Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Spl Issue [1] January 2023 : 01-05

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

REVIEW ARTICLE **OPEN ACCESS**

A Review on Cancer therapies and vaccine

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ABSTRACT
Cancer is the unchecked expansion of cells whose DNA expression has been damaged. Depending on its type, cancer or neoplasm can be benign or malignant. The malignant cells divide continuously, displacing healthy tissue. Benign cancer stays within its original tissue, whereas malignant cancer can spread to other organs. Worldwide, cancer will be responsible for around 10 million deaths in 2020, or one in every six. Carcinoma, Lymphoma, Sarcoma, Leukaemia, and Brain and spinal cord tumours are the most prevalent types of cancer. Today, a variety of cancer treatments are accessible, including surgery, radiation, chemotherapy and immunotherapy. Numerous variables affect a person's risk of developing cancer. According to research, actions like quitting smoking and keeping a healthy weight can lower the risk of developing cancer. Cancer prevention measures like vaccination may work. Immunotherapy like cancer vaccines has the potential to strengthen the immune system. There are numerous cancer vaccines being tested. This review's objective is to inform readers of the need for and progress of cancer vaccines.
Keywords:*Cancer, Tumor cells, Cancer vaccine, Cancer treatment.*

Received 20.11.2022 Revised 30.11.2022 Accepted 28.12.2022

INTRODUCTION:

A condition known as cancer takes place when some body cells develop out of control and spread to other body regions[1]. Different cell death methods are used by organisms to get rid of extra cells produced during development as well as potentially dangerous cells caused by pathophysiological circumstances. The most researched among them is apoptosis, and almost it was referred to as a significant defence plant that prevents cells from developing the ability to become tumors[2]. Leukaemia is one type of cancer that does not produce tumours. A cancer kind called leukaemia damages the body's forming tissues, including the lymphatic system and bone marrow [3]. Tests are performed once a malignancy is discovered to direct its size and whether it has gotten out of its original site. We refer to this as the cancer stage. A lower stage indicates that cancer has not spread widely. A higher number indicates that it has spread more widely. The final stage is the highest. When deciding on a person's optimal course of therapy, cancer's stage is crucial[4.] Primary cancer, also known as the primary site, refers to the location in the body where cancer first appears. Other bodily parts may become infected by cells that have spread from the initial site. When these cells continue to multiply, new tumours may develop. We refer to these as metastases or secondary malignancies.

Types of cancer:

- **Carcinoma:** 80% to 90% of all cancer diagnoses for carcinoma, which is the most prevalent type of cancer. Carcinoma develops in the epithelial tissues that line your skin, internal organ passages, and organs[25]. Carcinoma manifests as tumours and can develop everywhere in the body, including the skin, lungs, breasts, prostate, colon, kidneys and pancreas [5].
- **Sarcoma:** One uncommon form of Cancer is a sarcoma. Because they occur in a different type of tissue, Sarcomas differ from the much more Prevalent Carcinomas[25]. Cells that join or support other types of tissues in your body, known as connective tissue, are where Sarcomas develop [6].
- **Leukaemia:** In leukaemia white blood cells are malignant[25].It begins in the bone marrow, along with other tissues that produce blood cells[7].
- **Lymphoma:** The body's network for battling sickness is called the lymphatic system. It contains the thymus gland, bone marrow, lymph nodes, and spleen [25]. Hodgkin's and non-Hodgkin lymphomas are the two main Varieties of lymphoma[8].
- **Myeloma:** Myeloma, often known as Multiple myeloma, is a type of bone marrow malignancy[25]. The body creates its blood cell in the bone marrow a spongy tissue found in the centre of several bones. Because the malignancy commonly affects several bodily areas, such as the spine, skull, pelvis and ribs[9].

- **Brain and Spinal Cord Cancers:** Gliomas are a typical primary tumour seen in the brain or spinal cord and are a form of cancer. It strands in the brain's glial cells, which cover it's neurons. We handle every kind of glioma, including Glioblastomas. This cancer kind is one of the most prevalent glioma subtypes in adults[10].

