Overview of Cancer Therapies

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Objectives

• Describe the principles of cancer treatment
  – Surgery
  – Chemotherapy
  – Biotherapy & Targeted Therapy
  – Radiation Therapy
  – Hematopoietic Stem Cell Transplant
  – Complementary and Alternative Medicine

Goals of Cancer Therapy

• Prevention
• Cure
• Control
• Palliation

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Principles of Cancer Therapy

• Adjuvant Therapy
  – Therapy given after the primary treatment modality (e.g. adjuvant chemotherapy following lumpectomy for breast cancer)
  – Goal – target minimal disease or microscopic metastasis to reduce recurrence risk

• Neoadjuvant Therapy
  – Use of one or more treatment modalities prior to the primary treatment (i.e. chemotherapy prior to surgery)
  – Goal – shrink the tumor prior to removal, and/or decrease the likelihood of micrometastasis

Surgery

• Surgery is the oldest and the most investigated therapy for cancer.

• Many different rationales for cancer-related surgeries
  – Diagnostic: To obtain tissue necessary for diagnosis and staging
  – Curative: To remove entire tumor with adequate margins of normal tissue
  – Preventive or prophylactic: To reduce risk of cancer developing in high-risk patients
    • Esophageal resection for Barrett’s esophagus
    • Bilateral mastectomy for BRCA mutations
  – Palliative: To treat cancer symptoms, not cure
    • Tumor debulking
    • Esophageal stent placement

Surgical Approaches to Diagnose Cancer

• Used to both diagnose new cancers and evaluate metastases
• Incisional biopsy
• Excisional biopsy
• Needle biopsy
  – Fine-needle aspiration
  – Core needle
• Sentinel node biopsies

Surgery to Treat Disease

• Primary Treatment
  – Removal of malignant tumor and a margin of adjacent normal tissues, e.g. lobectomy, mastectomy
  – Surgical techniques used that
    • Decrease the local and systemic spread of cancer and
    • Minimize the functional and cosmetic impact

• Adjuvant Treatment
  – Removal of tissue to decrease risk of cancer incidence, progression, or recurrence
    • Prophylactic surgery: removal of tissue at risk of developing cancer (removal of colon polyps to prevent colon cancer or prophylactic mastectomy)
    • Cytoreductive therapy: removal of tumor volume to improve effect of other cancer treatment modalities (e.g. ovarian cancer)

Surgery to Treat Disease

• Salvage Therapy: Surgery after local recurrence
  – Extensive surgical approach to treat local recurrence after the use of a less extensive primary approach
  – E.g.: recurrence of breast cancer after lumpectomy and radiation therapy → mastectomy as salvage therapy

• Palliative Therapy: Promote comfort & QOL without goal of curing disease
  – Bone stabilization
  – Relief of obstruction
  – Therapy for oncologic emergencies
  – Management of cancer pain

• Combination Treatment: Surgery combined with chemotherapy, radiation, biotherapy or targeted therapies
Minimally Invasive Surgical Techniques for Cancer

- Laparoscopic surgery—Small incisions are used to insert a thin scope and specially designed surgical instruments to be inserted to remove tumor.
- Robotic surgery—Performed by a surgeon operating a robot capable of making extremely precise movements
- Thermal ablation—Thin, needle-like probe inserted into the tumor, and tip is heated to kill cancer cells
- Cryoablation—Similar to thermal ablation; uses rapid freezing and thawing of cells to kill cancer

Other Types of Cancer-Related Surgery

- Surgery for treatment access
  - Intravascular catheter placement
- Reconstruction
  - Breast implant reconstruction
  - Colostomy reversal
- Rehabilitation
  - Removal of adhesions to improve range of motion
- Treatment of oncologic emergencies
  - Surgery to relieve bowel obstructions, spinal cord compression, and cardiac tamponade

Surgical Side Effects/Complications

- Acute respiratory distress
- Aspiration pneumonia
- Bleeding/coagulopathies
- Infection
- Obstruction/ileus
- Pain
- Poor wound healing
- Risk for thrombosis
- Note: Some cancers predispose patients to some of these risks, such as postsurgical infection, coagulation problems, and difficulties with wound healing.

Role of Nursing & Surgical Team

- Expert assessment
- Psychosocial support
- Education
- Symptom management
- Prevention of complications
Principles of Chemotherapy: Cell Kill Hypothesis

- A given dose kills a constant proportion of a tumor cell population (rather than a constant number of cells)

Factors Affecting Outcomes

<table>
<thead>
<tr>
<th>Tumor-Related</th>
<th>Patient-Related</th>
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<tbody>
<tr>
<td>Growth Fraction of Tumor</td>
<td>Performance status</td>
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<tr>
<td>Tumor burden</td>
<td>Bone Marrow Capacity</td>
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<td>Type of cancer</td>
<td>Liver Function</td>
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<td>Stage of disease</td>
<td>Kidney Function</td>
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<td>Drug Resistance</td>
<td>Other Co-Morbidities</td>
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<tr>
<td>Age</td>
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Growth Fraction

