Management of the Cancer Patient – The Basics

KATHRYN E. TASILLO, PT, DPT

Provider Disclaimer

• Allied Health Education and the presenter of this webinar do not have any financial or other associations with the manufacturers of any products or suppliers of commercial services that may be discussed or displayed in this presentation.

• There was no commercial support for this presentation.

• The views expressed in this presentation are the views and opinions of the presenter.

• Participants must use discretion when using the information contained in this presentation.

Learning Objectives

General Overview of Cancer Statistics & Basics
Tests
Treatments
Side Effects
Lab Values
Oncologic Emergencies
Cancer Statistics

- Cancer is among the leading causes of death worldwide. In 2012, there were 14.1 million new cases and 8.2 million cancer-related deaths worldwide.

- 57% of new cancer cases in 2012 occurred in less developed regions of the world that include Central America and parts of Africa and Asia; 65% of cancer deaths also occurred in these regions.

- The number of new cancer cases per year is expected to rise to 23.6 million by 2030.

Cancer Statistics

In 2018, an estimated 1,735,350 new cases of cancer will be diagnosed in the United States and 609,640 people will die from the disease.

The number of new cases of cancer (cancer incidence) is 439.2 per 100,000 men and women per year (based on 2011–2015 cases).

The number of cancer deaths (cancer mortality) is 163.5 per 100,000 men and women per year (based on 2011–2015 cases).

Cancer mortality is higher among men than women (196.8 per 100,000 men and 139.6 per 100,000 women). When comparing groups based on race/ethnicity and sex, cancer mortality is highest in African American men (239.9 per 100,000) and lowest in Asian/Pacific Islander women (88.3 per 100,000).

In 2016, there were an estimated 15.5 million cancer survivors in the United States. The number of cancer survivors is expected to increase to 20.3 million by 2026.

Approximately 38.4% of men and women will be diagnosed with cancer at some point during their lifetimes (based on 2013–2015 data).

In 2017, an estimated 15,270 children and adolescents ages 0 to 19 were diagnosed with cancer and 1,790 died of the disease.

Estimated national expenditures for cancer care in the United States in 2017 were $147.3 billion. In future years, costs are likely to increase as the population ages and cancer prevalence increases. Costs are also likely to increase as new, and often more expensive, treatments are adopted as standards of care.

Lack of health insurance and other barriers prevent many Americans from receiving optimal health care. According to the US Census Bureau, approximately 48.6 million Americans (15.7%) were uninsured in 2011, including one in three Hispanics and one in 10 children (18 years of age and younger). Uninsured patients and those from ethnic minorities are substantially more likely to be diagnosed with cancer at a later stage, when treatment can be more extensive and more costly. The Affordable Care Act is expected to substantially reduce the number of people who are uninsured and improve the health care system for cancer patients.
Biology of Cancer

- Senescence
- Contact inhibition

Where to begin?

- Chart Review
- Medical History
- Current Symptoms
- Current Treatments
- Recent but Completed Treatments
- Potential POC
- Overall what does the patient want?
C = change in bowel or bladder habits
A = A sore that does not heal
U = unusual bleeding or discharge
T = thickening or lump in the breast or elsewhere
I = indigestion or difficulty in swallowing
O = obvious change in a wart or mole
N = nagging cough or hoarseness

Common Diagnostic Tests

PET Scan       Bone Scan       Biopsy
Blood tests    MRI and CT scan  X-ray
Nuclear Scans  Ultrasound

Primary vs. metastatic

• Original tumor and location
• Tumors that are a result of metastasis from the primary site
• Can also come from external or genetic factors
Common Metastatic Patterns

- Vascular: bone, liver, lung
- Lymphatic: lymph nodes, myeloma
- Seeding: ascites, effusion
- Breast: lymph nodes, lung
- Colon: liver
- Lung: pleural cavity, brain
- Ovary: peritoneal cavity, bone
- Prostate: bone

Staging Cancer\(^4,5\)

**T:** Primary Tumor  
TX: primary tumor cannot be assessed  
T0: No evidence of primary tumor  
Tis: Carcinoma in situ (site of origin)  
T1, T2, T3, T4: Progressive increase in tumor size and local involvement

**N:** Regional lymph node involvement  
NX: Nodes cannot be assessed  
N0: No metastasis to local lymph nodes  
N1, N2, N3: Progressive involvement of local lymph nodes

**M:** Distant metastasis  
MX: Presence of distant metastasis cannot be assessed  
M0: No distant metastasis  
M1: Presence of distant metastasis
Staging Examples

- T1, NO, MO
- T2, N1, MO

“Clinical” vs. “pathological”

