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RESEARCH ARTICLE

CANCER AND ITS TREATMENT: AN OVERVIEW

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Abstract

Cancer is a disease in which abnormal cells of the body grow uncontrollably ultimately causing harm to the body. The property of contact inhibition is absent in cancerous cells and thus they proliferate disorderly giving rise to tumors. Here we throw light on cancer prevention, different types of cancer, treatment methods currently available for cancer and also the recent advances in cancer treatment. Since the last couple of decades cancer cases have increased drastically, but at the same time due to advancement in science and technology, the mortality rate is decreasing. Cancer treatment is provided depending upon its type and stage. Apart from the conventional treatment like surgery, chemotherapy, radiation therapy, hormone therapy etc, some rapidly emerging treatment methods are immunotherapy, targeted therapies such as small molecule tyrosine kinase inhibitors and monoclonal antibodies (MABs) and gene therapy. Immunotherapy has rapidly transformed treatment methods for many types of cancer and one more encouraging step towards cancer immunotherapy is the use of personalized vaccines. The standard therapy methods do cure cancer but along with that they pose serious threat to normal healthy cells as well as have side effects, due to this reason, new treatment methods are being adopted.

Introduction:-

Cancer is a disease in which abnormal cells of the body grow uncontrollably ultimately causing harm to the body. These cells travel through blood or lymph to other parts of the body and forms tumor in those parts as well, this phenomenon is called Metastasis. The property of contact inhibition is absent in cancerous cells and thus they proliferate disorderly giving rise to tumors. The transformation of normal body cells to cancer cells may be due to reasons like mutations, whereas environmental factors can also cause mutations due to which the cells behave abnormally. Exposure to cancer causing agents known as carcinogens also contribute a great deal in causing the disease[1]. The International Agency for Research on Cancer (IARC) has provided classification of cancer-causing agents, such as:

1. Physical Carcinogens- UV and Ionizing Radiation
2. Chemical Carcinogens- alcohol, tobacco smoke, arsenic etc.
3. Biological Carcinogens- injections from certain viruses such as Human Papilloma Virus (HPV) and Hepatitis Virus, parasites or even bacteria.

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The history of Cancer dates back to more than 200 million years ago. Studies have found that cancers affected ancestors of *Homosapiens* as well, although earlier it was not that common[1]. Since the last couple of decades cancer cases have increased drastically. As recorded in 2020, there have been nearly more than 10 million deaths worldwide due to cancer. Bad eating habits such as low fruit and vegetable consumption, sedentary lifestyle without any physical activity, alcohol consumption and usage of tobacco accounts toaround 1/3rd of deaths from cancer.

The number of deaths due to cancer can be reduced if the disease is detected at an early stage and suitable treatment begins immediately. Cancer can only be detected once it reaches a size of 1 cm or be comprised of 1 million cells. It is detected as a "mass", "growth", "lesion", "lump", "tumor" or "nodule". But Leukemia and lymphomas are an exception to this as they usually do not produce any mass and are screened through laboratory test. The immune cells of the body are incapable of identifying cancerous cells as they are body's own cells which gets transformed. People who have suppressed immune system are at more risk of cancer[3]. There are many causes due to which the immune system is suppressed such as old age, frightful stress, previous chemotherapy usage, analgesics, antibiotics or corticosteroids abuse[2].

Standard treatments available for curing cancer includes surgery, Radiotherapy, Chemotherapy, Gene therapy, Hormone therapy, Bone marrow transplant, Cryosurgery, Immunotherapy, Photodynamic therapy, Peripheral stem cell transplant[2], [6].
Usually, all cancer cases require surgical treatment of cancerous mass or chemotherapy, hormonal therapy or radiation therapy, but in some extremely rare cases of kidney cancer or melanoma, the cancer cells vanish on their own by shrinking. Targeted therapies such as small molecule tyrosine kinase inhibitors and monoclonal antibodies (MABs) are also being used to treat cancers. Since cancer cells mutate and also results in modification of expression of various genes so targeted therapies are of great help as they canbe aimed at a class of molecular targets or a particular single molecular target in cancer cells[2].

