

MODULE 25 - CANCER & THE ENVIRONMENT

OBJECTIVES

By the end of this session students will be able to-

1. Completely understand about cancer and how it happens.
2. Understand the role of medicines and medicinal interventions that increase the risk of cancer.
3. List how various metals and chemicals in the environment increase cancer risk.
4. Take precautionary/preventive steps to protect themselves from the risk of cancer.

SUMMARY

The word 'Cancer' brings to mind all the horrors associated with the incurable, dreaded disease, with the overwhelming fear of intense pain and death associated with it. However, if cancer is detected in the early stages and treated immediately it is curable. Cancer is considered as a collection of variations of the disease, since it affects almost every part of the body and the treatment for all differs according to the organ that is affected. In this program we will discuss the broad causes of cancer and how we can prevent it, while also being aware enough to identify it at the earliest.

TRANSCRIPTION

INTRODUCTION TO CANCER:

'Cancer' – a term hearing which automatically seems to make one think of pain, suffering and death. A term that immediately makes someone diagnosed with cancer question 'Why Me'? However, what exactly is cancer? Why does it happen? And, how can we try to protect ourselves from it? These are some of the questions that we will attempt to address in this program.

HISTORY OF CANCER:

The earliest written record regarding cancer is from 3000 BC in the Egyptian Edwin Smith Papyrus and describes cancer of the breast. Cancer however has existed for all of human history.

Hippocrates (ca. 460 BC – ca. 370 BC) described several kinds of cancer, referring to them with the Greek word *carcinos* (crab or crayfish). This name comes from the

appearance of the cut surface of a solid malignant tumour, with "the veins stretched on all sides as the animal the crab has its feet, whence it derives its name".

The Greek, Celsus (ca. 25 BC - 50 AD) translated *carcinos* into the Latin *cancer*, also meaning crab and recommended surgery as treatment. Galen (2nd century AD) disagreed with the use of surgery and recommended purgatives instead. These recommendations largely stood for 1000 years.

In the 15th, 16th and 17th centuries, it became more acceptable for doctors to dissect bodies to discover the cause of death. The German professor Wilhelm Fabry believed that breast cancer was caused by a milk clot in a mammary duct. The Dutch professor Francois de la Boe Sylvius, a follower of Descartes, believed that all disease was the outcome of chemical processes, and that acidic lymph fluid was the cause of cancer. His contemporary Nicolaes Tulp believed that cancer was a poison that slowly spreads, and concluded that it was contagious.

The physician John Hill described tobacco snuff as the cause of nose cancer in 1761. This was followed by the report in 1775 by British surgeon Percivall Pott that cancer of the scrotum was a common disease among chimney sweeps. With the widespread use of the microscope in the 18th century, it was discovered that the 'cancer poison' spread from the primary tumor through the lymph nodes to other sites ("metastasis"). This view of the disease was first formulated by the English surgeon Campbell De Morgan between 1871 and 1874.

THE NATURE OF CANCER:

Cancers, usually it is said that they are more than 200 types of cancers. This is because of the nomenclature. The organ that is involved, the organ system that is involved, the type of the cells that have proliferated, the type of the cancer that has occurred, the level of compression that it has generated, the level of the tumor, the size of the tumor, the level of metastasize into the nodes, the metastasize into the tissues, this gives a nomenclature and thus there are more than 200 names of the same disease – ‘cancer’ – which generates in a particular and said manner.

First we shall have to understand how does this happen or occur in the human body. We know that body cells — the basic unit of body is cell and it forms the tissues — this basic cell is always growing; always the cells are multiplying and these multiplying cells, they replace the wear & tear parts of the body and thus the a-normal pattern of growth occurs. And this is always very well conducted in the body and it's all equated, just like a mathematical equation, that many calls shall go for wear and tear and that many cells shall be created within a specified period of time.

But, cancer breaks this orderly control of Nature and this is because certain nuclear changes do occur. That means the basic unit of the body i.e. the cell has a vital content, that is the nucleus, and this nucleus has a DNA. This DNA is changed. When this DNA is

changed there are 3 stages - Metaplasia, Anaplasia and Dysplasia - which stages the cancer out and when these nuclear changes occur, the cells start proliferation at a different pace. When the pace of proliferation, pace of cell division – this differentiates – in that condition there is an ‘overgrowth’ - that means an uncontrolled growth or a swelling. This swelling is known as tumor. This is the primary site of cancer that develops. This tumor basically does nothing. So usually what we say if “Cancer is not a disease. It is only a compression syndrome”, because the tumor increases in size gradually. Gradually over a very long period – say so many years - & after that it produces the symptoms of compression of adjoining tissues, adjoining cells. We see when the blood vessels are compressed that adjoining cells do not get blood. When the nerves are compressed the nervous symptoms do appear, the pain does appear, and such other things.

