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Hypoglycemia or Low Blood Sugar In a Person Diagnosed With Diabetes

"The reality or the possibility of hypoglycemia should not be used as an excuse for poor glycemic control in a person with diabetes." (1)

(1) Hypoglycemia: Endocrine Society Clinical Practice Guidelines, JCEM, April 2009.

There are NOT diabetic patients, there are persons diagnosed with diabetes (VEA/VWI)

"In the treatment of a person diagnosed with Diabetes Mellitus, the blood glucose levels should be lower as those to the non-diabetic/normal range. There should be individually set it as safely as possible to reduce the development and progression of acute (i.e., hypoglycemia, comas, glucotoxicity) and long term / chronic (i.e., blindness, polyneuropathy, renal failure, heart and vascular disorders) complications." (2)

(2) Vera, A., modified from Smith, R.J. "Individualizing Therapies in Type 2 Diabetes Mellitus based on patient characteristics (consensus statement Endocrine Society, ADA." JCEM, April 2010.

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Hypoglycemia or low blood sugar in person with Diabetes Mellitus

1. Introduction

You have hypoglycemia if your blood sugar (BS) is abnormally low, with or without symptoms. The American Diabetes Association (ADA) recommends that the blood sugar never be 70 mg/dL or less in a person self-monitoring their blood sugar in order to diagnose hypoglycemia. Any person with the diagnosis of Diabetes Mellitus (DM) has had experiences or felt in the past how uncomfortable the feeling (symptoms) of hypoglycemia are, but that could be happening unnoticeably (no symptoms at all), which is called hypoglycemia unawareness (see below). As we stated before, **there are NO diabetic patients...there are only persons diagnosed with diabetes**. The prevention / avoidance of low blood sugar is most important. Always be alert, prepared, and ready to act, and self-treat your hypoglycemia.

Why 70 mg/dL as the value to diagnosed lows/hypoglycemia ?

Everyone is different and reacts differently in the presence of every episode of hypoglycemia. That person may or may not have symptoms at all. On the other hand, 70 mg/dL is the fasting lower limit or value of glucose in a person without the diagnosis of diabetes. Furthermore, is the level of glucose in your blood when the body (brain, nervous system, adrenal gland, and other endocrine glands) responds or counteracts to alert and correct the low level of blood sugar. It is 70 mg/dL level, the highest level of glucose in a person with continuous episodes of hypoglycemia, when the response of the adrenal glands (releasing epinephrine) and the autonomic nervous system (releasing norepinephrine) may be reduced or impaired, making that person more unaware of hypoglycemia. The more often the person has hypoglycemia, the more at risk the person is to develop hypoglycemia unawareness.

The duration and severity of hypoglycemia episodes depends on its cause. According to the American Diabetes Association (ADA), the severity is extreme in persons who require assistance of another person, and this is an indication of extremely low levels. On the other end of the scale is a person with symptoms of low blood sugar/hypoglycemia with plasma concentration of 71 mg/dL or more, known as we call it relative hypoglycemia. This happens, for instance, in people who have been in poor control if the blood sugar is persistently elevated, more than 200 or 300, and when the blood sugar starts coming down/normalizing as a result of the treatment, appropriate diet, and lifestyle changes, the person feels symptoms of hypoglycemia, even if still high levels for other people. For instance, when 'going down' to the 150 / 160 range, the patient has symptoms of hypoglycemia.

To summarize, we must treat the person/individual, because every case is different. Our purpose is to prevent severe hypoglycemia, based on education, and to prevent and treat asymptomatic or mild hypoglycemia. Every blood sugar low should be taken seriously in order to prevent recurrent hypoglycemia because over time, over and over again, hypoglycemia may lead to unawareness or hypoglycemia, per se, can lead to not a good quality of life.