However, the most accurate cure for cancer is yet to be discovered because different types of cancers have different causes as well as treatments. Researches are emphasizing on avoiding immune destruction and are working on increasing the survival rate and permanence of response in patients. Biological therapies like gene therapies, cancer vaccines and MABs are the current topics of research.

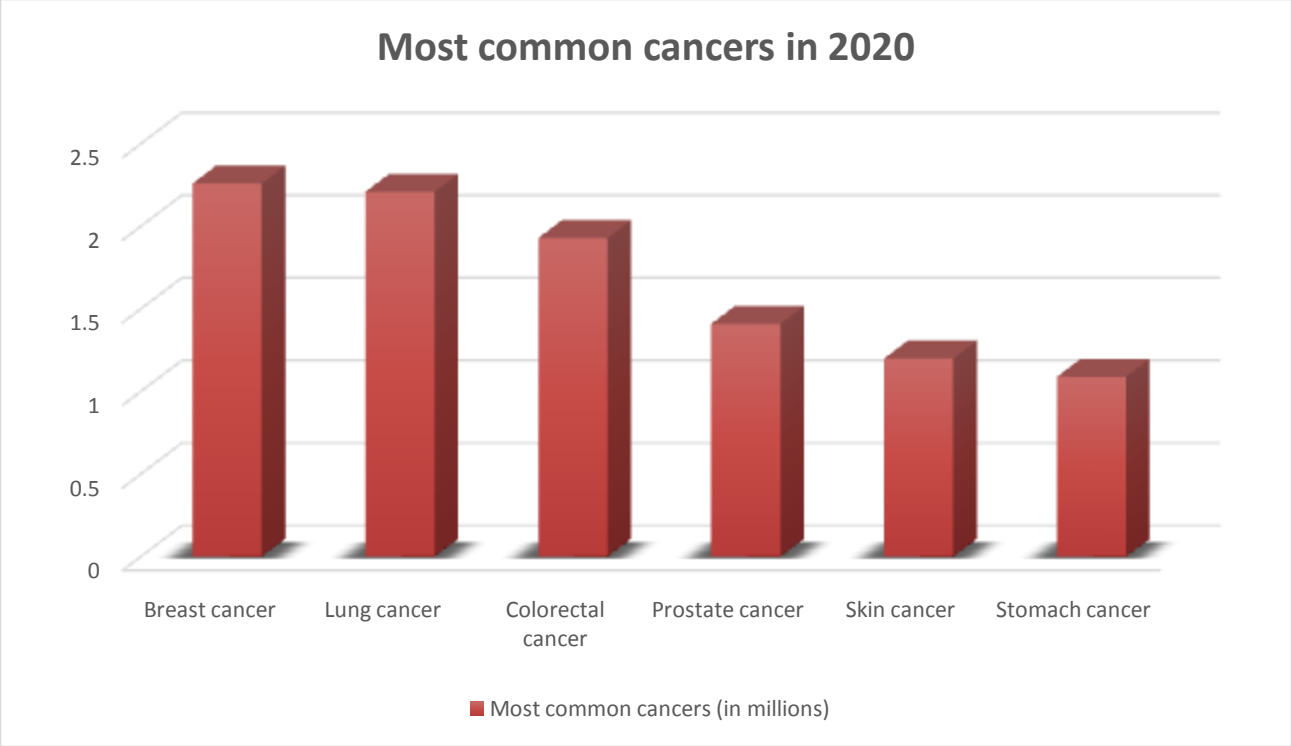
Types, Treatments and Prevention
Not always abnormal growth of cells giving rise to tumor formation can be termed as cancer, some tumors do not spread to other parts of the body and are hence called Benign tumors [6], [7], [8]. By performing Biopsy report of a tumor also, one can determine whether it is benign or malignant. The exact cause of benign tumor is unknown but some causes may include unhealthy lifestyle, excessive stress, consumption of toxins etc. usually these tumors are removed by performing surgery. Whereas the malignant tumors are termed as cancer. They do not show any symptoms in the early stage that is why detection in early stage is tough. Sometimes no signs or symptoms is found even in the last stage. A few local symptoms can be seen for example, if the growth of mass is present in the brain, then it affects brain functioning, if the growth of mass occurs in the breast, then a lump can be felt thus it indicates breast cancer. If a person observes difficulty in breathing followed by a series of respiratory disorder, then it might be a symptom of lung cancer because in such case the growth of mass has taken place in lungs, blocking the bronchus[9]. Apart from these the commonly observed symptoms might include night sweats, unintentional weight loss, unexplained fevers, bleeding, fatigue, bowel changes etc.