- Stage IV is always a Stage IV
- T1, NO, MO → rT2, rN1, rM1
Treatments

Primary | Palliative | Adjuvant | Neoadjuvant
--- | --- | --- | ---
Chemotherapy | Surgery | Radiation therapy | Biotherapy
Hormonal therapy | Targeted therapy

Side Effects of Treatments

- Emotional Effects
  - Anxiety/panic attacks
  - Depression
  - Fear
- Psychosocial Social Worker is available to follow both during and after hospital stay
- Some psych medications have to be adjusted during cancer treatments
Radiation

<table>
<thead>
<tr>
<th>EARLY</th>
<th>LATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Skin changes</td>
<td>• Radiation Fibrosis</td>
</tr>
<tr>
<td>• Swelling</td>
<td>• Lymphedema</td>
</tr>
<tr>
<td>• Fatigue</td>
<td>• Pain</td>
</tr>
<tr>
<td>• Hair loss in the treatment area</td>
<td>• Infertility</td>
</tr>
<tr>
<td>• Mouth problems</td>
<td>• Pneumonitis</td>
</tr>
<tr>
<td>• Nausea &amp; vomiting</td>
<td>• Pulmonary Fibrosis</td>
</tr>
<tr>
<td>• Sexual changes</td>
<td>• Radiation Myelitis</td>
</tr>
<tr>
<td>• Urinary &amp; bladder changes</td>
<td>• Myelopathy</td>
</tr>
</tbody>
</table>

Chemotherapy

<table>
<thead>
<tr>
<th>EARLY</th>
<th>LATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bone marrow suppression</td>
<td>• &quot;Chemo Brain&quot; or &quot;chemo fog&quot;</td>
</tr>
<tr>
<td>• Appetite loss &amp; weight changes</td>
<td>• Cardiac toxicity</td>
</tr>
<tr>
<td>• Taste changes</td>
<td>• Central &amp; cranial NS changes</td>
</tr>
<tr>
<td>• Mucositis</td>
<td>• Pulmonary toxicity</td>
</tr>
<tr>
<td>• Infection</td>
<td>• Pulmonary Fibrosis</td>
</tr>
<tr>
<td>• Fatigue</td>
<td>• Gastrointestinal toxicity</td>
</tr>
<tr>
<td>• Alopecia</td>
<td>• Liver Damage</td>
</tr>
<tr>
<td>• Memory/cognitive changes</td>
<td>• Kidney and urinary damage</td>
</tr>
<tr>
<td>• Nausea/vomiting</td>
<td>• Sexual &amp; fertility changes</td>
</tr>
<tr>
<td>• Diarrhea/constipation</td>
<td>• Skin &amp; nail changes</td>
</tr>
<tr>
<td>• Peripheral neuropathy</td>
<td>• Tissue fibrosis</td>
</tr>
<tr>
<td>• Pain</td>
<td>• Alopecia</td>
</tr>
<tr>
<td></td>
<td>• Psychosocial issues</td>
</tr>
<tr>
<td></td>
<td>• Secondary cancer (rare)</td>
</tr>
</tbody>
</table>

Chemo Drugs

Alkylating Agents
- Busulfan, Cisplatin, Carboplatin, Chlorambucil, Cyclophosphamide (cytoxan), Ifosamide, Dacarbazine (DTIC), mechlorethamine, melphalan, temozolomide

Nitrosoureas
- Carmustine (BCNU), Lomustine (CCNU)

Antimetabolites
- 5-fluorouracil, capetacetabine, 6-mercaptopurine, methotrexate, gemcitabine, cytarabine (ara-C), fludarabine, pemetrexed
Chemo Drugs cont’d

- Anthracyclines and Related Drugs
- Topoisomerase II Inhibitors
- Mitotic Inhibitors
- Corticosteroid Hormones
  - Prednisone, dexamethasone

Mucositis 12,13

Most common, debilitating complication
Oral mucosa very sensitive to chemo and radiation
Can impact nutrition
More complicated by nausea and vomiting
Shows up 5-10 days after treatment begins
Can last 1-6 weeks but depends on treatment
*“Magic mouthwash”*

Trismus 12,13

Tonic contraction of muscles of mastication
Restriction to opening mouth due to trauma, surgery or radiation
Can lead to difficulty speaking, swallowing, and reduced nutritional intake
Compromised oral hygiene
Depends on amount of radiation

Precautions and Considerations 7,89,74

- Steroids often needed to manage edema, especially dexamethasone
- Effects typically seen in 24-48 hours and taper should proceed ASAP but over a 2 week period
  - Most common in elderly and when prolonged use in high doses
- Steroid Myopathy
  - Onset: insidious or rapid
  - Impairments: Proximal upper and lower extremity weakness
  - Rehab considerations/functional limitations:
    - Difficulty ambulating
    - Difficulty climbing stairs
    - Difficulty getting up from a chair
    - Dyspnea
Osteoporosis

