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REVIEW ARTICLE

Physical therapy pathway and protocol for patients undergoing hematopoietic stem cell transplantation: Recommendations from The Eastern Mediterranean Blood and Marrow Transplantation (EMBMT) Group

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Abstract
Background: Patients undergoing hematopoietic stem cell transplantation (HSCT) are often referred for physical therapy (PT) to help improve their quality of life. However, to our knowledge there is no clear PT pathway to guide therapists and patients before, during, and after HSCT.
Methods: A comprehensive literature review was carried out exploring the role and benefits of PT in HSCT patients. The current evidence was comlimented with recommendations and opinions from the experts in the field, which included PT's and hematology consultants from PTAGVHD and the EMBMT group.
Result: A clear pathway and protocol as a working guide for rehabilitation professionals working with the HSCT patient's was developed.
Conclusion: This paper not only reviews the current evidence on safe PT practice but also puts forward a protocol and pathway for HSCT rehabilitation, highlights the importance of individualized exercise intervention for HSCT patients, and outlines safe practice guidelines for the physical therapists working in this field.

Contents

Introduction

Physical therapy (PT) has been advocated [1] as a promising adjunct to treatment during and after hematopoietic stem cell transplantation (HSCT) because of its multidimensional effectiveness [2]. There is growing evidence that a significant difference in strength, endurance, lung function, and quality of life can be achieved with PT intervention [3]. However, to achieve the desired results in the setting of HSCT, type, frequency, duration, and intensity of the exercise should be well planned and executed to reflect the diverse needs of individual patients [4].

This article has been developed by the Rehabilitation Association for Hematopoietic Stem Cell Transplantation (RHSCT), formerly known as PTAGVHD (Physical Therapy Association Graft Versus Host Disease), team with the support and input from the Quality of Life Committee of the Eastern Mediterranean Blood and Marrow Transplantation (EMBMT). The main aim of this work is to recommend a framework for the hospitals involved in HSCT to help maximize the benefit from PT services. The article is combined with evidence-based recommendations along with opinions from experts from within the field to help structure service provision.

Objectives

1. Define a clear PT pathway for patients before, during, and after HSCT.
2. Recommend subjective and objective measures to help monitor and relay progress to the patients and the multidisciplinary medical team involved in their care.
3. Highlight the importance of individualized exercise intervention for hsct patients. the importance of individualized exercise intervention for HSCT patients.
4. Recommend safe practice PT guidelines for HSCT inpatients.

The need for PT clinical pathway for HSCT

Clinical pathways are often created to help improve patient services, enhance recovery, standardize practice for research and data collection, ensure continuity and quality of care, better utilize resources, to be cost-effective, and streamline cases based on the priority, thereby positively influencing the opinions of the stakeholders involved in the provision of the services [5—9]. Considering the extent of complications both before and after transplant, which the potential HSCT patients present with, it is vital that these patients receive a structured and standardized care that can help in not only early detection of musculoskeletal (MSK)-related complications but also timely intervention to prevent functional loss.

PT pathway

HSCT pretransplant PT assessment

One of the main rationale behind obtaining the pretransplant functional capacity score is to help monitor any deterioration after transplantation, such as development of the MSK manifestations such as chronic graft versus host disease (cGVHD) or other complications. Thus, each hospital should develop their own comprehensive PT assessssment which will enable them to capture the diverse functional elements.

Subjective evaluation

It is recommended that the subjective evaluation includes, apart from the usual PT assessment, the following:

1. Existing MSK-related conditions: This helps in planning both pretransplant and post-transplant rehabilitation with a focus on existing functional incapacity and to also differentiate between post-transplant complications and existing conditions.
2. Occupation: Discussing return to work (if applicable) at the initial assessment can help physical therapists understand the area that needs more focus during rehabilitation and perhaps plan an early return to work depending on patients' individual medical and physical condition. If possible, some of the work-related functional evaluation tests can be carried out at this stage and can be vital in not only monitoring but also for making work-related recommendations to the patients and their employers.
3. Medications: The physical therapists should make themselves aware of the history of medications, which should be obtained from either the patients or their respective doctors and PTs, including the potential side effects in relation to patient's potential recovery [10].

