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Future of Gene Therapy

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Abstract: -
Although up to this point its success has been very limited and the fact that's its had many problems the most important of which being ethical problems. Gene therapy is a very prospecting technique that potentially can have many different therapeutic potentials. 2017 has been a pretty eventful year for gene therapy and this report will mainly aim to discuss the future gene therapy and some of the prospecting cases that it has had in the past year.

Introduction: -
Gene therapy is when DNA is introduced into a patient to treat a genetic disease. The new DNA usually contains a functioning gene to correct the effects of a disease-causing mutation. Gene therapy uses sections of DNA? (usually genes?) to treat or prevent disease. The DNA is carefully selected to correct the effect of a mutated gene that is causing disease. The technique was first developed in 1972 but has, so far, had limited success in treating human diseases. Gene therapy may be a promising treatment option for some genetic diseases including muscular dystrophy, and cystic fibrosis,
There are two different types of gene therapy depending on which types of cells are treated:

1. Somatic gene therapy: transfer of a section of DNA to any cell of the body that doesn't produce sperm or eggs. Effects of gene therapy will not be passed onto the patient's children.
2. Germline gene therapy: transfer of a section of DNA to cells that produce eggs or sperm. Effects of gene therapy will be passed onto the patient's children and subsequent generations. [1]

There are three main different techniques for gene therapy the first of which being Gene augmentation therapy, This method is used to treat diseases caused by a mutation that stops a gene from producing a functioning product, such as a protein?.
This therapy adds DNA containing a functional version of the lost gene back into the cell. The new gene produces a functioning product at sufficient levels to replace the protein that was originally missing. This is only successful if the effects of the disease are reversible or have not resulted in lasting damage to the body.
For example, this can be used to treat loss of function disorders such as cystic fibrosis by introducing a functional copy of the gene to correct the disease. The second method being Gene inhibition therapy which is suitable for the treatment of infectious diseases, cancer and inherited disease caused by inappropriate gene activity. The aim is to introduce a gene whose product either: inhibits the expression of another gene interferes with the activity of the product of another gene.[2]
The basis of this therapy is to eliminate the activity of a gene that encourages the growth of disease-related cells. For example, cancer is sometimes the result of the over-activation of an oncogene? (Gene, which stimulates cell growth). So, by eliminating the activity of that oncogene through gene inhibition therapy, it is possible to prevent further cell growth and stop the cancer in its tracks. The last technique is Killing of specific cells this is suitable for diseases such as cancer that can be treated by destroying certain groups of cells. The aim is to insert DNA into a diseased cell that causes that cell to die. This can be

achieved in one of two ways: the inserted DNA contains a "suicide" gene that produces a highly toxic product which kills the diseased cell the inserted DNA causes expression of a protein that marks the cells so that the diseased cells are attacked by the body's natural immune system. It is essential with this method that the inserted DNA is targeted appropriately to avoid the death of cells that are functioning normally.[2]

Discussion: -

The first case that will be discussed in this report is a case about hemophilia, which is a medical condition in which the ability of the blood to clot is severely reduced, causing the sufferer to bleed severely from even a slight injury. The condition is typically caused by a hereditary lack of a coagulation factor, most often factor VIII. Researchers have scored their first clear success in using gene therapy to treat hemophilia, an inherited blood disorder. Ten men received a single intravenous infusion of a harmless virus ferrying a gene for factor IX, a blood-clotting protein missing in people with hemophilia B. Up to 18 months later, the men's livers are making, on average, 34% the normal level of factor IX. That's enough that nine of the 10 patients have had no bleeding episodes, researchers report today in *The New England Journal of Medicine*. What's more, eight of the 10 no longer need factor IX injections every few days. Previous gene therapy trials for hemophilia B didn't go well, either because patients' immune systems destroyed the modified cells or the cells didn't make enough factor IX. In the new trial, sponsored by Spark Therapeutics and Pfizer, researchers gave the patients' liver cells the gene for an unusually potent version of the factor IX protein. That allowed the team to lower the vector dose, minimizing immune responses. Two patients had elevated liver enzymes in reaction to the vector, but those levels came down after they received steroids. Only 20% of hemophilia patients have the B form, but efforts are also underway to use gene therapy to treat the most common type, hemophilia A.[3] The second case is about sickle cell disease, In March, researchers announced that a teenage boy in France had been cured of sickle-cell disease after receiving an experimental gene therapy developed by Bluebird Bio. Caused by a single genetic mutation, sickle-cell is an inherited blood disorder that affects 100,000 people in the U.S. and millions around the world. Scientists removed stem cells from the boy's bone marrow and modified them in the lab by introducing copies of a gene to prevent his red blood cells from becoming "sickled." When the treated cells were infused back into his body, they began to make normal blood cells. More than two years after treatment, the patient has enough normal red blood cells to evade any side effects of the disorder.[4] Third case is about building new skin. This is when a bacterial infection threatened his life, a boy with a devastating connective tissue disorder called epidermolysis bullosa got new skin created with gene therapy. To make it, scientists extracted cells from a part of the child's body that wasn't blistered. They isolated skin stem cells and added copies of a healthy version of the gene. They let these cells grow into small sheets and, in a series of three surgeries, transplanted them onto the patient's body at a hospital in Germany. Researchers announced the groundbreaking skin graft in November. Gene therapy like I stated earlier gene therapy has a bright future but it has many different challenges some of which are Delivering the gene to the right place and switching it on: it is crucial that the new gene reaches the right cell delivering a gene into the wrong cell would be inefficient and could also cause health problems for the patient even once the right cell has been targeted the gene has to be turned on cells sometimes

obstruct this process by shutting down genes that are showing unusual activity. Avoiding the immune response: The role of the immune system is to fight off intruders. Sometimes new genes introduced by gene therapy are considered potentially-harmful intruders. This can spark an immune response in the patient, that could be harmful to them. Scientists therefore have the challenge of finding a way to deliver genes without the immune system 'noticing'. This is usually by using vectors that are less likely to trigger an immune response. Making sure the new gene doesn't disrupt the function of other genes: Ideally, a new gene introduced by gene therapy will integrate itself into the genome of the patient and continue working for the rest of their lives. There is a risk that the new gene will insert itself into the path of another gene, disrupting its activity. This could have damaging effects, for example, if it interferes with an important gene involved in regulating cell division, it could result in cancer but the important problems are ethical.[5]

Conclusion: -

In conclusion gene therapy has a very bright future in treating different disease and it has had some promising success in the past two years, with some different diseases. Although it has had some success gene therapy still has to overcome many of the challenges it's facing and in my opinion the most important of which is ethical problems.

References:-

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