

Dysglycemia refers to any disorders in serum (blood) glucose stability. We will be covering hypoglycemia, insulin resistance, diabetes and some of the technical information related to glucose management. A study by J. Grimm in Public Health and Nutrition conservatively estimated that 30% of the population suffers from insulin resistance, an advanced state of dysglycemia. I have read that if current trends continue, projections hold that 60% of the population will be in this state or worse and that it will probably bankrupt our current medical system in the next ten years, caring for more than a hundred million people suffering from severe diseases related to blood sugar physiology.

Blood sugar disorders affect every aspect of our physiology. One of our body's primary sources of energy is dependent on the ability to convert glucose into ATP, adenosine triphosphate. Glucose is also called dextrose and is comprised of 6 carbon atoms, 12 hydrogen atoms, and 6 oxygen atoms, and is split into ATP by the enzyme ribase. ATP is made of adenine and ribose with three phosphoric acid groups. Adenine and ribose are both forms of pentose, sugars with 5 carbon atoms. ATP is used by all cells of the body and particularly muscle cells for energy. The splitting of these groups of atoms is known as the citric acid cycle. A steady supply, storage of, and re-conversion of glucose back into the blood supply and the proper conversion of glucose into ATP are important for many reasons, as we will see.

First I will review basic components of glucose regulation.

Insulin is a protein hormone secreted by beta cells of the pancreas. Insulin allows glucose to enter the cells and begins the process of transforming glucose into energy that is used by all the cells in the body. Insulin is secreted when glucose levels are high. Insulin is also an anabolic hormone. This hormone promotes the production and growth of tissues. It signals the liver to produce and store glycogen, a stored form of glucose. Glucose is thus lowered in the blood stream by the utilization of the cells (forming ATP), and by the formation of glycogen in the liver called glycolysis.

Cortisol is secreted when glucose levels in the blood are low. It is a catabolic hormone secreted by the adrenal glands that breaks down glycogen into glucose, putting it back in the blood stream. This is called glycogenesis. This steroid hormone is also known as an adreno-cortico-tropic hormone, or ACTH. Cortisol should be highest in the morning after the body has been fasting. It should be low in the evening when glucose has been made available by feeding. When blood sugar levels are low, signals are sent to the hypothalamus to secrete cortisol releasing hormones. The hypothalamus thus becomes another critical link in stabilizing blood sugar.

Leptin is a hormone secreted by fat cells that signal the hypothalamus to stop feeding, by shutting down the production of hunger signals, altering the production of neuropeptides and neurotransmitters that stimulate feeding. The process of fat metabolism is closely related to sugar metabolism, as both are sources of energy. Fat metabolism is also called lipid metabolism. Lipolysis and Lipogenesis refer to the storage and synthesis of lipids. Lipids play many important roles in physiology such as regulating temperature, called thermogenesis. -Temperature is very important for enzyme processes and pH. The average number of enzyme reactions per cell is 35,000 per second. Lipids are also important for hormone production, prostaglandin production, regulating intercellular communication, transformation and

transportation of micronutrients between cells. Lipids are closely related to phosphatides, cerebrocides, and sterols.

The liver is the main tissue that responds to signals indicating high or low blood sugar. High and low blood sugar trigger hormonal responses that induce pathways of restoring blood sugar. Signals like growth hormone released from the pituitary increase blood glucose by inhibiting uptake in the liver. Gluco-corticoids also leave more glucose in the blood stream to be used where it is most needed. Thus the pituitary/liver relationship is also important in blood sugar physiology. The liver performs glycolysis, gluconeogenesis, lipolysis, lipogenesis.

Now we will begin to explore various forms and effects of dysglycemia. Hypoglycemia refers to a lowered fasting glucose state. There are two types, hypoglycemia and reactive hypoglycemia. Reactive hypoglycemia has all the symptoms of hypoglycemia but may not be outside the laboratory range for glucose and may or may not have a lactic acid dehydrogenase, LDH below 140 U/L. The symptoms will include dizziness or light headedness if meals are missed or between meals, shaky, jittery, tremors, craving sweets during the day, craving coffee in the morning, eating relieves fatigue, easily agitated, poor memory, and blurred vision, and when severe can cause fainting blackouts and will eventually result in seizures. All proteins, fats and carbohydrates can and should be converted to glucose eventually. If a person only ate lean meats, they should still have a glucose level between 85-100 mg/dl.

