**INNOVATIVE TREATMENT POSSIBILITIES VIA CANCER DIAGNOSIS, THERAPIES AND SURGERIES**

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**ABSTRACT**

The world has discovered the term “cancer” and its ill consequences since hundreds of working years now. But the term in itself is a word of huge consequence and substance. As yet, the scientific communities round the globe have not been able to combat this illness unconditionally and absolutely. The designation “cancer” holds its existence in many historical chronicles and up to the minute records where there is more than plentiful morbidity rate followed by mortality rate. It is one of the non-communicable diseases that is a persistent repercussion due to some triggering factors that lead to uncontrolled cell proliferation, division and growth. Cancer holds the evidence of the second most customary justification of expiration in the United States of America.[1] This article gives short overview on the cancer diagnosis and use of various therapies and medicines for the treatment of cancer.

**KEYWORDS** Cancer, Diagnosis, Surgery, Radiation Therapy, Chemotherapy

**1-INTRODUCTION**

Cancers are the ramification by numerous genres of exogenous carcinogens, encompassing physical, chemical, and biological factors (inclusive of various kinds of carcinogenic microorganisms especially species of bacteria such as *Chlamydia pneumonia*that is associated with lung cancer and numerous oncoviruses such as *Epstein-Barr virus (EBV)*and by endogenous procedures that manufacture impairment to the host’s genetic information that is what is termed as genome or smooth the path of the augmentation of cellular specie count – the clone with amended genomes. In majority of habitual cases, numerous factors interrelate and communicate only to cause the root disease –cancer. [2]

Nevertheless, as luck would have it, lesser amount of humanly mortals are losing their precious lives because of cancer in the latest times, than the time compared to the one that has passed 20 years ago. Premature observation accompanied by latest technological and medicinal managements have proved to be victorious in restoring normal health against cancer and giving its conquerors a long lifespan [2]

The first step is marked byfaultless determination of the developing cancer and its segments are the most demanded requisite of the diagnosis that is specific for specific type of cancer.Till date, the involved treatments conventionally enumerate various types of organ specific surgeries, therapies through radiation or chemicals such as alkylating agents Nitrogen Mustard or anti metabolites like Methortrexate or treatments through plant alkaloids such as vinblastine, vincristine, vindesine derived from a medicinal plant called *Catharanthusroseus* [4] and/or systemic therapy collectively called chemotherapy and other treatments including hormonal managements, selectively employed biological therapies. [3]

Logical medical attention in treatments of cancer requires division by stage in which the cancer is, by the intensity or grade of its danger and histology that is followed by support through several other diagnostics.[1]

**2- DIAGNOSIS**

To be certain and or to accurately finalize the epitome of a person having cancer is not the outcome of a no single diagnostic test instead it is a series of successive tests leading to finalization of the idea of one having cancer. The absolute estimation of a sufferer usually stands in needs of an in depth historical and physical examination along with series of eventual tests for diagnosis. Diagnostic testing for cancer may call for imaging, tests done in the labs which may consider tests for tumor markers, biopsy of the tumors of specific organs, examination through endoscopy, surgery or testing involving genetics. [5]

**Following ways are used to diagnose the existence or occurrence of cancers.**

**A. BIOPSY**

An examination that takes samples by removing the cells or tissue from the sufferer’s body. A medical analyser that is called a pathologist examines the cells or tissue with the help of a microscope to extract the knowledge for destruction or damage or disease. Every part of the body can be subjected to biopsy but only the part that is suspicious of carrying the disease is considered.

There are different types of biopsies, some of which are:

**A needle biopsy** removes tissue or fluid with a needle passed through your skin to the site of the problem. This method is used to perform  [bone marrow aspiration](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000046505&version=Patient&language=es) , [lumbar punctures](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000046592&version=Patient&language=es) , and some breast, prostate, and liver biopsies.[6]

**With**[**endoscopy**](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000045678&version=Patient&language=es)the doctor uses a thin, lighted probe called an endoscope to examine areas inside the body. The endoscope is inserted through natural openings in the body, such as the mouth or anus. [6]

**B. COLONOSCOPY**

Colorectal cancer gets initiated in either colon or the rectum. Such cancers can also be designated as colon cancer or rectal cancer respectively, based on where exactly they originate. Cancer in colon or in rectum are grouped together often the reason behind being that they have several related characters and facts.

