European Journal of Oncology Nursing 16 (2012) 475–482

Contents lists available at SciVerse ScienceDirect

European Journal of Oncology Nursing

journal homepage: www.elsevier.com/locate/ejon

The long-term effects after hematopoietic stem cell transplant on leg muscle strength, physical inactivity and fatigue

Akiko Tonosaki*

St Luke's College of Nursing, Tokyo, Japan

Keywords:
Hematopoietic stem cell transplantation
Fatigue
Muscle endurance
Physical activity
Knee extension strength
Ankle plantar flexion strength
Ankle dorsiflexion strength
Step-counts

ABSTRACT

Purpose: The purpose of this study was to analyze the effects of leg muscle strength and fatigue on step-count as a measure of physical activity for people staying at home after hematopoietic stem cell transplantation (HSCT).

Method: Nineteen persons receiving HSCT were assessed from hospitalization until about 2 months after discharge. Mean daily step-count was taken as a measure of physical activity. Leg muscle strength was measured in three ways (knee extension, ankle plantar flexion, and ankle dorsiflexion strength) at two points in time (time of hospital discharge and after 2 months). Fatigue and anxiety were assessed using the Japanese Cancer Fatigue Scale and State-Trait Anxiety Inventory. Correlations between the above and factors affecting physical activity were also investigated by multiple regression analysis.

Results: Clinical follow-up measurements in subjects were made an average of 81.0 days after discharge. Subjects with higher mean step-count during hospitalization ($\beta = 0.647$, $p = 0.000$) and greater ankle plantar flexion strength/kg ($\beta = 0.361$, $p = 0.021$) reported higher mean step-count at home (adjusted $R^2 = 0.701$, $p = 0.021$). Subjects with body mass index <22.0 kg/m^2 also showed higher step-counts at home compared to other subjects. Mean fatigue score at home was 16.8 (SD = 8.75), a level not associated with clinical problems, and the proportion of physical fatigue was significantly lower than during hospitalization.

Conclusion: Mean step-count at home was most strongly affected by ankle plantar flexion strength/kg, and increasing ankle plantar flexion strength/kg was shown to promote recovery of normal physical activities.

Introduction

Hematopoietic stem cell transplant (HSCT) often requires long-term recovery. The intensive treatment regimen, graft-versus-host disease (GvHD), infection and physical inactivity during long-term hospitalization necessitate a long recovery period. Moreover, psychological problems tend to occur due to differences between the pre-transplant expectation of normal recovery and actual post-transplant conditions (Andrykowski et al., 1995a). Quality of life (QOL) generally declines post-HSCT, accompanied by severe fatigue, diminished activity, and various physical symptoms (Wingard et al., 1994; Andrykowski et al., 1995b; Larsen et al., 2004; Bevans et al., 2008). With regards to QOL, patients receiving allogeneic HSCT with higher body mass index (BMI) had better physical well-being after transplantation; higher weight loss after HSCT was associated with poorer psychological and social well-being. HSCT patients with higher BMI had better QOL and were more likely to return to work sooner after HSCT than patients with lower BMI (Wong et al., 2010).

Recent studies of breast cancer survivors found that patients were susceptible to developing sedentary lifestyles due to feelings of fatigue and depression following treatment. Such sedentary lifestyles may cause the patient to become overweight or obese (Irwin et al., 2003). According to a 2005 regional health survey in Canada, fewer breast cancer survivors exercised than healthy people, and without an exercise habit there is a higher risk of various diseases, including cerebrovascular disorder, heart disease and diabetes mellitus. Exercise has thus come to be strongly recommended to breast cancer survivors to counter these risks (Courneya et al., 2008). Therefore, many experimental studies have examined the effects of exercise in cancer survivors. Studies evaluating the effects of physical exercise as adjuvant therapy for patients undergoing HSCT have been reported (DeFor et al., 2007; Wiskemann and Huber, 2008; Jarden et al., 2009; Shelton et al., 2009) with similar findings.

Regarding long-term effects on well-being, physical activity was related to self-efficacy, physical self-esteem, and positive affect in older adults (Elavsky et al., 2005). Previously Tonosaki (2012)

* National College of Nursing, Japan, 1-2-1, Umezono, Kiyose-shi, Tokyo 204-8575, Japan. Tel.: +81 42 495 2406; fax: +81 42 495 2675.
E-mail address: tonosakia@adm.ncn.ac.jp.

1462-3889/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ejon.2011.11.005

reported, step-count and physical status immediately before hospital discharge affected fatigue and anxiety in patients who had undergone HSCT. In addition fatigue at the time of hospital discharge was associated with delayed recovery of food intake amount and decreased leg muscle strength, such as knee extension and ankle dorsiflexion strengths per body mass. A strong correlation was also identified between fatigue and anxiety among pre-discharge patients. The present study followed the same patients from the previous study (Tonosaki, 2012) and focused on the home-stay period after hospital discharge assessing leg muscle strength and step-count as measures of physical activity for the patients.

