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Experimental Cancer Treatment: An Emerging Approach

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Introduction

Cancer

Cancer is a class of diseases in which a group of cells display uncontrolled growth (division beyond the normal limits), invasion (intrusion on and destruction of adjacent tissues), and sometimes metastasis (spread to other locations in the body via lymph or blood). These three malignant properties of cancers differentiate them from benign tumors, which are self-limited, do not invade or metastasize.

Causes

Cancer is a diverse class of diseases which differ widely in their causes and biology. The common thread in all known cancers is the acquisition of abnormalities in the genetic material of the cancer cell and its progeny. These abnormalities may be due to the effects of environmental risk factors such as UV radiation, viruses including hepatitis B and C, human papilloma viruses (HPV), chemicals, alcohol, high cholesterol diets or infectious agents, hereditary risk factors, hormonal imbalances and immune system dysfunction.

What Are the Options in Treating Cancer

The journey with cancer is a long, stressful and strenuous one. The treatment procedure itself may be detrimental to the emotional well-being of the patient. This is where complementary and alternative therapies have stepped in to offer holistic treatment. Complementary and alternative medicine (CAM)—also referred to as integrative medicine—includes a broad range of healing philosophies, approaches and therapies. These therapies are used in an effort to prevent illness, reduce stress, prevent or reduce side effects and symptoms.

The terms "complementary" and "alternative" are often used interchangeably, when in fact they are two different therapies. Complementary therapies such as acupuncture, aromatherapy, art therapy, counseling, massage, meditation, etc. are therapies which are given alongside conventional cancer treatments. The former, however, does not replace the latter. They play a supportive role and are only used in addition to standard treatments. Some commonly used methods of complementary therapy include mind-body control interventions such as visualization or relaxation; manual healing, including acupressure and massage; homeopathy; vitamins or herbal products; and acupuncture. Alternative therapies, on the other hand, are used instead of conventional treatments. Electromagnetic therapy, essiac (a mixture of herbs), iscador (mistletoe extract) and gerson therapy are some examples of alternative treatments.

Traditional or conventional treatment

Traditional or conventional treatment options may include surgery, chemotherapy, radiation, immunotherapy and hormonal therapy. These therapies have all been tested in clinical research trials and proven to be acceptable, safe and effective, although with often unpleasant side effects.

1. Surgery:

Surgery can cause certain side effects such as surgical anxiety, bleeding problems, blood clots (deep vein thrombosis), death, difficult breathing and infections after surgery.

2. Chemotherapy:

Chemotherapy can cause side effects like hair loss, an upset stomach, and sexual side effects such as loss of labido, erectile dysfunction, vaginal dryness, vaginal infections, and dehydration symptoms.

3. Radiation therapy:

Radiation therapy uses certain types of energy to shrink tumors or eliminate cancer cells.

High levels of radiation like those from radiation therapies and x-rays can damage normal cells and increase the risk of developing leukemia, as well as cancers of the breast, thyroid, lung, stomach and other organs.

4. Immunotherapy

Currently the vaccine is not recommended for pregnant women. It may cause soreness around the injection area.

5. Hormonal therapy

Removing or blocking estrogen or testosterone for treatment is a major drawback associated with hormonal therapy.

Experimental cancer treatments

These are medical therapies intended or claimed to treat cancer by improving on, supplementing or replacing conventional methods (surgery, chemotherapy, radiation, hormonal and

immunotherapy). Experimental cancer treatments include:

1. Bacterial treatments

Chemotherapeutic drugs have a hard time penetrating tumors to kill them at their core because these cells may lack a good blood supply. Researchers have been using anaerobic bacteria, such as Clostridium novyi, to consume the interior of oxygen-poor tumors. These should then die when they come in contact with the tumor's oxygenated sides, meaning they would be harmless to the rest of the body.

Another strategy is to use anaerobic bacteria that have been transformed with an enzyme that can convert a non-toxic prodrug into a toxic drug. With the proliferation of the bacteria in the necrotic and hypoxic areas of the tumor, the enzyme is expressed solely in the tumor. Thus a systemically applied prodrug is metabolized to the toxic drug only in the tumor. This has been demonstrated to be effective with the non pathogenic anaerobe Clostridium sporogenes [1].

2. Photodynamic therapy

Photodynamic therapy is generally a non-invasive treatment using a combination of light and a photosensitive drug. Photodynamic therapy uses photosensitive drugs such as 5-ALA, Foscan, Metvix, Tookad, WST09, WST11, Photofrin and Visudyne which are triggered by light of a specific wavelength.

