Non-Diabetic Adult Hypoglycemia

A Review of Symptoms and Diet Therapy

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Abstract

Objective: To specifically evaluate non-diabetic hypoglycemia and offer options for dietary control.

Summary of Background Data: This literature review explores hormones, involved anatomy, background, symptoms, and gives a brief examination of dietary control of hypoglycemia. A clinical emphasis is placed on Reactive and Fasting hypoglycemia.

Data Sources and Key Indexing Terms: A computerized search was conducted using search engines Yahoo.com and Pub Med with "Non-diabetic hypoglycemia" as the key word.

Results: Numerous studies were obtained under each subheading, and reviewed by category. Human studies are described.

Conclusion: Hypoglycemia is a condition, not a disease, of low blood sugar or rapid decrease in blood sugar as a result of the body's deficiency to regulate it. The best treatment is usually dietary adjustment prescribed by a dietitian or other health care professional should be implemented.

Introduction:

In general, hypoglycemia can be categorized as drug-related or non-drug-related. Most cases of hypoglycemia

occur in diabetics and are drug-related, which will not be discussed in this review. Non-drug-related hypoglycemia can be further divided into fasting hypoglycemia, in which hypoglycemia occurs after fasting, and reactive hypoglycemia, in which hypoglycemia occurs as a reaction to eating, usually a meal in carbohydrates (1,2).

Hypoglycemia has several different causes: excessive secretion of insulin from the pancreas, an abnormality in the pituitary or adrenal glands, or an abnormality in the liver's storage of carbohydrate or production of glucose. This condition may occur due to a variety of other reasons too. Though these other forms may not be as common as drug-related hypoglycemia, they can be equally deadly to the body systems or the whole body if the condition is not identified and treated (3,4).

Hypoglycemia can present with many different symptoms, or no symptoms at all. This makes it essential for anyone suspecting hypoglycemia to immediately consult a health care physician for testing to seek out the cause. This condition is also capable of simulating other diseases, making it important to be properly diagnosed by a professional.

Discussion

Chemical And Hormone Involvement

To understand hypoglycemia, there must be an understanding of glucose in the body's function. Glucose or blood sugar is needed for proper brain and body function. Without glucose, the brain can suffer damage in a very short time. The body acquires this fuel from ingestion or the digestion of carbohydrates (5). These carbohydrates are found in foods like, bread, potatoes, and rice, to name a few. Some other sugars introduced to the body by foods are fructose, lactose, and galactose (5,6,7).

After ingestion, glucose is introduced to the blood stream and transported to all cells. Any left over glucose is converted to glycogen for storage purposes in the liver. The glucose in blood can be measured, and is done so in units of mg/dL. The normal or safe range can be between 60 mg/dl and 120 mg/dL (2). A person fasting can fall below 60mg/dL, and we would not necessarily be concerned. However, levels below 45 mg/dL usually indicate a problem like hypoglycemia (2,6).

The two regulating hormones are glucagon and insulin. Insulin and glucagons are the major hormones regulating levels of blood sugar. Both of these hormones are regulated

by blood glucose concentration. Glucagon stimulates the liver to convert glycogen and noncarbohydrates into glucose. This occurs when blood glucose is low. It also stimulates the breakdown of fats. Insulin promotes the formation of glycogen from glucose, inhibits conversion of noncarbohydrates into glucose, and enhances the movement of glucose through cell membranes. This causes the blood glucose concentration to fall. Too much or too little of these hormones can cause unnatural blood sugar levels. Both of these hormones are manufactured in the pancreas. Thus, healthy pancreas function is necessary for maintaining correct blood sugar levels (8,1). To a lesser degree, cortisol, norepinephrine, and epinephrine also contribute to regulation. These are also known as counter regulatory hormones (9).

