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Cancer: Understanding the disease, treatment, and hope for the future

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Abstract

Understanding the nature of cancer is crucial for developing effective strategies to combat it. Cancer is characterized by the uncontrolled growth and spread of abnormal cells in the body. It is not a single disease but encompasses a wide range of different types, each with its own characteristics, causes, and treatment approaches. Cancer can affect various parts of the body, including organs, tissues, and even the blood. The most common types of cancer in India are lung cancer (15%), breast cancer (10%), cervical cancer (8%), Oral cancer (7%), and stomach cancer (6%).

Treatment options for cancer are diverse and continually evolving. Surgery is often the primary treatment for solid tumours, while radiation therapy uses targeted radiation to destroy cancer cells. Chemotherapy, a systemic drug treatment, is effective against many types of cancer. Emerging trends in cancer treatment offer new hope. Immunotherapy harnesses the body's immune system to fight cancer, targeted therapy utilizes precision medications for specific genetic mutations, and innovative approaches like gene therapy and CAR-T cell therapy hold promise for the future. Advancements in cancer research have led to improved understanding, early detection methods, and novel treatment options. Clinical trials play a crucial role in advancing treatment modalities and personalized medicine. Collaborations among researchers, healthcare professionals, and patient advocacy groups are instrumental in driving progress in the field.

Keywords: uncontrolled growth, tumours, staging and grading, treatment options, cancer research

Introduction

Cancer is a complex and devastating disease that has a profound impact on individuals, families, and communities. It is characterized by the uncontrolled growth and spread of abnormal cells throughout the body. Cancer is not a single disease but rather a diverse group of diseases, each with its own unique characteristics, causes, and treatment approaches. It can affect various parts of the body, including organs, tissues, and even the blood.

It is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. These contrast with benign tumours, which do not spread. Possible signs and symptoms include a lump, abnormal bleeding, prolonged cough, unexplained weight loss, and a change in bowel movements. While these symptoms may indicate cancer, they may have other causes. Over 100 types of cancers affect humans.

Tobacco use is the cause of about 25% of cancer deaths [1]. Another 10% is due to obesity, a poor diet, lack of physical activity, and excessive drinking of alcohol. Other factors include certain infections, exposure to ionizing radiation and environmental pollutants. In the developing world, 15% of cancers are due to infections such as *Helicobacter pylori*, hepatitis B, hepatitis C, human papillomavirus infection, Epstein-Barr virus, and human immunodeficiency virus (HIV). These factors act, at least partly, by changing the genes of a cell [2]. Typically, many genetic changes are required before cancer develops. Approximately 5–10% of cancers are due to inherited genetic defects from a person's parents. Cancer can be detected by certain signs and symptoms or screening tests. It is then typically further investigated by medical imaging and confirmed by biopsy.

In India, cancer is the second leading cause of death after heart disease. It is estimated that about 1.2 million new cases of cancer are diagnosed in India each year [3]. The most common types of cancer in India are lung cancer, breast cancer, colorectal cancer, and stomach cancer. Compared to 66 years old in the United States, the average age of diagnosis for cancer in India is 55 years old.

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Types of Cancer: A Comprehensive Overview of Common Varieties

Cancer can manifest in various forms, each with unique characteristics and treatment approaches. Understanding the different types of cancer is crucial for accurate diagnosis, effective treatment, and improved patient outcomes. Some common types of cancer include.

Breast Cancer: Breast cancer is one of the most prevalent cancers among women in India. Carcinomas: Originating from epithelial cells that line the internal and external surfaces of the body, carcinomas account for the majority of cancer cases. This category includes lung, breast, prostate, and colorectal cancer.

Sarcomas: Arising from connective tissues like bones, muscles, and cartilage, sarcomas are relatively rare. Examples include osteosarcoma and leiomyosarcoma.

Leukaemia: Leukaemia begins in the bone marrow, where abnormal white blood cells multiply uncontrollably. These cancers primarily affect the blood and can be classified as acute or chronic.

Lymphomas: These cancers affect the lymphatic system, a vital component of the immune system. Lymphomas can be further categorized into Hodgkin lymphoma and non-Hodgkin lymphoma.

Brain and Central Nervous System (CNS) Tumours: Brain tumours can develop within the brain tissue or from cells surrounding the brain and spinal cord. They can be benign (noncancerous) or malignant (cancerous).