These tumors are the cancerous growths. Cancerous growths are of two types – one is ‘benign’ & other is ‘malignant’. ‘Benign’ is the one which is encapsulated. There is a sheath around it and this tumor does grow within several minutes but it does not metastasize; it does not go through the lymph nodes into the other parts of the body, while the malignant one is the one which spreads into the other parts of the body, in the vital centers of the body also – may be liver, may be brain, may be lungs and it causes disastrous effects.

When we come to the grading and staging of the cancers we know the basic way of grading and staging of the cancers is knowing at which stage are we detecting a cancer of the disease pattern? We see that there is a ‘T’, ‘N’, ‘M’ classification i.e. ‘tumor’, ‘node’ & ‘metastasize’.

As you said, these tumor cells may migrate anywhere in the body if it is a malignant cancer & when it migrates we do not know where it’s going but we definitely know it is going to flow through the lymph which is just like blood, a fluid tissue, & it goes into the lymph nodes.

The lymph nodes are seal like structures. They are used to filter the things, filter the organisms and other things. But, however, the cancer cells do pass into the lymph nodes. So lymph nodes get swollen and these swollen lymph nodes again create problems. When the metastasize is gone further, in that condition it may metastasize into the vital organs of the body. So, if there is tumor only, the cancer is at early stage. When it has lymph nodes it is at a progressive stage. If it is metastasized into the vital organs of the body, may be it may be a terminal stage. So, this sort of a grading and staging is used and this the basic way. Other grading and staging methods are also used by many health professionals.

Several factors, both inside and outside the body contribute to the development of cancer. In this context, scientists refer to everything outside the body that interacts with humans as the “environment.”

Coming to the causation and role of the environment in the cancer, We see that the constitution of the human body has two major factors to play in. A child born in the environment carries his or her genetic factors as given by the parents, grandparents. This is one genetic constitution that comes into the body of the human being. The rest of the factors that we acquire from hither and thither, this is the environment where we have

been born and brought up. So this environment does a lot to help us survive well. But, many a times it may generate the diseases like cancer – we are coming to the same.

Environment has two types of factors which the person voluntarily brings about inside his life or her life – this is the micro environment of that person, the habits, the habitat of the person, the addictions that the person acquires, may be tobacco, may be smoking, may be alcohol or certain other things, the diet that the person takes, the food the lifestyle. When the lifestyle is sedentary, obesity is bound to occur. The sexual behavior, the work place atmosphere and the chemicals with which the person comes in contact every now and then.

Coming to the involuntary factors, naturally environmental pollution is one of the greatest things. We are polluting air with several of the chemicals. We are polluting water. And this air and water pollution acts as a major factor.

SUBSTANCES IN THE ENVIRONMENT KNOWN TO CAUSE CANCER

Commentary:

The “Report on Carcinogens” published by the National Toxicology Program (NTP) of the United States lists more than 200 carcinogenic agents. Some of them are:

Tobacco

Cigarette, cigar, and pipe smoking, chewing tobacco, snuff, and exposure to environmental tobacco smoke (ETS or second-hand smoke) are all linked to increased cancer risks. Cigarette, cigar, and pipe smoking have been associated with various cancers.

For the sake of tobacco we know that 1, 48, 000 deaths each year are occurring in the world. The cancer of the trachea, cancer of the lungs, cancer of the bronchus, pancreas, bladder, urinary bladder, cervix, testicular cancer, patients of the smoker mothers, they are been noted. Even in the smoker women we have seen that lung cancers are more than the breast cancer incidences.

In 1997, A.K. Hackshaw detected that excess risk of lung cancer is 24% in non-smokers who live with a smoker, say wife of a smoker person, and tobacco specific carcinogens are found in the blood and urine of non-smokers who are exposed to environmental tobacco smoke. So any type of environmental tobacco smoke which causes passive smoking, not an active smoking, raises the risk of cancer by 24%.