- Percentage of tissue actively dividing
  - Percentage of cells NOT in G0 (resting stage)
- Varies depending on type of tissue or tumor
- Normal tissue example:
  - Intestinal epithelium contains approximately 16% actively proliferating cells
  - Neurons are non-proliferating
- Malignant tissue example:
  - Malignant solid tumors: 1-8% cells actively proliferating
  - Aggressive, rapidly growing tumors: 20-30% cells actively proliferating

Cell Cycle Time

<table>
<thead>
<tr>
<th>Cell Cycle Time</th>
<th>Normal Cells</th>
<th>Tumor Cells</th>
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</thead>
</table>
| Short (hours to days)| • GI Mucosa
                       • Bone Marrow
                       | • Burkitt's lymphoma
                       • Acute myeloid leukemia
                       • Germ Cell Tumors   |
| Intermediate (days to weeks)| • Skin & hair follicles | • Small Cell Lung Cancer
                           • Hodgkin's Disease
                           • Non-Hodgkin's Lymphoma |
| Long (months)       | • Liver                    | • Breast cancer
                       • Kidney                  | • Colon Cancer
                       |                           | • Non-Small Cell Lung Cancer |
Tumor Burden

• The number of tumor cells present

• Cancer with small tumor burden (smaller tumors) are usually more sensitive to antineoplastic therapy

Cell Life Cycle

- G0 Phase
  - Resting (cells not committed to cell division)

- G1 Phase
  - RNA & protein synthesis (enzymes produced necessary for DNA synthesis)

- S Phase (Synthesis)
  - DNA synthesis

- G2 Phase
  - RNA, protein synthesis

- M Phase (Mitosis)
  - Cellular division

Action of Antineoplastic Drugs

- Alter cellular activity during one or more phases of cell cycle

- Affects both normal & malignant cells

Pharmacologic Classifications

Cell Cycle Non-specific
- Alkylating agents
- Nitrosureas
- Antitumor antibiotics

Cell Cycle Specific
- Antimetabolites
- Plant Alkaloids (Mitotic inhibitors)
  - Vinca alkaloids
  - Taxanes
  - Epipodophyllotoxins
- Topoisomerase I inhibitors


**Cell Cycle Specific Agents**

- Exerts effect only in specific phases of cell cycle
- Most effective against rapidly proliferating (cycling) cells
- Cell kill dependent on schedule (duration & timing rather than dose)

**Cell Cycle Non-Specific Agents**

- Affect cells in all phases of cell cycle (including G₀)
- Both proliferating & nonproliferating cells killed
- Cell kill dependent on total dose rather than schedule
- Combined with cell cycle-specific agents

**Alkylating Agents**

- Cell cycle non-specific
- Break DNA helix, interferes with DNA replication
- **Examples of alkylating agents**
  - Cyclophosphamide
  - Ifosfamide
  - Cisplatin
  - Carboplatin
  - Oxaliplatin
  - Temozolomide

**Alkylating Agents Toxicities**

- **Hematopoietic**
  - Myelosuppression
- **GI**
  - Nausea/vomiting
- **Reproductive**
  - Azoospermia, amenorrhea
- **Integumentary**
  - Alopecia
- **Carcinogenic**
  - Secondary malignancies
- **Hemorrhagic cystitis**
  - Ifosfamide, cyclophosphamide
- **Neuropathy**
  - Cisplatin analogs
- **Hypersensitivity**
  - Carboplatin (after 6-7 doses)

Nitrosureas

- Cell cycle non-specific
- Breaks DNA helix, interferes with DNA replication
- Cross blood-brain barrier
- **Examples of Nitrosureas:**
  - Carmustine
  - Lomustine
  - Streptozocin

Nitrosureas Toxicities

- Hematopoietic
  - *Delayed* myelosuppression
  - Nadir 4-6 weeks after therapy starts
- GI
  - Severe nausea/vomiting

Antitumor Antibiotics

- Cell cycle non-specific (most agents)
- Binds with DNA, inhibits DNA & RNA synthesis
- **Examples of antitumor antibiotics**
  - Actinomycin D
  - Bleomycin
  - Mitomycin
  - Mitoxantrone
  - Anthracycline Antitumor antibiotics
    - Daunorubicin
    - Doxorubicin
    - Epirubicin
    - Idarubicin
    - Liposomal doxorubicin

Antitumor Antibiotics Toxicities

- Hematopoietic
  - Myelosuppression (all drugs except Bleomycin)
- GI
  - Nausea/vomiting
  - Stomatitis, mucositis
- Reproductive
  - Gonadal suppression
- Integumentary
  - Alopecia
  - Vesicants (except Bleomycin, Mitoxantrone, and liposomal anthracyclines)
- Cardiotoxicity
  - Anthracycline antibiotics (dose dependent)
- Pulmonary fibrosis
  - Bleomycin
### Common Chemotherapy Agents