Causes and Risk Factors of Cancer

- a. **Genetic Factors:** Hereditary Cancer Syndromes
Genetic factors play a role in certain types of cancer. Inherited mutations in specific genes, such as BRCA1 and BRCA2, significantly increase the risk of developing breast, ovarian, and other cancers. These hereditary cancer syndromes can be passed down through generations, highlighting the importance of genetic testing and counselling for individuals with a family history of cancer [4].
- b. **Environmental Factors:** Carcinogens and Their Impact
Environmental factors can also contribute to the development of cancer. Exposure to carcinogens, which are substances that can cause cancer, is a significant risk factor. Carcinogens include tobacco smoke, asbestos, certain chemicals, radiation (such as ultraviolet rays from the sun), and air and water pollutants. Occupational hazards, such as exposure to chemicals in industrial settings or certain occupations, can also increase the risk of developing cancer [5].
- c. **Lifestyle Factors: Smoking, Diet, and Physical Activity:**
Lifestyle choices play a crucial role in cancer risk. Smoking tobacco is a well-established cause of various cancers, including lung, throat, and mouth cancers. Quitting smoking and avoiding second-hand smoke can significantly reduce the risk [6].

Dietary choices also impact cancer development. A diet high in processed foods, red and processed meats, and low in fruits and vegetables can increase the risk of colorectal

and other cancers. Conversely, a balanced diet rich in fruits, vegetables, whole grains, and lean proteins can help lower the risk.

Cancer Staging and Grading: Understanding the Severity

Cancer staging and grading are essential components in assessing the severity of cancer and guiding treatment decisions. They provide valuable information about the extent of cancer spread, tumour behaviour, and prognosis.

Let's explore these aspects in more detail

- a. **Staging Systems:** TNM and AJCC Classification
Staging systems, such as the TNM (Tumour, Node, Metastasis) system and the American Joint Committee on Cancer (AJCC) classification, are widely used to stage cancers. The TNM system assesses the size and extent of the primary tumour (T), the involvement of nearby lymph nodes (N), and the presence of metastasis (M). These factors are combined to assign a cancer stage, ranging from stage 0 (in situ) to stage IV (advanced or metastatic cancer). The AJCC classification provides specific criteria for staging different types of cancer, ensuring consistency in assessing cancer severity across healthcare institutions [7, 8].
- b. **Grading Systems:** Differentiating Tumour Behaviour
Grading systems evaluate the characteristics of cancer cells under a microscope to determine their differentiation and aggressiveness. The most used grading system is the Gleason score for prostate cancer, while other grading systems, such as the Nottingham system for breast cancer and the WHO grading system for brain tumours, exist for different types of cancer. Grading involves examining the tumour cells' appearance, growth patterns, and other features to assign a grade, typically ranging from low (well-differentiated) to high (poorly differentiated). A higher grade indicates more aggressive tumour behaviour [9].
- c. **Prognostic factors and predicting cancer outcome:**
Staging and grading systems provide important prognostic information, helping healthcare professionals predict the likely course and outcome of cancer. Prognostic factors, such as cancer stage, grade, tumour size, lymph node involvement, and the presence of specific biomarkers, influence the prognosis and guide treatment decisions. They help estimate the risk of cancer recurrence, the likelihood of response to treatment, and overall survival rates. Prognostic factors are valuable tools in tailoring treatment plans and providing patients with an understanding of their disease's expected outcome.

Treatment Options for Cancer

- a. **Surgery:** Primary Treatment for Many Solid Tumours
Surgery is often the primary treatment for solid tumours. It involves the removal of the cancerous tissue and nearby lymph nodes. Surgical procedures can vary depending on the tumour's location, size, and stage. In some cases, surgery may be curative, while in others, it may be performed to alleviate symptoms or as part of a multimodal treatment approach.
- b. **Radiation Therapy:** Targeting Cancer Cells with Precision
Radiation therapy uses high-energy radiation

beams to kill cancer cells or inhibit their growth. It is a localized treatment that precisely targets the tumour while sparing surrounding healthy tissues. Radiation therapy can be used as a primary treatment, in combination with surgery or chemotherapy, or to relieve symptoms in advanced stages of cancer.

