CANCER

Cancer stands out as one of the most feared afflictions among humanity, constituting a significant contributor to global mortality rates. Within the population of India alone, cancer afflicts over a million individuals annually, claiming a substantial number of lives each year.

The intricate balance of cell growth and differentiation within the human body is meticulously regulated. However, in the case of cancer, this regulatory framework breaks down, leading to abnormal and uncontrolled cell division. Unlike healthy cells, cancer cells lack the characteristic property of contact inhibition, whereby neighboring cells restrict their growth. Consequently, cancer cells proliferate unchecked, forming masses of cells known as neoplasms or tumors.

Tumors manifest in two primary forms benign and malignant

Benign tumors remain localized, posing minimal threat as they do not spread to other regions of the body. Conversely, malignant tumors exhibit aggressive growth, rapidly invading and damaging surrounding tissues. These malignant cells outcompete normal cells for essential nutrients, thereby inducing starvation. Moreover, cells shed from malignant tumors disseminate through the bloodstream, establishing new tumors upon lodging in distant sites—a phenomenon termed metastasis, representing the most dreaded aspect of malignant tumors.

Causes of Cancer and Carcinogenic Agents

The process of transforming normal cells into cancerous, neoplastic cells can be instigated by various factors, including physical, chemical, and biological agents.

(i) Physical agents:
such as ionizing radiations like X-rays and gamma rays, as well as non-ionizing radiations like UV rays, inflict damage to DNA, thereby facilitating the transformation of cells into neoplastic forms.

(ii) Chemical agents:
exemplified by carcinogens present in tobacco smoke, have been identified as significant contributors to the development of lung cancer.

(iii) Biological agents:
specifically, viruses capable of inducing cancer, known as oncogenic viruses, carry genes referred to as viral oncogenes. These viral oncogenes possess the capacity to trigger cancerous transformations within cells. Additionally, within normal cells, there exist a set of genes termed cellular oncogenes (c-onc) or proto-oncogenes. Under specific conditions, the activation of these genes can lead to the oncogenic or carcinogenic alteration of cells.

Detection and Diagnosis

Detecting cancer at an early stage can be life-saving, as treatment efficacy diminishes when the disease spreads to multiple parts of the body. Cancer diagnosis typically involves several methods:

(i) Biopsy and Histopathological Studies: Suspected tissue undergoes biopsy, where a small piece is extracted, sliced into thin sections, stained, and examined under a microscope by a pathologist to identify cancerous cells.

(ii) Blood and Bone Marrow Tests: These tests are conducted to check for increased cell counts, particularly in cases of leukemia.

(iii) Imaging Techniques: Radiography, CT (Computed Tomography), and MRI (Magnetic Resonance Imaging) are utilized to detect cancers within internal organs. CT scans employ X-rays to produce three-dimensional images, while MRI employs strong magnetic fields and non-ionizing radiations to accurately identify pathological and physiological changes in living tissue.

(iv) Cancer-Specific Antigen Antibodies: Antibodies targeting cancer-specific antigens, such as Herceptin, are employed to detect certain types of cancer.

(v) Molecular Biology Techniques: These methods are utilized to identify genes associated with inherited susceptibility to specific cancers. Upon detecting these genes in individuals, they may be advised to avoid exposure to particular carcinogens, such as tobacco smoke in the case of lung cancer.

Cancer Treatment

Treatment strategies for various types of cancers commonly include:

(i) Surgery: Typically, tumors are surgically excised whenever feasible.

(ii) Radiotherapy/Radiation Therapy: Tumor cells are exposed to lethal doses of gamma radiation, with precautions taken to protect surrounding normal tissues. For instance, the use of l^{131} is employed for thyroid cancer treatment.

(iii) Chemotherapy: Various chemotherapeutic agents are utilized to eradicate cancer cells. Some of these drugs are tailored for specific tumor types.
For example, two anticancer medications, vincristine and vinblastine, derived from the common weed Catharanthus roseus, are used in treating leukemia. However, most chemotherapy drugs come with side effects such as hair loss and anemia.

(iv) Immunotherapy: In certain cases, tumor cells evade detection and destruction by the immune system. Therefore, patients may receive biological response modifiers like q-interferon to activate their immune system, aiding in tumor destruction.

(v) The process involves restraining the synthesis of DNA within the cell cycle of cancerous cells, albeit with associated side effects.