

INNOVATIVE TREATMENT POSSIBILITIES VIA CANCER DIAGNOSIS, THERAPIES AND SURGERIES: AN UPDATE 2023

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. 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

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I. 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 by faultless 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 Methotrexate or treatments through plant alkaloids such as vinblastine, vincristine, vindesine derived from a medicinal plant called Catharanthus roseus [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]

II. 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 tumour markers, biopsy of the tumours of specific organs, examination through endoscopy, surgery or testing involving genetics. [5]

Following Ways are Used to Diagnose the Existence or Occurrence of Cancers

1. **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:

- **Biopsy done with the help of a needle** removes tissue or fluid with a needle pierces and goes through the your skin to the target area of the problem. This method is used to perform bone marrow aspiration , lumbar punctures and biopsies including the regions of prostate, liver and breast.[6]
 - **Sometimes endoscopy** is performed by the doctor who makes use of a thin, light probe called an endoscope to inspect target regions inside the body. The endoscope is inserted through natural openings in the body, such as the mouth or anus. [6]
- 2. 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]

- 3. 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 arranged on a even level plate for support and squeezed with a parallel plate that is referred as a paddle. Now the x-ray instrument that causes a minor split of x-rays that progress within 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]

- 4. Pap Test:** Cancers targeting cervical region are ranked as the second main 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 of screening for cervical cancer is to detect find alterations in precancerous cervical cell, 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 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 produced by HPV which if not treated, develop into cervical cancer. It is able to detect cells of precancerous nature . It may also sometimes find circumstances that may not be cancer, but may be some infection or inflammation. [13]

- 5. Magnetic Resonance Imaging – Mri:** A technique based on magnetic resonance is a non-interfering technology of imaging that generates three dimensional images with anatomical details. It is frequently utilized for diagnosis and detection of illness along with managing and monitoring treatments. It is dependent on knowledgeable technology that is competent enough to detect the change in the direction of the axis of rotation of protons present in the water that constitutes the 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 idea towards the neural activities happening inside the brain.

This method has contributed towards the uprising advancements in 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 current of radiofrequency is then made to pass through the patient, the protons are made sensitive, and they are spinned out of equilibrium, straining opposed to the force exerted by the magnetic field. [15] As MRI utilizes magnets of high power, the appearance of metal in the body can be a serious threat to safety if attracted to the magnet. Even in the case when not attracted to the magnet or its existence, objects with metal origin can bring about potential changes and distortion in the MRI images. [17]

When the field of radiofrequency is brought to off state, the sensors of MRI are capable enough to discover the energy liberated as the protons rearrange 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]

- 6. 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 emerged as a potential tool for screening and detecting attainable lesions or tumours found inside 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 rotating turns round the patient, bringing tapered beams through the body. In the place of a film, CT scanners utilizes unusual specialized x-ray detectors that are digital, which are placed exactly contrasting to the x-ray source. As the x-rays exit the patient, they are collected up by these digital detectors and are made to transmit to a computer.[19]

III. CANCER SURGERY

Cancer surgery is a course of action to eliminate or extract a tumour 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.

Table 1: List of Cancer Surgeries

S.No	Type of Surgery	Mode of Action	Reference
1.	Curative Surgery	Extraction of a tumour that is of cancerous nature or certain growth from body that is restricted to a target region of the body. For example, laryngectomy, is the removal of a tumour, (big in size) of the larynx, which may entail removing part of the tongue or oropharynx. A surgical procedure called Parathyroidectomy, removes parathyroid glands or tumours.	[20]
2.	Preventive Surgery	In some women, that have a history of breast cancer in their family, may inherit an abnormality in the genes (such as those called BRCA1 or BRCA2)that can cause breast cancer (As the breast cancer has a very high risk, seperating the breasts (prophylactic mastectomy)can also be opted.	[21]
3.	Diagnostic Surgery	Cancer diagnosis falls in the accession of tissue for exact histology based diagnosis. Staging processes involving laparoscopy may detect metastatic disease, hence the individual who is affected by cancer may be able to omit an operation that might be major.	[21]
4.	Cryosurgery	Cryosurgery is a form of treatment in which utmost cold is utilized that is produced by argon gas or liquefied nitrogen that is used to devastate aberrant tissue growth. Cryosurgery is also found to be used in treatment of early-stage retinoblastoma, precancerous growths on the skin and cervix and skin cancers.	[22]
5.	Staging Surgery	The TNM system is the most commonly utilized cancer staging system. Laparoscopy methods are also 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	The Gynaecologic Oncology Group (GOG) has Explained optimal debulking as residual implants less than 1 cm. Such measurements are evaluated at the successful end of surgery. Due to tissue in duration or inadequate exploration, assessments of residual tumour size are often not entirely accurate.	[25] [26] [27]

