Cancer, Exercise & Bone Health

Beyond the Break Web Module
Part 2

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EDUCATION SERIES
Abbreviated Cancer Rehab 101
Osteoporosis & Cancer
Physical activity & bone health
Questions!
Exercise guidelines & special considerations

OSTEOPOROSIS AND CANCER

Agenda
Osteoporosis and Cancer

Detailed review in part 1 of this series presented by Kate Smith from Wellsprings
Recoding available at http://webcast.otn.ca/
Click on “Public Events”
Search TSM#: 47517837

Osteoporosis and Cancer

• Cancer is a major risk for both generalized and local bone loss
• Bone loss, assessed by bone mineral density (BMD) is significantly higher in people with cancer compared to the general population, independent of cancer type
• Many contributing factors including:
  ➢ Age-associated bone loss, unrelated to cancer
  ➢ Direct effect of cancer cells (primary site and metastases)

Osteoporosis and Cancer

• Effect of chemotherapy agents
• Use of corticosteroids (as chemotherapy or for side-effect management)
• Aromatase inhibitors
• Androgen deprivation therapy
• Other: deconditioning, wait-room sitting, diet changes

Lumbar spine BMD loss at 1 year (%)
Modified from Drake 2013
Osteoporosis and Cancer

Breast Cancer

• Premenopausal women:
  ➢ On average, menopause onset is 10 years earlier than normal in women receiving chemotherapy
  ➢ Increased risk of ovarian failure (highest risk for bone loss)
  ➢ Note: Tamoxifen can lead to bone loss in premenopausal women who continue to menstruate after adjuvant chemotherapy (estrogen receptor antagonist)

• Postmenopausal women:
  ➢ Risk for osteoporosis and fractures is increased due to both menopausal status and cancer
  ➢ Tamoxifen protects bone due to being a weak agonist at the estrogen receptor, especially when compared to Aromatase Inhibitors
  ➢ Bisphosphonates are often prescribed to limit bone loss and preventing fractures and hypercalcemia

Osteoporosis and Cancer

Prostate cancer:

• Osteoporosis-related treatments that are aimed at reducing total and free testosterone levels leading to a significant risk for fractures
• Implementing strategies for early identification and treatment of osteoporosis has been shown to reduce the risk of fracture in this population by more than 70%
• Sarcopenia is common for men receiving ADT. This can lead to reduced stability and increased risk of falls and fractures

Osteoporosis and Cancer

Hematologic Cancer

• Bone loss and increased risk for fractures has been reported following bone marrow transplant
• Multiple myeloma often is associated with osteolytic lesions and general bone loss
• 2/3 of patient have bone pain on diagnosis
• Fracture rates are increased 16X compared to general population in the year preceding diagnosis
Hematologic Cancer

- Even in disease remission, skeletal lesions rarely heal
- Bisphosphonates help reduce fracture incidence

Gastric Cancer

- Those who underwent gastrectomy are at an increased risk for osteoporosis
- Likely due to a decrease in gastric acidification that is required for optimal intestinal calcium absorption

Pharmacologic interventions (Drake 2013):

- **Bisphosphonates:**
  - Zoledronic acid infusing every 6-months for three years resulted in increased bone mineral density when administered with Tamoxifen or Aromatase inhibitor compared to reduction in BMD without it
  - Oral bisphosphonates clodronate and risedronate both resulted in improved BMD compared to placebo

- **Denosumab**
  - Human monoclonal antibody
  - Increases BMD compared to placebo for women on AI therapy
  - Reduces the risk of vertebral fractures in men on ADT
Osteoporosis and Cancer
Non-pharmacologic interventions:
• Exercise: will be discussed more shortly
• Limiting fracture risks with counseling regarding high-risk activities (falls, contact sports, heavy lifting)
• Adequate intake of calcium and vitamin D

Physical Activity and Bone Health
Position Stand by the American College of Sports Medicine (2004)
• Greatest effects on bone health occur during childhood and adolescence during high-intensity loading forces (plyometrics, gymnastics, high-intensity resistance training)
• Adult recommendations are based on small randomized controlled studies and large observational studies
• Recommended exercise prescription for preserving bone health in adulthood is...