Cancer Prevention
Cancer prevention is a newer field of medicine. Preventions can be of various types like:

1. Chemoprevention- the prevention of cancer by usage of nutrient or other compounds dates back to 1925. Wolbach and Howe outlined that due to loss of fat-soluble vitamin A, the epithelial tissue of rats gained neoplastic property[11].
2. Prevention with Vaccines and Other Non-nutrient, non–Molecular-Targeted Agents- prevention with vaccines are a relatively newer field of medicine and still research work is being conducted for the same.
3. Molecular-targeted agents-Beatson paved the way for molecular-targeted hormonal prevention of breast cancer by reporting that oophorectomy had an advantageous effect on advanced breast cancer[12].
4. Surgical Prevention- surgically the tumour is removed before it starts spreading to different parts of the body.
5. Behavioural Prevention-quitting smoking can lead to prevention from lung cancer, similarly changing lifestyle habits and quitting or controlling alcohol consumption can lead to prevention from cancer as well[10].

Types Of Cancer

There are several types of cancers depending upon the cause and part of the body which is affected. The most common type of cancer is breast cancer followed by lung cancer, prostate cancer, colorectal cancer and skin cancer.



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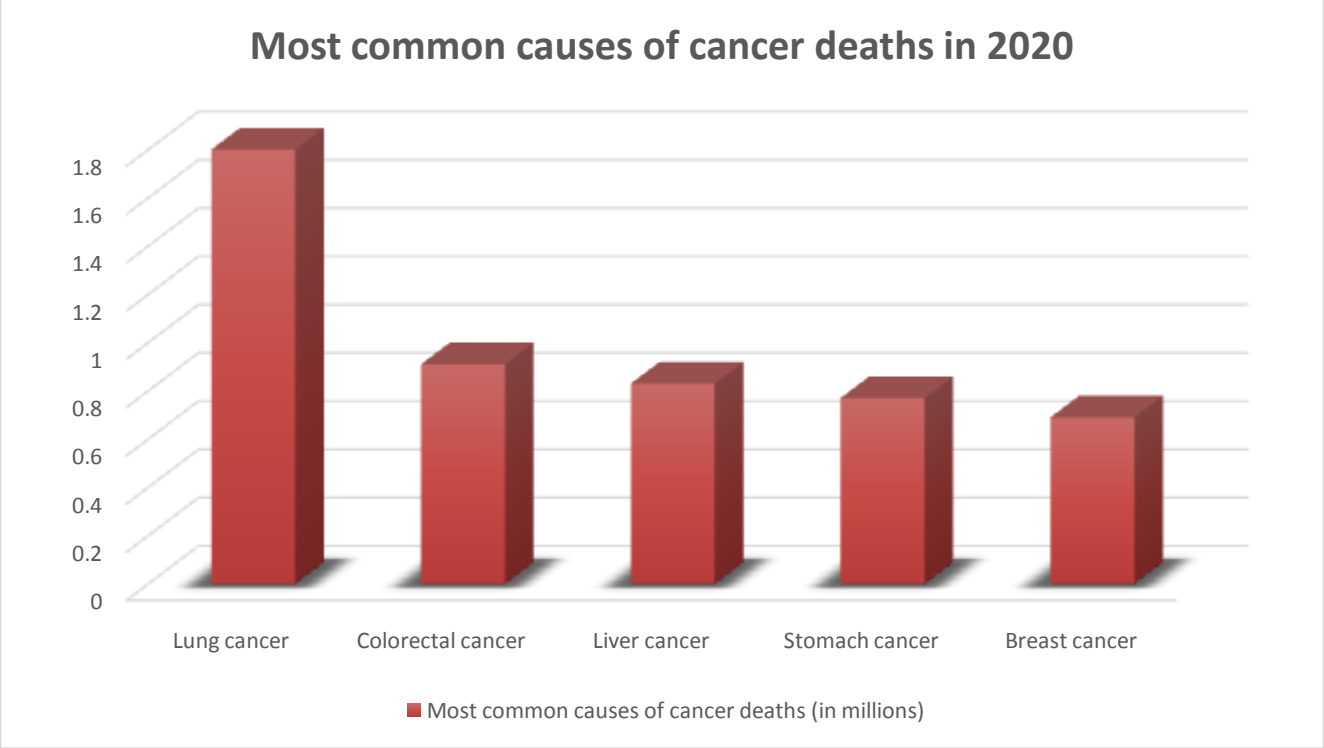

