Chapter 6

Physical Therapy in Patients with Cancer

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Additional information is available at the end of the chapter

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Abstract

Physical therapists often treat cancer patients. Cancer treatment includes chemotherapy, radiotherapy, and surgery, which are being continuously developed and thus increase survival of patients with each cancer diagnosis. More specifically, 5-year survival rates increase with each cancer diagnosis. Cancer patients have many problems including muscle weakness, pulmonary dysfunction, fatigue, and pain. In the end, patients with cancer tend to have a decline in activities of daily living (ADL) and quality of life (QOL). Additionally, cancer patients often have progressive disease, depression, and anxiety. Physical therapy often helps patients regain strength and physical function and improve their QOL and independence of daily living that they may have lost due to cancer or its treatment. Physical therapy has an important role in increasing physical function of cancer patients, cancer survivors, and children with cancer. In the future, physical therapy may be progressively needed for management of cancer patients.

Keywords: physical therapy, cancer, cancer survivor, ADL, QOL

1. Introduction

Cancer and its treatments are associated with a wide range of distressing physical and psychological symptoms that can affect patients for many years following treatment [1]. Many cancer patients also have physical dysfunction and experience deficits in muscle strength, flexibility, and endurance as a result of chemotherapy, radiation therapy, and surgery [2]. Physical therapy is a comprehensive, multidisciplinary approach to the evaluation and treatment of patients diagnosed with various forms of cancer. Physical therapy can improve functional problems such as weakness, soft tissue tightness, joint stiffness, fatigue, and swelling or edema [3, 4]. Physical therapy allows experts to find the best ways for cancer patients to stay active. Physical therapy-led exercise is clinically effective and can help cancer patients

improve their quality of life (QOL) [5]. Physical therapy includes stretching, strengthening, and aerobic exercises for the inpatients, outpatients, and cancer survivors. It often helps patients regain strength, physical functioning, quality of life, and independence in activities of daily living (ADL) that they may have lost due to cancer or its treatment. Physical therapists are available in multiple treatment settings, including preoperative, postoperative, acute care, nursing home, and inpatient and outpatient rehabilitation. Physical therapists also work in conjunction with the rehabilitation team to design components of a survivorship care plan in order to optimize overall functional outcomes (**Figure 1**) [6]. Cancer has four stages, and cancer patients have differences in disease and disabilities during each stage (**Table 1**). Physical therapists often use four cancer rehabilitation stages and identify the stage before physical therapy for cancer patients (**Table 2**) [7]. There are different approaches for therapy of cancer patients during each stage.

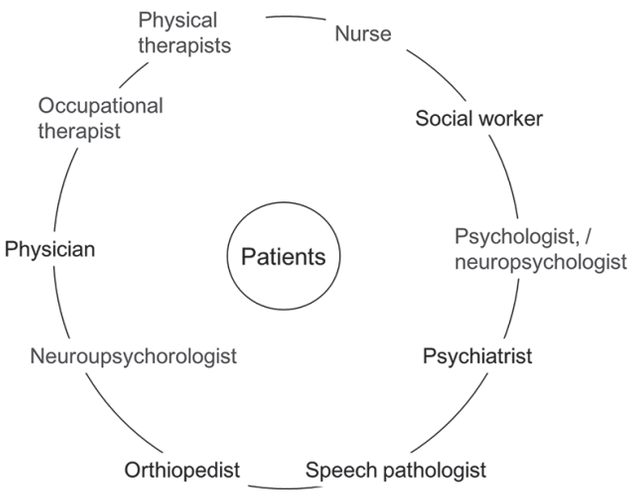

Figure 1. Rehabilitation team for cancer patients.

Stage	Characteristics
Stage 1	Cancer is relatively small and contained within the organ it originated from. This stage describes cancer in situ, which means "in place." Stage 1 cancers have not spread to nearby tissues. This stage of cancer is often highly curable, usually by removing the entire tumor with surgery
Stage 2	Cancer has not started to spread into surrounding tissue but the tumor is larger than in Stage 1. Sometimes, Stage 2 means that cancer cells have spread into lymph nodes close to the tumor. At this stage, cancer or tumor is relatively small and has not grown deeply into the nearby tissues. It also has not spread to the lymph nodes or other parts of the body. It is often called an early-stage cancer
Stage 3	Cancer is larger. It may have started to spread into surrounding tissues, and cancer cells may be present in the lymph nodes of the area. This stage indicates larger cancers or tumors
Stage 4	Cancer has spread from where it started to another organs or parts of the body. This is also called a secondary, advanced, or metastatic cancer

Table 1. Cancer stage.

