

Oncology Knowledge Base

Cancer Biology and Pathophysiology

Cell Cycle and Cancer

- **Cell Cycle Phases**: G1, S, G2, M phases
- **Checkpoints**: DNA damage checkpoints, spindle checkpoints
- **Oncogenes**: Genes promoting cell growth (RAS, MYC, HER2)
- **Tumor Suppressors**: Genes preventing cancer (p53, RB, BRCA1/2)

Hallmarks of Cancer

1. **Self-sufficiency in Growth Signals**
2. **Insensitivity to Anti-growth Signals**
3. **Evading Apoptosis**
4. **Limitless Replicative Potential**
5. **Sustained Angiogenesis**
6. **Tissue Invasion and Metastasis**
7. **Reprogramming Energy Metabolism**
8. **Evading Immune Destruction**

Metastasis Process

- **Local Invasion**: Basement membrane breakdown
- **Intravasation**: Entry into blood/lymphatic vessels
- **Circulation**: Survival in bloodstream
- **Extravasation**: Exit from vessels
- **Colonization**: Growth at distant sites

Common Cancer Types

Lung Cancer

- **Types**: Non-small cell (NSCLC) 85%, Small cell (SCLC) 15%
- **NSCLC Subtypes**: Adenocarcinoma, squamous cell, large cell
- **Risk Factors**: Smoking, radon, asbestos, family history
- **Staging**: TNM staging system
- **Treatment**: Surgery, chemotherapy, radiation, targeted therapy, immunotherapy

Breast Cancer

- **Types**: Invasive ductal carcinoma (IDC), invasive lobular carcinoma (ILC)
- **Molecular Subtypes**: Luminal A/B, HER2+, Triple-negative
- **Biomarkers**: ER, PR, HER2, Ki-67
- **Staging**: TNM system, stage 0-IV
- **Treatment**: Surgery, chemotherapy, hormone therapy, targeted therapy

Colorectal Cancer

- **Adenomatous Polyp Sequence**: Normal → Adenoma → Carcinoma
- **Molecular Pathways**: Chromosomal instability, microsatellite instability
- **Screening**: Colonoscopy, FIT, Cologuard
- **Staging**: TNM system, Duke's classification
- **Treatment**: Surgery, chemotherapy, targeted therapy

Prostate Cancer

- **Gleason Score**: Histologic grading system (6-10)
- **PSA**: Prostate-specific antigen screening
- **Risk Stratification**: Low, intermediate, high risk
- **Treatment**: Active surveillance, surgery, radiation, hormone therapy

Cancer Staging and Grading

TNM Staging System

- **T (Tumor)**: Primary tumor size and extent
- **N (Nodes)**: Regional lymph node involvement
- **M (Metastasis)**: Distant metastasis presence
- **Stage Grouping**: Stage I-IV based on TNM

Histologic Grading

- **Grade 1**: Well-differentiated, low grade
- **Grade 2**: Moderately differentiated, intermediate grade
- **Grade 3**: Poorly differentiated, high grade
- **Grade 4**: Undifferentiated, high grade

Performance Status

- **ECOG Scale**: 0-5 scale of functional status
- **Karnofsky Scale**: 0-100% functional assessment
- **Clinical Significance**: Treatment selection, prognosis

Cancer Treatment Modalities

Surgery

- **Curative**: Complete tumor removal
- **Palliative**: Symptom relief, debulking
- **Reconstructive**: Functional/cosmetic restoration
- **Minimally Invasive**: Laparoscopic, robotic surgery

Chemotherapy

- **Mechanisms**: DNA damage, mitotic inhibition, antimetabolites
- **Administration**: Oral, intravenous, intrathecal
- **Cycles**: Treatment periods with rest intervals
- **Combination Therapy**: Multiple agents for synergy

Radiation Therapy

- **External Beam**: Linear accelerator delivery
- **Brachytherapy**: Internal radioactive source placement
- **Stereotactic**: High-precision, high-dose treatment
- **Fractionation**: Divided doses over time

Targeted Therapy

- **Monoclonal Antibodies**: Trastuzumab (HER2), Rituximab (CD20)
- **Tyrosine Kinase Inhibitors**: Imatinib (BCR-ABL), Erlotinib (EGFR)
- **Angiogenesis Inhibitors**: Bevacizumab (VEGF)

Immunotherapy

- **Checkpoint Inhibitors**: PD-1, PD-L1, CTLA-4 inhibitors
- **CAR-T Therapy**: Chimeric antigen receptor T-cells
- **Cancer Vaccines**: Preventive and therapeutic vaccines
- **Adoptive Cell Transfer**: Tumor-infiltrating lymphocytes

Supportive Care and Side Effects

Chemotherapy Side Effects

- **Hematologic**: Neutropenia, anemia, thrombocytopenia
- **Gastrointestinal**: Nausea, vomiting, diarrhea, mucositis
- **Neurologic**: Peripheral neuropathy, cognitive changes
- **Dermatologic**: Alopecia, rash, hand-foot syndrome

Radiation Side Effects

- **Acute**: Skin reaction, fatigue, organ-specific effects
- **Late**: Fibrosis, secondary malignancies, organ dysfunction
- **Site-specific**: Pneumonitis (lung), cystitis (bladder)

Supportive Medications

- **Antiemetics**: 5-HT3 antagonists, NK1 antagonists, steroids
- **Growth Factors**: G-CSF, erythropoietin
- **Bisphosphonates**: Bone metastases, hypercalcemia
- **Pain Management**: Opioids, adjuvant analgesics

Cancer Screening and Prevention

Screening Guidelines

- **Breast Cancer**: Mammography starting age 40-50
- **Cervical Cancer**: Pap smear, HPV testing
- **Colorectal Cancer**: Colonoscopy starting age 45-50
- **Lung Cancer**: Low-dose CT for high-risk patients
- **Prostate Cancer**: PSA discussion starting age 50

Primary Prevention

- **Lifestyle Factors**: Diet, exercise, weight management
- **Tobacco Cessation**: Single most important prevention
- **Vaccination**: HPV, Hepatitis B vaccines
- **Chemoprevention**: Tamoxifen, aspirin in selected patients

Palliative and End-of-Life Care

Palliative Care Principles

- **Symptom Management**: Pain, dyspnea, nausea
- **Psychosocial Support**: Patient and family counseling
- **Spiritual Care**: Chaplaincy, cultural considerations
- **Goals of Care**: Quality of life, comfort measures

End-of-Life Discussions

- **Advance Directives**: Living wills, healthcare proxy
- **Code Status**: DNR, DNI discussions
- **Hospice Care**: Comfort-focused care
- **Bereavement Support**: Family grief counseling