Diabetes Research: Quebec

Since 1971, Diabetes Canada (formerly the Canadian Diabetes Association) has proudly supported outstanding diabetes research in Canada, administering more than $140 million in research grants, awards and partnerships to scientists and clinicians who have dedicated their careers to the fight against diabetes.

Since Banting and Best's discovery of insulin in Toronto, in 1922, Canadian researchers have made huge strides and key advances in mapping and understanding the physiology, biochemistry and genetics of diabetes. This is why we choose, each year, to fund Canada's most renowned researchers in their quest for new and innovative developments in the prevention, treatment and management of diabetes. And although the research is diverse in its scope, covering a broad range of specialties and topics, the underlying goal of each study remains the same - to improve the quality of life of people living with diabetes and to find a cure.

Every year, our researchers continue a tradition of innovation and discovery. Below is a list of the scientists and clinicians in Quebec who are currently funded by Diabetes Canada.

Research Grants & Awards

Dr. Rémi Rabasa-Lhoret (Diabetes Investigator Award)

Clinical Research Institute of Montréal (Montréal, QC)
Funded: 2017-2022

Title: Strategies to reduce exercise-induced hypoglycemia in adults with type 1 diabetes

Fear of hypoglycemia is a major limitation for physical activity for patients with type 1 diabetes. Strategies to reduce the risk of exercise-induced hypoglycemia, such as reduction in insulin dose in the hours preceding the exercise and food intake, have not been well validated and new avenues are emerging. In this study, Dr. Rabasa-Lhoret will be assessing the efficacy of:

- Multiple small snacks during exercise vs. a large snack before exercise to reduce exercise-induced hypoglycemia
- Novel technologies, such as the artificial pancreas, to avoid exercise-induced hypoglycemia

- Medication increasing concentrations of glucagon (hormone to increase blood glucose) to reduce exercise-induced hypoglycemia
- Insulin reduction vs. bedtime snack to prevent nocturnal hypoglycemia after daytime exercise.

The results of these trials will identify new strategies to reduce hypoglycemia and could be used to encourage patients with type 1 diabetes to practice regular physical activity. Increased physical activity should improve quality of life, could improve glucose control and should reduce the risk of obesity and cardiovascular disease.

Dr. Mathieu Ferron (End Diabetes:100 Award)

Clinical Research Institute of Montréal (Montréal, QC)
Funded: 2021-2024

Title: A hormone produced by bone to treat diabetes

Osteocalcin is a hormone produced by bone and communicating with different organs, including the pancreas, the fat tissue and the muscles. When osteocalcin reaches the pancreas, it promotes the release of insulin, which helps regulate the levels of glucose in the blood. Osteocalcin also travels to other organs such as muscle, where it helps to convert fats and glucose into energy in response to insulin. Hence, osteocalcin could be potentially harnessed as a therapy for type 2 diabetes. Recently, our team has discovered that in mouse osteocalcin a small group of sugars is attached to its structure, a modification called “glycosylation”. We found that glycosylation prevents osteocalcin from being degraded by enzymes in the blood. Glycosylation was not found on human osteocalcin, but we showed that when it was modified so the sugar group could attach, the human hormone was also more stable in blood. The goal of this project is to test if improving the stability of osteocalcin through glycosylation can enhance its therapeutic action.

Methods: In the first part of this project, we will treat diabetic mice with glycosylated osteocalcin and compare the effect on diabetes with plain osteocalcin. Our experiments are designed to test if glycosylated osteocalcin can slow down or reverse type 2 diabetes in mice.

In the second part of the project, we will first determine if glycosylated human osteocalcin is more stable than the non-glycosylated form, in non-human primates. Next, we will test the activity of this modified hormone on pancreatic islets from post-mortem human donors.

Outcome: The completion of this project should establish if glycosylated osteocalcin is a promising anti-diabetic agent. It will also determine if this modified protein is more stable in

primate and if it is active on human beta cells. By translating our basic findings to a novel therapeutic approach for diabetes, we believe this project could have a strong impact on the treatment of this disease.