The patients staying at home after HSCT were predicted to have a sedentary lifestyle due to prolonged fatigue and other physical symptoms, as mentioned above. Thus, purposes of this study were to: 1) determine the impact of leg muscle strength and fatigue on daily step-count (as a measure of physical activity) after hospital discharge and 2) provide supporting evidence for the construction of a rehabilitation program for restoring the ability of patients to walk at a normal speed. This was ultimately directed toward enabling early recovery of physical activity and acquiring self-management capabilities (Wilde and Garvin, 2007) for patients following HSCT, and would thus contribute to return to work or other social tasks to improve QOL.

Method

Design and sample

This study design was descriptive and correlational with a cohort of subjects measured over time. Participants in this study were a convenience sample recruited from patients who satisfied the eligibility criteria of the research hospital, The Institute of Medical Science at The University of Tokyo, Japan. To be eligible, the participant had to be: a) ≥18 years old; b) capable of speaking and reading Japanese; c) scheduled for initial HSCT as a treatment for a hematological disease and d) willing to undergo muscle strength measurements and complete questionnaires. Exclusion criteria were: a) thrombocytopenia (platelets $<30 \times 10^9$/L); b) heart failure or systolic blood pressure ≥180 mmHg or c) functional impairment or bone metastasis precluding leg muscle strength measurement. The primary physician of each patient determined eligibility for participation in the study. Of the 66 individuals who were recruited to participate from November 2002 to January 2006, six did not consent, leaving 60 (90.9%) enrolled in the study. However 44 (73.3%) actually began the study as 16 were excluded because they were unable to provide a record of their step-counts. Subsequently, nine patients died during hospitalization and 10 withdrew because of their deterioration from the acute disease. Data were gathered up to the time of hospital discharge from the remaining 25 (56.8%) participants. Subsequently, another six patients failed to continue recording step-count after discharge and were withdrawn from this study. Data were thus gathered up to and including the time of the clinic follow-up assessment for those 19 participants (43.1%) (see Fig. 1 flow chart of participant retention).

Measures

Leg muscle strength (muscle force, knee extension and ankle strengths)

To measure leg muscle force, a hand-held-dynamometer (HDD) was used. HDD (Isoforce GT-300 and GT-100, OG Giken Co., Ltd., Okayama, Japan) is a reliable and valid measurement tool of strength testing in clinical settings (Bohannon, 1986; Surburg et al., 1992; Busse et al., 2008; Tonosaki, 2004). Isometric strength at maximum voluntary contraction was measured (Bohannon, 1986), with the participant instructed to maintain maximum muscle force for 2–3 s after measurement initiation. Measurements were performed twice for each leg and the mean was calculated (see Tonosaki, 2012 for further details).

For measurement of knee extension force, the participant sat in a chair and was instructed to extend the knee from the flexed position, with encouragement to use only the force of the knee joint. To measure ankle strength (ankle plantar flexion strength and ankle dorsiflexion strength), the participant was instructed to lie

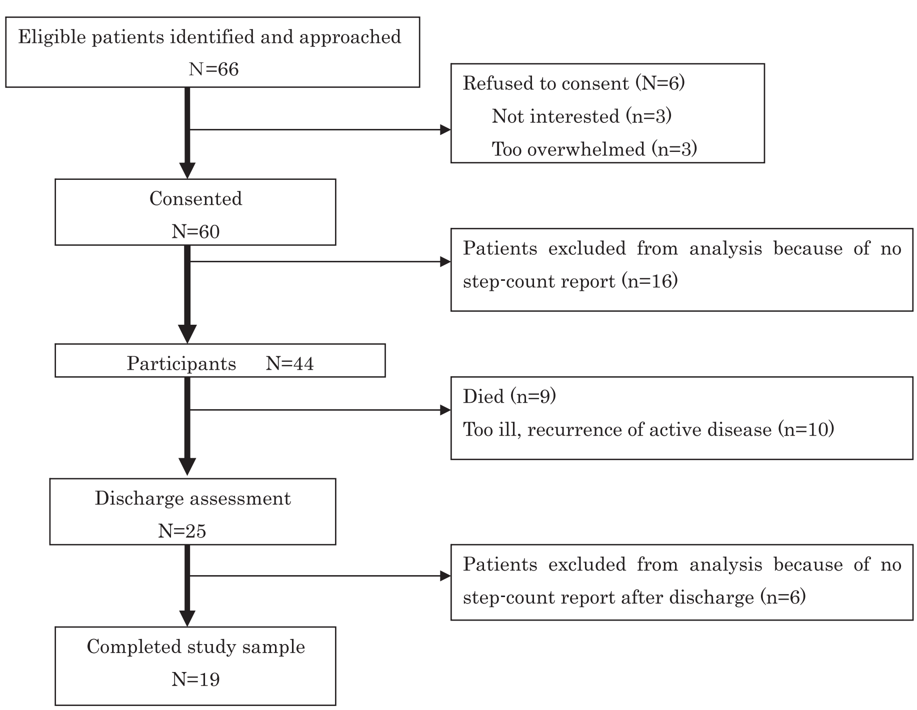

Fig. 1. Flow chart of subject recruitment, enrollment and attrition.