Diet/Weight/Physical Inactivity

The cancer of the rectum, prostate, endometrial cancers – because of high animal fat intake has been noted down. Rectal and endometrial cancers, even because of obesity,

i.e. the lifestyle, have been noted. The mouth, esophagus, pharynx, larynx and liver cancers because of alcohol are known.

Regarding the gastro-intestinal cancers, i.e. the stomach and intestines, the respiratory and colonic cancers, they are preventable as per the American Society of Health, American Cancer Society. It has been said that more than five servings of fresh fruits and vegetables per day can prevent these GI cancers, respiratory centers and respiratory cancers and colonic cancers.

Because of physical activity as we know obesity occurs and even lack of physical activity causes many other diseases also. Just a brisk walk of 30 minutes every day heals all these things; rather they may reverse the process of cancer that may have generated in the body.

Alcoholic drinks

Heavy drinkers (more than two drinks per day) have an increased risk of cancer, particularly among those who also smoke. Cancers associated with heavy drinking include cancers of the mouth, throat, voice box, liver, and oesophagus. There is also some evidence linking alcohol and cancer of the breast.

Ultraviolet radiation

Ultraviolet (UV) radiation from the sun, sunlamps, or tanning beds causes premature aging of the skin and DNA damage that can lead to melanoma and other forms of skin cancer. The incidence of skin cancers is rapidly increasing.

Viruses and bacteria

Viruses and bacteria contribute to the development of several types of cancer. A sexually transmitted virus called **human papillomavirus** (HPV) is the primary cause of cervical and **anal** cancer. Women who begin sexual intercourse at age 16 or younger or have many sexual partners, have an increased risk of infection. However, even though infection with HPV is the primary cause of cervical cancer, most infections do not result in cancer. **Hepatitis B** (HBV) and **Hepatitis C** (HCV) viral infections are major causes of liver cancer.

Ionizing radiation

Ionizing radiation is invisible, high-frequency radiation that can damage the DNA or genes inside the body. Everyone is exposed to very small doses of ionizing radiation from rays that enter the earth's atmosphere from outer space. Radiation from this source may account for a very small percentage (about 1 percent) of our total cancer risk

Radon, produced by the breakdown of uranium, releases low levels of ionizing radiation. Higher levels of radon can be found in certain types of rocky soil. Radon causes lung cancer

People are also exposed to ionizing radiation during certain **medical procedures**.

Patients who receive **radiation** to treat cancer or other conditions; or **X-rays** to diagnose or screen for a disease may be at increased cancer risk.

Fibers, fine particles, and dust

Exposures to various **fibers, fine particles**, and **dust** occur in several industrial settings and are associated with increased cancer risks. Exposure can also occur in nonindustrial settings.

Asbestos fibers and all commercial forms of asbestos are human carcinogens. Increased rates of mesothelioma, a rare cancer of the lining of the lung and abdominal cavity, and cancer of the lung have been consistently observed in a variety of occupations involving asbestos exposure.

Ceramic fibers now used as insulation materials, **Silica dusts** found in industrial and occupational settings such as coal mines, mills, granite quarrying and processing, crushed stone and related industries, and sandblasting operations cause lung cancer. **Wood dust**, from sanding operations and furniture manufacturing causes cancers of the nasal cavities and sinuses.

Diesel exhaust particles

Particles in diesel exhaust cause lung cancer.

A landmark study – it was a 20-year study done by OEEB & NIOSH that heavy exposure to diesel was linked to lung cancer. This acted as a boon that even the mine workers, even the urban population that was exposed to diesel, this study gives us an insight that exposure to diesel or heavy amount or heavy doses of diesel, I that condition the cancer may occur.

Toxins from fungi

Aflatoxins are produced by certain types of fungi growing on food which create liver cancer. They grow on grains and peanuts and may also be found in meat, eggs, and milk from animals that eat aflatoxin contaminated feed.

MEDICAL DRUGS & CHEMICALS CAUSING CANCER:

Cancer treatment drugs like **cyclophosphamide**, **chlorambucil**, **melphalan** have been shown to increase the occurrence of second cancers, including leukemia. Immunosuppressants, like **cyclosporin** and **azathioprine**, used for patients having organ transplants, are associated with increased cancer risks, especially lymphoma. **Estrogens** used to treat symptoms of menopause and other gynecological conditions may increase the incidence of endometrial cancer & breast cancer. Increased risks of breast cancer, heart disease, stroke, and blood clots are associated with the use of estrogen in combination with progestin, a synthetic form of progesterone. Long-term users of combination oral contraceptives increases early-onset breast cancers and liver cancer.