2. What To Do- What Action To Take?

a. If there is doubt, repeat the tests or recheck. Do not initiate risky or critical activities or tasks such as driving, taking an elevator, or operating a machine. Do not stay alone and do not start exercising. Do not adjust doses or change treatments/regimen, before you or your caregiver has had a chance to contact your health care provider. Always continue in an alert and defensive mode.

b. If your blood sugar is between 51 and 70 mg/dL, you should take 15 g of carbohydrates/1 serving.

Orange juice, 4 ounces/1/2 cup
Apple juice, 4 ounces/1/2 cup
Grape juice, 2.5 ounces/1/3 cup
Cranberry juice, 2.5 ounces/1/3 cup
Soda (not diet), 4 ounces/1/2 cup
Skim milk, 8 ounces/1 cup
Honey, 1 or 2 Tbsp
Corn syrup, 1 or 2 Tbsp
Glucose tablets, 3 or 4 tablets
Lifesavers, 4-8 pieces
Sugar packets, 3 packets
Glucose gel/cream...squeeze into the mouth

Then you may eat / take in your meal or snack as scheduled.

c. If you check your blood sugar and it is 50 or below, double the amount of the carbohydrates listed above. For instance, 30 g of carbohydrates/2 servings:

Orange juice, 8 ounces/1 cup
Apple juice, 8 ounces/1 cup
Grape juice, 5 ounces/2/3 cup
Cranberry juice, 5 ounces/2/3 cup
Soda, 8 ounces/1 cup
Skim milk, 16 ounces/2 cups
Honey, 3 or 4 Tbsp
Corn syrup, 2-4 Tbsp
Glucose tablets, 6-8 tablets
Lifesavers, 8-16 pieces
Sugar packets, 6 packets
Glucose gel/cream...double the amount squeezed into the mouth

Then you may eat / take in your meal or snack as scheduled.

d. If you or your caregiver, family member, significant other, loved one, etc. suspect that you have hypoglycemia/low blood sugar and are not able to check tests, but: you are able to swallow or drink, take 15 g of carbohydrates as follows: 15 g of carbohydrates is 1 serving:

- Orange juice, 4 ounces/1/2 cup
- Apple juice, 4 ounces/1/2 cup
- Grape juice, 2.5 ounces/1/3 cup
- Cranberry juice, 2.5 ounces/1/3 cup
- Soda (not diet), 4 ounces/1/2 cup
- Skim milk, 8 ounces/1 cup
- Honey, 1 or 2 Tbsp
- Corn syrup, 1 or 2 Tbsp
- Glucose tablets, 3 or 4 tablets
- Lifesavers, 4-8 pieces
- Sugar packets, 3 packets
- Glucose gel/cream...squeeze into the mouth

Then you may eat / take in your meal or snack as scheduled.

e. Next, 10-20 minutes later, you should check your blood sugar after you took carbohydrates or foods. Your blood sugar should be above 71 mg/dL, ideally above 100 mg/dL, and completely free of symptoms and alert. If the blood sugar is again below 70 mg/dL or below, or you still have symptoms (see below), take another 15-30 g of carbohydrates and repeat the checking/testing 10-20 minutes later.

f. PLEASE SHOW THIS PARAGRAPH TO YOUR CAREGIVER, FAMILY MEMBER, SIGNIFICANT OTHER, LOVED ONE, etc:

If you are **found unconscious, unresponsive, making noise, having seizures, comatose, not able to drink, swallow, chew, or eat**, do not attempt to force-feed or provide carbohydrates through the mouth. You should receive Glucagon 0.5-1 mg subcutaneous or intramuscular (Glucagon readiness and preparation, see attached). The injection should be in the abdomen, arm, or thigh. Then your caregiver or significant other calls 911 and ask for further assistance/help or initiates CPR if needed. The reason to call 911 is sometimes the administration of intravenous (IV) glucose is required in order to obtain a full recovery and prevent: repetition of the low level of glucose, brain dysfunction or not functioning well; serious brain damage or death.

3. How To Recognize Hypoglycemia/Low Level of Blood Sugar/Symptoms

Remember low blood sugar will catch you and your caregivers by surprise! There could be no symptoms at all, totally unaware, or just feeling any or several of the following:

a) The following neuroglycopenic symptoms are the result of a brain glucose deprivation phase.