<table>
<thead>
<tr>
<th>Phase of Cell Cycle</th>
<th>Class</th>
<th>Common Agents Generic (Brand) Names</th>
<th>Common Toxicities</th>
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</thead>
<tbody>
<tr>
<td>Cell Cycle Non-specific</td>
<td>Alkylating Agents</td>
<td>Cyclophosphamide (Cytoxan)</td>
<td>Hematopoietic</td>
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<td></td>
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<td>Ifosfamide (Ifex)</td>
<td>Reproductive</td>
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<td>Cisplatin (Platinol)</td>
<td>Integumentary</td>
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<td>Carboplatin (Paraplatin)</td>
<td>Hemorrhagic cystitis</td>
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<td>Oxaliplatin (Eloxatin)</td>
<td>Secondary malignancy</td>
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<td>Temozolomide (Temodar)</td>
<td>Neurologic</td>
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<td></td>
<td>Nitrosureas</td>
<td>Carmustine (BCNU)</td>
<td>Hematopoietic</td>
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<td></td>
<td>Lomustine (CeeNu)</td>
<td>GI</td>
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<tr>
<td></td>
<td>Antitumor Antibiotics</td>
<td>Actinomycin D (dactinomycin)</td>
<td>Hematopoietic</td>
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<td></td>
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<td>Bleomycin (Blenoxane)</td>
<td>Reproductive</td>
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<td></td>
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<td>Mitomycin (Mutamycin)</td>
<td>Integumentary</td>
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<td></td>
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<td>Mitozantrone (Novantrone)</td>
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<td>Daunorubicin (Daunomycin)</td>
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<td>Doxorubicin (Adriamycin)</td>
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<td>Epirubicin (Ellence)</td>
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<td>Idarubicin (Idamycin)</td>
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<td>Liposomal doxorubicin (Doxil)</td>
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<td>Liposomal daunorubicin</td>
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### Pharmacologic Classifications

#### Cell Cycle Specific
- **Antimetabolites**
- **Plant Alkaloids (Mitotic inhibitors)**
  - Vinca alkaloids
  - Taxanes
  - Epipodophytoxins
- **Topoisomerase I inhibitors**

#### Antimetabolites
- **Cell cycle specific (S Phase)**
- Mimics & incorrectly substitutes for metabolites (nutrients) needed for cellular function (e.g. folate)

#### Antimetabolite Toxicities
- **Hematopoietic**
  - Myelosuppression
- **GI**
  - Nausea, vomiting
  - Mucositis/stomatitis
- **Diarrhea**
- **Fatigue**
- **Integumentary**
  - "Hand/foot syndrome" (palmar-planter erythrodysesthesia)
- **Ocular toxicity**
  - Ara-C high-dose: keratitis
  - **SFU:** photosensitivity

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Plant Alkaloids
(Mitotic Inhibitors)
• Vinca alkaloids
• Taxanes
• Epipodophyllotoxins

Vinca Alkaloids
• Acts in late G2 & M phase
• Prevents formation of mitotic spindle (prevents cell mitosis)
• Examples of Vinca Alkaloids
  – Vinblastine
  – Vincristine
  – Vinorelbine

Vinca Alkaloid Toxicities
• Hematopoietic
  – Myelosuppression (except vincristine)
• GI
  – Nausea/vomiting (except vincristine)
• Integumentary
  – All are vesicants
  – Alopecia
• Neurotoxicity
  – Sensory-motor peripheral neuropathy
  – Constipation (autonomic neuropathy)

Epipodophyllotoxins
• Interferes with topoisomerase II enzyme reaction
• Acts in late G2 & S phase
• Examples of Epipodophyllotoxins:
  – Etoposide
  – Teniposide
Epipodophyllotoxin Toxicities

• **Myelosuppression**
• **GI**
  – Nausea/vomiting
  – Mucositis (high-dose etoposide)
  – Diarrhea (high-dose etoposide)
• **Cardiovascular**
  – Hypotension if infused too rapidly

Taxanes

• Inhibits cell division in G2 & M phase
• Promotes early microtubule assembly and prevents disassembling, arresting mitosis
• **Examples of Taxanes:**
  – Docetaxel
  – Paclitaxel
  – Paclitaxel Protein-bound particles

Taxane Toxicities

• **Hematopoietic**
  – Myelosuppression
• **GI**
  – Nausea/vomiting
• **Integumentary**
  – Alopecia
  – Vesicants *(paclitaxel & docetaxel classified by ONS)*
• **Neurologic**
  – Sensory-motor peripheral neuropathy
  – Arthralgia & myalgias
• **Hypersensitivity reactions**
  – Paclitaxel & docetaxel

Camptotecans *(Topoisomerase I inhibitors)*

• Cell cycle phase specific
• Acts in S phase to prevent unwinding of DNA strand (by inhibiting topoisomerase I)
• **Examples of Camptotecans**
  – Irinotecan
  – Topotecan
### Camptotecan (Topoisomerase I Inhibitor) Toxicities

- **Hematopoietic:**
  - Myelosuppression
- **GI:**
  - Early diarrhea (cholinergic – reversed with atropine)
  - Late diarrhea (motility)
- **Integumentary:**
  - Alopecia

