CANCER REHABILITATION

Has become #1 cause of death in the United States

Deficits: 1) Gait  2) ADLs  3) vocation  4) Depression (Braddock)
    #1 weakness  2) ADLs  3) pain  4) ambulation (Lehman from C)

Stages of disease

Preventive: goal to achieve maximal function for patients who are cured or in remission
Supportive: providing adaptive self-care equipment to offset expected decline, ROM
Palliative: improve or maintain comfort and function during terminal stages

Marciniak: rehab helps, especially with brain cancer

NUTRITION

Many cancer patients place ability to eat at top of determining physical well-being
40-80% malnourished: impaired wound healing, immunocompromised, endocrine dysfunction, fluid imbalance
Caloric intake: 115-130% of resting energy expenditure
Protein 1.5-2.5 g/kg/day
Learned food aversion: meats, veggies, caffeine
    Encourage to eat very little before therapy
    Appetite stimulants: megestrol

Treat emesis with serotonin antagonist: ie Zofran (ondansetron hydrochloride) = 5HT blocker

RADIATION

Nutritional impairments (includes surgery)
Head and neck: alters taste and saliva production, impaired mastication, swallowing, smell
Esophagus: gastric stasis, diarrhea, steatorrhea
Pancreatin: DM, impaired digestion
Bowel resection: malabsorption, Vit B12, D, A deficiencies
Gastrectomy: impaired digestion, malabsorption, megaloblastic anemia, hypoglycemia
Stomach and intestines: nausea, vomiting, cramps, diarrhea
    Chronic problems: obstruction, intestinal perforation, GI bleed, malabsorption, enteral fistulas
Diet: lactose-free, low residue oral diets, small frequent meals, increase fluids
Parenteral nutrition recommenced if lost >20% of body weight

Transient myelopathy/Lhermitte's syndrome: Radiation induced spinal cord damage
head and neck, lymphoma RTX
occurs after latent period 1-30 months
peak 4-6 months
resolves 1-9 months after onset
imaging normal
Lhermittes sign
Not a risk factor of delayed myelopathy

Delayed radiation myelopathy
Irreversible with incidence of 1-12%
Onset 9-18 months after completing treatment
Latent period decreases with increased radiation, shortened in children
LE paresthesias \( \rightarrow \) sphinter dysfunction \( \rightarrow \) weakness
Partial Brown-Sequard syndrome can develop
Progressive deficits
20% get central pain syndrome: TCA. Steroid, anticonvulsants
Post radiation plexopathy
Occurs with breast, lung, mediastinal tumors and lymphoma
Latency 1 month – 15 years
Resents with paresthesias and pain
Signs: sensory loss, depressed reflexes, weakness
Distinguishing between plexopathy and tumor invasion
  Tumor invasion 10x more common
  Associated with Horner’s syndrome, lower trunk involvement, pain
  Radiation: upper trunk involvement more common, lymphedema
  myokymic discharges, abnormal sensory conduction

Lumbosacral plexopathy
colorectal & gyn tumors
present with bilateral unilaterial pain, paresthesias prior to weakness

radiation may damage nerve itself, or surrounding structures: weakness, parasthesias, decreased ROM, atrophy

THROMBOCYTOPENIA
Platelets <10,000/ml preclude exercise therapy
  Increased risk of ICH
Some centers allow aerobic but not resistive activities in patients with platelets 10,000-20,000/ml

PAIN
25% die with unrelieved pain (WHO)
Unrelieved pain is risk factor for suicide
Etiologies
  #1 tumor invasion of bone
  #2 compression/infiltration of peripheral nerves by tumor
  mucositis 2/2 RTX and CTX
  peripheral neuropathies: taxanes, vinca alkaloids, platinum
treatment algorithm: WHO’s three step ladder
  start with non-opioids +/- adjuvant: ceiling effect
  then add opioid for mild-mod pain: no ceiling effect
  then add opioid for mod-severe pain
Addiction: behavioral syndrome of compulsive, harmful use not requiring the existence of physical dependence or tolerance, not likely in cancer patients without h/o substance abuse

