



### Introduction

- Each disease treatment modality may individually or collectively introduce risk for a host of potential safety issues
- A complex array of bio-psychosocial factors also affect and amplify risk:
  - pre-existing comorbidities
  - multiple medications and
  - other lifestyle factors
- Early identification and management of emerging adverse events may affect morbidity and survival

### Safety considerations after surgery

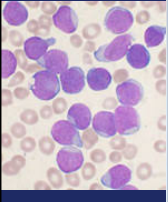
- Be aware of postsurgical precautions & contraindications regarding movement and activity restrictions to develop a rehab plan that:
  - facilitates tissue healing
  - prevents restrictions in function and
  - optimises functional status
- These precautions should be:
  - **balanced with evidence-based mobilisation**
  - **postoperative activity recommendations and**
  - **informed by surgical precautions and guidance**

### Safety considerations after surgery references

- Mobility and exercise participation in the acute postoperative stage of treatment may:
  - reduce the risk of adverse events [1,2]
  - affect overall length of stay [3]
  - reduce readmissions and complications in various cancer populations [1,4]

Common Chemotherapy agents and side effects - 1 [ref 61]		
Drug Category	Drug Brand Name	Side Effects
<b>Alkylating agents</b>	Cyclophosphamide, Busulfan, Ifosfamide, Thiopeta, Carmustine, Melphalan, Dacarbazine	Congestive heart failure, Pulmonary fibrosis, Shortness of breath, Dyspnea on exertion, Dizziness, joint pain, anemia, renal failure
<b>Anthracyclines</b>	Danorubicin, Doxorubicin (Adriamycin), Epirubicin, Bleomycin	Cardiotoxicity, left ventricular dysfunction, congestive heart failure, cardiomyopathy
<b>Antiandrogens</b>	Flutamide (Eulexin), Nilutamide	Muscle-wasting, osteoporosis, Erectile dysfunction
<b>Antimetabolites</b>	5-Fluorouracil, Xeloda, Gemcitabine, Fludarabine, Methotrexate	Anemia, shortness of breath, skin rash/dermatitis
<b>Aromatase Inhibitors</b>	Letroxole (Femara), Anastrozole (Arimidex), Exemestane (Aromasin)	Joint arthralgias, osteopenia/osteoporosis, hot flashes, weight gain, mood fluctuations
<b>Cytoskeletal Disruptors (taxanes)</b>	Paclitaxel (Taxol), Docetaxel (Taxotere) Abraxane	Peripheral neuropathy, cytopenia (reduction in mature blood cells), Acute myocardial infarction
<b>Gonadotropin - releasing hormone agonist</b>	GNRH- A (Cetorelix)	Osteoporosis, weight gain, heart failure, heart disease
<b>Luteinizing hormone agonist</b>	Goserelin (Zoladex), Leuprolide (Lupron), Triptorelin (Trelstar)	Bone pain, sexual dysfunction, anemia, cognitive dysfunction

Common Chemotherapy agents and side effects - 2 [ref 61]		
Drug Category	Drug Brand Name	Side Effects
<b>Kinase inhibitors</b>	Erlotinib (Tarceva), Lapatinib (Tykerb), Imatinib, Gefitinib	Acute Myocardial infarction, stroke, DVT/PE, Interstitial lung disease, Bradycardia
<b>Monoclonal antibodies</b>	Alemtuzumab (Campath), Trastuzumab (Herceptin)	Cytopenia, Pulmonary inflammation, congestive heart failure, hypertension, reduced wound healing, skin rash
<b>Platinum-based agents</b>	Carboplatin, Cisplatin, Oxaliplatin	Neurotoxicity, Ototoxicity
<b>Retinoids</b>	Tretinoin, Alltretinoin	Increased intracranial pressure, DVT / PE
<b>Selective estrogen receptor modifiers</b>	Tamoxifen (Nolvadex), Raloxifene (Evista)	Hot flashes, weight gain, Cognitive and memory dysfunction, DVT / PE, Stroke
<b>Topoisomerase Inhibitors</b>	Irinotecan (Cemtoposar), Topotecan (Hycamtin)	Cytopenia, Severe diarrhea and dehydration,
<b>Vinca alkaloids</b>	Vincristine, Vinblastine	Peripheral neuropathy, Dyspnea, hypertension, angina, Acute myocardial infarction



