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Review Article

CANCER AND NEW PROSPECTIVE TO TREAT CANCER

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ABSTRACT

Cancer is a condition when a few of the body's cells grow out of control and spread across other bodily regions. In the millions of cells that make up the human body, cancer may develop practically anywhere. Human cells often divide (via a process known as cell growth and multiplication) to create new cells when the body requires them. New cells replace old ones when they die as a result of ageing or injury. Aside from recent significant advancements in stem cell treatment, targeted therapy, ablation therapy, nanoparticles, natural antioxidants, radionics, chemodynamic therapy, sonodynamic therapy, and ferroptosis-based therapy, traditional treatment modalities like surgery, chemotherapy, and radiotherapy are still in use. Oncology practices today concentrate on creating effective and secure cancer nanomedicines. Targeting both primary and metastatic cancer foci, stem cell treatment has demonstrated remarkable success in regenerating and repairing sick or damaged tissues, and nanoparticles have introduced novel diagnostic and therapeutic possibilities. The development and spread of particular cancer cells can be prevented by targeted treatment, which also protects good cells from harm. Ablation treatment has become a less invasive method for freezing or burning tumours without performing open surgery. Natural antioxidants have shown promise in locating free radicals and counteracting their damaging effects, perhaps treating or preventing cancer. Clinical trials are being conducted on a number of innovative technologies, some of which have already received approval. A summary on current developments and discoveries in cancer therapy was provided in this review.

Keywords: Cancer, Treatment, Stem cell, Targeted drugs, Ablation, Natural antioxidants and gene therapy

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INTRODUCTION

One in every six fatalities globally is caused by the global health issue of cancer. Globally, there will likely be 10.3 million cancer deaths and 19.3 million new instances of the disease in 2020. Cancer involves a very complex chain of symptoms that develops over time with a generalised lack of growth inhibition. Occasionally, this systematic process fails, causing damaged or aberrant cells to proliferate when they shouldn't. Tumours, which are tissue masses, can develop from these cells. Cancerous or non-cancerous (benign) tumours are both possible [1].

Cancerous tumours can metastasize, which is the process by which they migrate to distant parts of the body and invade neighbouring tissues to produce new tumours. Malignant tumours are another name for cancerous tumours. Malignancies of the blood, including leukaemias, seldom develop solid tumours, although many other malignancies do. Noncancerous tumours do not penetrate or spread to surrounding tissues. Benign tumours often don't come back after removal, however malignant tumours can. However, benign tumours can occasionally grow to be extremely enormous. Some, like benign brain tumours, might have grave side effects or even be fatal [2, 3].

Combinatorial tactics, including multiple targeted therapies or "traditional" chemotherapeutics, including the taxanes and platinum compounds, have been found to have a synergistic effect. Recently, however, the many pathways involved in cancer therapy progression as well as how they can be targeted have improved dramatically [4]. Even though the level of accepted therapy has not been reached that reduces the prolonged survival time for metastatic cancer and fights the death rate, new techniques, such as medications, biological molecules, and immune-mediated treatments, are being employed for treatment [5].

The development of a fresh revolution in neoplastic cancer or medications that target specific tumour entities rely on those pathways and traits. When used alone or in conjunction with radiation, chemotherapy is thought to be the most efficient and often employed treatment option for cancer [6, 7]. Chemotherapy medications target tumour cells primarily by creating reactive oxygen species, which primarily kill tumour cells. Hormonal therapies are also frequently used for cancer malignancies and are regarded as cytostatic because they inhibit the growth of tumours by limiting the hormonal growth factors that act via the hypothalamic-pituitary-gonadal axis (HPGA), blocking hormone receptors, and limiting the production of adrenal steroid hormones [8].

A basic summary of the most cutting-edge and cutting-edge cancer medicines was given in this narrative review. Also included are various approaches to cancer diagnosis and treatment, which are now utilised in the clinical setting, underscoring their impact as cutting-edge anti-cancer approaches, as well as new strategies that are currently being studied at the research stage as well as should outweigh the drawbacks of conventional therapies [9].

Background about cancer

How does cancer develop?

Since genes that determine how our cells behave, particularly how they expand and contract, are altered, cancer is a genetic illness.