Physical Activity and Bone Health
• Mode: weight-bearing endurance activities, jumping, and weight lifting (targeting all major muscle groups)
• Intensity: moderate to high (in terms of bone loading)
• Frequency:
  ➢ weight-bearing endurance 3-5 x/week
  ➢ Resistance exercise 2-3 x/week
• Duration: 30-60 min/day of a combination of above exercise
SPECIAL CONSIDERATIONS

Special Considerations

- Steroids
- Radiation Therapy and Bone Health
- Falls
- Metastases

Steroids

- Steroids are medications that have been used for many years (described in 1901 for treatment of sciatica and cancer pain)
- They have many uses, and in oncology they are used to treat cancer and to manage treatments’ side-effects
- Many mechanisms of action including anti-inflammatory and inducing neuronal reorganization
- Side-effects include mania, hyperglycemia, hypertension, weight gain, insomnia, and disorders of bone metabolism that lead to osteoporosis

Steroids

- Glucocorticoid (GC) steroids (corticosteroids) are the leading cause of secondary osteoporosis
- Almost 50% of those using chronic steroids will develop osteoporosis with 17% of those developing fractures within the 1st year of drug use
- Risk factors for fracture development after steroid exposure include age >65, steroid use >3 months, family history of osteoporosis, and low calcium intake
Steroids

- GC alter the balance between osteoclast and osteoblast activity
- Specifically:
  - Induces apoptosis in osteoblasts and osteocytes. Also inhibits stem cell differentiation into osteoblasts (stimulates creation of adipocytes) → reduced new bone formation
  - Increases production, and prolongs life, of osteoclasts = increased bone resorption

Steroids GC also:
- Reduced production of adrenal and gonadal hormones (inhibiting osteoclast activity)
- Decreases renal uptake and intestinal absorption of calcium (dose dependent)
- Can lead to avascular necrosis (fat accumulation in bone marrow → intraosseous hypertension → decreased blood flow to bone → bone necrosis)

Radiation Therapy and Bone Health

- Radiation Therapy uses different types of radiation to shrink/kill cancer cells (x-rays, gamma rays, and charged particles)
- Can be delivered via external-beam, internal radiation, or systemic radiation therapy
- Works by damaging cell DNA directly, or indirectly (creating charged free radicals that damage cell DNA)
- Radiation Therapy prescription is individualized and depends on many factors

Radiation Therapy and Bone Health

Radiation Therapy for bone pain:
• Often delivered via external beam
• May be delivered in one session, or daily over several sessions
• Effects of radiation:
  ➢ Pain reduction by shrinking/removing tumor
  ➢ Bone/fracture healing due to healthy bone growing in space left by the treated tumor
  ➢ Healthier bone is less likely to fracture in the future

Radiation Therapy and Bone, some Evidence:
• Jegoux et al (2010) summarized the effects of radiation on bone healing and reconstruction and concluded that “most available studies reveal that radiation reduces osteogenic cell numbers, alters cytokine capacity, and delays and damages bone remodeling”
• Radiation effects on bone are caused by direct effect on bone cells (osteocytes, osteoclasts, and osteoblasts), as well as effect on blood vessel walls

Radiation Therapy and Bone Health

Radiation Therapy and Bone, some Evidence:
• Changes in bone physiology are long term (e.g. increased radiation-induced bone remodeling is seen 12-months after treatment) and are observed in either single-dose or fractionated-dose schedules
• Bone damage is also attributed to radiation effect on bone marrow microenvironment for stem cells (Cao et al 2011)
• In animal models, bone mineral and collagen cross-link abnormalities are seen as early as one week after radiation and lasting 26 weeks (Gong et al 2013)

Radiation Therapy and Bone Health

Radiation Therapy and Bone, some Evidence:
• Incidence of fractures in radiated fields is increased in people treated for a variety of cancers such as breast, soft-tissue sarcoma, anal, and others
• The increased risk for fracture is considered “a significant public health issue” (Gong et al, 2013; Song et al, 2006; Small and Kachnic, 2005; Park et al, 2011)
Radiation Therapy and Bone Health

• So, does radiation help or hinder?
• Radiation therapy has important benefits!
• It is important to have an understanding of the specific treatment the patient received
• Radiation therapy can also affect the skin, requiring exercise modifications
• Check with orthopedic team (if possible) if the bones are at a risk for fracture (or level of risk)
• Educate the patient about risks and benefits of exercise
• Do not forget the rest of the body!

