29%
Acute myeloid leukemia	55	21.40%
Non-Hodgkin lymphoma	48	18.68%
Acute lymphoblastic leukemia	20	7.78%
Hodgkin's lymphoma	16	6.23%
Multiple sclerosis	10	3.89%
Total	**257**	**100.00%**

the obesity prevalence among the higher socioeconomic classes in the country[10].

A limitation of this retrospective study is that we do not have body composition evaluation data available. The analysis of body composition would be important because loss of muscle mass is commonly seen post-transplantation[12]. Although body composition evaluation is important, the BMI is a simple measurement and associated with engraftment time[15]. Furthermore, pretransplantation BMI was associated with a significantly greater risk of grade II-IV acute graft-versus-host disease and obesity, detected by BMI, was associated with an increased risk of infection compared with normal BMI in a study conducted in Japan[16].

The number of overweight and obese people and the number of elderly people are increasing worldwide, and this is true for HSCT patients too. However, this group of patients is in risk of HSCT complications.

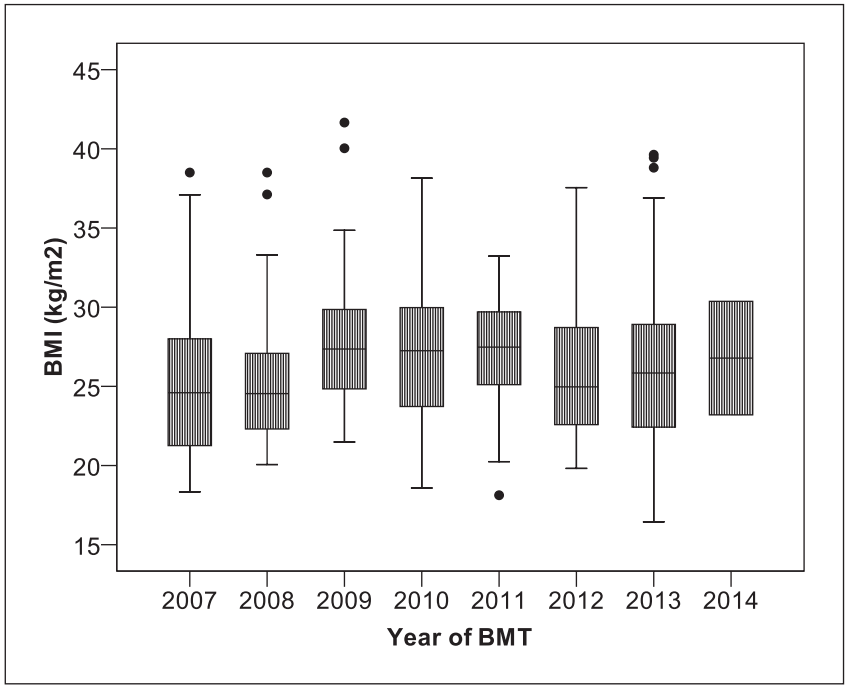

Fig. 1.—Boxplot of the distribution of body mass index (BMI) of patients according to the year.

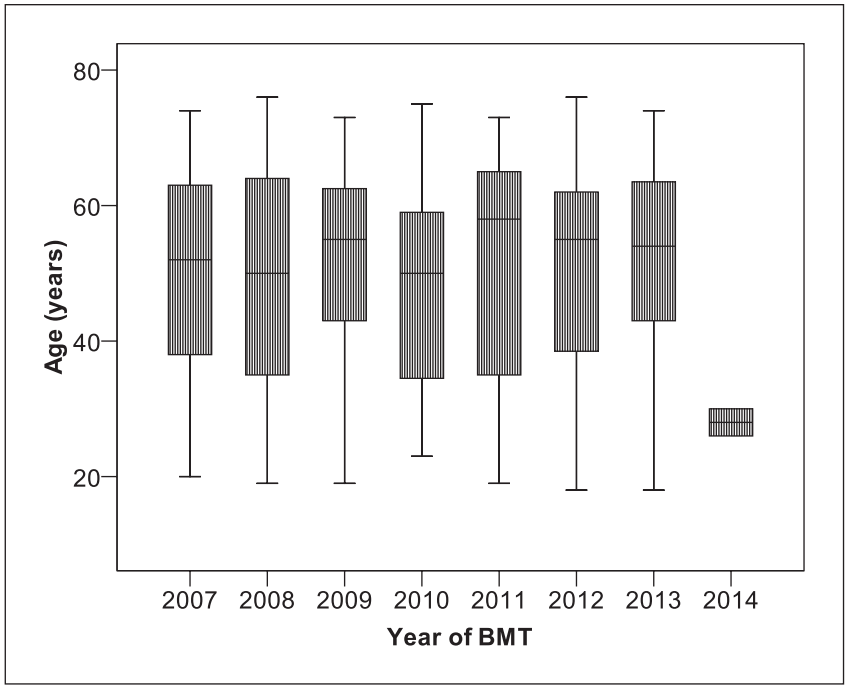

Fig. 2.—Boxplot of the distribution of the age of patients according to the year they underwent bone marrow transplantation (BMT).

Table III
Association of the year of hematopoietic stem cell transplantation and body mass index (BMI) and age

		Year of HSCT								P
		2007	2008	2009	2010	2011	2012	2013	2014	
BMI (kg/m²)	Average	25.6	25.7	27.9	26.7	27.1	25.6	26.1	26.8	0.411
	Minimum	18.3	20.1	21.5	18.6	18.1	19.8	16.4	23.2	
	Maximum	38.5	38.5	41.7	38.2	33.2	37.6	39.6	30.4	
	Standard deviation	5.8	4.8	5.0	4.4	3.5	3.9	5.4	5.1	
	n	21	26	31	35	38	48	56	2	
Age (years)	Average	49.4	49.2	52.6	48.1	52.3	50.2	52.0	28.0	0.429
	Minimum	20.0	19.0	19.0	23.0	19.0	18.0	18.0	26.0	
	Maximum	74.0	76.0	73.0	75.0	73.0	76.0	74.0	30.0	
	Standard deviation	17.0	17.2	12.8	15.0	15.5	16.3	14.7	2.8	
	n	21	26	31	35	38	48	56	2	

Table IV
Classification of patients undergoing hematopoietic stem cell transplantation by nutritional status according to the body mass index (BMI) and association with age and gender

BMI (kg/m²)	Age (years)				P
	< 65		≥ 65		
	n	%	n	%	
Normal or overweight	159	78.3%	25	46.3%	<0.001
Obesity	38	18.7%	26	48.1%	
BMI (kg/m²)	**Gender**				**P**
	Female		Male		
	n	%	n	%	
Normal	59	56.2%	45	31.5%	
Overweight	25	23.8%	55	38.5%	<0.001
Obesity	21	20.0%	43	30.1%	

Conclusion

In conclusion, our study showed less underweight and more overweight and obesity, differently to other studies about nutritional status in HSCT. The mean BMI of the total sample indicated overweight. Elderly patients had higher prevalence of obesity. Therefore, in our hospital these groups must undergo nutritional interventions more frequently to reduce the complications in HSCT.

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