The Implementation of CRISPR Cas_9 in Providing Present Day Solutions to Type 2 Diabetes

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Abstract

- Affecting approximately 95% of diabetic patients, Type-2 Diabetes Mellitus (T2DM) is a common chronic disease seen globally. Exhibited in 81% of patients diagnosed with Alzheimer's, T2DM is further considered a potential pathway to the development of Alzheimer's Dementia (AD). Recent studies suggest individuals affected by Alzheimer's are in a "diabetic state," due to their decrease of insensitivity to insulin deeming it a third type of diabetes. Although diabetics can control their condition through the use of insulin and inhibitors, those affected by T2DM are still at a high risk of eventually developing AD. As society advances, the gap between technology and medicine has been bridged to create more efficient devices to help combat medical challenges. Seen in the field of gene therapy, one such therapeutic approach has entered a new era, with the dawn of Clustered Regularly Interspaced Short Palindromic Repeats Protein 9 (CRISPR Cas_9). Though it was always available in nature, this procedure has been rediscovered to tame into a genome editing tool, allowing for the precise and prompt modification of DNA in a genome. This literature review examines studies conducted on CRISPR Cas_9 and its genetic role in the body while simultaneously exploring how it can effectively be applied to potentially provide present-day solutions to T2DM and accordingly AD. Preliminary work related to CRISPR Cas_9 experimentation in rodent studies with T2DM provided a therapeutic effect lasting four weeks longer than the usual daily dosage need of Sitaglibin, an anti-diabetic medication. Recognized globally, CRISPR Cas_9 is a revolutionary approach, providing physicians the opportunity to rewrite life-threatening illnesses with a simple insertion or deletion of a gene, and can be seen as a stepping stone in the evolution of medicine.

Background

- CRISPR-Cas9 technology derives from a naturally occurring genome editing system found in bacteria. This bacteria captures minute sequences of DNA from invading viruses and utilizes them to generate DNA segments known as CRISPR arrays. These arrays allow for the bacteria to recall the viruses, and in the instance that the virus attacks again, the bacteria produces an RNA segment from the CRISPR arrays to target the viruses' DNA. The bacteria then uses the Cas9 enzyme to cut the DNA apart, immobilizing the virus.
- Similarly, this editing system can be mimicked in a lab setting. Researchers can create a small segment of RNA with a short "guide" sequence that binds to a specific target in the DNA as well as the Cas9 enzyme. Resembling that of the bacteria, the modified RNA is used to recognize the DNA sequence, and the Cas9 enzyme cuts the DNA at the targeted location. Once the DNA is cut, researchers use the cell's DNA repair machinery to insert or delete pieces of genetic material, or to make adjustments to the DNA by replacing a current segment with a customized DNA sequence.

1.

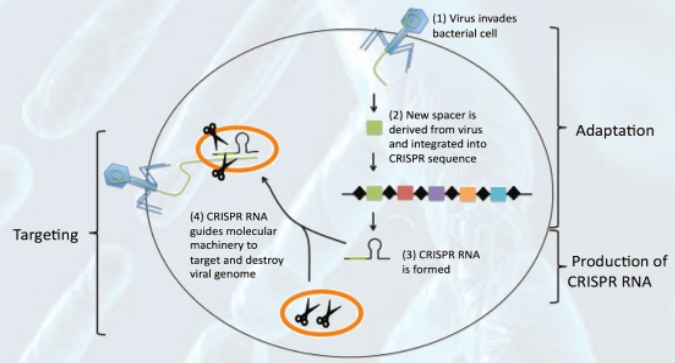

Figure 1: The process of using CRISPR Cas_9. *CRISPRs are small components found in the bacterial genome. Composed of minute DNA repeats (black diamonds) and spacers (colored boxes), CRISPR helps in the immobilization of the virus. If an unfamiliar virus infects the bacterium, a new spacer from that virus is integrated into the existing spacers. Then transcribed and processed, this sequence proceeds to generate CRISPR RNA. This RNA affiliates and guides the Cas 9 enzyme to a matching target sequence in the virus, and invalidate the virus.*

2.

