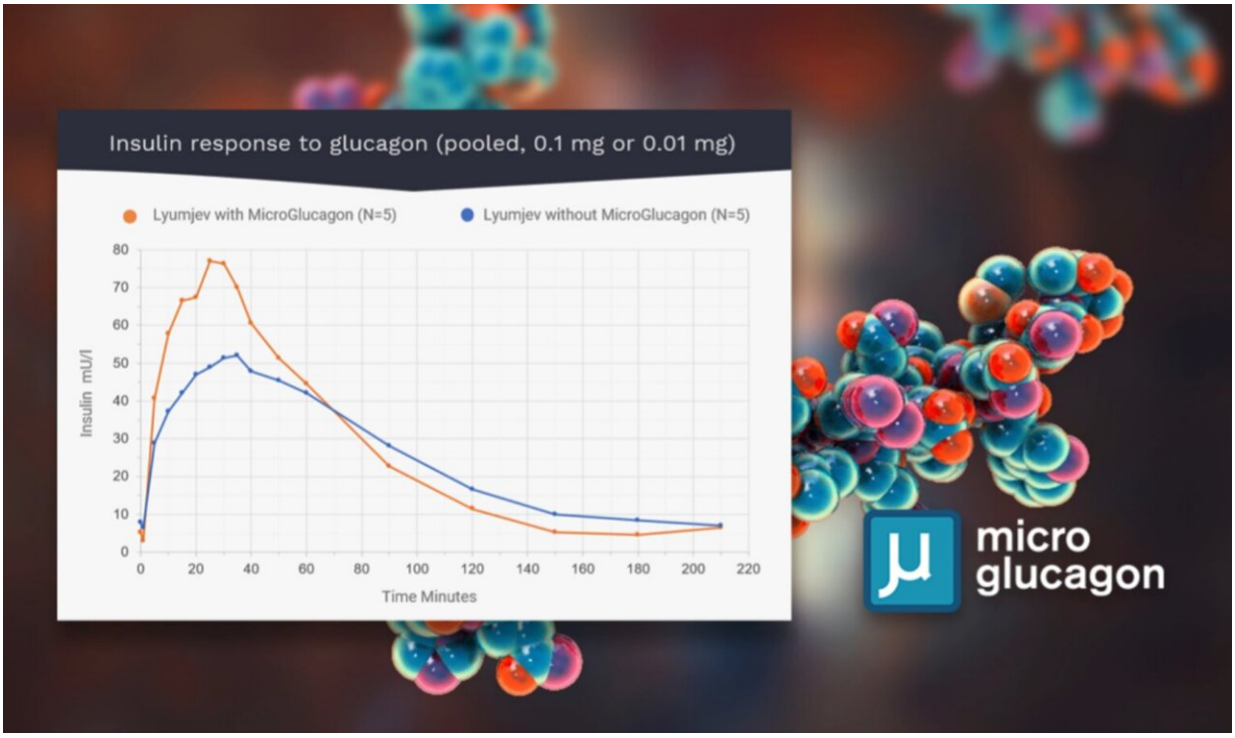
New insulin mixture could make life easier for patients with type 1 diabetes

January 4 2024, by Sølvi Normannsen



Tests show that MicroGlucagon (orange curve) works faster and is more effective than the fastest-acting insulins on the market (Lyumjev, blue curve). Credit: APT/NTNU Technology Transfer

Norwegians are at the top of the list when it comes to new annual cases of type 1 diabetes among children, young people and adults. The disease is caused when the pancreas doesn't make enough insulin. There is no

cure, and patients must take insulin for the rest of their lives.

The Artificial Pancreas Trondheim (APT) research group has now applied for a patent for a new solution they call MicroGlucagon. It can help type 1 diabetics tackle a major challenge, by inhibiting the rise in blood sugar after meals, giving them much better control over their blood sugar levels.

Insulin is needed to lower blood sugar levels. Diabetic patients lack this hormone, because their pancreas has stopped making it. They must therefore take an accurate dose themselves, at the right time—several times a day.

This poses a fine balancing act: Too much or too little insulin, can have fatal consequences.

Glucagon with added rapid-acting insulin

In the new approach developed by researchers at NTNU and St. Olavs Hospital, microamounts of glucagon have been added to regular rapid-acting insulin mixtures. Glucagon is a hormone that greatly increases blood flow in the exact area of the dermis where insulin is administered. The solution provides the body with extra impetus to quickly absorb the insulin the patient takes with their meals.

"We see that MicroGlucagon can work both better and faster than the best and most effective rapid-acting insulin preparations for use with meals that are currently available on the market," says Professor Emeritus Sven Magnus Carlsen.

Based at NTNU and St. Olavs Hospital, Carlsen has led the APT interdisciplinary research group since its inception in 2013.

Promising trials involving pigs

Carlsen is an endocrinologist, an expert on organs that produce hormones and diseases that occur in these organs.

Trials carried out by the researchers on pigs under general anesthesia show that insulin with added microdoses of glucagon reach full effect up to 10 minutes faster than the fastest insulin currently available. In addition, the amount of insulin absorbed by the body appears to increase when the MicroGlucagon mixture is used, perhaps by as much as 30%.

"The most important thing, however, is that when insulin is absorbed faster, it also disappears from the body faster," says Carlsen.

The researchers believe that their solution may also reduce the risk of low blood sugar for as long as to 3–5 hours after meals. Low blood sugar after meals can be a problem for some patients.

Can be used by all type 1 diabetics

MicroGlucagon can be used by all patients who inject themselves with daily doses of insulin. It can also be used in insulin pumps and in semi-automatic, artificial pancreas systems.