Anatomy

THE BRAIN. The brain is the major player in hypoglycemia. As previously mentioned the brain depends on glucose (sugar) for fuel. It has very little ability to store any glucose and depends on a constant supply from the glucose concentration in the blood. Just as the brain

requires oxygen and extracts it from the blood, the same thing occurs with glucose. Without enough glucose (or oxygen) the brain goes into a coma. (1,5)

The brain senses the glucose concentration and will cause specific symptoms when it drops too low. When the glucose concentration goes below the 60s mg/dl there are several hormones that are released to help drive the glucose back up. These are called the counter regulatory hormones and consist of glucagon (the hormone most effective at raising glucose), epinephrine, norepinephrine, growth hormone, and cortisol. These cause many of the symptoms associated with hypoglycemia. (1,2,4)

THE LIVER. The liver's job is to keep the blood glucose concentration constant. After eating, the glucose concentration stays up for 3-4 hours, so the liver needs to do nothing to maintain an adequate glucose concentration. When the meal is metabolized after the 3-4 hours, the liver maintains the glucose concentration by breaking down glycogen. Glycogen is a molecule made of many glucose molecules branched in different orientations. This process is called glycogenolysis and releases glucose when the body (brain) needs it. (1,8)

The other way that the liver maintains the glucose

concentration when you haven't eaten for a while is called gluconeogenesis. Gluconeogenesis is the manufacture of glucose from other things, like protein and fat. This is the major way the glucose concentration is maintained when fasting for a long time and when the glycogen stores run out. (3)

THE PANCREAS. The pancreas is located in the abdomen. It lies behind the stomach, in front of the spine, and is surrounded by the intestines and liver. The gland is approximately six inches long and resembles a compressed bunch of grapes (9). The pancreas plays an imperative role in the endocrine system by secreting the hormones and other chemical substances mentioned subsequently. Specific clusters of pancreatic cells, known as islet cells, produce a variety of these hormones, with each cluster specializing in the production of a precise hormone. For example the two most significant hormones produced by these specialized cells are glucagon and insulin. After a meal, blood sugar rises and the pancreas releases insulin to aid in cellular uptake of glucose. When blood sugar decreases, the pancreas releases glucagons, which causes the release of stored glycogen and conversion back to glucose. (10,3,4)

Symptoms Review and Clinical Evidence

Hypoglycemia, in non-diabetics, can be diagnosed by an observation of symptoms: blood sugar less than 45 mg/dL, and relief of symptoms with sugar are two big ones. Other lab tests can be utilized to measure insulin production. There are specific symptoms associated with hypoglycemia. These can be mental and physical. Mental symptoms include restlessness, nervousness, anxiety, phobias, depression, loss of concentration, and anti social behavior. Physical symptoms can consist of headaches, fatigue, tremors, sugar cravings, fainting, skin blotches, and joint pain. (9,11)

Clinical trials have exhibited a relationship of headaches to abnormal regulation of glucose. Blau and Cumings were able to cause migraines in 50 percent of subjects tested in a study requiring fasting overnight and into the next day for a total of nineteen hours. These subjects presented with headaches that increased in pain over the next few hours. This view recognizes fasting as a cause of migraines and headaches in general. The study also recognizes dietary habits associated with migraines and headaches. These habits consist of fasting and increased carbohydrate load. Both of these situations elicit a sympathetic nervous system response causing many of the

symptoms associated with hypoglycemia. (12,10)

Peters, Rohloft, and Kerner did a study on ten non-diabetic men by causing periods of hypoglycemia for one hour a day, four days in a row. The subjects were then given eight days off, and returned to have it done for one day. The periods of hypoglycemia were achieved by eight hours of fasting, followed by an intravenous introduction of insulin to the body. Blood samples were obtained every fifteen minutes from thirty minutes before the introduction of insulin to two hours after. (12)

Symptoms of hypoglycemia could easily be recognized on each testing day. There was a notable increase in counter regulatory hormones, which are often the cause of some symptoms, during induced hypoglycemia. This response was the same for each day. This study shows that short periods of hypoglycemia repeated over time do not cause the same adaptations of the body as prolonged periods. This conflicts with other studies, which used prolonged episodes of hypoglycemia. These other studies acknowledged adaptation and noted faster response to hypoglycemic episodes. (12)

