Cancer Treatment Modalities

- Discuss nursing implications of the surgical treatment of cancer
- Discuss nursing implications of radiation therapy for the treatment of cancer
- Discuss nursing implications of chemotherapy/biotherapy
- Discuss stem cell transplantation

Objectives

Surgery Roles in the Treatment of Cancer

- Prevention
- Diagnosis
- Resection
- Reconstruction
- Palliation
- Devices

Goals of Surgical Resection

- Remove the tumor for maximum chance of cure and/or tumor control while minimizing complications all with active patient/family participation (Lester, J., 2013)

Prevention

- Identifying high-risk patients
- Performing prophylactic resection

Diagnosis

- Must have confirmation of diagnosis with tissue
- Biopsy techniques
  - **Fine-needle aspiration (FNA)**—Small gauge needle. Used for skin, breast lesions or palpable abnormalities
  - **Core-needle biopsy (CNB)**—Larger gauge needle. Used for breast, prostate or brain masses, palpable lesions
  - **Excisional**—removes entire mass. May be used for any lesion
  - **Incisional**—removes part of a lesion. May be used for any mass.
Resection

- Based on the type of cancer/location
- Can be with curative or palliative intent
- Lymph node evaluation
- Nurses are involved in the preoperative, perioperative and postoperative phases.

Nursing Concerns in the Preoperative Phase

- Preoperative Assessment—typically performed by the provider but the RN still needs to have an idea of what is included in an assessment and the physical classification category the patient fits into.
- RN may need to review preoperative medications, nutritional status, lab values and infection risk.

American Society of Anesthesiologists Classification System

- 6 Categories
  - 1) normal, healthy
  - Non-smoker, no ETOH
  - 2) mild systemic disease
  - Smoker, well-controlled DM
  - 3) severe systemic disease
  - Smoker, poorly-controlled DM/HTN, COPD, BMI >40, hepatitis, ETOH abuser
  - 4) severe systemic disease that is a constant threat to life
  - Hx of MI, CVA, TIA > 3 months ago, valve disease, ESRD not on dialysis
  - 5) patient is not expected to survive without the procedure
  - Ruptured AAA, trauma, intracranial bleed, ischemic bowel
  - 6) brain dead patient undergoing organ harvest

American Society of Anesthesiologists Classification System (Cnt’d.)

Rehabilitation

- Improving the patient’s quality of life while minimizing any handicaps from the cancer and surgical procedure. (Lester, 2013)
- Wounds, ostomies, grafts, speech/swallow function

Reconstruction

- Reconstruction may be done at the initial time of surgery or later
- Most common sites for reconstruction include breast, vagina, head/neck, extremities (Cordeiro, 2006)
Palliation/ Cytoreduction

- Palliative surgery most commonly done to alleviate distressing symptoms caused by the cancer.
- Cytoreductive surgery is done to reduce tumor burden and hopefully slow the progression of cancer.

Devices

- Implanted ports
- Apheresis catheters
- Ommaya reservoirs

Staging

- Clinical stage
  - Using physical assessment, imaging reports and professional judgment to estimate the stage of cancer
- Pathologic stage
  - Can only be done after tissue has been obtained
  - Includes organ of origin, tumor size, lymph node status and metastatic sites
- Staging system
  - TNM (Tumor, Lymph Node Involvement, and Metastatic sites of disease)

Post Operative Management

- Pain
  - epidurals, PCA’s, IV, oral
- Nausea/vomiting
  - risk factors include female gender, young age, hx of motion sickness or morning sickness
- Infection
  - assessment/prevention
- Thrombus
  - DVT/PE prevention

Other Surgical Procedures

- Video Assisted Thorascopic Surgery (VATS)
  - Minimally invasive
  - Used to obtain tissue for biopsy, treatment/evaluation of pleural effusions
- Radiofrequency Ablation (RFA)
  - Use of high-frequency sound waves to destroy tissue
  - Typically used to treat sites of metastatic disease in the liver
- Cryotherapy
  - Uses liquid nitrogen to destroy tissue (freezing)

Radiation
Radiation

- Causes breaks in DNA preventing cell reproduction
- Forms free radicals producing cell damage (cells with more oxygen are more easily damaged)
- May be given alone or in conjunction with chemotherapy/biotherapy
- May be given as neoadjuvant, adjuvant or palliative therapy

Princeton University, 2014

Types

- External beam - Most common, photon beams, daily treatment for several weeks
- Intensity-Modulated - Higher doses of radiation delivered to a certain region with less exposure to other tissue
- Brachytherapy - permanent or temporary
- Radionucleotides/Radioimmunotherapy - I-131, Zevalin (MoAb)

Planning

- Scans
- Simulation
- Measured in gray (Gy) or centigray (cGy)
- Fractionation is the total does of RT divided into equal doses
- Any guesses as to the most common sites that are radiated???