- Mistakes that arise while cells divide which can lead to genetic alterations that cause cancer.
- Because of DNA deterioration is brought on by unfavourable elements in the environment, including the chemicals in cigarette smoke and the sun's UV radiation. (More details may be found in our section on cancer causes and prevention.)
- Our parents passed these on to us.

Types of genes that cause cancer

Proto-oncogenes, tumour suppressor genes, and DNA repair genes are the three primary gene groups that are often impacted by the genetic alterations that cause cancer. These modifications are referred to be cancer's "drivers" at times. Proto-oncogenes play a role in regular cell division and proliferation. However, these genes may develop into cancer-causing genes (or oncogenes), enabling cells to grow and survive where they shouldn't by being changed in certain ways or being more active than usual [10-12].

Genes that inhibit tumours additionally play a role in regulating cell division and proliferation. Certain tumour suppressor gene mutations can cause cells to proliferate uncontrollably. DNA damage must be repaired using DNA repair genes. It is common for cells with mutations in these genes to also have mutations in other genes and chromosomal abnormalities, including duplications and deletions of chromosomal segments. These alterations could work together to turn the cells malignant [12-15].

When cancer spreads

Metastatic cancer is a kind of cancer that has progressed from the site of its initial formation to another location in the body. Metastasis is the process through which cancer cells migrate to different areas of the body. The initial or original cancer's name and cancer cell type also apply to metastatic cancer. For instance, breast cancer that spreads to the lung and develops a tumour is considered metastatic breast cancer rather than lung cancer [16].

Metastatic cancer cells typically resemble the original tumour's cells when seen under a microscope. Additionally, there are certain biological similarities between metastatic cancer cells and the initial cancer cells, including the existence of particular chromosomal alterations [17]. Individuals with metastatic cancer may occasionally survive longer with the aid of therapy. In other circumstances, preventing the spread of the disease or reducing the symptoms it is causing are the main objectives of treatment for metastatic cancer. Most cancer patients die from metastatic illness, which can seriously impair how the body works.

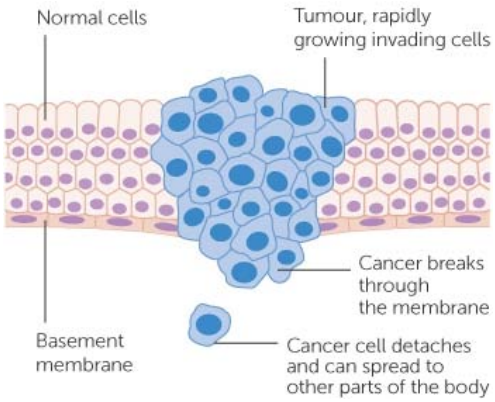

Fig. 1: Diagrammatic representation of the spreading of cancer

Types of cancer

In addition to 100 different cancers exist. Typically, cancer types are called for the organs or tissues in which they first appear. For instance, brain cancer begins in the brain, while lung cancer begins in the lung. The type of cell that gave rise to a cancer, such as an epithelial cell or a squamous cell, can also be used to define the condition.

Carcinoma

The most prevalent kind of cancer is carcinoma. Epithelial cells, which are the cells that line the interior and exterior surfaces of the body, are responsible for their formation. Epithelial cells come in a variety of varieties, and when they are magnified under a microscope, they frequently resemble columns. There are distinct names for cancers that start in several kinds of epithelial cells:

Adenocarcinoma is a kind of cancer that develops in mucus- or fluid-producing epithelial cells. Occasionally, glandular tissues are referred to as epithelial tissues. Adenocarcinomas make up the majority of cases of breast, colon, and prostate cancer. The basal (base) layer of the epidermis, which is a person's outer layer of skin, is where basal cell carcinoma, a kind of cancer, first appears [18-21].

Squamous cells, which are epithelial cells found just below the skin's surface, are where squamous cell carcinoma develops. Numerous other organs, such as the stomach, intestines, lungs, bladder, and kidneys, are lined by squamous cells. Squamous cells appear flat under a microscope, similar to fish scales. Epidermoid carcinomas are another name for squamous cell carcinomas. The epithelial tissue known as transitional epithelium, or urothelium, is where transitional cell carcinoma, a kind of cancer, develops. The linings of the bladder, ureters, renal pelvis, and a few additional organs are created up of this tissue that is composed of several layers of ectoderm cells that can develop bigger and smaller [22].