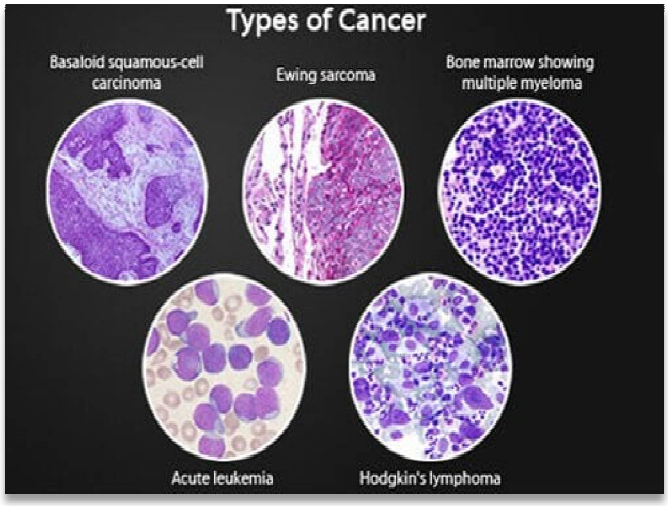

Figure 1: Types of cancer [25]

Cancer treatment: Chemotherapy, Surgery, Radiationtherapy, and Immunotherapy are used for cancer treatment[26].

i. **Chemotherapy**: Chemotherapy is a pharmacological therapy that targets your body's rapidly proliferating cells with potent chemicals. Chemotherapy is the most popular method used to treat cancer because cancer cells grow and multiply far more quickly than the bulk of body cells. There are numerous options for chemotherapy medications. In order for subsequent therapies, including Radiation therapy and Surgery, to be effective, a tumour can be shrunk using chemotherapy. Drugs used in chemotherapy are Melphalan, Busulfan, Capecitabine, 5 fluorouracil, Cyclophosphamide, Docetaxel, and Oxaliplatin[3].

ii. **Surgery:**Surgery Comes in a variety of forms. The types vary depending on the operation's goals, the body portion that needs surgery, the volume of tissue to be removed, and occasionally, the patient's Preferences. Surgery is used to treat a variety of malignancies. Solid tumours that are localised in one place respond best to surgery. It is a local treatment, which means that it just deals with the affected area of your body, leukaemia is not treated with it [11].

iii. **Radiation therapy -** About 50% of all cancer patients receive radiation therapy during their illness, demonstrating the continued importance of this form of treatment. Radiation therapy's primary objective is to deprive Cancer cells of their capacity for cell division and proliferation. Radiation is a physical substance that can be utilised to kill cancer cells. The radiation is referred to as ionising radiation because it creates ions and releases energy into the tissue's cells as it passes through. This energy can destroy cancer cells or result in genetic alterations that kill cancer cells[12].

iv. **Immunotherapy** - The immune system has created a sophisticated set of mechanisms toidentify and destroy cancer cells. Although these Pathways Can encourage the selection of tumour cells that can evade the host'simmune response, they also serve to prevent the development of malignancy. In addition to revolutionising the way that many solid and hematologic Cancers are treated, immunotherapies also came with unique toxicity Profiles that change based on the type of immunotherapy used and are linked to its particular mode of action[13].

v. **Microorganism is used for cancer therapy**: Magneto-tactic bacteria can be used for the cancer treatment. Microorganisms such as *E.coli, S. typhirium,* and *Magnetospirullum* can be used in targeted drug therapy as a microbial robots for cancer treatment (27)

Need for vaccine:

There is hope that the vaccination strategy could be effective against cancer. Over the last century, there have been innumerable attempts to test the theory in clinics. A firm basis & potent new tools are provided for advancement in cancer immunology based on exceptional insights from basic immunology to guide current efforts to build efficient cancer vaccines[14].

Cancer vaccine development strategies: A major challenge in cancer immunotherapy is evolving strategy a characteristically weak immune response of the host against tumour-associated antigens. Therefore, some vectors can be used to deliver recombinant genes in antigen-presenting cells.

- **Viral, Bacterial or Yeast Vector Vaccine:**
  Recombinant vector-based vaccines can inspire the immune system to create a strong inflammatory response, directed towards vector protein. This, in turn, can lead to an inflammatory response for enhanced immune responses against genes of interest, which are inserted into the vector. The choice of the vector can have important implications For the immune system against Tumour Associated Antigens because each vector has its own Feature & potentially uniquely stimulates the host immune system. Pox viral vectors are among the most utilized in vaccine development. Smallpox is totally eliminated from the world by using prototype Vaccinia [15].
- **Peptide Vaccine:**
  The goal of synthetic peptide vaccines is to stimulate & grow T cells that can either control or eradicate the tumour. Clinical experiments using peptide vaccines have yielded unsatisfactory outcomes, despite the great hopes based on preclinical investigations. As a result, many scientists in the field believe that peptide vaccines are no longer useful for treating cancer. However, recent advancements in knowledge of the crucial functions of immune adjuvant, delivery systems for vaccines and T-cell dynamics have resulted in a resurgence of peptide vaccines & rethinking the application of peptide vaccines in the management of malignant diseases [16].
- **Tumour cell vaccines:**
  Cancer cells taken from a patient following surgery are used to create tumour cells. In order to increase the likelihood of an immune response against these cells, these cells are subsequently destroyed & modified in the lab. Most tumour cell vaccines are called Autologous, which means that they were created using cells from the patient who will be receiving treatment [17].
- **DNA – RNA vaccine:**
  Recently, nucleic acid vaccines have been studied as a potential cancer treatment. Immune responses against cancer cells are triggered by the host after receiving genetic information encoding tumour antigens (TAs) via DNA & RNA vaccines. Nucleic acid vaccines are simple, safe & straightforward to produce, but they haven't been thought of as a real alternative to peptide vaccines up until now[18].