### Common Chemotherapy Agents

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<th>Common Agents</th>
<th>Generic (Brand) Names</th>
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<tbody>
<tr>
<td><strong>Antimetabolites</strong></td>
<td></td>
<td>Azacitidine (Vidaza)</td>
<td>Cytosine arabinoside (Ara-C)</td>
<td>Fluorouracil (5FU)</td>
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<td><strong>Vinca Alkaloids</strong></td>
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<td>Vinblastine (Velban)</td>
<td>Vincristine (Oncovin)</td>
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<tr>
<td><strong>Epipodophyllotoxins</strong></td>
<td></td>
<td>Etoposide (VP-16, VePesid)</td>
<td>Teniposide (VM-26, Vumon)</td>
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<tr>
<td><strong>Taxanes</strong></td>
<td></td>
<td>Docetaxel (Taxotere)</td>
<td>Paclitaxel (Taxol)</td>
<td>Paclitaxel: protein-bound particles (Abraxane)</td>
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<tr>
<td><strong>Camptotecans</strong></td>
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<td>Irinotecan (Camptosar)</td>
<td>Topotecan (Hytopar)</td>
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### Hormonal Agents

Interfere with protein synthesis & alter cell metabolism by changing cells hormonal environment

- **Antiandrogens (nonsteroidal)**
  - Bicalutamide
  - Flutamide
- **Antiandrogens (nonsteroidal)**
  - Tamoxifen
  - Toremifene
- **Antiandrogen (receptor antagonist)**
  - Fulvestrant
- **Antiestrogens (nonsteroidal aromatase inhibitor, reversible)**
  - Anastrozole
  - Letrozole
- **Antiestrogens (steroidal aromatase inhibitor, irreversible)**
  - Exemestane
- **Estrogens**
  - Estradiol
  - Estramustine
  - Estrone
- **Luteinizing hormone-releasing hormone analog**
  - Goserelin acetate
  - Leuprolide acetate

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### Combination Chemotherapy

- Combine drugs with different mechanisms of action
- Increases proportion of cells killed at any one time
- Reduces drug resistance
- Must have proven efficacy as single agents with minimally overlapping organ toxicity
- Uses drug synergy to maximize effects

### Principles of Cancer Treatment

- **Why is most chemotherapy administered in cycles?**
  - For example:
    - Chemotherapy administered on day 1, repeated every 3 weeks for 6 cycles
    - Chemotherapy administered on day 1 & day 8, repeated every 3 weeks for 6 cycles

### Chemotherapy Dosing

- **Fixed dosing:** mg
- **Weight based dosing:** mg/kg
- **Body surface area (BSA) based dosing:** mg/m²
- **Area under the curve (AUC):** Carboplatin
  - Calculation includes renal function

### Verification of Dose Calculation

- Requires complete prescriber order
  - Height, weigh, BSA or AUC, & total calculated dose
- Two chemotherapy-competent individuals (nurse and/or pharmacist), *in addition to prescriber*, independently double-check dosage calculations

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**Routes of Chemotherapy Administration**

- Intra-arterial
- Oral
- Subcutaneous
- Intrathecal/intraventricular
- Intraperitoneal
- Intrapleural
- Intravesicular
- Intravenous

**Oral**

**Advantage:**
- Convenience
- Ease and portability
- Increase sense of independence

**Disadvantage:**
- Difficulties with adherence
- Inconsistency of absorption
- Potential drug-herb-diet interactions
- Adherence
- Cost/reimbursement

**SC or IM Injection**

**Advantages**
- Ease of administration
- Decreased side effects

**Disadvantages**
- Inconsistency of absorption
- Requires adequate muscle mass & tissue absorption

**Nursing implications**
- Wear appropriate PPE
- Platelet count and ANC prior to administration
- Assess previous injection site for signs and symptoms of infection or bleeding

**Intrathecal/intraventricular**

**Advantage**
- Consistent drug level in CSF
- Bypasses the blood-brain barrier
- Sample CSF
- Administer opiates and antibiotics

**Disadvantage**
- Requires lumbar puncture or surgical placement
- Requires a physician or specially trained RN
**Intraperitoneal**

**Advantages**
- Provides direct exposure
- Bypasses the cellular enclosure of the peritoneal cavity
- Allows instillation of radioactive or colloid materials
- Allows for cyclic treatments

**Disadvantage**
- Requires placement of peritoneal catheter or port
- Requires small enough tumor volume

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**Intrapleural**

**Advantage**
- Scleroses the pleural lining preventing recurrence of effusions

**Disadvantage**
- Requires insertion of chest tube
- Must be administered by a physician

**Potential complications**
- Pain
- Infection

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**Intravenous**

**Advantages**
- Consistent absorption
- Required for vesicant

**Disadvantages**
- Requires nursing/patient time
- Interferes with patient’s activities

**Potential complications**
- Infection
- Phlebitis
- Infiltration
- Extravasation
- Local discomfort

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**Hazardous Drug Safe Handling**

Drugs defined as hazardous if they exhibit one or more of the following characteristics:

- a. Carcinogenicity
- b. Teratogenicity or developmental toxicity
- c. Reproductive toxicity
- d. Organ toxicity at low doses
- e. Genotoxicity