- Most commonly in hormonally driven breast and prostate cancer; worsens with prolonged exposure to hormonal therapies
- Many cancer treatments may result in rapid and severe bone loss
- Decreased bone mass increases risk of falls and fractures
- Rehab considerations:
  - Spinal precautions
  - Weight bearing and resistive exercises – may have a protective effect in mitigating bone density depletion during hormonal therapy interventions
  - Proper nutrition

Medications

Pain

- Overall, pain is reported by ~50% of people at all stages of disease and over 70% with advanced neoplasms
- Types of pain: somatic, visceral, neuropathic
- Pre-medicate if necessary
- Red flags
Pain Medications

• Opioids/Narcotics
  ◦ Morphine, Dilaudid
  ◦ Chart on next slide

• Nonopioids
  ◦ Tylenol, Aspirin

• NSAIDs
  ◦ Ibuprofen, Naproxen, Toradol, Advil, Nuprin, Indocin

Opioids/Narcotics

<table>
<thead>
<tr>
<th>Drug</th>
<th>A.K.A.</th>
<th>Parenteral</th>
<th>Oral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Morphine Slow Release</td>
<td>MS Contin</td>
<td>NA</td>
<td>X</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>Dilaudid</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Fentanyl</td>
<td></td>
<td>X</td>
<td>NA</td>
</tr>
<tr>
<td>Transdermal Fentanyl</td>
<td></td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Oxycodone</td>
<td></td>
<td>Percocet, Tylox</td>
<td>X</td>
</tr>
<tr>
<td>Codeine</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td></td>
<td>Vicodan, Lortab</td>
<td>X</td>
</tr>
<tr>
<td>Methadone</td>
<td></td>
<td>Demerol</td>
<td>X</td>
</tr>
<tr>
<td>Levorphanol (Short Acting)</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Methadone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levorphanol (Short Acting)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Anti-emetics

• Zofran (ondansetron)
• Phenergan (promethazine)
• Ativan (lorazepam)
• Marinol (dronabinol)
Neuropathy

• Chemotherapy induced peripheral neuropathy (CIPN)
• Neuropathic pain

PNS

Sensory
• First and most affected

Motor
• Less often affected
• Associated with more severe sensory involvement
• Potential for re-generation

Autonomic
• Rarely affected

Presentation

Dose-dependent

Symmetric

Stocking-glove distribution

Onset after chemotherapy
• Progressive, rapid or
• Cessation

Property of Kathryn E. Tasillo, PT, DPT, not to be copied without permission
Symptoms

- Pain (burning, sharp, or aching)
- Muscle cramps
- Numbness
- Tingling
- Constipation
- Odd feelings like your feet feeling squishy, like you have a rolled up sock under your foot
- Swelling and redness
- Weakness

Symptoms Continued

- Often begin after 3rd or 4th chemo cycle but can sometimes worsen for a few months after completed
- Diabetes, heavy alcohol consumption, and Vitamin D deficiencies can also cause nerve damage
- Higher the does, higher the risk of neuropathy

Diagnostic Classification

<table>
<thead>
<tr>
<th>Toxicity</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
<th>Grade 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Neuropathy</td>
<td>Asymptomatic, clinical or diagnostic observations only</td>
<td>Moderate symptoms, limiting instrumental ADL</td>
<td>Severe symptoms, limiting self-care ADL; assistive device indicated</td>
<td>Life-threatening consequences; urgent intervention indicated</td>
<td>Death</td>
</tr>
<tr>
<td>Sensory Neuropathy</td>
<td>Asymptomatic, loss of DTR or paresthesia</td>
<td>Moderate symptoms, limiting instrumental ADL</td>
<td>Severe symptoms, limiting self-care ADL</td>
<td>Life-threatening consequences; urgent intervention indicated</td>
<td>Death</td>
</tr>
<tr>
<td>Paresthesias</td>
<td>Mild symptoms</td>
<td>Moderate symptoms, limiting instrumental ADL</td>
<td>Severe symptoms, limiting self-care ADL</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
### Neurotoxic Chemotherapeutics

<table>
<thead>
<tr>
<th>CLASSES</th>
<th>INDICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum Analogues</td>
<td>Ovarian</td>
</tr>
<tr>
<td></td>
<td>Lymphoma</td>
</tr>
<tr>
<td></td>
<td>Ovarian</td>
</tr>
<tr>
<td>Cisplatin</td>
<td>Lung</td>
</tr>
<tr>
<td></td>
<td>Leukemia</td>
</tr>
<tr>
<td></td>
<td>Breast</td>
</tr>
<tr>
<td>Carboplatin</td>
<td>Testicular</td>
</tr>
<tr>
<td></td>
<td>Multiple Myeloma</td>
</tr>
<tr>
<td></td>
<td>Lung</td>
</tr>
<tr>
<td>Oxaliplatin</td>
<td>Bladder</td>
</tr>
<tr>
<td></td>
<td>Breast</td>
</tr>
<tr>
<td></td>
<td>Bladder</td>
</tr>
<tr>
<td>Vindesine</td>
<td>Colon</td>
</tr>
<tr>
<td></td>
<td>Lung</td>
</tr>
<tr>
<td></td>
<td>Prostate</td>
</tr>
<tr>
<td>Vinorelbine</td>
<td>Colorectal</td>
</tr>
</tbody>
</table>

