



Disclosures

- I have none

Objectives

- Differentiate the types of diabetes mellitus
- Understand the benefits of exercise in patients with diabetes mellitus
- Prevent, recognize, and treat hyperglycemia in diabetic athletes
- Prevent, recognize, and treat hypoglycemia in diabetic athletes
- Anticipate and prevent late onset hypoglycemia

Diabetes Mellitus

- Most common metabolic disease in the US
- Characterized by hyperglycemia
- Falls into 2 categories
 - Type 1 – absence of insulin secretion
 - Type 2 – insulin resistance and inadequate compensatory secretion

Type 1 Diabetes Mellitus

- Usually diagnosed in children and young adults
- 5% of diabetics
- Insulin is not produced due to pancreatic beta cell destruction
- Results in hyperglycemia, increased thirst and urination, fatigue, and weight loss
- Prone to develop ketoacidosis

Type 2 Diabetes Mellitus

- Usually diagnosed in adults, but incidence in younger patients is increasing
- Begins with insulin resistance resulting in increased insulin secretion
- Over time the pancreas is unable to produce adequate insulin to maintain normal blood glucose
- Results in hyperglycemia, asymptomatic initially
- Less likely to develop ketoacidosis

This presentation is the intellectual property of the author.
Contact them for permission to reprint and/or distribute.

Benefits of Exercise

- Increased insulin sensitivity
 - Augments glucose transport
- Reduction in cardiovascular risk factors
 - Decreased blood pressure
 - Decreased total cholesterol, LDL, and triglycerides
 - Increased HDL
- Improved self-esteem

Medical Clearance

- A stress test is warranted in diabetics:
 - Older than 40 years
 - Older than 30 years old and:
 - Diabetes greater than 10 years duration
 - Presence of additional cardiovascular risk factors
 - Peripheral vascular disease
 - Neuropathy
 - Smoker

Hypoglycemia

- Blood glucose below 70 mg/dL
- Symptoms include headache, hunger, sweating, anxiety, tremor, dizziness, tachycardia or palpitations
- Frequent hypoglycemia promotes unawareness resulting from an attenuated epinephrine response
- Blood glucose below 40 mg/dL can cause the athlete to be combative, severely obtunded, or unconscious

Hyperglycemia

- Fasting blood glucose above 126 mg/dL
- Random blood glucose greater than 200 mg/dL
- Can be asymptomatic
- Symptoms include excessive thirst, dry mouth, headache, fatigue, nausea/vomiting, blurry vision, confusion

Exercise

- Blood glucose should be well controlled before starting an exercise program
- Blood glucose should be monitored before, during, and after exercise
- If blood glucose exceeds 300 mg/dL prior to exercise, it tends to increase rather than fall during exercise
 - More likely in athletes using insulin or insulin secretagogues
- If ketones are present prior to exercise, they tend to increase during exercise

Typical Response to Exercise

- Aerobic exercise elicits glycogenolysis, lipolysis, and gluconeogenesis
 - Increases serum glucose
- Insulin and insulin like growth factor increase
 - Drives glucose into the muscles for consumption
- Feedback mechanisms maintain blood glucose

Diabetic Response to Exercise

- Impaired gluconeogenesis
 - Less glucose available
- Increased insulin sensitivity
 - Can persist for 4-28 hours after exercise
- Insulin levels can remain elevated
 - Decreases serum glucose
- Impaired feedback mechanisms (insulin regulated)
 - Hypoglycemia can result

Diabetic Response to Exercise

- Depends on several factors:
 - Intensity and duration of exercise
 - Baseline glucose control
 - Type of medication
 - Insulin or insulin secretagogues
 - Site of insulin injection
 - Meal prior to exercise

Hyperglycemia and Exercise

- Pregame anxiety can mimic hypoglycemia
- This may lead to increased carbohydrate intake or reduced dosage of medication leading to hyperglycemia
- If blood glucose is < 300 mg/dL, and no ketones are present the athlete may participate with close glucose monitoring
- If blood glucose is > 250 mg/dL and ketones are present, or > 300 mg/dL the athlete should not be allowed to participate

Hypoglycemia and Exercise

- More likely during exercise in the evening due to variation in cortisol and growth hormone levels
- Reduce insulin/insulin secretagogues prior to exercise based on duration
 - If exercise is less than 1 hour – 30% reduction
 - If exercise is 1-2 hours – 40% reduction
 - If exercise is 2 hours or more – 50% reduction

Hypoglycemia and Exercise

- Carbohydrate intake should be based on blood sugar prior to exercise
 - If blood glucose is below 120 mg/dL – consume 15 g of carbohydrate prior to exercise, then 30 grams per hour of exercise
 - If blood glucose is 120-180 mg/dL – consume 30 grams of carbohydrate per hour of exercise
 - If blood glucose is 180-250 mg/dL – consume no carbohydrates and monitor blood glucose during exercise

Hypoglycemia and Exercise

- If hypoglycemia develops
 - Treat with easily digested carbohydrates if the athlete is conscious (sugar, honey, candy, glucose tablets, sports drinks)
 - Use intramuscular glucagon if the athlete cannot protect the airway (short acting – continue to monitor and encourage carbohydrates when improved)

Late Onset Hypoglycemia

- Can occur 2-72 hours after exercise
- Increased insulin sensitivity can persist for 4-28 hours after exercise
- More likely in athletes using insulin or insulin secretagogues
- Increase caloric intake for 12-24 hours following exercise (replenishment meal – 1.5 gm carbohydrate per kg body weight)
- Avoid evening exercise if possible
- Monitor nighttime blood glucose to avoid nocturnal hypoglycemia

Be Prepared

- The athlete, coaches, and trainers should know the symptoms and treatment steps
- Glucose and ketone measurement equipment should be accessible
- Easily digested carbohydrates should be readily available
- A glucagon kit should be available

Thank you!

- *American College of Sports Medicine and American Diabetes Association: Exercise and type II diabetes. Diabetes care 33: 147-167, 2010.*
- *McKeag DB, Moeller JL. ACSM's Primary Care Sports Medicine 2nd ed. Philadelphia 2007.*
- *Madden CC et al. Netter's Sports Medicine. Saunders Elsevier. Philadelphia, 2010*
- *Peirce NS. Diabetes and exercise. Br J Sports Med 1999;33:161-173*

21