Peripheral neuropathy can occur with tumors of lung, multiple myloma, breast, colon

CHEMOTHERAPY
Methotrexate: inhibits folic acid metabolism (synthesis of DNA)
  SE macrocytic anemia, leukopenia, ulcerative stomatitis
Vit B1 deficiency: occurs with severe and recurrent vomiting
  Results in beriberi (muscle weakness, tachycardia, heart failure)
thiamine deficiency: parasthesias, neuropathy, heart failure
  occurs with 5-fluorouracil and 6-mercaptopurine (prevent nucleic acid synthesis)
Vit K deficiency: bleeding, ecchymosis
  Occurs with long-term antibiotic treatment
Cisplatin: distal symmetrical sensory neuropathy, autonomic neuropathies with fluctuation BP, HR
Vincristine: severe PPN, hearing loss, autonomic neuropathies with fluctuation BP, HR
Cytarabine: PPN
<table>
<thead>
<tr>
<th>TABLE 9-10. Chemotherapeutic Agents and Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cytosar</strong></td>
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<tr>
<td><strong>Nitrogen Mustard</strong></td>
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<td><strong>Nitrosoureas</strong></td>
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<tr>
<td><strong>Platinum Complexes</strong></td>
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<tr>
<td><strong>Azacitidine</strong></td>
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<tr>
<td><strong>Cytarabine</strong></td>
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<tr>
<td><strong>Fluorouracil</strong></td>
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<td><strong>Mercaptopurine</strong></td>
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<tr>
<td><strong>Methotrexate</strong></td>
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<tr>
<td><strong>Previous irradiated areas: skin erythema, pulmonary fibrosis, transverse myelitis, osteoblasts</strong></td>
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<tr>
<td><strong>Thalidomide</strong></td>
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<tr>
<td><strong>Actinomycin D</strong></td>
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<tr>
<td><strong>Bleomycin</strong></td>
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<td><strong>Doxorubicin</strong></td>
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<tr>
<td><strong>Adriamycin</strong></td>
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<tr>
<td><strong>Adriamycin</strong></td>
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<tr>
<td><strong>Mitomycin C</strong></td>
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<tr>
<td><strong>Vinblastine</strong></td>
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<tr>
<td><strong>Vincristine</strong></td>
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<tr>
<td><strong>Vindesine</strong></td>
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<tr>
<td><strong>VP-16-213</strong></td>
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<tr>
<td><strong>L-Asparaginase</strong></td>
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<tr>
<td><strong>Daunorubicin (DNR)</strong></td>
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<tr>
<td><strong>Hexamethylmelamine (HMM)</strong></td>
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<tr>
<td><strong>Hydroxyurea</strong></td>
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<td><strong>Mitotane</strong></td>
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<td><strong>Procarbazine</strong></td>
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<tr>
<td><strong>Steptosporin</strong></td>
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<tr>
<td><strong>Adrenocorticosteroids</strong></td>
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<tr>
<td><strong>Osteopenia, avascular necrosis, skin fragility, susceptibility to infection</strong></td>
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<tr>
<td><strong>Androgens</strong></td>
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</tbody>
</table>

**Estrogens** | Fluid retention, feminization, uterine bleeding, hypercalcemic flare (breast cancer) |
**Progestins** | Mild fluid retention |
**Taxol** | Hypersensitivity reactions, peripheral polyneuropathy, myalgia, arthralgias, bradykardia |
**Suramin** | Peripheral polyneuropathy, coagulopathy, adrenal insufficiency, renal toxicity | (Capecitabine 1998)
BRAIN TUMORS
Slow growing often do not cause cognitive deficits
Most patients have significant return of function after surgical resection
Improvements in cognition seen with methylphenidate 10 bid
Radiation: subacute affects can occur 1-4 months after completed due to reversible demyelination
   Delayed effects can occur after 6-12 months
   Focal necrosis, atrophy, calcification, necrotizing leukoencephalopathy, aneurysms, secondary CA
Chemotherapy: 18% with deficits
   3 weeks after discontinued
   Impaired visual perception, verbal memory, judgement
More deficits with multimodal therapy than single

