Relationship between muscle oxidative metabolism and muscle strength in patients who receive allogeneic hematopoietic stem cell transplantation

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Introduction

- Cancer related fatigue significantly reduce the QOL of cancer patients (the Oncologist 2007 Hoffman H et al)
- Patients after hematopoietic stem cell transplantation (HSCT) reduce physical function and psychological status (Psyco - Oncology 2012 Morishita S, et al)
- It is possible to understand the muscle oxygen dynamics of skeletal muscle in the study of NIRS (Hamaoka T et al 2011)
- Recovery of oxygen saturation post-exercise (ΔStO_2) shows impaired oxygen delivery following exercise and skeletal muscle fatigue.(McCully K et al 1999)

Purpose

The purpose of this study was to investigate the relationship between knee extensor muscle strength due to impaired nutrition and muscle oxidative metabolism in patients who receive allo-HSCT.

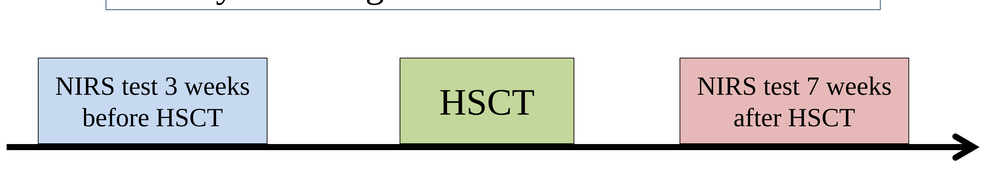
Methods

Study design

This study was a prospective, observational investigation of muscle strength, nutrition and, muscle oxidative metabolism in allo-HSCT patients using NIRS.

- Muscle O2 Saturation of hemoglobin levels in the tibialis anterior was measured non-invasively using NIRS (BOM-L1TRW, omega wave, co, Japan) (fig1)
- Changes in StO2 were mesured after 3minutes of repeated isometoric dorsiflexions using a dynamometer (Biodex System4, New York, NY, USA)
- We evaluated skeletal muscle reoxygenation after exercise using the ΔStO2 during recovery time
- ΔStO2 reflect the muscle fatigue

The day of testing NIRS before and after HSCT

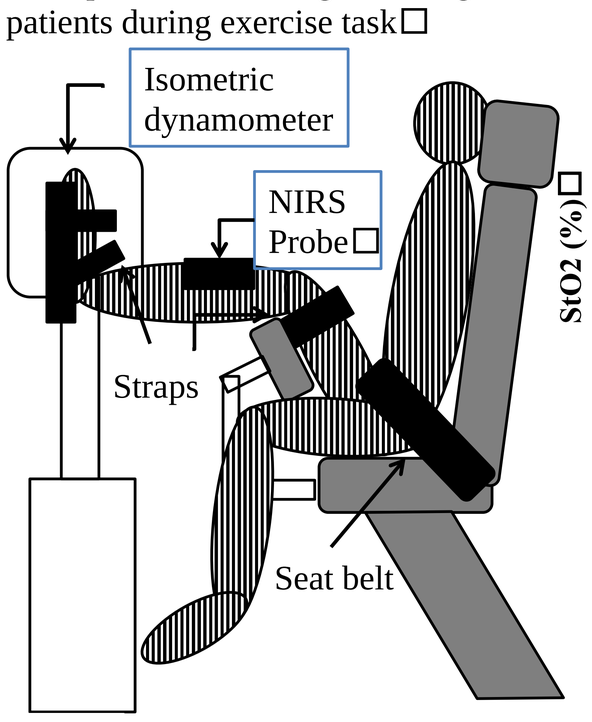


Participants

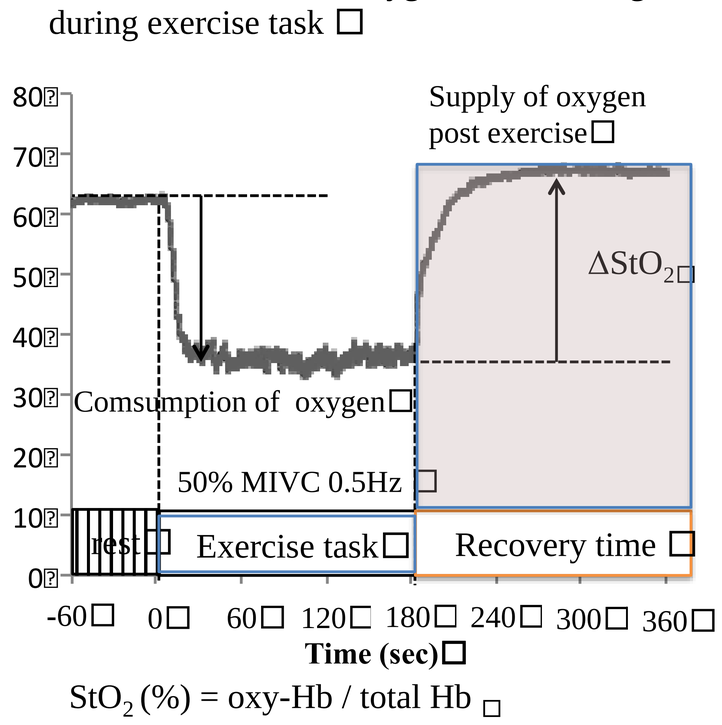
The study included 18 patients who underwent allo-HSCT between November 2009 to October 2012.

