Oral Insulin Delivery Nanoparticles for Diabetes Treatment

An improved method for insulin delivery that is more convenient and non-invasive.

Technology Overview

This invention from the Trabolsi Lab (NYU Abu Dhabi) describes novel organic nanoparticles for oral insulin delivery in the treatment of diabetes. The invented nanoparticles show high insulin loading capacities, resistance toward harsh acidic conditions, and the ability to traverse the intestinal barrier. In proof-of-concept studies (*Benyettou et al. Chemical Science 2021*), these insulin-loaded nanoparticles demonstrated high bioavailability and reduced blood glucose levels in diabetic rats (T1D) to normal levels without inducing systemic toxicity. Further studies have been conducted to determine differences between standard subcutaneous insulin injection and oral insulin nanoparticle delivery. Oral insulin nanoparticle administration reduced hemostasis disorders and improved the oxidant/antioxidant balance by reducing lipid peroxidation and enhancing the lipid profile. On the other hand, subcutaneous insulin treatment worsened lipid profile disturbances, lipid peroxidation and prolonged bleeding time which resulted in hypercoagulable state and endothelial oxidative stress. The nanoparticles also showed the potential to transport insulin into insulin-resistant cells (T2D), demonstrating their applicability and utility in treating both diabetes sub-types. Altogether, these nanoparticles are a promising preclinical drug delivery system for effectively reducing blood sugar and limiting complications in patients with diabetes.

Background

Diabetes is an increasingly prevalent chronic disease which affects approximately 10% of the world's population and is the 7th leading cause of death worldwide. Insulin therapy is currently the standard of care in controlling and regulating blood glucose levels in diabetes; however, current methods of administration (by subcutaneous injection) are not convenient and result in some patient populations delaying or avoiding treatment due to fear of needles and self-injection. Therefore, new methods of insulin delivery that are more convenient and non-invasive have the potential to revolutionize diabetes care by driving increased patient adoption.

Application

The treatment of diabetes (Type 1 and Type 2)

Advantages

Technology ID

TRA02-04

Category

Life Sciences/Drug Delivery Systems

Doug Brawley

Authors

Ali Trabolsi, MS, PhD

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- **Oral administration:** Oral insulin is more convenient and less painful than subcutaneous injection and therefore should drive favorable patient adoption.
- **Stable glucose-responsive release:** Insulin release from the nanoparticles is selectively and stably triggered under hyperglycemic conditions.
- **High bioavailability:** Oral insulin is protected from the harsh acidic conditions of the digestive tract and gradually released from the nanoparticles in the liver.
- **No systemic toxicity:** The nanoparticles are biocompatible delivery vehicles with no observed cytotoxicity or immunotoxcity.
- **Reduced complications:** Oral insulin nanoparticle delivery avoids vascular and thrombotic complications common to subcutaneous delivery.

Intellectual Property

- National stage patent applications covering the nanoparticle composition and the method of diabetes treatment are pending in the US, CA, KR, JP, EP, CN and AE (NYU ref TRA02-04)
- A U.S. provisional patent application covering new uses of the TRA02-04 nanoparticle compositions for the treatment of hemostasis disorders, dyslipidemia, or disorders stemming from lipid peroxidation (NYU ref TRA02-05)

References

1. Trabolsi et al. , https://pubs.rsc.org/en/content/articlelanding/2021/SC/D0SC05328G#!divAbstract
2. Trabolsi et al. , https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11070859/