Most of the cancers of the colorectal region begin as an extension making the inner lining of the colon or rectum as their base or substrate. These extensions are referred to as polyps.

Few classes of polyps can alter themselves to cancer with time. Different types of polyps exist in nature for example **hyperplastic polyps,** adenomatous polyps referred as adenomas**and inflammatory polyps.**

If in case where cancer develops in a polyp, it may extend into the colonal wall or rectal wall as it ages. Screening via colonoscopy is vital to discover and attend initial level of colorectal cancers. [7]

In case where cells of cancers are growing in the wall, they may then develop invading in vessels of blood and lymph. From that point, they have the tendency to migrate to the lymph nodes in the vicinity or to various other distant parts of the body frame. [8]

Colorectal cancers, in the Western Hemisphere, rank the third most common type of cancer and its chances of happening elevate with age. [9]

Colonoscopy is found to be a diagnostic and also a therapeutic process that is conducted to examine the portions of large intestine-colon, rectum, and anus in addition to the small intestine’s distal portion. The data visualization that the camera inputs onto the screen assists to realize deformities and permits to estimate the biopsy results and eliminate mucosal lesions making use of several types of biopsical appliances via these accessory channels. Along with these massive utilities, colonoscopy has elevated its existence to a high level for making colorectal cancer an trouble free preventable illness.[7]

 **C. MAMMOGRAPHY**

The technique is imaging process employing X-rays that is used to investigate the breast for the initial discovery of cancer and other such breast illnesses. It is utilized as a tool for both diagnostic and screening purposes. [10]

During the mammogram procedure, a sufferer’s breast is positioned on a flat plate for support and squeezed with a parallel plate that is referred as a paddle. Now the x-ray machine generates a minor split of x-rays that progress through the breast to a device called detector pinpointed on the contradictory side. The generated images are termed as mammograms. [10]

In digital mammography, the procedures of image accession, storage and display are set apart, which permits optimization of each. Transmitted radiation via the breast is soaked up by an electronic detector, the comeback of which is committed over a wide variety of potency. Once this data is trapped, it can be unveiled by using computer’s capability of image-processing and related techniques to permit arbitrary settings of image glaze and contrast, irrespective of the necessity for additional subjection to the sufferer. [11]

**D. PAP TEST**

Cervical cancer is ranked as the second most customary cancer in the females round the globe, preceded by breast cancer. The appearance of high-risk human papillomaviruses genital subcategories elevates the potential threat of malignant transformation. [12]

The aim for cervical cancer screening is to find changes in [precancerous](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=46220&version=patient&language=English&dictionary=Cancer.gov) cervical [cell](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=46476&version=patient&language=English&dictionary=Cancer.gov), when medication can avoid cervical cancer from extending. At times, cancer is detected when cervical screening is done. Cervical cancer is easier to treat when found at the initial level. But by the time [symptoms](https://www.cancer.gov/types/cervical/symptoms) show appearance, cervical cancer may begin to spread, bringing difficulties in required treatments. [13]

A Pap smear that is done under the process of Pap testing, causes the screening of cervical cancer. The examination inspects for aberrant cells in the cervical region that might be cancerous or may possess the actual potential to cause cancer.[14]

Also called cervical cytology test, it accumulates cervical cells so as to check for alterations caused by HPV that might if left untreated, develop into cervical cancer. It can find cells of precancerous nature . It may also sometimes find circumstances that may not be cancer, but may be some infection or [inflammation](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=44042&version=patient&language=English&dictionary=Cancer.gov). [13]

**E. MAGNETIC RESONANCE IMAGING - MRI**

Magnetic Resonance Imaging is a non-interfering technology of imaging that generates three dimensional images with anatomical details. It is frequently utilized for disease diagnosis, detection, managing and monitoring treatments. It is dependent on knowledgeable technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissues.[15]

Another type, called functional MRI (fMRI), full form- Functional magnetic resonance imaging utilizes MRI technical knowledge to quantify cognitive activity by observing flow of blood to respective regions of the brain. It eases the study of uninjured and normal brain. The blood flow elevates in regions where there is presence of active neurons. This provides an insight into the neural activity inside the brain.

