Learning Objectives

• Understand and Gain Knowledge of
  – Etiologies, symptoms, and treatments of primary bone and soft tissue cancers vs. metastatic bone disease
  – Precautions and restrictions with patients with bone disease
  – Surgical procedures for treatment of bone disease
  – Appropriate rehabilitation strategies and interventions
  – Continuum of care for orthopedic patients throughout their cancer treatment and beyond

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Primary Sarcomas Versus Metastatic Bone Disease

Primary Sarcomas

- **Primary bone sarcomas**: cancer which originates in bone tissue itself
- **Primary soft tissue sarcomas**: cancer that develops from soft tissues like fat, muscle, nerves, fibrous tissues, blood vessels, or deep skin tissues

Statistics

- **Primary bone sarcomas**
  - <0.2% of all cancers
  - 3,010 new cases will be diagnosed
  - 1,440 deaths from these cancers are expected*

- **Primary soft tissue sarcomas**
  - 11,410 new cases will be diagnosed
  - 4,390 deaths from these cancers are expected*

*The American Cancer Society's Estimates for 2013

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Primary Sarcomas

• Etiology
  – Exact cause unknown, potential risk factors may include
    • Genetics
    • Previous exposure to large doses of radiation or radioactive materials

Primary Sarcomas

• Bone sarcomas:
  – Osteosarcoma
  – Chondrosarcoma
  – Ewing's sarcoma
  – Chordoma
  – Giant cell tumor
  – Fibrosarcoma

• Soft tissue sarcomas
  (50 subtypes)
  – Rhabdomyosarcoma
  – Liposarcoma
  – Malignant fibrous histiocytoma
  – Synovial sarcoma
  – Fibrosarcoma
  – Leiomyosarcoma

Primary Sarcomas

<table>
<thead>
<tr>
<th>Primary Sarcoma</th>
<th>Incidence by Age</th>
<th>Origin</th>
<th>Location of Tumor/s</th>
<th>5-year Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteosarcoma</td>
<td>Adults: 26%</td>
<td>Bone cells</td>
<td>Distal femur, Proximal tibia, Proximal humerus</td>
<td>Localized tumors: 60-80%, Metastatic tumors: 15-30%</td>
</tr>
<tr>
<td></td>
<td>Children &amp; adolescents: 58%</td>
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<tr>
<td>Chondrosarcoma</td>
<td>Adults: 40%</td>
<td>Cartilage cells</td>
<td>Shoulder girdle, Pelvis, Proximal femur</td>
<td>90%</td>
</tr>
<tr>
<td>Ewing's Sarcoma</td>
<td>Adults: 8%</td>
<td>Cartilage cells</td>
<td>Shoulder girdle, Ribs, Proximal humerus, Pelvis, Proximal femur</td>
<td>Localized tumors: 70%, Metastatic tumors: 15-30%, MSKCC: 85%</td>
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<tr>
<td></td>
<td>Children &amp; adolescents: 34%</td>
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</tbody>
</table>
Metastatic Bone Disease

- Cancer cells that break off from a primary tumor and spread to the bone via the bloodstream or lymph vessels.
- More common than primary bone cancers, especially in adults.
- Prognosis – varied but dependent upon
  - Primary cancer
  - Extent of metastases
  - Treatment options

Metastatic Bone Disease

- Primary cancers with likelihood of metastasis to bone:
  - Prostate
  - Breast
  - Kidney
  - Lung
  - Thyroid

Metastatic Bone Disease

- Most common locations for bone metastases:
  - Most common in axial skeleton
    - Spine
    - Pelvis
    - Femur
    - Humerus
    - Ribs
    - Skull
Metastatic Bone Disease

- Types of bone metastases
  - Osteolytic
    - Cancer cells → bone destruction
  - Osteoblastic
    - Cancer cells → bone formation
  - Mixed
    - Cancer cells → both bone destruction and bone formation

