



Gene Therapy In Cancer

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Abstract :

- Cancer remains a leading cause of mortality worldwide, posing a significant challenge to modern medicine.
- While conventional therapies such as chemotherapy and radiation have made strides in treating cancer, their efficacy is often limited by severe side effects and the development of drug resistance.
- Gene therapy, a revolutionary approach that directly targets the genetic basis of cancer, offers a promising alternative.
- This review provides a comprehensive overview of gene therapy in cancer, encompassing its diverse applications, methodologies, and clinical outcomes.
- We discuss the mechanisms of action, challenges, and future directions of gene therapy, highlighting its potential to personalize cancer treatment and improve patient outcomes.
- Furthermore, we explore the ethical considerations associated with this rapidly evolving field, emphasizing the importance of responsible research and clinical translation.

Keywords:

Cancer treatment, Gene therapy, Conventional therapies, Chemotherapy,

Introduction:

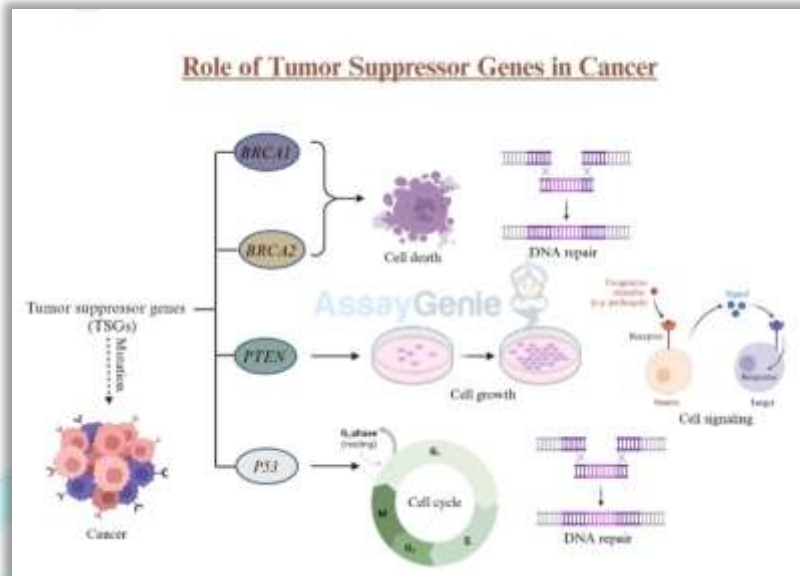
- Gene therapy involves the transfer of genetic material into cells to treat or prevent disease. In the context of cancer, gene therapy aims to modify the genetic makeup of cancer cells or the patient's immune system to target and eliminate the tumor. This approach offers several advantages over traditional cancer therapies, including enhanced specificity, reduced side effects, and the potential for long-lasting remission.
- **Gene therapy strategies can be broadly categorized into two main approaches:**
- Gene replacement therapy
- Gene editing therapy

Gene replacement therapy involves replacing a mutated or malfunctioning gene with a functional copy. Gene editing therapy, on the other hand, uses specialized enzymes to modify the genetic code of cells, correcting or eliminating disease-causing mutations.

Future Scope of Gene Therapy in Cancer :

The future of gene therapy in cancer holds immense promise, driven by continuous advancements in technology and research. As our understanding of the genetic basis of cancer deepens, gene therapy approaches are poised to revolutionize personalized medicine, enabling targeted and effective treatments with minimal side effects.

Fig 1 – Role of Tumor Suppressor Genes in Cancer

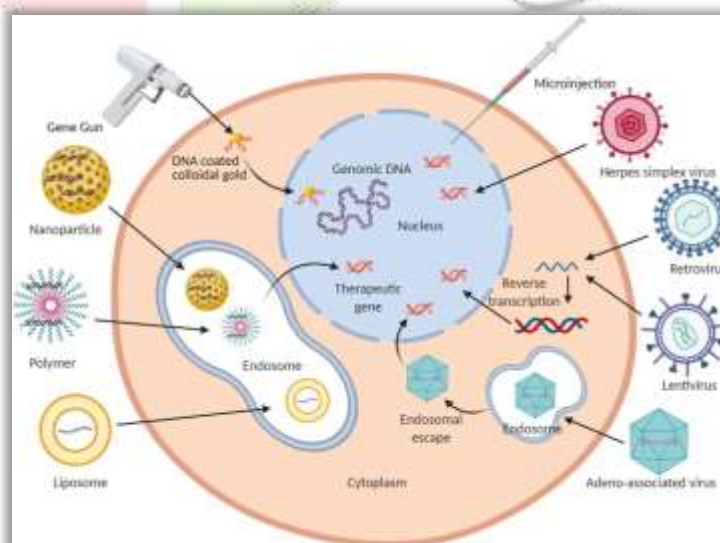


Review of Gene Therapy Methods in Cancer :

1. Tumor Suppressor Gene Therapy-

This approach involves delivering functional copies of tumor suppressor genes, such as p53, to cancer cells. These genes, when functioning properly, suppress tumor growth and promote apoptosis, the programmed death of cells. By restoring the expression of these genes, tumor suppressor gene therapy aims to inhibit tumor development and progression.