This method has revolutionized mapping of the brain, by permitting analysis’s to evaluate spinal cord and the brain irrespective of the requirement for invasive procedures or injections of drugs.[16]

MRIs makes use of magnets of great strength which generates a strong field of magnetism that compels protons to align within that field in the body itself. When a radiofrequency current is then pulsed through the patient, the protons are made sensitive, and they are spinned out of equilibrium, straining opposed to the pull of the magnetic field. [15] As MRI utilizes magnets of high power, the appearance of metal in the body can be a serious hazard to safety if attracted to the magnet. Even if not attracted to the magnet, metal objects can bring about potential changes and distortion in the MRI images. [17]

When the radiofrequency field is brought to off state, the MRI sensorsare capable enough to discover the energy released as the protons realign themselves with the magnetic field. The time taken for the protons to realign themselves within the field of magnetism, and the amount of energy set free, alters depending on the ambience and the of the molecule’s chemical nature. [19]

**F. CT SCAN**

A technique called computed tomography (CT) scan, generally subjected as a CT, is a study for radiological imaging.[18] CT scans can be utilized to recognize any injury or illness within several areas of the body. For instance, CT has become a potential tool for screening and detecting attainable tumors or lesions found within the abdomen. [19]

The benefits of these tomographic images when related to conventional X-rays is that they possess high-throughput knowledge of a specific area of target in cross-section, reducing images of the superimposition, which provides a huge benefit over plain films. CT scans impart excellent clinic pathological interrelation for a suspected illness.[18]

Throughout a CT scan, the sufferer lays on a bed that gradually moves through the gantry while the x-ray tube takes turns around the patient, bringing narrow beams of x-rays through the body. Instead of film, CT scanners utilizes unusual digital x-ray detectors, which are found directly opposite the x-ray source. As the x-rays exit the patient, they are collected up by the detectors and transmitted to a computer.[19]

**3- CANCER SURGERY**

Cancer surgery is acourse of action to eliminate or extract a tumor from the body. It is an age old kind of cancer treatment and till date works beneficially to treat several forms of cancers existing in these times.