Hyperglycemia refers to a state of excess glucose in the blood. This is a definite indication that glucose is not being managed properly. Hyperglycemia usually includes hyperinsulinemia. Hyperglycemia usually begins with hypoglycemia and progresses to insulin resistance or syndrome X, and then to diabetes. Insulin resistance is a state where the insulin receptors in the cells become desensitized to insulin. The cells are thus deconditioned to insulin stimuli and do not take up glucose as well. When people have insulin resistance they will display symptoms such as fatigue, especially after eating; difficulty with sleep patterns; usually difficulty falling asleep; digestive disturbances, such as gastric reflux, which may be proxysmal; other G.I. disturbances; cravings for sugar; inability to lose weight; constant hunger; eating sweets does not reduce cravings; increased thirst and appetite; migrating aches and pains. Lesser recognized but related dysfunctions may occur, such as leptin resistance and cortisol resistance. These display similar symptoms and will usually be accompanied by heightened stress and anxiety levels. Hypoglycemics can also have dysfunctions in cortisol that will manifest as stress. Hyperinsulinism is an independent risk factor for cardiovascular disease. It adversely affects the physiology of lipoproteins, coagulation protein synthesis, and blood pressure. Insulin upregulates the synthesis of cholesterol by stimulating the Hmb-coA reductase enzyme. This is why cholesterol goes up when glucose is not being managed properly. This is the same enzyme that statin drugs down regulate. We will see more examples of how some drugs only mask disease processes and do not address the underlying biochemical dysfunction. Insulin also negatively impacts the cholesterol ester transfer protein, CETP, the protein that is responsible for shifting cholesterol into HDL. The result is lower HDL. HDL is responsible for moving cholesterol out of the arteries. LDL transports cholesterol into arteries. HDL protects against

arthrosclerosis by moving cholesterol to the liver where it can be removed from the body. Cholesterol is important for the formation of hormones. High cholesterol and the body's inability to manage it properly negatively impacts hormone balance, as we will see.

When the insulin is not managed properly, males and females both have difficulty binding or synthesizing proper hormones and eliminating excess hormones. This leads to a variety of metabolic malfunctions. Hyperinsulinemia and its resultant hormone imbalance have different effects in males and females.

Females respond to a hyper insulin state with up-regulated hormone synthesis in the adrenal glands and ovaries of testosterone and cortisol. This is called an androgen shift. These hormones become abnormally increased and further promote insulin resistance, creating a vicious cycle. The increased androgen hormones increase free fatty acids in the liver, which decrease the liver's ability to respond appropriately to the hormones. The androgen shift also affects the hypothalamus-pituitary feedback loop, resulting in changes in the leutinizing hormone, LH. This is an important signal that regulates menstruation and induces changes in the reproductive system. There are several other causes for disruption of LH. They are surges in estrogen at the end of the follicular phase and elevations of b-endorphin. Other causes of androgenism should be ruled out. These include ovary and adrenal hormone dysfunction in the absence of insulin disorders. The most common effect of the androgen shift in hormones is poly-cystic ovarian syndrome. Eighty percent of all women with this disorder have it as a result of the androgen shift due to hyperinsulinemia. The current model suggests using birth control to treat the androgen shift. This further dysregulates the hypothalamus-pituitary feedback loop creating post birth control syndrome, or an inability to regain a normal cycle after oral contraceptives. The current health care model suggests another way to treat the hormone imbalance is to prescribe drugs that directly suppress adrenal function such as prednisone, dexamethasone, or gluco-corticoids. These drugs have a long list of side effects and do not treat the underlying problems of hyperinsulinemia.