Solvents

Several solvents used in paint thinners, paint and grease removers, and in the dry cleaning industry are known or suspected of being cancer-causing in animal studies. These include **benzene**, **carbon tetrachloride**, **chloroform**, **dichloromethane**

(methylene chloride), tetrachloroethylene, and trichloroethylene. **Benzene** is known to cause leukemia

Pesticides

About 20 active ingredients in registered pesticides in the United States, have been found to be carcinogenic in animals. These include **ethylene oxide, amitrole**, some **chlorophenoxy herbicides, DDT, dimethylhydrazine, hexachlorobenzene, hexamethylphosphoramide, chlordecone, lead acetate, lindane, mirex, nitrofen**, and **toxaphene**. Farmers, pesticide applicators, crop duster pilots, and manufacturers, have found high rates of blood and lymphatic system cancers, cancers of the lip, stomach, lung, brain, and prostate, as well as melanoma and other skin cancers.

Dioxins

Dioxins are unwanted byproducts of chemical processes that contain chlorine and hydrocarbons. At least 100 different kinds of dioxins are produced by paper and pulp bleaching; incineration of municipal, toxic, and hospital wastes; certain electrical fires; and **smelters**. They also contaminate some insecticides, herbicides, and wood preservatives.

Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) from burning wood and fuel for homes gasoline and diesel exhaust, soot, **coke**, cigar and cigarette smoke, and charcoal-broiled foods open fires, waste incinerators, coal gasification, and coke oven emissions cause lung, skin, and urinary cancers. Foods that contain small amounts of PAHs include smoked, barbecued, or charcoal-broiled foods, roasted coffees, and sausages.

Vinyl chloride

Vinyl chloride is a colorless gas, associated with lung cancers and angiosarcomas (blood vessel tumors) of the liver and brain. It is used in the plastics industry in manufacturing containers, wrapping film, electrical insulation, water and drain pipes, hosing, flooring, windows, and credit cards.

METALS CAUSING CANCER:

Arsenic compounds are associated with many forms of skin, lung, bladder, kidney, and liver cancers. Arsenic is used in wood preservatives, glass, herbicides, **insecticides** (ant killers), and pesticides, mining & copper smelting. They are a general environmental contaminant of air, food, and water.

Beryllium compounds cause lung cancer. They are used as metals for aerospace and defense industries; for electrical components, X-ray tubes, nuclear weapons, aircraft brakes, rocket fuel additives, light aircraft construction, and the manufacture of ceramics; and as an additive to glass and plastics, dental applications, and golf clubs, fiber optics and cellular network communication systems.

Cadmium metal and cadmium compounds are associated with lung cancer. Workers with the highest exposures are those involved in removing zinc and lead from minerals,

producing cadmium powders, welding cadmium-coated steel, and working with solders that contain cadmium.

Some **chromium compounds** are known to cause lung cancer. The highest exposure occurs in occupations related to stainless steel production, welding, chrome plating, and leather tanning.

Nickel and nickel compounds are associated with cancers of the nasal cavity, lung, and possibly the larynx (voice box). Nickel is used in steel, dental fillings, copper and brass, permanent magnets, storage batteries, and glazes.

WAYS TO REDUCE THE RISK OF CANCER:

Some precautions can be taken to try to reduce the risk of cancer.