**List of Cancer Surgeries: Table 1**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Type of Surgery** | **Mode of Action** | **Reference** |
| 1. | Curative Surgery | Extraction of either cancerous tumor or growth from the body that isrestricted to a specific area of the body. For example, laryngectomy, is the removal of a tumor, (big in size) of the larynx, which may entail removing part of the tongue or oropharynx. A surgical procedure called Para thyroidectomy, removes parathyroid glands or tumors. | [20]  |
| 2. | Preventive Surgery | In some women, that have a family history of breast cancer, may inherit change in a breast cancer gene (called BRCA1 or BRCA2). As the breast cancer has a very high risk, removing the breasts (prophylactic mastectomy)canbe considered.  | [21 ]  |
| 3. | Diagnostic Surgery | Diagnosis of cancer lies in the acquisition of tissue for exact histologic diagnosis.Laparoscopic staging procedures may identify metastatic or unresectable disease so the person affected by cancer may avoid a major operation. | [21 ]  |
| 4. | Cryosurgery | [Cryosurgery](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000045407&version=Patient&language=en) is a form of treatment in which extreme cold is utilized that is produced by liquid nitrogen or argon gas that is used to devastate abnormal tissue growth. Cryosurgery is also found to be used in treatment of early-[stage](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000045885&version=Patient&language=English)[retinoblastoma](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000046774&version=Patient&language=English),[precancerous](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000046220&version=Patient&language=English) growths on the skin and cervix and skin cancers.  | [22]  |
| 5. | Staging Surgery | The TNM system is the most commonly utilized cancer [staging system](https://www.cancer.gov/Common/PopUps/popDefinition.aspx?id=CDR0000689095&version=Patient&language=English). Laparoscopy methodsarealso employed to examine the body and remove samples of tissues.It such case, camera or lens is utilized, though that which analysis the tissue cell is done. |  [23 ] [24] |
| 6. | Debulking Surgery | Dr.Joe V. Meigs, a gynecologic surgeon at Massachusetts General Hospital, in Boston, initially described ovarian tumor debulking in 1934.The Gynaecologic Oncology Group (GOG) has Explained optimal debulking as residual implants less than 1 cm. Such measurements are determined at the completion of surgery. Due to tissue induration or inadequate exploration, assessments of residual tumor size are often not entirely accurate.Debulking cytoreductive surgery is a common treatment procedure for ovarian cancer. | [25] [26 ] [27] |
| 7. | Palliative Surgery | The purpose of palliative surgery is mainly to reduce pain for the patient.Palliative surgery was defined as ‘surgery performed for relief of cancer-related symptoms in patients with advanced and incurable cancers.’The indications for surgery included fungation, intractable pain, obstruction, bleeding or perforation due to tumours.  | [28]  |
| 8. | Supportive surgery | An example of supportive surgery is the insertion of a catheter to help with chemotherapy. | [29] |
| 9. | Restorative (reconstructive) surgery | It’s also used to restore the function of an organ or body part after surgery.Examples- include breast reconstruction after mastectomy or the use of tissue flaps, bone grafts, or prosthetic (metal or plastic) materials after surgery for head and neck cancers. | [29] |
| 10. | Cryo-surgery | Cryosurgery dates back to the 19th century, when Arnott first described the benefits of local application of cooling for various conditions, such as for pain control.He used a salt solution containing crushed ice at −18°C to −24°C to treat advanced breast and uterine cancers. He considered this technique as a method for eradicating cancer cells to prolong life, if not as a cure in the early stages of disease. | [30]  |
| 11. | Laser Surgery | This method uses beams of light energy to remove very small cancers (without damaging surrounding tissue), to shrink or destroy tumors, or to activate drugs to kill cancer cells. Breast cancer-related lymphedema (BCRL) is a issue that arises after mastectomy surgery in women.  | [31 ] |
| 12. | Electro Surgery | Electro surgery is a method used in dermatology surgery to provide superficial or deep coagulation or cutting of the skin.In this method, high frequency alternating electrical current is passed through the skin at different voltages (200 to 10,000 V) to produce heat. It requires a power supply with one or two electrodes and a hand piece. The mechanism is controlled by a hand piece switch or a footswitch. | [29] |
| 13. | Microscopic Controlled Surgery | This surgery is important when cancer affects delicate parts of the body, such as the eye. Layers of skin are removed and detected until cancerous cells cannot be detected. | [29] |

**4- Radiotherapy**

Radiation is a method of healing via therapywhich is used to destroy cancer cells. There are two ways to discover radiation to the location of the cancer. External beam radiation is delivered from outside the body by aiming high-energy rays (photons, protons or particle radiation) to the location of the tumor. This is the most common approach in the clinical setting. Internal radiation or brachytherapy is delivered from inside the body by radioactive sources, sealed in catheters or seeds directly into the tumor site. This is used particularly in the routine treatment of gynaecological and prostate malignancies. [32]

|  |  |
| --- | --- |
| **Early cancer curable with radiation therapy alone** | **Cancer curable with radiation therapy in combination with other modalities** |
| Skin cancer ( Squamous and Basal cell ) | Breast Carcinomas |
| Prostate carcinomas | Rectal and Anal carcinomas |
| Lung carcinomas | Local advanced cervix carcinomas |
| Cervix carcinomas | Local advance head and neck carcinomas |
| Lymphomas | Locally advanced lung carcinomas |
| Head and Neck carcinomas | Advanced lymphomasBladder carcinomasCNS tumorSoft tissue sarcomas [32] |

**Examples of cancers treated with radiation therapy: Table 2**

**4.1 Radiation Therapy Technique**

**A. Fractionation**

Radiation therapy delivered in a fractionated regime that is based on the radiobiological properties of cancer and various normal tissues. A typical radiation therapy regime consists of daily fractions of 1.5 to 3Gy given over several weeks. [32]