3. HAMLET (human alpha-lactalbumin made lethal to tumor cells)

HAMLET is a molecular complex derived from human breast milk that kills tumor cells by a process resembling programmed cell death. HAMLET causes apoptosis and tumor cell death in tumor cells. HAMLET has broad antitumor activity in vitro, and its therapeutic effect has been confirmed in vivo in a human glioblastoma rat xenograft model, in patients with skin papillomas and in patients with bladder cancer [2].

4. Gene therapy

Introduction of tumor suppressor genes into rapidly dividing cells has been thought to slow down or arrest tumor growth. Adenoviruses are a commonly utilized vector for this purpose. Much research has focused on the use of adenoviruses which cannot reproduce, or reproduce only to a limited extent, within the patient to ensure safety via the avoidance of cytolytic destruction of noncancerous cells infected with the vector. However, new studies focus on adenoviruses which can be permitted to reproduce, and destroy cancerous cells in the process, since the adenoviruses' ability to infect normal cells is substantially impaired, potentially resulting in a far more effective treatment [3,4].

5. Telomerase therapy

Because most malignant cells rely on the activity of the protein telomerase for their immortality, it has been proposed that a drug which inactivates telomerase might be effective against a broad spectrum of malignancies. Currently, Inositol hexaphosphate, which is available over-the-counter, is undergoing testing in cancer research due to its telomerase-inhibiting abilities [5].

Geron Corporation is currently conducting two clinical trials involving telomerase inhibitors. One uses a vaccine (GRNVAC1) and the other uses a lipidated drug (GRN163L).

6. Hyperthermia therapy

Localized and whole-body application of heat has been proposed as a technique for the treatment of malignant tumors. Intense heating will cause denaturation and coagulation of cellular proteins, rapidly killing cells within a tumor.

There are many techniques by which heat may be delivered. Some of the most common involve the use of focused ultrasound (FUS or HIFU), microwave heating, induction heating, magnetic hyperthermia or direct application of heat through the use of heated saline pumped through catheters. Experiments have been done with carbon nanotubes that selectively bind to cancer cells. Lasers are then used that pass harmlessly through the body, but heat the nanotubes, causing the death of the cancer cells. Magnetic hyperthermia makes use of magnetic nanoparticles, which can be injected into tumors and then generate heat when subjected to an alternating magnetic field [6].

7. Dichloroacetate (DCA)

Dichloroacetate has been found to shrink tumors in vitro in rats [7]. These studies received attention in the media [8] and some doctors began controversially using the chemical off-label [9]. A small clinical trial has been planned with patients originating from the Edmonton area [10, 11].

8. Quercetin

In vitro, quercetin shows some antitumor activity. Cultured skin and prostate cancer cells showed significant mortality (compared to nonmalignant cells) when treated with a combination of quercetin and ultrasound [12].

9. Non-invasive RF cancer treatment

This preclinical treatment involves using radio waves to heat up tiny metals which are implanted in cancerous tissue. Gold nanoparticles or carbon nanotubes are the most likely candidate. Promising preclinical trials have been conducted [13, 14].

10. Insulin potentiation therapy

In IPT, insulin is given in conjunction with low-dose chemotherapy. Its proponents claim insulin therapy increases the uptake of chemotherapeutic drugs by

malignant cells, permitting the use of lower total drug doses and reducing side effects. Some In vitro studies have demonstrated the principle of IPT [15, 16].

Conclusion(s)

Complete removal of the cancer without damage to the rest of the body is the goal of treatment. Sometimes this can be accomplished by surgery, but the propensity of cancers to invade adjacent tissue or to spread to distant sites by microscopic metastasis often limits its effectiveness. The effectiveness of chemotherapy is often limited by toxicity to other tissues in the body. Radiation can also cause damage to normal tissue.

The three "proven" methods of treating cancer—chemotherapy, radiation, and surgery—may actually shorten life in many instances. Each of these treatments is invasive, has devastating side effects, and treats only symptoms. Each can cause the spread or recurrence of cancer.

Hence, a number of experimental cancer treatments are under development in which, alternative therapies share certain common features. They are relatively nontoxic, unlike chemotherapy and radiation, which destroy normal cells. They aim to cleanse the body, to stimulate its natural defenses and tumor-destroying capacity.

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