**Principles of Safe Handling**
- Personal protective equipment
- Preparation in biologic safety cabinet with vertical laminar airflow
- Label as hazardous drugs
- Safe techniques during storage, transport, administration

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**Immediate Complications of Cytotoxic Therapy**
- Extravasation
  - Vesicants
  - Irritant
- Flare reaction
- Hypersensitivity reaction
- Anaphylaxis

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**Chemotherapy Summary**
- Mechanisms of action:
  - Interferes with DNA
  - Blocks cell replication in dividing cells (leading to cell death)
- Affects both normal and malignant cells
- Chemotherapy toxicities related to effect on:
  - Normal, frequently dividing cells
    - Hematopoietic (bone marrow suppression)
    - GI mucosa (nausea, vomiting, diarrhea)
    - Reproductive (amenorrhea, azoospermia)
    - Integumentary (alopecia)
  - Drug-specific organ toxicities
    - Cardiac (e.g. anthracycline antitumor antibiotics cardiomyopathy)
    - Pulmonary (e.g. Bleomycin pulmonary fibrosis)
    - Neurons (e.g. peripheral neuropathies)

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**Chemotherapy Summary**
- Administered by multiple routes
- Typically administered over 4-6 “cycles”
- Classified as hazardous agents
  - Require special handling and use of personal protective equipment
- Most agents dosed according to body surface area
- Requires special training to:
  - Verify dose calculations
  - Safely handle & administer
  - Monitor, assess, and provide nursing actions to manage side effects
Biotherapy

• Use of agents:
  — Derived from biologic sources
  or
  — That affect biologic responses.
• Therapy that capitalizes on the use of natural body proteins and their functions to fight cancer.

Types of Biotherapy

• Cytokines
• Targeted Therapies
• Antiangiogenesis agents

Cytokines

• Cytokines are a broad class of protein cell regulators produced by the immune system
• Most cytokines possess multiple effects
• Cytokines include
  — Interferons
  — Interleukins
  — Hematopoietic growth factors

Interferons

• Actions:
  — Antiviral (inhibit viral replication)
  — Antiproliferative (prevent proliferation of tumor cells)
  — Immunomodulatory (modulate immune response of host)
• Examples:
  — Interferon alfa-2a
  — Interferon alfa-2b
• Side Effects:
  — Fever, chills, headache, N/V, diarrhea, fatigue, depression, anorexia, confusion, myelosuppression, injection site erythema
Interleukins

- Stimulate activation of immune cells (T and B cells, NK cells, LAK cells, tumor-infiltrating lymphocytes).
- Examples:
  - Aldesleukin (IL-2, Proleukin®)
  - Oprelvekin (IL-11, Neumega®)
- Side Effects:
  - Fever, chills, headache, N/V, diarrhea, myelosuppression, cardiac changes, capillary leak syndrome

Hematopoietic Growth Factors

- Stimulates the differentiation, proliferation, maturation, and functioning of hematopoietic cells.
  - **Erythropoietic stimulating agents:**
    - Stimulate red blood cell production
    - Epoetin alfa (Procrit®), Darbepoetin (Aranesp®)
  - **Granulocyte colony stimulating factors (G-CSF):**
    - Regulates production of neutrophils
    - Filgrastim (Neupogen®), pegfilgrastim (Neulasta™)
  - **Granulocyte macrophage colony stimulating factor (GM-CSF):**
    - Regulates differentiation neutrophils, monocytes, macrophages & dendritic cells
    - Sargramostim (Leukine®)

Targeted Therapies

- Advances in molecular biology led to development of “targeted therapies”
- Two types
  - Monoclonal antibodies
  - Small molecular inhibitors
    - Novel new agents
    - Oral therapies
Targeted Therapies

- Cellular growth, function, & apoptosis are regulated by complex network of biochemical & molecular signals
- Referred to as “cell signaling”
- “Signal transduction” is generation of a signal from either
  - Outside the cell (growth factors and growth factor receptors)
  - Inside the cell (tyrosine kinase inhibitors)
- Produces signaling cascade that travels down a pathway to the cell nucleus

Monoclonal Antibodies

- Antibodies cloned from a single antibody
  - Recognize and bind to only one tumor associated antigen
- Highly specific proteins
**Antiangiogenesis Agents**

- **Action:** Target the neovasculature of tumors to halt their growth, prevent tumor invasion, and preclude metastatic spread.
- **Examples:**
  - Bevacizumab *(Avastin®)*
  - Thalidomide *(Thalomid®)*
  - Lenalidomide *(Revlimid®)*

**Angiogenesis**

**Biotherapy Summary**

- **Agents**
  - Derived from biologic sources or
  - That affect biologic responses
- **Mechanisms of action**
  - Vary depending on classification of agents
  - Directed towards identifiable molecular targets on tumor cells

**Radiation Therapy Principles**

- Radiation causes the formation of free radicals which damage the DNA strand.
- Normal cells are able to repair the damage.
- Usual time to repair is about 6 hours
- Different cell types have different radiosensitivity
- Dose is based on maximum cell kill balanced with maximum normal cell tolerance
Radiation Therapy Treatment Principles