**B. Technological advances**

Technological incorporating new imaging modalities provide powerful computers and software, and new delivery systems such as advanced linear accelerators have helped achieve this.[28]

**C.3 D Conformal radiotherapy (3DCRT)**

3D radiation therapy based on CT imaging which allows accurate localization of the tumour and to deliver radiation to the gross tumour volume (GTV), with a margin for microscopic tumour extension called the clinical target volume (CTV), and a further margin uncertainties from organ motion and setup variations called the planning target volume (PTV).[32]

**D. Intensity modulated radiation therapy (IMRT)**

IMRT allows the oncologist to create irregular-shaped radiation and IMRT is available in many clinical departments and can be delivered by linear accelerators with static or dynamic multi-leaf collimators or tomotherapy machines. [32]

**E. Image-guided radiotherapy (IGRT)**

The improved accuracy has made dose escalation feasible, and this has allowed an improvement in the therapeutic ratio for several tumor sites, such as head and neck cancers and prostate cancers.[32]

**F. Stereotactic body radiation therapy (SBRT)**

SBRT has shown excellent results in the treatment of early stage non-small cell lung cancer in patients unfit for surgery. Other tumours include in the prostate, head and neck, hepatic, renal, oligometastases, spinal and pancreatic.

Photon beams carry low radiation charge and have a much lower mass. X-rays and gamma rays are routinely used photons in radiation therapy to treat various cancers.

Particle radiations (electron, proton and neutron beams) has been used. [32]

**5. Chemotherapy and Anticancer drugs**

Term “chemotherapy” was coined by German chemist Paul Ehrlich who investigated the use of drugs to treat infectious diseases. He was also the first scientist to study animal models to screen a series of chemicals regarding their potential activity against diseases. Historical documents suggest the use of arsenicals started in the 1900s. Radiotherapy and surgery were the mainstays of cancer management in the 1960s. [33] [34] [35] [36]

**List of Drugs used in Chemotherapy: Table 3**

 [33] [34] [35] [36]

|  |  |  |  |
| --- | --- | --- | --- |
| **S.no** | **Chemotherapeutic agent** | **Classification of agent** | **Mode of action** |
| 1. | Alkylating Agents  | Nitrogen mustard- bendamustine, cyclophosphamide.Nitrosoureas – carmustine, lomustinePlatinum analogs – carboplatin, cisplatin. | Inhibit DNA replication and transcription.Toxicity: Dose-limiting toxicity:myelosuppression |
| 2. | Antimetabolites | CytidineanalogsFolate antagonistsPurine analogsPyrimidine analogs  | Inhibit the replication of DNAToxicity: Dose-limiting hand-foot, mucositis, diarrhea. |
| 3. | Antimicrotubular agents | Topoisomerase II inhibitorsTopoisomerase I inhibitorsTaxanesVinca alkaloids | Inhibition of DNA repair resulting in blockade of DNA and RNA synthesis.Toxicity: Peripheral), myelosuppression |
| 4. | Antibiotics  | Actinomycin D, bleomycin, daunomycin | Inhibit RNA and DNA synthesisToxicity: Cumulative pulmonary toxicity, hyperpigmentation |
| 5. | Miscellaneous | HydroxyureaTretinoinArsenic trioxideProteasome inhibitors | Inhibits ribonucleosidediphosphatereductaseToxicity: Peripheral neuropathy |

**Conclusion** - A plan for the diagnosis and treatment of cancer is a key component of any overall cancer control plan. Its main goal is to cure cancer patients or prolong their life considerably, ensuring a good quality of life. It needs to be linked to an early detection programme so that cases are detected at an early stage, when treatment is more effective and there is a greater chance of cure. It also needs to be integrated with a palliative care programme, so that patients with advanced cancers, who can no longer benefit from treatment, will get adequate relief from their physical, psychosocial and spiritual suffering. Furthermore, programmes should include a awareness-raising component, to educate patients, family and community members about the cancer risk factors.

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