## Myelosuppression

- Myelosuppression = decrease in the ability of the bone marrow to produce blood cells
- A common side effect associated with nearly all chemotherapy & immunosuppressive agents
- Can result in decreased production of:
  - Red blood cells, White blood cells and platelets
- Increases the increase risk of infection, compromise metabolic function and alters physiological responses to exercise in severe circumstances

General rehabilitation considerations in the context of hematological compromise [ref 61]	
Blood count	Rehabilitation Considerations
<b>White blood cells</b>	<ul style="list-style-type: none"> <li>• &gt; 11,000 – symptom-based approach, monitor for fever</li> <li>• &lt; 4,000 – symptom-based approach, monitor for fever</li> <li>• &lt; 1500 – (Neutropenia): symptom-based approach, neutropenic precautions based on facility guidelines</li> </ul>
<b>Platelets</b>	<ul style="list-style-type: none"> <li>• &lt; 150,000 cells (thrombocytopenia): symptom-based approach, monitor tolerance to activity</li> <li>• &gt; 50,000 cells : progressive exercise as tolerated, aerobic, and resistive with monitoring for symptoms associated with bleeding</li> <li>• &gt; 30,000 cells: active range of motion exercises, moderate exercise, aquatic therapy based on immune status</li> <li>• &gt; 20,000 cells: light exercise, walking, activities of daily living without strenuous effort; assess risk and implement safety plan for falls prevention</li> <li>• &lt; 20,000 cells: Understand transfusion status or plan of care, walking, light activities of daily living, system monitoring, precaution for falls</li> </ul>
<b>Hemoglobin</b>	Reference values: Male = 14 – 174 Female = 12 – 16 g/dL <ul style="list-style-type: none"> <li>• &lt; 11 g/dL (anemia): Symptom limited, monitoring self-perceived exertion</li> <li>• &lt; 8 g/dL (severe anemia): short periods of intervention, symptom-limited, energy conservation education, blood transfusion maybe indicated</li> </ul>

Deficiency Type Of White Blood Cells

## Chemotherapy induced neutropenia

Typically occur 3 – 7 days after administration of chemotherapy

- Neutropenia predisposes patients to infection
- Primary sites of infection are - GI tract, sinuses, lungs & skin
- Cancer rehab physios should practice **good hand hygiene**
- Special consideration to individuals **feeling sick, dizzy or extreme fatigue**
- Reduce exposure to potential risks found in public therapy spaces
- Neutropenic infections are a major cause of morbidity & mortality
- Closely monitor at-risk patients for early signs and symptoms of infection so medical management can be quickly utilised

General rehabilitation considerations in the context of hematological compromise [ref 61]	
Blood count	Rehabilitation Considerations
<b>White blood cells</b>	<ul style="list-style-type: none"> <li>• &gt; 11,000 – symptom-based approach, monitor for fever</li> <li>• &lt; 4,000 – symptom-based approach, monitor for fever</li> <li>• &lt; 1500 – (Neutropenia): symptom-based approach, neutropenic precautions based on facility guidelines</li> </ul>
<b>Platelets</b>	<ul style="list-style-type: none"> <li>• &lt; 150,000 cells (thrombocytopenia): symptom-based approach, monitor tolerance to activity</li> <li>• &gt; 50,000 cells : progressive exercise as tolerated, aerobic, and resistive with monitoring for symptoms associated with bleeding</li> <li>• &gt; 30,000 cells: active range of motion exercises, moderate exercise, aquatic therapy based on immune status</li> <li>• &gt; 20,000 cells: light exercise, walking, activities of daily living without strenuous effort; assess risk and implement safety plan for falls prevention</li> <li>• &lt; 20,000 cells: Understand transfusion status or plan of care, walking, light activities of daily living, system monitoring, precaution for falls</li> </ul>
<b>Hemoglobin</b>	Reference values: Male = 14 – 174 Female = 12 – 16 g/dL <ul style="list-style-type: none"> <li>• &lt; 11 g/dL (anemia): Symptom limited, monitoring self-perceived exertion</li> <li>• &lt; 8 g/dL (severe anemia): short periods of intervention, symptom-limited, energy conservation education, blood transfusion maybe indicated</li> </ul>