Feeling hungry, weak, fatigued, dizzy, difficulty thinking, sleepy, slurred speech, confused, blurry vision, incoordination, bloating, you could be found unresponsive, with seizures or in a coma.

b) The following neurogenic symptoms where the brain and the neuroendocrine system sense the lowering of blood sugar and set in motion a series of an 'alarm system' in preparation to counteract / raise the blood sugar level back to normal:

Anxious, hyper or panicky, nauseated, queazy stomach, sweating, palpitations, irritable, easily upset, depressed, tremors, numbness around mouth and tongue, slow motion, slow reactivity, light-headedness or headache, intermittent movement of the limbs, double vision, blurry vision, and/or bizarre behavior.

Remember, the most important thing is preparation. You could have no symptoms at all or you could develop severe symptoms such as seizures, unconsciousness or unresponsiveness suddenly. The most important thing is prevention.

4. How To Avoid Hypoglycemia/Prevention

There is no substitution for a motivated, well-informed person/patient with diabetes. The success of self-monitoring should be continuously reinforced with education and empowerment.

a. Do not skip meals. Snacks or any intake of food and carbohydrates is scheduled in advance for your diabetes management.

b. Before driving, exercising, or at bedtime, check your blood sugars. Always keep the level based on your own individual glycemic goals or targets/"ROAD MAP". These goals or targets or glucose values must be set in advance and you should follow and self-manage/self-monitor appropriately and continuously.

c. Review your log book or download your data. Discuss with your caregiver, family member, and/or significant other, and most importantly your health care provider. Look for lows, less than 70 mg/dL. Find the reason why it was low and at what time...in relation to the time of eating and the doses of medication, especially insulin and oral agents that lower the blood sugar (see below).

d. You should know insulin type, doses, time of injection, frequency, peak or maximum effect and lasting effect (see special section for intensive insulin treatment and continuous glucose monitoring).

e. The doses of insulin require adjustment after losing weight, increased physical activity or changes in lifestyle, during acute illness (flu, infections, etc.), stress (physical or emotional), around surgical operation (it should be done in agreement with the health care provider), with the addition or discontinuation of new medical treatments or drugs (cortisone, prednisone, for instance), treatments for other diseases or complications caused by diabetes (renal failure or insufficiency with or without dialysis), and/or liver abnormalities, heart disease, after stroke, just to mention a few. In all of these

circumstances, you should be in close contact with your health care provider about the appropriate doses of medication, insulin, time of eating, and quality and quantity of diet.

f. Nocturnal (night) hypoglycemia prevention. More common using regular insulin, less common using human insulin analogues such as Lispro/Humalog, aspart/NovoLog, glulisine/Apidra.

It is more common in a person using NPH/Humulin N or Novolin N than using long-acting insulin analogues such as glargine/Lantus or detemir/Levemir.

With the combination of mixed insulins such as NPH and Regular or NPH and analogues, it is our experience that these makes it more difficult to have optimal control of your diabetes plus you may experience more frequent episodes of hypoglycemia with and without symptoms.

Sleep favors hypoglycemia because the mechanisms to counteract or defend against hypoglycemia are diminished or impaired. The same thing that happens after exercise or in a person with repeated episodes of hypoglycemia. Snacks at bedtime with carbohydrates with and without protein have been used. To prevent low blood sugar during the night in a patient with type 1 diabetes or intense insulin treatment, the drug terbutaline (5 mg) has been used. Be aware that this can decrease nocturnal hypoglycemia, but may cause morning hyperglycemia (see more below).