Adult brain tumors
   Headache is most common presenting symptom
   Weakness is most common sign
   Seizures frequently are the first presenting sign
   60%-90% of primary CNS tumors are high grade astrocytomas
   most common tumors of brain are metastatic
   carcinomas from breast or lung>GI, urinary tract, melanoma
   pounding headache = LBS KG
   lung>breast>skin>kidney>GI
   cerebrum (frontal lobe most common) >cerebellum>brainstem
   GBM or high grade astrocytomas: most less than 2 years survival

Pediatric Brain tumors
   Second most common malignancy of childhood (after leukemia)
   Low grade astrocytomas are most common primary brain tumors in children
   Medulloblastomas 20% of intracranial in children, located near cerebellar vermis
   Tend to be infratentorial (adults tend to be supratentorial): nausea and vomiting

SPINAL CORD LESIONS
   Majority metastatic
   95% extradural
   Most arise in vertebral body and compress anterior cord
   70% of diagnoses mets occur in thoracic spine because has smaller canal to cord diameter
   Presents with pain, worse recumbent position
   Rapid evolution of paraparesis over several hours usually signifies arterial compromise by tumor invasion
   or pressure with guarded prognosis for recovery
   Stability is of concern if tumor involves 2-3 vertebrae
   Sternal-occipital-mandibular immobilization is tolerated better than Halo fixation, better stabilization than
   Philadelphia collar

BREAST CA
   18% of cancer deaths in women
   #1 cause of death for 40-55 year old women
   Radical mastectomy: resection of pectoralis major and minor, axillary lymph nodes
   Shoulder dysfunction, pain, lymphedema, emotional trauma
   Modified radical mastectomies: spare the pectoralis major, more common
   Transverse Rectous Abdominis Muscle (TRAM) flap: weakened abdominals
   First month s/p modified radical mastectomy
      Tight chest wall>difficulty lifting>limited mobility>arm weakness>lymphedema>numbness
      Early PT improves post-op shoulder motion
      Shoulder abduction and flexion 45-90 allowed postop
      Hand pumps, elbow AROM, shoulder PROM with progression to FROM
**Lymphedema** = 25-40%

Onset after 2 years could mean tumor reoccurrence
Progresses if untreated and increases risk of cellulites, further lymphatic damage and extremity enlargement, and vicious cycle
Elevation, manual lymphatic drainage, compressive bandaging and garments, pneumatic pumps

Temporary prosthesis postop
Permanent prosthesis fitted at 3-8 weeks, after edema resolved and chest wall healed

**Grading**
Grade 1: Pitting edema reversed by elevation
Grade 2: Nonpitting, brawny, hardened skin 2/3 fibrotic tissue due to chronic excess protein in the interstitial spaces and deposition of adipose tissue. Unresponsive to elevation.
Grade 3: lymphostatic elephantiasis, cartilage-like

**BONE TUMORS**
Osteosarcomas of knee and proximal humerus are most common sarcomas in adults and children
80% five year survival
Amputation is preferred for high-grade malignancies of the **distal lower extremity**
Provides good function and less morbidity than salvage or reconstruction
CTX induced fatigue, anemia, nausea, cardiovascular toxic effects can diminish functional capacity
Anorexia, muscle atrophy and fluid shifts can delay definitive prosthesis
Delay in wound healing over irradiated ports
Skin less tolerant to prosthesis wear

**Metastatic bone lesions**
40x more common than primary lesions
breast: 50-85% of all bone mets
prostate: most common for mets in men 60%
 hematogenous spread: Batson's plexus
lung, renal, bladder, thyroid, bowel
myeloma
painful, progressive, worse at night
bone scans often have false negative results in lung, melanoma and multiple myeloma

**In Patients with Metastatic Bone Disease**
- 75% have breast, lung or prostate cancer
- 25% have renal, thyroid, or other cancer
- 60% of all bone metastasis in males are secondary to prostate cancer, and approximately >
  90% of patients with advanced prostate CA will develop bone metastases
- 50% to 85% of bone metastasis in females are secondary to breast cancer
- More than 50% of all patients with breast, lung, or prostate cancer will eventually develop bone metastasis. Skeletal metastasis arise through hematogenous spread. Bone is the third most common site for metastasis.
Involvement of the Upper Extremity
- More than 90% of upper extremity metastasis involve the humerus.
- In the upper extremity the majority of symptomatic lesions are from:
  1. Breast CA
  2. Multiple Myeloma
  3. Renal CA