Deficiency Of Platelets

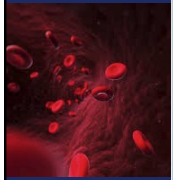
## Thrombocytopenia

- A low level of platelets can result – bruising & heavy bleeding
- Platelet counts <20,000 cells - increased risk & need special consideration for rehab
- Generally activity - restricted to walking & ADLs
  - Light exercise may be possible with close symptom monitoring
  - maintain blood pressures below 170/100
  - Screen patient for symptoms of bleeding, bruising & bleeding around the gums.
- Those with counts > 30,000 cells can engage in moderate exercise & light resistive exercise within tolerance

Deficiency Of Red Blood Cells


## Anemia

- Worsening anemia reduces **exercise tolerance & endurance** – symptoms of fatigue, dizziness, weakness, rapid heart rate, shortness of breath
- Caution when prescribing:
  - progressive resistive & moderate to high intensity aerobic exercise in individuals with severe anemia (**hemoglobin <8**)
- Low intensity exercise may promote improvements in blood counts
- Monitor functional & exertional status + patient symptoms : chest pain, lightheadedness and inappropriate shortness of breath




### Bone marrow transplants

- Transplant patients normally have high-dose chemo first with concurrent radiation
- Patients are cytopenic at the time of transplantation & remain so for weeks
- Increased risk of neurotoxicities affecting peripheral nerve function, myopathy due to chronic corticosteroid use, prolonged immobility, nutrition deficiencies & cognitive dysfunction
- Research suggests exercise not only determines better performance at discharge in this population, but a shorter duration of anemia, neutropenia, thrombocytopenia & length of hospitalisation [5,6]



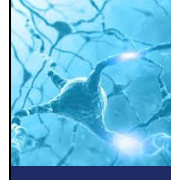
### Cardiopulmonary Toxicity 1

- Chemotherapy, immunotherapy drugs + radiation therapy to the chest wall = can affect cardiac & pulmonary function, during and after cancer treatments
  - Anthracyclines can have a significant & irreversible impact on cardiac function
  - Cardiac changes typically manifest clinically at least 6 - 12 months after radiation
  - Impact on cardiac function can be identified 20 years after completion of radiation therapy, affecting long-term morbidity & function
- Low intensity exercise, during chemotherapy cycles, maybe protective against chemo drug induced cardiotoxicity [7]
- Consider dose scheduling, prior cardiac comorbidities & shortness of breath when prescribing exercise to this population



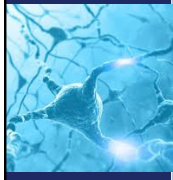
### Cardiopulmonary Toxicity 2

- Awareness of risk for reduced tolerance to exercise & altered physiological responses to rehab
- Monitoring during rehab should include:
  - a focus on patient self-report of tolerance to exercise via the Borg Scale or another index
- Observation for symptoms that may indicate undetected cardiac dysfunction or exercise that is too vigorous for someone with known heart disease include:
  - excessive fatigue, sweating, or pallor changes with exercise or activity and severe shortness of breath




### Neurotoxicity 1

- Taxane-based and Platinum-based chemotherapeutic agents
- Neuropathic changes are typically progressive with additional chemotherapy cycles
- Progression of sensory changes presents in stocking/glove pattern
- Severe cases, motor disturbance - primarily in the lower extremities
- Symptoms tend to abate after the completion of chemo
- Persistent impact on sensation and proprioception does occur and shown to have a negative impact on:
  - balance, gait, and mobility even more than 5 years after the completion of treatment [10]



### Neurotoxicity 2

- Fall risk is 2-3 x greater in individuals with a history of receiving neurotoxic chemotherapeutic agents [11]
- Rehabilitation implications:
  - Assessment of sensation, strength, and balance and continued screening for changes over time, and observation of gait deviation
  - Safety considerations for patients with balance deficits, to enhance gait, stability and improve function should be applied
  - Providing assistive devices may be required to maintain patient safety with severe neuropathy with motor changes [12 -14]