Common Sites Treated

- Breast
- Lung
- Brain
- Head and Neck
- Prostate
- GI
- GYN
- Lymphoma/Leukemia
- Skin
- Metastatic Lesions
Side Effects

- **Early/Acute**
  - Hair loss
  - Fatigue
  - Diarrhea
  - Mucositis
  - Nausea/Vomiting
  - Skin changes
  - Incontinence/Urgency
  - Cystitis

- **Late**
  - Skin/Tissue fibrosis
  - Sterility
  - Diarrhea
  - Neuropathy
  - Thyroid failure
  - Xerostomia
  - Secondary malignancies

(Gosselin, T. 2014)

Chemotherapy

- **General Principles**
  - Chemotherapy agents have been used for more than 50 years
  - Chemotherapy can cause direct cell death (cytotoxic) or can alter cell growth and prevent cell division (cytostatic)
  - Typically nonspecific in cell targeting
  - Can be cell cycle specific or cell cycle nonspecific

- **Cell Cycle**
  - **Phase 1** - G0
    - Resting phase
    - Cells remain here until recruited into the cell cycle
  - **Phase 2** - G1
    - Cell goes here when recruited into the cell cycle
    - Cell is committed to division if all conditions are met
    - Substances for DNA duplication are made
  - **Phase 3** - S (Synthesis)
    - Cell actively replicates DNA
    - If any errors in DNA are discovered they should be fixed
    - If unable to be fixed they undergo apoptosis

Cell Cycle (Cnt’d.)

- **Phase 4** - G2
  - Cell repairs for mitosis
  - Cell is again inspected for damage

- **Phase 5** - M (Mitosis)
  - Mutations can occur during this phase
  - New cells may contain too many or too few chromosomes which causes cancer

Cell Cycle

- G1
- S
- G2
- M
- Go
Classification

**Cell Cycle Specific**
- **Antimetabolites** (S Phase prevents DNA synthesis)
  - 5FU, Xeloda, Cytarabine, Gemcitabine, Methotrexate
- **Antimitotics** (M Phase, prevents mitosis)
  - Vincristine, Vinblastine, Docetaxel, Paclitaxel
- **Topoisomerase I/II Inhibitors** (Prevents DNA/RNA synthesis)
  - Irinotecan, Topotecan, Etoposide, Daunorubicin

**Cell Cycle Nonspecific**
- **Anti Tumor Antibiotics** (end in the suffix “mycin”)
  - Doxorubicin, mitomycin, epirubicin, bleomycin
- **Alkylators**
  - Carboplatin, cisplatin, ifosfamide, oxaliplatin, cyclophosphamide

Side Effects

- Patient education discussion
- Enzyme deficiencies
  - DPD (5FU)
  - UGT1A1 (irinotecan)

**Hormones**
- **Antiandrogens**
  - Bicalutamide
- **Antiestrogens**
  - Tamoxifen, Fulvestrant, Anastrozole, Letrozole, Exemestane
- **LHRH**
  - Leuprolide, Goserelin

Side Effects

- Hot flashes
- Decreased libido
- Nausea/Vomiting
- Weight gain
- Depression
- Bone pain and decreased bone density (aromatase inhibitors)
- Increased risk of thromboembolic events and endometrial cancer (tamoxifen)

Dosing

- Based on two principles
  1. **Cell Kill Model** (Skipper, H.E., 1971)
- Treatment responses are determined by tumor burden, rate of tumor growth, single vs. doublet therapy, dose intensity, hormone status, and drug resistance.
- BSA, AUC, mg/m^2
Dosing

- BSA
  \[ \text{BSA (mg)} = \frac{\text{Height (cm)} 	imes \text{Weight (kg)}}{3600} \]
- AUC
  \[ \text{Calculated Dose} (\text{mg}) = \frac{\text{Target AUC} \times \text{GFR}}{25} \]
- GFR
  \[ \text{Creatinine clearance} = \frac{\text{Creatinine} \times \text{weight (kg)} \times 0.85}{\text{urea} \times \text{weight (kg)} \times 0.001} \]
- Flat/fixed/capped

In obese patients it is recommended that the dose of chemotherapy be based on actual weight. ASCO guidelines do not support the practice of capping doses. There have been no studies to show that this leads to increased toxicities; conversely however, obese patients do have worse outcomes although it is not clear if that is due to underdosing or comorbid conditions (Griggs, J.J., Mangu, P.B., Anderson, H. et al., 2012).

