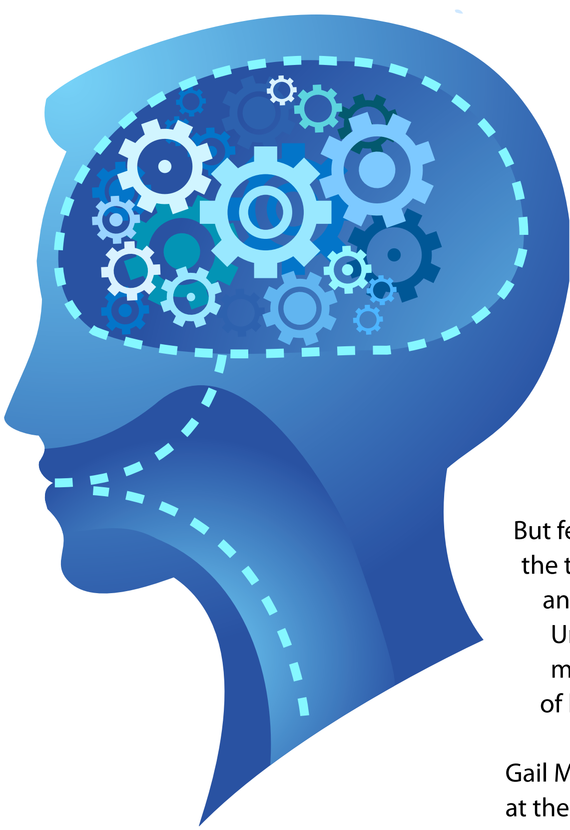
DIABETES ON THE BRAIN:

Hypoglycaemia and Your Grey Matter



When you attend diabetes education classes you learn about all the complications you can avoid by keeping your blood glucose and weight in control. A1Cs under seven lower the risk of nerve and kidney damage, heart attacks, oral problems, eye disease and sexual dysfunction.

But few diabetes classes ever address the toil that diabetes takes on another of our organs: our brains. Unfortunately, the brain is not magically spared from the ravages of high or low blood glucose.

Gail Musen, PhD, Assistant Investigator at the Joslin Diabetes Center is a cognitive psychologist with interests in the areas of memory and cognition. She has collaborated with biophysicists, psychiatrists and endocrinologists at Joslin and Beth Israel Deaconess Hospital to design studies looking at what areas of the brain are affected by diabetes and how glycaemic variations can modify usual brain processes.

Using a technique called magnetic resonance imaging (MRI) Musen and her team were able to identify brain areas that may be associated with alterations caused by diabetes.

The normal brain consists of both white and grey matter. Most of us have heard of grey matter which is involved in muscle control, seeing and hearing, memory, emotions, and speech.

But the grey matter doesn't stand alone. The grey matter we have is divided into different regions and the white matter helps these regions talk to each other. You can think of the white matter as the network cabling connecting a series of computers together.

Musen's research showed that people with type 1 diabetes have less grey matter in some brain regions than people of the same age who do not have diabetes. Specifically, there was less grey matter density in areas that are responsible for learning and memory.

In addition to looking at how diabetes can change brain anatomy, she also compared brain activity during episodes of experimentally induced hypoglycaemia in people with and without diabetes.

A special kind of MRI called a functional MRI (fMRI) can detect blood flow and oxygen consumption in the

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brain. This technique allows scientists to see which brain regions are most active as we perform particular tasks. The areas with the greatest oxygen consumption are working the hardest.

Luckily, these changes do not necessarily translate into poor cognitive function for people with type 1 diabetes.

When people with type 1 are acutely hypoglycaemic, they draw on more areas of the brain to help them maintain cognitive capacity than people without diabetes who have had hypoglycaemia induced.

For example, Musen and colleagues showed that during a memory task conducted while hypoglycaemic, people with type 1 diabetes needed to engage more brain regions than non-diabetic control subjects to maintain good performance.

What this means is that even though people with type 1 have less grey matter in certain regions, they may be able to compensate by recruiting more brain tissue than non-diabetic individuals to complete the same task.

This may help to explain why people who are frequently hypoglycaemic can often appear to be in control even though they have blood glucose values in the forties.

Researchers have been attempting to determine the affects of glycaemic control on real-world cognitive performance for some time now.

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The Epidemiology of Diabetes Interventions and Complications (EDIC) study, which continued where the Diabetes Control and Complications Trial (DCCT) left off, compared the brain function of those who received intensive control (lower A1C) to those who received conventional therapy (higher A1C). One concerning finding of the DCCT was that intensive control equalled a greater risk of hypoglycaemia.

EDIC, however, discerned no long-term effects of frequent hypoglycaemia on cognitive performance.

But it is not just people with type 1 who have cognitive changes. "People with type 2 heading into middle-age need to be especially concerned," says Musen. This is when structural changes occur in the brains of people with type 2. Type 2 diabetes is a risk factor for dementia.

In the general population, groups at risk for dementia show less brain activity in some regions than people without that risk – Musen and her team showed that this was also true in those with type 2 diabetes.

- Does this mean that because you have diabetes you will automatically lose cognitive function? Absolutely not. Diabetes is but one risk factor among many. And like so many other risks associated with diabetes, new research is investigating the benefits of diet and exercise as a preventative measure.

- Like other diseases that cause structural brain changes, the effects of glycaemic variation appear to take a long time to produce detrimental effects on long-term cognition.

- Will people with type 1 in the 70s and 80s start to show cognitive dysfunction directly attributable to diabetes, even if they have been in excellent control? We don't know at present but the brain is a very resilient organ with a large reserve capacity.

- Advances in medicine and knowledge about proper lifestyle have far extended the years people with diabetes can expected to live healthy lives. We now have people with type 1 who are 75-year medalilsts at the Joslin Diabetes Center. Keeping blood glucose in good control especially in middle age is the best preventive medicine we have to ensure long-term brain health.

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