Cancer Vaccines - A Promising Frontier in Oncology

Cyriac Thomas[a]

a. Editor, KMJ; Consultant Physician, Department of Medicine, Marian Medical Centre, Arunapuram, Pala*

Published on 30th December 2024

ABSTRACT

Cancer remains one of the leading causes of death worldwide, prompting extensive research into innovative therapeutic strategies. Among these, cancer vaccines have emerged as a promising approach to prevent and treat various types of cancer. This review article explores the development, mechanisms, types, and current status of cancer vaccines, along with their challenges and further prospects.

INTRODUCTION

Cancer vaccines are produced to stimulate and enhance the body's immune system to identify, recognize and neutralise cancer cells. Unlike traditional vaccines that prevent infectious diseases, cancer vaccines can be classified into two main categories: preventive (prophylactic) vaccines and therapeutic vaccines. Preventive vaccines aim to avert cancer development, while therapeutic vaccines are intended to treat existing cancers.

MECHANISMS OF ACTION

Cancer vaccines work by introducing antigens—substances that provoke an immune response—associated with cancer cells. The immune system, upon identifying these antigens, mounts a response that can include the activation of T cells, and B cells, and the production of antibodies. This immune response can lead to the destruction of cancer cells and potentially provide long-lasting immunity against recurrence.

TYPES OF CANCER VACCINES

Preventive Vaccines:

HPV Vaccine: The human papillomavirus (HPV) vaccine is a notable example, which protects against cervical and other cancers caused by HPV.

HBV Vaccine: The hepatitis B virus (HBV) vaccine reduces the risk of liver cancer.

Therapeutic Vaccines:

Sipuleucel-T (Provenge): This is the first FDA-approved therapeutic cancer vaccine for prostate cancer, utilizing a patient's own dendritic cells.

T-VEC (Talimogene laherparepvec): An oncolytic virus therapy that selectively infects and destroys cancer cells, approved for melanoma treatment.

Neoantigen Vaccines: These are personalized vaccines designed based on the unique mutations present in an individual's tumor, allowing for a tailored immune response.

DNA and RNA Vaccines: These vaccines use genetic material to instruct cells to produce antigens, thereby eliciting an immune response.

CURRENT STATUS AND CLINICAL TRIALS

Numerous clinical trials are ongoing to evaluate the safety and efficacy of various cancer vaccines. The results have been promising, with some vaccines showing significant improvements in survival rates and quality of life for patients. However, the complexity of the immune response and tumor microenvironment poses challenges in achieving consistent results across different patient populations.

Challenges in Cancer Vaccine Development

Tumor Heterogeneity: Variability within tumors makes it difficult to identify universal antigens that can be targeted effectively.

Immune Evasion: Cancer cells often develop mechanisms to evade immune detection, hindering the effectiveness of vaccines.

Cite this article as: Thomas C. Cancer Vaccines - A Promising Frontier in Oncology. Kerala Medical Journal. 2024 Dec 30;17(4):198–9. | DOI: https://doi.org/10.52314/kmj.2024.v17i4.677

Corresponding Author:
Dr. Cyriac Thomas, Editor, KMJ; Consultant Physician, Department of Medicine, Marian Medical Centre, Arunapuram, Pala
Email : doccyri@gmail.com

Regulatory Hurdles: The approval process for cancer vaccines can be lengthy and complex, requiring extensive clinical data.

FUTURE PROSPECTS

Russia recently announced the development of a new vaccine which is a personalized mRNA cancer vaccine that is expected to be available in early 2025.

The vaccine is a type of immunotherapy that trains the body's immune system to fight cancer. It can be customized to each patient based on a genetic analysis of their tumor.

Russia's mRNA cancer vaccine uses artificial intelligence to create a personalized treatment based on a genetic analysis of the patient's tumor.

The vaccine identifies mutations in the tumor called neoantigens. Pre-clinical trials have shown that it can suppress tumor growth and metastasis. Further details of the vaccine is yet to be publicised.

The future of cancer vaccines appears promising, especially with advancements in personalized medicine and immunotherapy. Combining cancer vaccines with other treatments, such as checkpoint inhibitors, may enhance efficacy. Ongoing research into the tumor microenvironment and immune modulation will further refine vaccine strategies.

CONCLUSION

Cancer vaccines represent a transformative approach in the fight against cancer, with the potential to improve patient outcomes significantly. Continued research and clinical trials are essential to overcome existing challenges and unlock the full potential of cancer vaccines in oncology.

END NOTE

Author Information

Dr. Cyriac Thomas, Consultant Physician, Department of Medicine, Marian Medical Centre, Arunapuram, Pala

Conflict of Interest: None declared

REFERENCES

1. Pardoll, D. M. (2012). The blockade of immune checkpoints in cancer immunotherapy. Nature Reviews Cancer, 12(4), 252-264.
2. Melief, C. J. M., & van der Burg, S. H. (2008). Therapeutic cancer vaccines. Nature Reviews Cancer, 8(5), 351-360.
3. Bhardwaj, N., & Puri, R. K. (2019). Cancer vaccines: Current status and future directions. Cancer Immunology, Immunotherapy, 68(6), 929-943.