

Blood Chem Hyperglycemia and Hypoglycemia Treatment Review

The main considerations in the treatment of hyperglycemia are:

1. Diet

- a. Paleo diet is effective for glucose control and reversal of type 2 diabetes.
 - i. Moderate carb intake, with 25 to 35% of calories with Paleo-friendly (cellular) carbs: starchy tubers and whole fruits, as opposed to acellular carbs that impact human physiology differently. If this is not sufficient, consider a low-carb (15%) or very low-carb (10% or less) ketogenic approach.
- b. Remind the patient not to snack between meals.
- c. Intermittent fasting can reduce blood sugar and improve insulin sensitivity.
 - i. Consider compressing food intake into an eight-hour window each day.
 - ii. Fasting is not recommended during pregnancy or nursing; for patients with significant HPA axis dysfunction, particularly hypocortisolism; or for patients with eating disorders.
- d. Protein-sparing modified approach (PSMF): high-protein, low-carb, low-fat, and low-calorie diet. Consider adding a multivitamin for adequate nutrient intake.
 - i. Unlike voluntary calorie restriction, patients will spontaneously reduce their calorie intake.
 - ii. Doesn't lead to muscle breakdown like some other low-calorie diets and is easier to follow than other severe calorie-restricted diets.
 - iii. You could do a PSMF three to four days a week and eat normally the other days. Weight loss would be slower, but compliance will be higher.
- e. Potato hack: All-potato diet
 - i. This low-calorie, low-fat, and high-carbohydrate diet can be effective for diabetes treatment.
 - ii. Consider modifying the diet to potatoes that have been cooked and cooled, which creates resistant starch. This will not have a significant impact on blood sugar because resistant starch is not absorbed in the human digestive tract.
 1. Consider this for patients who have a blood sugar spike on glucometer testing after eating one or two potato only meals.
 - iii. The potato diet spontaneously decreases calorie intake as patients are eating foods that are not highly palatable or rewarding.
 - iv. It reduces inflammation and improves gut microbiota.

- v. A variation patients may prefer is potatoes by day, where patients eat potatoes only for breakfast and lunch. Then eat a normal dinner with their family.
- 2. Physical activity
 - a. Increase nonexercise physical activity; for example, standing at least 50% of the day and taking 10,000 steps a day.
 - b. Get enough exercise; for example, high-intensity interval training and other kind of steady-state activities as desired.
- 3. Sleep
 - a. A single night of poor sleep can impair insulin sensitivity the next day.
 - b. Get at least seven to eight hours of sleep a night, use proper sleep hygiene, and control exposure to light at night and during the day.
- 4. HPA axis dysfunction
 - a. Prescribe stress management for your patients.
- 5. Nutrients associated with hyperglycemia: Low vitamin D, low magnesium, low and high levels of iron, low choline, and low chromium.
- 6. Assess and correct gut pathologies

NUTRIENTS FOR BLOOD SUGAR REGULATION

Nutrient	Dose
Chromium chelate	100-300 mcg/d
Alpha-lipoic acid	200-400 mg/d
Magnesium	300-500 mg/d
Biotin	200-500 mcg/d
Green tea extract	200-300 mcg/d

Metabolic Synergy from Designs for Health contains chromium, alpha-lipoic acid, taurine, green tea extract, manganese, magnesium, potassium, vanadium, and other nutrients that can be helpful in regulating blood sugar. The dosage is two capsules three times a day or three capsules two times a day.

BOTANICALS FOR BLOOD SUGAR REGULATION

Botanical	Dose
Berberine	400-600 mg/d
Gymnema	200-400 mg/d
Banaba	40-60 mg/d
Fenugreek	200-300 mg/d

Berberine targets AMP-activated protein kinase (AMPK), which stimulates uptake of glucose into cells, improves insulin sensitivity, and reduces glucose production in the liver. Some studies have shown it to be just as effective as metformin in treating diabetes.

Gymnema reduces insulin requirements, decreases fasting blood sugar, enhances the action of insulin, and may even promote regeneration of the beta cells of the pancreas, which produce insulin. It is also very helpful for reducing sugar cravings.

Banaba lowers blood sugar, reduces inflammation, and protects against oxidative damage.

Fenugreek slows enzymatic digestion of carbohydrates, reduces gastrointestinal absorption of glucose, and thus reduces postprandial glucose levels. It also stimulates glucose uptake in peripheral tissues and improves insulin production.

GlucoSupreme from Designs for Health combines several of these botanicals. The recommended dose is two capsules twice a day with meals.