Dr. Corinne A. Hoesli (End Diabetes:100 Award)

McGill University (Montréal, QC)
Funded: 2021-2024

Title: Engineering a new islet transplantation site to improve access to cellular therapy as a treatment option for diabetes

Purpose: Islet transplantation allows most people with type 1 diabetes to live without insulin for at least 1 year. Because of the side effects of the immune suppressive drugs needed to avoid transplant rejection, only patients that struggle to control their blood glucose are eligible for islet transplants. Instead of immune suppression, islets could be shielded from immune cells via a physical barrier using encapsulation. While encapsulated islets can reverse diabetes in rodents, this has not yet been shown in humans. This is likely due to insufficient blood supply to larger devices. The objective of this project is to engineer vascularized islet transplantation devices that also protect the islets from immune rejection.

Methods: When designing encapsulation devices, there is a trade-off between islet vascularization and immune protection. Blood vessels carry oxygen and insulin to and from the graft, but on the other hand they also carry immune cells which attack the graft. To find this “sweet spot”, we will test device performance in vitro and in rats. We will also predict performance of human scale devices using mathematical models and in vitro studies.

Outcome: At the end of this project we will have sufficient data to test our device in larger animals like pigs.

Relevance to people affected by diabetes: Because our devices would avoid transplanted cell escape, stem cells could be used safely instead of human islets which are in limited supply. This project could make islet transplantation broadly available as an alternative to insulin injections or pumps.

Engagement: Steven Paraskevas, co-applicant on the team, leads the clinical islet transplantation program in Québec. His laboratory is in a unique position to set up future clinical studies and transplants. Three partners with lived experience with type 1 diabetes are engaged in the project. They will provide input on research directions and reach out to the broader community to share our results.

Dr. Sylvain Iceta (End Diabetes:100 Award)

Université Laval (Quebec City, QC)
Funded: 2021-2024

Title: Do “sugar swings” impact the brain software of people with Type 1 Diabetes?

It has been reported that one out of 2 people aged over 60 years and living with type 1 diabetes (PWT1D) have alterations in cognitive functions. Cognitive functions are like the software required for the brain to decide or to influence behaviors. Modifications in the brain software can have important consequences on daily well-being, diet (e.g., urge to eat) and treatment decisions to manage diabetes. This in turn can lead to more difficulties to maintain adequate blood sugar levels, setting up a vicious circle. One factor that may affect both eating behaviors and cognitive functions is blood sugar variation (up and downs: “sugar swings”), but it has been poorly studied.

Our fully online project aims to compare two groups of PWT1D: a group with a low blood glucose variability and a group with a high blood glucose variability. Glucose variability will be determined with a glucose sensor (Freestyle® Libre or Dexcom G6) measuring blood sugar continuously. Using computerized tasks and self-reported measures, a wide range of cognitive functions and eating behaviors will be assessed. PWT1D will be also invited to participate in virtual interviews to gather information on how glycemic variability impact their life.

This project will contribute to highlighting the consequences of sugar swings in everyday life, especially how they disturb eating behaviors and brain function. A better knowledge of the mechanisms involved will also result in early detection and management of these issues. Our study will also seek patients’ perspectives that will help design suitable and meaningful recommendations.

Dr. Meranda Nakhla (End Diabetes:100 Award)

McGill University (Montréal, QC)
Funded: 2021-2024

Title: Group Education Trial to Improve Transition for Parents of Adolescents with T1D (GET-IT for Parents)

Adolescence is a challenging life stage that is complicated for those with type 1 diabetes (T1D) as they learn to take responsibility for their health. Parents face uncertainty of what constitutes appropriate involvement and express distress around the health consequences of transferring

responsibility to their adolescent. We know little about how to provide transition care services to parents as they attempt to support their adolescents during the transition to adulthood. We are currently conducting a multicenter randomized controlled trial (RCT) evaluating patient-driven group education for adolescents with T1D. Parents have expressed a need for education on how to transition responsibility of diabetes care from parent to adolescent. Purpose: We will study if group education for parents of adolescents with T1D will improve the transition from adolescence to adulthood. Methods/Procedure: Our overall aim is to conduct a pilot RCT of parent group education sessions to assess the feasibility and refine the intervention for a full-scale multicenter RCT. We will recruit parents and their adolescents with T1D. Control arm participants will receive usual care. Active arm participants will attend >= 3 in-person/virtual group sessions for parents plus usual care over 12 months. The group session, facilitated by a diabetes social worker, will be parent-driven discussions on topics relevant to adolescence and transition care. Outcomes: Results of the pilot study will inform a full multicenter RCT. Relevance to people affected by diabetes: Parent group education sessions as a beneficial method for transition care delivery, has potential to lead to wide and sustainable adoption into diabetes care and is directly aligned with the End Diabetes:100 priorities of developing solutions to diabetes management for people living with diabetes. Engagement: The proposed research includes parent partners who will inform the design of our intervention and recruitment strategies.

