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Regeneration of the tissue with antibiotic resistance through stem cell gene therapy

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ABSTRACT

Stem cell therapies have always been a great platform to cure any disease. They can replace, repair, regenerate and have the capability of self-renewal. The process of introducing the desired antibiotic resistance gene into the stem cell enhances the defense mechanism of our body without the usage of drugs and chemicals. We can overcome the problem of arising tumors and mutations, by introducing controllers to confine the action of the desired gene to provide only resistance. If at all, the tumors develop, we can destroy them in their initial stages as all the genes of that regenerating part are under our control and observation.

Keywords— *Gene therapy, Abnormal genes, Stem cell gene therapy, Induced pluripotent stem cell, Desired gene, Vectors, Antibiotic resistance gene, In vitro, Mutations, Tumors, Cancers, Biomarkers, Controllers*

1. INTRODUCTION

Nowadays stem cells are being used as a panacea for almost all diseases due to their ability to regenerate tissues and organs. Pluripotent stem cells, as well as the induced pluripotent stem cells, were involved in breakthrough inventions over world wide. Regenerating the tissue by stem cells has a great impact in curing many diseases. But still - something working doesn't mean that it cannot be improved. Applying the theory of expressing the desired gene in plants through vectors, we can also improve the stem cells' ability to not only regenerate tissue but also with resistance against a particular disease.

Gene therapy is an experimental technique that uses genes to treat or prevent disease. Gene therapy is designed to introduce genetic material into cells to compensate for abnormal genes. The approach of introducing the resistance genes in stem cells might sound familiar to gene therapy procedure but, when we compare both - the uniqueness that lies in stem cell gene therapy is that unlike the gene therapy it is not involved in correcting genes, rather it is involved in providing a resistance to the cell and generating a whole tissue with resistance.

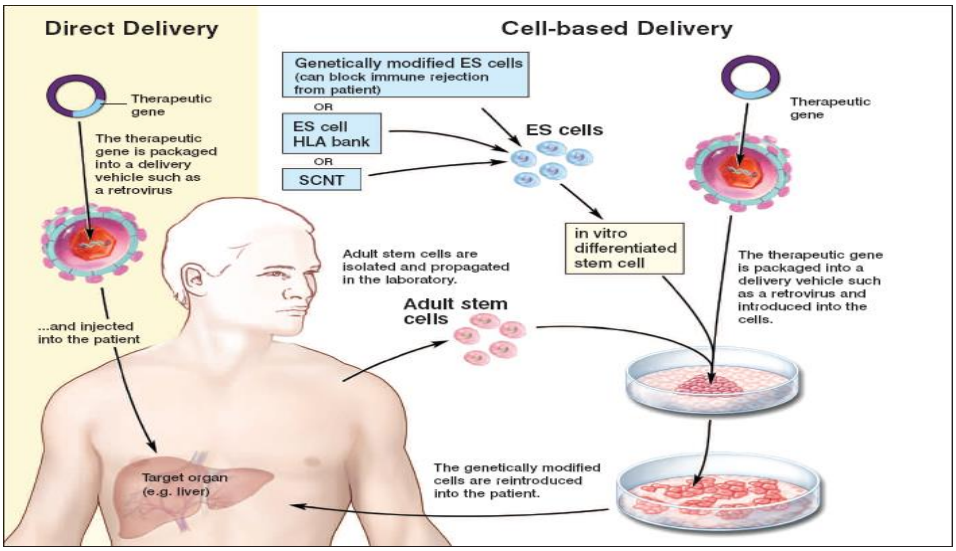
2. BACKGROUND

In our body, there are millions of cells that are involved in various metabolic activities. Among these many cells, we have a special cell type called a stem cell. The characteristic feature which differentiates the stem cells from all other cells is its capacity to become any cell type except the placenta. There are three types of stem cells present in our body – Embryonic stem cells, adult stem cells, Induced pluripotent stem cells (iPSC). Though all three types are stem cells, their function has some restrictions like, adult stem cells that are present in almost all the adult tissues such as bone marrow, heart, skin, teeth, peripheral blood, gut, and liver can develop into only limited cell types. Their function is restricted to a few cell types. But when coming to embryonic stem cells - these are the highly potent stem cells derived from the inner cell mass of the blastocyst. They are also called as pluripotent, which are capable of developing into any cell type present in our body. Compared to adult stem cells, embryonic stem cells have more applications due to this characteristic feature. But, as these are derived from the pre-implantation embryo, there is fetal destruction while isolating these cells. Thus, to overcome this problem, many trails were made and it resulted in a new type called induced pluripotent stem cells. By isolating the adult stem cells, pluripotency is induced in them. Adult stem cells are readily available and can be isolated without any harm.