Objective assessment

Wherever possible, each pre-HSCT patient should be offered the following PT assessment and the outcomes recorded in the patient notes according to the individual hospital recording system. The aim is to obtain an overall body functional capacity; however, patients who are not able to undergo this comprehensive test should aim to get a minimum of one upper limb and one lower limb objective measure along with completion of a quality of life questionnaire and a functional questionnaire:

1. Upper and lower limb active range of motion [11] (goniometer or other objective measure).
2. Jamar Grip and Pinch Strength [12].
3. Upper and Lower Limb Strength Test (use a valid and reliable method).
4. 30-second Chair-Stand Test [13].
5. 6-minute Walk Test [14].
6. EORTC QLQ-C30 [15] Questionnaire.
7. Lower Extremity Functional Scale (LEFS) [16].
8. Disabilities of the Arm, Shoulder and Hand Questionnaire (QuickDASH) [17].

The physical therapist should communicate any existing functional incapacity or concerns to the multidisciplinary team involved in patient care and make appropriate interventional plan for the patient.

Patients requiring PT input prior to transplant should be scheduled for appropriate intervention and communicate the rehabilitation to the inpatient physical therapist highlighting the risk areas (Fig. 1).

Pretransplant physical fitness

The pretransplant physical assessment can also be beneficial in determining the existing fitness level of a patient, as several studies have indicated a positive post-transplant outcome for patients with good pretransplant fitness levels

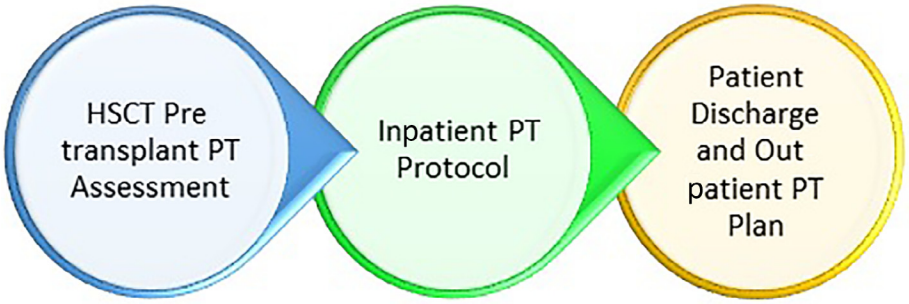

Fig. 1 Physical therapy (PT) pathway for hematopoietic stem cell transplantation (HSCT) patients.

[18]. Improvements in muscle strength and cardiopulmonary fitness before HSCT have been found to be crucial for maintaining post-treatment physical function, especially in elderly individuals with acute GVHD requiring a long-term stay in a protective environment [19].

Inpatient PT protocol

For all patients with documented baseline parameters (pre-transplant), an individualized strength, endurance, cardiovascular, and balance training should be prescribed by the physical therapist based on the patient's individual ability. It should be noted that the exercise program needs tailoring based on patient's day-to-day symptoms throughout the inpatient admission period.

Platelet count

Although low platelet (<20,000/mcL) count has historically been a concern and considered a contraindication for exercises, recent studies have shown that most HSCT patients are able to tolerate and benefit from exercises despite low platelet counts (<10,000/mcL) [20,21]. Furthermore, no association between minor bleeding events and intensities of PT interventions or between minor bleeding events and platelet counts in children under the age of 18 [22] was reported. Although these studies lack in their quality, their findings can be suggestive for physical therapists that the entire clinical situation of the individual patient should be taken into account when weighing the risk and benefits of exercise interventions rather than just solely relying on the platelet count itself. This is encouraging for both patients and rehabilitation specialists working with this population considering the high risk and associated complications due to reduced mobility. For the ease of therapists, a safe practice guideline for exercise intensities are summarized in Table 1.

Table 2 Exercises Versus Platelet Count.

Platelet count	Exercise intensity
5000/mcL	Very light
5000—20,000/mcL	Light to moderate
21,000—30,000/mcL	Moderate
31,000—50,000/mcL	Moderate to intensive

It is vital that the physical therapists involved in patient care should modify the exercise intensity to reflect individual patient's medical and physical condition on a day-to-day basis. Platelet counts are outlined in Table 2 to help guide exercise programs; however, as discussed earlier, the clinician should use his/her own clinical judgment before progressing the patient to ensure patient safety.

Caution

In some patients, platelet or blood transfusions would be recommended before training if the platelet count and hemoglobin levels are below 10,000/μL and 8 g/100 mL, respectively [23]. Patients who have a hemoglobin level below 80 g /100mL should not receive any PT management, however, the risks and benefits of exercising with low hemoglobin should also be considered on an individual basis within the patient's overall clinical picture.

Table 1 Exercise intensities.