### Lymphoedema

- Several studies show exercise does not exacerbate lymphoedema or have a significant impact on worsening symptoms [15-18]
- Early use of compression therapy in the presence of early, subclinical lymphedema is safe & effective
- Individuals with lymphedema should be advised to exercise with some form of compression on their limbs to prevent fluid accumulation
- Any signs of redness, pain, or new onset or exacerbation of swelling should be referred for more extensive medical management
- For individuals with lymph nodes removed = astute observation of any changes in the limb that indicate an emerging infection should be addressed



## Frailty



Characterised by:

- reduced physiological capacity
- weight loss
- weakness
- slow walking speed
- self-reported exhaustion and
- low physical activity

- Optimising nutrition and muscle mass may delay frailty
- Studies on exercise interventions in frail institutionalized adults, balance and functional training were shown to be effective in improving functional performance, activities of daily living, and quality of life [19 - 24]



## Osteoporosis and Secondary Bone Loss 1



- Most common in hormonally driven breast & prostate cancer
- Modify rehab interventions to optimise safety
- Weight-bearing exercise may have protective effect in reducing bone density depletion during hormonal therapy
- Bone metastases occur prevalently in breast, lung & prostate cancers
- Bone lesions often result in pain, spinal cord compression, fracture, and hypercalcaemia reducing quality of life & limiting functional mobility [25 -29]




## Osteoporosis and Secondary Bone Loss 2



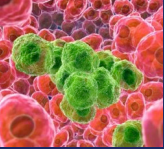
- Metastatic lesions (long bones & spine) present greatest risk of pathologic fractures
- Functional pain = the single best predictor of pathological fracture
- Rehabilitation indicated with bone metastases to:
  - maintain function & promote safety & fracture prevention with ADLs
  - fall prevention strategies & education for safety with activities that require lifting and carrying heavy objects [30 - 34]

### General Safety measures for bone metastasis [ref 61]


- No manual muscle testing in affected limb
- No progressive resistive exercises in affected limb Monitor for increasing functional pain
- Offloading weight bearing through the affected limb with an assistive device
- Avoid excessive spinal flexion, extension, and rotation; clarify need for bracing
- Monitor for increasing functional pain




## Advanced Cancers 1




- Functional impairments prevalent in patients with advanced cancer & can lead to:
  - disability
  - increased caretaker dependency and
  - psychological distress
- Often have a range of comorbid conditions, multiple medications considerations, & impact functioning, & require a more complex rehabilitative prescription
- Exercise without appropriate protein & energy balance, may pose a risk for further functional decline in people with cachexia [35-38]



## Advanced Cancers 2



- Central & peripheral neural structures may be affected by a primary or metastatic tumor as well chemotherapy
- Neurological changes may be the first presenting sign of metastatic disease
- Neurological symptoms- often consistent with spinal level or central location of the lesion
- Patients may present with cognitive changes, memory loss, personality changes, altered mental status, speech and word finding complications, as well as sensory or motor dysfunction
- Caregiver education important - patients may have altered safety judgment, reduced reflexive reactions, poor visual acuity & word-finding issues that make functioning independently difficult [39,40]



**Exercise prescription**  
Unique considerations are necessary based on the type of cancer & body structures affected by cancer treatment

- Breast cancer:** 35%-58% of breast cancer survivors report persistent shoulder and arm pain – important to minimise the risk of msk injuries and have awareness of cardiac compromise
- Prostate cancer:** Aerobic & resistive exercise lessen the impact of ADT
- Lung cancer:** Moderate intensity exercise in controlled clinical settings, respiration should be closely monitored, self-limited by the patient
- Gynecological cancer:** Lower-extremity monitoring for lymphoedema (inguinal lymph node dissection and/or radiation therapy)
- Leukemia:** Exercise may be limited by infection & thromboembolic disease. Aerobic and strength- training exercises are safe after stem cell transplant; however, exercises should be less intense and progressed slowly [41-53]

**What impact does exercise have on treatment-related side effects?**

Preservation or improvements	Reductions
• Muscle mass, strength, power	• Symptoms and side-effects reported
• Cardiovascular fitness	• Nausea, fatigue, pain
• Physical function	• Intensity of symptoms reported
• Physical activity levels	• Duration of hospitalisation
• Range of motion	• Psychological and emotional stress
• Immune function	• Depression and anxiety
• Chemotherapy completion rates	• Deconditioning
• Body image, self esteem and mood	