These are so-called hybrid solutions, which are already commercially available.

If the researchers succeed in bringing the solution to the market, it will pave the way for significantly better blood sugar management in all patients with type 1 diabetes, regardless of the type of insulin treatment they use.

A lot of research and documentation remains to be done. However, researchers can already see that the MicroGlucagon solution is helping them to achieve their goal.

"By using MicroGlucagon, we believe that the current semi-automatic solutions will improve a lot. But we also believe it will help in the development of a new, artificial, fully automatic pancreas system," says Carlsen.

The goal is a fully automatic, closed system that constantly measures blood sugar levels. The system calculates how much insulin the body needs at any given time, and ensures that the correct doses are administered on an ongoing basis.

This means that patients will not have to constantly monitor their blood sugar levels throughout the day.

Hormone that relaxes blood vessels

Taking insulin is vital for type 1 diabetics, but it is different hormone, glucagon, that plays a leading role in the APT group's latest research. This hormone is also produced in the pancreas, but while insulin lowers blood sugar levels, glucagon works to increase them.

This is how the two hormones ensure balanced glucose levels—in healthy individuals.

Glucagon has one very special property that researchers have discovered and exploited. In technical terms, the hormone causes vasodilation. This means that it relaxes the smooth muscles on the inside of the smallest blood vessels. As a result, the blood vessels expand and local blood flow increases greatly.

"What we have done, and which could be the big breakthrough, is that we have added microscopic amounts of glucagon to rapid-acting insulin solutions. In particular, we have studied the fastest acting insulin solution on the market. The point was to see if it was possible to improve what is currently the best option," says Sven Magnus Carlsen.

Although glucagon increases blood sugar levels, the new microdoses will be so minuscule that they will not affect the liver's release of glucose. The risk of side effects is therefore not an issue.

In addition, adding glucagon costs almost nothing.

"We are talking about 5 nanograms per unit of insulin, which means that the solution contains 1 glucagon molecule per 420 insulin molecules. The dose is so small that the cost is negligible," Carlsen says.

He has calculated that the annual extra cost of glucagon in Norway will be around NOK 100 for a patient with an average consumption of 60 units of insulin per day.

At the top of discouraging statistics

In total, it is estimated that around half a billion people worldwide have diabetes. The latest figures from the World Health Organization reveal that around 9 million of these had type 1 diabetes mellitus in 2017.

Currently, approximately 26,000 Norwegians live with this condition, and more than 400 young people under the age of 18 are diagnosed with type 1 diabetes every year in Norway. According to the Norwegian Institute of Public Health, the number of new cases in this group has doubled every year since the 1970s.

Type 1 diabetes can be neither prevented nor avoided, while type 2

diabetes can largely be prevented through a healthy and active lifestyle.

The researchers now have to document that the MicroGlucagon solution is stable and that it works just as effectively on humans. Professor Sven Magnus Carlsen and his colleagues are preparing crucial clinical trials on type 1 diabetes patients in the spring of 2024.

Carlsen is cautious when estimating how long it will be before MicroGlucagon might hit the market. Just documenting that the solution is completely stable will take a couple of years, and drug manufacturers must also get involved.

"So, at best, it may take 3–4 years, but that is only if everything that remains to be done goes completely smoothly," says Carlsen, who adds that 3–4 years is actually a very short time when it comes to medical research.

A long-term race

"Developing new medicines is a long -term race. It is both about understanding the market and the industry's needs, and at the same time challenging solutions that already exist," says Hilde Kjeldstad Berg at NTNU Technology Transfer.

Berg has helped the researchers with patenting and business development. The goal is to license the solution to an established industry actor during 2024.

"We have to work with major global players in this market. NTNU and St Olavs Hospital can only take this type of development to a certain level. Then the industry must take over," she says.

Berg says it takes an average of 10–15 years before a new medicine can

be launched in the market. She still thinks it can go faster with Microglucagon, since it is a naturally occurring hormone with little danger of side effects.

The world's most technological disease

Type 1 diabetes mellitus is a complicated and challenging disease, which can neither be prevented nor cured. People who get it have to self-medicate with insulin for the rest of their lives.

"Thousands of patients walk around every day treating themselves via small computers—with a medicine that, in the worst case, can actually kill them, either by not getting it, or by getting too much of it. The number of patients and the degree of technology with which they treat themselves means that type 1 diabetes is the world's most technological disease," says hormone expert Sven Magnus Carlsen.

Insulin must work as quickly and efficiently as possible, and the time it takes is the biggest challenge. Everyone with type 1 diabetes must take rapid-acting insulin with their meals.

However, even the very fastest acting insulins on the market take an hour and a half before they reach full effect, meaning patients have to make sure they take insulin 15–20 minutes before eating.

"All diabetics forget to take their insulin every now and again, and even when they do remember, their meal might be delayed. Naturally, many people do not always know what or how much they are going to eat. Some people wait until after their meal to take insulin—and then it is definitely too late to achieve good blood sugar management," says Carlsen.

Developing an insulin solution that works just as well on blood sugar

when taken with a meal as it does 15 minutes before eating would therefore be a huge advance.

"The quantum leap will only take place when a fully automatic, artificial pancreas is created that provides adequate blood sugar management. We are actively working on the matter," says Carlsen.

Provided by Norwegian University of Science and Technology

Citation: New insulin mixture could make life easier for patients with type 1 diabetes (2024, January 4) retrieved 10 May 2024 from https://medicalxpress.com/news/2024-01-insulin-mixture-life-easier-patients.html