Carnitine Palmitoyltransferase-2 (CPT-2) Deficiency
What is Carnitine Palmitoyltransferase-2 (CPT-2)?

Tiny cucumber shaped mitochondria are in every cell of the body except for red blood cells. The mitochondria is responsible for making energy for the body. CPT-2 is an enzyme that is located inside the mitochondria that transports long chain fatty acids into the mitochondria where fatty acid oxidation occurs as part of the energy production process.

What is fatty acid oxidation?

The main source of energy for the body is a sugar called glucose. When the glucose runs out, fat (in the form of long chain fatty acids) is broken down into energy by the process of fatty acid oxidation.
What is CPT-2 deficiency?

People with CPT-2 deficiency have problems breaking down the long-chain fats into energy for the body because their CPT-2 enzyme does not work properly or is not made at all in the body.

What causes CPT-2 deficiency?

Genes tell the body to make various enzymes. People with CPT-2 deficiency have a pair of genes that do not work correctly. Because of the changes in this pair of genes, the CPT-2 enzyme does not work properly or is not made at all. CPT-2 deficiency is inherited in an autosomal recessive manner. Everyone has a pair of genes that make the CPT-2 enzyme. In people with CPT-2 deficiency, neither of these genes work correctly. These people inherit one non-working gene for the condition from each parent. Parents of people with CPT-2 deficiency are rarely affected by the disorder. Instead, each parent has a single non-working gene for CPT-2 deficiency. They are called carriers. Carriers do not have CPT-2 deficiency because the other gene of this pair is working correctly. When both parents are carriers, there is a 25% chance in each pregnancy for the child to have CPT-2 deficiency. There is a 50% chance for the child to be a carrier, just like the parents. And, there is 25% chance for the child to have two working genes.
What are the 3 types of CPT-2 deficiency and their signs and symptoms?

1. **Lethal neonatal form** – it occurs during the first month of life. Prognosis is poor. Death occurs within days or months. The lethal neonatal form is characterized by reduced CPT-2 enzyme activity in many organs and increased levels of long chain acylcarnitines and lipids in the body.

   Signs and symptoms:
   - Episodes of liver failure
   - Heart muscle problems
   - Heart rate problems
   - Breathing problems
   - Seizures and coma after fasting or infection
   - Facial abnormalities or structural malformations

2. **Severe infantile hepatocardiomuscular form** – a severe infantile form that affects the liver (hepatic), heart (cardio), and muscles (muscular). Signs and symptoms usually appear between the ages of 6 to 24 months. Episodes of signs and symptoms are often triggered by infections, fever or fasting.

   Signs and symptoms:
   - Liver failure and enlarged liver
   - Heart muscle problems that can result in sudden unexpected death during infancy
• Hypoketotis, or recurring episodes of low ketone levels. Ketones are products of fat breakdown that are used for energy.
• Hypoglycemia, or low blood sugar. Hypoketotis and Hypoglycemia can happen at the same time which can cause loss of consciousness or seizures.
• Muscle problems
• Recurrent attacks of abdominal pain and headache

![Symptoms of Hypoglycemia (or low blood sugar)](image)

3. **Myopathic form** – the less severe form for it only affects the muscles. It is more frequent in teenagers and/or young adults. Signs and symptoms are usually triggered by exercise, fasting, or infection. This muscular form of CPT-2 deficiency is usually considered as relatively mild as long as life-threatening complications are prevented.

**Signs and symptoms:**
- Recurrent attacks of myalgia (muscle pain) accompanied by myoglobinuria (reddish-brown, tea or cola coloured urine) caused by prolonged exercise (especially after fasting), cold exposure, or stress.
- Possible muscle weakness during attacks
- Usually no signs of myopathy (disorder in muscle tissue), myalgia (muscle weakness), elevation of serum creatinine kinase [CK] enzyme between attacks.
Myoglobinuria (reddish-brown, tea or cola coloured urine)

How is CPT-2 Deficiency Diagnosed?

1. Blood tests that includes measurement of acylcarnitines
2. Physical examination
3. Family medical history
4. Personal medical history
5. Skin biopsy. Definitive diagnosis is usually made by detection of reduced CPT enzyme activity in skin cells called fibroblasts.

How is CPT-2 treated and managed?

1. Avoid going a long time without food. It is important to avoid long periods of fasting. It is recommended that you eat every 4 to 6 hours. Most teens and adults with CPT-2 deficiency can go without food overnight unless ill.

2. Diet
   Sometimes a low fat, high carbohydrate diet is recommended. Carbohydrates give the body many types of sugar that can be used as energy. In fact, for people needing this treatment, most food in the diet should be carbohydrates (bread, pasta, fruit, vegetables, etc.) and protein (lean meat and low-fat dairy foods). Any diet changes should be made under the guidance of a metabolic dietitian.

People with CPT-2 deficiency cannot use certain building blocks of fat called "long chain fatty acids". A dietitian can help create a food plan low in these fats. Much of the rest of the fat in the diet will likely be in the form of medium chain fatty acids.
A low fat, high carbohydrate (starches) diet is recommended. A dietitian can create a specific food plan for the patient.

3. MCT oil and L-carnitine
Medium Chain Triglyceride oil (MCT oil) is often used as part of the food plan for people with CPT-2 deficiency. This special oil has medium chain fatty acids that can be used in small amounts for energy. Your metabolic doctor or dietitian can guide you in how to use this supplement.

Some people may be helped by taking L-carnitine. This is a safe and natural substance that helps mitochondria make energy. It also helps the body get rid of harmful wastes. Your doctor will decide whether or not you need L-carnitine.

4. Call the metabolic clinic at the start of any illness
During any illness, people with CPT-2 deficiency need to eat extra starchy food and drink more fluids even if they do not feel hungry.

Always call the metabolic clinic right away when you have any of the following:
- Persistent myalgia (muscle pain),
- Muscle weakness
- With or without myoglobinuria (reddish-brown, tea or cola coloured urine)

Go to your nearest hospital lab and have your blood and urine collected as soon as possible if you have extreme myalgia (muscle pain) and/or myoglobinuria (reddish-brown, tea or cola coloured urine). Use the emergency orders provided to you from the Adult Metabolic Diseases Clinic.

5. Avoid long periods of exercise and avoid getting cold
Long periods of strenuous exercise and cold can trigger signs and symptoms. Muscle effects can include: muscle aches, cramps and weakness accompanied by myoglobinuria (reddish-brown, tea or cola coloured urine).
If muscle symptoms occur, prompt treatment is needed to prevent kidney damage. Adults with muscle symptoms should:
* drink fluids right away
* eat something starchy or sugary
* go to a hospital for treatment

73x697

To help prevent muscle symptoms:
* avoid prolonged or heavy exercise
* keep the body warm like using warm blanket
* eat starchy or sugary food before and during periods of moderate exercise

6. Carry the yellow emergency wallet card provided by the Adult Metabolic Diseases Clinic with you at all times.

Helpful Resources:

The Adult metabolic Diseases Clinic
Vancouver General Hospital
Level 4 -2775 Laurel Street
Vancouver, BC
V5Z 1M9
Phone: 604 875 5965
Fax: 604-875-5967
E-mail: adultmetabolic@vch.ca
Good Websites with useful links

Carnitine Palmitoyltransferase Deficiency Website
http://www.spiralnotebook.org/

Carnitine Palmitoyltransferase II Deficiency