- c. **Chemotherapy:** Systemic Drug Treatment for Cancer Chemotherapy involves the use of powerful drugs to destroy cancer cells or inhibit their growth. It is a systemic treatment that circulates throughout the body, targeting cancer cells both at the primary site and any potential metastases. Chemotherapy can be administered orally or intravenously and is often used in combination with surgery, radiation therapy, or other treatments.

Emerging Trends in Cancer Treatment

- a. **Immunotherapy:** Harnessing the Immune System to Fight Cancer Immunotherapy is a ground-breaking approach that stimulates the body's immune system to recognize and attack cancer cells. It includes immune checkpoint inhibitors, adoptive cell therapy, and cancer vaccines. Immunotherapy has shown remarkable success in treating certain types of cancer, providing durable responses and improved long-term survival rates.
- b. **Targeted Therapy:** Precision Medications for Specific Mutations Targeted therapy involves the use of drugs that specifically target cancer cells with specific genetic mutations or altered proteins. These medications block the signals that drive cancer cell growth and survival. Targeted therapies are designed to be more precise and selective, resulting in fewer side effects compared to conventional chemotherapy.
- c. **Gene Therapy and CAR-T Cell Therapy:** Innovative Approaches Gene therapy aims to introduce genetic material into cancer cells to correct genetic abnormalities or enhance the body's natural defences against cancer. CAR-T cell therapy involves modifying a patient's immune cells to recognize and attack cancer cells more effectively. These innovative approaches show great promise, particularly in haematological malignancies and certain types of solid tumours.

As our understanding of cancer advances, so do treatment options. The emergence of immunotherapy, targeted therapy, gene therapy, and CAR-T cell therapy has revolutionized cancer care, offering new avenues for personalized and effective treatments. By combining different modalities and tailoring therapies to individual patients, healthcare professionals can improve outcomes and enhance the quality of life for those affected by cancer.

Cancer research and advances in the field

- a. **Breakthrough Discoveries:** Promising Areas of Cancer Research Cancer research has witnessed numerous breakthrough discoveries that have transformed our understanding of the disease. Researchers are exploring various avenues, including molecular biology, genomics, and immunology, to uncover new insights into cancer development and progression. Promising areas of research include identifying key genetic mutations and biomarkers, understanding the tumour microenvironment, studying

cancer stem cells, and exploring the role of the immune system in cancer control [10, 11].

- b. **Clinical Trials:** Advancing Treatment Options and Personalized Medicine Clinical trials play a crucial role in advancing cancer treatment options and driving personalized medicine. These trials evaluate the safety and efficacy of new therapies, including novel drugs, targeted treatments, immunotherapies, and innovative treatment combinations. By participating in clinical trials, patients can access cutting-edge treatments before they become widely available. Clinical trials also provide researchers with valuable data to refine treatment approaches and improve patient outcomes. [12]
- c. **Collaborations and Innovations:** Moving Towards a Cure The fight against cancer necessitates collaboration and innovation. Researchers, clinicians, and pharmaceutical companies are joining forces to accelerate progress in cancer research and treatment. Collaborative efforts foster knowledge sharing, data integration, and the development of novel therapeutic strategies. Additionally, technological advancements, such as artificial intelligence, big data analytics, and precision medicine, are revolutionizing cancer research and enabling personalized treatment approaches. These collaborations and innovations are key drivers in moving closer to finding a cure for cancer.

The field of cancer research continues to evolve rapidly, driven by breakthrough discoveries, clinical trials, and collaborative efforts. Each new insight brings us closer to improved prevention, detection, and treatment strategies. The ongoing advancements in the field offer hope for better outcomes, enhanced patient care, and ultimately, a future where cancer can be conquered.

Conclusion

Cancer remains a formidable challenge, but through continued research, advancements in treatment, and a comprehensive approach to care, progress is being made in the fight against this disease. By understanding the causes, risk factors, early detection, and treatment options for cancer, we can empower ourselves with knowledge and take proactive steps towards prevention and early intervention. With ongoing research and emerging innovations, there is hope for a future where cancer can be more effectively managed, and ultimately, conquered.

Overall, the future scope of cancer in India lies in leveraging scientific advancements, fostering collaborations, and focusing on preventive measures and personalized treatment approaches. By combining these efforts, we can strive towards reducing the burden of cancer, improve survival rates, and enhance the quality of life for individuals and families affected by this disease.

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