Falls in People with Cancer: Contributing Factors

• Increased risk for fall is multi-factorial
• Findings from different research is conflicting
• Selected factors identified:
  ➢ History of osteoarthritis and osteoporosis*
  ➢ Multiple comorbidities* and Neuropathy*
  ➢ Lower functional ability with ADL’s*
  ➢ Use of gait aids, Pain, delirium
  ➢ Cognitive impairments* lack of Social support* and depression*
  ➢ Metastases (especially brain), higher ESAS, fever, and low blood pressure

Metastases

• People with metastases are often follow exercise precautions similar to those with osteoporosis
• Specific precautions depend on the location, or risk, of the metastases
• Free online presentation on Physiotherapy for people with metastatic cancer is available through the World Confederation of Physical Therapy at www.wcpt.org/ipt-hope

EXERCISE GUIDELINES
Definition of Exercise

**Physical activity**
- Can be thought as energy expenditure throughout the day (e.g. getting dressed)

**Physical exercise (exercise training)**
- a form of physical activity that is planned and performed with the goal of achieving/preserving physical fitness

Looking at Exercise: Holistic/Evidence View

<table>
<thead>
<tr>
<th>Factors To Consider</th>
<th>Effects of Exercise</th>
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<tbody>
<tr>
<td>Pain</td>
<td>Reduce</td>
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<tr>
<td>Nausea and Vomiting</td>
<td>Reduce</td>
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<tr>
<td>Quality of Life</td>
<td>Improve</td>
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<td>Blood Counts (red/white blood cells and platelets)</td>
<td>Improve</td>
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<tr>
<td>Bone mass density</td>
<td>Improve</td>
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<td>Cardiac function</td>
<td>Improve</td>
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<td>Prevent cancer</td>
<td>Reduces risk of developing some cancers</td>
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<td>Survival</td>
<td>Improve</td>
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<td>Disease relapse</td>
<td>Prevent</td>
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<tr>
<td>Fatigue</td>
<td>Reduce</td>
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<tr>
<td>General function</td>
<td>Improve</td>
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<tr>
<td>General strength</td>
<td>Improve</td>
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<tr>
<td>Mood status and sleep</td>
<td>Improve</td>
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Osteoporosis Exercise Guidelines - Modified

The Canadian recommendation for Healthy Adults:
- Adults aged 18 and above should accumulate at least 150 minutes of moderate to vigorous intensity aerobic training per week in bouts of 10 minutes or more
- Add muscle and bone strengthening activities using major muscle groups at least 2 times per week
- More physical activity provides greater health benefits
- For those over 64 and have poor mobility: add activities that enhance balance

Osteoporosis Exercise Guidelines - Modified

- The recommendation for Adults with osteoporosis:
  - Adults aged 18 and above should accumulate at least 150 minutes of moderate to vigorous intensity aerobic training per week in bouts of 10 minutes or more
  - Add muscle and bone strengthening activities using major muscle groups at least 2 times per week
  - More physical activity provides greater health benefits
  - For those over 64 and have poor mobility: add activities that enhance balance!
**Osteoporosis Exercise Guidelines - Modified**

**General advice for adults with osteoporosis:**
- Introduce exercise gradually. Start with short durations, lower intensities and work up to recommended targets.
- Stretching of major muscle groups is recommended after exercise (not before). Hold stretch for 15-30 seconds. No pain!


**Aerobic exercise:**
- Aimed to increase heart rate and breathing.
- Performed 4-7 days a week, 20-60 minutes (depending on intensity).
- Can perform several short bouts of exercise throughout the day.
- Choose weight-bearing (brisk walking, dancing, land aerobics) over non-weight bearing exercise (cycling, swimming).
- Those with moderate or high risk of fracture should avoid high-impact activities (skiing) or activities with high risk of fall (hiking on uneven ground).