Sarcomas

Sarcomas are tumours that develop in the muscle, fat, blood, lymph, and fibrous tissues (such as tendons and ligaments) that make up soft tissues as well as bone. The most typical type of bone cancer is osteosarcoma. Liposarcoma, Kaposi sarcoma, malignant fibrous histiocytoma, liposarcoma, and dermatofibrosarcoma protuberans are the most prevalent varieties of soft tissue sarcoma [23, 24].

Leukaemia

Leukaemias are cancers that start in the bone marrow, which produces blood. Solid tumours are not produced by these malignancies. Instead, the bone marrow and blood become overpopulated with aberrant white blood cells (leukaemia cells and leukemic blast cells), which drive out healthy blood cells. It may be more difficult for the body to manage bleeding, fight infections, or provide oxygen to its tissues when the normal blood cell count is low [25].

There are four major forms of leukaemia, which are categorised according to the type of blood cell the malignancy begins in (lymphoblastic or myeloid) and how rapidly the illness worsens (acute or chronic). Leukaemia grows more swiftly in its acute forms than in its chronic variants.

Lymphoma

Cancer that starts in lymphocytes (T cells or B cells) is called lymphoma. These white blood cells, which are a component of the immune system, combat illness. In lymphoma, aberrant cells accumulate in the body's lymph nodes, lymph arteries, and other organs [26].

The two primary kinds of lymphoma are as follows:

- Reed-Sternberg cells, which are aberrant lymphocytes, are seen in people with Hodgkin lymphoma. Usually, B cells are the source of these cells.
- Non-Hodgkin lymphoma is a broad category of malignancies that originate in lymphocytes. The malignancies can develop from either B or T cells and can spread swiftly or slowly.

Multiple myeloma

Plasma cells, another type of immune cell, are where multiple myeloma develops. Myeloma cells, which are aberrant plasma cells, amass in the bone marrow and develop into tumours in bones all throughout the body. Kahler disease and plasma cell myeloma are other names for multiple myeloma [27-31].

Melanoma

Melanoma is a kind of cancer that starts in the cells that develop into melanocytes, which are specialised cells that produce melanin, the pigment responsible for the colour of the skin. The majority of melanomas develop on the skin, but they can also develop in other pigmented tissues, such the eye [32].

Spinal cord and brain tumours

Tumours of the brain and spinal cord can take many distinct forms. These tumours are given names depending on the cell type in which they originated and the region of the central nervous system where the tumour initially appeared. For instance, astrocytes, which assist maintain the health of nerve cells in the brain, are the origin of an astrocytic tumour. Benign (not cancer) or malignant (cancer) brain tumours are both possible [33].

Conventional cancer therapies

The standard cancer treatment approaches that are most frequently advised involve surgically removing the tumours, followed by radiation using x-rays and/or chemotherapy. Surgery is the one of these treatments that works best while the illness is still in its early stages. Radiation therapy has the potential to harm healthy tissues, cells, and organs. Despite the fact that chemotherapy has decreased morbidity and death, almost all chemotherapeutic drugs harm healthy cells, particularly those that divide and expand quickly [34-37]. A significant issue with chemotherapy is drug resistance, which occurs when cancer cells that were originally inhibited by an anti-cancer treatment start to become resistant to the agent. Reduced drug absorption and enhanced drug efflux are the main contributors to this. Constraints of traditional chemotherapeutic methods include difficult dose selection, lack of selectivity, quick drug metabolism, and mostly negative side effects [38].

Advanced and innovative cancer therapies

Drug resistance and its delivery mechanisms are the biggest barriers to treating cancer and reducing its symptoms, yet there are presently several authorised therapy modalities and medications. Due to aberrant blood artery architecture and tumour biology, traditional cancer is less effective than it formerly was. The most cutting-edge and creative cancer therapeutic approaches are listed here, along with their advantages and disadvantages [39-41].

