

# Bionic Pancreas

## Introduction

It is an aid in the treatment of diabetes mellitus type I combining the dosing of insulin and glucagon with the measurement of blood glucose levels. This method of treatment helps maintain glucose levels in the target range for a longer period of time while reducing the incidence of hypoglycemia conditions. This is currently a unique project that **Edward Damiano Ph.d, Ms, BS is working on**. This device is in the clinical trials stage.

## Principal of bionic pancreas

The device uses **Dexcom G4 platinum** (continuous glucose monitor) to measure glucose levels at regular five-minute intervals. The measurement is performed using a glucose sensor inserted into the subcutaneous tissue. A transmitter is connected to the sensor, which transmits the data to the Dexcom receiver, which sends the received values via Bluetooth to the Tandem t pump. The Tandem t pump uses a **two-chamber system**, one chamber is filled with insulin supply and the other with glucagon supply.

Thus, the device is able to respond to changes in glucose levels by releasing a specific dose of one of these two hormones. This ability to release insulin or glucagon leads to alternative names of technology, which are **dual hormone**, **bi hormone**, etc.

## Mechanism and benefits of bionic pancreas

Using precise dosing, it is possible to influence the glucose level with insulin or glucagon.



Conventional insulin pump

- Insulin administration lowers blood glucose levels. Insulin is given by calculating the current glucose level associated with the interim glycemia values
- Due to various factors affecting glucose levels, such as physical activity, stress, etc., it is possible that **glucose levels will drop excessively** and hypoglycemia will occur (a problem with conventional insulin delivery). Another possible problem is insulin dosing during sleep, when glucose uptake is limited and so-called "Dead-In-Bed-Syndrome" can occur.
- In the case of a decrease in glucose below a specified level, glucagon is applied by a pump, which acts as an insulin antagonist and at the same time promotes gluconeogenesis and glycogenolysis, and thus increasing the glucose levels.
- The ability to respond to low blood glucose levels with glucagon, along with automation, is a major difference from conventional therapy.

## Clinical tests

A number of tests were performed to compare the effectiveness of **dual hormone therapy** versus conventional therapy. For example, in a study entitled: "Comparison of dual-hormone artificial pancreas, single-hormone artificial pancreas, and conventional insulin pump therapy for glycemic control in patients with type 1 diabetes: an open-label randomized controlled crossover trial"

### The study results

Time for which the glucose level was maintained within the established standards within 24 hours:

- Dual hormone bionic pancreas: 63 %
- Classical insulin pump therapy: 51 %

Number of hypoglycemic events within 24 hours:

- Dual hormone bionic pancreas: 9 out of which 0 were symptomatic
- Classical insulin pump therapy: 52 of which 12 were symptomatic

Similar results are also presented in the study: doi: 10.1503 / cmaj.121265

## Conclusion

Based on the results of the study, it is clear that the method of treatment is a benefit for the patient.

## Advantages

- The length of time the patient's glucose level is maintained in the target range
- Ability to respond to hypoglycemic episodes
- Automation
- Possibility of data collection
- Personalized medicine

## Disadvantages

- Price
- Insufficient number of clinical trials
- Dependence on technology and energy
- To date, no studies have been performed on the long term use of glucagon and its effects on the body

## References

### Related articles

- diabetes mellitus
- insulin
- glucagon
- insulin pump

### References

- HAIDAR, Ahmad, Laurent LEGAULT and Virginie MESSIER. Comparison of dual-hormone artificial pancreas, single-hormone artificial pancreas, and conventional insulin pump therapy for glycaemic control in patients with type 1 diabetes: an open-label randomized controlled crossover trial. *The Lancet Diabetes & Endocrinology*. 2015, vol. 1, vol. 3, pp. 17-26, ISSN 2213-8587. DOI: 10.1016 / s2213-8587 (14) 70226-8 .
- HAIDAR, A., L. LEGAULT, and M. DALLAIRE. Glucose-responsive insulin and glucagon delivery (dual-hormone artificial pancreas) in adults with type 1 diabetes: a randomized crossover controlled trial. *Canadian Medical Association Journal*. 2013, vol. 4, vol 185, pp. 297-305, ISSN 0820-3946. DOI: 10.1503 / cmaj.121265 .

### External links

- Edward Damiano, Ph.D. (<https://www.wikilectures.eu/w/Http://www.bu.edu/eng/profile/edward-damiano-ph-d/>)
- BLOOD GLUCOSE CONTROL SYSTEM (<https://www.wikilectures.eu/w/Http://www.freepatentsonline.com/y2017/0095612.html>)
- Glucose-responsive insulin and glucagon delivery (dual-hormone artificial pancreas) in adults with type 1 diabetes: a randomized crossover controlled trial (<https://www.wikilectures.eu/w/Http://www.cmaj.ca/content/185/4/297.short>)