Hyperinsulinemia affects male hormone pathways differently. First progesterone may not be converted to testosterone and may be converted to cortisol instead. Excess cortisol again down-regulates insulin receptors creating a vicious cycle. Insulin resistance again disturbs proper fat metabolism. Progesterone is one of the hormones that protects and regulates the prostate function. Other factors that relate to prostate function are estrogen levels, and conversion of testosterone to dihydrotestosterone. Changes in insulin and adrenal hormones can impact the conversion of these hormones. When any or all of these processes occur, the prostate will undergo changes similar to the ovaries in women when LH is disturbed, swelling and abnormal growth. Progesterone also influences neurochemistry and osteoblastic activity.

The most important indicator of blood sugar management is how you feel after you eat a meal. If anything in your diet creates an insulin surge, you will feel tired after you eat. This indicates that glucose is not being converted to ATP. Food allergies and infections will also disturb the citric acid cycle and must be ruled out. Food allergies will induce inflammatory states, which stress the liver's ability to

respond to hormones, as well as adrenal stress affecting cortisol, disrupt intercellular communication between lipolysis and lipogenesis, decrease the activity and synthesis of thyroid hormones, upregulate the immune system and many other stressful and destructive effects. Infections will uncouple the citric acid cycle by disturbing phosphorylation. Gastro intestinal dysfunction may induce anemia, thus compromising the blood's ability to carry oxygen, which is necessary in the production of ATP. Anemia must be treated before the blood sugar can return to normal. The lungs may also play a role in the failure to provide enough oxygen to the blood. When glucose is incompletely metabolized, the leftover glucose in the system will oxidize, lose electrons, and thus become free radicals called glycolated end products. These compounds will cause inflammation and damage to sensitive tissues such as the retina, small nerves and blood vessels, and the kidneys.

When the glucose pathways are disturbed significantly enough, the body will begin to seek other sources of energy. When the glucose cannot be utilized directly for energy, it will be shifted into adipose or fat. The fat will then be converted to energy. This process is not very efficient for ATP production for several reasons. First, the breakdown of fats into ATP leaves a residue of ketones or ketone bodies. Ketone bodies deplete the cellular and extracellular acid buffers and the system becomes very acidic. When the system becomes acidic and loses its buffers, mineral and electrolyte reserves are damaged. Abnormal urination, kidney and adrenal dysfunction will ensue. This will further compromise the kidney/adrenal function already disturbed by glycolated end products. The body may try to reestablish pH by producing ammonia. Ammonia is very alkaline, but also very toxic. The body may try to restore mineral reserves in the blood by taking calcium from the bones. The second reason why utilizing fats for ATP is inefficient is that it requires more energy to break down the fats than is gained, resulting in low energy and weight gain. When the patient eats, they will put out more energy for the process of lipogenesis and lipolysis and have less potential for ATP from these cycles than they will be gaining.

Hyperinsulinemia has several other serious consequences for the human organism. Hyperinsulinism will down regulate the glucose-6-phosphate dehydrogenase (G6PD), which will then suppress the hexose monophosphate shunt (HMS). Reduced HMS activity will decrease NADP, which is the cofactor required to produce glutathione. Glutathione is the major nutrient for the oxidation/reduction axis. The net result is compromised phase I and phase II liver detoxification. Poor elimination of toxins will further compromise the liver's ability to respond to managing blood sugar and other metabolic functions. The patient will also report heightened stress levels. In women menses may get heavier and more painful. Over exposure of insulin also has deleterious effects on fatty acid metabolism. It upregulates enzymes that convert DGLA into arachidonic acid. This is a precursor to prostaglandins and will shift the balance of prostaglandins, creating an inflammatory state and all of its detriments, as well as affecting prostaglandin function, which regulate lipolysis, platelet aggregation, gastro-intestinal activities, neurotransmission; and many other functions. Prostaglandins are short-lived intracellular modulators of the biochemical activity of the tissues in which they were formed. They are called autoids and are similar to hormones. Alterations of fatty acids affect many prostaglandin functions.

Diet is the most critical factor in treating dysglycemia. All forms of dysglycemics must eat a healthy breakfast, with lean meats, vegetables and legumes. A protein dominant diet will ensure a slow steady supply of glucose that avoids surges in hormones and glucose. If a person exhibits fatigue after eating, they may have exceeded their carbohydrate limits or may be exhibiting food intolerance symptoms. Each person will have different tolerances and limits in both these areas.