Hayes S, et al. (2009). J Sci Med Sport;12:429-34; Schmitz KH, et al. (2005). Cancer Epi & Biomarkers; 14:1588-95




**Recommended Physical activity levels -**  
Needs to be: Individually tailored and progressed

**150** minutes per week  
of moderate intensity  
**AEROBIC** exercise

**2 – 3** sessions per week  
**RESISTANCE** exercise



**Physical Modalities in Patients with Cancer**

**When patients have a history of cancer**

- Only do joint mobilisation or manipulation over areas proven cancer free with recent imaging
- Recent unexplained weight loss or fatigue are **red flags**
- Soft tissue work
  - If no cancer in the underlying skin or myofascia
  - If adequate skin integrity
  - Caution over previously irradiated skin
  - Caution with pressure (bleeding, fracture, etc.)

**What's NOT OK**

- Ultrasound directly over a known cancer
- Electrical stimulation over a known cancer
- Joint mobilisation/manipulation without imaging
- Soft tissue work in the area of current radiation
- Ultrasound over a previously irradiated area

Modality indications, precautions, and contraindications for cancer survivors 1 [ref 61]			
Modality	Indication	Precaution	Contraindication
Heat	Pain relief, muscle relaxation, tissue extensibility	Impaired lymphatic drainage, scar tissue, open wounds or tissue fragility	Unmanaged tumor/active disease, Peripheral vascular disease, Severely impaired sensation, Irradiated tissue
Ultrasound	Tissue extensibility, Inflammation management	Impaired sensation, open wounds or skin fragility	Individuals with unmanaged tumor or active disease
Cryotherapy	Pain relief, acute management of inflammation, hair loss management	Open wounds or skin fragility	Ischemic tissue, peripheral vascular disease, raynaud syndrome
TENS	Sensory pain management, scar desensitisation	Tissue lacking physical sensation	Unmanaged tumor / active disease, over pacemaker, open wounds
Functional electrical stimulation	Restoration of muscle firing when nerve conduction is intact (eg ambulation, limb function, swallowing, pelvic floor retraining)	Poor skin condition or indurated tissue	Unmanaged tumor / active disease

Modality indications, precautions, and contraindications for cancer survivors 2 [ref 61]			
Modality	Indication	Precaution	Contraindication
Low level light laser	Oral mucositis, scar tissue extensibility, lymphoedema	Open wounds or skin fragility	Acute radiation dermatitis, unmanaged tumor or active disease
Manual therapy	Pain relief, tissue extensibility, joint mobility, soft tissue and radiation fibrosis management, lymphatic stimulation	Impaired sensation, dysvascular tissue, open wounds or skin fragility	Acute radiation dermatitis, Individuals with unmanaged tumor or active disease, bone fragility due to metastasis or osteoporosis
Spinal manipulation	Spinal mobility and alignment, pain relief	Open wounds or skin fragility	Bone fragility due to metasis or osteoporosis, radiculopathy, spinal stenosis, myelopathy, spinal cord compromise from tumor or lesion

## Spinal Cord compression – oncologic emergency

- Presenting Symptoms
  - Localised back pain, primarily in thoracic region
  - Thoracic pain escalating with lying supine at night, with increased thoracic pressure during sneezing, coughing, or straining
  - Muscle weakness below the area of spinal involvement
- Rehabilitation Implications
  - Worsening pain in supine position helps to differentiate SCC from other forms of mechanical back pain
  - Pain is the most frequent presenting symptom
  - Identification of SCC before onset of motor or sensory loss improves outcomes
  - Pain assessment should be routine during rehab interactions with assessment of muscle strength & sensory changes

## Summary

- Cancer Rehabilitation provides so many benefits to people affected by cancer
- There are numerous important rehab considerations that are unique to this population
- Cancer treatments & protocols are constantly advancing therefore, cancer rehab physios need to keep up to date to ensure the safety of the patients they treat