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Breast cancer is one of the most common types of cancer and is a matter of great concern. With the passage of time and advancements in technology and health sectors, there has been a decrease in mortality rates. Due to large

number of mammographic screenings, proper diagnosis and large number of women getting precise treatment, the mortality rates have declined in countries like America, Australia and western Europe. Tamoxifen is a selective estrogen receptor modulator which has turned out to be beneficial in preventing breast cancer in women. The cause of this disease may be many like pregnancy related andhormone related factors, physical activity, diet, environmental factors etc[13].

Family history plays an important role when considering risk factors. The most common symptom includes the formation of lump on breast, changed breast size, nipple discharge, redness around nipple, pain and swelling in breast and armpit. Due to increased number of cases of breast cancer, it is advisable to patients that they examine their breast on their own on a daily routine basis[15].

Colorectal cancer is one of the 3rd most common cancer worldwide. The causes may be sporadic and, in that case, the genetic and environmental factors play a key role. Heredity is also considered when risk factors are taken into account. The major hereditary forms being Hereditary nonpolyposis colorectal cancer (HNPCC) and Familial adenomatous polyposis (FAP), the latter one being an autosomal dominant disease[16].

Some screening methods for this disease include flexible sigmoidoscopy, colonoscopy, double-contrast barium enema, faecal occult blood tests. Sigmoidoscopy and faecal occult blood tests are less effective than colonoscopy. The sensitivity of colonoscopy has been increased with the help of modern facilities like magnification endoscopy and chromoendoscopy[16].

Treatment For Cancer

Standard treatments available for curing cancer includes: -

1. Surgery
2. Radiotherapy
3. Chemotherapy
4. Gene therapy
5. Hormone therapy
6. Bone marrow transplant
7. Cryosurgery
8. Immunotherapy
9. Photodynamic therapy[2], [6]
10. Peripheral stem cell transplant

Cancers can be treated by performing surgery and removing the localized tumor or in some cases the whole organ itself. It is used for non-hematological cancers only and also can treat those cancers which has not metastasized to other parts of the body. Even if a single cancer cell has metastasized to different part of the body it can lead to the formation of a new tumor. The chance of recurrence of cancer is determined by biopsy test. Staging of cancer can be done by examining the presence of healthy tissues and cancerous tissues in the surgically removed tissues. Surgery isperformed to treat cancers like, mastectomy of breast cancer, liver cancer, lung cancer, prostatectomy for prostate cancer, kidney cancer etc[6].