It has also been found that the combinations of foods eaten will affect how carbohydrates and fats are absorbed. These factors make the glycemic index a poor predictor of how foods will affect someone. Therefore, when determining food intolerances, the most important initial indicator is the body's reaction to what is eaten. These reactions may include mental clarity or dullness, an increase or decrease in energy levels, a general feeling of well being or discomfort. It is up to each individual to begin to notice how they feel after eating specific foods, and note how their energy level reacts. Restricting diet to identify problem foods is of paramount importance. The most likely initial reason for tiredness after eating in hyperglycemics is an insulin surge, resultant from poor glucose metabolism. The important thing to do is not to exceed the carbohydrate limits for that individual. This will minimize the insulin surge, and all its concomitant hormone, lipid, inflammatory, toxicity reactions.

There are three critical guidelines for hypoglycemics. 1) They must eat a healthy breakfast, 2) they must not go long periods without eating, 3) they must not snack on sweets. This will stress the adrenals, which will result in cortisol excess and often manifest as insomnia. These patients may also complain that they experience nausea in the morning or at other times when they eat. This is due to the stressed adrenals putting the body into an excess sympathetic nervous system state. If they eat small meals and stabilize their blood sugar, this will take the body out of sympathetic stress, and they will have an easier time eating breakfast. They must not snack on fruit alone. However, if they want to eat a piece of fruit after a protein rich meal, they can.

Fat metabolism has not been studied as extensively as sugar metabolism, and there are many competing theories on what kinds of fats are better. Dr. Watson was probably the most groundbreaking theorist and researcher in this area. He found that hypoglycemics do better with meats high in adenine and saturated fats. Hyperglycemics have been found to do better with meats low in adenine and low in saturated fats. He also coined the terms glucogenic and ketogenic to describe different metabolic tendencies. He further developed specific amino acid and other micro nutrient supplementation for the different types. There have been extensive trials of this theory, and its practice has been found to be extremely beneficial for hypoglycemia and its severe consequence of seizure disorders, as well as benefiting hyperglycemics and their disease processes. The general guidelines for hypoglycemics, according to Dr. Watson, is to eat chicken organ meats, lamb, venison or beef protein at every meal, nut butters, sardines, salmon and tuna, vegetables, especially cauliflower. Hyperglycemics should eat fish or poultry protein at every meal and vegetables. Whole grains are neutral for both groups and both groups must avoid sweeteners of all kinds and fruit juices.

Modern biological testing can identify dysfunction in all of the systems we have covered. We have

seen how virtually every part of the organism is involved in and affected by sugar metabolism. Most noticeably the gastrointestinal system, the kidneys and adrenal glands, pancreas, thyroid, pituitary, hypothalamus, liver and lungs. We have briefly looked into some of the micro-nutrient processes underlying these organs. There are also many natural compounds that can assist with these bio-chemical processes. Some examples of these are:

For insulin resistance:

Banaba Leaf: contains triterpenoid, lagerstroemin, flosin B, reginin A, and corosolic acid that have been shown to help regulate glucose levels. Studies indicate that these compounds produce glucose lowering effects by enhancing peripheral glucose utilization.

Gymnema Sylvestre: has been shown to enhance the action of insulin, decreasing fasting glucose levels and regenerate the pancreas beta cells

Maitake mushroom: improves peripheral glucose sensitivity

Bitter Melon: glucose lowering

Opuntia Streptacantha: glucose stabilizing

L-arginine

Chromium

Vanadium

Alpha Lipoic Acid (thiotic acid)

Magnesium

Biotin

Zinc

Inositol

Niacin

L-Carnitine

Other important topics:

Exercise: Hyperglycemics tend to be hyper adrenal and thyroid. Hypoglycemics tend to be hypo adrenal and thyroid. Both need exercise to regulate all these glandular secretions

Sex

Sleep, rest

Holographic influences of mind body integration to protect against uncoupling of biochemical processes