## References 1

- Sabin Garcia R, Ya n, et al. Bragg M, Geme, neo Mothayyan E, Grainger CL, Danelly F. Functional and postoperative outcomes after pre-operative exercise training in patients with lung cancer: A systematic review and meta-analysis. *Can Med Assoc*. 2020;192:34-41.
- McNally ML, Campbell KL, Brown BH, Klassen TP, Mackey JR, Courneya KS. Effects of exercise on breast cancer patients and survivors: A systematic review and meta-analysis. *Can Med Assoc*. 2006;179:34-41.
- Ans SC, Hu H, Kim D-H, et al. The effects of inpatient exercise therapy on the length of hospital stay in stages III colon cancer patients: Randomized controlled trial. *Int J Colorectal Dis*. 2013;28:843-851.
- Singh J, Galleher J, Davis K, Johnson A, Ekins E, Hubbard RE. Predictors of adverse outcomes on an acute geriatric rehabilitation ward. *Age Ageing*. 2012;41:342-345.
- Gillis TA, Donovan ES. Rehabilitation following bone marrow transplantation. *Cancer*. 2007;99:4:549-558-3007.
- Dineen F, Bertel H, Fink J, Fetscher S, Merlmann R, Kaul J. An aerobic exercise program for patients with haematological malignancies after bone marrow transplantation. *Bone Marrow Transplant*. 1996;18:1157-1160.
- Chico A, Hydock DS, Schwelke CM, Hayward R. Low-intensity exercise training during docubicin treatment protects against cardiotoxicity. *J Applied Physiol*. 2006;100:599-607.
- Harris EE, Combs C, Huang W, et al. Late cardiac mortality and morbidity in early-stage breast cancer patients after breast-conservation treatment. *J Clin Oncol*. 2006;24:4100-4105.
- Lipshutz SE, Adams MJ, Collin SD, et al. Long-term cardiovascular toxicity in children, adolescents, and young adults who receive cancer therapy. Pathophysiology, course, monitoring, management, prevention, and research directions. *Circulation*. 2013;128:1927-1935.

## References 2

- Winters-Stone KM, Horak F, Jacobs PG, et al. Falls, functioning, and disability among women with persistent symptoms of chemotherapy-induced peripheral neuropathy. *J Clin Oncol*. 2017. JCO2016755292.
- Winters-Stone KM, Fowler SA, et al. Systematic review of falls in older adults with cancer. *J Geriatr Oncol*. 2015;6:70-83.
- Karimian N, Galati A, Curcio S, Chianese C, Pagan D, Balasubramanian D. Long-term effects, pathophysiological mechanisms, and risk factors of chemotherapy-induced peripheral neuropathy: A comprehensive literature review. *Front Pharmacol*. 2017;8:86.
- Gu Y, Dennis SH. Are falls prevention programs effective at reducing the risk factors for falls in people with type 2 diabetes mellitus and peripheral neuropathy? A systematic review with narrative synthesis. *J Diabetes Complications*. 2017;31:504-516.
- Stubbins MD, McNeil ML, Alfano CM, Meyer DK. A prospective surveillance model for physical rehabilitation of women with breast cancer. *Cancer*. 2012;118:2950-2959.
- Schmitz KH, Ahmed RL, Trowel A, et al. Weight lifting in women with breast-cancer-related lymphedema: A randomized trial. *JAMA*. 2010;304:2699-2705.
- Schmitz KH, Ahmed RL, Trowel A, et al. Weight lifting for women at risk for breast cancer-related lymphedema: A randomized trial. *JAMA*. 2010;304:2699-2705.
- Chen B, Guo CA, Lian K, Fatouros S, Singh MA. Progressive resistance training in breast cancer: A systematic review of clinical trials. *Breast Cancer Res Treat*. 2008;109:39-48.
- Shahman SF, Cromwell KD, Rasmussen JC, et al. Recent progress in cancer-related lymphedema treatment and prevention. *CA Cancer J Clin*. 2016;66:55.