• Chemotherapy may be given concurrently to enhance radiation effect
• May be given at any stage of therapy
• Simulation done to plan treatment – plan takes 1-2 weeks be completed
• Treatment happens in daily doses over 1-8 weeks

Radiation Safety

• Cardinal principles
  – Decrease time of exposure to radiation.
  – Increase the distance from radiation exposure.
  – Use shielding devices to absorb radiation.
• Radiation monitoring devices
  – Personal dosimetry badges: not to be worn by others
  – Ring dosimeter: worn by person handling radioactive material

Radiation Delivery Methods

• External Beam
  – Photon
  – Neutron
  – Proton
• Implants
  – Seeds

  • Brachytherapy
    – Mammosite
    – Sonosite
    – Cylinders
  • Radiolabeled Isotopes

Radiation Therapy Side Effects

• Based on area being treated
  – Spine: esophagitis, nausea, diarrhea
  – Lung: pulmonary fibrosis
  – Heart: arteriole stenosis
  – Abdomen: nausea, diarrhea
  – Prostate/rectum: urinary frequency, diarrhea
  – Brain: headache, nausea
• Skin
  – Dry to moist desquamation
  – Radiation Recall: months to years after initial treatment. May be activated by anthracycline or sunburn
• Fatigue
External Beam Radiation Therapy (EBRT)

- EBRT is the most common form of radiotherapy.
- Radiation is delivered from outside the body.
- Linear accelerator is the most common treatment machine used to deliver EBRT.

EBRT: Indications

- Can be the primary treatment
- Used before surgery to shrink tumor
- Used after chemotherapy or surgery to get tumor cells left behind
- Delivered to high-risk areas to prevent cancer growth
- Used to control cancer
- Used to manage symptoms or to improve quality of life
- Used to treat structural emergencies

EBRT: Treatment Planning

- Simulation
  - Obtain images for treatment planning.
  - Immobilization devices are made.
  - Determine treatment position each day.
- Treatment planning
  - Based on CT, MRI, and PET/CT scans
  - Determine volume of tumor to be treated.
  - Computer calculation of dose to tumor and surrounding tissues

EBRT: Treatment Delivery

- Once a day, five days/week (Mon–Fri)
- Treated two to nine weeks based on tumor type
- Actual beam is on for few minutes, with the rest of time used for positioning.
- Patient does not feel anything during treatment.
- Patient is not radioactive after treatment.
EBRT: Patient Education

• Radiation is a local/regional treatment.
• Concurrent therapy (RT and chemotherapy) to optimize treatment outcomes
• Side effects are specific to area treated.
• Side effects usually occur during treatment and resolve in two weeks.
• Some patients will experience long-term side effects.
• Your doctor or nurse will work with you to manage your side effects.

Brachytherapy

• Indications
  – Temporary or permanent placement of a radioactive source into:
    • Body cavity
    • Tissue
    • Surface of the body
• Can be used in conjunction with EBRT
• Two types of brachytherapy
  – Low dose rate (LDR)
  – High dose rate (HDR)
  – May be used as a “boost” with EBRT

Brachytherapy: Goals of Treatment

• Improve local tumor control.
• Irradiate small volumes.
• Potentially minimize complications.
• Preserve organ function.
• Treat recurrent or inoperable cancers.
• Control disease in previously irradiated sites.

LDR Brachytherapy

• Hospitalized: Operative procedure with anesthesia
• Hollow applicator device or catheter is placed.
• Radioactive sources are manually loaded once patient returns to room.
• Strict room confinement and bed rest
• Specialized nursing care
• Requires radiation precautions
**HDR Brachytherapy**

- Involves the use of automated remote afterloading devices for placement of the radioactive source
- HDR treatments done as an outpatient
- Treated with high doses of radiation in shorter treatment times
- Anesthesia or sedation may be required depending on the site.

**Brachytherapy: Pretreatment**

- **LDR**
  - Pretreatment bowel regimen (enema) on morning of procedure
  - Educate patient on respiratory complications and prevention of immobility.
  - Anticoagulation if indicated
- **HDR**
  - Foley catheter and rectal tube may be placed.
  - Premedicate with pain and anxiety medication.
  - Radiation implant briefs for gyn implants

**Brachytherapy: Post-Radiation Care**

- **LDR**
  - Antidiarrheals to minimize bowel movements
  - Low-residue diet
  - HOB not elevated more than 30 degrees
  - Modify bath and linen changes.

**Brachytherapy: Side Effects**

- Localized and involves only the site implanted
- Pain and swelling of tissue implanted
- Soft tissue injury or necrosis (long-term)
- Diarrhea, proctitis, nausea, moist desquamation in skin folds
- GU symptoms
- Side effects are managed using standard treatment strategies.
Brachytherapy: Patient Education

• Prepare patient for procedure and what is expected.
• Prepare patient for the social isolation associated with strict radiation precautions.
• Teach symptoms to report during treatment.
• Explain the importance of prevention measures (resp, immobility)

Brachytherapy: Emergency Procedures

• Dislodged sources
  – Notify radiation safety officer (RSO) immediately for dislodged sources.
  – Never pick up a dislodged source.
  – Use long-handle forceps to pick up source and place in lead container in room.
  – RSO scans everything before removing the source from the room.