Characteristics		
		Median
Age		41 (18-63)
		n(%)
Sex	Male	18 (100.0)
		Mean (SD)
Height (cm)		174 (5.87)
Body weight (kg)		64.1 (9.26)
		n(%)
Diagnosis	Acute leukemia	9 (50.0)
	Malignant lymphoma	5 (27.7)
	Myelodysplastic syndrome	2 (11.1)
	Multiple myeloma	1 (5.5)
	Chronic myelogenous leukemia	1 (5.5)
Stem cell source	Peripheral blood stem cell	14 (77.7)
	Bone marrow	2 (11.1)
	Cord blood	2 (11.1)
Conditioning	Myeloablative	3 (16.6)
	Reduced intensity	15 (83.3)
Time to engraftment(day)		11 (2)
Acute GVHD		
No		17 (94.4)
Yes		1 (5.5)
Infection		
No		18 (100.0)
Yes		0 (0)
relapse		
No		18 (100.0)
Yes		0 (0)

A. Experimental setting of the leg of patients during exercise task



B. Skeletal muscle of oxygen saturation signals during exercise task



StO_2 (%) = oxy-Hb / total Hb

Figure 1 Experimental protocol

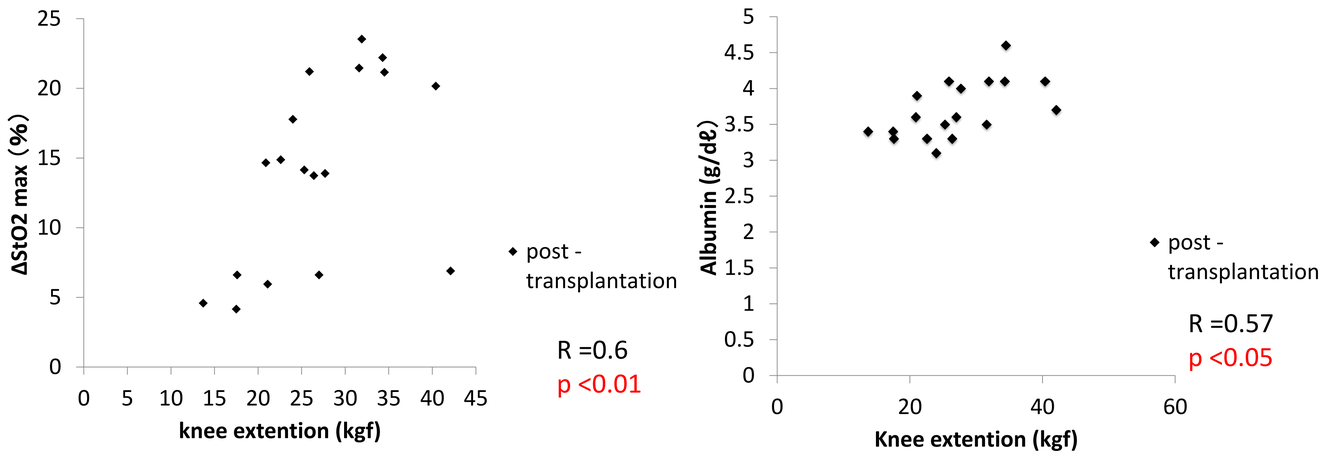
Abbreviations : StO_2, tissue oxygenation saturation. Hb, hemoglobin. MIVC, maximal isometric voluntary contraction. ΔStO_2, recovery of StO_2 after exercise task

Results

Results 1. Changes in muscle strength, albumin and, muscle oxidative metabolism in HSCT patients.

	Pre HSCT	Post HSCT	P value
Knee extension (kgf)	35.2±7.0	26.9±7.5	$p < 0.01$
ΔStO2 (%)	25.6±10.8	14.1±6.6	$p < 0.01$
Alb (g/dl)	4.0±0.5	3.7±0.4	$p < 0.05$

Results 2. Relationship between knee extensor StO2 or albumin



Conclusions

Skeletal muscle strength was associated with muscle oxidative metabolism and nutritional status after allo-HSCT. Physiotherapists may need to promote muscle oxidative metabolism through exercise in order to maintain muscle strength.