3. DESCRIPTION

Stem cells have been widely used in replacing the damaged cells as they have a self-renewal mechanism. The stem cell divides and produces daughter cells that are identical to the original stem cells. Although all are stem cells, their potency makes them

more efficient to become any cell type or restricted to form only a few cell types. Only morula stage stem cells can form all the tissues including placenta, these are called as Totipotent or Omnipotent cells, which have the capacity to form a complete organism. Embryonic stem cells come next to the totipotent ones. They can divide into almost all the cells excluding extraembryonic cell types such as placenta. Multipotent- these stem cells are capable of differentiating into many cells, which are of only closely related cell types. Oligopotent – they either develop into myeloid or lymphoid cell types. Unipotent - they can form only one type. All these stem cells can be identified from the normal ones by the presence of a specific set of cell surface markers. Adult stem cells are reprogrammed by inserting the transcription factors like Oct 3/4, SoX2, Klf4 and c-Myc in cells by using retroviral or lentiviral vectors to form induced pluripotent stem cells. [In another case, where adeno or Sendai virus are used as alternative vectors, but they do not integrate into the genomic DNA.]

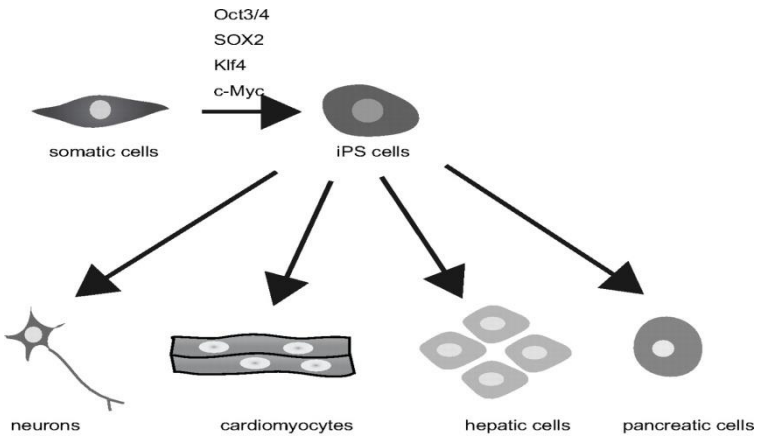


4. MATERIALS AND METHODOLOGY

Embryonic stem cells are present in the inner cell mass of the blastocyst and adult stem cells are found in almost every organ. The stem cells isolation, culture, and the media that should be used, will depend on the type of stem cells we experiment with. Human, mouse and other embryonic stem cell lines are available through commercial vendors. We consider mouse stem cells as our experimental source.

This experimental technique involves:

- Isolation of the stem cells from peripheral blood.
- Inducing the pluripotency by co-operating the transcription factors into the isolated adult stem cells to form iPSC.
- Selection of the desired gene with antibiotic resistance.
- Incorporating the desired gene into the stem cell.
- Cross-checking the extent of integration of the desired gene in the stem cell under laboratory conditions, as there is a chance of cultured stem cells to undergo phenotypic and genotypic changes.
- Incorporating the controllers along with the desired gene into the stem cells to inhibit the tumor formation and cease the action of causing mutations by the desired gene.
- Re-introducing the stem cells from where they have been isolated.
- Steady observation of the gene expression in giving antibiotic resistance.



5. RESULT

Reprogrammed somatic stem cells expressed the desired gene but along with some backdrops. It started forming tumors and, in some cases, it altered the genes and caused a disturbance in the function of adjacent cells. Insertion of the controllers had resolved the problem in both cases by confining the function of the desired gene to express only resistance to some extent.

6. CONCLUSION

Introducing the desired gene into the stem cell-expressed the resistance. The proliferation of these cells formed a tissue, which is not only a means of replacing a damaged cell but also making it resistant towards a particular damage/infection.

The principle of inducing resistance can be applied to various bacterial, fungal or even viral infections. Resistance induced stem cells gene therapy assures that the infection cannot be reoccurred. Everything under the medical and laboratory is organized and regulated.

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