Biologic and Targeted Therapies

- Biologics can be given as single agent or in conjunction with chemotherapy/radiation
- Biologics use patients normal immune mechanism to kill cancer cells
- By targeting a specific part of the malignant cell there is a reduction in side effects to normal cells

Monoclonal Antibodies

- Genetically engineered from one clonal parent cell
- They target a certain substance on the cell surface, attach to that cell and this allows our normal immune system to more easily “see” the cancer cell and attack it
- Cancer cells are destroyed by several different potential mechanisms (ADCC, direct apoptosis, CDC)
- 4 Types of mAbs:
  - Human, murine, chimeric and humanized

Types of Monoclonal Antibodies

- Murine  
- Chimeric  
- Humanized  
- Human

(Viale, P. 2009)
### Monoclonal Antibodies (cnt’d.)

- **Rituximab** - Targets CD20 Antigen
  - Used in the treatment of CD20 positive non Hodgkins lymphoma
  - Side Effects
    - Hypersensitivity reactions, fever/chills, tumor lysis syndrome, hepatitis B reactivation, progressive multifocal leukoencephalopathy
- **Trastuzumab** - Targets HER2 Receptor
  - Used in the treatment of HER2 positive breast cancer and some gastric/esophageal cancers
  - Side Effects
    - Rare
    - Decreased LVEF cardiomyopathy
- **Cetuximab** - Targets EGFR1
  - Used in the treatment of mCRC and head/neck cancer
  - Side effects
    - Hypersensitivity reactions, skin rash, diarrhea, electrolyte imbalances
- **Bevacizumab** - Targets Vascular Endothelial Growth Factor (VEGF)
  - Used in the treatment of mCRC
  - Side effects
    - Bleeding, clotting, delayed wound healing, proteinuria, hypertension

### Tyrosine Kinase Inhibitors

- Oral medications
- Names end in the suffix “-inib”
- **Erlotinib** - targets EGFR/TKI
  - Used in the treatment of mNSCLC, mpancreatic
  - Side effects - rash, diarrhea, mucositis, anorexia
- **Imatinib** - targets BCR/ABL
  - Used in the treatment of CML, GIST
  - Side effects - pancytopenia, rash, n/v, muscle cramping, diarrhea

### Cytokines

- Substances released from activated lymphocytes that affect immune cells
- **Interleukin-2 (IL-2)**
- **Interferon (IFN)**

### Colony Stimulating Factors (cnt’d.)

- **Erythropoietin**
  - Stimulates erythropoiesis to increase hemoglobin
  - Darbepoetin Alfa, Epoetin Alfa
  - Side effects
    - Headache, diarrhea, risk of thrombosis, can stimulate growth in certain cancers
- **Granulocyte-CSF**
  - Stimulates neutrophil production
  - Filgrastim, Pegfilgrastim
  - Side effects
    - Bone pain, rare allergic reactions, rare splenic rupture, rare ARDS, fever
- **Myeloid Progenitors/GM-CSF**
  - Stimulates production of macrophages and neutrophils
  - Sargramostim
  - Side Effects
    - Flu like reactions, bone pain, rash at injection site, renal and hepatic dysfunction
Bone Marrow Stem Cell Transplantation

Types of Transplants

- **Autologous** - collecting and reinfusing cells from the patient themselves
- **Allogeneic** - collecting and infusing cells from a donor
  - May be related or unrelated donors, matched or non-matched
- **Syngeneic** - cells are collected from an identical twin donor

Sources of Stem Cells

- **Bone Marrow**
- **Peripheral blood**
- **Umbilical cord blood**

Conditions Treated with Stem Cell Transplant

- Leukemia - ALL, AML, CML
- Multiple Myeloma
- Lymphoma
- Germ Cell tumors
- Breast cancer

Patient Selection

- Disease status
- Response to prior treatment
- Other co-morbid medical conditions
- Donor availability
- Testing:
  - CBC, CMP (evaluate liver/kidney function), pregnancy test, infectious disease titers (Hepatitis, CMV, EBV), Cxray, EKG, PFT, echo, psych evaluation. Possibly LP, CT, MRI, BMBx, PET.