Stage
(1) Preventive
Intervention focused on improving the patient's level of function prior to the onset of the effects of the cancer and its treatment, patient education, and psychological support
(2) Restorative rehabilitation
Intervention focused on returning the patient to a previous level of function and addressing impairments from cancer and its treatment
(3) Supportive rehabilitation
Intervention is meant to assist the cancer patient to function at the highest level within the context of his or her impairments, activity limitations, and participation restrictions
(4) Palliative rehabilitation
Intervention focused on minimizing complications such as pressure ulcers, contractures, and muscle deconditioning ensuring adequate pain control and emotional support for the family

Table 2. Four cancer rehabilitation stages.

This chapter introduces overview, treatment, common dysfunctions, physical therapy assessment, physical therapy, key points in diagnosis, and palliative care of following cancer types: breast cancer, gynecologic cancers, brain tumor, head and neck cancer, lung cancer, esophagus cancer, bone cancer, and blood cancer. This chapter also shows the important role of physical therapy in cancer patients.

2. General concept of physical therapy

Physical therapists must undergo assessment based on the International Classification of Functioning, Disability and Health (ICF) model before, during, and after physical therapy for each cancer patient (**Figure 2**). ICF enables physical therapist to provide cancer patients with therapy. Cancer patients have many problems caused by cancer treatment or cancer itself. Physical therapy assessment should include manual muscle testing (MMT), range of motion (ROM), balance test, endurance test, and ADL test. Performance status (PS; **Table 3**) [8], Palliative Performance Scale (PPS; **Table 4**) [9], Barthel index (BI) [10], functional independence measure (FIM) [11, 12], and QOL are also used as assessment tools for cancer patients. Physical therapists should be aware that cancer patients are exposed to various risks such as infectious diseases due to immunosuppressive effects of the treatment. Thus, physical therapists must manage risks that are related to cancer and its treatment (**Table 5**) [13]. Additionally, physical therapists must recognize that cancer is a progressive disease. In general, cancer patients have a gradual decline in their physical function. Once a goal is set, physical therapists must be aware of cancer progression and patients' prognosis [14]. Physical therapists also must know a variety of other problems that occur in cancer patients. Cancer patients might not only have physical function problems but may also develop depression and anxiety in the future [15]. Cancer patients might feel the fear of cancer recurrence or death. Physical therapy may be effective in reducing fatigue, increasing muscle strength and exercise capacity, and improving QOL in various cancer patients.

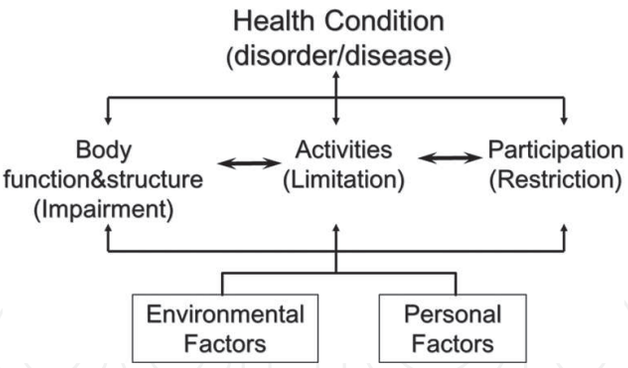

Figure 2. International Classification of Functioning, Disability, and Health.

Grade	ECOG performance status
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work
2	Ambulatory and capable of all self-care but unable to carry out any work activities. Up and about more than 50% of waking hours
3	Capable of only limited self-care, confined to bed or chair more than 50% of waking hours
4	Completely disabled. Cannot carry on any self-care. Totally confined to bed or chair
5	Dead

Table 3. Performance status (PS).

PPS level	Ambulation	Activity and evidence of disease	Self-care	Intake	Conscious level
100	Full	Normal activity and work no evidence of disease	Full	Normal	Full
90	Full	Normal activity and work Some evidence of disease	Full	Normal	Full
80	Full	Normal activity with effort Some evidence of disease	Full	Normal or reduced	Full
70	Reduced	Unable normal job/ work Significant disease	Full	Normal or reduced	Full
60	Reduced	Unable hobby/house work Significant disease	Occasional assistance necessary	Normal or reduced	Full or confusion

PPS level	Ambulation	Activity and evidence of disease	Self-care	Intake	Conscious level
50	Mainly sit/lie	Unable to do any work Extensive disease	Considerable assistance required	Normal or reduced	Full or confusion
40	Mainly in bed	Unable to do most activity Extensive disease	Mainly assistance	Normal or reduced	Full or drowsy ± confusion
30	Totally bed bound	Unable to do any activity Extensive disease	Total care	Normal or reduced	Full or drowsy ± confusion
20	Totally bed bound	Unable to do any activity Extensive disease	Total care	Minimal to sips	Full or drowsy ± confusion
10	Totally bed bound	Unable to do any activity Extensive disease	Total care	Mouth care only	Drowsy or coma ± confusion
0	Death				

[1]PPS scores are determined by reading horizontally at each level to find a "best fit" for the patient who is then assigned as the PPS% score.