Radioisotopes and Radiopharmaceuticals

• Radioisotopes
  – Used for palliation of bone pain
  – Generally administered via IV and given outpatient
  – Can be used alone or in combination with bisphosphonates
• Radiopharmaceuticals
  – Unsealed sources that can be ingested, injected, or instilled
  – Example: I-131 is used to treat thyroid cancer.
  – Sr-89 and Sm-153 are used to treat multiple bone metastases.

Radiopharmaceuticals

• Very effective in treating specific tumors and have very few side effects
• Dose
  – Less than 33 mCi: outpatient
  – Greater than 33 mCi: inpatient
• Follow radiation precautions.
• Follow body fluid precautions.
Radioisotopes and Radiopharmaceuticals: Side Effects

- Leukocytopenia and thrombocytopenia may occur.
- Bone pain flare
- Erythema, tenderness or dryness of the skin

Radioisotopes and Radiopharmaceuticals: Assessment

- Check blood counts one week prior to administration of radioisotopes.
- Routine assessment of pain and effectiveness of pain regimen
- Patient needs to continue taking analgesics (if treating bone pain); may take two to three weeks for response.
- IV access if indicated

Radioisotopes and Radiopharmaceuticals: Management of Side Effects

- Obtain blood counts one week after administration.
- Aggressive pain regimen
- Use of NSAIDs, opiates, and steroids for management of bone pain flare

Radioisotopes and Radiopharmaceuticals: Patient Education

- Bone pain flare may occur 72 hours after administration and last up to one week.
- Blood counts can be weekly for up to eight weeks.
- Precautions should be taken for at least 12 hours after administration.
  - Flush toilet at least two times after each use.
  - Wash hands with soap and water after toileting.
  - Wash linens separately if exposed to body fluids.
References


Theory behind Therapy

• Autologous:
  - Potentially lethal doses of chemotherapy/radiation therapy
  - Patient’s own stem cells “rescue” the ablated marrow
  - Cure is chemotherapy/radiation, stem cells are supportive care

• Myeloablative Allogeneic:
  - Potentially lethal doses of chemotherapy/radiation
  - Donor stem cell “rescue” of the ablated marrow and “re-set” of the immune system for a graft versus tumor effect
  - Cure is chemotherapy/radiation and stem cell infusion

• Nonmyeloablative Allogeneic:
  - Less lethal doses of chemotherapy/radiation along with immunosuppression
  - Cure is the graft vs tumor effect, chemotherapy eliminates microscopic disease

Indications for BMT

- Malignant diseases:
  - Acute and Chronic Leukemia
  - Hodgkin’s Lymphoma and Non-Hodgkin’s lymphoma
  - Myelodysplastic Syndromes
  - Multiple Myeloma
  - Amyloidosis
  - Selected solid tumors
    • Renal cell
    • Germ cell
    • Primary CNS
    • Neuroblastoma

- Non-malignant diseases:
  - Hematologic Disorders (Aplastic Anemia, Fanconi’s Anemia, Sickle Cell, Thalassemia)
  - Congenital Immune deficiencies (SCID, Wiskott Aldrich Syndrome)
  - Inborn Errors of Metabolism (Hurle’s Syndrome, Guacher Disease)
  - Autoimmune Diseases (Systemic Sclerosis, Multiple Sclerosis)

Stem Cell Sources

<table>
<thead>
<tr>
<th>Bone Marrow</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundance of stem cells in BM</td>
<td>Lower rate of infections days +100 to +365</td>
<td>Anesthesia risk for donor</td>
</tr>
<tr>
<td>Post-operative pain for donor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Peripheral Blood</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faster engraftment</td>
<td>Reduced treatment-related mortality</td>
<td>Bone pain for donor</td>
</tr>
<tr>
<td>Lower rate of infections to day +100</td>
<td>More GVH effect than BM or UCB</td>
<td>Slightly higher risk of GVHD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Umbilical Cord Blood</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readily available</td>
<td>Less risk of GVH</td>
<td>Delayed engraftment</td>
</tr>
<tr>
<td>Less donor risks</td>
<td>More “matches”</td>
<td>Smaller “dose” of stem cells</td>
</tr>
<tr>
<td>Cannot obtain more cells from donor</td>
<td>Slightly higher rate of early mortality</td>
<td></td>
</tr>
</tbody>
</table>
Steps of HSCT

- Evaluation
- Mobilization (Autologous Patients): GCSF +/- chemotherapy, then PBSC collection
- Conditioning: Chemotherapy +/- Total Body Irradiation (TBI)
- Pre-engraftment period
- Engraftment
- Recovery
- Long term side effects

Side effects

- Conditioning related
  - Acute
    - Nausea/vomiting/diarrhea
    - Alopecia
    - Hemorrhagic cystitis
    - Sinusoidal obstructive syndrome
  - Long term
    - Pulmonary fibrosis/Bronchiolitis Obliterans Organizing Pneumonia (BOOP)
    - Sterility
- Graft vs Host Disease: Donor immune system attacks host
  - Acute: Skin, liver, gut
  - Chronic: Skin, mucosal membranes

CAM

CAM therapies can be commonly referred to as integrative, integrated or complementary when these therapies are combined with conventional treatments.