		Debulking cytoreductive surgery is a frequently opted procedure for the treatment of ovarian cancer.	
7.	Palliative Surgery	The purpose of palliative surgery is mainly to reduce pain for the patient. Palliative surgery was explained as ‘surgery performed for comfort of symptoms related to cancer in sufferers with high level and cure-impossible cancers.’ The signs for surgery included fungation ,pain that is intractable, obstruction, perforation due to tumours or bleeding in some cases.	[28]
8.	Supportive surgery	An example of supportive surgery is the tucking of a catheter to assist with chemotherapy.	[29]
9.	Restorative (reconstructive) surgery	As the name suggests, it is utilized to bring back the purpose of a body part or an organ after a surgery. Example includes reconstruction of the sufferer’s breast post mastectomy, bone grafts, the utilization of tissue flaps, prosthetic materials made of metal or plastics, post surgery for cancers that are located in the head or neck.	[29]
10.	Cryo-surgery	Cryosurgery is an old practice since the 19th century, dating to the time when Arnott described the advantages of application of local cooling for various purposes such as for controlling the pain. He utilized a solution containing salt along with ice at -18°C to -24°C (that was crushed) to treat high level uterine and breast cancers. He believed that this technique can be used as a tool for eliminating cancerous cells to prolong life, if not as a cure in the early stages of disease.	[30]
11.	Laser Surgery	This method make use of beams of light and its energy to eliminate small sized cancers (without creating hindrance for the neighbouring tissue), to diminish/destroy tumours, or to promote drugs to combat 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 generate heat. It needs a good supply of power 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 vital at times when cancer is responsible for creating problems in delicate body parts such as the eye. Layers of skin are to be removed for detection of cancerous cells until found.	[29]

IV. RADIOTHERAPY

A method of providing comfort from cancer through therapy which destroys cancer cells. Two ways are used to locate radiation to the target affected by cancer. Beams provided externally are radiated to be delivered from outer region by subjecting rays of high-energy (photons, protons or particle radiation) to the targeted area of the tumour. This is the utmost used step in the clinical setting. Internal radiation or brachytherapy is dispatched from inside the body by sources of radioactive nature, sealed inside catheters or seeding directly into the site of the tumour. This is used precisely in the routine like treatment of gynaecological and prostate malignancies. [32]

Table 2: Examples of some cancers that are treated via radiation therapy

Early cancers that are alone curable with radiation therapy.	Cancers that are curable with radiation therapy in assistance with some other modalities and treatments
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 lymphomas Bladder carcinomas CNS tumour Soft tissue sarcomas [32]