1. **Avoid using tobacco products, such as cigarettes, snuff and chewing tobacco.** This is especially important for individuals who drink alcoholic beverages. Cancer risk of tobacco and alcohol combined is greater than the sum of their individual effects.
2. **Choose most of the foods you eat from plant sources.** Eat five or more servings of fruits and vegetables each day. Eat other foods, such as breads, cereals, grain products, rice, pasta or beans, several times each day. Wash fresh fruits and vegetables before eating.
3. **Limit your intake of high-fat foods, particularly from animal sources.** Choose foods low in fat and limit consumption of high-fat red meats. Choose baked and broiled meats, seafood and poultry, rather than fried food.
4. **Be physically active and achieve and maintain a healthy weight.** Be moderately active for at least 30 minutes on most days of the week. Stay within your healthy weight range. Be aware that many fat-free cakes, cookies, snack foods and other desserts are high in calories.
5. **Limit consumption of alcoholic beverages.** Men should have no more than two drinks per day. Women should have no more than one drink per day because they absorb alcohol more readily and are usually smaller in body size.
6. **Avoid or reduce exposure to sunlight, particularly in childhood.** Reduce your sun exposure by avoiding sun during the middle of the day, wearing protective hats and clothing, seeking shade while outdoors and applying sunscreen to uncovered skin.
7. **Follow safety rules and regulations at your workplace.** If possible, carcinogens should be replaced with safer substitutes. Workers should handle hazardous materials in a ventilated area and be trained to protect themselves. Personal protective clothing and respirators may be required. If you work in an environment with high exposures to fine particles, fibers, or dusts, wear the appropriate protective mask over your nose and mouth and make sure it fits properly and does not obstruct your view. Make sure the room is well ventilated when working with solvents. Work outside, if possible, or open the windows. Avoid contact with pesticides. Exposure to pesticides comes largely through the skin. If contact occurs, wash up quickly.

8. ***Avoid viral or bacterial infections:*** Do not engage in unprotected or otherwise unsafe sexual intercourse that may result in HIV, HPV, hepatitis B, or hepatitis C infection.
Do not use recreational injection drugs, such as heroin or cocaine that may result in HIV, hepatitis B, or hepatitis C infection. Get vaccinated against hepatitis B infection, an easy and safe procedure if you are 18 years of age or younger. Also, get vaccinated if you are over 18 and at risk of infection. At-risk people include health care workers, IV drug users, and homosexual men. Currently, there is no vaccine for hepatitis C.
Seek medical attention for chronic stomach problems because they might be caused by *H. pylori* infection, which can be treated.
9. ***Seek medical attention*** and adhere to recommended treatments if you have HIV or hepatitis C infection. These infections increase your risk of developing certain cancers.
10. Because repeated exposure to diagnostic X-rays could be harmful, ***talk to your doctor about the need for each X-ray*** and the use of shields to protect other parts of the body.
11. ***Check your home for high levels of radon.*** Radon levels in a home can be greatly reduced by a professionally installed ventilation system in the basement.

DETECTING CANCERS AT AN EARLY STAGE:

We can take a few steps to try to detect cancer at an early stage.

1. Tell your health care provider about the chemicals you use at work or at home. With this information, your health care provider can perform appropriate medical screening tests for early detection of cancer.
2. Ask your physician if there are increased cancer risks associated with your family or personal medical history or medical drugs you are taking. Appropriate screening procedures may be advised.
3. Get a screening test on a regular basis for these cancers:
 - ***Breast:*** A mammogram, an X-ray of the breast, is the best method of finding breast cancer before symptoms appear.
 - ***Cervix:*** The Pap test or Pap smear is the most successful screening tool used to screen for cancer of the cervix. Cells are collected from the cervix and examined under a microscope to detect cancer or changes that may lead to cancer.

- *Colon and Rectum:* The fecal occult blood test checks for small amounts of blood in the stool; a sigmoidoscopy or a colonoscopy are used to examine the colon and rectum.

Whenever a tumor or an abnormal growth is found in any part of the body, in that condition, and even in the cancers of rectum, anal canal, even in cancers of bladder, urinary bladder, whenever there is a painless bleeding from the rectum, whenever painless bleeding in the stools, painless bleeding in the urine, all this should be reported immediately to the doctor. Since, not only because it is painless, we may ignore it. It is not to be ignored.

The person has to be alert for the changes in the body – any thickness or lump, any sore that does not heal, any nagging cough, any hoarseness of the voice, any changes in the bowel-bladder habit, any gain, changes in the weight, any bleeding or discharge in the body should be reported immediately to the health care provider.

We have seen how cancer is caused and how it affects the system. Some cancers are curable while others are not. We cannot totally avoid everything that may cause cancer. However, we can adopt a healthier lifestyle and keep careful watch over our health, so that we are able to identify the disease at the earliest. Early detection of the disease means that it can be treated at the earliest. This is the only way that the disease can be controlled and we can try to protect ourselves, resulting in a longer, happier life.