#### Class Recovery

- **Platinum Compounds**
  - Cisplatin & Carboplatin: Partial recovery, possible "coasting".
  - Oxaliplatin, acute: <1 week to resolve.
  - Oxaliplatin, chronic: 3 months to resolve, rare long-term persistence.
  - ↑ risk of sensory impairment as late effect (OR 1.62, 95% CI: 0.97-2.72).
- **Vinca Alkaloids**
  - < 3 months to resolve.
  - Vincristine may continue.
  - ↑ risk of motor impairment as late effect (OR 1.66, 95% CI: 1.04-2.64).
- **Taxanes**
  - <3 months to resolve.
  - May continue.

### Neuropathy

#### BASELINE
- Assess
  - Strength
  - Sensation
  - Balance
- Fall risk is 2-3 times greater in population of individuals with a history of receiving neurotoxic chemo agents.

#### OVER TIME
- Balance changes
- Observation of gait deviations

---

Property of Kathryn E. Tasillo, PT, DPT, not to be copied without permission
**Functional Implications**

- Deficits could be mild
- Teach visual compensation
- Have nightlights in halls
- Remove extension cords, loose rugs, other trip hazards
- Skin protection
  - Shoes, temperatures
- Assess gait
- Handwriting
- Buttoning
- Balance – an assistive device might be necessary
- Falls – greater risk in the evening; be ware of uneven surfaces like a yard
- Stair negotiation
- Decreased UE function

**Medications to help Neuropathy**

- Gabapentin (Neurontin) or Pregabalin (Lyrica) – calm down the nerves – can be taken 3x/day
- Cymbalta – 1x/day – may reduce nerve pain
- Nortriptyline (Pamelor) and Amitriptyline (Elavil) also used for nerve pain

**Management of Neuropathy**

- Physical activity
  - Reduce symptoms
  - Help with balance
  - Moving the body and use of hands is good for the nerves
  - Move in a gentle, pain-free way – think more general ROM (reaching overhead, shoulder circles, punches, roll a ball on table, roll marker between palms)
- Desensitization
  - Find various textures and rub your feet/hands on them
  - Rub where you have sensory loss and where it is normal
  - Off and on throughout day for 20 min total
  - Compression stockings (decrease pain and provide sensory feedback)
- Relaxation
- Acupuncture
- Electrical stimulation
Diabetes and the Cancer Patient⁸,⁹,¹⁰,¹⁹

- Chemotherapy
  - Renal function already impaired from diabetes and is only worsened with chemo
- Glucocorticoids
  - Increase BS and insulin will be given – increased weight
- Tube feeding and TPN
  - BS monitored every 6 hrs
- Nausea and vomiting
  - Stress hormones will raise BS even with no food on board after N&V

Lymphedema ⁷⁴

- Slow, progressive swelling that appears asymmetrically in the limbs after lymphadenectomy or radiation therapy
- New onset is a concern:
  - DVT
  - Cancer recurrence
  - Infection
- Under controlled circumstances, exercise does not exacerbate this condition or have a significant impact on worsening symptoms
- Should be advised to wear some form of compression while exercising to prevent fluid accumulation
- Cellulitis infections are common in these individuals

Lab Values
CBC 8,9,10

- WBC - 3,500 to 10,500 cells/ml
- Platelets - 150,000 - 450,000 ml
- ANC - 2,500 - 6,000
- Hgb - Male: 13.5 - 17.5 grams/dL
  Female: 12.0 - 15.5 grams/dL
- HCT - Male: 38.8 - 50.0%
  Female: 34.9 - 44.5%
- Albumin - 3.4 to 5.4 g/dL

WBCs 8,9,10

- Produced in bone marrow
- Indicates infection, inflammation
- Leukocytosis
- Leukopenia

ANC 8,9,10,14

- Total number of neutrophils (mature white cells) circulating in the body
- Calculated by multiplying WBCs × neutrophils
  - For instance, if the WBC count is 8,000 and 50% of the WBCs are neutrophils, the ANC is 4,000 (8,000 × 0.50 = 4,000).
- Body’s ability to fight infection
- Neutropenia – ANC is BELOW 1,000
- Severe neutropenia – ANC is below 500 – severe risk of infection → Neutropenic Fever
- Neutropenic precautions – White Protective Environment Sign outside of room
- Neupogen (filgrastim)
Hgb/HCT