Human Leukocyte Antigen (HLA) Matching

- HLA is a protein on your chromosome that can differentiate self from non-self.
- Inherited from your parents
- HLA matching tells us how closely the donor tissue and recipient tissue match
- Currently over 2,500 HLA markers
- A match is typically made of 8-10 markers
- The more markers in common the better (immune system is less likely to attack)
- Siblings have a 25% chance of being a match
- If no related match is found you move to looking for an unrelated donor through the National Bone Marrow Donor Program (SCCA, 2015).
Stem Cell Collection

- Mobilization involves pushing the stem cells out of the marrow into the peripheral blood
- Can use chemotherapy or colony stimulating factors for mobilization or a combination
- Cells are collected at various times depending on the type mobilization that was used and may need to be collected several times if an insufficient number of cells are obtained

We try to collect somewhere in the range of 2-4 million CD34+ cells (Cottler-Fox et al., 2003), (Negrin, R., 2013)
- If the patient is a potential candidate for tandem transplants then collect for both at the same time
- If the patient is undergoing an allogeneic transplant the cells are typically infused fresh, if an autologous transplant is planned the cells are cryopreserved – DMSO

Stem Cell Infusion

- The conditioning regimen is completed prior to infusion. The type of regimen is based on the disease being treated, past medical hx, immunosupression potential.
- The purpose of the conditioning regimen is to cause immunosuppression to prevent rejection of the tissue and to eliminate the disease that is being treated (Negrin,R., 2013)

Infusion is performed on day “zero”
- Allogeneic
  - Most often infused fresh and patients typically have fewer side effects.
  - Infused over several hours
  - Side effects may include chills/fever, nausea/vomiting, flushing, SOB, hypotension, tachycardia, rash or anaphylaxis
- Autologous
  - Cells are thawed at the bedside in a warm water bath and infused over a period of minutes
  - Side effects- fever/chills, cough, nausea/vomiting, diarrhea, abdominal cramps, flushing, tachypnea, hypertension
  - Cardiac arrhythmias, hypotension and electrolyte imbalances are possible but rare
  - All patients are premedicated with an antihistamine, steroid and APAP

Treatment Schema

- Gastrointestinal: Nausea, Diarrhea, Mouth Sores
- Fever/Infections, Blood transfusions
- Cardiac Arrhythmia, Pulmonary: Pneumonia, DAH
- Renal: Dialysis, Veno-occlusive disease
- Refractory Infection, Bleeding

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Stem Cell Infusion

- Nausea
- Diarrhea
- Mouth Sores
- Fever/Infections
- Blood transfusions

Blood

- White Blood Cells
- Red Blood Cells
- Platelets

- No Active Infection
- No Diarrhea
- Eating
- Ambulating

Hospital

- Stages
- Weeks
- Months

Cardiac Arrhythmia

- Pulmonary: Pneumonia, DAH
- Renal: Dialysis
- Veno-occlusive disease
- Refractory Infection
- Bleeding
### Complications of Stem Cell Transplantation

- **Graft-Versus-Host Disease**
- Pancytopenia
- Risk for Infection
- GI complications - nausea/vomiting, diarrhea, anorexia, taste alterations
- Hepatic complications - Hepatitis infections, gallbladder disease, veno-occlusive disease
- Pulmonary complications - Diffuse alveolar hemorrhage, infections
- Cardiac complications - arrhythmias (afib), infections
- Renal complications - renal insufficiency

### Graft Versus Host Disease

- Occurs in up to 50% of patients having undergone allogeneic transplant
- Skin, GI tract and liver are the most commonly affected organs (rash, diarrhea, elevated LFTs/bili, n/v)
- Classified as:
  - Classic Acute-
    - onset within 100 days of transplant and acute features
  - Persistent, recurrent or late onset-
    - occurs after 100 days post transplant with acute features
  - Classic chronic-
    - onset at any time post transplant with chronic features
  - Overlap or “acute on chronic”-
    - onset at any time with features of both

### Late Effects following Stem Cell Transplantation

- Cataracts
- Recurrent respiratory infections
- Pulmonary fibrosis
- Infertility
- Thyroid dysfunction
- Decreased bone density
- Hepatitis
- Gallstones
- Avascular necrosis
- Secondary malignancies - MDS, AML

(Ezzone, S. 2013)

### Questions

- [Open Source Radiation Safety Training](http://web.princeton.edu/sites/ehs/osradtraining/biologicaleffects/page.htm)
- [Bone Marrow Transplant](http://www.seattlecca.org/diseases/BMT-hla.cfm)
- [Wound VAC Dressing Change](http://secure.ucdmc.ucdavis.edu/cppn/resources/clinical_skills_refresher/wound_vac_dressing_change/index.html)

### References