GLOSSARY

1. Anal cancer: Cancer that begins in the anus, the opening at the end of the large intestine where the waste from the body's digestive system passes out of the body.
2. Asbestos: Hard, nonflammable fibers used for insulating buildings.
3. Bacteria: Made of a single cell, bacteria are the simplest organisms found in nature. Bacterial infections can often be treated with antibiotics.
4. Benign tumor: Not cancerous; tumor does not invade nearby tissue or spread to other parts of the body.
5. Cancer: Diseases in which abnormal cells divide without control. Cancer cells can invade nearby tissues and can spread through the bloodstream and lymphatic system to other parts of the body.

6. Carcinogen: A substance that causes cancer.
7. Carcinoma: A cancerous growth made up of epithelial cells: cells from tissues that form the covering around organs, such as lung, liver, or breast, or the lining of blood vessels.
8. Cell: The basic unit of all living things. Organs are made up of millions of cells. Each cell contains several smaller components enclosed in a membrane.
9. Coke: Solid black material similar to charcoal that is left after burning coal. Coke is used as fuel and in making steel.
10. Colorectal cancer: Cancers that begin in either the colon or the rectum are called colorectal cancer. Together, the colon and rectum make up the large intestine, a long, muscular tube where the waste from the body's digestive system is stored until it passes out of the body through the anus. The colon makes up the first four to five feet of the large intestine and the rectum is the last four to five inches.
11. DNA: Deoxyribonucleic acid is the molecule inside the cell that carries genetic information and is passed on from one generation to the next.
12. Endometrium: Tissue lining the wall of a woman's uterus, the organ where a baby grows.
13. Epidemiology: The study of the patterns of diseases in human populations and the factors that influence the patterns.
14. Familial cancers: Cancers that occur frequently in certain cancer-prone families in which a mutated gene that is associated with a high risk of developing cancer is passed on from one generation to the next.
15. Focus group: A qualitative research technique in which an experienced moderator leads about 8–10 participants through a semi-structured discussion on a selected topic, allowing them to talk freely and spontaneously.
16. Fungicide: An agent that destroys fungi.
17. Gene: Pieces of DNA, or heredity units found inside cells passed from parent to offspring. Genes contain the information for making proteins.
18. Herbicide: An agent that destroys weeds.
19. Incidence: The number of people who develop a disease divided by the number of people at risk of developing the disease in a specific time period.
20. Insecticide: An agent that destroys insects.

21. Leukemia: A type of cancer that forms from cells in the blood and bone marrow, including leukocytes or white blood cells that help the body fight infections and other diseases.
22. Linear dose response: A type of response in which the cancer risk changes at the same rate as the exposure—if the exposure increases, the cancer risk increases at the same rate. A cancer risk is present at all levels of exposure, even very low ones.
23. Lymphatic system: The tissues and organs that produce, store, and carry white blood cells, which fight infection and other diseases. This system includes the bone marrow, spleen, thymus, and lymph nodes, and a network of thin tubes that carry lymph and white blood cells to all the tissues of the body.
24. Lymphoma: Cancer that arises in cells of the lymphatic system.
25. Malignant tumor: A cancerous growth with a tendency to invade and destroy nearby tissue and spread to other parts of the body.
26. Melanoma: A malignant form of skin cancer that arises in melanocytes, the cells that produce pigment. Melanoma usually begins in a mole.
27. Mortality: The number of people who die from a disease divided by the number of people at risk of dying from the disease in a specific time period.
28. Oncogene: An altered gene that normally directs cell growth. An oncogene promotes uncontrolled growth of cancer. Alterations can be inherited, occur randomly, or be caused by an environmental exposure to carcinogens.
29. Pesticide: An agent used to destroy pests of any sort; the term includes fungicides, herbicides, and insecticides.
30. Proteins: Molecules in the cell that perform a wide variety of functions, such as protection (skin), support/movement (muscles), transportation (e.g., hemoglobin transports oxygen), and activation of the chemical reactions that sustain life (e.g., enzymes for digesting food).
31. Sarcoma: A cancer of the bone, cartilage, fat, muscle, blood vessels, or other connective or supportive tissue.
32. Smelters: Plants where valuable metals are extracted from rocks or minerals.
33. Susceptible: A term used to describe someone who is more likely to develop a disease.