FIBER

High-fiber diets reduce the risk of diabetes and aid in the treatment of high blood sugar. Fiber may decrease insulin peaks after meals because it slows absorption of carbs and increases insulin sensitivity. Instruct patients to follow a diet high in microbiota-accessible carbohydrates, or MACs.

FIBER SUPPLEMENTS

Glucomannan (PGX) soluble fiber

- Reduces hyperglycemia and improves insulin sensitivity.
- Suggested dose is 0.5 g per 100 kcalories consumed per day, which works out to about 8 to 13 g a day for most patients. In powder form - where a half teaspoon is 2 g, dose would be two to four teaspoons per day depending on the patient's calorie intake.

Resistant starch has also been shown to be helpful in regulating blood sugar.

- Can be obtained in the diet from cooked and cooled potatoes, white rice, and lentils.
- As a supplement, you can use green banana, green plantain flour, or Bob's Red Mill potato starch, which is gluten-free.
- Maximum therapeutic dose is four tablespoons a day.
 - Start at a much lower dose such as a half a teaspoon.

HYPERGLYCEMIA TREATMENT

Intervention	Comments
Diet	Basic Paleo, Low-carb/ketogenic Paleo, IF, PSMF
Lifestyle	Physical activity, sleep, stress management
Address pathologies	Primarily gut and HPA axis
Rebalance nutrients	Vitamin D, iron, magnesium
Therapeutic supplementation	Metabolic Synergy, GlucoSupreme
Fiber	Glucomannan, resistant starch

METFORMIN (GLUCOPHAGE)

- Long track record of safety.
- Associated with lower risk of death from CVD and cancer in diabetics.
- Inhibits gluconeogenesis, stimulates glucose uptake in muscles, blocks triglyceride synthesis, and promotes fat burning.

- Takes three days to kick in and three weeks to achieve maximum effect.
- Most common side effect is GI disturbance.
- Taking metformin ER at night results in stronger effect on FBG.
- Taking metformin in the morning gives best coverage for lunch/dinner but results in highest FBG and most GI discomfort.
- Contraindications: kidney/liver damage, CHF.
- Avoid alcohol.
- Watch B12 and folate levels.

INSULIN

- If there has already been significant beta cell destruction, and type 2 diabetes is advanced or the patient has autoimmune diabetes, they will often need insulin.
- One important note: If you're treating a patient on insulin, and you implement some of the diet, lifestyle, and supplement botanical interventions we've talked about, you should warn them that their required dose of insulin may decrease. Ask them to coordinate with their endocrinologist.

HYPOGLYCEMIA

- True hypoglycemia is far less common in clinical practice than hyperglycemia is
- In order for a patient without diabetes to be diagnosed with hypoglycemia in the conventional setting, he has to meet criteria known as Whipple's triad. This includes,
 - Symptoms consistent with hypoglycemia;
 - Low plasma glucose measured with a precise method, meaning not a glucometer, when symptoms are present;
 - Relief of those symptoms if plasma glucose is raised.
- The symptoms of hypoglycemia are diverse and nonspecific. They're primarily broken into two categories: neurogenic, or autonomic, and neuroglycopenic.
- Neurogenic symptoms include tremor, palpitations, anxiety, and arousal, which are catecholamine-mediated and adrenergic; and then sweating, hunger, and paresthesias, which are acetylcholine-mediated and cholinergic.
- Neuroglycopenic symptoms include cognitive impairment, behavioral changes, psychomotor abnormalities, and, at lower plasma glucose concentrations, seizure and coma
- Hypoglycemia may also be asymptomatic due to what is known as hypoglycemia unawareness. This is thought to be the result of reduced sympathoadrenal responses to a given degree of hypoglycemia

- In patients without diabetes, the most common causes of hypoglycemia according to the conventional model are certain medications, alcohol, critical illness, malnourishment, cortisol deficiency, islet cell tumors, endogenous hyperinsulinism
- Follow up testing includes: fasting glucose, fasting insulin, C-peptide, beta-hydroxybutyrate, and proinsulin
- Evaluation of low fasting glucose and hypoglycemia in children is a little different. One of the primary possible causes in kids is mitochondrial dysfunction or mitochondrial disease.
- Next consideration is hypoglycemia in patients with diabetes and impaired glucose tolerance. This typically occurs in the postprandial state rather than the fasted state
- The goal is to document Whipple's triad and demonstrate low glucose below 50 mg/dL at the time symptoms are occurring, within four hours after a meal. The difference is patients with reactive hypoglycemia should be evaluated in the postprandial state after a mixed meal. OGTT, oral glucose tolerance test, is actually no longer recommended as the test for postprandial