Primary Sarcomas and Metastatic Bone Disease

- Diagnosis
  - Signs and symptoms
    - Pain
    - Swelling
    - Palpable mass
    - Sensory and/or motor changes
    - Functional changes
    - Gait disturbances
    - Systemic symptoms (fever, malaise, weight loss...)
  - Biopsy
    - Provides definitive diagnosis
  - Imaging
    - X-ray
    - Bone scan
    - CT scan
    - MRI
    - PET scan
    - Ultrasound

- Systemic treatment
  - Chemotherapy
  - Hormone therapy
  - Other drugs (bisphosphonates, radiopharmaceuticals, Denosumab)

- Localized treatment
  - Radiation
  - Surgery

- Goals of care: curative versus palliative
Principles of Rehabilitation Following Surgery

General Orthopedic Post-Operative Considerations

- Weight bearing (WB) restrictions
- Range of Motion (ROM) restrictions
- Activity restrictions
- Lab value and imaging results
- DVT/PE
- History of present illness, past medical history, social history

Post-Operative Treatment Guidelines

<table>
<thead>
<tr>
<th>Lab Values</th>
<th>HOLD</th>
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<tbody>
<tr>
<td>Hemoglobin</td>
<td>&lt;8</td>
</tr>
<tr>
<td>Platelets</td>
<td>&lt;20</td>
</tr>
<tr>
<td>INR</td>
<td>&gt;3.0</td>
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</tbody>
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<table>
<thead>
<tr>
<th>DVT/PE</th>
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<tbody>
<tr>
<td>Location of clot</td>
</tr>
<tr>
<td>Lower extremity</td>
</tr>
<tr>
<td>Upper extremity</td>
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<tr>
<td>PE</td>
</tr>
</tbody>
</table>
Basic OT and PT Assessment Principles

- Vital signs and pain
- Cognition
- ROM
- Strength
- Sensation
- Functional transfers
- Functional mobility and gait
- Balance
- ADL
- Adaptive equipment, assistive devices, DME

Excision

- Goal is to remove the cancer
  - **Wide-excision** – removal of tumor and some normal-appearing surrounding tissue to ensure that all of the cancer is removed
  - Excisions may or may not require surgical fixation or stabilization (intramedullary nail, screws, rods or cement)

Excision with Stabilization

- Surgical stabilization photos (ORIF, nails, screws)
Joint Replacements

- Partial and total joint replacements
  - Proximal humerus replacement
  - Proximal femur replacement
  - Total hip replacement (THR)
  - Total knee replacement (TKR)
- Unique post-op considerations with oncologic population
  - Have standard joint replacement precautions
  - May have additional treatment or disease-related conditions or impairments
    * These may affect or require additional restrictions and/or precautions

Post-op considerations
- WB status – NWB→WBAT
- Activity restrictions related to procedure (ROM, THP)

Rehab implications and plan of care (POC)
- Bed mobility*
- Functional transfers*
- ADL modifications*
- Adaptive equipment, assistive devices, DME*
- Balance
- Gait training*
Upper Extremity Resections

- Scapulectomy
  - Partial
  - Total
  - Tikoff-Linberg procedure – gold standard
- Amputation

Scapulectomy

- Tikhoff-Linberg
  - Limb-sparing surgery for tumors in and around the proximal humerus and shoulder girdle
  - Portions of the scapula, clavicle, and proximal humerus are resected along with all muscles originating from or inserting on the involved bones.
  - Optimal function is achieved with muscle transfers and skeletal reconstruction.

Scapulectomy

- Post-op considerations
  - WB status – NWB
  - Immobilization – Shoulder abduction brace
- Rehab implications and plan of care (POC)
  - Bed mobility*
  - Functional transfers*
  - ADL modifications*
  - Balance*
  - Gait training
  - ROM (elbow→digits)
  - Adaptive equipment, assistive devices, DME*
Shoulder Abduction Brace

Literature Review

• Vitale KC, Jimenez A., 2009⁴
  – Developed sample rehabilitation protocol after scapulectomy
  – Always consult with surgeon before advancing therapy**
    • Elbow flexion allowed; limit elbow extension first 2 weeks
    • Strengthening allowed after 4-6 weeks
    • Address posture and balance in sitting, stance, and gait
    • Strict NWB of UE, limit shoulder ROM
    • Shoulder sling x 2-4 weeks
    • Wrist and digit AROM allowed