Stem cells therapy

In the bone marrow (BM), stem cells are undifferentiated cells with the capacity to develop into any kind of body cell. Another cancer therapy method that is thought to be both safe and efficient is the use of stem cells. The therapeutic application of stem cells is yet in the exploratory stage of clinical trials; one potential use is the regeneration of other damaged tissue. Trials are now using mesenchymal stem cells (MSCs) that are given from the bone marrow (BM), adipose tissues, and connective tissues [42-43].

Pluripotent stem cells

The embryo's homogenous inner mass cells, known as embryonic stem cells (ESCs), can give birth to every type of cell, with the exception of those found inside the placenta. A breakthrough in cell biology occurred in 2006 with the development of Yamanaka factors, which allowed physical cells in a culture to become pluripotent stem cells (iPSCs) [44]. Because iPSCs and ESCs have identical traits, there are no ethical concerns associated with embryo destruction. Current methods for producing anti-tumor vaccines and effector T cells and natural killer (NK) cells include hematopoietic embryonic stem cells (hESCs) and induced pluripotent stem cells (iPSCs) [45].

Adult stem cells

Hematopoietic stem cells (HSCs), mesenchymal stem cells (MSCs), and neural stem cells (NSCs) are adult stem cell categories that are often employed in tumour treatment. All adult blood cells in the body can be formed by HSCs, which are found in BM. Only the infusion of HSCs produced from cord blood is currently authorised by the Food and Drug Administration (FDA) to treat multiple myeloma and leukaemia [46]. MSCs are present in a variety of tissues and organs and are crucial for tissue regeneration into osteocytes, adipocytes, and chondrocytes as well as for tissue repair. MSCs are employed in conjunction with other methods of treating tumours due to their unique biological properties. NSCs are employed to treat both primary and metastatic breast and other tumours since they can self-renew and produce new neurons and glial cells [47-49].

Cancer stem cells

Epigenetic alterations cause normal stem cells, precursor/ progenitor cells, or cancer stem cells (CSCs) to develop. They play a part in the development, metastasis, and recurrence of cancer, which suggests that they may be effective in treating solid tumours [50]. There are several ways that stem cells might fight the tumour. One method involves the HSCs quickly migrating into specific stem cell niches in the bone marrow (BM), following which the transplants go through the engraftment phase before producing specialised blood cells. The production of the matrix-degradable enzyme MMP-2/9, contact with endothelial cells through LFA-1, VLA-4/5, and CD44, and the active interaction among stem cell CXCR4 receptors are all necessary for this pathway [51].

The second mechanism is the tumor-tropic effect, in which MSCs migrate towards the tumour microenvironment (TM) after being drawn there by the tumour cells' secretions of CXCL16, SDF-1, CCL-25, and IL-6, and then differentiate within the tumour cells to aid in the growth of the tumour stroma. In addition to secreting paracrine factors, which includes extracellular vehicles (EVs) and soluble substances, stem cells also have the ability to differentiate into all various types of blood cells through transplanted HSCs [52].

Cancer is typically treated with stem cell therapy employing a variety of techniques, such as HSC transplantation, MSC infusion, therapeutic carriers, the creation of immune effector cells, and vaccine development. The negative effects of the stem cell cancer therapy technique included carcinogenesis, adverse events in allogeneic HSC transplantation, medication toxicity and drug resistance, elevated immunological responses and autoimmune and viral infection [53-55]. Despite these achievements, there are still problems that need to be looked at and resolved in the future, including therapeutic dosage management, poor cell targeting, and retention in tumour sites. Additionally, while early results from the use of stem cell therapies to treat tumours are very promising, more work needs to be done to increase their safety and effectiveness before they can be used in clinical trials [56].

Targeted drug therapy

Targeted cancer treatments include medications or other substances that are commonly referred to as "molecularly targeted drugs," "molecularly targeted therapies," or "precision medicines." These medications work by interfering with growth molecules, which prevents cancer from developing and relocating [57]. The TM of an atypical tumour, which is made up of endothelial cells, pericytes, smooth muscle cells, fibroblasts, different inflammatory cells, dendritic cells, and CSCs, controls the beginning and growth of the tumour. The TM-forming cells actively engage with the malignant cells through a variety of signalling routes and processes that are suited for supporting a moderately high level of cellular growth. Therefore, employing TM circumstances to mediate efficient targeting strategies for cancer therapy is the field of study focus [58-60].