In summary, nocturnal hypoglycemia could be prevented. Understanding why and how it is produced is very important. It is very common. Be extremely careful about doses, type, and timing of insulin, and use of continuous glucose monitoring is advisable (see more below). Finally, morning headaches could be the early symptoms of hypoglycemia while you are sleeping.

g. Seniors and elderly. Older adults have more symptoms of lack of glucose in the brain or central nervous system such as confusion, agitation, irritability, weakness, fatigue, incoordination, dizziness, hyperactive, impaired memory, plus they would be more quiet and less active. Severe hypoglycemia requires sometimes hospitalization. It has been associated with increased risk of dementia, and in the frail, underweight or malnourished elderly person it may lead to severe adverse occurrences with more episodes of dizziness, loss of balance, weakness, falls, and fractures leading to nursing home placement. Many episodes of hypoglycemia have been misdiagnosed and treated as a stroke. Doses of insulin and oral agents (pills) must be controlled very carefully along with the timing of food intake (snacks, meals) and doses of other medicines, not to mention polypharmacy as a result of multiple medical problems. All of these factors might trigger or precipitate or aggravate hypoglycemia episodes.

h. Muscles "burn" glucose; therefore, physical/muscle activity can cause hypoglycemia, even in a person with moderate elevated glucose or normal glucose before exercise. It is recommended to check immediately before, during, and after exercise, and as frequently as needed. Hypoglycemia may occur even hours after finishing exercise. If the blood sugar is normal or slightly elevated, you may take 20-30 g of carbohydrates before starting exercising or doing strenuous physical activity. Likewise, do not forget a snack at bedtime the day that you exercise or do physical training or activity. Reduce insulin doses before exercise. Likewise, incretin mimetics such as exenatide/Byetta,

liraglutide/Victoza, DPP-4 inhibitors such as sitagliptin/Januvia and vildagliptin and Onglyza and oral agents (pills) that lower blood sugar must be adjusted based on recommendation and coordination with your health care provider.

Avoid injection of insulin in the limb that you perform exercise with. For instance, do not inject into the thigh, if you are planning to walk, run or jog. Likewise, if you practice or do resistance exercise or weight bearing exercise with your arm, do not inject insulin into your arms.

i. Never ever drink alcohol without eating and especially in a person receiving insulin or oral agents, a person with congestive heart failure, cardiovascular disease, renal problems, liver disease, or malnourishment. Alcohol can precipitate or aggravate hypoglycemia and a person who is totally alert could develop severe hypoglycemia, even seizures when skipping meals or a snack. I advise before going to a party check your blood sugar. Needless to say, obviously in a patient diagnosed with diabetes it is recommended do not abuse alcohol, especially so in a person with the medical conditions mentioned above or on doses of insulin or oral agents.

In summary, a person with the diagnosis of diabetes should always be prepared to treat hypoglycemia or lows in order to prevent devastating consequences. Also, be aware the hypoglycemia could be totally asymptomatic or just a few symptoms or particular symptoms that may vary from person to person and from episode, to episode, there could be severe manifestations of symptoms leading to rapid deterioration and compromise of consciousness leading to seizures. Persons at high risk for hypoglycemia include those with type 1 diabetes on multiple doses of insulin or continuous subcutaneous insulin administration with the use of the insulin pump, a person with that intensive control reflected by the level of glucose in the log book or hemoglobin A1c of 6 or below, glycosylated hemoglobin. On the other hand as well, a person with diseases accompanying diabetes or complications of diabetes such as adrenal insufficiency, malabsorption, malnutrition, renal insufficiency or renal failure, and medications that can prevent or reduce the manifestation or symptoms of low blood sugar such as beta blockers, propranolol/Inderal, carvedilol/Coreg, metoprolol/Toprol, Bystolic/nebivolol, just to mention a few. Obviously important to prevent hypoglycemia is do not skip meals or snacks scheduled in advance with your health care provider, the use or abuse of alcohol, exercise, sleep, and finally oversleeping. One of the major causes of hypoglycemia is the use of insulin, especially overdoses with and without skipping meals as well as overdoses of oral medication, especially drugs that stimulate the production of insulin by the pancreas (see below).



Diabetes and Low Blood Sugar (Hypoglycemia)

What is hypoglycemia?

Hypoglycemia is the term for *low* blood sugar (or blood glucose). Glucose is the "fuel" that your brain and body need to function properly.