## References 3


- Handforth C, Clegg A, Young C, et al. The prevalence and outcomes of falls in older cancer patients: A systematic review. *Ann Oncol*. 2015;26:1908-1915.
- Bonnet F, Monzie J, Baudet C, et al. Usefulness of frailty markers in the assessment of the health and functional status of older cancer patients referred for chemotherapy: A pilot study. *J Geriatr Oncol*. 2013;4:518-522.
- Huang PH, Blackwood J, Goodshen M, Pizarro L. Prevalence of self-reported falls, balance or walking problems in older cancer survivors from Surveillance Epidemiology and End Results. *Medicine Health Outcomes Survey*. *J Geriatr Oncol*. 2017;8:259-265.
- Mohla SG, Magnuson A. Comprehensive geriatric assessment in oncology. *Cancer*. 2013;28:85-93.
- July TA, Dai AM, Nyrop KA, et al. Geriatric assessment-identified deficits in older cancer patients with normal performance status. *Oncology*. 2010;20:379-385.
- Wearing D, Deakin S, de Greef H, Schuster E, Davis JR, van der Schueren CP. Frailty in older cancer patients: A comprehensive review on physical exercise, physical fitness, activities of daily living, and quality of life. *Am J Phys Med Rehabil*. 2011;90:155-165.
- Bouvard B, Soule P, Hoppa E, et al. Fracture incidence after 3 years of aromatase inhibitor therapy. *Ann Oncol*. 2014;25:843-847.
- Zaran S, Shroot B, Lee JQ, Liu A, Allen DD. The effect of bone-loading exercise on bone mineral density in women following treatment for breast cancer: A systematic review and meta-analysis. *Rehabil Oncol*. 2015;3:444-455.
- Eastley H, Newey M, Ashford RJ. Skeletal metastases—the role of the orthopaedic and spinal surgeon. *Surg Oncol*. 2015;24:215-223.
- Coleman RE. Clinical factors of metastatic bone disease and risk of skeletal morbidity. *Clin Cancer Res*. 2006;12:3243-3249.
- Costa B, Saba X, Choo E, Lison A, Wipfey A. Impact of skeletal complications on patients' quality of life, mobility, and functional independence. *Support Care Cancer*. 2008;16:879-889.

## References 4

- Mohla M. Metastatic disease in long bones: A proposed scoring system for diagnosing impending pathologic fractures. *Clin Orthop Relat Res*. 1989;256:264.
- Harrington KD. Impending pathologic fractures from metastatic malignancy: Evaluation and management. *Inst Course Lect*. 1986;35:37-381.
- Burning RW, Shea B. Bone metastasis and rehabilitation. *Cancer*. 2005;92:1020-1038.
- Chenilla AL, Murthy N, Basford J, et al. Imaging and clinical characteristics predict near-term disablement from bone metastases: Implications for rehabilitation. *Arch Phys Med Rehabil*. 2016;97:53-60.
- Burning R, Lamont-Hawes W, Schwenn D, Kiman A. Pathologic fracture risk in rehabilitation of patients with bony metastases. *Clin Orthop Relat Res*. 1985;222:227.
- Silver JK, Ray VS, Fu JB, Wilentz EM, Smith SR, Kitch BA. Cancer rehabilitation and palliative care: Critical components in the delivery of high-quality oncology services. *Support Care Cancer*. 2015;23:3623-3643.
- Jones LM, Eves ND, Henley JR, et al. Safety and feasibility of cardiopulmonary exercise testing in patients with advanced cancer. *Lung Cancer*. 2017;95:225-232.
- Mucarcobol M, Anwar S, Angles J, et al. Consensus definition of sarcopenia, cachexia and pre-cachexia: Joint document elaborated by the International Consensus Group (ICG) "Sarcopenia, cachexia and pre-cachexia and nutrition in geriatrics". *Clin Nutr*. 2016;35:484-492.
- Hoskins RB. The varying contribution to nutritional care in cancer cachexia. *Proc Nutr Soc*. 2015;34:43-49.
- Gigli P, Gilman HD. Neurologic complications of cancer and its treatment. *Curr Oncol Rep*. 2010;12:55-59.
- Ray VS, Silver JK, Pugh TH, Fu JB. Palliative care and physical therapy in the oncology care spectrum: An opportunity for distinct and collaborative approaches. *Phys Med Rehabil Clin N Am*. 2017;28:35-47.