It is challenging to selectively target cancer cells with traditional chemotherapy because they resemble normal cells. Cellular processes, such as cell cycle arrest, induction of apoptosis, suppression of proliferation, and interference with metabolic reprogramming by targeted pharmacological treatment agents, intervene in order to address these issues. Two tactics that can be employed for the treatment of cancer include altering TM and targeting TM for medication delivery [61]. Drugs used in targeted therapy do differ from those used in traditional chemotherapy in the manner they attack cancer cells while causing less harm to healthy cells; this is the programming that distinguishes cancer cells from healthy, normal cells [62].

The addition of erlotinib to regular chemotherapy boosted the survival rate for some illnesses, bringing it from 17% to 24% in patients with advanced pancreatic cancer. Rituximab, sunitinib, and trastuzumab have all revolutionised the treatment of renal cell carcinoma and breast cancer, respectively. Imatinib has had a significant impact on chronic myeloid leukaemia [63]. Based on how they operate or where they target, we may categorise the agents that target cells. Some enzymes act as growth signals for cancer cells. Some targeted medicines block the growth-stimulating enzymes that cancer cells use as signals. Enzyme inhibitors are the name of these medicines. By suppressing these cell signals, cancer can be prevented from developing and spreading [64].

These substances prevent tumours from forming new blood vessels, which helps to cut off the tumours' supply of blood and prevent tumour growth. Additionally, they halt the growth of tumours by

reducing the amount of blood that reaches the tumour by blocking the activity of angiogenic factors like vascular endothelial growth factor (VEGF) or its receptors. According to the study, individuals with advanced colorectal cancer had their lives prolonged by months when Avastin (bevacizumab) was combined with chemotherapy that used the drug 5-fluorouracil [65].

Types of target agents

Monoclonal antibodies

Drugs called antibodies are synthetic copies of immune system proteins that are injected into the body to assault specific targets on cancer cells. They have a higher percentage of human than murine components. Their assault strategies involve inducing the host immune system to attack the target cell, attaching to ligands or receptors to stop vital cancer cell operations, and delivering a deadly payload to the target cell, such as a radioisotope or poison. By conjugating with calicheamicin, the monoclonal antibody Gemtuzumab, for instance, targets CD-33 and is now utilised to treat AML. Ibritumomabtiuxetan is also a clinically developed anti-CD20 that is based on a 90Y metal isotope.46 Targeting agents of monoclonal antibodies can also deliver active medicines, prodrug activation enzymes, and chemotherapeutic toxins [66, 67].

Small-molecule blockers

These proteins are smaller in size (500 Da) than monoclonal antibodies, making it easier for them to cross plasma membranes and be ingested. Their primary function is to disrupt cellular processes by interfering with tyrosine kinase signalling that occurs intracellularly. This causes tyrosine kinase signalling to be inhibited, which sets off a molecular chain reaction that can stop cell growth, proliferation, migration, and angiogenesis in malignant tissues?Gefitinib and erlotinib, two examples of small molecule inhibitors, block the kinase and EGFR, respectively, in patients with non-small cell lung cancer (NSCLC). Lapatinib and sorafenib are other medications that act to block the EGFR/Erb-B2 Receptor Tyrosine Kinase 2 (ERBB2) for breast cancer that is ERBB2-positive and the VEGFR kinase for renal cancer [68].

Ablation cancer therapy

When surgery is not a possibility for tiny tumours smaller than 3 cm in size, ablation is a therapy method that eliminates tumours without removing them. For bigger tumours, embolization and ablation are combined. Owing to the destruction of part of the normal tissue around the tumour, this method may not be recommended for treating tumours close to major blood arteries, the diaphragm, or major bile ducts [69].

Cryoablation

Cryoablation is one of the ablation methods that destroy large amounts of tissue by freezing it to fatal levels, followed by liquid formation. The majority of original tumours treated with this treatment are both benign and malignant. After experimenting with the use of low temperatures by salt and ice solutions for the formation of local numbness before surgical procedures in the nineteenth century, James Arnott found that freezing temperatures can affect cancer cell survival. He recommended cryoablation as an appealing treatment choice that improved a patient's chance of survival.