[2]Begin at the left column, read downward until the appropriate ambulation level is reached, and then read across to the next column and downward again until the activity/evidence of disease is located. These steps are repeated until all five columns are covered before assigning the actual PPS for that patient. In this way, "leftward" columns (columns to the left of any specific column) are "stronger" determinants and generally take precedence over others.

[3]PPS scores are in 10% increments only. Sometimes, there are several columns easily placed at one level but one or two which seem better at a higher or lower level. One then needs to make a "best fit" decision. Choosing a "halfwit" value of PPS 45%, for example, is not correct. The combination of clinical judgment and "leftward precedence" is used to determine whether 40% or 50% is the more accurate score for that patient.

Table 4. Palliative Performance Scale (PPSv2).

1. Hematologic profile: hemoglobin <7.5 g, platelets <20,000, white blood cell count <3000
2. Metastatic bone disease
3. Compression of a hollow viscous (bowel, bladder, or ureter) vessel or spinal cord
4. Fluid accumulation in the pleura, pericardium, abdomen, or retroperitoneum associated with persistent pain, dyspnea, or problems with mobility
5. CNS depression or coma or increased intracranial pressure
6. Hypokalemia/hyperkalemia, hyponatremia, or hypocalcemia/hypercalcemia
7. Orthostatic hypotension
8. Heart rate in excess 110 beat/min or ventricular arrhythmia
9. Fever greater than 101°F

Table 5. Precaution rehabilitation for cancer patients.

3. Physical therapy in cancer patients

3.1. Breast cancer

3.1.1. Overview

Breast cancer is the most common invasive cancer in women worldwide [16]. Breast cancer alone accounts for 25% of all cancer cases and 15% of all cancer deaths among women [17]. Breast cancer starts when cells in the breast begin to grow out of control. These cells usually form a tumor that can be often seen on an X-ray or felt as a lump. Breast cancer can develop following changes in genetic material leading to cellular changes that causes cells to start multiplying in an uncontrolled fashion, forming lumps or nodules.

3.1.2. Treatment

In general, breast cancer patients have few treatment options such as surgery (breast-conserving surgery and mastectomy), radiation therapy, chemotherapy, and hormone therapy [18, 19]. In some cases, lymph nodes located close to the affected breast need to be surgically removed.

3.1.3. Common dysfunctions in breast cancer

Muscle weakness around the shoulder joint, decline of ADL using upper extremities, dizziness, loss of appetite, shortness of breath, depression are present in a substantial majority of patients during or after their initial treatment (surgery, radiation, and/or chemotherapy) [20, 21]. Physical therapists must pay attention to the occurrence of musculoskeletal disorders and lymph vascular disorders following breast surgery. Musculoskeletal disorders include postsurgical pain, rotator cuff disease, and adhesive capsulitis [22]. Lymph vascular disorders are common after removal of lymph nodes [23]. As a result, breast cancer patients have limited range of motion, muscle weakness, pain, and ADL decline such as difficulties while brushing hair or taking off the jacket. In some cases of breast cancer, cellulitis occurs that can become a potentially serious bacterial skin infection [21, 24].

3.1.4. Physical therapy assessment

Physical therapy assessment of cancer patients includes the ICF, examination of shoulder ROM, MMT, pain levels, fatigue, upper limb volume, an upper limb disability questionnaire, and QOL evaluation. Additionally, in the cases of breast cancer patients, physical therapists assess exercise tolerance.

3.1.5. Physical therapy

Many previous studies showed that physical therapy has effectiveness in breast cancer patients [25, 26]. In general, combined physical therapy is effective to treat postoperative lymphedema,

pain, and impaired ROM after treatment for breast cancer [26]. Physical therapy for breast cancer patients includes lymphatic drainage massage, vantage, manual stretching, myofascial therapy, relaxation massage, stretching, strengthening, resisted exercise, proprioceptive neuromuscular facilitation (PNF) exercises, isometric exercises, aerobic exercises, transcutaneous electrical nerve stimulation (TENS), heat and cold, patient education, and behavioral training. Breast cancer patients also receive ADL training such as bathing, showering (washing the body), and dressing.

3.1.6. Key points

Physical therapists should improve mobility of upper extremities with a reduction of their volume. This should be followed by an attempt to recover upper limb function in ADL.

3.2. Gynecologic cancers

3.2.1. Overview

Gynecologic cancers accounted for 19% of the 5.1 million estimated new cancer cases and 13 million 5-year prevalent cancer cases among women in the world in 2002 [27]. Gynecologic cancer is described as the uncontrolled growth and spread of abnormal cells originating in the female reproductive organs. They are found in different places within a woman's pelvis, which is the area below the stomach and in between the hip bones. Five main types of gynecologic cancers are present: cervical, ovarian, uterine, vaginal, and vulvar.