- **Hgb** – protein that carries oxygen from your lungs to the rest of the body
- **HCT** – % of RBCs in the blood

**Decreased**
- Anemia, nutritional deficit, recent hemorrhage, fluid retention
- Low BP, SOB

**Increased**
- Hemoconcentration, polycythemia vera, dehydration
- Blood clots

Platelets

- A.k.a. thrombocytes – form in the bone marrow, a sponge-like tissue – major role in blood clotting
- Thrombocytopenia – high risk for bleeding
  - Avoid using BP cuffs
  - Use soft toothbrushes
  - Monitor for changes that indicate intracranial bleeding (LOC, restlessness, H/A, seizures)
  - If available, encourage the ambulating patient to wear shoes
  - Maintain bedrest during ACTIVE bleeding
  - Protect from trauma
- Thrombocytosis – high risk for blood clots
  - Recent hemorrhage, infection, surgery
  - Glucocorticoids may increase counts

PTT and aPTT

- Partial thromboplastin time (PTT) – how long it takes for blood to clot
  - Also called aPTT or Activated PTT
  - Clotting should occur within 25-35 seconds
  - If taking blood thinners, can take up to 2.5x longer

- Prothrombin time (PT) – blood test that measures the time it takes for the liquid portion (plasma) of your blood to clot
Fibrinogen

- Fibrinogen 150-400 mg/dL
- Produced in the liver
- Tests are run to check for:
  - Bleeding disorders, thrombotic events, suspected DIC, abnormalities in coagulation panel (PT/APTT), liver disease, dysfibrinogenemia, and occasionally risk of CAD
- Increased levels can be seen in:
  - Inflammation, tissue damage/trauma, infection, cancer, acute coronary syndrome, strokes
- Decreased levels can be seen in:
  - Afibrinogenemia, hypofibrinogenemia, end stage liver disease, severe malnutrition, disseminated intravascular coagulation (DIC), abnormal fibrinolysis, and large volume blood transfusions

Fresh Frozen Plasma (FFP)

- To treat the prolonged protime (PT) and activated partial thromboplastin time (aPTT) associated with hypofibrinogenemia
- Not optimal blood component due to the large volumes of plasma required to increase fibrinogen to hemostatic levels

FFP

- The plasma taken from a whole unit of blood
- Contains all coagulation factors in normal concentrations
- May be transfused up to 5 days after thawing
- Plasma is free of RBCs, WBCs, and platelets
- Indicated in patients with documented coagulation factor deficiencies and active bleeding, or who are about to undergo an invasive procedure.
- Deficiencies may be congenital or acquired secondary to liver disease, warfarin anticoagulation, disseminated intravascular coagulation, or massive replacement with red blood cells and crystalloid/colloid solutions.
- Usually, there is an increase of at least 1.5 times the normal PT or PTT, or an INR ≥ 1.6 before clinically important factor deficiency exists. This corresponds to factor levels <30% of normal.
- Conditions that may affect platelet function include renal failure, medications and myelodysplasias, and congenital disorders.
FFP 56

- Plasma - Dosage
  - Volume of 1 Unit Plasma: 200-250 mL
  - 1 mL plasma contains 1 u coagulation factors
  - 1 Unit contains 220 u coagulation factors
  - Factor recovery with transfusion = 40%
  - 1 Unit provides ~80 u coagulation factors
  - 70 kg X .05 = plasma volume of 35 dL (3.5 L)
  - 80 u = 2.3 u/dL = 2.3% (of normal 100 u/dL) 35 dL
  - In a 70 kg Patient:
    - 1 Unit Plasma increases most factors ~2.5%
    - 4 Units Plasma increase most factors ~10%

- Initial Dose of FFP
  - 10cc/Kg (round up to nearest 200cc) = n units FFP / 200 cc/unit FFP

- Therapeutic Effect
  - Usually an increase in factor levels of at least 10% will be needed for any significant change in coagulation status, so the usual dose is four units, but the amount will vary depending on the patient’s size and clotting factor levels. Hematology consultation is advised concerning the dose of plasma.