34. Threshold dose response: A type of response in which, at very low exposures, there appears to be no detectable increased risk of disease; there is a threshold below which no risk is detected.
35. Tissue: A group or layer of cells, such as the skin, that together performs specific functions.
36. Tumor: An abnormal mass of tissue that results from too much cell division. Tumors perform no useful body function. They may be either benign (not cancerous) or malignant (cancerous).
37. Tumor suppressor gene: A gene whose normal function is to prevent abnormal cells from dividing. Certain mutations in tumor suppressor genes lead to cancer.
38. Virus: Viruses are smaller than a single cell or bacteria and cannot reproduce outside a living organism.

FAQs

Q1. What is cancer?

Ans: Cancer is not a single disease. It is a group of more than 200 different diseases. Cancer is an uncontrolled growth of cells that disrupts body tissues and organs. Cancerous cells are not normal in their structure and function. They grow and multiply to form tumors that invade local tissues and sometimes scatter throughout the body. In the beginning, there are no warning signs to alert us to the disease. Later, the signs of cancer are related to the location of the tumor. As cancer progresses, it commonly causes loss of muscle tissue, pale skin, pain, fatigue and loss of appetite.

Q2. How widespread is cancer?

Ans: It is estimated that one out of every two men and one of every three women will have cancer in their lifetimes. About one in four persons will die of cancer. The American Cancer Society estimates that about 570,000 cancer deaths occur each year in the United States. Cancer is the second leading cause of death after heart disease.

Q3. Which cancers cause the most deaths?

Ans: In the United States, lung cancer is the leading cause of cancer-related deaths for both sexes, followed by prostate cancer in males and breast cancer in females. For children younger than 15 years old, cancer is the fifth leading cause of death after accidents. Leukemia and cancers of the brain and central nervous system are the leading cancers in children in this age group.

Q4. How many kinds of cancer are there?

Ans: There are many types of cancer because cancerous cells can grow anywhere in the body. The location of the cancer and the type of tissue involved helps to give the disease a specific name, such as lung cancer, ovarian cancer, breast cancer and prostate cancer. Other examples are melanoma (involving cells that contain skin pigment called melanin) and leukemia (involving the white blood cells).

Q5. How does cancer develop?

Ans: Cancer is a process with three steps: initiation, promotion and progression. Each step plays a vital role in stopping the cancer process. Since a period of many years usually exists between the initiation of the cancer process and the onset of the symptoms, cancer prevention methods like risk control and early detection are most effective in the first two steps.

The first step involves changes to the genetic code (DNA) of a cell called *initiation*. Initiation is simply a mistake (mutation). The mistake may appear on a chromosome, or it could turn up in a gene segment of DNA. Usually, initiation by itself is not enough to produce cancer; the body's repair systems can replace damaged sections of DNA, which allow the cell to recover under normal circumstances. If the cell reproduces while the DNA is damaged, more abnormal cells can be made that may develop into cancer.

The altered cells undergo more changes that may require an additional substance called a *promoter*. A promoter is something that speeds up the pace of cell division, which can create more genetic mutations. A promoter may be a hormone such as estrogen or a toxic substance such as a chemical in tobacco smoke.

The last step is *progression*, which means that the cells have begun to grow out of control and is the basis for all cancers. The out of control cells form a tumor. A tumor is simply a mass of abnormal cells that keep growing and can extend into nearby tissues or spread to other parts of the body. How quickly a cancer progresses is determined by body conditions, such as hormones, and by genetic factors.

No one completely understands this process, but certain aspects of a person's lifestyle can be linked to cancer formation.

Q6. What causes cancer?

Ans: There is no single cause of cancer. Cancer development depends on things such as family history (genetics), health, nutrition, personal habits and the environment. Genetic factors by themselves probably account for only a small fraction of cancers. Genetic factors do have an important influence on a person's chance of developing cancer when combined with outside factors. These factors are either voluntary (such as cigarette smoking, diet, and sexual behavior) or involuntary (such as breathing polluted air or drinking contaminated water).

Q7. What factors contribute to cancer?

Ans: *Cigarette smoking* is the leading cause of cancer. Cigarette smoke contains more than 3,800 individual chemicals, and more than 40 are carcinogenic (cancer causing). Portions of the diet, especially *fatty foods and alcoholic beverages*, also are linked to cancer.

Skin exposure to *ultraviolet radiation* in sunlight is the primary cause of melanoma, a skin cancer.