3.2.2. Treatment

In general, gynecologic cancers can be cured with aggressive treatment involving surgery, chemotherapy, and/or radiation. Treatment goal in recurrent and metastatic cancer is to decrease progression of the disease [28, 29].

3.2.3. Common dysfunctions in gynecologic cancer

Weakness of pelvic floor muscles, decline in ADL, dizziness, loss of appetite, shortness of breath, depression are the symptoms present in a substantial majority of patients during or after their initial treatment (surgery, radiation, and/or chemotherapy) [30]. Lower extremity weakness often occurs in gynecologic cancer patients; thus, locomotion disability is common [31]. Physical therapists must pay attention to occurrence of musculoskeletal and lymph vascular disorders at the lower extremities following gynecologic surgery [32]. Lymphovascular disorders cause problems after removal of lymph nodes [33]. As a result, patients experience limited ROM, muscle weakness, pain, and decline in ADL.

3.2.4. Physical therapy assessment

First, physical therapists should assess pelvic floor muscle strength as gynecologic cancers have urinary incontinence after the treatment [34, 35]. Second, physical therapists should

assess ICF category: lower extremities such as hip, knee, and ankle ROM; MMT; assessment of pain levels; fatigue; upper limb volume; locomotion ability such as gait speed; balance function; QOL; ADL; and sexual function [36]. Additionally, physical therapists should assess exercise tolerance.

3.2.5. Physical therapy

A few previous reports showed that physical therapy has a positive effect on gynecologic cancer patients [37]. Physical therapists should perform pelvic floor physical therapy as a tool to aid in addressing pelvic floor symptoms [37]. In general, physical therapy for gynecologic cancer patients includes locomotion ability exercises such as standing and walking, lymphatic drainage massage, vantage, manual stretching, myofascial therapy, relaxation massage, stretching, strengthening, resisted exercise, PNF, aerobic exercise, TENS, patient education, and behavioral training.

3.2.6. Key points

Physical therapists should improve muscle strength of lower extremities and reduce their volume as soon as possible. This should be followed by acquiring locomotion.

3.3. Brain tumor

3.3.1. Overview

The worldwide cancer incidence of a malignant brain tumor is 3.4 per 100,000 for men and 3.0 per 100,000 for women [38]. Brain tumor is the most common neurological complication related to cancer [39]. Brain tumors can originate from the patient's brain (primary brain tumors) or from other parts of the patient's body (secondary or metastatic brain tumors) [40, 41]. Brain tumors can destroy brain cells, increase inflammation, and elevate brain pressure. Brain tumors may cause a wide range of neurological dysfunctions, including disorders of the nervous system.

3.3.2. Treatment

In general, treatment options include surgery, radiation therapy, chemotherapy, targeted biological agents, or a combination of these [42]. Surgical resection is commonly the first recommended treatment in order to rapidly reduce brain pressure.

3.3.3. Common dysfunctions in brain tumor

Brain tumor patients commonly experience weakness, sensory loss, and abnormal muscle tone. These include spasticity, visuospatial deficits, hemi-neglect or bilateral visual deficits, ataxia, cognitive deficits (thought processes, memory changes, apraxia, etc.), speech difficulties, dysphagia, bowel and bladder dysfunction, psychological problems, and fatigue. As a result, ADL decline and lower QOL are common in brain tumor patients [43, 44].

3.3.4. Physical therapy assessment

Physical therapists often assess ICF category, Glasgow Coma Scale, Mini-Mental State Examination, Fugl-Meyer, Motor Assessment Scale, Motricity Index, Berg Balance Assessment, Beck Depression Inventory (BDI), and Hospital Anxiety and Depression Scale (HADS). They examine pain levels and locomotion ability such as gait speed, QOL, and sexual function. Additionally, physical therapists should assess exercise tolerance in brain tumor patients [45, 46].

3.3.5. Physical therapy

To date, no previous study has reported positive effects of physical therapy in adult brain tumor patients. However, a few reports showed that physical therapy may be effective in pediatric brain tumor patients [47]. In general, physical therapy performed in brain tumor patients is also performed in stroke patients [48]. It includes neurofacilitation techniques such as Bobath, PNF, Brunnstrom, motor relearning, functional electrical stimulation (FES), biofeedback, balance retraining, gait reeducation, and use of supportive equipment. Physical therapists must be aware of the progress of paralysis in brain tumor patients as a result of increasing tumor size. Physical therapists should know how to improve convalescence of the brain. Additionally, cognitive dysfunction, apraxia, and aphasia should be assessed [49].

3.3.6. Key points

Physical therapists should aim to treat paralysis and improve ADL as soon as possible. Attention should be paid to progressive paralysis in brain tumor patients.