Another study examined the effects of hypoglycemia on cognition and vision specifically. Hypoglycemia has a

tendency to effect cognition more drastically than motor tasks. In this study, twenty non-diabetic subjects were studied on three separate times, separated by multiple weeks. These subjects were to eat a light breakfast and show up for testing five hours later. At an interval of twenty minutes apart, these subjects were taken from baseline glucose to euglycemia to hypoglycemia. This was done by intravenous administration of glucose, and insulin separately. Half of the subjects were done in the order mentioned above. The other half was done in the opposite order from baseline. (5)

When the subjects reached the desired levels of blood glucose for a period of ten minutes, they were asked to fill out symptom questionnaires and subjected to information processing tests. The combination of these tests and questionnaires gave valuable information on visual acuity, visual information processing, and cognitive abilities. Hypoglycemia conditions showed no mentionable effects on visual acuity, but very significant decreases in cognitive ability and the processing of visual input. (5)

Hypoglycemia Treatment and The Diet

Symptoms of hypoglycemia can often be controlled by a proper intake of certain foods and a decrease or elimination of others. Foods to include in ones diet consists of raw vegetables, salads, seeds, nuts, and organic meats and eggs. The foods that are potential dangers and need to be eliminated or decreased are sugars, alcohol, hydrogenated oil, flour, rice, peanuts, and corn. By a good dietary control, a person suffering from non-diabetic hypoglycemia can avoid potential health hazards and can lead a nearly normal life. (10,6)

Daniel Flanagan et al. tested the hypothesis that alcohol can cause reactive hypoglycemia by attenuating the release of counter regulatory hormones. Eight healthy volunteers abstained from alcohol intake for three days and fasted overnight. Following this each subject participated in three studies separated by two weeks. They were given regular Indian tonic water containing 60g carbohydrate with 0.5g/kg ethanol in the form of Beefeater gin in one study. In another they were given Slim-line tonic containing 0.5g carbohydrate and gin as described above. Finally they were

given the Indian tonic water alone. (13)

Vital signs as well as blood alcohol, counter regulatory hormones, cerebral blood flow, and symptoms of hypoglycemia were monitored over the next 300 minutes. After drinking the Indian tonic alone glucose and insulin excursions became more substantial. Blood glucose proved to be lower with the gin and Indian tonic than either the slim-line and gin or the Indian tonic alone. Growth hormone was shown to be suppressed in this study. Since GH is an insulin antagonist there may be a connection to increased insulin sensitivity. (13)

The treatment is dietary adjustment prescribed by a dietitian or other health care professional. Less carbohydrate and more slowly absorbed carbohydrate in your diet means less insulin released and a lower peak of insulin following your meal, and consequently less bottoming out of glucose after the carbohydrates are absorbed. This will be helpful in avoiding symptoms of hypoglycemia. A good idea when symptoms occur is to somehow introduce sugar to the system. Usually juice is ideal. (14,15,6,1)

Conclusion

Hypoglycemia is a condition, not a disease, of low blood sugar or rapid decrease in blood sugar as a result of the body's deficiency to regulate it. In general, hypoglycemia can be either drug-related or non-drug-related. Non-Diabetic hypoglycemia can be caused by many factors, including early pregnancy, extended fasting, long-term strenuous exercise, certain medications, and often time's alcohol. A rare from, called Reactive or Post Prandial Hypoglycemia occurs two to five hours after ingesting a high glucose meal. An empty stomach can result in what is called, Fasting Hypoglycemia. This usually occurs in the morning, and is also rare. Pancreatic tumors, which are usually benign, can cause an increase in insulin production, and a decrease in blood sugar levels.

Non-Diabetic hypoglycemia symptoms can have effects on many parts of the body, but most importantly, the brain. If these symptoms are ignored and not treated, permanent damage can occur. Irritability, visual information processing, cognitive effects, and perception deficiency are some of these symptoms. In many cases, these symptoms can be relieved or even avoided with a simple change in

diet and implementation of nutrient supplements.

Hypoglycemia can present with many different symptoms, or no symptoms at all. This makes it essential for anyone suspecting hypoglycemia to immediately consult a health care physician for testing to seek out the cause. This condition is capable of simulating other diseases, making it important to be properly diagnosed by a professional. The best treatment of dietary adjustment prescribed by a dietitian or other health care professional should be implemented.

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