Recommended Coagulation Parameters

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Platelet Count</th>
<th>INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar Puncture</td>
<td>≥50,000</td>
<td>≤1.5</td>
</tr>
<tr>
<td>Paracentesis</td>
<td>≥30,000</td>
<td>≤2.0</td>
</tr>
<tr>
<td>Thoracentesis</td>
<td>≥50,000</td>
<td>≤1.5</td>
</tr>
<tr>
<td>Transbronchial Lung Biopsy</td>
<td>≥50,000</td>
<td>≤1.5</td>
</tr>
<tr>
<td>Saliva/IJ Line</td>
<td>≥30,000</td>
<td>≤1.5</td>
</tr>
<tr>
<td>Renal Biopsy</td>
<td>≥50,000</td>
<td>≤1.5</td>
</tr>
<tr>
<td>Liver Biopsy</td>
<td>≥50,000</td>
<td>≤1.5</td>
</tr>
<tr>
<td>Hickmann, Groshong Catheters</td>
<td>≥50,000</td>
<td>≤1.5</td>
</tr>
</tbody>
</table>

Cryoprecipitate 34,55

- Proteins that precipitate out of solution when a unit of fresh frozen plasma is slowly thawed out in the cold
- Prepared from one unit of FFP
- Outdates 6 hours after being thawed or 4 hours after being pooled
- ABO compatible cryoprecipitate is desirable if large volumes will be transfused
- Can be transfused quickly
- Preferred because it contains same concentration of fibrinogen as FFP in less than 1/20 of the volume
Electrolytes

**BUN (Blood Urea Nitrogen)/Creatinine**
- BUN normal range - 6 to 20 mg/dL.
- Creatinine - normal range - 0.7 to 1.3 mg/dL for men and 0.6 to 1.1 mg/dL for women.
- Often evaluated together with the ratio being 15:1-24:1
- BUN – the most prevalent of non-protein nitrogenous compounds in blood. Increased in instances of renal failure and gastro-intestinal bleeding
- Most chemo excreted through kidneys which is why good function is important
- BUN – down in severe liver damage, up in kidney disease
- Cr – up in kidney damage, down in severe liver disease

**Na**
- The normal range for blood sodium levels is 135 to 145 mEq/L.
  - regulation of body water
  - Hyponatremia
    - s/s thirst, restlessness, HTN, SOB
  - Hypernatremia
    - lethargy, confusion, focal weakness, seizure
  - SIADH – oncologic emergency
**K+**

- The normal range is 3.7 to 5.2 mEq/L.
- Regulation of muscle activity (essential in maintaining electrical conduction of heart and skeletal muscles)
- Hypokalemia
  - Diaphoresis, Decreased reflexes, Confusion, Hypotension, Anorexia, EKG changes
- Hyperkalemia
  - ARF, Leukemia, Weakness, Malaise, Nausea, Diarrhea, Decreased HR
- Tumor Lysis syndrome — oncologic emergency

**Cl**

- A typical normal range is 96 to 106 mEq/L.
- Regulation of blood volume and arterial pressure
- Hypochloremia
  - Addison disease, Bartter syndrome, Burns, CHF, dehydration, Excessive swelling, hyperaldosteronism, metabolic alkalosis, Respiratory acidosis (compensated) SIADH, Vomiting
- Hyperchloremia.
  - Carbonic anhydrase inhibitors (used to treat glaucoma), Diarrhea, Metabolic acidosis, Respiratory alkalosis (compensated), Renal tubular acidosis

**CO2**

- The normal range is 23 to 29 mEq/L
- Good indicator of acidosis and alkalinity
- Most of the CO2 is in the form of a substance called bicarbonate (HCO₃⁻). Therefore, the CO2 blood test is really a measure of your blood bicarbonate level.
- Higher-than-normal levels
  - Breathing disorders, Cushing syndrome, Hyperaldosteronism, Vomiting
- Lower-than-normal levels
  - Addison disease, Diarrhea, Ethylene glycol poisoning, Ketaacidosis, Kidney disease, Lactic acidosis, Metabolic acidosis, Methanol poisoning, Salicylate toxicity (such as aspirin overdose)
Calcium/Phosphorus

• Normal values range from 8.5 to 10.2 mg/dL.
• Neuromuscular, skeletal and endocrine disorders
• Hypocalcemia – Renal failure, Acute pancreatitis
• Hypercalcemia – Metastatic CA, Multiple fractures, Prolonged immobilization
• Signs and symptoms: nausea, vomiting, dehydration, confusion (elderly), lethargy, muscle weakness, coma
• Tumor lysis syndrome

Normal values range from 2.4 to 4.1 mg/dL.
• Phosphorus – generally inverse with calcium
• Build strong bones and teeth
• Also important for nerve signaling and muscle contraction
• Kidney, liver, and certain bone diseases can cause abnormal phosphorus levels

Other Lab Values

Other Lab Values

Red Flags
SIADH

• Serum sodium concentration of <135 mmol/L
• Very dangerous if not treated quickly due to severe neurological complications that can arise
• Hyponatremia is most frequently encountered electrolyte disturbance in clinical practice
• Associated with increased mortality, morbidity, length of stay and medical resource utilization
• Symptoms of hyponatremia are non-specific, vary in presentation and may mimic other conditions
• Polypharmacy of elderly patients can make diagnosis difficult

