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The Benefits of Therapeutic Exercise During Hematopoietic Stem Cell Transplantation: Literatures Review

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Background and Objective

Bone marrow or hematopoietic stem cell transplantation (HSCT) is the only chance cure for high-risk leukemias or chemotherapy-refractory lymphoid cancers. The HSCT treatment itself is associated with multiple side effects, adverse events, and long-term sequelae. Moreover, prolonged isolated hospitalization required for HSCT leads to sedentary behavior, causing further numerous adverse symptoms. All side effects will have a negative effect on the quality of life (QOL) and recovery. Therapeutic exercise therapy has been shown to be a supportive strategy to minimize or even prevent these transplant-related consequences. The goal of therapeutic exercise includes: 1. reducing or avoiding functional limitations or impairment, 2. controlling risk factors for chronic disease, and 3. improving overall health.

Methods/intervention

In PubMed.gov, we use hematopoietic stem cell transplantation, physical exercise, and quality of life as keywords to search between the duration of 2012 to 2022.

Results

100 articles were found. The results show that exercise can benefit cancer patients by improving quality of life, but it may also prolong survival after cancer treatment. Baseline physical fitness offered significant protection against mortality. The findings suggest that improvements in muscle strength and cardiopulmonary fitness before HSCT are crucial for maintaining post-treatment physical function.

Conclusions

Exercise training based on short, higher intensity intervals has the potential, which is consisted of five, 3 min intervals of walking, jogging or cycling at 65-95% maximal heart rate (MHR) with 3 min of low-intensity exercise (<65% MHR) between intervals to efficiently improve cardiorespiratory fitness. The duration of the intervention was at least 6 weeks, depending on each patient's scheduled transplantation date. Exercise prior to hematopoietic stem cell transplantation is safe and feasible, and positive trends suggest favorable preliminary effectiveness. A higher functional status at the start of hematopoietic stem cell transplantation may positively influence the level of decline and recovery. To maximizing physical capacity before HSCT could lead to better functional outcomes, as well as reduce the length of hospital stay and mortality risk.

Table 2. Adherence and efficacy data for autologous and allogeneic patients. Values are reported as medians

	Autologous cohort		P-*value*	*Allogeneic cohort*		P-*value*
	Pre	*Change*		*Pre*	*Change*	
VO_{2peak} (ml/kg min)	16.1	+1.1	0.12	18.1	+3.7	0.005
VO_{2peak} (L/min)	1.23	+0.15	0.09	1.33	+0.31	0.004
6MWD (m)	525	+30	0.19	495	+34	0.006
RER (pre-post)	1.15–1.19			1.23–1.27		
Number of weeks participated	4.0			5.0		
Number of IET sessions participated	7.0			11.0		
Median duration of IET sessions (minutes)	30			30		
Maximum HR achieved (bpm, %MHR)	159, 91%			161, 89%		
Daily steps	5547			5178		

Abbreviations: bpm = beats per minute; HR = hazards ratio; IET = interval exercise training; MHR = maximal heart rate; RER = respiratory exchange ratio.

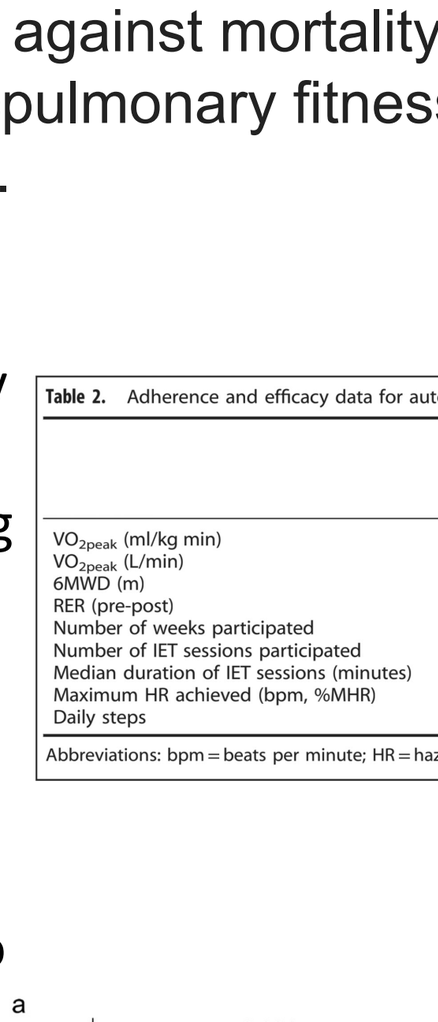

Fig. 1 Comparison of leg extension torque (**a**) and peak oxygen consumption (VO_2) (**b**) pre- and post-hematopoietic stem cell transplantation (HSCT)
The post-HSCT values of both variables significantly decreased compared to the pre-HSCT values. Error bars indicate standard deviation

Table 2 Correlation coefficients between continuous variables and leg extension torque and peak VO_2 post-hematopoietic stem cell transplantation

Variable		Post-HSCT			
		Leg extension torque ($n = 88$)		Peak VO_2 ($n = 67$)	
		Correlation Coefficient	*p* value	Correlation Coefficient	*p* value
Pre-HSCT	Age, years	−0.55	< 0.001	−0.30	0.013
	Serum albumin, g/dL	0.16	0.131	0.19	0.127
	Hemoglobin, g/dL	−0.08	0.444	−0.06	0.648
	Leg extension torque, N·m/kg	0.71	< 0.001	0.32	0.008
	Peak VO_2, mL/kg/min	0.24	0.038	0.50	< 0.001
	Karnofsky performance status score	0.14	0.181	0.05	0.695
Pre- and post-evaluation interval, days		−0.37	< 0.001	0.07	0.578
Duration from HSCT to neutrophil engraftment, days		−0.01	0.935	−0.01	0.921
Grades of acute GVHD		−0.35	0.001	0.04	0.972

VO_2 oxygen consumption, *HSCT* hematopoietic stem cell transplantation, *GVHD* graft-versus-host disease

Table 4 Multiple regression analysis of post-hematopoietic stem cell transplantation muscle strength and cardiopulmonary fitness

	Unstandardized coefficient	Standard error	Standardized coefficient	t	*p* value
A. Model for post-HSCT leg extension torque ($n = 88$)[a]					
Pre-HSCT leg extension torque	0.601	0.082	0.519	7.345	< 0.001
Grades of acute GVHD	−0.101	0.032	−0.222	−3.143	0.002
Age	−0.009	0.003	−0.225	−2.917	0.005
Pre- and post-evaluation interval	−0.007	0.002	−0.229	−3.241	0.002
Constant	1.405	0.275		5.104	< 0.001
B. Model for post-HSCT peak VO_2 ($n = 67$)[b]					
Pre-HSCT peak VO_2	0.457	0.098	0.502	4.684	< 0.001
Constant	9.174	2.269		4.043	< 0.001

HSCT hematopoietic stem cell transplantation, *GVHD* graft-versus-host disease, *VO_2* oxygen consumption
[a] $F(4, 72) = 40.86$, $p < 0.001$, adjusted $R^2 = 0.677$
[b] $F(1, 65) = 21.94$, $p < 0.001$, adjusted $R^2 = 0.252$

Relevance to HPH

More active have better results in pulmonary function and functional capacity. Exercise can benefit cancer patients by improving quality of life, but it may also prolong survival after cancer treatment.

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