Challenges:

- **Choosing the right antigen**
  Historically live attenuated pathogens have been the main component of effective Vaccinations. Entire tumour-cell vaccinations pose a serious health risk, just like Vaccines based on whole viruses are linked to risk of reactivation and disease development.
- **Choosing the right adjuvant**
  whether a Cancer Vaccine is made up of entire cells, specific proteins, or peptides. ADJUVANTS are essential Components. Adjuvants can stimulate T cells more effectively by activating natural killer (NK) cells, antigen-presenting cells(APCs), or other innate system cells.
- **Generating the right type of immune response**
  Systemic immunity is anticipated to keep an eye on the systemic condition known as metastatic cancer. In addition to boosting the protective response, mucosal vaccinations must maintain this carefully managed equilibrium[19].The best chances for a general decrease in morbidity and mortality from this disease are still in the areas of cancer prevention and early detection, which remain to be the most promising areas for effective strategies. Despite the obvious progress made over the previous five years, a further obstacle is an enormous gap that still exists between basic research and clinical application [20].

Recent vaccines for cancer

1. **Cervical Cancer Vaccine**
   With 1.23 lakh incidences & over 67,000 fatalities each year, India represents nearly a fifth of the world's cervical cancer burden. The scientific development of CERAVAVAC. India's First qHPV vaccine, has been completed, according to Union Minister of Science & Technology Dr. Jitendra Singh, who made the announcement on Thursday. September 1, 2022 [21]. The Drug Controller General of India authorised CERAVAVAC, a Serum Institute of India-developed product, in July. The incident also demonstrated how important the Indian government's Department of Biotechnology was in allowing trials & funding for the vaccine candidate [22]. The HPV vaccines that were previously offered in India were made by foreign manufacturers & went for between Rs. 2000 to 3500 per dosage. CERAVAVAC is anticipated to cost between Rs. 200 and 400 making it much less expensive. The largest challenge will be finding enough funding & staff to adequately vaccinate the vast population of adolescent females between the ages of 9& 15 in order to provide early HPV protection [21]. The method used to create CERAVAVAC exposes VIP to the body in order to activate

an immunological response that results in the development of antibodies [22]. According to experts, immunisation programmes offered in schools can be successful. Since there are none at the moment, planning will need to be done in that direction [21].

2. **Brain cancer vaccine**
   The first brain cancer vaccine's global study showed that it can add years to life. The most prevalent & dangerous type of brain cancer is glioblastoma. A new brain cancer vaccine, DCVAX-L was evaluated globally & the result indicates that it may increase glioblastoma patients' Five-year survival rate by
   a factor of two. A patient's dendritic cells & biomarkers. from a sample of their own tumour are used to create DCVAX-L, a totally customised immunity therapy [23].
3. **Breast cancer vaccine**
   In order to stop the emergence of triple-negative breast cancer, researchers are developing the first–ever vaccination. Because the tumour cells test negative for three important receptors, it is known as TNBC.

1. Estrogen
2. Progesterone
3. HER2

These receptors are targets for a number of potent therapies for breast cancer. Because TNBC doesn't react to hormone treatments or targeted medicines, it is often more difficult to treat. The vaccine especially targets medicines, often more difficult to treat. The vaccine especially targets the milk protein a-lactalbumin also known as alpha-lactalbumin. It is occasionally referred to as a "retired protein" and is typically absent from nonlactating individual tissues. But it does happen in the majority of TNBC cases. The vaccine, also known as the aLA breast cancer vaccine, is expected to function similarly to vaccines that treat infectious disorders [24].

Table 1: Types of cancer and their vaccines

Cancer type	Name of vaccine
Cervical cancer	CERAVAVAC
Brain cancer	DCVAX-L
Breast cancer	aLA breast cancer vaccine

CONCLUSION:

In future, cancer vaccines will be more effective than the current vaccines. Advances in cancer vaccines will make it easier for us to fight against cancer. From this review, we suggest that the targeted drug therapy is more important to reduce side effects of therapies on patients. For targeted therapy, use of microorganisms is one of the best options.

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CITATION OF THIS ARTICLE

A. Shinde, A. Pawar, A. Jadhav, B. Pawar and N. Josh: A Review on Cancer therapies and vaccine. Bull. Env. Pharmacol. Life Sci., Spl Issue [1]: 2023:01-05.