

## Science of Cancer and Chemotherapy

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### ABSTRACT

Cancer is a life threatening disease which retards growth of the tissue. Signs and symptoms appear as the mass produces or ulcerates. The isolated tumours are called metastatic tumours, while the original is called the primary tumour. There are number of environmental factors and behavioural factors which are responsible for generation of cancer such as tobacco, alcohol, smoking, harmful radiations etc. Highly salt rich diet also contributes to cancer. Radiation from mobile phones, electric power transmission is hazardous mutagens and they affect all parts of the body at any age. Hereditary and fluctuating hormone levels are other reasons behind cancer development. We can avoid suffering from cancer by improving our dietary habits also. Cancer is treated by using chemotherapeutic agents, by radiation therapy or in advanced cases surgery is performed.

**Keywords:** Tumour, leukaemia's, neoplasm, metastasis, oncogens, Aflatoxin B1, over nutrition.

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### INTRODUCTION

Cancer is an abnormal cell growth spread to parts of the body. Cancer is fundamentally a disease of tissue growth regulation. In order for a normal cell to transform into a cancer cell, the genes that regulate cell growth and differentiation must be new.

### DISCUSSION

#### Signs and symptoms

Symptoms of cancer depend on the location of the tumour. When cancer initiates, it produces no symptoms. Signs and symptoms appear as the mass produces or ulcerates. Few symptoms are exact. Many commonly occur in individuals who have other conditions. The findings that result depend on the cancer's type and site. Cancer is a "great imitator". Thus, it is common for people analysed with cancer to have been treated for other diseases, which were hypothesized to be causing their symptoms. People may become anxious or depressed post-diagnosis. The risk of suicide in people with cancer is nearly double.

#### Local symptoms

Local symptoms may occur due to the mass of the tumour or its ulceration.

#### Example

Mass effects from lung cancer can block the bronchus resulting in cough or pneumonia; esophageal cancer can cause narrowing of the

esophagus, making it difficult or sore to swallow; and colorectal cancer may lead to narrowing or blockages in the bowel, affecting bowel habits. Masses in breasts or testicles may produce visible tumors. Ulceration can cause bleeding that, if it occurs in the lung, will lead to coughing up blood, in the bowels to anemia or rectal bleeding, in the bladder to blood in the urine and in the uterus to vaginal bleeding. Although to the skin. Hodgkin disease, leukemia's and cancers of the liver or kidney can cause a persistent fever. Examples include the presence of myasthenia gravis in thymoma and clubbing in lung cancer.

#### Metastasis

Metastasis is the spread of cancer to other sites in the body. The isolated tumors are called metastatic tumours, while the original is called the primary tumour.

Cancer can spread from its original location by local spread, lymphatic spread to local lymph nodes or by haematogenous spread by the blood to distant sites, known as metastasis. When cancer spreads by a haematogenous route, it usually spreads all over the part of the body. The symptoms of metastatic cancers depend on the tumour site and can include enlarged lymph nodes (which can be felt or sometimes seen under the skin and are typically hard), enlarged liver or enlarged spleen, which can be felt in the abdomen, pain or fracture of affected bones local pain may occur in advanced cancer, the initial swelling is

usually painless. Some cancers can cause a buildup of fluid within the chest or abdomen.

### Systemic symptoms

General symptoms occur due to effects that are not related to direct or metastatic spread. Some cancers may cause specific groups of systemic symptoms, called paraneoplastic syndrome. These may include involuntary weight loss, fever, excessive fatigue and changes and neurological symptoms. However, cancer 'seeds' grow in certain selected site only ('soil') as hypothesized in the soil and seed hypothesis of cancer metastasis.

### Causes

All cancers are caused by mutations. The genes affected by these mutations are called cancer genes or oncogenes. Environmental factor used in cancer researcher are those that is not inherited genetically, for instance lifestyle, economic and behavioural factors and not purely pollution. Common environmental factors that contribute to cancer death are Such as tobacco (25–35%), diet and obesity (30–34%), infections (15–25%), radiation (both ionizing and non-ionizing, up to 10%), stress, lack of physical activity and pollution, Alcohol, smoking. Exposure to particular substances have been correlated to specific types of cancer. These substances are called carcinogens. The majority of mutations in cancer, in 90–95% cases, are due to environmental factors. The left behind 5–10% are inherited.

### Diet and exercise

Diet, physical inactivity and obesity are associated to up to 30–35% of cancer deaths. In India or other country excess body weight is related with development of many types of cancer and is a factor in 14–20% of cancer deaths. Physical inactivity also contribute to cancer risk, not only through its effect on body weight but also through negative effects on the immune system and endocrine system. Some specific foods are linked to specific cancers. A high-salt diet is related to gastric cancer. Aflatoxin B1, a recurrent food contaminant may lead to liver cancer. Betel nut chewing can cause oral cancer. National differences in dietary practices may explain differences in cancer incidence. For example, gastric cancer is more common in Japan due to its high-salt diet, while colon cancer is more common in the United States. More than half of the effect from diet is due to over nutrition (eating too much), rather than from eating too few vegetables or other healthful foods.