3.4. Head and neck cancer

3.4.1. Overview

Overall, the annual incidence of head and neck cancer worldwide is more than 550,000 cases with around 300,000 deaths [50]. Men are affected significantly more than women [51]. Head and neck cancer includes cancers of the mouth, nose, sinuses, salivary glands, throat, and lymph nodes in the neck. Most originate from the moist tissues that line the mouth, nose, and throat. Head and neck cancers can also originate within the salivary glands. Salivary glands contain many different types of cells that can become cancerous leading to many different types of salivary gland cancers.

3.4.2. Treatment

Treatment options include surgery, radiation therapy, chemotherapy, and targeted therapy [52]. Surgery or radiation therapy alone or a combination of these treatments may be part of a patient's treatment plan [53]. Tracheostomy is performed when there are concerns about breathing due to airway obstruction associated with a throat cancer or treatment side effects [54]. Nutritional status of patients declines following tracheostomy. As patients are not able to eat, they usually receive intravenous feeding.

3.4.3. Common dysfunctions in head and neck tumor

Aspiration pneumonia after concurrent chemoradiation therapy and surgery is seen in head and neck cancer patients [55]. Most patients have dysphagia and are at increased risk of having aspiration and subsequent pneumonia [56]. Additionally, physical therapists must be aware of the decline in nutritional status after surgery or chemoradiation in these patients [57]. Paralysis of accessory nerve that causes trapezius muscle dysfunction is often seen following neck dissection [58]. This dysfunction leads to shoulder syndrome with adhesive capsulitis. Muscle weakness, decline of ADL, dizziness, loss of appetite, shortness of breath, depression are observed in a substantial majority of patients during or after their initial treatment (surgery, radiation, and/or chemotherapy) [59]. Upper and lower extremities tend to be weaker following long-term bedridden and sedentary treatment.

3.4.4. Physical therapy assessment

General pulmonary function tests are performed: spirometry; breathing pattern and cough; breath sounds including wheezing, coarse crackles, fine crackles, and rhonchi; and posture deformities in the chest or the spine; dysphagia evaluation; and ADL. Additionally, physical therapists should perform exercise tolerance test in gynecologic cancer patients. Furthermore, physical therapists should assess shoulder function including strength, mobility, and pain after surgery or chemoradiotherapy. Physical therapists often assess ICF category and lower and upper joint ROM; perform MMT; and evaluate pain levels, fatigue, and locomotion ability such as gait speed, balance function, and QOL.

3.4.5. Physical therapy

Physical therapy of the arms is performed to improve locomotion and pulmonary dysfunction. Some previous reports showed that physical therapy has effectiveness in head and neck cancer patients [60, 61]. When patients have paralysis of the accessory nerve, physical therapists perform exercises for the trapezius muscle to reduce its dysfunction [62]. Additionally, physical therapy of head and neck cancer patients includes locomotion ability exercises such as standing and walking, massage, manual stretching, myofascial therapy, relaxation massage, stretching, strengthening, resisted exercise, PNF, aerobic exercise, TENS, patient education, and behavioral training [63, 64]. However, if patients are fasting and have aspiration, they may have lower nutritional status requiring physical function recovery to be delayed.

3.4.6. Key points

Physical therapists must recognize that head and neck cancer patients tend to experience decline of the pulmonary function and paralysis of accessory nerve following the neck surgery. Physical therapists should recover pulmonary and shoulder function and improve ADL in such patients.

3.5. Lung cancer

3.5.1. Overview

Lung cancer is the most frequently diagnosed cancer worldwide with about 1.35 million new cases diagnosed each year [65]. Lung cancer starts with uncontrollable growth of abnormal cells in the lung. These cells can invade nearby tissues and form tumors. Lung cancer can start anywhere in the lungs and affect any part of the respiratory system. Cancer cells can spread, or metastasize, to the lymph nodes and other parts of the body. There are two main types of lung cancer: small-cell lung cancer (SCLC) and non-small-cell lung cancer (NSCLC). Small-cell lung cancers usually grow quicker and are more likely to spread to other body parts. Non-small-cell lung cancer accounts for about 85% of all lung cancer cases, whereas small-cell lung cancer accounts for about 15% of all lung cancer cases [50, 66].

3.5.2. Treatments

Lung cancer treatment depends on its type. Small-cell lung cancer is mostly treated with chemotherapy [67]. Non-small-cell lung cancer can be treated with surgery, chemotherapy, radiotherapy, or a combination of these depending on the stage at which the cancer is diagnosed [68, 69].

3.5.3. Common dysfunctions in lung cancer

When lung cancer treatment involves chemotherapy only, patients experience a decrease in physical function including decreased muscle strength and flexibility, which is also observed before the treatment. However, if lung cancer patients receive surgery, they encounter more problems than without the surgery. These problems include pulmonary dysfunction and decline of locomotion and ADL. Additionally, lung cancer patients experience pain of a surgical wound following thoracotomy and costectomy. Muscle weakness, decline of ADL, dizziness, loss of appetite, shortness of breath, and depression occur in a substantial majority of patients during or after their initial treatment (surgery, radiation, and/or chemotherapy). Upper and lower extremity and trunk muscle strength decreases following long-term bedridden and sedentary treatment.