Possible causes

• Pneumonia
• Stroke-related
• Subcortical arteriosclerotic encephalopathy (senile SIADH)
• SSRIs
• Losartan, Omeprazole, Furosemide, Enalapril
• Hypoaldosteronism
SIADH

- Syndrome of inappropriate antidiuretic hormone
- "water intoxication"
- All cancers have the ability to cause SIADH, however, cancers with known ectopic hormone production have a higher incidence of SIADH
- Small cell lung cancer is most common
- S/s: confusion, weakness, muscle cramps, edema, lethargy, N/V, irritability
- Managed by fluid restriction and lasix

Malignant Pericardial Effusion 74

Background and Symptoms

• Due to primary pericardial tumor (rare) or metastatic pericardial disease associated with lung, breast, esophageal, lymphoma, leukemia, melanoma
• Results in increased intrapericardial pressure, reduced cardiac output, cardiac tamponade
• S/s: dyspnea, cyanosis, engorged neck veins, orthopnea, congested cough, fatigue, palpitations, drop in systolic BP of >10 mm Hg during inspiration
• Hypotensive, tachycardic, narrow pulse pressure, diaphoretic

Rehab Implications

• Frequent assessment of HR, hemodynamic and respiratory status (including oximetry)
• Skin color and temp, capillary refill, peripheral pulses
• Mental status changes, confusion, seizures
• Provide strengthening, reconditioning activities, pulmonary hygiene, postural positioning

Pericardial Tamponade 79

Background

• 20-34% of those who have cancer have pericardial involvement
• Lung, breast and esophageal most common
• Pericardial tamponade is an increase in intrapericardial pressure that impairs intracardiac filling and cardiac output
• Diagnosed with an echo and chest CT

Signs & Symptoms

• Exertional dyspnea
• Tachycardia
• Chest pain
• Beck triad – muffled heart sounds, hypotension, and increased jugular venous pressure is in 1/3 of patients
• Pulsus paradoxus – decrease in systolic blood pressure of more than 10 mm Hg with inspiration is seen in 77% of patients
Pericardial Tamponade

- Emergent pericardiocentesis under ultrasound guidance
- Almost half reaccumulate and sometimes an indwelling catheter is placed
- Pericardial window can also provide long-term symptomatic relief
- Intubation can make this worse with an increased risk of cardiac arrest
- Poor prognosis – median life expectancy of 5 months

Tumor Lysis Syndrome

- Destruction of large number of cells releasing potassium, phosphorus, and uric acid in blood with concurrent binding of calcium ions → HYPOCALCEMIA
- Seen a lot with leukemic patients
- Signs and Symptoms: Hyperuricemia (>8), hyperkalemia (>5.5), hyperphosphatemia (>5.5), hypocalcemia (>4.0), arrhythmia, bradycardia, uric acid crystals, elevated serum creatinine, seizures, weakness, confusion, irritability, numbness and tingling, muscle cramping, weight gain, edema, decreased urine output
- *Side note* - Uric acid crystals can cause kidney failure because uric acid crystals create blockages in the kidneys
- Medical management includes intravenous hydration, correction of metabolic alterations, and treatment of renal failure. Aggressive hydration is recommended for all patients, as this reduces the risk for calculus formation and obstructive nephropathy. Oral or intravenous allopurinol (110 mg/m² every 8 hours) is recommended for treatment of hyperuricemia in low- or intermediate-risk patients.

Superior Vena Cava Syndrome

- Obstructed venous flow through the SVC resulting in impaired venous drainage from the head and upper extremities
- Occurs 75% in lung CA, 15% in lymphoma
- Edema of head and UEs
- Signs and symptoms: cough, visual disturbances, dizziness, chest pain, tachypnea, cyanosis
- Medical Management: chemo, radiation, diuresis, oxygen, tranquilizers, steroids, anticoagulants
Venothrombolic Events

Background and Symptoms

- DVT present with swelling in the extremity, redness and extreme tenderness
- More commonly in the LE
- PE present with dyspnea, tachycardia, crackles, hemoptysis, chest pain, tachypnea, and anxiety
- Diagnostic imaging – Doppler US for suspected DVT and chest CT, ventilation perfusion scan and pulmonary angiography for suspected PE

Rehab Implications

- Support protocols for VTE prophylaxis including mechanical compression devices
- Ambulation is encouraged to reduce risk
- Awareness of pharmacologic interventions that alter platelet activity and clotting

DIC (Disseminated Intravascular Coagulation)

- MAJOR EMERGENCY
- Common in leukemic patients
- Abnormal activation of both coagulation and fibrinolysis factors leading to uncontrolled bleeding and thrombosis → thrombi lodge in microcirculation → block capillary flow → severe tissue ischemia → bleeding can occur anywhere and once it starts it cannot be reversed
- Signs you might see: intracerebral bleeding, petechiae, hematuria, oozing of mucous membranes or profound menstrual or GI bleeding
- Can help some with more blood products