The basis for cryoablation techniques is the Joule-Thomson effect, which was extensively researched in the 1930s. It was found that using liquid CO_2 under high pressure, liquid air, and liquid oxygen could produce ice crystals, which could then be used to treat lesions, warts, and keratosis. However, Allington took the position of liquid N_2 for the treatment of many skin lesion conditions after 1950 [70].

RFA therapy

RFA is a minimally invasive method that uses high-frequency electrical currents to create a hyperthermic environment to kill cancer cells. Needle electrodes are guided into a tumour cell using imaging methods, including ultrasound, computed tomography, or magnetic resonance imaging (MRI). RFA is often the best method for treating small-size tumours with a diameter of less than 3 cm. RFA can be used with other traditional cancer therapy modalities. RFA may treat medium tumours (up to 5 cm in diameter) after deployable devices or multiple-electrode systems have been introduced.

Gene therapy

In order to treat a particular condition, a faulty gene is replaced with a healthy copy in a process known as gene therapy. The adenosine deaminase (ADA) gene was initially delivered to T cells in individuals with severe combined immunodeficiency (SCID) in 1990 using a retroviral vector. Two-thirds of the over 2900 active clinical studies for gene therapy are focused on cancer. For cancer gene therapy, methods including the production of proapoptotic and chemosensitizing genes, wild-type tumour suppressor genes, genes able to elicit certain anti-tumour immune responses and targeted silencing of oncogenes are being considered [71].

For the injection of the prodrug ganciclovir to stimulate its expression and produce particular cytotoxicity, thymidine kinase (TK) gene delivery is efficient. The p53 tumour suppressor gene, which is carried via vectors, has recently been evaluated for therapeutic use. When taken alone or with chemotherapy, ONYX-015 demonstrated a good response rate in NSCLC patients. When paired with radiation, gendicine, a recombinant adenovirus containing wild-type p53, caused full disease regression in head and neck squamous cell carcinoma.

The correct circumstances and the finest delivery method to use are two issues that have been encountered with gene therapy. The therapy's genomic integration, limited effectiveness in some patient subgroups, and significant risk of immune system neutralization have all been identified as downsides. The effective method of RNA interference (RNAi), which may result in targeted gene silence, has been applied in basic research and medicinal translation. The messenger RNA (mRNA) is cut by the RNA-induced silencing complex (RISC), which also interferes with protein synthesis, to facilitate the targeted gene silencing process. It is possible to create siRNAs to disrupt specific targets, such as cell proliferation and metastatic invasion; as a result, particular molecular processes are a catalyst for tumour development. This approach depends on siRNA-mediated gene suppression of transcription factors (such as the c-myc gene), anti-apoptotic proteins, or cancer-related gene mutations (such as K-RAS).

Safety, excellent effectiveness, specificity, few adverse effects, and inexpensive production costs are benefits of siRNA-based medications. Sometimes, though, they can cause off-target effects or innate immune reactions that cause particular inflammation. There are several delivery strategies being investigated right now, including lipid encapsulation, conjugation with organic molecules (polymers, peptides, lipids, antibodies, small molecules), chemical modification (insertion of a phosphorothioate at the 3' end, introduction of a 2' O-methyl group, and modification by 2,4-dinitrophenol), and spontaneous cell membrane translocation of naked siRNAs. Simple electrostatic interactions between negatively charged nucleic acids and cationic liposomes make transfection simple and effective. They can be made up of N-[1-(2,3-dioleoyloxy) propyl]-N, Ntrimethylammonium methyl sulphate (DOTMA) and 1,2-dioleoyl-3-trimethylammonium propane (DOTAP).

