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REVIEW

Umbilical cord stem cells as regenerative therapy: advances in the treatment of type I diabetes

Células madre del cordón umbilical como terapia regenerativa: avances en el tratamiento de la diabetes tipo I

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ABSTRACT

Type I diabetes mellitus was presented as an autoimmune disease that destroyed the ß cells of the pancreas, generating an insulin deficit and metabolic complications. Although traditional insulin treatment was necessary, it failed to stop the progression of the disease. Regenerative medicine offered new alternatives, including the use of stem cells derived from the umbilical cord. These cells showed an ability to differentiate into pancreatic cells and modulate the immune system, which helped to improve glycaemic control and reduce dependence on exogenous insulin. Clinical studies confirmed that this therapy was safe, well-tolerated and ethically acceptable, making it a promising alternative in the treatment of T1D.

Keywords: Diabetes; Insulin; Stem Cells; Umbilical Cord; Regenerative Medicine.

RESUMEN

La diabetes mellitus tipo I fue presentada como una enfermedad autoinmune que destruyó las células ß del páncreas, generando un déficit de insulina y complicaciones metabólicas. Aunque el tratamiento tradicional con insulina fue necesario, no logró detener la progresión de la enfermedad. La medicina regenerativa ofreció nuevas alternativas, entre ellas, el uso de células madre derivadas del cordón umbilical. Estas células mostraron capacidad de diferenciarse en células pancreáticas y de modular el sistema inmunológico, lo cual ayudó a mejorar el control glucémico y a reducir la dependencia de insulina exógena. Los estudios clínicos confirmaron que esta terapia fue segura, bien tolerada y éticamente aceptable, lo que la posicionó como una alternativa prometedora en el tratamiento de la DM1.

Palabras clave: Diabetes; Insulina; Células Madre; Cordón Umbilical; Medicina Regenerativa.

INTRODUCTION

Type 1 diabetes mellitus (T1DM) represents a major medical challenge due to its autoimmune origin and the need for chronic treatment with insulin, without this implying a definitive cure. As medical science advances, regenerative medicine has emerged as an innovative field with therapeutic potential in chronic diseases such as T1DM.[(1)] In this context, stem cells, particularly those derived from the umbilical cord, are emerging as a promising alternative due to their ability to regenerate damaged tissue and modulate the immune system.[(2)] This text explores the role of these stem cells as a viable therapeutic option in the treatment of T1DM, highlighting their origin, characteristics, and clinical benefits.

DEVELOPMENT

Type 1 diabetes mellitus (DM1) is an autoimmune disease characterized by the destruction of the ß cells in the pancreas that are responsible for producing insulin. This destruction leads to an absolute insulin deficiency, resulting in chronic hyperglycemia and, consequently, multiple metabolic complications. Unlike type II diabetes, T1D usually manifests at an early age and requires lifelong insulin replacement therapy. However, insulin treatment does not stop the progression of cell destruction or restore pancreatic function.[3]

Regenerative medicine focuses on repairing or replacing damaged cells, tissues, or organs and has become a promising alternative for treating chronic diseases such as DM1. In this context, stem cells represent an innovative therapeutic tool aiming to restore impaired or lost biological functions. Stem cells can differentiate into various cell types, including pancreatic ß cells, making them ideal candidates for treating diseases such as DM1, where the loss of these cells is the leading cause of metabolic dysfunction.[4]

Stem cells are classified as embryonic and adult. Among adult stem cells, mesenchymal stem cells (MSCs) and hematopoietic stem cells, both present in the umbilical cord, are particularly noteworthy. These cells have high differentiation potential and immunomodulatory capacity and are relatively easy to obtain noninvasively. In particular, Wharton's jelly, a mucoid substance surrounding the umbilical cord vessels, contains a rich source of MSCs that is effective in preclinical and clinical studies.[5,6]

Umbilical Cord as a Source of Stem Cells

The umbilical cord has been established as an accessible and ethically acceptable source of stem cells. Unlike embryonic stem cells, its collection does not involve significant risks or ethical dilemmas. Cells obtained from the cord have immunomodulatory properties that can reduce the autoimmune response in patients with DM1 and a high potential for differentiation into insulin-producing pancreatic cells. In addition, because they are allogeneic, these cells can be used in different patients with minimal incidence of immune rejection.[4,5]

Clinical studies have explored umbilical cord stem cells' efficacy in treating DM1. The proposed mechanisms of action include:[7,8,9]

1. ß cell regeneration: through direct cell differentiation or trophic factors that stimulate their recovery.
2. Modulation of the immune system: reducing the autoimmune destruction of remaining ß cells.
3. Improvement of the pancreatic microenvironment: promoting a more favorable environment for cell regeneration.

These actions translate into improved glycemic control, evidenced by reduced HbA1c levels, increased C-peptide levels (a marker of ß-cell function), and a reduced need for exogenous insulin.

Clinical trials have shown that umbilical cord stem cell therapy is safe and well tolerated, with minimal adverse effects. In terms of ethics, cord stem cells are widely accepted due to their non-invasive procurement and the fact that they come from material usually discarded after birth. This contributes to their viability as a therapeutic alternative for future clinical application.

CONCLUSIONS

Umbilical cord-derived stem cells offer a promising therapeutic avenue for treating type I diabetes mellitus. Their ability to differentiate into pancreatic ß cells, immunomodulatory potential, and ethical and non-invasive procurement position them as an attractive option in regenerative medicine. Although further studies are needed to consolidate their efficacy and define standardized protocols, preliminary clinical results are encouraging and open the door to a future in which the treatment of DM1 not only controls symptoms but also addresses the underlying causes of the disease.

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CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTION

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