Involvement of the Lower Extremity
- Most metastasis of the lower extremity involve the hip and femur.
- In the lower extremity the majority of symptomatic lesions are from:

<table>
<thead>
<tr>
<th>HIP</th>
<th>FEMUR</th>
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<tbody>
<tr>
<td>Prostate CA</td>
<td>Breast CA</td>
</tr>
<tr>
<td>Breast CA</td>
<td>Renal CA</td>
</tr>
<tr>
<td>Lung CA</td>
<td>Multiple Myeloma</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>Prostate CA</td>
</tr>
</tbody>
</table>

Pathologic fractures
10-30% of patients with mets
Fx most common in long bones: femur, humerus
Increased fx risk if destruction >50% of cortical diameter, >2.5 cm in diameter, or involves >50% of medullary cross-sectional area or cortex
  - bone susceptible to torsion and rotation because forces no longer uniformly transmitted
CT with coronal views
Surgical fixation with removal of tumor through curettage, uses of methyl methacrylate, IM rods, modular prosthesis
Radiation treatments create transient softening of bone in increase fx risk for 6-8 weeks
  - May consider reduced weight bearing

Surgical Intervention Is Indicated When:

<table>
<thead>
<tr>
<th></th>
<th>Size of Lesion</th>
<th>Amount Cortex Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Extremity</td>
<td>&gt; 3 cm</td>
<td>&gt; 50%</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>&gt; 2.5 cm</td>
<td>&gt; 30% to 50%</td>
</tr>
<tr>
<td>(Figure 9-9)</td>
<td>femoral neck &gt; 1.3 cm in axial length</td>
<td></td>
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</tbody>
</table>

- Surgical intervention if greater than 50% to 60% of medullary cross-sectional diameter is involved
- Surgical intervention if involvement of a lesion of cortex equal to or greater than the cross-sectional diameter of the bone
- This determination is enhanced by CT sections
(Gerber, Vange 1988)

- Lytic Lesions are generally considered to be more prone to fracture than blastic lesions
- Lytic Lesions typically occur in tumors of the:
  - Breast
  - Lung
  - Kidney
  - Thyroid
  - Gastrointestinal tumors
  - Neuromas
  - Lymphoma
  - Melanoma

(Blastic Lesion typically occur in Prostate Cancer)

Blastic = BPH (prostate)
3 BBB'S Love to Lick Pollen
  - Bladder, Bronchus, Breast, Skin, Lung, Lymphoma, Prostate
Lytic = BLT with Ketsup & Mustard
  - Breast, Lung, Thyroid, Kidney (renal cell), Melanoma
INVolVEMENT OF THE AXIAL SKELeTOn

- Requires evaluation of the extent of metastatic involvement of the vertebral column. An MRI will clearly delineate epidural vertebral involvement even if radiographs are normal.
- Denis (1984) described stability of thoracic and lumbar injuries by utilizing the three-column model described as: (Figure 9.10)

<table>
<thead>
<tr>
<th>Anterior Column</th>
<th>Middle Column</th>
<th>Posterior Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior longitudina</td>
<td>Posterior half of vertebral</td>
<td>Spinous process</td>
</tr>
<tr>
<td>ligament</td>
<td>body</td>
<td>Laminae</td>
</tr>
<tr>
<td>Anterior half of vertebral</td>
<td>Posterior annulus/</td>
<td>Facets</td>
</tr>
<tr>
<td>body</td>
<td>posterior disc</td>
<td></td>
</tr>
<tr>
<td>Anterior annulus fibrosis</td>
<td>Posterior longitudinal</td>
<td>Pedicles</td>
</tr>
<tr>
<td>Anterior disc</td>
<td>ligament</td>
<td>Posterior ligamentous</td>
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<tr>
<td></td>
<td></td>
<td>structures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ligamentum flavum</td>
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<tr>
<td></td>
<td></td>
<td>Infraspinous ligaments</td>
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<tr>
<td></td>
<td></td>
<td>Supraspinous ligaments</td>
</tr>
</tbody>
</table>