Radiation Therapy Technique

- **Fractionation:** A method of delivery of radiation therapy in a fractionated arrangement that relies on the effects of radiobiology of cancer and other normal tissues. A conventional radiation therapy arrangement includes daily fractions of 1.5 to 3Gy given till a span of numerous weeks. [32]
- **Technological advances:** Technology incorporating latest imaging procedures provide computers and its softwares that are powerful and latest systems of deliveries namely modernized linear accelerators have helped achieve this.[28]
- **3 D Conformal radiotherapy (3DCRT):** It is a kind of radiation therapy that is three dimensional and relies on CT imaging which permits absolute tumour localization and delivers radiation to the gross tumour volume (GTV), including microscopic tumour extension margin referred as the clinical target volume (CTV), and a progressive margin unpredictability from organ motion and setup variations referred to as the planning target volume (PTV).[32]
- **Intensity modulated radiation therapy (IMRT):** IMRT permits the oncologist to allow the making of non uniform radiation and IMRT is present in several clinical divisions or sections and can be conveyed by accelerators of linear nature along with tomotherapy machines or dynamic or static multiple-leaf collimators. [32]
- **Image-guided radiotherapy (IGRT):** The enhanced accuracy has proved to be dose escalation practicable and this has led an advancement in the therapeutic ratio for numerous tumour regions, such as the cancers of the head or neck along with cancers of the prostate as well. [32]
- **Stereotactic body radiation therapy (SBRT):** SBRT has proved itself beneficial in terms of results in the treatment of initial stage non-small cell lung cancer in sufferers that were not found to be fit for surgery. Other examples of tumours include the prostate, head/neck, spinal, renal, hepatic, oligometastases, or the ones that are pancreatic.
- Photon beams delivers lower radiation charge and have a quite lesser mass. Gamma and X-rays are procedurally employed photons in radiation therapy to treat several kinds of cancers.
- Several times, radiations via particles (proton, electron and neutron beams) has been employed. [32]

V. CHEMOTHERAPY AND ANTICANCER DRUGS

The term designation “chemotherapy” was punched by a chemist of German origin, Paul Ehrlich who discovered the utilization of drugs to give treatment for infectious diseases. He was one of the very first scientist to investigate animal models to discover a series of chemicals with respect to their activity potential against diseases. History’s documents suggest the employment of arsenicals that initiated in the 1900s. But radiotherapy and surgery were the conventional methods of cancer treatments in the 1960s. [33] [34] [35] [36]

Table 3: List of Drugs used in Chemotherapy
[33] [34] [35] [36]

S.no	Chemotherapeutic agent	Classification of agent	Mode of action
1.	Alkylating Agents	Nitrogen mustard- bendamustine, cyclophosphamide. Nitrosoureas – carmustine, lomustine Platinum analogs – carboplatin, cisplatin.	Stops DNA transcription and replication. Toxicity: Dose-limiting toxicity: myelosuppression
2.	Antimetabolites	Cytidineanalogs Folate antagonists Purine analogs Pyrimidine analogs	Inhibit the replication of DNA Toxicity: Dose-limiting hand-foot, mucositis, diarrhea.
3.	Antimicrotubular agents	Topoisomerase II inhibitors Topoisomerase I inhibitors Taxanes Vinca alkaloids	Stops DNA repair resulting in blockage of synthesis of DNA and RNA. Toxicity: Peripheral), myelosuppression
4.	Antibiotics	Actinomycin D, bleomycin, daunomycin	Stops RNA and DNA synthesis Toxicity: Cumulative pulmonary toxicity, hyperpigmentation
5.	Miscellaneous	Hydroxyurea Tretinoin Arsenic trioxide Proteasome inhibitors	Inhibits ribonucleosidediphosphate reductase Toxicity: Peripheral neuropathy

VI. CONCLUSION

An absolute practice for various kinds of diagnosis and treatments of cancer marks the key role of any cancer control and its comfort plan. Its ultimate aim is to cure cancer sufferers or prolong their life up to a greater extent, enabling a better quality of life. It needs to be associated to an initial detection programme such that the cases are found out at a stage where it is curable, at a stage where treatment becomes far more effective and the chance of

cure becomes attainable. It also demands to be incorporated with an intensive care programme, so that sufferers with high end cancers, who no longer are able to get benefit from various treatments, will get ample relief from their psychosocial ,physical, mental and spiritual sufferings. On top of that, programmes should raise an awareness-raising component, to educate and guide the patients, their families and community members about the cancer risks and its causing factors.

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