Sexual behavior that helps spread sexually transmitted diseases is closely linked to cervical cancer in women.

Environmental pollution by chemicals in drinking water, air, food and in the workplace may contribute to cancer. The harmful health effects of chemicals depend on the dose, strength of the chemical compound, the length of exposure and the general health of the individual. Outside the workplace, **very few cases** of cancer are believed to be caused by exposure to chemicals in the environment.

Most cancers may be prevented through the identification and control of external factors. Approximately 30 percent of cancers are linked to cigarette smoking. The remaining 70 percent are likely the result of interaction among various factors.

Q8. How do chemicals cause cancer?

Ans: Some chemicals in the environment are toxic substances that can produce cancer in humans and animals. Most chemicals act by causing the initiation step in the cancer process (altering the DNA), but they also can act as promoters.

Q9. What cancers are caused by chemicals?

Ans: Most cancer-causing chemicals were first recognized in workplace settings. The workplace is unique because workers are often exposed to large amounts of chemicals over long periods of time. The first association of cancer with the workplace occurred in 1775. A London doctor related cases of cancer of the scrotum among young chimney sweeps to their exposure to soot. Other cause-and-effect relationships have been noted in workers between –

- benzene and leukemia
- asbestos and lung cancer; and
- vinyl chloride and liver cancer.

Workers may be exposed to a combination of cancer-causing chemicals (carcinogens), which increases their cancer risk. The risk of lung cancer in asbestos workers who also smoke cigarettes is at least 50 times higher than the risk in nonsmoking asbestos workers. Reducing chemical exposure can prevent most work-related cancers.

Q10. How are chemicals tested for cancer- causing properties?

Ans: Studies and experiments with laboratory animals are the main sources that identify whether exposure to a certain chemical causes cancer. Laboratory tests often use doses much higher than those found in the environment. Scientists then apply the animal results

to humans to calculate the “cancer risk” for the tested chemical. This process is difficult because there is no complete match between cancer in animals and cancer in humans.

Q11. If I am exposed to a carcinogen, will I get cancer?

Ans: Cancer development is a complex process that occurs over a long period of time, and is influenced by many factors. There are many different substances that act as carcinogens. Some, like asbestos, are linked to many different human cancers and risk of cancer development is high. Therefore, the risk of getting cancer from exposure depends upon the type of carcinogen and length of exposure.

The good news is that if exposure to carcinogens is stopped soon enough, the body can stop or reverse the cancer process.

Q12. What can you do to reduce your risk of getting cancer?

Ans: Scientific evidence shows that lifestyle choices, a healthy diet, good nutrition and physical activity can reduce cancer risk. It is never too late to make these changes, but changing long-term behavior can be difficult. You must be persistent over time to reduce your risk of getting cancer. The American Cancer Society recommends the following –

12. **Avoid using tobacco products, such as cigarettes, snuff and chewing tobacco.** This is especially important for individuals who drink alcoholic beverages. Cancer risk of tobacco and alcohol combined is greater than the sum of their individual effects.
13. **Choose most of the foods you eat from plant sources.** Eat five or more servings of fruits and vegetables each day. Eat other foods, such as breads, cereals, grain products, rice, pasta or beans, several times each day. Wash fresh fruits and vegetables before eating.
14. **Limit your intake of high-fat foods, particularly from animal sources.** Choose foods low in fat and limit consumption of high-fat red meats. Choose baked and broiled meats, seafood and poultry, rather than fried food.
15. **Be physically active and achieve and maintain a healthy weight.** Be moderately active for at least 30 minutes on most days of the week. Stay within your healthy weight range. Be aware that many fat-free cakes, cookies, snack foods and other desserts are high in calories.
16. **Limit consumption of alcoholic beverages.** Men should have no more than two drinks per day. Women should have no more than one drink per day because they absorb alcohol more readily and are usually smaller in body size.
17. **Avoid or reduce exposure to sunlight, particularly in childhood.** Reduce your sun exposure by avoiding sun during the middle of the day, wearing protective hats and clothing, seeking shade while outdoors and applying sunscreen to uncovered skin.
18. **Follow safety rules and regulations at your workplace.** If possible, carcinogens should be replaced with safer substitutes. Workers should handle hazardous materials in a ventilated area and be trained to protect themselves. Personal protective clothing and respirators may be required.