- The spine is considered stable when only one column is involved except if it is the middle column.
- The spine is considered unstable when two or more columns are involved or the middle column is severely involved.
- The spine is also considered unstable if greater than 20 degrees of angulation is present.
- These basic principles can be applied in evaluating metastatic bony involvement of the spine. (Denis 1984)

HEAD AND NECK
5% of all malignancies: larynx most common

Radical Neck dissection
spinal accessory nerve usually sacrificed: loss of trapezius
scapula moves laterally and deepens the axilla
limited shoulder abduction = shoulder pain

REHAB: strengthen levator scapulae, rhomboids, serratus anterior to stabilize scapula, diminish pain
avoid strengthening deltoid, supraspinatus and infraspinatus increases pain, overworks disadvantaged muscles
avoid contracture of unopposed pectoralis muscle
unilateral disruption of SCM, platysma, omohyoid can lead to asymmetrical neck motion
often need to support neck and head when changing from supine to sitting
bilateral, cannot flex neck
ROM initiated once sutures removed
advanced to active resistive strengthening by post op week 4-6
scar massage daily

PEDIATRIC
Most common childhood CA is leukemia: ALL
Increased risk of falling behind a grade level
Brain irradiation is associated with cognitive decline especially if less than 7 years old
Usually have abnormal growth patterns after treatment
17% incidence of developing second malignancy by 20 years

MISCELLANEOUS
Pancoast's syndrome
carcinomas in superior pulmonary sulcus
pain in c8-T2 distribution
Horner's syndrome
pain in shoulder and vertebral border of scapula
RX: surgery and radiation
Van Nes procedure: ankle becomes knee

Tikhoff-Lindberg procedure: en bloc humeral interscapulothoracic resection

Myopathy: Paraneoplastic Polymyositis and Dermatomyositis
Associated with malignancies of breast and lung
Carcinomatous Myopathy – syndrome in metastatic disease consistent with muscle necrosis, presents with proximal muscle weakness
Carcinomatous neuropathy – affects peripheral nerves and muscle. Distal motor and sensory loss, proximal muscle weakness, decreased reflexes and sensation. Occurs with lung cancer. Type II muscle atrophy.
Steroid myopathy: atrophy of type II muscle fibers of proximal musculature
Isometrics used to improve muscle strength

II. Multiple Myeloma
- Represents 10% to 25% of patients with pathologic fractures
- Characterized by presence of cells resembling plasma cells originating in the bone marrow. This abnormal protein leads to termination of cells
- Occurs most commonly in patients 50 to 70 year old Males > female
- Usually progresses with gradual development of pain
- Frequently involves the lumbar spine, pelvis/sacrum, chest, skull, and ribs
- Often, there may be no early findings and pathologic fracture may be the presenting manifestation of the disease
- Course of disease is insidious and eventually leads to extensive marrow replacement, anemia, thrombocytopenia, and hypercalcemia

<table>
<thead>
<tr>
<th>Complications</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>Renal failure occurs as a result of tubular blockage by protein cast deposition</td>
<td>Radiotherapy</td>
</tr>
<tr>
<td>Bone involvement on roentgenograph reveals diffuse osteoporosis and multiple lytic lesions</td>
<td>Chemotherapy</td>
</tr>
<tr>
<td>Early films are often negative</td>
<td>Intramedullary fixation may be difficult or impossible because of the remaining abnormal bone</td>
</tr>
<tr>
<td>Bone scans may be normal. However, a skeletal survey may reveal diffuse “punched out” lytic lesions with black sclerotic borders</td>
<td>Rehabilitation concerns are similar to those patients with metastatic involvement of other primary malignancies. A high index of suspicion is necessary to identify patients at risk for pathologic fractures.</td>
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<tr>
<td>Amyloid deposits may also infiltrate peripheral nerves causing a peripheral neuropathy</td>
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