Literature Review

• Hayashi et al., 2011⁵
  – Functional outcomes of 7 patients assessed after total scapulectomy
  – Enneking scoring system: assess pain, function, emotional acceptance, hand positioning, strength, manual dexterity
    • Shoulder ROM severely limited in most cases
    • No significant difference of functional parameters observed between soft tissue reconstruction and non-reconstruction groups
    • Mean total score overall satisfactory score
    • Pain and dexterity scores satisfactory
Upper Extremity Amputation

• Post-op considerations
  – WB status – NWB
  – Activity as tolerated
  – Positioning
    • To promote wound healing and joint integrity
    • To prevent contractures and skin breakdown
  – Phantom sensation and pain
• Rehab implications and plan of care (POC)
  – Bed mobility*
  – Functional transfers*
  – ADL modifications*
  – Residual limb management*
  – Adaptive equipment, assistive devices, DME*
  – Balance*
  – Gait training

Lower Extremity Resections

• Sacrectomy
• Amputation
• Hemipelvectomy
  – Internal
  – External
• Rotationplasty

Sacrectomy

• Partial or complete removal of the sacrum and attachments to lumbar vertebrae and ilium
• Resection of S3, S2, possibly S1 nerve
• Reconstruction
Sacrectomy

Post-op considerations:
- WB status - WBAT
- Activity determined by wound closure
  - Pressure-relieving mattress
  - No sitting allowed (6 weeks)
  - No supine
  - Orthostatic hypotension
  - Neurological deficits
  - Bowel/bladder dysfunction

Rehab implications and Plan of Care (POC):
- Bed mobility/Functional transfers – side-lying → stand*
- ADL modifications*
- Adaptive equipment, assistive devices, DME*
- Balance
- Gait training
- Orthotics

Pressure-Relieving Mattress and Cushioning
Lower Extremity Amputation

- Post-op considerations
  - WB status - NWB
  - Activity as tolerated
  - Positioning
    - To promote wound healing and joint integrity
    - To prevent contractures and skin breakdown
  - Phantom sensation and pain
- Rehab implications and plan of care (POC)
  - Bed mobility
  - Functional transfers*
  - ADL modifications
  - Residual limb management*
  - Adaptive equipment, assistive devices, DME*
  - Balance*
  - Gait training*

Hemipelvectomy

- Internal hemipelvectomy (Internal hemi-pelvic resection)
  - Resection
    - Part or all of unilateral pelvis
    - Proximal femur
  - Preservation
    - Neurovascular bundle
    - Lower extremity
- External hemipelvectomy
  - Resection
    - Entire unilateral pelvis with disarticulation at SI joint and pubic symphysis
    - Entire lower extremity

Internal Hemipelvectomy

- Post-op considerations
  - WB status
    - WBAT, PWB, FFWB (foot-flat weight bearing)
  - Activity as tolerated
- Rehab considerations and Plan of Care (POC)
  - Bed mobility
  - Functional training
  - ADL*
  - Balance
  - ROM and strengthening of uninvolved extremities
  - Adaptive equipment, assistive devices, DME*
  - Gait training*
  - Leg length discrepancy*
  - Orthotics*
External Hemipelvectomy

- Post-op considerations
  - WBAT through remaining extremities
  - Activity determined by wound closure
  - Pressure-relieving mattress
  - No prolonged sitting initially
  - Phantom sensation and pain
  - Psychosocial considerations
- Rehab implications and Plan of Care (POC)
  - Bed mobility
  - Functional transfers
  - Cushioning for comfort and OOB tolerance*
  - ROM and strengthening of uninjured extremities
  - Adaptive equipment, assistive devices, DME*
  - ADL
  - Balance*
  - Gait training*