### Radiation-induced cancer

Up to 10% of invasive cancers are related to radiation exposure, including both ionizing radiation and non-ionizing ultraviolet radiation. Additionally, the majority of non-invasive Cancers are non-melanoma skin cancers caused by non-ionizing ultraviolet radiation, mostly from sunlight. Sources of ionizing radiation include medical imaging and radon gas.

Ionizing radiation is not a mostly powerful mutagen. Residential exposure to radon gas may cause cancer. Cancer due to harmful radiations affects most parts of the body, in all animals and at any age. Children and young people are twice as likely to develop radiation-induced leukaemia as adults; radiation exposure before birth is more dangerous. Prolonged exposure to ultraviolet radiation from the sun can lead to melanoma and other skin malignancies.

World Health Organization, International Agency for Research on Cancer describes Non-ionizing radio frequency radiation from mobile phones, electric power transmission and other similar sources as a possible carcinogens.

### Heredity

Hereditary cancers are primarily caused by an inherited genetic deficiency. Less than 0.3% of the population are carriers of a genetic mutation that has a large effect on cancer risk and these cause less than 3–10% of cancer.

### Hormones

Hormones are the most important agents in sex-related cancers. Cancer of the breast, ovary and testis and also of thyroid cancer and bone cancer are related to sometimes fluctuating level of hormones. Similarly, African folks have higher levels of testosterone than men of European ancestry and have a correspondingly higher level of prostate cancer. Obese people have higher levels of some hormones associated with cancer and a higher rate of those cancers. Women who take hormone replacement therapy have a elevated risk of developing cancers associated with those hormones. Osteosarcoma may be promoted by growth hormones.

### Diagnosis

Most cancers are recognized either because of the appearance of signs or screening. Remaining requires the examination of a tissue sample. These commonly include blood tests, X-rays, CT scans and endoscopy.

**Prevention**

Cancer prevention is defined as to decrease cancer risk. The majority of cancer cases are due to environmental risk factors. Many of these environmental factors are controllable lifestyle choices. Thus, cancer is generally preventable. Between 70% and 90% of common cancers are due to environmental factors and therefore potentially preventable. Greater than 30% of cancer deaths could be prevented by avoiding risk factors including: tobacco, excess weight/obesity, insufficient diet, physical inactivity, alcohol, sexually transmitted infections and air pollution. Not all environmental causes are controllable, such as naturally occurring background radiation and cancers caused through hereditary genetic disorders and thus are not preventable by personal behaviour.

**Dietary**

Dietary recommendations for cancer prevention typically include an emphasis on vegetables, fruit, whole grains and fish and an avoidance of processed and red meat (beef, pork, lamb), animal fats and refined carbohydrates.

**Medication**

Medications can be used to prevent cancer in a few circumstances. In the general populace, NSAIDs reduce the risk of colorectal cancer; however, due to cardiovascular and gastrointestinal side effects, they cause overall harm when used for prevention. Aspirin has been found to reduce the risk of death from cancer by about 7%. COX-2 inhibitors may reduce the rate of polyposis formation in people with familial adenomatous polyposis; however, it is related with the same adverse effects as NSAIDs.

**Vaccination**

There are number of Vaccines that prevent infection by some carcinogenic viruses. Human papillomavirus vaccine (Gardasil and Cervarix) reduce the risk of developing cervical cancer. The hepatitis B vaccine prevents infection with hepatitis B virus and therefore decreases the risk of liver cancer.

**Screening**

Different diagnostic pain driven by symptoms and medical signs, cancer screening involves to detect cancer after it has formed, but before any obvious symptoms appear. This may involve physical examination, blood or urine test. Strongly mentions cervical cancer screening in women who are sexually active and have a cervix at least until the age of 65. Some people get screened for colorectal

cancer by fecal occult blood testing, sigmoidoscopy, or colonoscopy starting at age 50 until age 75. Routine screening is not recommended for bladder cancer, testicular cancer, ovarian cancer, pancreatic cancer, or prostate cancer. Mammography for breast cancer screening every two years from ages 50-74, but does not mention either breast self-examination or clinical breast examination.

**Cancer Research**

Agents (e.g. viruses) and events (e.g. mutations) that cause genetic changes in cells. The enhanced understanding of molecular biology and cellular biology due to cancer research has led to new treatments for cancer since US President Richard Nixon declared the "War on Cancer" in 1971. Since then, the country has paid over \$200 billion on cancer research, including resources from public and private sectors. The cancer death rate declined by five percent between 1950 and 2005.

**Pregnancy**

Diagnosing cancer in a pregnant woman is difficult. Some procedures, such as MRIs (magnetic resonance imaging), CT scans, ultrasounds and mammograms with fetal shielding are considered safe during pregnancy; some others, such as PET scans, are not safe during pregnancy.

Some treatments can affect with the mother's ability to give birth vaginally or to breastfeed.. Radiation to the breast reduces the ability of that breast to produce milk and increases the risk of mastitis. Also, when chemotherapy is given after birth, many of the drugs appear in breast milk, which could harm the baby.