**Strength exercise:**
- Can use resistance bands, dumbbells, or body weight.
- Should be performed 2-4 days per week.
- Choose all major muscle groups. At a minimum include the legs (hip and knee extensors and flexors), chest, back extensors, abdominals, and scapular retractors. 8-10 exercises should be performed.
- Each exercise should include 2-3 sets of 8-12 repetitions. Weight is adjusted so that there is muscle fatigue at the end of the exercise.
- Those with moderate or high risk of fracture should avoid exercises that involve bending, twisting (especially to end range), or holding weights overhead. Abdominal exercises focus on isometric or pelvic tilt activities.
- Exercises to correct flexed posture and posture awareness are recommended.
Osteoporosis Exercise Guidelines - Modified

Balance exercise:
• Any exercises that challenge stability (but do not cause a fall)
• Performed 2 or more times per week
• General population guidelines are good... But...

Example: Person-specific Exercise Modifications

Person with Multiple Myeloma
Exercise considerations:
• Risk Consideration: Increased risk of fracture due to fragile bones
• Exercise considerations:
  • Understand relevant medications
    ➢ Melphalan (thrombocytopenia and anemia)
    ➢ Cyclophosphamide (anemia and thrombocytopenia)

Example: Person-specific Exercise Modifications

Person with Multiple Myeloma
Exercise considerations:
• Understand relevant medications
  ➢ Prednisone and Dexamethasone (osteoporosis, thrombocytopenia, proximal muscle weakness and loss of lean muscle mass)
  ➢ Vincristine (peripheral neuropathy, ataxia, loss of deep tendon reflexes)

Example: Person-specific Exercise Modifications

Person with Multiple Myeloma
Exercise considerations:
• Low impact exercises
• Treadmill exercises (jarring, neuropathy, balance)
• Reduced resistance for weight training
• Remember muscles that cross multiple joints and the produced stress on bones
• Gait aids and weight bearing considerations
• Working with the Orthopedic team

Good reference: Multiple Myeloma: Diagnosis and Orthopaedic Implications. 2011
Improving Bone Health for Cancer Patients: The Evidence
2010 Review by Winters-Stone et al.
• Limited number of studies focusing primarily on bone health as the primary outcome
• Modest methodological quality, inconsistencies in bone-locations measured
• Research primarily focused on women with breast cancer followed by men with prostate cancer
• But... growing body of evidence is being accumulated

Improving Bone Health for Cancer Patients: The Evidence
2010 Review by Winters-Stone et al. key points:
• Moderate intensity exercise may preserve bone health during/after cancer treatment, but has limited benefits over and above bisphosphonate treatment
• A minimal increase in BMD related to exercise (1-2%) translates to a 7-14% decrease in fracture risk!

Improving Bone Health for Cancer Patients: The Evidence
2010 Review by Winters-Stone et al. key points:
• Exercise prescription for bone health should focus on:
  ➢ Specificity: target specific bones (e.g. lower extremity resistance will improve femur but not lower spine BMD; can use lunges, squats, and rows)

Patients: The Evidence
2010 Review by Winters-Stone et al. key points:
Exercise prescription for bone health should focus on (continued):
  ➢ Overload: increased load compared to normal daily loading. Moderate to high bone loading activities include impact (e.g. going down stairs), resistance, and weight-bearing endurance activities.
  ➢ Initial values: know values prior to starting exercise and assess for change
Patients: The Evidence

2010 Review by Winters-Stone et al. key points:

• Reversibility: if training is stopped, benefits will reverse 😞
• Diminishing return: exercise needs to be progressed
• Bone health is important, but need to also focus on fall prevention!
• All wrist fractures, 90% of hip fractures, and 50% of vertebral fractures are associated with a fall

Exercise Safety

• Safety is a fundamental consideration
• Need to consider safety of the participant and their caregiver
• Need to consider the environment
• Need to consider specific precautions and contraindications
**Do Not Exercise!**

- Shortness of breath with minimal exertion or at rest
- Unrelieved bone or any pain
- Extreme fatigue
- Dizziness

Courneya et al, 2000

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**Keeping Health-care Team Informed**

New pains?
Not sure?
Any questions?

The team cannot help if they do not know!

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Questions? Comments?
Email me for slides and reference list

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