**PING & STEEL**



### References 5

41. Schmid D, Leitzmann MF. Association between physical activity and mortality among breast cancer and colorectal cancer survivors: A systematic review and meta-analysis. *Ann Oncol* 2014;25:1263-1271.
42. Singh F, Swanson RL, Lathan DA, Spry N, Baker MK. A systematic review of pre-surgical exercise intervention studies with cancer patients. *Surg Oncol* 2013;22:92-104.
43. Speck RM, Courneya KS, Mawardi LC, Duval S, Schmitz KH. An update of controlled physical activity trials in cancer survivors: A systematic review and meta-analysis. *Cancer Surviv* 2012;4:87-102.
44. Fong DY, Ho JN, Ha BB, et al. Physical activity for cancer survivors: Meta-analysis of randomised controlled trials. *BMJ* 2012;344:e702.
45. De Bakker IC, Schey G, Backx FJ, Vreugdenhil G, Kuipers H. Resistance training in cancer survivors: A systematic review. *Int J Sports Med* 2009;30:703-712.
46. Mishra S, Scherer RW, Gange SJ, et al. Exercise interventions on health-related quality of life for cancer survivors. *Cochrane Database Syst Rev* 2012;8:CD007582.
47. Chenna BS, Kilbreath SL, Fahay PP, Dolaney GP, Attarisi E. Safety and efficacy of progressive resistance training in breast cancer: A systematic review and meta-analysis. *Breast Cancer Res Treat* 2014;148:249-268.
48. Kostziar J, Dijkstra PJ, Beeman H, et al. A longitudinal study of shoulder and arm morbidity in breast cancer survivors 7 years after axillary lymph node biopsy or axillary lymph node dissection. *Breast Cancer Res Treat* 2015;159:151-158.
49. Bourke L, Smith D, Steed L, et al. Exercise for men with prostate cancer: A systematic review and meta-analysis. *Eur Urol* 2016;69:693-703.
50. Gardner JB, Longston PM, Fraser SF. Effects of exercise on treatment-related adverse effects for patients with prostate cancer receiving androgen-deprivation therapy: A systematic review. *Clin Oncol* 2015;32:355-366.
51. Granger CL, Chao C, McDonald CF, Barney S, Danahy L. Safety and feasibility of an exercise intervention for patients following lung resection: A pilot randomized controlled trial. *Injg Cancer Ther* 2013;10:275-284.

**PING & STEEL**



### References 6

52. Dreven CE, Peckers ME, Granger BC, et al. Effects of pre-habilitation and rehabilitation including a home-based component on physical fitness, adherence, treatment tolerance, and recovery in patients with non-small cell lung cancer: A systematic review. *Clin Rev Oncol Hematol* 2017;14:62-76.
53. Zeman S, Smoed B, Lee JQ, Liu A, Allen CD. The effect of home-based exercise on bone mineral density in women following treatment for breast cancer: A systematic review and meta-analysis. *Rehabil Oncol* 2016;24:44-50.
54. Chevillon AJ, Bedford JI. Role of rehabilitation medicine and physical agents in the treatment of cancer-associated pain. *J Clin Oncol* 2014;32:1021-1032.
55. Pothier LA. Physical agents/modality for survivors of cancer. *Rehabil Oncol* 2013;19:12.
56. El-Lawati OF, Alshaykh HF, Bergmann A. Low-level laser therapy in secondary lymphedema after breast cancer: Systematic review. *Laser Med Sci* 2014;29:1289-1295.
57. Titi Corbin L. Safety and efficacy of massage therapy for patients with cancer. *Cancer Control* 2005;12:155-164.
58. Pheasant SD, Cameron M, Walker BF, Raggars JN, Esterman AJ. A Cochrane review of superficial heat or cold for low back pain. *Spine* 2006;31:2881-2905.
59. Titi Corbin L, Rosebaum L, Danoff AJ, Guthrie JA, Eckhaus MA. Effects of energy-matched pulsed and continuous ultrasound on tumor growth in mice. *Phys Ther* 1998;78:271-277.
60. <https://www.ncbi.nlm.nih.gov/pubmed/27000000>. The Impact of Supervised Cancer Rehabilitation Equipment and Treatment. <https://www.ncbi.nlm.nih.gov/pubmed/27000000>.
61. <https://www.ncbi.nlm.nih.gov/pubmed/27000000>. A Focused Review of Safety Considerations in Cancer Rehabilitation. <https://www.ncbi.nlm.nih.gov/pubmed/27000000>. 2017 Sep;9(32):5435-5438. doi: 10.1016/j.cpr.2017.08.003.