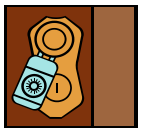
UNDERSTANDING GLYCOGEN STORAGE DISEASE

What is Glycogen Storage Disease?

Glycogen storage diseases are genetic deficiencies that result in the storage of abnormal amounts of glycogen in the body. About 1 out of 100 000 babies are born with glycogen storage diseases each year in Canada. There are 5 different types of these diseases depending on the enzyme missing, however, only type 1a will be described here.

All people who are born with GSD have one thing in common. They are unable to properly metabolize or break down **glycogen**, the storage form of sugar in the body. The food we eat is usually used for growth, tissue repair and energy. The body stores what it does not use. Excess sugar, or **glucose**, is stored as glycogen in the liver and muscle tissue. Between meals and during sleep (i.e. periods of fasting), or during exercise, the body breaks down glycogen and uses the stored sugar for energy. Due to an enzyme deficiency, people with GSD have the ability to store sugar as glycogen but are unable to use these stores to provide the body with energy during fasting or exercise.

Think of a pantry where extra food is stored. In times of need, the pantry door can be opened and food can be accessed. In glycogen storage disease, food can be placed in the pantry for storage, but can't be accessed in times of need. The pantry door is locked. Food can be pushed through a slot in the door but the door cannot be opened to get the food out.



How do people get glycogen storage disease?

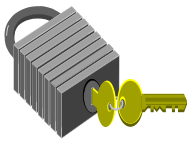
Glycogen storage diseases are inborn errors of metabolism. They are genetic. This means that the person has the disorder from the time they are conceived. At conception, the baby receives two sets of genetic material, one from the mother, and one from the father. This genetic material, called **DNA**, acts as a recipe for the baby's development.

DNA includes information about the baby's eye and hairs colour, sex and even whether the baby will be right or left-handed. DNA comes in units called **genes**. Each pair of genes gives directions to a certain part of the body.

Glycogen storage diseases are caused by getting two copies of the faulty gene, one from the mother, and one from the father. If the child inherits only one copy of the gene, they are a **carrier** for the disorder but are not affected. There is a 1 in 4, or 25% chance that 2 carriers of the gene will have a baby with glycogen storage disease. Boys and girls are equally affected.

What is Glycogen storage disease type 1a (von Gierke disease)?

Glycogen storage disease type 1a was first described in 1929 by von Gierke. In 1952, researchers found the enzyme defect responsible for the disease, making it the first metabolic disorder in which an enzyme defect was identified. The missing or malfunctioning enzyme is glucose-**6-phosphatase**, found in the liver, kidneys and bowel lining. **Enzymes** can best be described as keys that unlock doors in the body. When this enzyme is missing, the glycogen accumulates in the liver, kidneys and lining of the bowel. Fat also accumulates in the liver. Back to the pantry comparison, the accumulated glycogen, or food in storage, cannot be accessed in times of need. People with GSD type 1a, even if treated, are often not as tall as family members, have enlarged livers with swollen abdomens and low blood sugar.



How are glycogen storage diseases treated?

The treatment for all glycogen storage diseases is aimed at prevention of low blood sugars and excess glycogen accumulation in the body. Treatment needs to be started as soon as the disorder is diagnosed. **For GSD type 1a,** diet is the cornerstone of treatment. The brain can only use glucose for energy. To avoid low blood sugar, it is therefore essential for the person to eat frequently and often use uncooked cornstarch to ensure the body has a source of energy at all times. Since it is impossible to eat while sleeping, people with this type of GSD usually:

- have tube feedings while they sleep, or
- wake up in the night to take **cornstarch**

Uncooked cornstarch takes a long time for the body to break down and is therefore available as an energy source during periods of fasting.

Untreated glycogen storage disease type 1a can lead to:

- Very low blood sugar, which can be life-threatening
- Enlarged liver
- Liver tumors
- Muscle wasting
- High levels of cholesterol
- Blood clotting problems
- Susceptibility to infections
- Stunted growth

- Kidney disease
- Bone problems (osteoporosis)
- Liver problems
- Kidney problems

People with GSD type 1a who are in good metabolic control through diet management can prevent low blood sugar. They also have fewer symptoms and long-term complications.

What are the long-term complications of glycogen storage disease?

Although GSD type 1a mainly affects the liver, other organs are also involved. The long-term complications that have been observed are from adult patients whose disease had not been adequately treated. With early diagnosis and initiation of treatment, complications can be prevented.

Possible complications include:
- stunted growth
- gout
- inflammation of the pancreas
- liver tumours that may or may not be cancerous
- kidney disease

Other treatments

Because the enzyme defect is mainly in the liver, it is possible to treat GSD type 1a by doing a liver transplant. There are numerous risks to liver transplants and this decision must be made with careful consideration of the pros and cons.

The balancing act

The challenge in treating glycogen storage disease type 1a is to provide enough glucose to avoid low blood sugar but not an excess that needs to be stored as glycogen. Visits to the metabolic clinic are needed to consult with the team and make adjustments to diet. Regular blood work is necessary to monitor changes in

levels of blood sugar, liver enzymes and other nutritional indicators. Self-monitoring using a glucometer is important to detect changes in blood sugar.

The delicate balance can be upset by strenuous exercise, stress and illness. Special attention needs to be paid at these times to prevent low blood sugar.

How can friends and family help?

Learn to recognize the warning signs, symptoms and treatment of low blood sugar, or **hypoglycemia**.

Signs of mildly low blood sugar include:
- feeling hungry
- feeling shaky or lightheaded
- feeling nervous or irritable
- cold sweats
- feeling weak
- feeling confused
- numbness or tingling in the tongue or lips

Signs of moderately low blood sugar include:
- complaining of feeling unusually sleepy
- complaining of not being able to see clearly
- acting angry or sad for no apparent reason
- acting drunk

Signs of severely low blood sugar include:
- seizures
- unconsciousness

If the person with GSD is showing signs of low blood sugar, offer them a regular soft drink such as gingerale or a sugary drink such as Koolaid®. Then, make sure they have a snack such as cheese and crackers. **If they are unconscious or having seizures, call 911 and get them medical attention as soon as possible.**
Help them to avoid fasting. If you have invited the person with glycogen storage disease over for a meal, provide finger foods to munch on before you eat such as:
- crackers and cheese
- bean dip
- bread sticks
- pita or carrot sticks with dip

- corn chips
- other carbohydrate-containing snacks

Helpful resources

Association for Glycogen Storage Disease
http://www.agsdus.org/

Genetic Home Reference
http://ghr.nlm.nih.gov/condition/glycogen-storage-disease-type-i

- National Organization for Rare Disorders, Inc.
  P.O. Box 8933
  New Fairfield, CT 06812-8923
  Phone: 1-800-999-6673
  Web site: www.rarediseases.org/