It's important to maintain levels of blood sugar that are healthy: not too high and not too low. If hypoglycemia is not corrected right away, it can quickly worsen. You may become very confused and unable to manage your condition. In severe cases, you may even lose consciousness, have a seizure, or go into a coma.

Hypoglycemia can happen if you do not eat when you need to or as much as you need, or if you skip a meal, drink too much alcohol, exercise more than usual, or if you have diabetes.

What is the relationship between diabetes and hypoglycemia?

If you have *diabetes*, a disease characterized by *high* blood sugar and you are taking medication to control your blood sugar, you are at increased risk of hypoglycemia. Medications to treat diabetes act on *insulin*, the hormone that your body produces to keep blood sugar levels from getting too high or too low. Sometimes these medications can make insulin stronger, and, thus, lower your blood sugar more than necessary. Likewise, if you are taking insulin shots to manage your diabetes, it's important to check your blood sugar before taking insulin to make sure you don't take too much.

What are the signs and symptoms of hypoglycemia?

Hypoglycemia can be mild, moderate, or severe. If your blood sugar drops below normal (between 70 and 99 mg/dL), you may experience a variety of symptoms.

How is hypoglycemia treated?

If you have diabetes and you experience symptoms of hypoglycemia, it is important to check your blood sugar level. If it is low, you should eat or drink something that will quickly raise your blood sugar. For mild to moderate hypoglycemia, you need to consume 15 grams of carbohydrates (e.g., a piece of hard candy, a cup of milk, 6 ounces of orange juice, or 7 ounces of regular soda). Wait 15–20 minutes and retest your blood sugar level. If the level is still low, consume an additional 15 grams of carbohydrates.

Close friends or relatives should be aware of your condition and be taught how to recognize severe hypoglycemia and treat it quickly with an injection of *glucagon* (hormone that raises blood sugar levels) if you cannot do it yourself. They will need to take you to the hospital or call for emergency assistance if:

- your consciousness is affected and no glucagon is available
- confusion continues after treatment with glucagon
- your blood sugar remains low despite eating or receiving glucagon

How can you avoid hypoglycemia?

The best way to avoid hypoglycemia is to test your blood sugar regularly, follow the diet and exercise plan suggested by your diabetes healthcare team, and always take your diabetes medications as recommended. Also, it is important to follow your meals schedule. Eat or drink carbohydrates before and/or during exercise. Ask your doctor if your diabetes medication can produce or contribute to hypoglycemia. If it can, ask whether you need to take additional precautions.

What should you do with this information?

The most important thing for you to remember is "Be prepared." Be prepared to check your blood glucose level regularly and especially when you experience any symptoms of hypoglycemia. Be prepared to treat those symptoms by keeping glucose tablets or hard candies handy. Make sure family and friends are prepared to help if you exhibit the signs of low blood sugar. Also, you should wear a diabetes medic-alert bracelet or necklace to ensure proper emergency care if you are unable to speak for yourself.

Remember, you should check your blood sugar level before driving any vehicle or operating any potentially harmful machinery to make sure it is in the normal range. This is especially important if you have repeated episodes of hypoglycemia or if you have trouble sensing when your blood sugar is low.

Resources

Find-an-Endocrinologist:
www.hormone.org or call
1-800-HORMONE (1-800-467-6663)

Hormone Foundation: Diabetes
Information: www.hormone.org/diabetes

National Diabetes Education Program
(NIH): <http://ndep.nih.gov>

National Diabetes Information
Clearinghouse (NIDDK):
<http://diabetes.niddk.nih.gov/>

Signs and symptoms of Hypoglycemia

Mild: below 70 mg/dL

- an urgent need to eat
- nervousness and shakiness
- perspiration

Moderate: below 55 mg/dL

- dizziness
- sleepiness

- confusion
- difficulty speaking
- feeling anxious or weak

Severe: below 35–40 mg/dL

- seizure or convulsion
- loss of consciousness, coma

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