Dr. Vincent Poitout (End Diabetes:100 Award)
Centre de recherche du CHUM (Montréal, QC)
Funded: 2021-2024

Title: How the cells that make insulin adapt to puberty

The rise in obesity in children is a major health issue, and as a result, the age at which type 2 diabetes occurs has been steadily decreasing in recent years. Children who are overweight during puberty have an increased risk of developing type 2 diabetes later in life. The reasons why pubertal obesity confers a type 2 diabetes risk are unknown.

There are many hormonal changes that occur during puberty. One such change is a decrease in the ability of insulin to promote the storage of energy into its target tissues. This transient so-called “insulin resistance” is normally compensated for by an increase in the production of insulin from the pancreas, due in part to the replication of the beta cells that secrete insulin. Surprisingly, very little is known about the mechanisms by which beta cells adapt to puberty. The objectives of this project are to discover the cellular mechanisms underlying beta-cell adaptation to puberty, and to ascertain whether these mechanisms are altered in an obese environment. \

Based on preliminary findings obtained by our group, we hypothesize that beta-cell mass expansion during puberty involves two signaling pathways, the growth hormone/serotonin pathway and the sex hormone pathway. To test this hypothesis, we will first examine in male and female rat models and human samples the contribution of the growth hormone/serotonin pathway by manipulating the expression of the receptor for growth hormone and the enzyme that makes serotonin. Second, using similar strategies we will test the implication of the sex hormones (testosterone and estrogens). Finally, we will feed rats with a diet enriched in fat and examine whether the pathways studied above are impaired.

This project will provide detailed information as to how the pancreatic beta cell adapts to insulin resistance during puberty, and how these mechanisms are affected by obesity. These findings will help devise strategies to curb the alarming increase in type 2 diabetes in young adults

Dr. Rémi Rabasa-Lhoret (End Diabetes:100 Award)
Clinical Research Institute of Montréal (Montréal, QC)
Funded: 2021-2024

Title: Prevention of exercise-induced hypoglycemia with the artificial pancreas

In healthy individuals, blood sugar levels are tightly controlled by insulin. Secretion of insulin, a vital hormone to reduce blood sugar, is lost in type 1 diabetes (T1D). Thus, people living with T1D (PWT1D) need life-long intensive insulin therapy through multiple injections or an insulin pump. Hypoglycemia (low blood sugar) is a frequent complication of insulin therapy and affects quality of life, mental health, and everyday activities. Tools for managing T1D and preventing hypoglycemia improve every year. PWT1D can now combine insulin pumps and continuous glucose monitors to make an artificial pancreas, which automates insulin delivery (AID). While these systems improve day to day blood sugar levels, hypoglycemia during physical activity (PA) is still common. There are no studies looking at what pre-PA target blood sugar level works best for different activities and different times of day. AID systems have not been rigorously tested for PA and propose a unique pre-set “exercise” glucose target that does not work for most PWT1D and types of PA. With the help of patient partners, we developed a research program to study Automated Insulin Delivery and hypoglycEmia (AIDE).

With this project we will:

- Compare three different pre-PA target blood sugar levels to determine which will provide the best blood sugar levels during and after aerobic exercise (e.g. jogging).

- Examine if the menstrual cycle phases or if time of the day (morning fasting vs afternoon) influences required targets.
- Determine if targets should be changed for different types of PA (lifting weights, combined weights and aerobic exercise).
- Assess the feasibility of artificial intelligence in predicting PA-induced hypoglycemia.

As fear of hypoglycemia prevents many PWT1D from being more active, this project has the potential to reduce barriers to PA and improve quality of life for PWT1D. Results of this project will be easily integrated into current AID systems.