3.5.4. Physical therapy assessment

General pulmonary function tests include spirometry; breathing pattern and cough; breath sounds like wheezing, coarse crackles, fine crackles, and rhonchi; postural deformities in the chest or the spine; and dysphagia evaluation on ADL [70, 71]. Additionally, physical therapists should assess exercise tolerance and shoulder function including its strength, mobility, and pain following surgery or chemoradiotherapy in patients with lung cancer. Physical therapists often assess ICF category and lower and upper joint ROM; perform MMT; and assess pain levels, fatigue, and locomotion ability such as gait speed, balance function, and QOL.

3.5.5. Physical therapy

Physical therapy of the arms is done in order to improve locomotion and pulmonary dysfunction after the treatment [72]. Some previous studies reported that preoperative physical therapy has effectiveness in lung cancer patients [73, 74]. Intensive physical therapy appears to increase oxygen saturation, reduce hospital stay, and change ventilation/perfusion distribution in lung cancer patients [73]. Following surgery with resection, physical therapists promote mobilization starting at the intensive care unit (ICU) because lung cancer patients tend to be sedentary leading to progressive decline in their physical function. Physical therapy for lung cancer patients includes massage, manual stretching, myofascial therapy, relaxation massage, stretching, strengthening, resisted exercise, PNF, aerobic exercise, TENS, patient education, and behavioral training.

3.5.6. Key points

Physical therapists should prevent development of further weakness after the treatment. Following surgery, physical therapists must make lung cancer patients perform pulmonary and mobilization exercises as soon as possible.

3.6. Esophageal cancer

3.6.1. Overview

Esophageal carcinoma affects more than 450,000 people worldwide, and the incidence is rapidly increasing [75]. Esophageal cancer is a disease in which malignant (cancer) cells form in the tissues of the esophagus. The most common types of esophageal cancer are squamous cell carcinoma and adenocarcinoma. Smoking and heavy alcohol use increase the risk of esophageal squamous cell carcinoma [76]. Esophageal cancer is often diagnosed at an advanced stage because there are no early signs or symptoms. A cancerous tumor is malignant, meaning it can grow and spread to other parts of the body. Esophageal cancer can also spread into the lungs, liver, stomach, and other parts of the body.

3.6.2. Treatment

Chemotherapy, radiotherapy, and surgery are often used as treatments for esophageal cancers [77]. Chemotherapy by itself rarely is effective. It is often combined with radiation therapy. Chemoradiation is often used before the surgery aiming to remove the cancer and some of the normal surrounding tissues. In some cases it might be combined with other treatments, such as chemotherapy and/or radiation therapy [78].

3.6.3. Common dysfunctions in esophageal cancer

If esophageal cancer patients receive chemotherapy or radiotherapy alone, they tend to have decreased physical function including loss of muscle strength and flexibility which is also observed before treatment. However, if surgery is performed, patients have more problems

than without surgery, including pulmonary dysfunction and decline of locomotion and ADL. Following surgery, patients have to stay in ICU for few days. During this period, patients may develop a decline in pulmonary function and as a result, they may be intubated for a long time. Additionally, fasting is common for a few weeks until patients can eat food without aspiration. Muscle weakness, decline of ADL, dizziness, loss of appetite, shortness of breath, depression are observed in a substantial majority of patients during or after their initial treatment (surgery, radiation, and/or chemotherapy). Upper and lower extremity and trunk muscle strength decreases following long-term bedridden and sedentary treatment.

3.6.4. Physical therapy assessment

General pulmonary function tests should be performed in cancer patients. This includes spirometry; breathing pattern and cough; breath sounds like wheezing, coarse crackles, fine crackles, and rhonchi; and postural deformities in the chest or the spine. Evaluation of dysphagia on ADL should be also often assessed. Additionally, physical therapists should assess exercise tolerance in esophageal cancer patients and shoulder function including strength, mobility, and pain after surgery or chemoradiotherapy in patients with esophageal cancers. Physical therapists often assess ICF category and lower and upper joint ROM; perform MMT; and assess pain levels, fatigue, and locomotion ability such as gait speed, balance function, and QOL [79].

3.6.5. Physical therapy

To date, there are no previous studies reporting that physical therapy is effective in esophageal cancer patients. In general, physical therapy has few aims in these patients. First, performance of pulmonary exercises including positioning and breathing exercises promotes weaning of the ventilator and extubating. Second, improvement of locomotion promotes mobilization in patient's bedside [80]. Third, physical therapy aims to improve muscle strength and exercise tolerance during hospitalization. Physical therapy often includes massage, manual stretching, myofascial therapy, relaxation massage, stretching, strengthening, resisted exercise, PNF, aerobic exercise, TENS, patient education, and behavioral training.