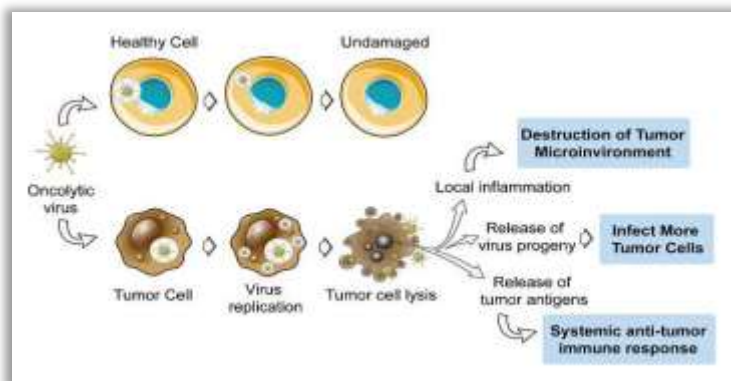
Fig 2 – Tumor Suppressor Gene Therapy



2. Oncolytic Virus Therapy-

Oncolytic viruses are genetically engineered viruses that selectively infect and destroy cancer cells. These viruses are often modified to target specific cancer cells, sparing normal cells. Once inside the cancer cell, oncolytic viruses replicate and spread, ultimately leading to tumor destruction.

Fig 3 – Oncolytic Virus Therapy



3. Immune Checkpoint Inhibition Therapy -

Immune checkpoint inhibitors are proteins that regulate the immune system's response to cancer cells. By inhibiting these checkpoints, gene therapy can boost the immune system's ability to recognize and destroy cancer cells. This approach has shown significant promise in treating a range of cancers, including melanoma and lung cancer.

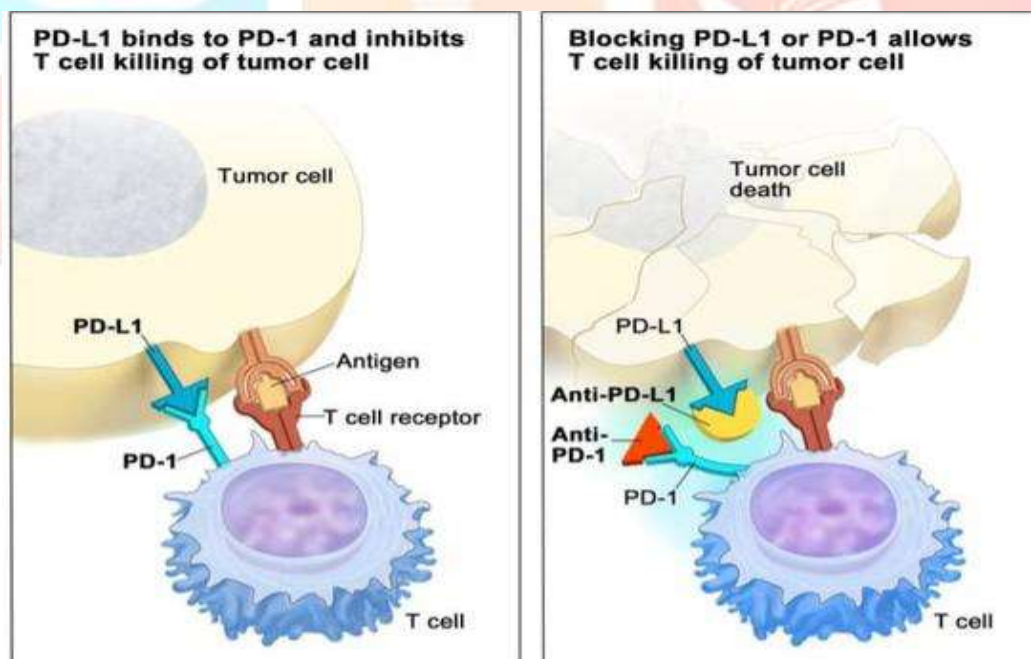


Fig 4 – Immune Checkpoint Inhibition Therapy

Conclusion :

Gene therapy has emerged as a promising treatment modality for cancer, offering the potential to overcome the limitations of traditional therapies. It provides a targeted and personalized approach, aiming to address the genetic underpinnings of cancer. While ongoing research is refining the methodologies and addressing challenges, the field holds immense promise for the future of cancer treatment.

However, several challenges remain. These include ensuring the safety and efficacy of gene delivery systems, addressing the potential for off-target effects, and developing cost-effective therapies. Despite these

challenges, ongoing research and clinical trials are paving the way for the development of gene therapy as transformative cancer treatment option.

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