Chemotherapy is performed by using anticancer drugs. Anticancer drugs hinder the growth of tumors and also knock down the cancerous cells. But in case of chemotherapy and radiation therapy, the normal tissues of the body are also damaged. The most common side effect of chemotherapy and radiation therapy are:

1. Hair loss
2. Bruising and bleeding
3. Infection
4. Fatigue
5. Constipation
6. Anemia
7. Nausea
8. Vomiting

The usage of excessive radiations which are usually ionizing radiation for killing cancerous cells and demolishing tumor tissues, is known as radiation therapy. Itis used in combination with surgery methods for the treatment of

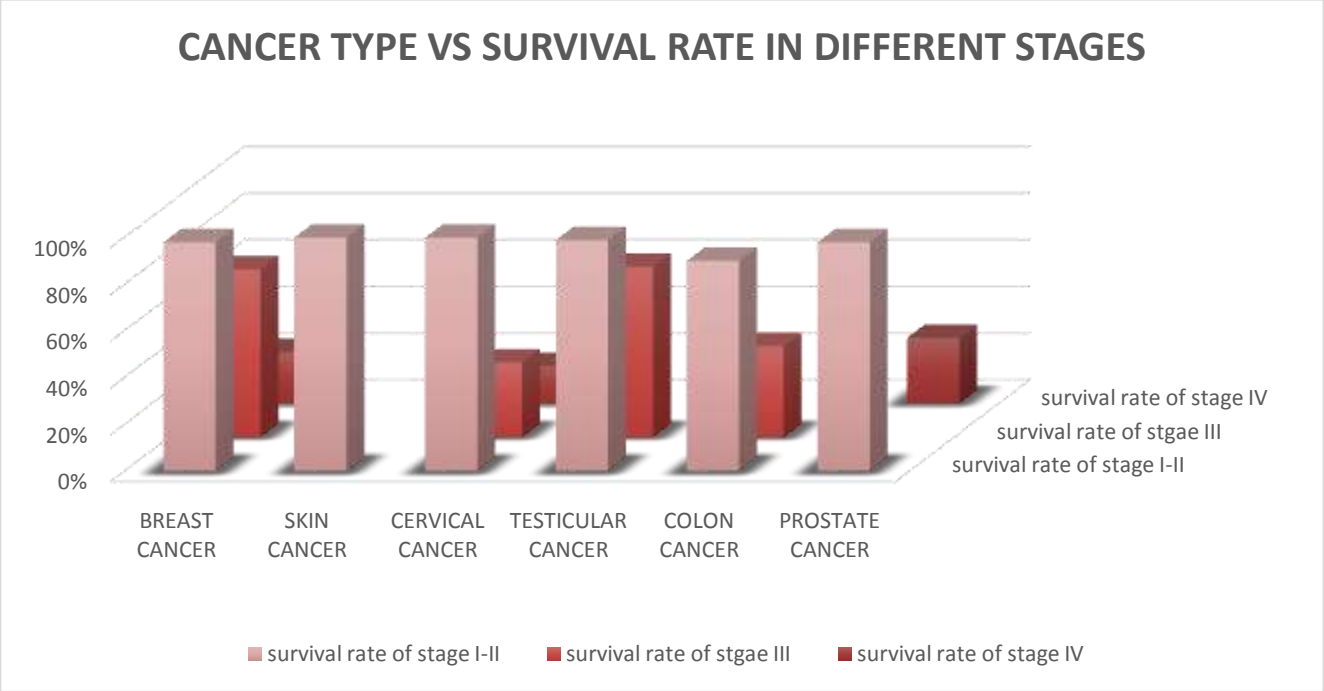
cancers[6]. Apart from treating breast cancer, cervix cancer, skin cancer etc., this treatment method can also be used to treat leukemia and lymphoma.[20]

Immunotherapy also known as biologic therapy is a treatment method in which the immune system is trained to fight with cancer cells. A lot of researches have been conducted in this direction, one of them being, the use of monoclonal antibodies which block specific protein function by binding to cancerous cells. These train the immune system to identify and fight with cancerous cells. One more advantage of this method is that it causes lesser side effects when compared to others.

