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Gene therapy in cancer treatment

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Gene therapy for cancer is a new treatment in which genetic elements are delivered to the cancerous cells to correct the abnormalities in the cell or to induce an immune response against cancer. Basically, in gene therapy a healthy copy of a genetically engineered gene is transferred inside the body. The modified gene may replace the damaged gene, inactivate the mutated gene, or introduce new genes into the cancerous cell or to the surrounding tissues to cause death or retard the growth of cancer as the genetic function of the cells is altered due to the changes made. The prerequisites for gene therapy include finding the best delivery system for the gene, confirming whether the transferred gene can express itself in the host cell, and lastly, determining if the procedure to transfer the gene is safe. There are three main ways to transfer genes into tumour cells and they are viral vectors, nonviral vectors and cell-based vehicles. Commonly used viral vectors are adenoviruses (most dominantly used), retroviruses, etc. Viral vectors differ from each other in their cell tropisms, different transgene expression durations, etc. They are also differentiated into integrating and non-integrating vectors. Integrating vectors can integrate into the host genome while non-integrating ones lack that ability. Nonviral vectors are known as the replacement of viral vectors. They are basically naked plasmid DNA and the main advantages of nonviral vectors are lower levels of toxicity, easy formulation and inexpensive to produce.

The success of gene therapy using viral vectors depends on the various extracellular and intracellular barriers that affect the efficacy of all gene delivery systems. Lastly, cell-based vehicles are used to transfer genes as they are more stable, have tumour homing properties, and can be administered locally. The vehicles that are used in this process are related to body immunity so that they are not rejected by the host’s immune system. The success of gene therapy mainly depends on the targeting sites. Two types of targeting strategies are seen in gene therapy, namely physical targeting and biological targeting. Methods used in physical targeting are local injections, catheters, gene guns and electroporation. It is usually done for local delivery of gene therapy vectors. Biological targeting methods are used to modify viral and nonviral carriers so that they can bind only to cancer cells. Methods used for this purpose are transcriptionally targeted vector and transductionally targeted vector. Although most methods of gene therapy are still in clinical trials and have shown their efficiency only on some specific cancers, they have shown highly encouraging results and are believed to treat cancer properly if the drawbacks are taken care of.

Keywords: Adenovirus, Retrovirus, Gene gun, Transcription, Transduction, Cancer therapy, Gene therapy, Targeted therapy

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