Very light	Light	Moderate	Intensive
AROM/AAROM	Transfers	Muscle motor training	Stretching/elongation
Essential ADL (sitting at the edge of the bed or in the bed/chair)	Limited ambulation (in the room)	Dynamic balance/coordination (uneven surfaces)	Strengthening
Grooming	AROM	Endurance	Progressive resistive exercises
Bed mobility (rolling, supine to sit on the edge of the bed)	ADL (standing at the edge of the bed)	Unlimited ambulation (out of the room)	Jumping, obstacle course, climbing
Therapeutic activity in the bed	Static balance on even and stable surfaces (mat or floor)		

Note. ADL = activities of daily living; AROM = active range of motion; AAROM = active assisted range of motion.

Blood transfusion patients

Until recently, the PT intervention during blood transfusion was believed to be contraindicated, but recent studies have provided preliminary evidence that participation in a well-monitored PT session may be safe for individuals with hematologic malignancies and for those who are receiving a red blood cell (RBC) transfusion. Furthermore, adverse events related to RBC transfusion are believed not to be influenced by PT intervention [24].

Patients with complications

Post HSCT patients might develop certain complications resulting in their admission to the intensive care unit (ICU). These patients, on return from the ICU, can benefit from being reassessed for their functional capacity so that their physical therapy plan reflects their current medical and physical status.

Prioritizing patients

A physical therapist should prioritize the delivery of the PT sessions on a case-by-case scenario, for example, more PT resources should be dedicated to patients who are identified as high risk compared with those who are independent and are able to follow exercise prescription (these patients might be given an exercise log). This also means that some patients might even require two to three sessions a day (e.g., patients with GVHD).

Exercise prescription and progression

- The exercise prescribed to patients should be aimed at progressing various parameters (i.e., strength, endurance, cardiovascular, balance, and function).
- The baseline parameters should be retested each week or as deemed appropriate depending on the patient's condition and progression. However, all patients should receive an initial assessment and predischarge assessment.
- The physical therapist should record each exercise session, the progression plan, and communicate this to the rehabilitation team alongside the nurse and the consultant/doctor.

Discharge and plan

- Patients due for discharge should receive a full PT assessment according to the pretransplant protocol and this should be compared with the pretransplant scores to help identify the need for outpatient rehabilitation.
- Appropriate arrangements for outpatient PT should be made before the patient is discharged from the hospital.
- Home exercise and precaution education should be provided to the patients before they are sent home.

Outpatient long-term PT follow-up

A significant proportion of the transplant patients show some signs of cGVHD [25,26]. PTs can be best utilized in the early detection of MSK-related cGVHD, especially for those patients in whom the impact is on muscle power, fascia, functional capacity, and quality of life and in those with advanced sclerotic skin changes. With the baseline functional score already available to the physical therapists from the pretransplant assessment record, it should be relatively easy to correlate any deterioration in patient's functional capacity, thus helping in early detection, flagging, and intervention. However, to achieve this, it is important that patients are offered full-body functional evaluation after transplantation at 4 weeks, 8 weeks, 12 weeks, 15 weeks, 18 weeks, and 21 weeks. This repeated assessment could help in monitoring subtle changes in the myofascial level and the patient-reported symptoms. Physical therapists should make themselves familiar with the myofascial movement pattern so that the measurements of the movement reflect the myofascial chain and not just the joint range of motion.

Physical therapists who are trained in using diagnostic ultrasound can also utilize this technology to help monitor the changes in the skin/fascia on selective sites such as hand, forearm, calf, hamstrings, and spinal area during each assessment to monitor changes.

The rehabilitation should follow SMART (specific, measurable, attainable, realistic, and time bound) goals, which should be reflected via individualized exercise prescription plan. Some patients might also need functional restoration program to help them return to work or sports activities, which again will need a careful planning and execution on behalf of the physical therapist along with the multidisciplinary team. The return-to-work recommendations must only be made by physical therapists or health-care professionals who are experienced in the occupational health field and qualified to do so.

Take away points

1. HSCT patients can benefit from a structured PT pathway to ensure safety, continued service, enhanced recovery, and reduced burden of disease before, during, and after transplant rehabilitation.
2. A well-defined personalized exercise prescription program is vital in achieving individual patient goals.
3. Whole-body functional assessment should be considered for all patients undergoing HSCT to help monitor and detect any MSK changes.
4. Knowledge of myofascial movement pattern and chains is essential in capturing the true functional incapacity in patients.
5. Ongoing assessments at regular intervals can help in early detection of MSK-related complication, thereby helping patients with timely intervention.
6. Communicating between various health-care professionals involved in the patient care can be a key to a successful patient journey in the hospital.

Conflicts of interest

There are no conflicts of interest to disclose from any authors.

Authors' contributions

J.M., M.A., and S.H. wrote the first draft of the manuscript. All authors contributed substantially to the conception, acquisition, analysis, and interpretation of the data for the work. No funding was received from any source.

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