

Strategies to Prevent Hypoglycemia

Blood glucose monitoring

- Athletes should measure blood glucose levels before, during, and after exercise.
- Athletes who exercise in extreme heat or cold or at high altitude or experience post exercise late-onset hypoglycemia, which may lead to nighttime hypoglycemia, require additional monitoring.
 - Measure blood glucose levels 2 to 3 times before exercise at 30-min intervals to determine directional glucose movement.
 - Measure glucose levels every 30 min during exercise if possible.
 - Athletes who experience post exercise late-onset hypoglycemia should measure glucose levels every 2 h up to 4 h post exercise. Athletes who experience nighttime hypoglycemia should measure blood glucose values before going to sleep, once during the night, and immediately upon waking.

Carbohydrate supplementation

(Note: The athlete should discuss specific carbohydrate quantities and types with his or her physician.)

- Before exercise
 - Consumption of carbohydrates before exercise depends on the prevailing blood glucose level. In general, when the blood glucose level is 100 mg/dL (5.5 mmol/L), carbohydrates should be consumed.^{26,27}
- During exercise
 - Additional carbohydrate supplementation may be needed for practices or games lasting 60 min when the pre-exercise insulin dosage has not been reduced by at least 50%.
 - Athletes who are exercising at the peak of insulin activity may require additional carbohydrates.
- Post exercise
 - Athletes should eat a snack and/or meal shortly after exercise.

Insulin adjustments (Physician determines insulin reduction strategies)

(Note: These are very important for moderate-intensity to high-intensity exercise sessions of 30 min.)

- Insulin pump (may use one or more of the following strategies)
 - Reduce basal rate by 20% to 50% 1 to 2 h before exercise.
 - Reduce bolus dose up to 50% at the meal preceding exercise.

- Suspend or disconnect the insulin pump at the start of exercise. Note: Athletes should not suspend or disconnect from pump longer than 60 min without supplemental insulin.
- Multiple daily injection
 - Reduce bolus dose up to 50% at the meal preceding exercise.
- Nighttime hypoglycemia
 - Reduce evening meal bolus insulin by 50%.

Treatment Guidelines for Mild and Severe Hypoglycemia

Mild Hypoglycemia

(Athlete is conscious and able to follow directions and swallow.)

1. Administer 10 g to 15 g of fast-acting carbohydrate: eg, 4 to 8 glucose tablets, 2 T honey.
2. Measure blood glucose level.
3. Wait approximately 15 min and remeasure blood glucose.
4. If blood glucose level remains low, administer another 10 g to 15 g of fast-acting carbohydrate.
5. Recheck blood glucose level in approximately 15 min.
6. If blood glucose level does not return to the normal range after second dosage of carbohydrate, activate emergency medical system.
7. Once blood glucose level is in the normal range, athlete may wish to consume a snack (e.g., sandwich, bagel)

Severe Hypoglycemia

(Athlete is unconscious or unable to follow directions or swallow.)

1. Activate emergency medical system.
2. Prepare glucagon for injection following directions in glucagon kit. The glucagon kit has either (1) a fluid-filled syringe and a vial of glucagon powder, or (2) a syringe, 1 vial of glucagon powder, and 1 vial of fluid.
 - a. Inject the fluid into the vial of glucagon. Note: If the vial of fluid is separate, draw the fluid into the syringe and inject it into the vial of glucagon powder.
 - b. Gently shake the vial until the glucagon powder dissolves and the solution is clear.
 - c. Draw fluid back into the syringe and then inject glucagon into the arm, thigh, or buttock.
 - d. Glucagon administration may cause nausea and/or vomiting when the athlete awakens. Place the athlete on his or her side to prevent aspiration.
 - e. The athlete should become conscious within 15 min of administration.
3. Once the athlete is conscious and able to swallow, provide food.

*Athletic trainers should be trained in the mixing and administration of glucagon. The athlete or athlete's family can provide training. In addition, a video demonstrating the preparation and administration of glucagon is available at <http://www.diabetes.org/type-2-diabetes/hypoglycemia.jsp>.

American Diabetes Association Guidelines on Hyperglycemia and Exercise

Blood Glucose Level

- Fasting* blood glucose level is 250 mg/dL (13.9 mmol/L).
 - Test urine and/or blood for ketones.
 - If ketones present, exercise is contraindicated.
 - If ketones not present, exercise is not contraindicated.
- Blood glucose value is 300 mg/dL (16.7 mmol/L) and without ketones.
 - Exercise with caution, and continue to monitor blood glucose levels.

*Fasting is defined as 4 h or more after eating a meal.

Variables That Affect Insulin Absorption Rate

- Exercise of the injected area
 - Exercise of injected area within 1 h of injection may increase the rate of absorption.
- Massage of the injection site
 - Do not rub or vigorously massage injection sites within 1 h of injection.
- Thermal modalities
 - Heat increases absorption, whereas cold decreases absorption.
 - Avoid using thermal modalities for 1 to 3 h postinjection.
- Insulin dose
 - Larger doses are associated with slower absorption rates.
- Lipohypertrophy (accumulation of subcutaneous fatty lumps caused by repeated injections of insulin into the same spot)
 - Injection into lipohypertrophic sites delays absorption.