

MPS 453: FUNDAMENTALS OF CANCER BIOLOGY

Teaching hours: Each Unit – 12 h

Objective:

Familiarizing the students with the causes and mechanism of cancer induction, diagnosis and staging of cancer and modalities of treatment.

Outcomes:

- Students will learn basics of cancer biology and different processes involved in it and have knowledge regarding the process of cancer initiation, promotion, progression and malignancy.
- They acquire the knowledge in classifying the type of cancer and various risk factors involved development of cancerous cells.
- They will have knowledge of pathogenesis involving infiltration of cancers into lymph nodes and migration of tumour cells into distant organs.
- They will understand the optimisation of therapy techniques.
- They will understand the comprehensive treatment protocols involving multimodal treatment protocols.

Unit I: Basics of Cancer Biology

Biokinetics Parameters of Tumours- Physiological Compartments-Proliferating; Quiescent; Differentiated (Sterile); Necrotic cells; Hypoxic cells. Cell cycle time T_c ; Labelling Index (LI); Mitotic Index; Growth Fraction; Potentially doubling time T_p and Volume doubling time T_d ; Cell loss factor; Relationship between various biokinetic parameters.

Benign Tumours Vs. Malignant Tumours, Nomenclature – definition of neoplasm, Types of Cancer, Common Symptoms, Molecular Hallmarks of Cancer – Growth Signal Autonomy, Evasion of Growth Inhibitory Signals, Evasion of Apoptosis (Programmed Cell Death), Unlimited Replicative Potential, Angiogenesis (Formation of New Blood Vessels), Invasion and Metastasis, Molecular Basis of Cancer - Cancer Genes (Oncogenes and Tumour Suppressor Genes), Carcinogenesis – A Multistep Process, Evidences for Multistage Models of Carcinogenesis.

Cancer Metabolism: Altered Metabolism in Cancer Cells, Energetic of Cell Proliferation, Genetic Events Important for Cancer Influence Metabolism, Targeting Cancer Metabolism

Unit II: Cancer Staging, Classification and Risk Factors

Cancer Classification – TNM Classification - Purpose, Types of Staging, TNM System, Stage Grouping, Other Factors That Can Affect the Stage, Other classification System – FIGO Classification, Special staining tumours – ERPR, Molecular Classification of Cancer

Cancer Risk Factors: Theories of Carcinogenesis, oncogene and antioncogene -Physical, Biological, Chemical - Exogenous and Endogenous Carcinogens, Metabolism of Chemical Carcinogens, DNA Adduct Formation, Biological - DNA Viruses and RNA Viruses, Genetic Syndromes, Life Style Factors.

Unit III: Cell Cycle, Apoptosis and Tumorigenesis

Cell cycle - Alterations in Pathways Affecting Growth and Proliferation, Mutations Neutralizing Stress Responses, Mutations Causing Genetics and Genomic Instability, Cell Cycle and Cancer Therapy; Apoptosis - Molecular Mechanisms (Intrinsic and Extrinsic Pathway), p53 and Apoptosis, Apoptosis and Cancer, Apoptotic Pathways and Cancer Therapy, Autophagy (Mechanism, Autophagy in Tumourigenesis, Autophagy Modulation for Cancer Treatment), Necrosis.

Unit IV: Pathophysiology of Cancer

Invasion and Metastasis: Evaluation and Pathogenesis of Metastasis, An Integrated Model of Metastasis, Tools of Cell Migration – Tumour Invasion, Cell Adhesion, Integrins and Proteases, Intravasation, Transport, Extravasation, Metastatic Colonization, Organ Selectivity of Metastasis, Metalloproteinases Inhibitors (MPIS).

Etiology of Cancer – Physical, Chemical, Biological, hormonal, Hereditary and Immunity – Systemic effects of Neoplasia – Cancer Pattern-incidence in India – Cancer markers for oral cancer – prostate cancer – head and neck – colorectal – cervical, lungs – breast – gastrointestinal cancer – Alpha fetoproteins – carcino - embryonic antigens – leukemia.

Unit V: Cancer Screening and Treatment Modalities

Screening - Definition, Principles, Evaluating Screening Tests, Developing and evaluating a Cancer Screening Programme, Different Kind of Screening Tests, Screening for Specific Types of Cancer, Genetic Counselling; Treatment – Essential Terms, Surgery, Radiation, Chemotherapy, Biological Therapy, Hormone Therapy, Transplantation, Targeted Therapies,

Radiolabelled Immunotherapy, Gene Therapy, Other Treatment Methods (Cryosurgery, Laser Therapy, Photodynamic Therapy, Hyperthermia), Cancer Clinical Trials.

Treatment intent – Curative and Palliative, Cancer Prevention and Public education – Patient Management on treatment – side effects related to radiation dose and chemotherapeutic drug.

Reference Books:

1. Robert A. Weinberg, The Biology of Cancer, Garland Science, 2012
2. Robin Hesketh, Introduction to Cancer Biology, Cambridge University Press, 2013
3. Vincent T. DeVita, Jr., Theodore S. Lawrence, Steven A. Rosenberg, Cancer: Principles and Practice of Oncology, 9th Edition, Lippincott Williams and Wilkins, 2011