**Chemotherapy**

Chemotherapy is the treatment of cancer with one or more cytotoxic and antineoplastic drugs (chemotherapeutic agents) as part of a consistent treatment. The term involves a variety of drugs, which are divided into broad categories such as alkylating agents and antimetabolites. Traditional chemotherapeutic agents act by killing cells that divide rapidly, a critical property of most cancer cells.

**Types of Chemotherapy****Alkylating Agents**

Alkylating agents are most dynamic in the inactive phase of the cell. These types of drugs are cell-cycle non-specific. Various types of alkylating agents are as follows.

1. Ethylenimines: Thiopeta and Hexamethylmelamine.
2. Alkylsulfonates: Busulfan.

3. Nitrosureas: Carmustine, Lomustine and Streptozocin. Nitrosureas are unique because, unlike most types of chemo treatments, they can cross the blood-brain barrier. They can be useful in treating brain tumors.
4. Metal salts: Carboplatin, Cisplatin, and Oxaliplatin.
5. Hydrazines and Triazines: Altretamine, Procarbazine, Dacarbazine and Temozolomide.
6. Mustard gas derivatives: Mechlorethamine, Cyclophosphamide, Chlorambucil, Melphalan, and Ifosfamide.

### Plant Alkaloids

Plant alkaloids are chemotherapy treatments derivative made from certain types of plants. The vinca alkaloids are made from the periwinkle plant (*Catharanthus rosea*). The taxanes are made from the bark of the Pacific Yew tree (*Taxus*). The vinca alkaloids and taxanes are also known as antimicrotubule agents. The podophyllotoxins are derivative from the May apple plant. Camptothecan analogs are derivative from the Asian "Happy Tree" (*Camptotheca acuminata*). Podophyllotoxins and camptothecan analogs are also known as topoisomerase inhibitors, which are used in certain types of chemotherapy. The plant alkaloids they attack the cells during various phases of division.

- ✓ Vinca alkaloids: Vincristine, Vinblastine and Vinorelbine.
- ✓ Taxanes: Paclitaxel and Docetaxel.
- ✓ Podophyllotoxins: Etoposide and Teniposide.
- ✓ Camptothecan analogs: Irinotecan and Topotecan.

### Antitumor Antibiotics

Antitumor antibiotics are chemo treatments through from natural products produced by species of the soil fungus *Streptomyces*. These drugs act during multiple phases of the cell cycle and are considered cell-cycle specific.

- ✓ Anthracyclines: Doxorubicin, Daunorubicin, Epirubicin, Mitoxantrone, and Idarubicin.
- ✓ Chromomycins: Dactinomycin and Plicamycin.
- ✓ Miscellaneous: Mitomycin and Bleomycin.

### Antimetabolites

Antimetabolites can have toxic effects on cells, such as cell growth prevention and cell division. Therefore these compounds are used as chemotherapy for cancer. When the cells

combine these substances into the cellular metabolism, they are unable to divide. They attack cells at DNA production phase. Antimetabolites are classified as follows.

- ✓ Folic acid antagonist: Methotrexate.
- ✓ Pyrimidine antagonist: Foxuridine, Capecitabine, and Gemcitabine, 5-Fluorouracil,
- ✓ Purine antagonist: 6-Thioguanine, 6-Mercaptopurine

### Topoisomerase inhibitors

Topoisomerase inhibitors are types of chemotherapy drugs that inhibit with the action of topoisomerase enzymes (topoisomerase I and II). During the process of chemo treatments, topoisomerase enzymes control the manipulation of the structure of DNA necessary for replication.

- ✓ Topoisomerase I inhibitors: Irinotecan, topotecan
- ✓ Topoisomerase II inhibitors: Amsacrine, etoposide, etoposide phosphate, teniposide

### Radiation

Radiation therapy involves the use of ionizing radiation in entry to either cure or improve symptoms. It destroy the DNA of cancerous tissue most probably kill it. To replacement normal tissues (such as skin or organs, which radiation must pass through to treat the tumour), designed radiation beams are directed from multiple exposure angles to traverse in to the tumor. Larger dose of ionising radiation is provided at cancerous cell than in healthy tissue present in surrounding.

### Surgery

Surgery is the primary method of treatment for most cancers and may play role in palliation and prolongation of survival. It is typically an important part of definitive diagnosis of tumours. In localized cancer, surgery typically attempts to remove the entire mass along with, in certain cases, the lymph nodes in the area.

### CONCLUSION

Macronutrients and excess calories are probably, greatly responsible for dietary cancer risk. Only a small number of specific carcinogens and anticarcinogens have been identified in the human diet (e.g., aflatoxins) however it seems unlikely that important carcinogens are yet to be identified. alcoholic beverages (particularly ethanol, the macronutrient found in alcoholic beverages) consumed in excess are associated with increased risk for specific types of cancer. The specific chemicals that provide the protective effects of vegetables and fruits should be

identified and their protective mechanisms delineated.

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