3.6.6. Key points

Physical therapists should aim to prevent further weakness after the treatment. Following surgery, physical therapists must make patients perform pulmonary exercise and mobilization as soon as possible.

3.7. Bone cancer

3.7.1. Overview

The age-adjusted incidence rate of primary malignant bone tumors in the United States is 0.9 per 100,000 persons per year, accounting for approximately 0.2% of all malignancies [81]. Bone cancer is a rare form of cancer that can affect any bone in the body. Bone cancer is a

cancer that arises from the cells that make up the bones. When cancer is detected in the bone, it most often has started somewhere else (e.g., in another organ) and then spread to the bones. This is known as cancer that has metastasized to the bone and is named after the site where the original cancer began. Bone cancer can vary widely from person to person depending on its location and size. The most common type of malignant bone tumor is osteosarcoma, which most often develops in the bones of the arms, legs, and pelvis. Other types of bone cancer include the following: chondrosarcoma, Ewing's tumor, chordoma, fibrosarcoma, giant cell tumor, and malignant fibrous histiocytoma [82].

3.7.2. Treatment

Treatment includes surgery, chemotherapy, and radiation therapy [83, 84]. Amputation may be necessary if limb-sparing surgery is not possible or had no positive outcomes [85].

3.7.3. Common dysfunctions in bone cancer

Chemotherapy or radiotherapy alone results in and improvement of physical function including muscle strength and flexibility. However, if bone cancer patients received surgery, they could develop some problems. Patients may have pain and weakness of the affected limb and may have restricted weight bearing and movement of limbs or the spine. In addition, when amputation of the arm, leg, hand, or foot is performed, patients become more physically disabled. Bone cancer patients with spine tumor, paraplegia, or quadriplegia have declined motor and sensory function in addition to bladder and bowel dysfunction [86].

3.7.4. Physical therapy assessment

Physical therapists should often assesses ICF category; pain levels; affected bone tumor; ROM; MMT; fatigue; ADL; and locomotion ability such as gait speed, balance function, and QOL. Physical therapists should be aware of motion and weight-bearing restrictions that occur after the surgery. In case of amputation, physical therapists should assess phantom limb pain, muscle strength, and mobility of the affected limb. Patients with spine tumor have paralysis; hence, physical therapists should use the American Spinal Injury Association (ASIA) scores for evaluation of sensory function, strength, mobility, and pain after the surgery or chemoradiotherapy.

3.7.5. Physical therapy

To date, there are no previous studies reporting that physical therapy is effective in bone cancer patients. In general, physical therapists must pay attention to fragile bones. Bone tumors make bones easy to fracture with vigorous movements. Physical therapy differs depending on the treatment of bone cancer. When bone cancer patients receive chemotherapy and radiotherapy only, muscle strengthening and endurance exercises are performed. However, when patients receive surgery, physical therapists must pay attention to contraindicative exercises. When patients receive amputation, limb prosthetics should be considered by the physiotherapist together with a prosthetist and an orthotist. In bone cancer patients with paraplegia such

as bone tumor in the spinal cord, physical therapy is carried out in accordance with physical therapy of spinal cord injury. Otherwise, physical therapy often includes stretching, strengthening, resisted exercise, PNF, aerobic exercise, patient education, and behavioral training.

3.7.6. Key points

Physical therapists must know the location and progression of bone tumor as it is an important factor allowing improvement of physical function after treatment.

3.8. Blood cancer including hematopoietic stem cell transplantation (HSCT)

3.8.1. Overview

The number of new cases of leukemia is 4.5–9.1 per 100,000 men and 3.6–6.0 per 100,000 women per year [50]. Blood cancer affects the blood and lymph systems. Bone marrow has a function of producing blood cells such as red blood cells, white blood cells, and platelets. Bone marrow is a flexible soft tissue found in the hollow interior of the bones. Blood cancer may begin in blood-forming tissue (e.g., bone marrow) or in the cells of the immune system. There are different types of hematological cancers including leukemia, non-Hodgkin lymphoma, Hodgkin lymphoma, and multiple myeloma. Leukemia is a cancer that originates in the white blood cells and affects people of all ages [87].

3.8.2. Treatment

In general, blood cancer treatment includes chemotherapy, corticosteroids, radiation, and HSCT.

3.8.3. Common dysfunctions in blood cancer

First, blood cancer patients that have received chemotherapy experience a decrease in physical function including muscle strength and endurance capacity. Second, if complete remission is not achieved after chemotherapy, HSCT has to be chosen. In this case, patients experience even more decreased muscle strength and endurance capacity as they have to stay in a hospital for a few weeks [88, 89]. Hospitalized patients often have graft-versus-host disease (GVHD). GVHD normally affects the skin, liver, and gastrointestinal system resulting in further dysfunctions. Furthermore, following HSCT treatment, patients must stay in the isolation room to prevent infection; hence, a decrease in physical activity during these days will occur [90].