The type of cancer which is dependent upon hormones for their growth and spreading can be treated by hormone therapy because in this treatment method hormone levels in the body are altered. It can be beneficial for treating breast, prostate and reproductive system cancer.

Sometimes two or more treatment methods are used combinedly for the recovery of the patient. These treatments come along with its own set of side effects. Themain motive is to kill all cancerous cells without posing threat to body's healthy cells[6].

Cancer can be cured if detected at early stage. Here is a comparative chart about survival rate of different types of cancer based on detection in different stages.



[2],[4], [5],

The standard treatment for early-stage breast cancer is modified radical mastectomy. But in the recent times Breast-conserving surgery are being more recommended because this surgery has the highest success rate in case of early-stage breast cancer. Whole breast radiation therapy is performed after the surgery. In case of stage III patients with non-inflammatory type, Induction chemotherapy is given first and then breast conserving surgery is performed which is then followed by radiation therapy. Whereas in case of inflammatory type, first Induction chemotherapy is given which is then followed by mastectomy and ultimately radiation therapy. And in the case of stage IV patients, radiation therapy or bisphosphonates for bone pain are advised.[14]

Since more than the last 30 years, with the discovery of steroid-hormone receptors there has been increase in number of biomolecular markers and therapeutic drugs for treatment of breast cancer. [13]

For the treatment of colorectal cancer, surgery forms the most conventional treatment. Fast-track surgery and Laparoscopic surgery can be performed along with chemotherapy and radiotherapy[16]. But apart from all these, some modern treatment methods include Immunotherapy. In comparison to other treatment for metastatic cancer, immunotherapy has a higher durable remission[17],[18].

Recent advances in treatment

The standard therapy methods do cure cancer but along with that they pose serious threat to normal healthy cells as well and have side effects. Due to this reason, new treatment methods are being adopted. Tumor microenvironment allows to look into clinical trials tests, several treatment types like new drugs, new perspective in respect to treatment methodologies using radiation therapy, chemotherapy, surgery or combination of some treatments[6].

The conventional treatment methods have a number of disadvantages for example, vascular structures of the tumor are leaky and excessively perplexed. The tumor becomes immune to radiation because its core experiences lack of oxygenation. Due to these reasons, tumor microenvironment and a successful therapeutic method for diagnosis and treatment of cancer are much required[6].

Since past decades, immunotherapy has rapidly transformed treatment methods for many types of cancer. One more encouraging step towards cancer immunotherapy is the use of personalized vaccines. Neoantigens play major role in helping the body to make an immune response against cancer cells. It can activate CD4+ and CD8+ T cells to produce an immune response. Thus, these have a very high probability to become new targets of tumor immunotherapy. The advancements in bioinformatics and sequencing technologies are adding great value to working efficiency of neoantigen vaccines[19].

Conclusion:-

The history of cancer dates back to more than 200 million years ago, although earlier it was not that common. Since the last couple of decades, cancer cases have increased dramatically, but at the same time due to advancement in science and technology, the mortality rate is decreasing. The conventional treatments like surgery, chemotherapy, radiation therapy etc are useful but have negative impact on the healthy tissues of the body, hence it is important to find more effective techniques. Immunotherapy, targeted therapies like small molecule tyrosine kinase inhibitors, MABs and gene therapy are some recent advancements in cancer treatment. Also, studies are being conducted on the usage of personalized vaccines for cancers. A perfect cure for this deadly disease is still awaited and many more research work needs to be conducted for improving the survival rate and quality of lives of cancer patients.

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