Advancements in Gene and Stem Cell Therapies for Type 1 Diabetes Potential Treatment

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ABSTRACT

Type 1 Diabetes (T1D) presents a multifaceted challenge in healthcare delivery, characterized by the loss of insulin-producing pancreatic beta-cells. This review examines the intricate features of T1D, focusing on its autoimmune nature and the pivotal role played by factors such as T-cells, genetics, and the environment in its pathogenesis. To effectively manage T1D, it's essential to consider ethical challenges, healthcare system obstacles, and socioeconomic barriers to novel therapies. Current treatments predominantly target symptom management rather than addressing the underlying autoimmune processes of T1D. This review critically examines these shortcomings, emphasizing the necessity of interventions that address the root causes of the disease. Specifically, gene and stem cell therapies emerge as promising avenues, offering transformative potential in T1D management. By delving into the pathophysiology of T1D, this review sets the stage for exploring innovative therapeutic approaches. Gene and stem cell therapies hold promise in revolutionizing T1D treatment by targeting the underlying disease mechanisms. Delving into the pathophysiology of T1D lays the groundwork for investigating revolutionary therapies that show promise as interventions that can address the underlying causes of disease and transform the way it is managed.

Background

- Two types of diabetes: Type 1 diabetes and Type 2 diabetes **(7)**
  - Type 1 diabetes: Pancreas are unable to produce insulin. Cannot be prevented
  - Type 2 diabetes: Insulin production from pancreas are impacted but the body becomes insulin resistant. Genetics higher risk factor
- Current Treatments:
  - -Insulin Therapy **(10)**
  - -Encapsulation Methods **(2)**
- What is Gene Therapy?
- What is Stem Cell Therapy?

METHODS

- Literary review of primary and peer reviewed articles related to Type 1 diabetes, stem cell therapy and gene therapy
- Literature Article-43 sources/Poster-15 sources
- Articles reviewed were gathered from NCBI, PubMed, Science direct, etc.

Stem Cell

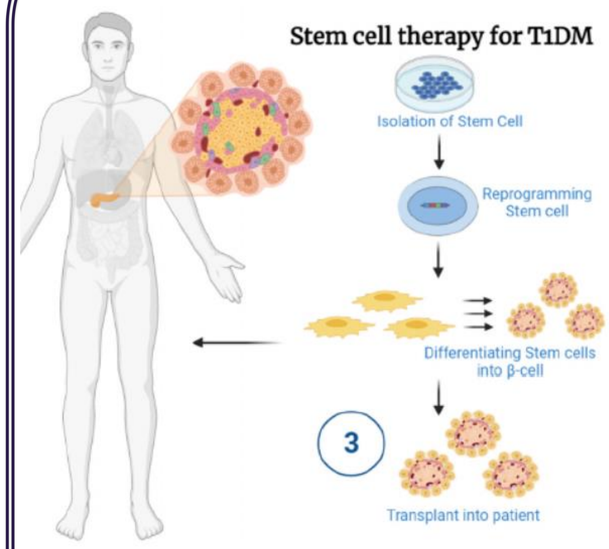

Figure 1 from Singh et al (2023). Mechanism of how Stem cell therapy will look like in T1D.

Gene Therapy

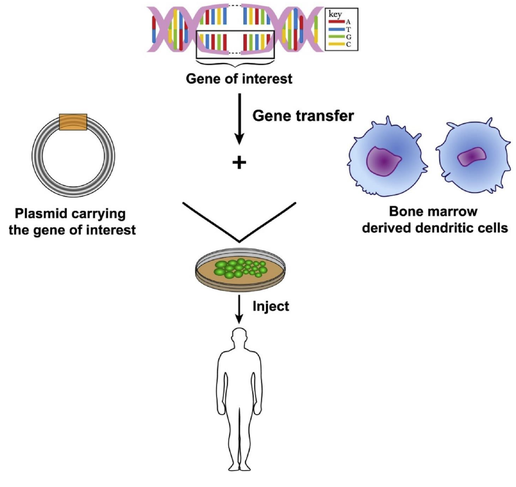

Figure 2 from Chellappan et al (2018). The gene of interest is identified. Which is then engineered into plasmid. The engineered plasmid in addition to the bone-marrow-derived dendritic cells is transferred into the biological system.

MECHANISM

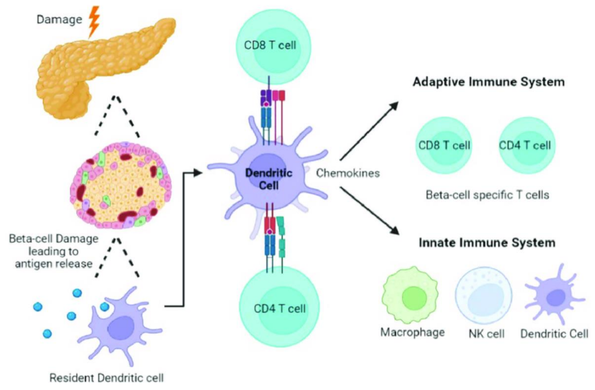

Figure 3 from Du et al (2022). Damaged pancreatic beta cells can trigger the release of antigens. Antigens are recognized by dendritic cells, leading to the activation of T cells and subsequent inflammation which ultimately leads to beta cell death.

Results

- Advancements in Gene Therapy **(13)**
  - -Significant steps in identifying genetic components associated with T1D vulnerability and developing specialized medications.
- CRISPR-Cas9 Technology **(5)**
  - -Investigating CRISPR-based techniques to target specific genes involved in autoimmune response or beta cell function, with goals of blocking disease-causing pathways.
- Potential for Individualized Therapy **(14)**
  - -Presenting the possibility of therapies of tailored to each patient's unique genetic profile.
- Generation of iPSCs **(12)**
  - -Possess the potential to differentiate into various cell types, including insulin-producing beta cells.

Challenges

- Immunological Barriers **(15)**
- Safety Concerns **(1)**
- Cost and Accessibility **(4)**

FUTURE DIRECTIONS

- Enhancing Differentiation Protocols **(9 & 15)**
- Optimizing Transplantation Strategies **(9)**
- Addressing Immunological Challenges **(3)**
- Cost Reduction and Accessibility **(3)**

Conclusion

- Both Gene and Stem Therapy offer promising solutions
- Offers personalized medicine approaches
- Long-Term outcomes and quality of life

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References