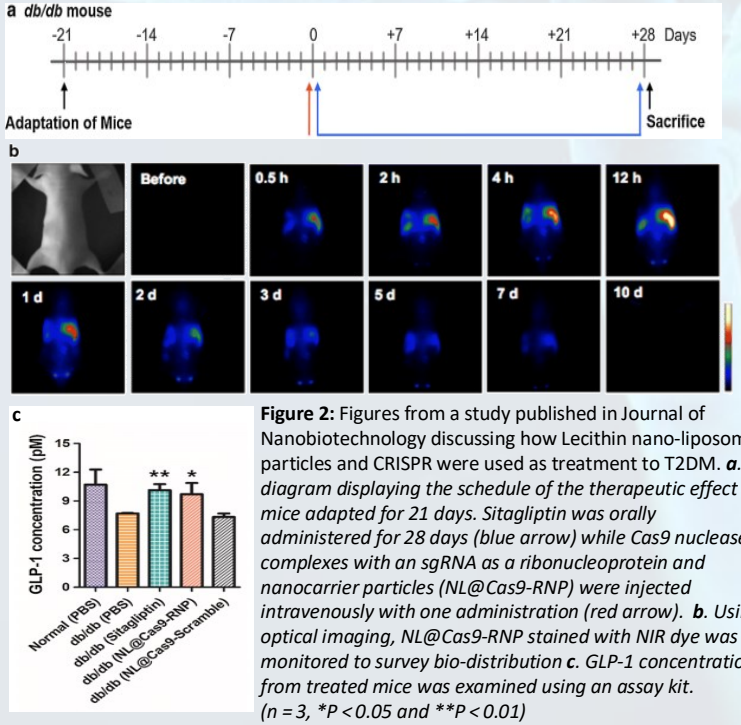

Figure 2: Figures from a study published in Journal of Nanobiotechnology discussing how Lecithin nano-liposomal particles and CRISPR were used as treatment to T2DM. ***a****. A diagram displaying the schedule of the therapeutic effect on mice adapted for 21 days. Sitagliptin was orally administered for 28 days (blue arrow) while Cas9 nuclease complexes with an sgRNA as a ribonucleoprotein and nanocarrier particles (NL@Cas9-RNP) were injected intravenously with one administration (red arrow).* ***b****. Using optical imaging, NL@Cas9-RNP stained with NIR dye was monitored to survey bio-distribution* ***c****. GLP-1 concentration from treated mice was examined using an assay kit. (n = 3, *P < 0.05 and **P < 0.01)*

Conclusion

- As seen in the data of the case study, CRISPR Cas_9 can be utilized to provided present day solutions to T2DM in rodents, leaving potential for it to be utilized in humans affected by T2DM and accordingly AD. Although this technology is still relatively new, it is being used globally and is offering long term solutions to various diseases. This technique is more effective than traditional methods used in the case ofT2DM (the use on insulin therapy and/or inhibitors).
- CRISPR Cas_9, has been utilized as a treatment method on individuals affected by cancer and human immunodeficiency virus (HIV). Though it is yet to be tested on humans affected by T2DM, this therapeutic approach has intrigued researchers universally, and is currently being enhanced to yield to this specific disease. Once accomplished, this techniques could revolutionize the way, diabetic and accordingly AD treatments is seen.

Future Direction

- CRISPR Cas_9 technology has been used to treat patients suffering from cancer, sickle cell anemia, and beta thalassemia. Recently, this ground-breaking technology was also tested to directly cure Leber Congenital Amaurosis, an eye disorder. Though it has been used in various fields, this technology still has a long way to go in being used as a medial approach to curing T2DM. Researchers are currently implementing their current knowledge on CRISPR Cas_9 in conjunction with new data in hopes of enhancing and perfecting this technique to make it a long term solution to T2DM while simultaneously ensuring it is efficient and accessible to the public.

References

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