Alternative treatments are CAM therapies that are used in place of conventional treatments.

Conventional treatments are treatments that are typically used in Western medicine (standard treatments).

Integrative Oncology

- A practice where health care practitioners and patient work together to combine conventional medical treatments and CAM modalities
- Provides a collaborative holistic approach to health care
  - Considers body, mind, soul, and spirit
**Prevalence CAM Use in US**

- **General Population**
  - 62% adults have used some form of CAM therapy during the previous 12 months
  - Spans all ethnic backgrounds
  - Greatest use if hospitalized in last year, former smoker, female, higher education levels

- **Oncology Populations**
  - 25-80% adults (studies since 2000)
  - 40-70% are not reporting use of CAM to their health care practitioners

**Population of CAM**

Over the last decade

- Increase in public interest in CAM
- Increase in federal research dollars
- Increase in consumer dollars spent on CAM
- A 2007 NCCAM study determined that $33.9 billion was spent by Americans on CAM

**Major Types of CAM**

- Alternative medicine systems
- Energy therapies
- Exercise therapies
- Manipulative and body-based methods
- Mind-body interventions
- Nutritional therapies
- Pharmacologic and biologic treatments
- Spiritual therapies

**Types of CAM Therapies:**

**Alternative Medical Systems**

- Well-developed theory and practice
- Examples:
  - Traditional Chinese medicine
  - Acupuncture
  - Homeopathy

**Mind-Body Interventions**

- Enhance the mind’s ability to impact bodily function and symptoms
- Examples:
  - Meditation
  - Imagery
  - Music therapy
  - Aromatherapy
Types of CAM Therapies:

**Manipulative & Body-Based Methods**
- Manipulation and movement of one or more body parts
  - Examples:
    - Chiropractic care
    - Massage
    - Reflexology

**Energy Therapies**
- Involve the use of energy fields
  - Examples:
    - Qi gong
    - Reiki
    - Therapeutic touch
    - Magnet therapy

**Nutritional Therapeutics**
- Diets used as preventative and/or treatment agents
  - Examples:
    - Macrobiotic diets
    - Vegetarianism
    - Vitamins
    - Antioxidants
    - Melatonin supplements
    - Selenium

**Pharmacological/Biological Treatments**
- Medications and products that are not yet accepted as conventional therapy and/or for prescription drug or off-label use
  - Examples:
    - Herbs
    - Botanicals
    - Tea polyphenols
    - Shark cartilage

**Exercise Therapy**
- Used to improve bodily movement
  - Examples:
    - Tai Chi
    - Hatha yoga

**Spiritual Therapies**
- Focus on religious beliefs and feelings, peace, purpose, connection with others, and the meaning of life
  - Examples:
    - Prayer
    - Spiritual healing
Oncology Nursing Responsibilities

- Evaluate personal & professional beliefs re: use of complementary & alternative therapies
  - Recognize how own values can affect patient care
  - Establish a collaborative relationship with patients
- Assess patients for use of CAM with each contact
  - Side effects or changes in patients condition at each appointment
- Assist with locating reliable, evidence-based information and resources

Questions for Patients to Ask

- Can this treatment:
  - Support the immune system or other systems?
  - Counteract the cancer?
  - Enable the conventional treatment to work better?
  - Relieve symptoms or side effects?
- Have results of this treatment been published in any recognized medical journals?
- Can the provider give you any references published by others?

Oncology Nursing Responsibilities

- Understand and appropriately utilize terms (complementary, alternative, integrative therapies)
- Promote integrated education with other health disciplines
- Awareness of therapies that potentially can interfere with the outcome of other cancer treatments

Questions for Patients

- Does the provider believe in this treatment because he/she has seen benefits with similar patients?
  - If so, would it be possible to speak to some of these patients?
- How will you know that the therapy is working or not working?
- Are there potential side effects?
- Is the provider willing to communicate with the patient’s primary care physician?

Adapted from American Cancer Society and Eisenberg, D. Recommendations to MD's on Counseling Patients' Use of Alternative Medicine, Annals of Internal Medicine, 127(1): 61-69.
Resources

- American Cancer Society/Complementary and Alternative Therapies
  - www.cancer.org/Treatment/TreatmentsandSideEffects/ComplementaryandAlternativeMedicine
- Society of Integrative Oncology
  - www.integrativeonc.org
- National Center for Complementary and Alternative Medicine (NCCAM)

Resources

- Medline Plus: Cancer Alternative Therapies
- MD Anderson Cancer Center: Complementary/Integrative Medicine
  - www.mdanderson.org/education-and-research/resources-for-professionals/clinical-tools-and-resources/cimer/index/htmlanish
- Memorial Sloan Kettering Cancer Information About Herbs, Botanicals, & other Products