

Therapeutic innovations in cancer-the need for prevention

Abstract

Cancer ranks second after cardiovascular diseases for death. Breast and prostate cancer were the most common types of cancer among men and women, currently. Over the years, a lot of research has been done to detect cancer at an early stage so that it can be managed at an early stage to improve its prognosis and reduce its drastic outcomes. Prevention is better than cure. So, enormous research is carried out to develop an anti-cancer vaccine. Treating the disease process with target specific therapy than the conventional chemotherapy is preferred, which would not only minimize side effects but also result in a better prognosis and reduce the treatment period with better results and preventing recurrences.

Keywords: cancer, immunotherapy, bacteria, virus, stress, nanomedicine

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Introduction

The word cancer causes quite a bit of stir in the affected person's life. But it does not sojourn there and becomes a burden for the affected person and his/her close ones. Its impact affects the economical, psychological and social welfare of the patient, but still there is no guarantee that it will be cured, such is the course of the disease process. It has been found that cancer ranks second after cardiovascular diseases for death, which is quite disheartening. Cancer arises due to the abnormal growth of the cell, which is really difficult to understand for a common man. The etiology for such uncontrolled growth has been attributed to genetics, tobacco usage (smoke & smokeless form), bacteria, virus, stress, anxiety and many other.¹⁻³ Damage to the DNA of the normal cells is the cause for cancer. This can be attributed to the damage caused to the oncogenes and tumor suppressor genes by chemicals (carcinogens), radiation, viruses and also inherited from ancestors. Most carcinogens damage the DNA, which led to abnormal growth of cells. Cells with damaged DNA do not perish at the end of their life cycle, however normal cells die at the end of their life cycle at a stipulated period of time.^{1,2} Breast and prostate cancer were the most common types of cancer among men and women, currently.^{4,5} Over the years, a lot of research has been done to detect cancer at an early stage so that it can be managed at an early stage to improve its prognosis and reduce its drastic outcomes. Various instruments have been used to diagnose different types of cancer as their behavior varies from time to time and person to person.^{1,2} Apart from the traditional cancer therapy, monoclonal antibodies (mAbs), the immune checkpoint therapy, adoptive cancer therapy and cancer vaccines have helped in treatment and management of the disease process.⁶

Further bacterial and viral organisms which are responsible for the disease process have also shown the capability of treating the disease process. The use of bacteria to treat cancer is not something new and is prevalent since 1893. The Mycobacterium bovis- Bacille Calmette Guérin (BCG) vaccine strain is used to treat bladder cancer whereas salmonella is used to transport several therapeutic agents

to the body, including anti-cancer medicines and genes.^{7,8} The latest being bacterial-based gene-directed enzyme prodrug therapy which is quite impressive at this stage.^{9,10} Even though viruses have been strongly associated with cancers in more than 20% of cancer cases, yet the discovery of virus as a potential therapeutic agent is not far as a group of scientists have used reo-virus to attack cancer affected brain cells while sparing the healthy unaffected normal cells.¹¹⁻¹³ Prevention is better than cure. Therefore, enormous research is carried out to develop an anti-cancer vaccine. The primary role of anti-cancer vaccine is the activation and proliferation of T cells and can induce Interferon γ (IFN- γ) secretion, which elicits the expression of programmed death ligand 1 (PD-L1) in the tumor and thus induces adaptive immune resistance.^{14,15}

Vaccine specific for tumor antigens may not only be specific in treating cancers but also have wide applications with utility for cancer prevention of recurrence in several diverse malignancies. For this purpose peptides which can be easily produced, standardized, and administered is recommended.^{16,17} The strategy of genetically modified tumor cells with major histocompatibility complex (MHC) class II transcriptional activator CIITA has been applied for the production of a novel generation of anti-tumor vaccine against human hepatocarcinoma that is now in clinical trial.¹⁸ Further, there is constant research in dendritic vaccines as an immunotherapeutic agent.

The US Food and Drug Administration (FDA) has approved some vaccines like Provenge, and T-VEC which were specifically approved for the treatment of melanoma.^{19,20} Clinical trials of personalized cancer vaccines in humans have unmasked the viability, safety and the immunotherapeutic activity of targeting individual tumor mutation signatures.^{11,21} Another new emerging trend in treating cancer is the use of Neo-antigen cancer vaccines (NCVs). Their use in the prevention of recurrent melanoma was reported in July 2017 by two research teams simultaneously as being quite impressive as they were specific for the disease process.^{22,23} The conventional cancer therapeutics includes ligand or receptor based targeting,

triggered release, intracellular drug targeting, gene delivery, cancer stem cell therapy, magnetic drug targeting and ultrasound mediated drug delivery, have added new modalities for cancer treatment. As the methods are cell specific and affect only the malignant cells, it helps in reducing the side effects during the treatment process. Further targeting the genome sequences helps in ascertaining the biomarkers and the fabrication of personalized vaccines which are tumor specific neoantigens.^{12,23}

The addition of cancer vaccines to the conventional immunotherapy, especially T cell checkpoint blockade is gaining popularity. It is no surprise that immunotherapy and chemotherapy together are a great combination, however the use of chemotherapy followed by immunotherapy has been found to be beneficial in recent studies.^{7,8} Also the use of microchips is nothing new and is being replaced with nanomedicine, nanowires and nano-cantilever, nanodevices.^{24,25} Further the advent of “self-regulating” nanoparticle by scientists from U.K and China which is able to expose tumors to heat while avoiding contact with healthy tissue is the new technological advancement.¹¹

Conclusion

Over the years enormous research has been done with a substantial amount of time, money and other factors being consumed to treat the disease process. With this being said, it may be time to move forward with the current knowledge and start treating the disease process with target specific therapy than the conventional chemotherapy is preferred, which would not only minimize side effects but also result in a better prognosis and reduce the treatment period with better results and preventing recurrences.

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Conflicts of interest

Author declares that there is no conflict of interest.

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