The Gene Gun: Current Genetic Revolutionary Engineering Technique

ARTICLE INFO
Article history:
Received: 04 June 2017
Accepted: 08 August 2017

Online:
www.nbmc.ac.bd

The advancement in genetics and molecular biology research has generated an increased interest in the field of gene therapy among medical scientists. Several clinical applications have been recently attempted and many others appear to be on the horizon. Originally, gene therapy was introduced as a mechanism to replace absent or defective gene in heritable disorders. In fact many heritable disorders have well-characterized genetic defects, making them favourable targets for gene therapy. The gene therapy has evolved to include genetic vaccination, suicidal genes for cancer therapy, immunomodulation, genetic pharmacology, and others.[1-5]

Gene gun is a biolistic technique of genetic engineering which is commonly used to transfer the genetic material inserts into the cells by the particles coated onto small DNA sequences. The gun is fired at the cluster of the cells and the DNA sequences enter the desired cell. The method of gene gun is used in the laboratory and for the research purposes. The gene gun was introduced around 1987 when the researchers wanted to insert the genetic material into the organism.[6] The method was first developed for the plant cells but it is also applied in human and animals studies. With time, modifications are made in this method to make it more useful to perform its functions efficiently. With the many new innovations to the original device, the gene gun has evolved in terms of applications and efficiency. From a device that revolutionized plant breeding and engineering to one that is slowly moving towards revolutionizing medical treatments for a variety of significant diseases.

This technique has been revolutionized the science of genetic engineering which involves manipulating genes on microscopic gold or titanium particles (bullets) into living tissues. The high velocity acceleration of particle using gene gun may be provided by compressed gas, centripetal force (external force to move a body along a curved path), electric discharge, or firing explosives.[7] Acceleration provides the necessary force to puncture the cell membrane and deliver the materials into cells of living tissues. These cells become genetically modified and can be used for various purposes. When the genetic material is inserted into the cells, a genetic marker is also inserted with the bullet so that it can show that the genetic material has entered the cells successfully. Gene gun is conducted using two main methods such as microprojectile gun method involves the use of a gas driven gene gun that launches high velocity microprojectiles or microparticles, which are small particles composed of metals such as tungsten or gold.[8]

The DNA is first coated on microparticles and then delivered into tissues using gene gun. Currently, hand-held instruments has been developed to utilize the ballistic particle-mediated delivery system, commercially these devices are available such as the Helios gene gun (Bio-Red, Hercules, California) (Figure 1). This gene gun is convenient to use to allow rapid transfer of genes into various targets in living tissues. The major advantage of this technique is very easy to transfer genetic material in different traits in a single experiment.[9]

The gene gun method has potential to be used for a wide spectrum of clinical applications both *in vivo* and *in vitro*. However currently it is being used mainly for DNA vaccination and gene therapy for replacing defective gene that can cause disease or preventing illness and immunomodulation, treatment of cancer disease. Sometimes the cell does not produce the desired protein, for this reason the researcher use this method to force the cell to produce the specific protein.

Figure 1: Gene gun technology with the Helios gene gun (Bio-Red, Hercules, California)

The gene gun has brought molecular biological techniques to the forefront of medical study. The gene gun has played an increasingly significant role most prominently in cancer research and potential tumor elimination techniques. It has also aided in the growth of the burgeoning field of gene therapy by providing an efficient delivery method for transmitting therapeutic genes into the bodies of patients. With the development of the new modifications of gene gun design, and its safety and efficiency have become exciting for us and for the next few years, it is likely that gene guns could become one of the most common treatment tools in fields ranging from common vaccination to cancer therapy.

The gene gun has proven to be useful and potential in gene therapy research and clinical applications gene replacement, vaccines, immunomodulation and cancer therapy. The ability of gene gun to deliver genes to a variety of cell type offers distinctive advantages over other delivery systems. That's why the gene gun will likely remain a standard gene delivery technique in future gene therapy applications.

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