Cushioning
Literature Review

• Beck et al., 2008
  – Patients after internal versus external hemipelvectomies
  – Functional outcomes using the Barthel Index and quality of life using the Linear Analog Self-Assessment tool (LASA)
    • Overall no significant difference in functional abilities between the groups at 3 different time points
    • LASA subcategories showed no difference between groups, except in pain category

• Guo et al., 2011
  – Postoperative rehabilitation, functional outcome, and pain management following internal versus external hemipelvectomy
    • Inpatient rehabilitation admission associated with older age, plastic surgery involvement, and post-op complications
    • Significant FIM increases from initial evaluation to discharge in both groups
    • Patients following external hemipelvectomy required higher demands for pain medication and increased hospital LOS

Rotationplasty

• Above the knee amputation for tumor of distal femur
• Resection of
  – Entire knee with both the distal femur and proximal tibia en bloc
  – All the surrounding soft tissue
  – Except popliteal artery and vein and tibial and peroneal nerves
• Distal portion of the extremity is rotated 180 degrees and the bones and soft tissues are re-approximated
Rotationplasty

- Post-op considerations
  - WB status – NWB (6 weeks)
  - Activity as tolerated
  - Positioning
    - To promote wound healing and joint integrity
    - To prevent Phantom sensation and pain
  - Psychosocial considerations
    - Contractures and skin breakdown
- Rehab implications and Plan of Care (POC)
  - Adaptive equipment, assistive devices, DME*
  - Bed mobility/functional transfers
  - ADL
  - Balance
  - Gait training*

Rotationplasty

- Rehab implications (continued)
  - ANKLE ROM and STRENGTHENING
  - Must be able to achieve NEUTRAL dorsiflexion
  - Prosthetic preparation
Continuum of Care

Discharge Planning

• Once patients are medically stable, discharged to:
  – Acute rehabilitation
  – Sub-acute rehabilitation
  – Home
    • With services (RN, PT, OT)
    • No services
  – Outpatient rehabilitation
  – Skilled Nursing Facility
  – Hospice

Discharge Planning

• Multi-factorial approach to goals and discharge planning
  – Patients’ and families’ directives
  – Functional status
  – Activity restrictions and allowances at time of DC
  – Home environment
  – Patients’ support system
  – Medical needs
  – Cancer treatment options (current and future)
  – Prognosis
  – Insurance
Discharge Planning

- Immediate equipment needs for safe DC home
  - AAD
  - DME
  - Adapted, off-the-shelf cushions, bracing, orthotics
  - Wheelchair
- Long-term equipment needs
  - Customized cushioning, bracing, orthotics, prosthetics
  - Customized wheelchair
  - Home adaptations and renovations for accessibility
- Optimal equipment needs often not able to be determined initially because:
  - Cancer and treatment-related long-term effects
  - Maximum return of function not always initially evident
  - Post-operative complications
  - Prognosis

Immediate Rehab Considerations After Discharge

- Oncology rehabilitation rapidly growing, however still a small community
- These patients can and will be encountered in any setting
  - NEED for increased knowledge!
    - Orthopedic restrictions
    - Basic oncology history
    - Current and future POC

Long-term Rehab Considerations

- Advances in treatment → increased survivorship
  - Progression of disease
  - Delayed or chronic treatment side-effects
  - NED (No Evidence of Disease)
    - Co-morbidities
- NEED for continued rehabilitation services!
Literature Review

- Silver JK, Gilchrist LS, 2011
  - “Without specific training dedicated to learning the nuances of oncology rehabilitation, it can be challenging to become skilled and effective providers.”
  - “More rehabilitation professionals (including, but not limited to, physiatrists, physical therapists, occupational therapists, and speech and language pathologists) need to have specific training in the field of oncology rehabilitation.”

Conclusion

- Primary sarcomas and metastatic bone disease often require surgical interventions.
- These patients have complex medical and rehabilitation needs.
- Well-informed rehabilitation professionals are vital in returning function and improving quality of life.
- A multi-disciplinary and multi-factorial approach to rehab POC is crucial.
- Increased survivorship = increased short-term and long-term rehabilitation needs.

References