In order to assess the safety of Eph receptor A2 (EphA2) targeting 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC) encapsulated siRNA (siRNA-EphA2-DOPC) in patients with advanced and recurring cancer, a Phase I clinical trial is now enrolling patients. In cationic polymers like chitosan, cyclodextrin, and polyethyleneimine (PEI), siRNAs can be concentrated. One of the cyclodextrin polymers coupled with human transferrin is entering a Phase I clinical study, and its name is CALAA-01. By creating tiny, cationic nanoparticles containing the human epidermal growth factor receptor 2 (HER-2 receptor)-specific siRNA, PEI has been employed as an anti-cancer agent. The evaluation of Local Drug EluteR (siG12D LODER), which targets the mutant Kirsten rat sarcoma (K-RAS) oncogene, for the treatment of advanced pancreatic cancer has begun as part of a phase II clinical study.

Enhancing cellular absorption of siRNAs by conjugating to peptides, antibodies, and aptamers increases stability throughout circulation. With the addition of nanocarriers, siRNAs' stability, pharmacokinetics, and biodistribution characteristics, as well as their targeting specificity, have been significantly enhanced. Polyallylamine phosphate nanocarriers were developed created to disassemble at low endosomal pH and release siRNAs into the cytoplasm.

Natural antioxidants

Daily exposure to several external insults, including ultraviolet (UV) rays, pollution, and cigarette smoke, causes the body to produce reactive species, mainly oxidants and free radicals, which are responsible for the development of a number of illnesses, including cancer. These molecules can also be produced as a result of the therapeutic administration of drugs, but they are also produced spontaneously by mitochondria and peroxisomes in our cells and tissues, as well as by the metabolism of macrophages during classic physiological aerobic activities [72].

By causing damage to DNA and other bio-macromolecules, oxidative stress and radical oxygen species can drastically alter how transcription factors are regulated.

Due to their inherent anti-inflammatory and antioxidant capabilities, vitamins, polyphenols, and bioactive chemicals produced from plants are utilised as preventative and therapeutic medications against harmful molecules that harm the body. Studies that recognised their proapoptotic and anti-proliferative capabilities were added to cancer treatment. Natural antioxidants that have been tested *in vitro* and *in vivo* include vitamins, alkaloids, flavonoids, carotenoids, curcumin, berberine, quercetin, and other substances.

One difficulty in using natural medicines in clinical settings is their low absorption and/or toxicity. At appropriate therapeutic levels; curcumin exerts cytotoxic effects on a variety of tumour types, including brain, lung, leukaemia, pancreatic, and hepatocellular carcinoma, while sparing normal cells. Studies are being conducted on the biological characteristics of curcumin, the length of therapy, and effective therapeutic dosages. About 27 clinical trials on curcumin are being completed now, while another 40 are being researched.

As a chemopreventive drug, berberine, an alkaloid molecule, has been shown via research to be effective against several cancers by modifying a number of signalling pathways. Due to their limited solubility in water, many nanotechnological techniques have been invented devised to help in their distribution through cell membranes. Six clinical trials are being investigated, and two have already been finished.

Another natural substance from plants, quercetin, has been shown to be helpful both on its own and in conjunction with chemotherapeutic drugs in the treatment of several malignancies, including lung, prostate, liver, colon, and breast cancers. The way quercetin works is by attaching to cellular receptors and disrupting various signalling pathways. Six clinical trials are being investigated at the moment, and seven investigations have been finished.

CONCLUSION

Oncology practises today concentrate on creating effective and secure cancer nanomedicines. Different approaches, including sequence medical care, siRNAs delivery, treatment, and inhibitor compounds, provide new potentialities to cancer patients. Targeted medical care assisted increase the biodistribution of current or already tested chemotherapeutical medicines around the target tissue to be treated. Direct in situ insertion of foreign genes into benign tumours is how gene therapy works. Because of their distinct biological effects on other cells, stem cells are particularly useful for regenerative medicine, therapeutic carriers, drug targeting, and the production of immune cells. On the other hand, intriguing replacements to the growth surgical procedure include thermal ablation and magnetic hyperthermia. In order to improve prognosis and outcomes, radionics and pathomics methods make it possible to handle enormous knowledge sets from cancer patients. Although many advances have already been accomplished, many more are anticipated to follow shortly, leading to an increase in the number of ad hoc personalised therapies. To improve treatment results, drug delivery methods must be developed and improved further.

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All the authors have contributed equally.

CONFLICTS OF INTERESTS

The authors confirm that the content of the article has no conflict of interest.

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