3.8.4. Physical therapy assessment

Physical therapists should assess muscle strength, body composition, mobility, and endurance capacity in blood cancer patients. Physical therapists often assess ICF category, lower and upper joint ROM, balance function, MMT, fatigue, and locomotion ability such as gait speed, balance function, and QOL [91–94].

3.8.5. Physical therapy

Physical therapy focused on the arms is performed in order to improve locomotion and muscle strength after treatment. Some previous reports showed that physical therapy is effective in pediatric leukemia patients [95, 96]. Additionally, some previous reports showed that physical therapy is effective in patients with HSCT [90, 97]. Following HSCT, physical therapists must wear a mask, plastic grove, and apron during physical therapy. The most common physical therapy of blood cancer includes massage, manual stretching, myofascial therapy, relaxation massage, stretching, strengthening, resisted exercise, PNF, aerobic exercise, balance training, TENS, patient education, and behavioral training.

3.8.6. Key points

Physical therapists should aim to increase muscle strength and exercise capacity in blood cancer patients. Additionally, physical therapists must be aware that patients may have myelosuppression as a result of chemotherapy. Physical therapy should be performed in such a way that it prevents infection in these patients.

3.9. Palliative care in cancer

Palliative care helps people cope with the symptoms of cancer and cancer treatment [98]. Palliative care aims to improve the quality of life of patients who have serious or life-threatening diseases [99]. The goal of palliative care is to prevent or treat the symptoms and side effects of the disease and its treatment in addition to related psychological, social, and spiritual problems [100]. However, the main goal is not to cure patients [101]. When many different treatments have been tried and showed no control over cancer, it could be the time to weigh the benefits and risks of continuing trying new treatments. Palliative care provides patients of any age or disease stage with relief from symptoms, pain, and stress and should be provided along curative treatment. Palliative care focuses on helping people get relief from symptoms caused by serious illness (e.g., nausea, pain, fatigue, or shortness of breath) [102].

3.9.1. Treatment

Palliative treatment is designed to relieve symptoms and often includes medication, nutritional support, relaxation techniques, spiritual support, emotional support, and other therapies [103, 104]. Palliative treatment improves patient's quality of life. It can be used at any stage of an illness and also if there are troubling symptoms such as pain or sickness. Palliative treatment can also mean using medicines to reduce or control side effects of cancer treatments.

3.9.2. Common dysfunctions in palliative care in cancer patients

Cancer patients have many problems making palliative care a good additional treatment option. Patients have many symptoms including pain, fatigue, loss of appetite, nausea,

vomiting, shortness of breath, insomnia, thirst, dry mouth, bad taste, and difficulty swallowing. Gradually, patients may become bedridden and sedentary. Patients usually have a bigger decrease in muscle strength, pulmonary function, ADL, and locomotion after they received palliative care. In some cases, cancer patients have lymphedema. Unfortunately, patients may die in a few weeks or months.

3.9.3. Physical therapy assessment

Physical therapists should often assess ICF category, pain levels, ROM, MMT, fatigue, ADL, and QOL. Additionally, physical therapists should perform pulmonary function tests including spirometry; breathing pattern; cough; breath sounds such as wheezing, coarse crackles, fine crackles, and rhonchi; and postural deformities in the chest or the spine and evaluate dysphagia on ADL. If cancer patients become bedridden for a long time, physical therapists should assess pressure ulcers at the sacrum and coccyx.

3.9.4. Physical therapy

A few previous reports showed that physical therapy may be effective in cancer patients who receive palliative care [105, 106]. In general, physical therapy helps to maintain mobility and improves body movements [7, 107]. Physical therapists improve locomotion ability by exercises that include standing and walking, massage, manual stretching, strengthening, resisted exercises, aerobic exercises, patient education, and behavioral training. If patients have severe pain related to cancer, physical therapy includes myofascial therapy, relaxation massage, TENS, heat and cold, and positioning. If patients are bedridden or sedentary for a long time, physical therapists should relieve pressure to prevent pressure ulcers on bones such as the sacrum and coccyx.

3.9.5. Key points

Physical therapists must be aware that cancer patients experience more fatigue and pain while improving their locomotion. When cancer patients cannot receive progressive physical therapy, physical therapists should use myofascial therapy, relaxation massage, TENS, heat and cold, and positioning to relieve pain.

4. Summary and conclusion

Cancer patients have some physical impairment. Physical therapy is helpful and contributes to patients' recovery. Cancer patients are exposed to some risk factors during physical therapy. Therefore, physical therapists must pay attention and manage those risk factors. Cancer survivors increase 5 years of survival in various cancer diseases. Physical therapy may have an important role to improve physical function, ADL, and QOL of cancer patients and cancer survivors.

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