Spinal Cord Compression

- Between 5 and 10 in every 200 patients with terminal cancer will experience this within the last two years of their life
- Caused by compression of dural sac and its contents by an extradural (more common) or intradural mass → irreversible neurological damage depending on level of lesion
- Haematogenous spread with bony metastasis to the vertebral spine causes collapse and compression, accounting for over 85% of cord compression
- 30-50% of patients show multi-level involvement so whole spine imaging is needed
Spinal Cord Compression
Cont’d

• May be first presentation of a cancer
• Corticosteroids and analgesia can be used
• Spinal stability chief concern
• Need neurosurgery and radiotherapy referrals
• Palliative care could also be appropriate option

Signs and symptoms

• Pain — back pain most common - 95% of patients up to 2 months before other symptoms — localized or radicular
• Motor deficit — limb weakness — 60-85% of patients — unsteady gait, trouble walking, standing, or transferring
• Sensory deficit — less common — paresthesias, numbness of toes and fingers
• Autonomic dysfunction — late consequence — bowel and bladder dysfunction — urinary retention, urinary or fecal incontinence, or constipation, with constipation being most common
• Cauda equina syndrome — decreased sensation over the buttocks, posterior-superior thighs, and perineal region in a saddle distribution, decreased anal sphincter tone

Spinal Cord Compression

• Very common
• Predominantly caused by metastatic spread of a primary malignancy through direct extension, hematogenous spread that causes mechanical compression, impaired vascularization, or vertebral compression with nerve entrapment
• Most common in metastatic breast, lung, prostate, kidney, lymphoma
• Managed by radiation, steroids, surgery, analgesics
• Check to see if MRI was done; if not, call MD regardless of activity orders
Sepsis

• One of most leading and lethal medical emergencies
• 9% of all cancer-related deaths
• More likely to be hospitalized and have worse outcomes than a non-cancer patient
• 30% increase in mortality in patients with cancer with severe sepsis
• Overall hospital mortality was 52% higher
• 29% increase in in-hospital mortality
• Incidence of severe sepsis was higher in hematological tumors than solid tumors

Sepsis → Severe Sepsis → Septic Shock

• Sepsis: documented/presumed infection and must have at least two of the following:
  • Temp above 101°F or below 96.8°F
  • HR higher than 90 bpm
  • RR higher than 20 breaths/min
  • Arterial carbon dioxide tension <32 mm Hg
  • White cell count >12 x10^9/L or >10% bands
• Severe Sepsis:
  • Significantly decreased urine output
  • Abrupt change in mental status
  • Decrease in platelet count
  • Difficulty breathing
  • Abnormal heart pumping function
  • Abdominal pain
• Septic Shock
  • You have the s/s of severe sepsis with
  • SBP <90 mm Hg or MAP <65 mm Hg
  • Lactate >2 mmol/L after an initial fluid challenge
  • The extremely low blood pressure that doesn’t adequately respond to simple fluid replacement

Sepsis Cont’d

• Causes
  • Pneumonia
  • Abdominal infection
  • Kidney infection
  • Bacteremia
• Risk Factors
  • Very young or very old
  • Compromised immune system
  • Already sick, often in an ICU
  • Wounds/injuries such as burns
  • Have intravenous catheters or breathing tubes
Sepsis Cont’d 43

• Complications
  - Blood flow to vital organs (brain, heart, kidneys) becomes impaired
  - Blood clots can form in organs and arms, legs, fingers, toes → organ failure and gangrene
  - Mortality rate of septic shock is 50%

• Treatment
  - Antibiotics
  - Vasopressors
  - Oxygen
  - Large amounts of IV fluids
  - In some cases, dialysis or ventilator
  - Surgery to remove abscesses in other cases

Hyperviscosity Syndrome (HVS) 79

• An increase in serum viscosity secondary to circulating problems
  - Sluggish blood flow and prolonged bleeding time caused by circulating proteins interfering with platelet aggregation
  - Triad: mucosal or skin bleeding, visual abnormalities, and focal neurologic deficits suggest HVS
  - Multiple myeloma is the second leading cause of HVS
  - Can be seen in multiple myeloma patients
  - Polycythemia and acute leukemic patients as well

• Prompt recognition of symptoms is important to prevent multisystem organ failure

• Signs and symptoms:
  - Visual symptoms
  - Altered mental status
  - Stroke
  - CHF
  - Acute tubular necrosis
  - Pulmonary edema

• Treatment:
  - Fluid resuscitation
  - Plasmapheresis
  - Do not transfuse RBCs until after plasmapheresis

Questions

katietasillo@gmail.com